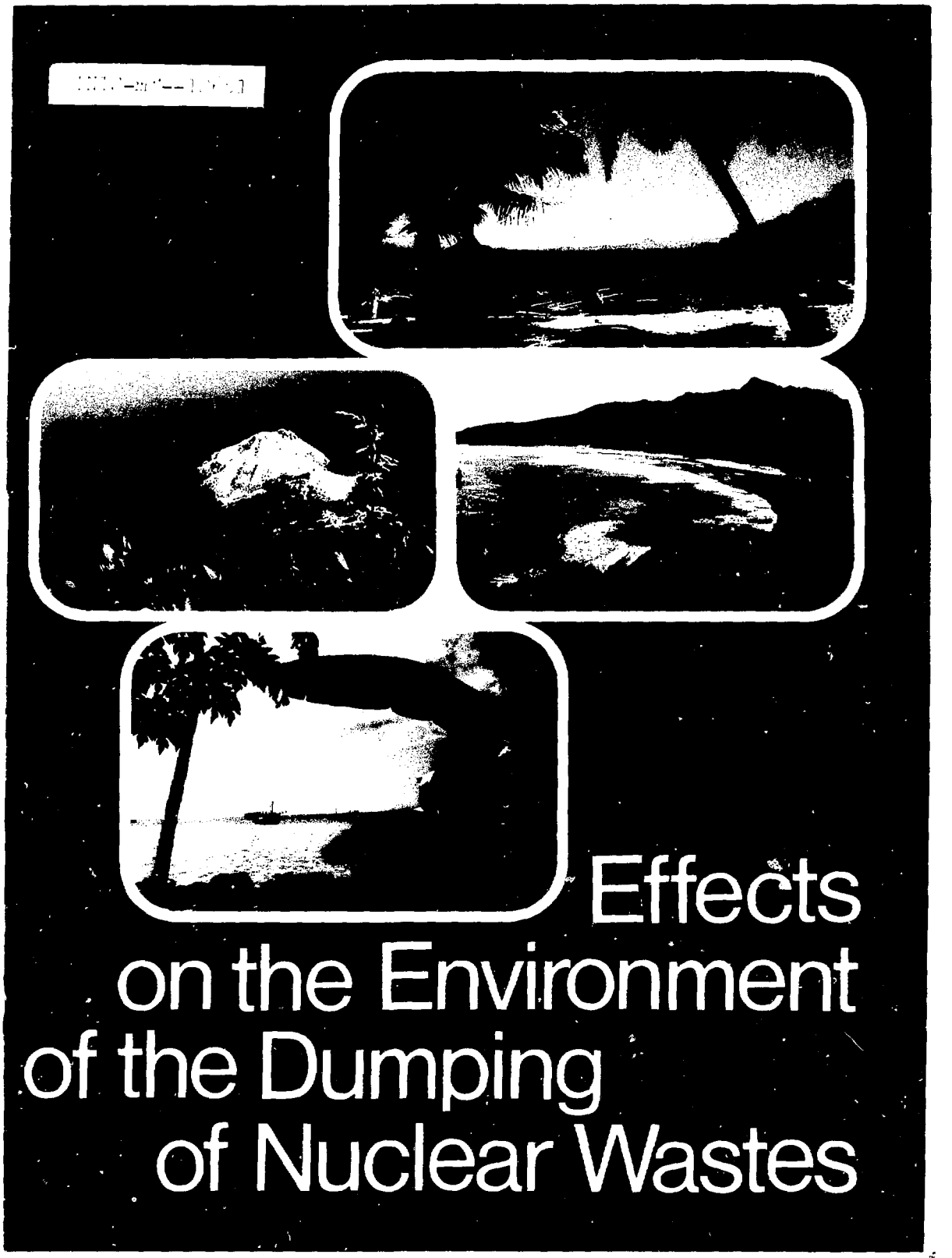

Effects on the Environment of the Dumping of Nuclear Wastes

INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1990

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XA 9026774

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EFFECTS ON THE ENVIRONMENT OF THE DUMPING OF NUCLEAR WASTES

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Printed by the IAEA in Austria
July 1990

EFFECTS ON THE ENVIRONMENT OF THE DUMPING OF NUCLEAR WASTES

REPORT PREPARED BY THE
INTERNATIONAL ATOMIC ENERGY AGENCY
FOR SUBMISSION TO THE
SECRETARY GENERAL OF THE UNITED NATIONS
THROUGH THE
UNITED NATIONS ENVIRONMENT PROGRAMME

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 1990

EFFECTS ON THE ENVIRONMENT
OF THE DUMPING OF NUCLEAR WASTES
IAEA, VIENNA, 1990
STI/PUB/858

FOREWORD

By its resolution No. 1988/174 on International Co-operation on the Environment, the Economic and Social Council (ECOSOC) of the United Nations (UN) requested the Secretary General of the UN to submit, through the United Nations Environment Programme (UNEP), to the 44th Session of the UN General Assembly a report on the 'effects on the environment of the dumping of nuclear wastes'.

