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BOARD OF GOVERNORS
GENERAL CONFERENCE

Sub-item 2(b) of the Board's provisional agenda
(GOV/1999/47)
Sub-item 13(c) of the Conference's provisional agenda
(GC(43)/1)

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

The Safety of Radiation Sources and the Security of Radioactive Materials

BACKGROUND

General Conference resolution GC(42)/RES/12

1. On 25 September 1998, in resolution GC(42)/RES/12, the General Conference - inter alia - welcomed a Secretariat report on the International Conference on the Safety of Radiation Sources and the Security of Radioactive Materials held in Dijon, France, from 14 to 18 September 1998, noted with interest the major findings of the Conference, encouraged all governments *"to take steps to ensure the existence within their territories of effective national systems of control for ensuring the safety of radiation sources and the security of radioactive materials"*, requested the Secretariat *"to prepare for the consideration of the Board of Governors a report on (i) how national systems for ensuring the safety of radiation sources and the security of radioactive materials can be operated at a high level of effectiveness and (ii) whether international undertakings concerned with the effective operation of such systems and attracting broad adherence could be formulated"* and requested the Director General to report to it at its next (1999) regular session on the implementation of that resolution.

Secretariat action pursuant to resolution GC(42)/RES/12

2. Resolution GC(42)/RES/12 was brought to the attention of the Ministries of Foreign Affairs of Member States in a note verbale (J1.01.Circ) dated 1 December 1998, in which the Secretariat recalled that the IAEA had, jointly with other organizations, established International Basic Safety Standards for Protection against Ionizing Radiation and for the

Safety of Radiation Sources (the BSS) and that it was ready to provide for the application of the BSS at the request of a State to any activity in that State involving radiation sources.

3. In response to the request made of it by the General Conference**,** the Secretariat submitted to the Board of Governors a report (contained in Attachment 1 hereto) which had been prepared by it on the basis of advice from a group of senior experts who had met at the headquarters of the Argentine National Atomic Energy Commission, Buenos Aires, from 7 to 10 December 1998 and at the headquarters of the United States Nuclear Regulatory Commission, Washington D.C., from 27 to 29 January 1999.[1]

4. In submitting the report to the Board of Governors, the Secretariat stated that it would, taking into account the conclusions and recommendations in and the Board's discussion of the report, draw up an action plan for responding fully to resolution GC(42)/RES/12.

Action taken by the Board of Governors

5. At its March 1999 session, the Board:

(a) noted the conclusions and recommendations in the report;

(b) requested the Director General to bring the report to the attention of national authorities by distributing it to all States, encouraging them, in particular, to

- establish or strengthen national systems of control for ensuring the safety and security of radiation sources, particularly legislation and regulations and regulatory authorities empowered to authorize and inspect regulated activities and to enforce the legislation and regulations,

- provide their regulatory authorities with sufficient resources, including trained personnel, for the enforcement of compliance with relevant requirements,

- consider installing radiation monitoring systems at airports and seaports, at border crossings and at other locations where radiation sources might appear (such as metal scrap yards and recycling plants), develop adequate search and response strategies, arrange for the training of staff and the provision of equipment to be used in the event that radiation sources were detected, and take similar urgent actions,

(c) requested the Secretariat to prepare an action plan that took into account the conclusions and recommendations in and the Board's discussion of the report;

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[1] Pursuant to resolution GC(42)/RES/18 entitled "Measures against Illicit Trafficking in Nuclear Materials and Other Radioactive Sources", the Secretariat has also prepared document GC(43)/13.

(d) requested the Director General to initiate exploratory discussions relating to an international undertaking in the area of the safety and security of radiation sources, it being understood that the international undertaking - which might take the form of a convention or some other type of instrument - should provide for a clear commitment by and attract the broad adherence of States; and

(e) authorized the Director General to include the report in the document to be submitted to the General Conference for consideration at its next (1999) regular session.

6. The Board took that action in the light of the following remarks by its Chairman:

"... there had been general support for the conclusions and recommendations in the ... report prepared on the basis of advice from a group of experts. Comments had been made on the individual recommendations - in particular on recommendation (d), concerning the establishment of categorization criteria, recommendation (i), that radiation sources be provided only to States having an adequate infrastructure, and recommendation (k), that monitoring systems be installed at airports and seaports and at border crossings. A suggestion had been made regarding the establishment by the Agency of an international database for use in monitoring transfers of radiation sources. The Secretariat had been urged to be cautious in implementing recommendations (i) and (k), on the grounds that there would be enforcement difficulties.

"As regards the recommendation that exploratory discussions be initiated by the Agency with a view to achieving an effective international undertaking by States in the area of the safety and security of radiation sources, while there had been no opposition to the Director General's initiating exploratory discussions relating to an international undertaking, some members had thought that to aim for an international convention would be too ambitious at the present time. They had felt that it might be more feasible to aim for other types of instrument - for example, codes of practice/conduct.

"Several members had commented on the proposed action plan. Some members had wanted more information about it (particularly information about its financial implications) and had called for prioritization of the envisaged activities. It had been noted that the action plan would come before the Board before being transmitted to the General Conference."[2]

FOLLOW-UP TO THE BOARD'S MARCH SESSION

7. The Director General distributed the report to the Ministers for Foreign Affairs of all States under cover of a letter (J1-I.03 Circ.) dated 11 May 1999 in which he - inter alia - requested them to transmit it to the relevant national authorities in their countries and invited them to submit their countries' views regarding the nature and scope of an international undertaking in the area of the safety and security of radiation sources.

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[2] See paras 96-100 of GOV/OR.967.

8. The Secretariat, with the help of a group of consultants who met in Prague from 25 to 28 May 1999, prepared a draft action plan which was further developed and endorsed by a Technical Committee (chaired by Ms. Mary Clark of the United States Environmental Protection Agency and consisting of senior experts from Australia, Canada, China, the Czech Republic, Egypt, Finland, France, Germany, Iceland, India, Israel, Spain, Turkey, Ukraine, the United Kingdom and the United States of America and an observer from the European Commission) which met in Vienna from 12 to 14 July 1999. The resulting action plan as proposed by the Secretariat is contained in Attachment 2 hereto.

9. As indicated by the Chairman of the Board, some Board members requested, at the Board's March session, information about the financial implications of the action plan. The action plan envisages certain activities for which no funds have been provided in the Regular Budget for 1999 and the Regular Budget estimates for 2000. The Secretariat estimates that implementation of the action plan would involve expenditures of about US $65 000 in 1999 - within Regular Budget Appropriation Section 3 (Nuclear, Radiation and Waste Safety) - and about $1.2 million over the following three years - mainly within Appropriation Section 3, but also within Appropriation Section 1 (Nuclear Power and Fuel Cycle) and Appropriation Section 4 (Nuclear Verification and Security of Material) and under the Technical Co-operation Programmes for those years. It envisages that the 1999 expenditures would be incurred only if the necessary funds are available within Appropriation Section 3. Regarding the year 2000, if no funds can be identified within the relevant appropriation sections during that year, the Secretariat would have to submit a supplementary Regular Budget estimate to the Board (as an alternative, if sufficient funds became available in other appropriation sections, the Secretariat could request Board approval of the necessary transfers of such funds); in addition, the relevant projects in the Technical Co-operation Programme for the year 2000 would have to be adjusted in such a way as to provide for implementation of the action plan. The funding of activities foreseen for implementation in 2001 and 2002 would be considered during programme and budget formulation for those years.

SUGGESTED BOARD ACTION

10. It is suggested that the Board, taking due account of the Secretariat's above comments regarding the necessary funding, approve the action plan and request the Secretariat to implement it.

SUGGESTED GENERAL CONFERENCE ACTION

11. It is suggested that the General Conference endorse the decision of the Board of Governors.[3]

[3] In an Addendum to the present document, the General Conference will be informed of the decision taken by the Board - at its meetings starting on 20 September 1999 - with regard to the action plan.

GOV/1999/46-GC(43)/10
Attachment 1

THE SAFETY OF RADIATION SOURCES

AND

THE SECURITY OF RADIOACTIVE MATERIALS

CONTENTS

PREAMBLE

In resolution GC(42)/RES/12 on "The safety of radiation sources and the security of radioactive materials", adopted on 25 September 1998, the General Conference of the International Atomic Energy Agency (IAEA) - *inter alia* - encouraged all governments *to take steps to ensure the existence within their territories of effective national systems of control for ensuring the safety of radiation sources and the security of radioactive materials* , requested the Secretariat of the IAEA *to prepare for the consideration of the* [IAEA's] *Board of Governors a report on (i) how national systems for ensuring the safety of radiation sources and the security of radioactive materials can be operated at a high level of effectiveness and (ii) whether international undertakings concerned with the effective operation of such systems and attracting broad adherence could be formulated* and requested the Director General of the IAEA to report to it at its next (1999) regular session on the implementation of that resolution.

In response to the request made of the IAEA's Secretariat, a group of senior experts - D. Beninson, President of the National Atomic Energy Commission, Argentina; D. Massé, Commissariat B l'énergie atomique, France; L. Weil, Bundesamt für Strahlenschutz [Federal Office for Radiation Protection], Germany; J. Lubenau, United States Nuclear Regulatory Commission; and P. Ortiz López and A. Wrixon, IAEA - met in Buenos Aires from 7 to 10 December 1998 and in Washington D.C. from 27 to 30 January 1999. The following report was prepared by the Secretariat on the basis of the advice given by the senior experts.

