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

INTERNATIONAL CONFERENCE ON THE SAFETY OF RADIOACTIVE WASTE MANAGEMENT

1. The *International Conference on the Safety of Radioactive Waste Management* took place in Córdoba, Spain, from 13 to 17 March 2000 within the framework of the Agency's safety programme for the year 2000.[1] More than 300 senior officials and scientists from 55 Member States and 6 international organizations participated in the Conference.

2. The Conference was organized by the Agency, in co-operation with the European Commission, the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development and the World Health Organization, and hosted by the Government of Spain.

3. The officers of the Conference were as follows:

(a) President: Mr. J.M. Kindelán, President of the Consejo de Seguridad Nuclear, Spain

(b) Chairpersons of the Technical Sessions:

(i) Ms. G.J. Dicus, Commissioner, Nuclear Regulatory Commission, United States of America
(ii) Ms. A. Bishop, President, Atomic Energy Control Board, Canada
(iii) Mr. K. Balu, Director, Nuclear Reactors Group, Bhabha Atomic Research Centre, India

(iv) Mr. A.-C. Lacoste, Director, Direction de la Sûreté des Installations Nucléaires, France

[1] In resolution GC(43)/RES/13, adopted on 1 October 1999, the General Conference urged governments to take steps to help ensure that the Conference was "well attended by policy-makers, regulators and other senior officials and by licensees and industry experts from all areas of radioactive waste management, particularly from developing countries".

(v) Mr. L. Williams, Chief Inspector of Nuclear Installations and Director of the Nuclear Safety Directorate, United Kingdom
(vi) Mr. D.J. Beninson, Scientific Advisor to the Nuclear Regulatory Authority, Argentina
(vii) Mr. S. McIntosh, Australian Nuclear Science and Technology Organisation, Australia

(c) Programme Committee members:

Mr. P. Metcalf, Deputy General Manager, Council for Nuclear Safety, South Africa - Chairperson
Mr. P. Carboneras, Empresa Nacional de Residuos Radiactivos SA, Spain
Mr. R. Clarke, Director, National Radiological Protection Board, United Kingdom
Mr. J. Greeves, Director, Division of Waste Management, Nuclear Regulatory Commission, United States of America
Mr. Y. Kawakami, Executive Managing Director, Research Association for Nuclear Facility Decommissioning, Japan
Mr. L. Nachmilner, Head, Department of Technical Development, Radioactive Waste Repository Authority, Czech Republic

4. The Chairman of the Board of Governors, Ambassador S. de Queiroz Duarte of Brazil, was a member of the panel on "Controversial issues in the international transit of radioactive waste", and the Resident Representative of the United States, Ambassador J.B. Ritch, addressed the Conference as a Guest Speaker. The Resident Representative of Spain to the Agency, Ambassador A. Ortiz, and representatives of other Member States also attended the Conference.

5. The heads of the four bodies involved in the establishment of relevant Agency safety standards participated in the Conference:

Mr. R. Clarke, Chairman of the International Commission on Radiological Protection
Mr. A.J. Baer, Chairman of the Agency's International Nuclear Safety Advisory Group
Mr. L. Williams, Chairman of the Agency's Advisory Commission on Safety Standards
Mr. P. Metcalf, Chairman of the Agency's Waste Safety Standards Advisory Committee

6. The President of the International Symposium on the Restoration of Environments with Radioactive Residues held in Arlington, USA, from 29 November to 3 December, Mr. C.B. Meinhold (President of the US National Council on Radiation Protection and Measurements), presented the conclusions and recommendations of the Symposium.

7. The topics covered by the Conference were:

Current international co-operative efforts

Recommendations from the International Commission on Radiological Protection
Recommendations from the International Nuclear Safety Advisory Group
Conclusions and recommendations of the International Symposium on the Restoration of Environments with Radioactive Residues
Siting of radioactive waste management facilities
Participation of interested parties
Legislative and general radiation safety aspects
Removal of material from regulatory control (exclusion, exemption and clearance)
Predisposal management (dilution, recycling, transmutation, etc.)
Near surface disposal
Residues from the mining and processing of radioactive ores
Long-term institutional control
Geological disposal
Prospects for the establishment of international repositories
Retrievability versus irreversibility
Long-term storage versus disposal
Management of disused radioactive sources
Transboundary movements of radioactive waste

8. The summary observations, conclusions and recommendations of the Conference are attached. The Secretariat will issue the Conference proceedings before the forthcoming (44th) session of the Agency's General Conference.