This report has been prepared by the International Atomic Energy Agency (IAEA) at the request of UNEP in fulfilment of the above. It has been presented at the Forty-fourth Session of the UN General Assembly as a Report of the Secretary General (document number A/44/480, 20 September 1989).

'Dumping' in the context of the ECOSOC resolution and as covered in this report is defined as illicit and uncontrolled disposal. This may be distinguished from 'controlled disposal' which is performed under appropriate national regulatory controls to ensure the safety of man and the environment*.

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* It should be made clear that the Convention on the Prevention of Marine Pollution by the Dumping of Wastes and Other Matter (London Dumping Convention, 1972) uses the word 'dumping' to mean 'controlled disposal at sea' as defined above and not uncontrolled or unauthorized disposal.

CONTENTS

EXECUTIVE SUMMARY

- Nationally and internationally accepted procedures and technologies are available for the safe handling and disposal of radioactive wastes. Authorized waste disposal practices are designed to ensure that there will be no significant impacts on man and his environment.
- 'Dumping' of nuclear wastes may result in the elimination of one or more of the barriers of the multibarrier protection inherent in an effective radioactive waste management system, thereby increasing the risk of radiological exposure to man and his environment. Quantitative assessments of the degree of environmental contamination and of the resulting hazards to man depend on the specific conditions surrounding the 'uncontrolled disposal' of radioactive waste. These include the nature and activity level of the waste, the physical form of the waste, the package that the waste is contained in and the characteristics of the dumping site. Depending on the scenario envisaged, the consequences of 'uncontrolled disposal' could vary from being insignificant to causing a situation where there is a significant hazard to an exposed population group.
- International transactions involving nuclear wastes are taking place between countries on the basis of bilateral agreements and under strict regulatory supervision so that radioactive wastes are transferred safely from one controlled area to another. Such transactions may increase in the future with increased international co-operation in sharing common waste repositories.
- No evidence exists that confirms that transboundary dumping of radioactive waste has occurred. Investigation by the International Atomic Energy Agency of alleged dumping of radioactive wastes has revealed that the 'suspect wastes' did not contain radioactive material.
- The IAEA is currently preparing a code of practice for international transactions involving nuclear wastes. This code of practice will establish legal and technical guidelines under which transboundary movement of nuclear wastes should be enacted.

1. INTRODUCTION

In common with other industrial activities, the generation of electricity by nuclear fission produces waste products. Wastes are also produced from the application of radionuclides in medicine, research, industry and other institutional uses. Wastes that contain radioactive material are termed radioactive wastes. Very many countries produce some amount of radioactive wastes.

The volumes of radioactive wastes generated from nuclear power production are small when compared to waste quantities generated by other energy producing activities (i.e. generation of electricity from coal burning plants). Radioactive wastes are very diverse in nature and can only be broadly categorized. This can be done in several ways, but the approach more commonly used is as follows. It is based on a classification that characterizes the radioactive wastes with regard to their potential hazards and to the methods used for their handling and disposal:

- Low level wastes (LLW). These wastes contain a negligible amount of long lived radioisotopes.
- Intermediate level wastes (ILW). This category is used in most but not all countries to describe wastes with significant beta/gamma activity and low alpha activity.
- High level wastes (HLW). These are wastes that arise from the reprocessing of spent nuclear fuel: they are highly radioactive, heat generating and long lived. Long term isolation from the biosphere is required. Unreprocessed spent reactor fuel elements may be considered as HLW and should meet the same criteria for disposal.
- Alpha bearing wastes. This category includes wastes that are contaminated with significant amounts of long lived, alpha emitting nuclides.

The radioactivity of low and intermediate level wastes becomes negligible through natural decay after a few hundred years. These wastes are usually disposed of by burial close to the surface (shallow land burial). The arrangements for burial range from simple trenches to artificial, engineered underground structures. Deep burial in disused mines is also a common practice.