1. INTRODUCTION

(1) Radiation sources, utilizing either radioactive materials or radiation generators, are used throughout the world for a wide variety of beneficial purposes, in industry, medicine, research, defense and education. Many applications involve sealed sources with the radioactive materials firmly contained within a suitable capsule or housing; some however involve radioactive materials in an unsealed form. The risks posed by these sources and materials vary widely, depending on the activities, the radionuclides, the forms, etc. Unless damaged or leaking, sealed sources present a risk from external radiation exposure only. Damaged or leaking sealed sources as well as unsealed radioactive materials may however lead to contamination of the environment and intake of radioactive materials into the human body.

(2) Until the 1950s, only radionuclides of natural origin, particularly radium-226, were generally available. Since then, radionuclides produced artificially in nuclear facilities and accelerators have become widely available, typically cobalt-60, strontium-90, caesium-137 and iridium-192. The risks associated with the use of radioactive materials must be restricted and protected against by the application of appropriate radiation safety standards. Regulatory control has, however, sometimes lagged behind developments in the use of radionuclides.

(3) The risks associated with the planned use of radioactive sources or materials are generally well known and the relevant safety requirements generally well identified. Nevertheless, accidents can occur during use. In recent years there has been a growing awareness of the potential for such accidents, some accidents having had serious, even fatal, consequences. The attention of the radiation protection community has therefore become focused on the prevention of accidents involving the use of such sources.

(4) More recently still, there has been a growing awareness of the problems associated with radiation sources that for one reason or another are not subject to regulatory control or over which regulatory control has been lost. As the sources may be transported across borders, such problems are not necessarily restricted to the State within which the sources were originally used. Such sources are commonly referred to as ‘orphan sources’, a term which is taken here to include:

(i) sources that were never subject to regulatory control;

(ii) sources that were subject to regulatory control but have been abandoned;

(iii) sources that were subject to regulatory control but have been lost or misplaced; and

(iv) sources that were subject to regulatory control but have been stolen or removed without proper authorization.

The number of such sources in the world is not known, but it is thought to be substantial.

(5) Sealed sources or their containers can be attractive because of their appearance or apparent value as scrap. Subsequent recovery of these sources by workers and members of the public unaware of the possible hazards can give rise to external irradiation or, if tampered with, the possibility of internal exposure. This has led to serious injury and in some cases death. The Annex to this report gives some of the accidents with orphan sources assessed by the IAEA. These occurred in Goiânia (Brazil), Tammiku (Estonia), Georgia and most recently in Turkey. There is also the possibility of the sources being incorporated into scrap metal for subsequent recycling leading to contamination of the plant and environment possibly causing serious economic consequences. International trade in scrap metal means that such material can be transferred from one country to another. The events that occurred in Ciudad Juárez (Mexico) - which had an impact in the United States - and Algeciras (Spain) are examples of this nature, and are also summarized in the Annex to this report.

(6) Many of these radiation sources originate from medical or industrial uses. Some however originate from defense activities, knowledge of which may not have been available to the civil authorities.

(7) In September 1998, an international conference took place in Dijon, France, on the Safety of Radiation Sources and the Security of Radioactive Materials. This was co-sponsored by the IAEA, the International Criminal Police Organization (INTERPOL), the World Customs Organization (WCO) and the European Commission and hosted by the French Government, with the support of the French Commissariat à l'Energie Atomique. A number of important conclusions arose out of this conference (see chapter 5).

(8) A report on the conference was considered by the IAEA's General Conference at its meeting later in September 1998. The concern expressed about orphan sources led to the adoption of Resolution GC(42)/RES/12, in which the General Conference, amongst other things, requested the Secretariat of the IAEA to prepare for the consideration of the IAEA's Board of Governors, a report on (i) how national systems for ensuring the safety of radiation sources and the security of radioactive materials can be operated at a high level of effectiveness and (ii) whether international undertakings concerned with the effective operation of such systems and attracting broad adherence could be formulated. The IAEA's Director General was requested to report to the General Conference at its 1999 regular session on the implementation of the resolution. A further resolution of the General Conference at its September 1998 meeting dealt with the related matter of illicit trafficking in nuclear materials and other radioactive sources (Resolution GC(42)/RES/18). In this, amongst other things, the Director General was requested to submit a report to the General Conference at its 1999 regular session on the activities undertaken by the Secretariat in the intervening period.

(9) Responding to the General Conference resolution the Secretariat called for a group of senior consultants to prepare this report. Consultants meetings took place first in the headquarters of the Argentine National Atomic Energy Commission, Buenos Aires (7-10 December 1998) and later at the US Nuclear Regulatory Commission, Washington D.C. (27-29 January 1999). The report contains a brief review of the safety and security of radiation sources, and specifically on the problems posed by orphan sources and the measures currently in place to deal with them and identifies

deficiencies and makes proposals for improvement. It also addresses the matter of whether international undertakings should be formulated to strengthen the international resolve to deal with it. It does not deal in any detail with the related topic of illicit trafficking, this topic being covered elsewhere.

2. INTERNATIONAL RADIATION SAFETY STANDARDS

(10) A comprehensive and consistent legal framework is one important element in ensuring safety of radiation sources and the security of radioactive materials. In fulfillment of a statutory obligation, the IAEA has established basic radiation safety standards since 1962. The IAEA standards are based on the recommendations of the International Commission on Radiological Protection (ICRP). The current version of the *International Basic Safety Standards for Protection against Ionizing radiation and for the Safety of Radiation Sources*, (the BSS), was approved by the Board, in September 1994 and issued in 1996. They stipulate the basic requirements for protection and safety. The BSS rely on the existence in every State of a system for the notification, registration and licensing of sources. The BSS apply to practices involving radiation sources and radioactive materials, essentially from 'cradle to grave'. It is noted that the BSS contain a graded approach to the control of radioactive sources: notification being all that is necessary for sources presenting a very low risk; registration being required for sources for which safety can largely be ensured by the design, operating procedures are simple, training needed is minimal and there is a history of few safety problems; and licensing being required for sources presenting the highest level of risk. The use of sources that need to be licensed requires trained personnel and a specific safety assessment.

(11) Specific requirements relating to safe transport of radioactive materials are given in detail in the *Regulations for the Safe Transport of Radioactive Materials,* approved by the Board in September 1996.

(12) The BSS do not impose any responsibilities on governments. This is made clear in the Preamble to the BSS, which touches on the responsibilities of governments and states. The Preamble indicates that the BSS are based on the assumption that governments have the authority and resources to deal with the safety and security of radiation sources and have established independent regulatory authorities to authorize activities involving sources, inspect them, enforce safety requirements and, if necessary, conduct intervention. The BSS also assume that governments can provide, either directly or indirectly, essential support such as personal dosimetry services, information exchange mechanisms and personnel training.

(13) However, many of these assumptions have proved not to be so in parts of the world. Some States have no legislation and regulations and in others there are no independent regulatory authorities vested with the necessary powers to perform the work required of them. Furthermore, even when a formal regulatory authority exists, it does not always have the necessary resources at its disposal.

3. PROVIDING FOR THE APPLICATION OF THE STANDARDS

(14) Under its Statute, the IAEA is authorized to provide for the application of its standards. There are several mechanisms of providing for doing this directly in activities promoted by the IAEA, and in the provision of assistance.

(15) In addition, the requirements of the BSS can be promoted through exchange of information, meetings of experts, co-ordinated research programmes and training courses.

(16) From 1984 to 1995, information specifically relevant to radiation safety in Member States was obtained through more than 60 Radiation Protection Advisory Teams (RAPATs) and follow-up missions. The RAPAT programme identified major weaknesses and the reports provided useful background for the preparation of national requests for IAEA technical assistance. The IAEA has set up arrangements to assist Member States to develop adequate infrastructures.

(17) The Model Project on Upgrading Radiation Protection Infrastructure was developed to assist those Member States that have inadequate infrastructures and are already receiving IAEA assistance so that they can comply with the Standards. Currently more than 50 countries are involved in the Project.

(18) Further support has been provided through the development of guidance documents, the most significant being an IAEA TECDOC on "*Organization and Implementation of a National Infrastructure Governing Protection against Ionizing Radiation and the Safety of Radiation Sources*".

(19) A systematic approach to verify the progress made within the Model Project is essential to identify corrective actions. A service to perform these reviews upon request from Member States is being established. For this purpose, a draft Safety Report, "*Assessment by Peer Review of the Effectiveness of Regulatory Programmes for Protection against Ionizing Radiation and the Safety of Radiation Sources*", has been prepared. This document is intended to assist in the appraisal of the effectiveness of the measures taken within a State.

(20) The IAEA has developed an international software package called the Regulatory Authority Information System (RAIS). This is intended to provide management of a regulatory programme with information on the location of radiation sources and facilities in the country, the authorization process, the inspection and enforcement actions, and the dosimetry of occupationally exposed personnel. It includes mechanisms for judging the performance of radiation safety measures within individual installations and of the overall regulatory programme.

(21) There is a substantial number of Member States of the United Nations that are not Member States of the IAEA (non-Member States) and also do not have appropriate infrastructures. The Secretariat has prepared a paper, for consideration by the Board of Governors, on provision for the application of the BSS, including the Model Project concept, to non-Member States.