INTERNATIONAL CONFERENCE ON THE SAFETY OF RADIOACTIVE WASTE MANAGEMENT

SUMMARY OBSERVATIONS, CONCLUSIONS AND RECOMMENDATIONS

GENERAL

(highlights of the closing speech of the Conference's President - J.M. Kindelán, Spain)

The principal objective of the Conference was to enable members of the scientific community and representatives of facilities which produce radioactive waste, of bodies responsible for radioactive waste management, of nuclear regulatory bodies and of public interest groups - among others - to engage in an open dialogue. The open dialogue which took place may, by providing policy- and decision-makers with a basis for political action, prove to be an important step in the search for the international consensus so essential in the area of radioactive waste management.

The relevant policies and activities of the International Atomic Energy Agency (IAEA), the European Commission, the Nuclear Energy Agency of OECD and the World Health Organization were presented. The evolution, under the aegis of the IAEA, of a *de facto* international radiation and nuclear safety regime was noted. In the area of radioactive waste safety, this regime consists of the *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management* (which, it is hoped, will enter into force soon), the body of international waste safety standards established by the IAEA and other international organizations, and the IAEA's mechanisms for providing for the application of those standards.

It was noted that the International Commission on Radiological Protection (ICRP) has approved three new documents containing recommendations for the safe management of radioactive waste - namely, "*Radiological protection policy for the disposal of radioactive waste*" (Publication 77), "*Radiological protection recommendations as applied to the disposal of long-lived solid radioactive waste*" (Publication 81, in press) and "*Protection of the public in situations of prolonged radiation exposure*" (Publication 82, in press). As the safety of radioactive waste management includes radiation protection issues and the ICRP's recommendations are taken into account universally, these new documents will be of great value in further developing and strengthening the body of international safety standards. The International Nuclear Safety Advisory Group (INSAG) also makes recommendations concerning the safe management of radioactive waste (for example, the recent recommendations in an INSAG report on "*The Safe Management of Sources of Radiation: Principles and Strategies*" issued by the IAEA as publication INSAG-11, on which the Conference was briefed): all these are taken into account in the establishment of the Agency's safety standards.

The recent International Symposium on the Restoration of Environments with Radioactive Residues, organized by the IAEA, hosted by the Government of the United States of America and held in Arlington, Virginia, resulted in conclusions and recommendations (see the Appendix to this Attachment) that are important for the safety of the management of radioactive waste.

Radioactive waste already exists, and doing nothing with it is not a sustainable option. It is the duty of the present generation to avoid imposing an undue burden on future generations, and therefore to devise and implement viable solutions for the safe management, including disposal, of that waste. In each country, it is the responsibility of parliament and government to establish the legislative framework and take the political decisions necessary for the implementation of a national radioactive waste management policy.

Such a policy should reflect the following considerations:

- The producers of radioactive waste have the prime responsibility for its safe management, and it is they who should propose appropriate options and secure the economic resources necessary in order to discharge that responsibility.

- Radioactive waste management should be dealt with "holistically"[1], so as to avoid actions which, while resolving immediate problems, could constrain future decision-making. However, where the demands of safety are overriding or long-term safety benefits can be secured, the waste may be managed with a view to improving the storage conditions.

- As there are uncertainties - not only scientific and technical, but also legal and political - inherent in the various options for the safe management of radioactive waste, it is necessary to pursue robust management approaches that will be acceptable in a wide range of possible future situations.

- Safety issues should be addressed independently, so as to ensure compliance with regulations and formally defined criteria, which may need periodic revision in order to take into account scientific and technical developments.

- The effective implementation of disposal options requires the clear definition, at the national level, of a step-by-step and transparent approach that enables the different interested parties, including the general public and public institutions, to participate in the decision-making process.

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[1] Within the IAEA, the term "radioactive waste" is used to mean all radioactive material - in gaseous, liquid or solid form - for which no further use is foreseen. It therefore covers not only solid waste "proper", but also radioactive material discharged into the environment and radioactive residues remaining after the termination of practices.