High level and alpha bearing wastes remain radioactive for many thousands of years. For disposal of these wastes, deep geological repositories (several hundred metres below the ground) in granite, clay, salt or other host rock formations are being actively investigated by many countries.

In considering the radioactive wastes that are generated from nuclear programmes, it is important to recognize that:

- The radioactivity and therefore the hazards associated with radioactive wastes decline with time.

— There are large volumes of waste that contain very low levels of radioactivity and can therefore be safely disposed of as non-radioactive industrial waste. These very low levels of radioactivity, sometimes referred to as 'exempt quantities' or 'de minimis levels', are usually established by the competent authority in each country.
— The radiological hazard associated with radioactive wastes varies considerably with waste types. Waste management practices are based on an assessment of the risk and consequences of radionuclides released from the waste reaching man and his environment. Different radioactive wastes will therefore be managed and disposed of according to the potential hazards associated with them.
— Technologies necessary for the safe management and disposal of radioactive wastes have been developed. No new technology breakthrough is required for the safe disposal of any type of radioactive waste.
— Countries may adopt different strategies for managing their wastes, but they are based on established concepts and technologies and are subject to strict regulatory controls.

The primary objective of radioactive waste management and disposal is the effective protection of man and his environment, now and in the future, from the radiological hazard of nuclear waste material. This objective is achieved through the planning and implementation of national radioactive waste management programmes which follow a systematic integrated approach to the management of radioactive wastes, including the following steps:

— minimization of the amount of radioactive waste generated;
— treatment of the wastes generated so as to reduce the volumes;
— conditioning (immobilization) and packaging of the waste to render it chemically and physically stable; and
— disposal of the waste at carefully selected sites using technologies and multiple barriers to effectively isolate the waste from man and his environment.

The management of radioactive wastes is based on the application of the above principles. Authorized waste disposal practices are designed to ensure that there will be no significant impacts on man and his environment, now or in the future. Such practices use a multibarrier concept (a system using two or more independent barriers to isolate radioactive waste from the biosphere). For the purpose of this report, the 'dumping' of nuclear waste means the 'illicit and uncontrolled disposal' of radioactive wastes. Uncontrolled disposal may be assumed to eliminate one or more of the multibarriers of protection and thereby increase the risk of radiological exposure to man.

2. NATIONAL AND INTERNATIONAL STANDARDS AND PROCEDURES FOR WASTE DISPOSAL

Over the last thirty years, an international consensus has gradually emerged on the guiding principles for the safe disposal of radioactive wastes. It is generally accepted that the main objective should be to dispose of radioactive wastes in such a way that man and his environment are afforded adequate protection. Recognizing that some types of waste, and especially the high level wastes, will remain radioactive, and therefore potentially hazardous for a very long time, the protection of future generations should also be an objective in waste disposal plans. With these basic safety objectives in mind, technical solutions to ensure safe disposal of radioactive wastes have been developed.

From a potentially wide number of technical solutions for the disposal of radioactive wastes, there is now considerable agreement between countries on the most appropriate disposal options for each of the different waste types. For the most highly radioactive and potentially hazardous wastes, the high level wastes, the most favoured option is deep underground disposal, and while a repository of this type has not yet been constructed, R&D programmes and plans are well advanced in several countries to establish such repositories within the next 10 to 20 years. The safety strategy in repositories of this type is firmly based on the 'defence in depth' or 'multibarrier approach', in which reliance for safety does not depend on the integrity of any single barrier. In the case of high level radioactive waste disposal, the following barriers can be identified:

the waste form	- - radioactive waste may be incorporated into a solid insclubie matrix such as glass
the canister/package	— the waste form is enclosed in a canister/ package designed to withstand corrosion and similar effects for thousands of years
the backfill	— the canister is surrounded by a water resistant radionuclide adsorbing material such as clay (bentonite)
the geological environment	— the repository is located in a stable and isolated geological formation with little groundwater flow at a depth of several hundred metres below the surface.

For less radioactive waste types, such as intermediate and low level wastes, the multibarrier concept is retained, but the associated hazard is lower and, therefore, fewer barriers may be required. For such wastes, the commonly used disposal

method is shallow land burial. Many repositories of this type exist in the world. Here safety may be based on the choice of waste form, package design, site location, and in some cases a concrete enclosure, but it is also dependent on the existence of an institutional structure in the country to monitor and to protect the disposal site from uncontrolled access by man and living species. However, it is recognized that it is inappropriate to rely on human surveillance very far into the future and therefore only those radioactive waste types which decay to fairly harmless levels within a few hundred years are considered for disposal by shallow land burial.