(22) An international system for reporting and disseminating information on unusual events is also needed. Such a system would help raise the awareness of the problem and thereby contribute to the prevention of accidents. An international database of unusual radiation events, referred to as RADEV, is currently under development. The system will include both accidents resulting in an exposure or radioactive contamination and any event that is relevant to safety. It is intended that it will provide information on causes and contributing factors and the lessons to be learnt. The information will need to be provided by Member States but this will only be feasible if they have their own national reporting systems.

(23) The IAEA has investigated some of the major accidents and collected information of others. The information is disseminated in the form of reports of individual accidents (seven have been published and others are in preparation) and summary reports on a large number of events in industrial radiography, industrial irradiators and radiotherapy.

(24) Consideration is also being given to establishing an international database of missing or lost radiation sources and sources that have been found, but could not be identified or attributed to an authorized owner or user. The information for such a database would have to be provided by Member States based on data from the national regulatory control systems, from law enforcement information and from data received from manufacturers, importers, etc. At its most useful, the system would need to be directly accessible by Member States for the purpose of identifying recovered radiation sources, clarifying their history and risk assessment. It would also lead to their return to the authorized users or owners, or their disposal, as appropriate.

(25) The IAEA has begun fostering an initiative among Member States to search for orphan sources in order to bring them under regulatory control.

4. SECURITY AND ILLICIT TRAFFICKING

(26) The BSS incorporate explicit requirements relating to the security of radioactive sources. Sources are required to be kept secure so as to prevent theft or damage and to prevent loss of control. A periodic inventory of movable sources is also required to confirm their location and that they are secure.

(27) Provisions should be made for sources no longer needed or suitable for use (spent sources) as part of the presentations required to obtain a license. Authorized users should not store spent sources for longer than is necessary. Member States not having an infrastructure for recycling or disposal for spent radiation sources should import radiation sources only from manufacturers that are entitled and prepared to take them back after use.

(28) The effectiveness of a national infrastructure that is intended to implement the requirements of the BSS will depend on the commitment of all the parties involved including the Regulatory Authority and those responsible for the radioactive sources. Nevertheless, whatever the level of commitment, a residual risk of loss of control over radioactive sources remains. Regulatory Authorities may also experience difficulties in identifying all radioactive sources that were produced in or have entered the country before the establishment of the infrastructure. The situation is however much more

serious in those countries where an infrastructure has not been established or has only partly been established.

(29) In addition, unexpected risks and hazards may arise as a result of unauthorized receipt, possession, use, transfer or disposal of radiation sources. These activities, whether intended or not, with or without crossing of international borders, are considered as illicit trafficking.

(30) Illicit trafficking is a symptom of the loss of control over radiation sources. Systems are in place at the borders of a number of States for the detection of radioactive materials to prevent proliferation risks. Metallurgical scrapyards and recycling plants also have set up systems to detect the presence of radioactivity in material entering their premises. In recent years, many incidents have been detected involving illegal movement of nuclear materials and other radioactive sources across state borders. Often only small quantities of radioactive materials have been involved, the vast majority (about 95 %) being small radioactive sources and non-sensitive nuclear materials (natural, depleted and low enriched uranium). There have however been a number of particularly serious events involving larger radioactive sources and the general apprehension is that the number of such cases will increase. The need for an IAEA programme explicitly directed at the problem of illicit trafficking in nuclear and other radioactive materials was raised by the Director General in 1994 and proposed measures were agreed by the IAEA Board of Governors in 1995.

(31) The IAEA initiated work on drafting a "*Safety Guide on Prevention, Detection and Response to Illicit Trafficking in Radioactive Materials*". This is being co-sponsored by the World Customs Organization (WCO) and INTERPOL. Appendices to this document will contain supporting material on such things as custom inspection techniques, instrumentation specifications and test and calibration protocols.

(32) Detection of radioactive materials crossing borders is still a major technical and economic problem. The equipment available today is designed for measurements in metallurgical recycling plants and may not be ideally suited for the conditions at borders. The systems are expensive and a large number would be required to deal with the matter of illicit trafficking comprehensively. A major effort within the IAEA programme of work is devoted to testing commercially available border monitoring equipment. An extensive pilot study will provide valuable practical experience in the use of the detection systems and will help the development of appropriate performance specifications. Particular efforts are made to reduce false alarm rates, to obtain adequate neutron sensitivity to detect shielded plutonium and to reduce the cost of the equipment.

5. THE DIJON CONFERENCE

(33) A number of important conclusions arose out of the International Conference on the Safety of Radiation Sources and the Security of Radioactive Materials, held in Dijon, France from 14 to 18 September 1998. In particular, the following are noted:

- Radiation sources should not be allowed to drop out of the regulatory control system. This means that the regulatory authority must keep up-to-date records

of those responsible for each source, monitor transfers of sources and track the fate of each source at the end of its useful life;

- Efforts should be made to find radiation sources that are not in the regulatory authority's inventory, because they were in the country before the inventory was established, or were never specifically licensed or were lost, abandoned or stolen;

- Because there are many orphan sources throughout the world, efforts to improve the detection of radioactive materials crossing national borders and moving within countries by carrying out radiation measurements and through intelligence-gathering should be intensified. Optimum detection techniques need to be developed, and confusion would be avoided if international agreement could be achieved on quantitative levels that would trigger investigations, for example, at border crossings.

6. CONCLUSIONS AND RECOMMENDATIONS

(a) Governments should be made aware of the fact that, as a result of safety and security breaches and of serious safety and security deficiencies, severe - even fatal - accidents involving radiation sources have already occurred and are continuing to occur and that the absence or loss of control over radiation sources may pose a risk of significant radiation exposure and have serious health and economic consequences not only in the country in which a given radiation source was used but also in other countries.

(b) Given the existence of orphan sources (i.e. radiation sources that either were never subject to regulatory control or were subject to regulatory control but have been abandoned, or lost, or misplaced, or stolen, or removed without authorization), States should be reminded of the risks presented by orphan sources and of the need to exercise strict control over radiation sources through appropriate infrastructures. The BSS and associated IAEA guidance, along with support programmes to help States implement the BSS, are suitable for the purpose of controlling radiation sources.

(c) National systems of control for ensuring the safety and security of radiation sources should be established or strengthened where necessary in order to meet the assumption, made in the Preamble to the BSS, that in each State there already exist legislation and regulations, a regulatory authority empowered to authorize and inspect regulated activities and to enforce the legislation and regulations, sufficient resources, and adequate numbers of trained personnel.

(d) The requirements of the BSS relating to notification and authorization apply to all radiation sources, unless the associated exposures have been excluded from the BSS because they are unamenable to control or because the practice involving the source has been exempted from the requirements on the grounds of the triviality of the dose. Although any loss of control over radiation sources covered by the BSS requirements should be regarded as unsatisfactory, loss of control over only some of them is likely to lead to serious injury to persons. It is important, therefore, to limit the focus to those sources which, if

they became "orphan", could pose a major risk. This calls for a categorization of the sources in use. There are as yet no internationally agreed categorization criteria, however, and it is suggested that the IAEA attempt to establish such criteria with some urgency.

(e) The IAEA's Model Project on "Upgrading Radiation Protection Infrastructure" is leading to progress in the development of national systems that comply with the administrative requirements of the BSS. It should be complemented by systematic peer reviews of the effectiveness of regulatory programmes.

(f) National requirements whereby authorized users must promptly report to the regulatory authority any case of a missing source should be put in place, and information on all missing sources should be kept in a database by the regulatory authority. The establishment of international databases on missing and found sources would facilitate the tracking of orphan sources. The information in such databases would need to be provided by national authorities or points of contact.

(g) Education in radiation protection should be encouraged, and it should be complemented with practice-specific training. In this connection, it may be useful to have national systems for the authorization of workers operating radiation equipment or radiation sources that can cause significant exposures and of other staff with responsibilities related to protection and safety. Although considerable effort has been invested in regional centres for the provision of education in radiation protection, and a large number of persons have been educated at such centres, staff turnover and the increasing need for new staff created by the establishment of regulatory authorities call for intensified education activities.

(h) Education programmes for medical personnel should include training designed to ensure that they recognize radiation injuries and apply the correct procedures.

(i) States and international organizations should be requested to consider providing radiation sources only to States that have an adequate infrastructure.

(j) Some accidents result from lack of security when sources that are in use are placed into temporary storage. Other accidents result from lack of security when sources that are no longer needed are placed into long-term storage. In the latter case, the risk can be significantly reduced by requirements to include a provision for the disposal of the source in the application for authorization of the practice in which the source is to be used and by a national strategy and systems to deal with spent sources. States without provisions for the storage or disposal of spent sources should be requested to authorize the import only of sources whose manufacturers agree to take them back when they are no longer required. As to existing spent sources, or sources that are in use without there being a strategy for their disposal, States should be encouraged to develop national strategies for dealing with spent sources and international assistance should be intensified in that connection.

(k) States should be encouraged to consider installing monitoring systems at airports and seaports, at border crossings and at other locations where radiation sources may appear (such as metal scrap yards and recycling plants). Strategies, including staff training and the provision of equipment. should be developed for responding to cases where radiation sources are detected at such locations. States should bear in mind that the loss of control over a source in one country may have transboundary consequences and may necessitate international information exchange and co-operation.