Good progress has been made in the development of technical approaches and in devising sound disposal options for radioactive waste, but further research and development work is always desirable. Irrespective of the option ultimately adopted by each country for high-level and long-lived waste, there is a need to continue with development and assessments in the field of deep geological disposal since this will be necessary in the future to a greater or lesser extent.

International co-operation is essential to achieving technical and public consensus in support of national programmes. The following mechanisms are especially important in this connection:

- the *Joint Convention*, an incentive legal instrument which presupposes a high level of commitment by Contracting Parties to the safe management of radioactive waste;

- the international safety standards already in place; and

- the international mechanisms for providing for application of these international safety standards.

In almost all of the Conference's Technical Sessions, there was discussion of the need to involve all interested parties ("stakeholders") in the decision-making processes related to radioactive waste management. The Guest Speaker, Ambassador Ritch of the USA, also referred to this need in his speech.[2] Against that background, the IAEA's initiative in calling for the establishment of an "International Forum" where radioactive waste management safety issues, which are of such importance to the future of mankind, might be discussed in a candid manner by all interested parties was welcomed.

SAFETY ISSUES IN THE SITING OF RADIOACTIVE WASTE MANAGEMENT FACILITIES

(summary presented by the Chairperson of Technical Session 1 - G.J. Dicus, USA)

Gaining the trust of the public appears to be a very important element in successfully progressing in the repository siting process. Such trust is gradually gained through sustained communication, but also, importantly, through actions. A siting process that provides

[2] Specifically, Ambassador Ritch said "In the realm of nuclear energy, our need is for a broad discussion - in two senses. We must have a broad range of participants that includes governments, operators, industry, regulators, non-governmental organizations, respected experts, and citizens groups - indeed any and all vessels or shapers of public opinion. We also need a broad range of subject matter, so that public dialogue is expanded beyond the narrowly contentious issue of where and how waste will be deposited. Our debate must be holistic, including a full and realistic discussion of energy alternatives - aimed *inter alia* at identifying a reasonable and accepted role for nuclear power and its by-products."

interested parties an opportunity to participate early in a well-defined and transparent process would afford greater chance of success.

Effectively communicating with the public is an important element in building trust, maintaining confidence and encouraging meaningful contributions to the decision-making process. Technical specialists need to express complex waste management issues in terms that are clear and understandable to all interested parties. The media can assist in this effort as well, but it must be recognized that journalists operate under their own pressures, and controversy may be more newsworthy than informing the public in a meaningful way. It must also be remembered that the public is not a single homogeneous group, and that different types of communication will be needed to reach different groups of people.

Opponents of the siting of geological repositories often quote the risk as a reason for their opposition. However, there are very different understandings of the nature and magnitude of the risk. Furthermore, consideration of risk in the context of geological disposal is particularly complex, as issues of risk transfer to other populations and other generations may be significant. Comparison of the technically assessed risk from high-level waste disposal with that from other technologies (e.g. the management of chemically toxic waste) may have a role to play in informing people of the safety of a repository, but efforts to date have had limited success. Indeed, people are often reluctant to accept any risk from waste disposal because they do not perceive a need for or benefit from it.

Repository siting has local, national and international dimensions. Explanations of disposal needs, as well as related criteria and process needs, should be provided at both the local and the national level. Increasing public confidence at the local level is an important step in any disposal siting process.

The siting process cannot realistically be a matter of finding the best possible site. It must identify sites that are good enough in terms of meeting the basic standards necessary in order to protect public health and safety and the environment, or better, and it should meet the requirement that doses be kept “as low as reasonably achievable” (the “optimization of protection” principle).

LEGISLATIVE AND GENERAL SAFETY ASPECTS

(summary presented by the Chairperson of Technical Session 2 - A. Bishop, Canada)

The *Joint Convention* imposes binding national commitments - backed by international peer review - to pursue internationally agreed safety objectives, and thus provides a mechanism to build confidence in national programmes. Experience with the Convention on Nuclear Safety has shown that incentive conventions can make a valuable contribution to national safety programmes, and the lessons learned will be beneficial in the implementation of the *Joint Convention*.

There is now a well-established and understood basis for developing national legislative and regulatory frameworks. Because of differing national cultures, the legislative and regulatory frameworks and the way in which they are implemented will vary from country to country.