Until 1982, low level radioactive wastes were also disposed of in the marine environment. Packages containing the wastes were dropped to the sea-floor in a suitably deep part of the ocean. This practice, known as 'sea dumping', was in fact a controlled and safe disposal method. The enormous dilution provided by the sea provides the necessary protection. The satisfactory nature of the sea dumping operation was checked by marine monitoring programmes which followed the disposal operations. In 1983, a voluntary moratorium on the practice of sea dumping was established by the Convention on the Prevention of Marine Pollution by the Dumping of Wastes and Other Matter (London Dumping Convention). Since that time no country is known to have disposed of radioactive waste packages at sea.

The general principles and strategies for radioactive waste disposal are well established in the regulations, standards and codes of practice of many countries. At the international level, organizations such as the International Commission on Radiological Protection (ICRP), the Nuclear Energy Agency of the OECD (OECD/NEA) and the International Atomic Energy Agency (IAEA) have provided guidance on the principles and practices of radioactive waste disposal. A detailed description of the IAEA's waste management programme and some of the topics covered in IAEA safety publications in the field of waste disposal are provided in the Appendix to this report.

Another important series of documents are those of the IAEA concerned with the Safe Transport of Radioactive Material (IAEA Safety Series No. 6 is the basic document; it was first published in 1961 and subsequently revised in 1964, 1967, 1973 and 1985). These documents establish the internationally accepted rules for the safe transport of radioactive materials, including radioactive wastes. They form the basis for national and international regulations on this subject.

3. ENVIRONMENTAL IMPACTS OF DUMPING OF RADIOACTIVE WASTES

It is first necessary to be clear about the meaning of 'dumping' and 'environmental impact' as used in this report. A definition of 'dumping' was given in Section 1. The principal harm which could be caused by the uncontrolled disposal or

dumping of radioactive wastes is likely to be associated with effects on man. Other environmental impacts, for example, on agriculture, animals and natural ecosystems, are likely to be small for most scenarios which can be envisaged. It is normal when considering effects on man to be concerned about the harm to the individual and to the population as a whole. In summary, the term environmental impact in this report means the effect on man of 'illicit and uncontrolled' radioactive waste disposal.

It is assumed that, in the context of the ECOSOC resolution, there is particular concern about the potential impact of drums or canisters containing radioactive wastes 'dumped' or stored in an uncontrolled way. The nature and seriousness of the harm that could result is critically dependent upon the scenarios which can be envisaged involving the waste drums, and also upon the radioactive contents of the drums, the nature of the waste form, i.e. whether it is solid and encapsulated or dispersed and loosely packed, and upon the way in which the drums are handled or stored. In most cases, properly treated and packaged wastes can be stored for considerable periods of time without causing any harm, provided that they are not interfered with. Certain types of low level waste present a very small hazard to man, while other waste types cannot be handled directly without causing radiation damage to skin and tissues. It is therefore difficult to generalize on the nature of the harm which can be caused by possible events associated with the uncontrolled disposal of waste drums.

It may provide some perspective, however, to note that low level wastes, which are typically made up of slightly contaminated paper, clothing, laboratory equipment, building rubble and soil, make up more than 80% by weight of the typical radioactive wastes arising from the nuclear industry. Furthermore, wastes in this category are the most likely types to become subject to uncontrolled disposal or dumping. The more hazardous waste types, the high and intermediate level wastes, are not amenable to illicit dumping because of the need for special handling and transport facilities and because of the higher level of security normally associated with them.

Provided that the IAEA's regulations for the packaging, labelling and transportation of radioactive wastes are complied with (and these regulations are incorporated into national regulations in all countries utilizing radioactive materials to any significant extent), the direct hazard associated with being in the proximity of a transport canister or drum will not be high. Only in the case where a canister is deliberately broken open or where, after many years, the canister corrodes and leaks, could a significant hazard result.

To provide some understanding of the possible events which may give rise to radiological hazards following the 'dumping' of drums or canisters containing radioactive wastes, three possible scenarios or event sequences are considered. It is stressed that these have been developed for the purpose of illustration and that the earlier statement concerning the difficulties in generalizing on the nature and magnitude of the hazard which could result still applies. A basic assumption in each case

is that the canisters or drums have not been identified as containing radioactive materials, receive no special attention, and are stored out of doors.