(l) Consideration should be given to making sources used for defence purposes subject to control either by the civilian authorities or by a body that passes all necessary information to the civilian authorities, particularly in the event of the loss of a radiation source.

(m) The IAEA should strengthen the mechanisms used by it in providing for the application of the BSS (particularly education and training, the fostering of information exchange and the rendering of technical assistance). The IAEA should also consider providing guidance with regard to search, detection and recovery actions, including guidance with regard to technical and personal protection measures. In addition, the IAEA should be prepared, upon request, to help with recovery actions itself and through the provision of outside expert services.

(n) There may be a need for an effective international undertaking in the area of the safety and security of radiation sources. Such an international undertaking could be formulated and might take the form of a convention or some other type of instrument. Whatever its form, it should provide for a clear determination by and attract the broad adherence of States. The IAEA is strongly encouraged to initiate exploratory discussions for achieving such an international undertaking.

ANNEX

EXAMPLES OF ACCIDENTS WITH ORPHAN SOURCES

1. Goiânia, Brazil - Teletherapy source assembly containing ^{137}Cs

In 1985, a private radiotherapy institute moved to new premises, leaving behind a 51 TBq ^{137}Cs teletherapy unit in an insecure building. The licensing authority was not notified. After a partial demolition of the building, the teletherapy unit was totally unsecured and remained so for 2 years. At that time, two individuals entered and removed the source assembly from the radiation head. They tried to dismantle it at home, and in the attempt the source capsule was ruptured. The radioactive source was in the form of caesium chloride, which is highly soluble and readily dispersible. Contamination of people and the environment ensued, resulting in the external and internal exposure of many persons.

After the source capsule was ruptured, the remnants of the source assembly were sold for scrap. The scrap dealer noticed that the source material glowed blue in the dark. Several persons were fascinated by this and over a period of days friends and relatives came and saw the phenomenon. Fragments of the source the size of rice grains were distributed to several families. This proceeded for five days, by which time a number of persons were showing gastrointestinal symptoms arising from their exposure to radiation from the source. The symptoms were not initially recognized as being due to exposure to radiation. However, one of the persons exposed suspected a connection between the illnesses and the source capsule and took the remnants to the public health department in the city. This action began a chain of events which led to the discovery of the accidents and the subsequent mobilization of a major emergency response.

Many individuals incurred external and internal exposures and the emergency response had to deal with both radiation injuries and major contamination throughout the city and beyond . In total, some 112 000 persons were monitored, of whom 249 were contaminated owing to the way they had handled the caesium chloride powder, such as daubing their skin and eating with contaminated hands, and via contamination of buildings, furnishings, fittings and utensils. Four of the exposed individuals died within four weeks of admission to hospital, having received total body radiation doses of 4.5 - 6 Gy.

Initial radiation surveys identified seven main foci of contamination, some of them with dose rates of up to 2 Sv h^{-1} at one metre. Aerial surveys were flown over 67 square kilometres. Of 159 houses monitored, 42 required decontamination. The programme lasted 6 months, involved significant resources and produced some 35 000 m^3 of active waste. The accident had a major economic impact on the area, depressing trade with other areas.

2. Tammiku, Estonia - Metal container with ^{137}Cs

In January 1994, a radioactive source was discovered in a shipment of scrap metal. The scrap was routinely surveyed using a hand held dose rate monitor. The Estonian Rescue Board was notified and recovered the metal container. The container was taken to the national waste disposal facility at Tammiku. The radionuclide and activity of the source were not determined prior to disposal and the origin of the container could not established.

The suitability of the waste disposal facility was important to subsequent events. The design anticipated that higher activity gamma sources would be placed in a more highly shielded vault. However, the container was too large to be placed into the vault through an S-tube provided for this purpose. Thus, the highly radioactive source was left in the relatively accessible and less shielded area of the disposal facility.

In October 1994, three brothers made an unauthorized entry into the waste repository and removed the container. The source was dislodged and fell to the ground. One of the men put the source in his pocket and took it home. The source remained in the house for approximately one month until the incident was identified. The man who picked up the source was hospitalized four days later and died about a week after that. He had injured his leg at the facility and based on his description of an injury while working in the woods, he was diagnosed as suffering from a "crush injury". The incident was discovered a few weeks later when the man's stepson was admitted to hospital with radiation burns to his hands after having picked the source up while working on his bike. The diagnosis of radiation burns was made and the police were notified. Five other people received doses between 0.3 and 2.7 Gy.

Security at the waste facility had included electric intruder alarms at the entrance gate and the door to the disposal pit, but these were easily overridden. The fence was in poor condition and was easily climbed over. The guards noted that a break-in had occurred and noted that measured dose rates had decreased. The reduced dose rates were attributed to changes in arrangement caused during the break-in and the facility operators took no action.

The staff involved in the recovery wore lead aprons and rubber gloves but did not have tongs or other handling tools. During the recovery operations, one person briefly picked up the source and this led to radiation injuries to the hand.

A governmental commission was set up to assess the consequences of the accident. On an inspection trip by car to a company, commission members happened to detect elevated radiation levels along the highway. A radiation source in a further metal container also with a ^{137}Cs source was located. A subsequent radiological survey failed to detect any more radiation sources.

3. Radiation sources in Georgia.

In September 1997, at the training centre for Georgian frontier troops at the village of Lilo near the city of Tbilisi, a group of radioactive sources were discovered. The Georgian government requested the IAEA assistance to assess the radiological situation at the site and to arrange for the medical treatment of the eleven soldiers exposed.

In the light of this incident and in order to verify the radiation situation at the sites of former Soviet military bases, a special Governmental Commission was set up under the chairmanship of the Minister for the Environmental Protection and Natural Resources. The commission drew up a schedule for verifying all the former Soviet military bases in Georgia. More than 40 different locations have been monitored in 10 cities. More than 70 radioactive sources, with activity between a few GBq up to a few PBq have been found. Several cubic meters of radioactive contaminated soil have been disposed of. The radionuclides involved are: ^{137}Cs, ^{60}Co, ^{226}Ra, ^{241}Am and ^{90}Sr. Two ^{90}Sr sources had extremely high levels of activity, of the order of hundreds of GBq. These were found at locations that were not related to any former or present military activities.

The medical treatment of the patients from Lilo was carried out at specialized centres in France and Germany. The conditions in which the sources were found in one village, Matkhoji, indicated the potential exposure of the population. In October 1998, the IAEA contacted the Institute for Protection and Nuclear Safety (IPSN, France) to carry out a haematological and biological dosimetry study of the people in the village. Blood samples were collected from 113 inhabitants, among them 44 children. Preliminary results of the haematological study carried out in situ show no alteration of the normal values for the blood parameters analyzed. However, 16 out of a total of 85 samples collected for biological dosimetry showed a higher number of dicentrics than expected. The highest dose estimate was approximately 0.3 Gy.

4. Turkey - Abandoned teletherapy sources

On the 28 December 1993 a company requested an import license for three ^{60}Co sources from the United States. The activity of these sources were:

Source A = 18 PBq (18 April 1986)

Source B = 43 PBq (26 July 1987)

Source C = 64 PBq (23 April 1992)

The sources were kept in the company's warehouse in Ankara, in their appropriate lead shipping containers. During the first quarter of 1998 they decided to ship sources A and C to another of their warehouses in Istanbul. However, when the sources arrived in Istanbul, instead of placing the sources in their deposit yard with their other goods they placed it in the facility next door because it was empty. The new owners of this facility, however, decided to sell the lead containers.

The person who purchased these containers took them to an open yard behind his apartment building and with another person started to dismantle them. After removing some parts of the containers they brought them to his father-in law's house. Here, using various types of tools and equipment they tried to break open the lead containers in search of gold.

Source A was found in a junkyard, recovered and is now under control at the CEKMECE Nuclear Research and Training Centre (CNRTC) of the TAEA in Istanbul. Two lead containers were found in front of the father-in-law's house and removed to the CNRTC. One lead plug of the containers (used to insert a new source) was also found at the junkyard and is also now at the CNRTC.

Source C with an activity of 26 PBq (as of 18 January 1999) is still missing.

All the locations where the sources were identified to have been in transit, according to persons who had bought them and tried to open them and who are still in hospital, were monitored (16 January 1999) but no missing source was found.

There was a possibility that the missing source and lead plug were brought to a metal production factory, located in the province of IZMIT (approximately 145 km from the CNRTC) and melted down. The factory was carefully surveyed (17 January 1999) and again nothing was found.

It has been decided, as recommended by the IAEA, to survey the whole region, street by street. Three well equipped monitoring teams were dispatched to the locations. Arrangements are also being undertaken to conduct an aerial survey (TAEA confirmed that they have the equipment and expertise).

At present, seven patients are still in hospital with bone marrow depression under aseptic conditions.

5. Ciudad Juárez, Mexico - Teletherapy head containing ^{60}Co

In 1977, a teletherapy unit with a 30 TBq ^{60}Co source was purchased and imported without the Regulatory Authority being notified. The source was shipped in the head of a teletherapy unit, but was not put into use and was stored in a general warehouse for six years. Except for any security provided by the warehouse, the owner exercised no control or surveillance of the source. The source consisted of about 6000 tiny pellets (1mm x 1mm diameter) of ^{60}Co, which is a metal with magnetic properties and low mechanical resistance.