Economic globalization has increased the potential benefits of internationally harmonized safety standards. However, the prospects for the adoption of such standards are limited, because some countries consider that to adopt such standards could detract from their national sovereignty. This perceived conflict between international harmonization and national sovereignty is a political question beyond the remit of the technical community.

A key issue in the licensing of repositories is the standard of proof expected of safety cases, i.e. what constitutes "reasonable assurance" that the repository will meet safety criteria in the long term. At present there appears to be no substitute for the exercising of judgement on the part of the regulator. International co-operation could play an important role in developing guidance for national authorities on difficult topics such as this.

There was a strongly expressed view that the commonly held opinion that the current generation must implement measures to dispose of present radioactive waste accumulations was presumptuous. This was based on at least two considerations relating to the long time-scales involved. Firstly, there can be no certainty that even the next generation (or later ones) will share the current generation's opinions on acceptability and hence on regulatory requirements. Secondly, it will be future generations who will have to continue and complete the projects started today.

Partly because of this, it was suggested that discussion of the acceptability of risks over horizons such as 10 000 years is largely meaningless and that opposition by the general public would be rendered less likely by concentration on shorter periods. In other words, the current generation should do whatever is possible for long-term safety; but it should do so without foreclosing options for future generations; and it should do so without relying unduly on long-term forecasts that are unlikely to be completely accurate over the time-scales involved.

Meaningful dialogue among all stakeholders, starting as early as possible in the licensing process, is crucial to finding an acceptable course of action. It is a fact that different stakeholders view risks from different sources differently from each other, and a comprehensive dialogue is an essential part of consensus-making. The regulator should encourage such dialogue, and participate fully and openly in it.

The regulator must maintain effective independence from the proponents and from political interference in regulatory decision-making. Legislative systems should ensure that this occurs.

SAFETY ISSUES IN THE PREDISPOSAL MANAGEMENT OF RADIOACTIVE WASTE

(summary presented by the Chairperson of Technical Session 3 - K. Balu, India)

The concept of exemption is well established and understood. The idea of clearance is also becoming established, but the terminology continues to cause some confusion. The philosophy of clearance now needs to be converted into a practical administrative process within national regulatory systems.

The application of clearance to naturally occurring radioactive materials is problematic. The clearance criteria usually applied to artificial activity can correspond to levels of natural radionuclides that are impossible to distinguish from background or that occur as natural variations in natural activity levels. Radiological protection arguments can be made for applying higher dose criteria to these materials (compared to those applied in the case of artificial radionuclides), but such differences may be difficult to explain to other interested parties.

To date, clearance has been discussed mainly as a technical issue. If it is to be successfully applied, it needs to be understood and accepted by the public and others who would be affected (e.g. the steel industry, which would need to accept cleared steel for recycling). Greater interaction with these groups will be needed in refining and implementing the concept of clearance.

Clearance is not a compromise concept, but rather should be regarded as an example of the existing concept of authorized release based on the international approaches to optimizing protection. Materials are cleared because this provides an optimized level of protection, not just because the annual doses are below - for example - 10 μSv. In cases such as the release of effluents or the handling of naturally radioactive ores, protection may be optimized at higher levels of dose (within established constraints and limits). Authorities may demand verification that protection is achieved, e.g. by monitoring, and the degree of verification needed will probably be greater for higher doses.

If problems with the movement of materials across national borders are to be avoided, international agreement is essential on levels below which control is not required. This is an example where concerns over national sovereignty may need to be overcome to achieve necessary international harmonization.

For each step in predisposal waste management, technology that is sufficient from a safety point of view already exists and, with very few exceptions, is already proven. The Agency should provide for the use of this technology in developing countries to ensure safe predisposal management of radioactive waste. The role of human factors in operating these technologies safely should not be forgotten.

Other technologies, notably partitioning and transmutation of long-lived radionuclides, are being developed in a number of countries as alternatives to the existing methods, but eventual disposal of waste will still be needed.

Uncertainty about eventual disposal causes problems for predisposal management (e.g. the possible need to recondition waste for a different disposal concept), and these problems will increase if disposal continues to be delayed. If no repository is available, it may be difficult to site the new storage capacity that will be needed, because the storage will be seen as potentially permanent.