Scenario A

In this scenario the wastes are assumed to be in a conditioned form, that is, they have been combined with a solid matrix material such as concrete or bitumen. It is therefore assumed that the drums or canisters containing the wastes have been dumped and are placed on the ground in the open air and left undisturbed. The design of the conditioned waste form is intended to allow no leakage of radioactive material in the short to medium term (some tens of years). Only in the longer term, and if the outer container or drum corrodes because of natural weathering processes, could some leakage from the conditioned waste be possible. The leakage would be most likely to occur through leaching caused by water. The radionuclides thereby released could be transported with groundwater or with runoff water during periods of rainfall. The radionuclides could eventually reach a stream if the runoff is on the surface or percolate downwards into the soil and possibly reach groundwater. It is likely, however, that much of the radionuclide content will have been reduced by adsorption on soil and sediments during transport from the leaking container. The resulting levels in drinking water from such a small source of release are unlikely to present a significant hazard to health. To provide some perspective, several radionuclides already exist in drinking water owing to the presence of naturally occurring radionuclides in rocks and soils.

Scenario B

In this scenario the same waste container as considered in Scenario A, with its content of conditioned waste, is assumed to be damaged either accidentally in transit or deliberately. In the case of accidental damage to the outer container while in transit, followed by undisturbed storage, there would be no impact on man in the short term but the slow leaching processes due to weathering, described in Scenario A, may be expected to occur earlier in time. In the event of a person deliberately trying to gain access to the waste form, it would be necessary to use fairly aggressive techniques; the use of drills, chisels or hammers would be necessary to break down the solid waste form. The harm caused to such an individual would depend upon the radioactive content of the conditioned waste and the events following the intrusion. In the worst circumstances, however, if an individual recovered a highly radioactive device or article from the conditioned waste and retained it in his/her clothing a serious injury could occur. Similarly, serious consequences could result from tampering with drums containing non-radioactive but hazardous toxic wastes.

Scenario C

The drum or canister is assumed to contain unconditioned wastes, that is, loosely packed, slightly contaminated materials such as soil, papers and plastics. It was noted earlier that wastes of this type make up the largest proportion, by weight and volume, of radioactive wastes from the nuclear industry. As described in Scenario A, the undisturbed storage of drums will give rise to no environmental impact in the short to medium term. In the longer term, corrosion of the drums can lead to slow leakage of the radioactive contents as a result of water ingress. The lack of a solid impermeable matrix facilitates the leaching process described in Scenario A. However, it seems reasonable to assume that the radioactive content of drums of unconditioned waste will be low and that the consequences of leakage are therefore unlikely to be serious. Deliberate intrusion into drums of this type is also unlikely to give rise to any significant health hazard owing to the absence of any highly radioactive individual components.

In summary, despite the examples which have been discussed here, it is not possible to make an unambiguous statement about the potential harm to man from uncontrolled disposal. However, what is clear is that there is only a small level of risk to health associated with much of the wastes generated by the nuclear industry. A separate evaluation, on a case by case basis, is necessary to evaluate the risks to the environment from any uncontrolled disposal of radioactive wastes.

4. TRANSBOUNDARY MOVEMENTS OF RADIOACTIVE WASTES

The IAEA Regulations for the Safe Transport of Radioactive Material, which include technical and administrative requirements, specifically govern the transboundary movements of radioactive materials. Transport of radioactive material has an outstanding record. In the past 35 years, it is estimated that more than 200 million packages have been transported, yet there has been no accident with serious radiological consequences to the public.

International transport of spent fuel takes place routinely from reactors to reprocessing plants. There are two large reprocessing plants that commercially reprocess spent fuel in western Europe — in France and in the United Kingdom. In addition, the Soviet Union carries out spent fuel reprocessing for the fuel of Soviet origin used in reactors outside the Soviet Union.

The large reprocessing plants are centres where both national and international transport routes meet. The most important international transport route is the one used to bring spent fuel by sea from Japan to Europe. Eventually the equivalent waste (in a conditioned form) will be shipped back to Japan. The Japan–Europe route is well established, with five ships continuously transporting spent fuel.

Another form of transboundary movement of radioactive waste is the return of sealed radiation sources, after use in medicine and industry, to the supplier countries.

5. FUTURE INTERNATIONAL CO-OPERATION IN RADIOACTIVE WASTE MANAGEMENT: ITS IMPACT ON TRANSBOUNDARY MOVEMENTS OF RADIOACTIVE WASTES

The concept of an international disposal system for nuclear wastes or regional repositories is one that continues to be pursued and has been strongly advocated by countries having limited land resources. Large, well organized, well located and well equipped sites would be preferable to a host of smaller sites. Besides, there are and will be countries with very small nuclear programmes and countries without geologically ideal disposal sites.