In late 1983, a maintenance technician and others, attracted by the scrap value, dismantled the head of the unit, and removed the cylinder containing the ^{60}Co. They deliberately ruptured the cylinder containing the source and many pellets were dispersed and remained in the truck when the heavy parts were unloaded at the scrap yard. The pick-up truck used to carry the source thus became contaminated. Owing to defects, the truck remained parked in the suburbs of the city for about 50 days, exposing local residents.

When the ruptured cylinder was moved by cranes, together with the other metal pieces, the ^{60}Co pellets were spread all over the scrap yard and were then attracted by the crane's magnetic field and mixed with the other metal materials. As a result, pellets and pellet fragments were also transferred to the vehicles used for transporting scrap to various foundries. Within two weeks, scrap contaminated with ^{60}Co had been used by the steel and iron production plants and, shortly thereafter, building reinforcing rods and cast iron table bases manufactured with contaminated material were exported.

The accident was only discovered when a truck containing items made from the contaminated steel triggered radiation alarms as it passed through a radiation monitor installed along a road near a nuclear laboratory.

An extensive investigation was undertaken which established that 30 000 table bases and 6600 tons of reinforcing rods were made from the contaminated material. Aerial surveys of an area of 470 square kilometres were conducted, and visits were made to 17 636 buildings in order to discover whether contaminated material was used in their construction. As a consequence, 814 buildings were then subject to demolition in whole or in part. It is estimated that the accident exposed approximately 4000 people to radiation, about 80 receiving doses greater than 250 mSv. It is believed that 5 people received doses of 3 to 7 Sv over a two-month period.

6. Spain - Incineration of a radiation source

On 30 May 1998, a ^{137}Cs source was accidentally placed into an electric furnace of a stainless steel factory. The source was melted and a substantial part of the activity was released to the atmosphere. The rest of the activity was retained in a dust collection system and as a consequence 270 tons of dust became contaminated.

Collected dust is periodically removed and transferred to two establishments for treatment. As a result, equipment of both establishments became contaminated.

The steel factory became aware of the incident when a truck that was used to carry the dust returned to the steel factory and passed through a portal radiation monitor which alarmed. The Regulatory Authority initiated an inspection and investigation process. It was discovered that the radiation was due to residual dust remaining in the truck. About the same time, the European Community Urgent Information Exchange (ECURIE) system informed its members that a significant increase in the level of ^{137}Cs was observed in the atmosphere in both southern France and northern Italy. It was subsequently determined that this resulted from the spread of the airborne release from the steel plant.

About 400 people were monitored for internal contamination and only six of them were found to have detectable levels of ^{137}Cs and the doses were trivial.

Substantial economical consequences of this accident were:

1. Suspension of operation of the factories costing more than $US 20 million
2. Decontamination operations costing more than $US 3 million
3. Radioactive waste storage costing more than $US 3 million
4. Impact on the steel company’s shares and potential loss of sales contracts.

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GOV/1999/46-GC(43)/10
Attachment 2

Safety of Radiation Sources and Security of Radioactive Materials: Action Plan of the Agency

TABLE OF CONTENTS

INTRODUCTION

Radiation sources, utilizing either radioactive materials or radiation generators, are used throughout the world for a wide variety of peaceful purposes, in industry, medicine, research and education, and also in military applications. Many uses involve sealed sources with the radioactive materials firmly contained or bound within a suitable capsule or housing; some, also, involve radioactive materials in an unsealed form. The risks posed by these sources and materials vary widely, depending on the radionuclides, the forms, the activities, etc. Unless breached or leaking, sealed sources present a risk from external radiation exposure only. However, breached or leaking sealed sources, as well as unsealed radioactive materials, may lead to contamination of the environment and the intake of radioactive materials into the human body.

Until the 1950s, only radionuclides of natural origin, particularly radium-226, were generally available. Since then, radionuclides produced artificially in nuclear facilities and accelerators have become widely available, including cobalt-60, strontium-90, caesium-137 and iridium-192. The risks associated with the use of radioactive materials must be restricted and protected against by the application of appropriate radiation safety standards. Regulatory control has, however, sometimes lagged behind developments in the use of radionuclides.

The risks associated with the planned use of radiation sources and radioactive materials are generally well known and the relevant radiation safety requirements generally well established. Nevertheless, accidents can occur during use. In recent years there has been a growing awareness of the potential for such accidents, some accidents having had serious, even fatal, consequences. The attention of the radiation protection community has therefore become focused on the prevention of accidents involving the use of such sources and materials.

More recently still, there has been a growing awareness of the problems associated with radiation sources that for one reason or another are not subject to regulatory control or over which regulatory control has been lost. As radiation sources may be transported across borders, such problems are not necessarily restricted to the State within which the sources were originally used. Such sources are commonly referred to as “orphan sources”, a term which is taken here to include: sources that were never subject to regulatory control, but should be under regulatory control as required by the BSS[1]; sources that were subject to regulatory control, but have been abandoned, lost or misplaced; or sources that were subject to regulatory control, but have been stolen or removed without proper authorization.

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[1] The International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, jointly sponsored by FAO, IAEA, ILO, OECD/NEA, PAHO and WHO, IAEA Safety Series No. 115 (1996).

The precise number of such sources in the world is not known, but it is thought to be substantial - possibly of the order of many thousands.

Sealed sources or their containers can have a certain attractiveness because of their appearance or their apparent value as scrap metal. The subsequent handling of such sources and containers by workers and members of the public unaware of the inherent hazards can give rise to external irradiation or, if tampered with, the possibility of internal exposure. This has led to serious injury and in some cases death. Sources incorporated into scrap metal for subsequent recycling can lead to the contamination of plant and the environment, possibly with serious economic consequences. Due to international trade in the scrap metal, such material can be transferred from one country to another.

Many sources that are currently regarded as "orphan" were originally used in medicine or industry. Some, however, derive from military activities about which knowledge may not be readily available to the civilian regulatory authorities.

While radioactive materials include nuclear materials, issues associated with the non-proliferation of nuclear materials are not the subject of the following action plan.

From 25 to 28 May 1999, the Secretariat convened a group of consultants in Prague to begin drafting the action plan**.** The draft was further developed in the course of a Technical Committee meeting (with senior experts from Australia, Canada, China, the Czech Republic, Egypt, Finland, France, Germany, Iceland, India, Israel, Spain, Turkey, Ukraine, the United Kingdom and the United States of America and an observer from the European Commission) held in Vienna from12 to 14 July 1999.

THE ACTION PLAN

SCOPE AND OBJECTIVES

The primary purpose of this action plan is to enable the Agency to develop and implement activities that will assist Member States in maintaining and, where necessary, improving the safety of radiation sources and the security of radioactive materials over their life cycle. Consideration is given to fostering a safety culture, including the development of effective regulatory infrastructures, and to the education and training and oversight of those responsible for radiation sources and radioactive materials. In particular, the training of the staff of organizations that use radiation sources or radioactive materials should lead to the development of an increased sense of responsibility and safety culture so as to ensure that operations are undertaken safely and the sources and materials are kept secure.

Even with an effective infrastructure, the possibility that sources may escape control remains, and States need to be able to respond appropriately. Consideration is therefore given in the action plan to the further strengthening of the Agency's programme for the provision of support in such circumstances. This includes consideration of the need to train the staff of regulatory authorities in how to respond to orphan sources should such be discovered and in developing a plan for ensuring proper recovery and disposition of the sources.

As noted in the Introduction, there is a wide variety of uses of radiation sources and radioactive materials throughout the world. While the action plan covers all such uses, it is recognized that the focus should be on those sources and materials which pose the most significant risks. Primary consideration is therefore given to sealed radiation sources with relatively high levels of radioactivity which might necessitate interventional measures should control over them be lost. The action plan therefore calls for the categorization of sources as the basis for a graded approach to regulatory control.

A special aspect of the orphan source problem is the impact on persons or organizations that do not normally handle radioactive sources but may be at a higher risk from them. Examples include scrap metal recyclers and sanitary landfill operators. The action plan therefore also addresses the need to disseminate information to such persons and organizations regarding the types of sources that they may encounter and the actions to be taken if such sources are discovered.

The initiation by the Director General of exploratory discussions relating to an international undertaking is also included in the action plan.

The action plan does not deal with commodities contaminated as a consequence of an accident or loss of control over radioactive materials, or for some other reason. It should, however, be noted that such commodities may trigger surveillance systems intended to detect orphan sources.

PRINCIPLES OF THE ACTION PLAN

The principles underlying the action plan are that all components should:

(a) strengthen the systems of safety of radiation sources and security of radioactive materials;

(b) fit within existing Agency sub-programmes and maximize the use of existing Agency initiatives; and

(c) identify methods to implement the recommendations in the Secretariat's report contained in Attachment 1 to the present document in a manner consistent with the views of the Board of Governors.

The regulatory components of the action plan comprise Agency activities aimed at (1) strengthening national regulatory programmes covering notification and authorization (by either licensing or registration), the safety of radiation sources and 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 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.

The action plan consists of relevant current Agency activities and of new initiatives (including modifications of current Agency activities).

RELEVANT CURRENT AGENCY ACTIVITIES

The relevant current Agency activities are being carried out within the framework of four sub-programmes, which are described in Appendix 2 hereto.