One of the most beneficial predisposal management steps in terms of safety is to convert liquid high-level waste to solid form.

Storage is becoming a more important and longer-term element of waste management as disposal is delayed. There may be a need to reconsider existing waste classification schemes (which are often based primarily on disposal considerations) to take more account of predisposal management considerations.

SAFETY ISSUES IN THE NEAR SURFACE DISPOSAL OF RADIOACTIVE WASTE

(summary presented by the Chairperson of Technical Session 4 - A.-C. Lacoste, France)

Near surface repositories for low- and intermediate-level radioactive waste from nuclear power plants are used in many countries, where they have been accepted both politically and by the public. They use a combination of restrictions on the levels of long-lived radionuclides, engineering, monitoring and institutional control to keep the risk associated with both radionuclide migration and human intrusion scenarios low. In this case, institutional control can reasonably be expected to prevent intrusion for the limited time until most of the activity in the waste has decayed.

Because of the very large volumes of waste from mining and milling, the only economically feasible disposal option is on or near the surface. Although the activity concentrations are not high, the radionuclides in mining and milling waste are extremely long lived, and therefore near surface disposal facilities for such waste would require institutional control “in perpetuity” to prevent human intrusion.

Although both approaches are near surface repositories, there is an inconsistency in the radiological criteria used to assess their performance. There is a need to explain this inconsistency in a convincing way.

This is one example of a more general problem, namely the use of quite different standards or criteria in different situations. The reasons for these differences may be sound and understood by the technical community, but the message being received by non-specialists is confused.

Reference to institutional control "in perpetuity" may be misleading: experience suggests that such control cannot be guaranteed for more than a few generations into the future. Beyond this, all that we can do is to recognize that it becomes an issue for future generations, and we cannot prejudge their decisions.

The concept of long-term institutional control should, therefore, be to provide a link to pass on information and experience to the institutions of the future generations who will have to maintain control. A possible way would be to implement a system comprising periodical assessments of the situation and presentation of the conclusions to designated bodies which can then reconsider, if necessary, the future of the repository and themselves take the appropriate steps to adapt the institutional control.

For most types of waste disposal, institutional control is, at most, one element in a defence-in-depth system; indeed, in the case of geological disposal its main purpose would be to provide reassurance rather than contributing to safety. For mining and milling waste, it may be the only feasible line of defence for the future.

Issues of this type go far beyond the purely technical stage, and need further discussion with a much broader spectrum of people to develop realistic solutions that can attract widespread support. The idea of an international forum to consider such issues has been suggested.

Although near surface disposal is used in many countries, other approaches exist or are being considered, e.g. surface storage pending the construction of a geological repository for several types of waste. Such variations are very dependent on national circumstances, and it was observed that public acceptance played a larger role than cost in such decisions.

SAFETY ISSUES IN THE GEOLOGICAL DISPOSAL OF RADIOACTIVE WASTE

(summary presented by the Chairperson of Technical Session 5 - L. Williams, UK)

Radioactive wastes exists, and failing to take decisions now on how to manage it is not an option. The deep geological disposal of radioactive waste raises a number of safety and ethical issues. It must be handled safely both now and in the future. The current generation must bear in mind the needs and the safety of future generations and not make the mistakes of the past. The key issues to be considered include: demonstrating the safety of deep geological disposal for long-lived radioactive waste, and gaining public acceptance of and commitment to it; the safety and sustainability of long-term surface storage; the safety implications of providing retrievable underground storage pending disposal; and the merits of international or regional disposal facilities to help small countries and limit the number of disposal sites.

A good deal of work has been done on research and development, including geological laboratories, and there is sufficient technical knowledge to enable this generation to safely manage and dispose of radioactive waste, however little progress has been made internationally in the actual provision of geological disposal facilities. Those instances where there have been advances have shown the advantages of public participation throughout the decision-making process. The benefit of communication and public involvement is now fully recognized. As part of this, the use of natural analogues could provide an effective means of communicating scientific concepts.

There is still a need for an international consensus on standards and criteria for the safety of disposal. This will have to be developed in parallel with consultative processes.