A few countries may join together on a regional basis to establish and share repositories as individual repositories in these countries may not be technologically and/or economically justifiable. To share waste disposal systems on a regional basis, countries should have commonality in:

- national legislation covering nuclear activities including radiation protection;
- regulations for waste management and disposal;
- criteria for site selection, waste package form and acceptance for disposal.

Such approaches were considered as part of regional or international planning of the nuclear fuel cycle by IAEA study and working groups in 1977 and 1982. A report by the Commission of the European Communities (CEC) in the 1980s has argued for a regional solution to the problem of waste disposal. A preliminary study of the feasibility of an international waste repository system was organized by the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD/NEA). This study, completed in 1986, concluded that, on the basis of international studies carried out so far, there are no apparent insurmountable safety, technical, economical or institutional reasons why such a project could not be seriously considered. Public acceptance of such a repository remains the key issue in the implementation of such a concept.

6. ISSUE OF ALLEGED DUMPING OF RADIOACTIVE WASTES

The Organization of African Unity (OAU) Resolution on Dumping of Nuclear and Industrial Wastes in Africa [CM/RES.1147–1176 (XLVIII)] was brought to the attention of the IAEA Director General by the OAU Secretary General's letter of 17 June 1988. In his reply dated 12 July 1988, the Director General expressed the

IAEA's readiness to give priority consideration to requests by African Member States for assistance in solving radioactive waste related problems. To date, the IAEA Secretariat has no evidence that any 'dumping' of nuclear wastes has occurred. A fact finding mission by the IAEA at the request of an African Member State revealed that the 'suspect wastes' were not radioactive.

7. CODE OF PRACTICE FOR INTERNATIONAL TRANSACTIONS INVOLVING NUCLEAR WASTES

The issue of transboundary movements of radioactive wastes has attracted public concern, following reports of illicit exports and disposal of hazardous wastes in developing countries. In May 1988, the Summit Conference of the OAU adopted a resolution which inter alia condemned such practices and requested the IAEA, UNEP, the Economic Commission for Africa (ECA) and other concerned organizations to assist African countries to establish appropriate mechanisms for monitoring and controlling the movement and disposal of radioactive and industrial wastes in Africa. Following the OAU Resolution, the issue of 'dumping of nuclear and industrial wastes' has been inscribed on the agenda of a number of policy making organs of intergovernmental organizations (e.g. 11th Summit of the Economic Commission of Western African States, Lomé, June 1988; meeting of the Zone of Peace and Cooperation of the South Atlantic, Rio de Janeiro, August 1988; Foreign Ministers' Conference of the Non-Aligned Movement, Nicosia, September 1988; UN Committee on Crime Prevention and Control; 43rd Session of the UN General Assembly, 1988). At the request of Nigeria, the issue of transboundary movement and 'dumping' of radioactive wastes was a subject of discussion at the June 1988 Session of the Board of Governors of the IAEA. At the 32nd Session of the IAEA General Conference, a draft Resolution proposed by Nigeria and submitted by Egypt on behalf of the African Group was adopted by consensus as Resolution GC(XXXII)/RES/490: 'Dumping of Nuclear Wastes'.

Resolution GC(XXXII)/RES/490 "calls upon the Agency to ensure that any assistance provided by it, or under its auspices, shall not in any way allow 'practices' (illicit disposal) which would infringe upon the sovereignty of states and/or would endanger the environment or public health of other countries". The Resolution also calls upon "the Agency to give priority consideration to requests by developing countries for assistance in the field of nuclear waste management".

In its main provision, the Resolution "requests the Director General of the Agency to establish a representative technical working group of experts with the objective of elaborating an internationally agreed code of practice for international transactions involving nuclear wastes based on, inter alia, a review of current national and international laws and regulations on waste disposal". The Director

General of the IAEA was requested to report to the General Conference at its 33rd Session (1989) on the implementation of the Resolution.

According to the Resolution, the code of practice should be based on, inter alia, a review of current national and international laws and regulations on radioactive waste disposal. Other regulations and rules relevant to the development of the code will be considered. This includes notably international conventions and agreements covering other types of hazardous waste that are being developed within the framework of international organizations.

In implementing this Resolution, the Director General of the IAEA invited a group of experts to meet at IAEA Headquarters during the period 22–26 May 1989 for its first session. The IAEA has also invited international organizations concerned, including UNEP, to attend the expert group meeting in an observer capacity. It is expected that the group of experts will complete its task during 1989/1990 in time for the results to be considered by the General Conference of the IAEA at its 34th session in 1990.