Highlights of ongoing activities

The main activities of relevance under those sub-programmes and within other parts of the Agency's programme are summarized below:

1. Support in strengthening regulatory infrastructures. The following have been made available to Member States:

   (a) IAEA-TECDOC-1067 on "*Organization and Implementation of a National Regulatory Infrastructure Governing Radiation Protection and the Safety of Radiation Sources*"; and

(b) the Regulatory Authority Information System (RAIS), which provides the management of regulatory programmes with information on the location of radiation sources and facilities, on the authorization process, on inspection and enforcement actions and on the dosimetry of occupationally exposed personnel.

2. The development of guidance on how to undertake peer reviews of regulatory programmes. A draft safety report on "*Assessment by Peer Review of the Effectiveness of Regulatory Programmes for Protection against Ionizing Radiation and the Safety of Radiation Sources*" is available. It contains a methodology for preparing, conducting and reporting on peer reviews and is seen as a prelude to a service for the provision to States, on request, of assistance with the regulatory control of radiation sources.

3. An education and training programme. Educational course manuals are available (in several languages) and courses are being held. However, other training materials are needed.

4. Pursuant to a memorandum of understanding (MOU) between the Agency and the World Customs Organization, signed in May 1998, the promotion of co-operation between customs and regulatory authorities at the national level and of information exchange, co-operation and harmonization at the international level, for the purpose of improving the control of radioactive materials.

5. The development of a "*Safety Guide on Prevention, Detection and Response to Illicit Trafficking in Radioactive Materials*", which is being co-sponsored by the World Customs Organization and the International Criminal Police Organization (INTERPOL). A set of technical manuals will contain information on materials typically involved in illicit trafficking, on prevention, detection and response and on training for customs and police officers. A database on illicit trafficking incidents involving nuclear and other radioactive materials has been operated by the Agency since 1995.

6. Work connected with the installation of radiation monitoring systems at airports, seaports and border crossings. A report on the Agency's Illicit Trafficking Radiation Monitoring Assessment Programme (ITRAP) is being prepared. A laboratory/field study sponsored by the Austrian Government and carried out by the Austrian Research Centre Seibersdorf will provide information about radiation measuring and monitoring equipment (hand-held, portable and fixed) available on the international market and suitable for the detection of illicit movements of radioactive materials.

7. An international database on unusual radiation events, referred to as RADEV, is being developed. It will cover accidents resulting in exposures or radioactive contamination and any other event that is relevant to safety. In addition, it will provide information on causes and contributing factors and on lessons to be learned.

8. Work connected with emergencies. The development of documents on the recognition of radiation injuries and how to deal with them. Safety reports on "*Diagnosis and Treatment of Radiation Injuries*" and "*Planning the Medical Response to Radiological Accidents*" and an IAEA-TECDOC-869 on "*Assessment and Treatment of External and Internal Radionuclide Contamination*" are available.

9. A recently finalized technical document on "*Generic procedures for assessment and response during a radiological emergency*" provides the tools and data required for the initial response to a radiological emergency. A technical document on "*Generic procedures for monitoring during a nuclear or radiological emergency*" has been published (IAEA-TECDOC-1092). The Secretariat is developing standard training materials on the basis of those two technical documents and plans to use the materials at regional workshops. A technical document entitled "*Method for the development of emergency response preparedness for nuclear or radiological accidents*" (IAEA-TECDOC-953) provides tools for and approaches to the development of emergency response preparedness. Training material exists and is being used in regional workshops. A technical document entitled "*A model national emergency response plan for radiological accidents*" (IAEA-TECDOC-718) provides an outline for a national response plan.

10. The IAEA operates an Emergency Response Centre that can respond to requests for assistance under the terms of the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency. Such emergency assistance includes medical response and radiological surveys, technical assessments or advice, or assistance in accident mitigation.

11. The Model Project on Upgrading Radiation Protection Infrastructure was developed to assist those Member States which have inadequate infrastructures and are already receiving IAEA technical assistance so that they can comply with the BSS. Currently more than 50 countries are involved in the Model Project.

12. Guidance on the management of disused sources is provided by a number of documents, such as "*Handling, conditioning and disposal of spent sealed sources*" (IAEA-TECDOC-548), "*Nature and magnitude of the problem of spent radiation sources*" (IAEA-TECDOC-620*)* "*Methods to identify and locate spent radiation sources*" (IAEA-TECDOC-804) and "*Reference design for centralized spent sealed sources facility*" (IAEA-TECDOC-886). Direct assistance is being provided to Member States with the conditioning of their radium inventories and with the demonstration of methods and procedures for the conditioning and storage of spent sealed radiation sources.

NEW INITIATIVES

The proposed new initiatives regarding the safety of radiation sources and the security of radioactive materials, including the problem of orphan sources, are grouped according to seven areas which provide a logical division of tasks to be carried out by the Agency:

- Regulatory Infrastructures
- Management of Disused Sources
- Categorization of Sources
- Response to Abnormal Events
- Information Exchange
- Education and Training
- International Undertakings

Some tasks fall logically within more than one area, but for simplicity they are described in relation to one area only. The recommendations of this action plan, including the order of the actions, are based on technical considerations. However, the members of the drafting group and the Technical Committee were aware of the fact that execution of the actions, including the time schedule, will depend on the budgetary and other resources of the Agency.

In regard to timing, the actions have been placed into three sets:

- the first set of actions should commence immediately following adoption of the action plan;
- the second set should commence within a year of adoption of the action plan; and
- the third set should commence after the categorization of sources has been carried out.

Regulatory Infrastructures

A number of the recommendations in the Secretariat's report contained in Attachment 1 to the present document can be grouped together under this broad heading.

The Preamble to the BSS defines in broad terms the necessary prerequisites for their successful application. IAEA-TECDOC-1067 on "*Organization and Implementation of a National Regulatory Infrastructure Governing Protection against Ionizing Radiation and the*

Safety of Radiation Sources" provides further information on the essential elements of a national regulatory infrastructure. A Safety Requirements document entitled "*Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety*" is currently in an advanced state of preparation. The development of a Safety Guide entitled "*Regulatory Infrastructure for Protection against Ionizing Radiation and for the Safety of Radiation Sources*" and based on IAEA-TECDOC-1067 is also in the current programme, but work on it is still at an early stage. The following technical documents related to emergencies are also relevant and available: "*Method for the development of emergency response preparedness for nuclear or radiological accidents*" (IAEA-TECDOC-953) and "*A model national emergency response plan for radiological accidents*" (IAEA-TECDOC-718). In due course, consideration will need to be given to the feasibility of consolidating into one document the appropriate guidance on the safety and security of radioactive materials over their life cycle.

The additional activities that the Agency should develop so as to assist Member States in maintaining or improving regulatory infrastructures for the safety of radiation sources and the security of radioactive materials are as follows:

***Action*:** to establish a service for advising States on the establishment of appropriate regulatory programmes.

This action should commence within a year of adoption of the action plan.

The current programme includes the establishment and maintenance of a service for assisting States, on request, with the regulatory control of radiation sources, including prevention of the occurrence of orphan sources. This service has yet to be established. Furthermore, the nature of the service has not been fully defined and, consistent with the discussion of document GOV/1999/14 ("Providing for the application of international radiation protection standards in States that are not Member States of the Agency") in the Board of Governors at its March 1999 meetings, consideration needs to be given to the requests of States that are not Member States of the Agency. Consequently, it is included here as a new initiative. Two types of service are envisaged:

(a) advice on the preparation of regulations and regulatory guidance, including practice-specific guidance; and

(b) peer reviews of regulatory infrastructures covering systems of notification, authorization, inspection and enforcement in States.

Feedback from the provision of these proposed Agency services will be useful in determining the way in which relevant Agency guidance may be consolidated.

Management of Disused Sources

National activities for regaining control of orphan sources need to include a strategy to deal with all disused sources safely, including orphan sources after they are detected or found. The preferred option for managing disused sources is return to the suppliers. However, this option may not be feasible for orphan and old disused sources. For the proper management of these sources, especially those with high activity and a long half-life, further guidance is needed.

***Action*:** to prepare documents on particular aspects of the handling and disposal of disused radioactive sources.

This action should commence within a year of adoption of the action plan.

Some types of sources (e.g. medical teletherapy sources and radiography sources) which are no longer suitable for their initial purpose still have high activity. The documents are intended to describe the proper handling, storage, conditioning and disposal of these sources, which require - inter alia - special procedures, technical infrastructure and qualified staff. Considering the high level of interest that many States are showing in the disposal of disused radioactive sources, a technical document summarizing existing practices and a safety document concerning the disposal of sources in boreholes is proposed.

***Action*:** to organize consultations and workshops on technical, commercial, legal and regulatory aspects of the return of disused sources to manufacturers and on the management of disused sources with long-lived radionuclides and of equipment containing such sources.

This action should commence immediately following the adoption of the action plan.

Consultative meetings with source and equipment manufacturers and regulators would provide an opportunity for discussing technical, commercial, legal and regulatory aspects of the return of disused sources and exploring possibilities for informal or formal co-operation in facilitating the return of sources to manufacturers or to other organizations able to manage them safely. Various types of long-lived sources or of equipment containing such sources (for example, ^{241}Am-Be or ^{239}Pu-Be neutron sources, lightning conductors with ^{226}Ra or ^{241}Am, static electricity eliminators with ^{239}Pu) are used in many countries. Many such sources are no longer being used, and it is therefore urgently necessary to disseminate information on their proper management.