The perpetual storage of radioactive waste is not a sustainable practice and offers no solution for the future; rather, it is an interim phase in the integrated management of radioactive waste. Although the monitorable, retrievable and passively safe storage of waste may be achievable for decades, progress must be made towards developing disposal. Without this, storage could be regarded as *de facto* disposal by the local community and result in opposition. Storage must not be used as an open-ended "wait and see" option; there will always be future developments that can be awaited, and the incentive and determination to proceed to disposal could be lost, which without effective regulatory control could lead to degraded safety performance and environmental damage. It has to be emphasized that long-term storage is not a simple or a cheap process. It will require institutional control by a body with the necessary knowledge, expertise and financial resources.

Investigations have indicated that dry storage can be continued safely for many decades, provided that regulatory control is maintained. However, even if technological advances were to make safe storage feasible for long terms, the issues concerning the maintenance of institutional control could be a limiting factor.

Some degree of explicit provision for waste retrievability in the design and implementation of geological repositories is now widely recognized as an important way to build public confidence in the ability to engineer the safekeeping of radioactive waste, and to avoid foreclosing options for future generations. However, this must be achieved without compromising the long-term safety of the repository, and it should not remove the requirement for assessing the long-term safety and suitability of the repository before waste emplacement starts.

The present generation should not prescribe the time at which decisions affecting the ability to retrieve waste should be taken. This should be a matter for future generations, as would any decision to actually commence retrieval. However, it is important to recognize that for as long as retrievability is maintained institutional control will be necessary to protect the public and the environment. Such controls should provide for the necessary nuclear safeguards for repositories containing spent fuel or other fissile materials.

International repositories could ultimately offer the possibility of geological disposal to countries that do not have suitable geological formations on their own territory. They could also offer countries with small amounts of waste the opportunity to pool economic and technical resources rather than each undertaking its own repository programme, and this co-operation could contribute towards a more broadly based consensus on waste safety issues. However, there seems to be little prospect of such projects achieving public acceptance until some national geological repositories have been demonstrated successfully. Furthermore, it might be counter-productive to pursue this concept as it could undermine national repository programmes.

SAFETY MANAGEMENT OF DISUSED RADIOACTIVE SOURCES

(summary presented by the Chairperson of Technical Session 6 - D. Beninson, Argentina)

Accidents due to radiation sources predominantly involve industrial radiography sources (about 90%) and teletherapy sources (about 10%): for fatal accidents, the corresponding proportions are approximately 70% and 30%. The radionuclides most commonly involved are iridium-192, cobalt-60 and caesium-137. About three quarters of accidents are due to procedural failures of the operator and only about 25% result from equipment failures.

Effective national regulatory systems, implemented by knowledgeable people, are the key to preventing such accidents. Such systems must include rigorous control of the inventory of sources, but also must ensure adequate planning of actions to be carried out in the event of loss of control of a source and the capability to carry out such actions.

Radiation sources out of control can impact upon organizations not regulated by the regulatory system, such as the steel industry. In these cases, regulators may be able to conclude with such organizations voluntary agreements that help to maintain or regain control of sources.

The safe disposal of disused sources is basically a national responsibility. If disused sources are stored for long periods of time, this will increase the probability of control somehow being lost. The purchasing price of sources should perhaps include some provision for the eventual cost of disposal.

For countries that have no disposal facilities, safe disposal will most commonly mean transferring disused sources to another country - normally the country of the supplier - that has the infrastructure to dispose of them safely. A possible alternative would be to develop inexpensive methods for the safe disposal of sources. An alternative under development is the so-called “borehole concept”.

As regards the possibility of returning disused sources to suppliers, in many cases the supplier of a source is not the same entity as the original manufacturer. Although there are

theoretical arguments for the return of sources to the manufacturer, return to the supplier will in practice be simpler and more reliable.

Some suppliers are prevented by the legal system in their country from - or have shown reluctance to commit themselves to - accepting returned sources. This problem might be eased if attention were focused on those sources which represent the highest risk, i.e. by *categorizing sources*, and seeking commitments at least to accept the return of these types of source.

When suppliers go out of business, States need to provide a "backstop" to make sure that sources are not allowed to fall out of control as a result.

The relevant issue is one of disused but not necessarily spent sources. In some regulatory systems this can be an important distinction for accepting the return of disused sources (spent sources may be regarded as radioactive waste, but disused sources may not).