Appendix

IAEA WASTE MANAGEMENT PROGRAMME

Radioactive waste management has been given due importance right from the inception of the IAEA. The activities cover regulatory, technical, safety and environmental aspects of waste management and provide Member States with opportunities for exchange of current information on the subject and guidance through publication of safety and technical reports. In addition, technical assistance and advisory services are provided for developing countries to promote safe radioactive waste management. The IAEA is ready to provide assistance to Member States which may have radioactive wastes dumped on their territory but do not have adequate resources to safely manage them.

Waste disposal programme

During the last 12 years the IAEA's underground disposal programme extensively covered all aspects of low and intermediate level wastes in shallow ground. This has now reached a stage where most of the aspects of regulation, criteria, siting, design, construction, closure, surveillance and safety assessment have been covered. Considerable information has been generated for the various options and alternatives available for disposal, and the procedures for site selection and assessment of safety. The IAEA's conclusion based on the experiences of Member States in the operation of shallow ground repositories is that repositories for disposal of low level waste in shallow ground can be sited, designed, constructed and operated safely without any harmful effects to man and his environment.

While the safety of disposal of high level waste cannot be directly demonstrated, the experiences so far in development work on deep geological repositories and the analysis methodologies available to predict migration of radionuclides under repository conditions strengthen the scientific community's confidence in the safety of high level waste disposal. There is international consensus that the use of deep geological repositories is the preferred disposal option for high level waste.

The experience of the IAEA can be made use of by Member States in their programmes for waste disposal and assessment of disposal sites and operations regarding their safety. Topics covered by IAEA publications on waste disposal are listed in Tables I and II at the end of this Appendix.

Responding to Member States' needs

The IAEA has assisted its developing Member States through training and technical co-operation, by providing assistance in starting and building necessary infrastructures and by providing fellowships and financial support through research

contracts for carrying out basic research in the nuclear energy field and nuclear applications. Emphasis is now being placed on helping countries to develop long term, integrated waste management programmes and to use recent technology that can be transferred to them. In so doing, the countries are able to gain the benefits of international experience in implementing their own waste management programmes, particularly when they are in the early stages of nuclear energy development.

WATRP service

In response to requests from Member States for peer reviews of their waste management programmes, the Agency has established a Waste Management Assessment and Technical Review Programme (WATRP). On request from Member States, the Agency will arrange to assemble teams of international experts to provide critical reviews and assessments on aspects of national waste management programmes. This service provides Member States with the facility of having independent international reviews of national plans and projects and may be seen as a way of improving public confidence in national arrangements.

WAMAP service

WAMAP — the acronym for Waste Management Advisory Programme — is helping developing countries by assessing their needs for waste management and related areas; reviewing operational and planned programmes; and evaluating available expertise and manpower, laboratories, equipment and services. Teams of experts in various waste management disciplines, under the auspices of the IAEA, upon request, visit a Member State for a comprehensive overview of waste management needs, practices, procedures and institutions.

WAMAP missions began in 1987, building upon the traditional base of information and expertise established within the IAEA. Eighteen missions have been organized so far, with eight more scheduled in 1989. The WAMAP missions advise developing Member States on a number of issues depending on the country's development in the uses of nuclear energy. The needs and assessment vary considerably. Waste management regulations, criteria, standards, waste treatment, conditioning, disposal safety and environmental assessments represent the most important areas of assistance provided.

WPSF service

Many of the requests that the IAEA receives for technical assistance in the field of processing radioactive wastes are similar in project scope and objectives. The volumes, characteristics and activity levels of the wastes generated, or expected to

be generated, by Member States are also often quite similar. Taking this into account, the IAEA has embarked upon a strategy for providing technical assistance in the form of a design package for a reference Waste Processing and Storage Facility (WPSF). The design package would be engineered so that the basic waste management processing and storage needs of Member States without nuclear power plants could be met by the construction of the reference plant.