Categorization of Sources

The wide variety of uses of radiation sources and radioactive materials necessitates the development of some form of categorization so that the controls to be applied will be commensurate with the radiological risks that the sources and materials present. Of particular concern are those radiation sources containing substantial levels of radioactivity which have

the potential for causing significant harm to persons in the short term. Account would need to be taken of the radionuclide, its activity, the physical characteristics and the design of the source and its container and conditions of use. Such categorization would be relevant to decisions regarding: notification and authorization by registration or licensing; the security requirements during each stage from manufacture, through transport, storage, use, transfer and repair, to decommissioning and disposal; and emergency preparedness. It would also be relevant to any future international databases of lost and found sources and incidents and accidents involving sources.

Action: to prepare a document on the categorization of sources on the basis of the associated potential exposures and radioactive contamination.

This action should be given high priority because it is a prerequisite for other actions of the plan. It should commence immediately following adoption of the action plan.

Two stages are envisaged in the development of the categorization. In the first stage, the categorization would be broadly defined, on the basis of simple scenarios. In the second stage, it would be based on a more detailed safety assessment.

Response to Abnormal Events

The term "abnormal events", as used in this section, refers particularly to events associated with orphan sources, including illicit trafficking in radioactive materials.

The Agency already has prevention and detection arrangements in place with regard to illicit trafficking in radioactive materials. It also has arrangements in place for responding to radiological emergencies involving orphan sources.

***Action*:**

(a) to prepare guidance on national strategies and programmes for the detection and location of orphan sources and their subsequent management;

(b) to formulate criteria for the development, selection and use of detection and monitoring equipment at border crossings, ports of entry, ports of exit, and scrap yards and other facilities;

(c) to develop further national response capabilities for dealing with radiological emergencies; and

(d) to strengthen the Agency's existing capabilities for the provision of assistance in emergency situations.

The preparation of guidance should commence after the categorization of sources has been carried out, and the other actions should commence within a year of adoption of the action plan.

Action (c) would involve activities addressing questions of command and control, organizational responsibilities, plans and procedures, logistic support and training, drills and exercises. It would also include the development of capabilities for the recognition and management of radiation injuries and the management of source disposition.

The other actions would involve expanding the capabilities of the Agency for carrying out radiological surveys in emergency situations, if orphan sources are detected or suspected, by strengthening the network of emergency response teams.

Information Exchange

There are several target audiences for the exchange of information - for example, national authorities and individuals who, in some way or other, may come into contact with orphan sources.

At its March 1999 meetings, the Board requested the Director General to bring the report attached to document GOV/1999/16 (and contained in Attachment 1 to the present document) to the attention of national authorities. This has been done. Nevertheless, it is a continuing responsibility of the Agency to draw attention to the risks presented by orphan sources and to the importance of strict control over radiation sources and radioactive materials through appropriate regulatory infrastructures. One mechanism for doing this would be an international conference with objectives similar to those of the International Conference on the Safety of Radiation Sources and the Security of Radioactive Materials held in Dijon, France, in September 1998.

***Action*:** to organize an *International Conference on the Control by National Authorities of Radiation Sources and Radioactive Materials* and regional workshops on specific topical issues.

This action should commence immediately following adoption of the action plan.

The terms of reference for the conference should take into account the conclusions of the International Conference held in Dijon and all relevant subsequent developments, including progress in the implementation of this action plan.

The primary purpose of the conference should be to maintain the focus on the need for the development of regulatory infrastructures in States. The conference should therefore be aimed at high-level officials from regulatory authorities, with the intention of sharing experience in the regulatory control of radiation sources and radioactive materials and encouraging - where necessary - the further development of regulatory systems.

The purpose of the regional workshops should be to target regional needs and provide relevant information to the manufacturers and users of sources and related devices. While planning for such workshops could commence immediately, the workshops should not be held until the document on the categorization of sources has been prepared.

The Agency's database on illicit trafficking in nuclear materials and other radioactive materials can provide Member States, the media and the public with reliable information on trafficking incidents obtained from nominated points of contact. It may not be sufficient to cover all needs and all audiences, however, and the establishment of other databases should therefore be considered.

Action: to develop an international database on missing and found orphan sources or to modify an existing database so as to include such sources.

This action should commence immediately following adoption of the action plan.

The purpose of such a database should be to facilitate the rapid exchange of information, particularly information on very hazardous sources. Since the utility and feasibility of such a database have yet to be confirmed, it is recommended that the Agency first consider them and then - if they are confirmed - the terms of reference. In doing this, the Agency would need to take account of any systems already being used by it and by Member States.

Action: to fully develop and maintain the international database on unusual radiation events (RADEV) and make it available to Member States.

This action should commence within a year of adoption of the action plan

The development of this database is already in the Agency's programme, but it is at a very early stage and for that reason included under the heading of "New Initiatives". The purpose of this database would be to provide a mechanism for feeding back information on lessons learned from particular events. The target audiences would include regulatory authorities, manufacturers and suppliers of radiation sources and of equipment containing such sources, and users of radiation sources or radioactive materials.

Action: to develop a repository of information on the characteristics of sources and of devices containing sources, including transport containers, and to disseminate the information, with consideration of the advisability of dissemination through the Internet.

This action should commence within a year of adoption of the action plan

This repository should also contain information about manufacturers and the current names and addresses of the entities responsible for the receipt of returned sources or related devices. Due to their very nature, orphan sources may be encountered by persons who have

no knowledge of what they are or of the risks that they may present. Such persons include customs officers and people who work with metallurgical scrap. A number of national and professional bodies have launched information campaigns, but there is a need to explore the possibility of providing information on an international basis. The mechanisms whereby this might be done would first need to be explored. The database should contain information on radiation sources and related devices both currently available and no longer being produced. It should provide information on the characteristics and appearance of sources, the devices in which they are used and their transport containers.

Education and Training

The General Conference has, on a number of occasions, given attention to the matter of education and training in radiological protection and nuclear safety. In particular, in resolution GC(XXXV)/RES/552, the General Conference, taking into account "the need for achieving a common level of understanding in matters relating to radiation protection and nuclear safety", requested the Director General "to prepare a comprehensive proposal for education and training in both radiation protection and nuclear safety" for consideration at the Conference's 1992 regular session. In resolution GC(XXXVI)/RES/584, the General Conference, reaffirming "its commitment to strengthening international co-operation in matters relating to nuclear safety and radiological protection" and emphasizing "the importance of education and training in such co-operation", took "positive note of the proposal for education and training in radiological protection and nuclear safety contained in document GC(XXXVI)/1016 (in particular paragraphs 18, 19 and 20)" and endorsed its contents. In document GC(XXXVI)/1016 it was stated that "*[t]he principal aim of the proposal is to strengthen the relevant parts of Member States national infrastructures so that, in the long term, the education and training of nationals in radiation protection and nuclear safety become self-supporting.*"

Education and training in radiation safety is therefore a very important component of the Agency's current programme. Nevertheless, the fact that safety and security breaches continue to occur indicates that further work in this area is highly desirable. Particular targets are the staff of regulatory authorities and manufacturers and suppliers of radiation sources and equipment - in order to develop a proper awareness of the requirements of the BSS - and users of radiation sources and radioactive materials - in order to ensure that proper control is exercised over sources and materials in the workplace. The training of users needs to be specific to the particular use of radiation sources or radioactive materials. Also, there is a need to develop a much greater knowledge among physicians of the injuries caused by high levels of radiation exposure and their treatment. Further target groups are police and customs officers who may encounter orphan sources in the course of their duties and other persons who do not normally handle radioactive materials, including personnel working in scrap yards.

Much attention has been given to the development of a standard syllabus of educational courses in radiation protection for post-graduates. This syllabus needs to be kept up to date, and regular review is already provided for in the Agency's programme. However, greater

attention needs to be given to the development of training material for the staff of regulatory authorities, users of radiation sources and radioactive materials and persons at higher risk of encountering orphan sources. Regulatory authority staff should be trained in the implementation of systems of notification and authorization, the development of regulatory requirements, the inspection of premises and the enforcement of BSS requirements. Users need to be instructed in the appropriate precautions to be taken, since it is often inadequate control in the workplace that leads to breaches of safety and security. Both regulators and users need to be trained in how to deal with radiological emergencies that may arise due to a breakdown of controls and to accidents. In particular, regulatory authority staff need to be trained in how to deal with the specific problem of orphan sources, including search and detection. Training material for particular uses of radiation sources and radioactive materials needs to be developed in a systematic fashion, starting with syllabuses and lecture plans and going on to course material, including lecture notes, exercises, visual aids and interactive computer programs. Such material should be used in Agency-sponsored courses and be available for use by States in any courses that they organize themselves.

Action: to intensify post-graduate educational course activities in accordance with General Conference resolution GC(XXXVI)/RES/584 on "*Education and training in radiation protection and nuclear safety*" and to develop, in a systematic way, syllabuses and training material for specific target groups and specific uses of radiation sources and radioactive materials.

This action should commence within a year of adoption of the action plan.