The Conference expressed its support for the Agency's Action Plan for the safety of radiation sources and the security of radioactive material and its interest in the ongoing development of an *international Code of Conduct* in this area.

TRANSBOUNDARY MOVEMENT OF RADIOACTIVE WASTE

(summary presented by the Chairperson of Technical Session 7 - S. McIntosh, Australia)

Any transboundary movement of radioactive waste means that such material is moved from one jurisdiction, namely that of the country of origin, to another jurisdiction, namely that of the country of destination. Such movement is often via one or more other jurisdictions - that or those of the country or countries of transit, or that of the high seas. By necessity, therefore, different legal regimes apply at different stages of the movement of such material. This in turn requires far-reaching international harmonization in this field. In the nuclear field such harmonization is comparatively far advanced, as demonstrated by international consensus documents such as the *International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources* (the BSS) and the *Regulations for the Safe Transport of Radioactive Material* (the Agency's Transport Regulations). Article 27 of the *Joint Convention* is a significant further contribution in this regard.

However, on the issue of the transboundary movement of so-called "low-risk materials", there is no international consensus on what materials are and are not covered by the *Joint Convention*. Uniformity is desirable not only at the international level but also at the national level, ensuring in particular consistency of different laws in different subject areas as well as of definitions in such legislation.

There is no general requirement under international law for approval by coastal States of shipments of radioactive waste through their territorial waters, provided that the necessary

safety precautions are taken. The concern of the Mercosur countries over the transit of radioactive material through South American waters and the European Union's regulation of transits of radioactive material were noted.

At present, liability is to a large extent governed by private international law, with all the uncertainties arising therefrom for potential victims. Given the role those uncertainties play in promoting opposition to the international transport of radioactive waste, wider adherence to the international nuclear liability regime would assist in gaining wider acceptance of such transport.

Responsibility for the observance of international standards for the maritime transport of radioactive material lies with the Flag State - although the International Maritime Organization (IMO) is expected to shortly make the observance of such standards mandatory. With regard to the movement of radioactive waste through international straits, transits in particular through the Panama Canal have not caused any significant problems. In many cases, the IMO has introduced particular regimes governing such straits.

The international transport of radioactive material has an excellent safety record. However, there is a very wide gap between public perception and reality in this regard. A constructive and open dialogue with stakeholders explaining the, albeit sometimes complicated, regime for the international transport of radioactive material, including waste, and the safety record thereof is needed. Those conducting any such dialogue would need to keep in mind the requirements of the physical protection of nuclear material.

REPORT ON THE SYMPOSIUM ON RESTORATION OF ENVIRONMENTS

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ABSTRACT

The Symposium on the Restoration of Environments with Radioactive Residues held at Arlington, Virginia, United States of America, brought together an international group of scientists to review a representative number of contaminated environments around the world and to review the criteria for, and approaches to, restoration, including a number of case studies. A most important conclusion was that although the International Commission on Radiological Protection and the IAEA can and should provide clear scientific and professionally sound recommendations, such advice must be considered as a decision aiding contribution to the broader issue of decision making. For this reason, particular attention was given to the role of public participation.

The International Symposium on Restoration of Environments with Radioactive Residues, sponsored by the IAEA and hosted by the US Government, was held in Arlington, Virginia, United States of America from 29 to 3 December 1999. The topic of this Symposium is one of the most important in radiation protection today. In very few other areas do the concerns of so many play such an important role. Public health and environmental protection on one side and social disruption, environmental degradation and extreme costs on the other. The mission of the Symposium was to explore these issues, attempt to understand the global implications, and yet remain mindful of the very local nature of the public's concern.

Perhaps we should begin with the realization that the worldwide environment has been contaminated with radioactive materials of primordial and cosmogenic origin since its creation. A colleague from the Islamic Republic of Iran reminded us that the worldwide primordial contamination of surface soils is highly non-uniform.

Once humankind discovered the richness of the underground deposits of minerals and ores, our primordial radionuclides became an early source of environmental contamination which continues to this day. Colleagues from Belgium, Australia, Canada, South Africa, the USA and Germany addressed the issues related to such mining and milling throughout the last century. Of course, specific mining, milling and processing of ore for radium extraction led to several sites of intense local contamination. A colleague from Belgium discussed such an example.