TOPICS COVERED IN IAEA PUBLICATIONS ON WASTE DISPOSAL

TABLE I. HIGH LEVEL RADIOACTIVE WASTE DISPOSAL

Safety principles and technical criteria (1989)
Site investigation techniques (1985)
Near-field effects (1985)
Safety analyses for deep repositories (1983)
Handling and storage of conditioned wastes (1983)
Site investigations for deep repositories (1982)
Safety assessment for underground disposal (1981)
Regulatory procedures (1980)
Site selection factors (1977)

TABLE II. LOW AND INTERMEDIATE LEVEL RADIOACTIVE WASTE DISPOSAL

Acceptance criteria (1985)
Performance assessment (1985)
Safety analysis methodologies (1984)
Site investigations, design, construction, operation, shutdown and surveillance (in rock cavities and shallow ground) (1984)
Disposal in rock cavities (1983)
Criteria for underground disposal (1983)
Guidance on underground disposal (1981)
Disposal in shallow ground (1981)

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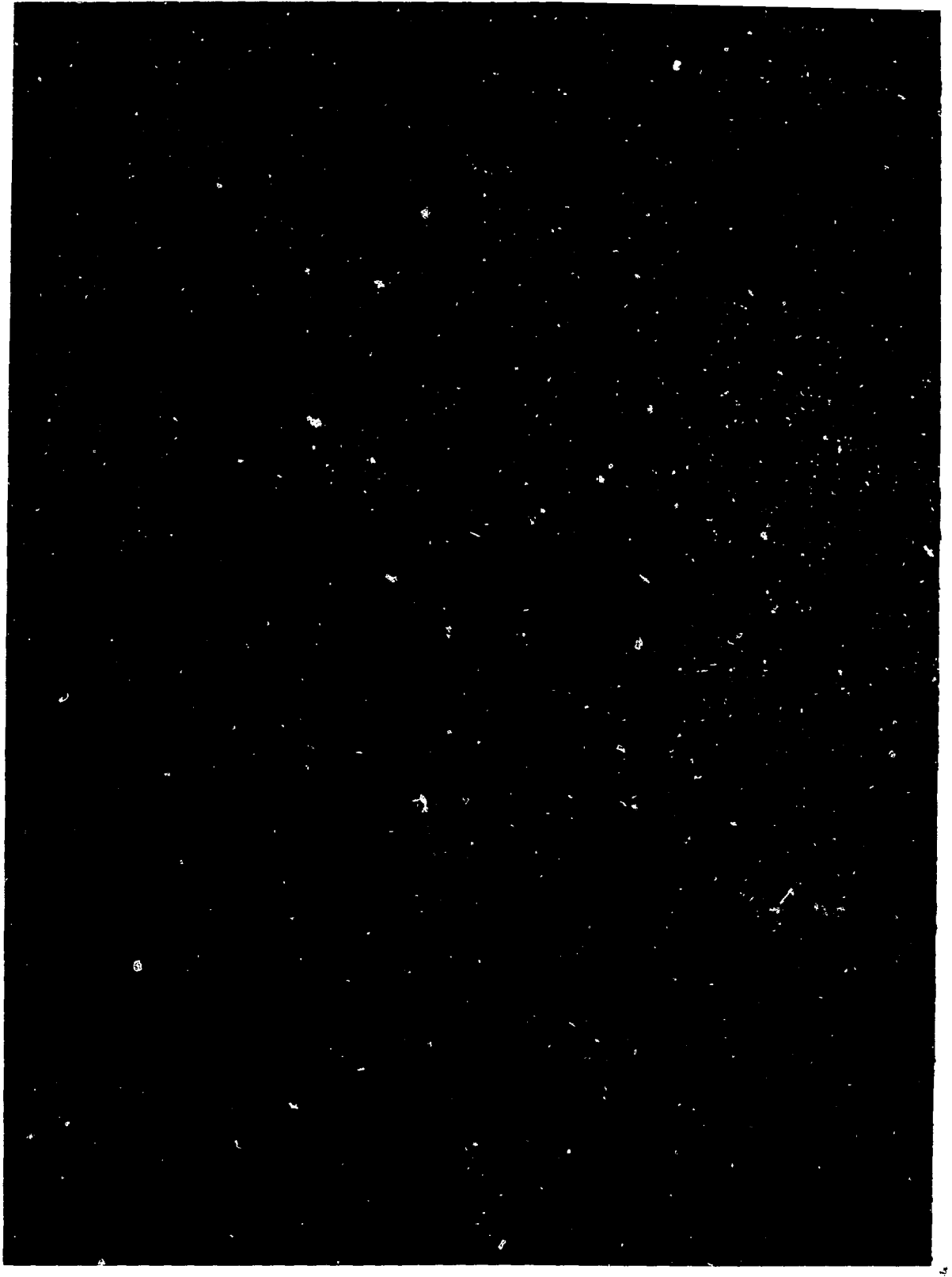

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VIENNA, 1990