International undertakings

The Board of Governors requested the Director General "to initiate exploratory discussions relating to an international undertaking in the area of the safety and security of radiation sources". Independently of its legal form, such an undertaking should be seen as part of a programme for strengthening the resolve of States to establish appropriate regulatory infrastructures for the safety of radiation sources and the security of radioactive materials, the existence of such infrastructures being a fundamental presumption of the BSS.

Action: to initiate a meeting of technical and legal experts for exploratory discussions relating to an international undertaking in the area of the safety of radiation sources and the security of radioactive materials.

This action should commence within a year of adoption of the action plan.

These exploratory discussions should focus on the form and content of the international undertaking. It is envisaged that the undertaking would address the elements of the infrastructure presumed by the BSS to exist in each State and, in particular, cover the following topics:

(a) the establishment of national legislation and regulations, and of regulatory authorities empowered to authorize and inspect regulated activities and enforce the regulations and with sufficient resources and adequately trained personnel;

(b) national arrangements for the prompt reporting and recording of missing sources;

(c) national systems for ensuring that all personnel using radiation sources or radioactive materials or having responsibilities related to protection and safety receive appropriate training;

(d) national arrangements for the proper management and disposal of disused sources from all applications; and

(e) arrangements for an adequate response to the detection of orphan sources.

Account will need to be taken of the provisions of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. Among other things, this convention places obligations on Contracting Parties with regard to the transboundary movement of spent fuel and radioactive waste and with regard to the possession, remanufacturing or disposal of disused sealed sources.

MAJOR FINDINGS OF THE INTERNATIONAL CONFERENCE ON THE SAFETY OF RADIATION SOURCES AND THE SECURITY OF RADIOACTIVE MATERIALS, 14-18 SEPTEMBER 1998

The attention of the radiation protection community was in the past focused on the prevention of accidents involving radiation sources subject to regulatory control, but the rise in the incidence of illicit trafficking in radioactive materials during the early 1990s led to greater awareness of the problem of radiation sources that are - for various reasons - not subject to regulatory control. Bearing this in mind, the Conference concluded that:

(a) Sources of ionizing radiation must have sufficient protection to allow for safe normal operations.

(b) The possibility of accidental exposures involving radiation sources must be anticipated and there must be appropriate safety devices and procedures. In this connection:

  (i) weaknesses in the design and construction of radiation sources must be corrected;

  (ii) a high level of safety culture in the handling of radiation sources must be promoted, so that - inter alia - human errors are minimized through good training; and,

  (iii) regulatory infrastructures for the control of radiation sources must be supported by governments and be able to act independently, and the regulatory authority in each country must maintain oversight of all radiation sources in that country - including those which have been imported.

(c) Radiation sources should not be allowed to drop out of the regulatory control system. This means that the regulatory authority must keep up-to-date records of the person responsible for each source, monitor transfers of sources and track the fate of each source at the end of its useful life.

(d) Efforts should be made to find radiation sources that are not in the regulatory authority s inventory, because they were in the country before the inventory was established, or were never specifically licensed or were lost, abandoned or stolen (such radiation sources are often referred to as orphan sources).

(e) Because there are many orphan sources throughout the world, efforts to improve the detection of radioactive materials crossing national borders and moving within countries by carrying out radiation measurements and through intelligence-gathering should be intensified. Optimum detection techniques need to be developed, and confusion would be avoided if international agreement could be achieved on quantitative levels that would trigger investigations at border crossings.

It is clear from these points that the key common element which would have the greatest part to play both in the avoidance of orphan sources - with their potential for misuse or accidents - and in the achievement and maintenance of safe and secure operating conditions is effective national regulatory authorities operating within suitable national infrastructures.

Governments are urged to create regulatory authorities for radiation sources if they do not exist. Whether the regulatory authority is newly created or has been in existence for some time, the government must provide it with sufficient backing and with sufficient human and financial resources to enable it to function effectively. Only in this way can the problem of the safety of radiation sources and the security of radioactive materials be tackled at its roots and eventually brought under control.

Further efforts should be made to investigate whether international undertakings concerned with the effective operation of national regulatory control systems and attracting broad adherence could be formulated.

THE FIVE SUB-PROGRAMMES WITHIN THE FRAMEWORK OF WHICH THE RELEVANT CURRENT AGENCY ACTIVITIES ARE BEING CARRIED OUT

[Taken from the Agency document GC(42)/7 - The Agency's programme and budget for 1999 and 2000]

Safety of radiation sources and security of radioactive materials (Sub-programme I.2)

Objectives

To promote the international harmonization of safety of radiation sources and security of radioactive material by: (i) developing safety standards for the effective regulatory control of radiation sources and radioactive materials and for their security and, consequently, for the reduction of the likelihood of accidents involving radiation sources; and (ii) providing for the application of these standards.

This sub-programme consists of three projects:

Control of Radiation Sources and Radioactive Material (I.2.01) - to promote the international harmonization of the control of radiation sources and radioactive material by: (i) developing safety standards and supporting documents for harmonizing, at the practical level, national systems for notification, registration, licensing, inspection and safety verification of radiation sources and radioactive material; and (ii) fostering of information exchange; the promotion of education and training in licensing and inspection of radiation sources; and the rendering of services in relation with the information system for radiation sources and on safety reviews of major irradiator facilities.

Safety Assessment of Radiation Sources (I.2.02) - to promote the international harmonization of prospective radiation safety assessments of radiation sources by: (i) developing safety standards and supporting documents relating to the prospective evaluation of potential exposures from radiation sources, including probabilistic assessment techniques, and for the implementation of the existing technological and managerial radiation safety requirements; and (ii) development of probabilistic safety assessment (PSA) techniques; information exchange on prospective safety assessments and design assessments of irradiation facilities; and the rendering of services in PSA application and data collection.

Assessment of Accidents involving Radiation Sources (I.2.03) - to assess accidents, incidents and near misses involving radiation sources, scrutinizing their initiating events and contributing factors, and evaluating their consequences; and to collect, analyse and disseminate the relevant information, in order to provide a repository of international knowledge to be used as feedback from retrospective safety assessment of radiation sources and for fostering information exchange on unusual events and lessons learned from accidents.

Radiation emergencies (Sub-programme I.4)

Objectives

To promote the international harmonization in radiation emergency preparedness and response by developing safety standards, providing for the application of these standards, and the rendering of services.

This sub-programme consists of two projects:

Emergency Planning and Preparedness (I.4.01) - to promote the international harmonization for emergency planning and preparedness by: (i) developing, in consultation and collaboration with other organizations, including the WHO, WMO, the Nuclear Energy Agency of the OECD, the United Nations Department of Humanitarian Affairs, FAO and the European Commission, safety standards for emergency planning and preparedness, including intervention and action levels; and (ii) fostering of information exchange both at the decision making level and at operational level on detailed procedures on emergency planning and preparedness and on generic prospective assessment techniques; the promotion of education and training on emergency planning, including planning of medical response; and the rendering of services for multilateral and bilateral agreements.

Emergency Notification, Assistance and Response (I.4.02) - to promote the international harmonization of emergency notification, assistance and response by: (i) developing, in consultation and in collaboration with the United Nations Office for Outer Space Affairs, UNESCO, ILO, UNIDO, UNEP, UNSCEAR and IMO, safety standards for the rapid transmission of relevant technical information and for the provision of assistance in the event of an emergency as well as for the emergency response; and (ii) serving the Conventions on Early Notification of a Nuclear Accident and on Assistance in the Case of a Nuclear Accident or Radiological Emergency by, in consultation, and collaboration with WHO, WMO, the Nuclear Energy Agency of the OECD, the United Nations Department of Humanitarian Affairs, FAO, the European Commission, the Office for Outer Space Affairs, UNESCO, ILO, UNIDO, UNEP, UNSCEAR and IMO, operating, maintaining and, as necessary, upgrading the Agency's Emergency Response System

and responding to requests for notification and assistance in the event of a nuclear accident or a radiological emergency.

Information (Sub-programme M.1)

Objectives

To provide a focal point for information about instances of trafficking in nuclear and other radioactive materials.

This sub-programme consists of one project:

Database on Illicit Trafficking in Nuclear Material and Other Radioactive Sources (M.1.01) - to provide reliable information to governments and the media on incidents of trafficking in nuclear and other radioactive materials from a centralized repository of reliable data on such incidents which is maintained by the Agency.

Protection of other radioactive materials. (Sub-programme M.3)

Objectives

To support Member States in the prevention, detection and response to trafficking of other radioactive materials.

This sub-programme consists of one project:

Assistance to Member States on Security of Radioactive Sources (M.3.01) - to provide assistance to Member States through the development of safety standards; to assist in the application of these standards; to provide education and training; and to support technical co-operation activities in the protection of radioactive materials.

Waste management information and technology transfer (Sub-programme B.4)

Objective:

To systematically identify, analyse and document the status and trends in the field of radioactive waste management; to develop tools to assist Member States waste management efforts; and to develop and maintain information systems to facilitate exchange and technology transfer, inform staff, promote common understanding, reduce the cost of distribution and optimize access to and dissemination of available data.

This sub-programme consists of two projects:

Direct Assistance and Support for National Waste Management Programmes (B.4.03) - to provide assistance to Member States in strengthening waste technology infrastructure, in developing competence in managing radioactive waste and implementing national programmes.

Support for the Management of Spent Radiation Sources in Developing Member States (B.4.04) - to assist Member States in strengthening and improving their capability to manage and dispose of spent radiation sources.