It was indeed atmospheric weapon testing that awakened public concern to the potential for widespread environmental contamination. The creation of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) came about as a direct consequence of this concern. The Committee's Scientific Secretary spoke about the levels of global contamination and, staying with weapon testing, colleagues from New Zealand and Australia addressed issues associated with environmental contamination at weapon testing sites in the Marshall Islands and at the Maralinga site in Australia.

Related to weapon testing, of course, are the weapon development and construction sites. However, there are also sites with contamination arising from operations and accidents. Colleagues from the USA and the Russian Federation addressed the issue of residues from the operation of US and Russian nuclear sites.

We were particularly fortunate to have had a strong contingent of colleagues from the Russian Federation and from Belarus to present in some detail the issues related to environmental contamination resulting from the Chernobyl and other accidents in the former Soviet Union.

The Chernobyl experience, of course, brings us to the nuclear fuel cycle as it relates to nuclear power generation. Our colleagues from China, France and the USA addressed the issue of radioactive residues related to nuclear power.

The environmental contamination associated with the Goiânia accident focused on a rather new source of widespread contamination: that of the uncontrolled radioactive source.

The contamination from fallout caused by a re-entering satellite seems to encompass the issue of environmental contamination in the 20th century. Our colleague from Canada reviewed the environmental impacts of the premature re-entry of a satellite powered by a small nuclear reactor.

These data demonstrated that not only is the scale of the problem from human-made residues large and widespread enough to be addressed by the international radiation protection community, but also the size of the challenges associated with naturally occurring radioactive residues are even larger and perhaps more widespread. There is a clear need to harmonize the characterization of both natural and human-made residues in a consistent way so that the risk and the remediation can be addressed with a common understanding.

By the time the session on “Restoration Principles and Criteria” began, there was general agreement that scientific, technical and professional recommendations are appropriate for decision aiding, while decision making involves input from those affected (the interested parties) and from their representatives (politicians). Even so, the scientifically based recommendations must be clear, unambiguous and transparent.

A recently approved publication of the International Commission on Radiological Protection (ICRP) dealing with prolonged exposures suggests that in making decisions on remediating existing situations, all the sources of exposure should be included, i.e. both natural and human-made radionuclides.

It was noted that for most contaminated environments the intervention system of the ICRP should be applied, i.e. simply “do more good than harm”. Although many countries have attempted to apply the intervention approach, most have found that the accepted values are those one would associate with practices. It seems that when the public knows there is a limit of 1 mSv/y or 0.3 mSv/y for practices, it wants the same level of protection for any remediation effort.

The dose criterion is generally considered to be either an action level (above which remediation is considered) or an investigation level (above which assessments are needed). Nearly all use effective dose as the metric, although there is some suggestion that activity concentration in soil might be more helpful.

There is a major, divergent opinion in the USA where legislative and legal events have resulted in the criteria for limiting the lifetime risk of cancer to be 10^{-4} to 10^{-6} for “Superfund” sites. Some relief was suggested in that institutional control could be used for difficult cases (where the criteria can not reasonably be met).

It would seem that the international radiation protection community, the IAEA and the ICRP, for example, should continue to provide clear advice, based on excellent science and sound professional judgement, as their decision aiding contribution to the broader issue of decision making.

Among the many technical contributions that can help is the standardization of computer codes and the establishment of requirements for selecting the parameters used in these codes.

Early in the Symposium, there was discussion about the need to educate the public, but it became clear that what is needed is public involvement early in the remediation planning phase.

Perhaps the most revealing paper on public involvement was presented by a colleague from France, whose intense and sensitive work with the residents of Belarus living with the residual contamination from the Chernobyl accident is a lesson for us all.

In closing, I want to mention that the site remediation Symposium had, as did this Symposium on waste disposal, a provocative welcoming address by A.J. González. In that Symposium, A.J. González raised the issue of the destructive nature of the linear-non-threshold controversy. Ardent supporters of hormesis, etc., on one side and genetic instability on the other have led to a loss of public confidence in the radiation protection community. A collective acceptance that there are very likely to be effects at very low doses, but that the probability of such effects at low doses is also very low, can, and should, lead to a strong nuclear programme and reasonable discussions on site remediation and waste disposal.