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DEVELOPMENT AND INTERNATIONAL ECONOMIC CO-OPERATION: ENVIRONMENT

Effects on the environment of the dumping of nuclear wastes

Report of the Secretary-General

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* A/44/150.

I. INTRODUCTION

1. At its second regular session of 1988, the Economic and Social Council, in its decision 1988/174 of 28 July 1988, requested the Secretary-General, in co-operation with the Director-General of the International Atomic Energy Agency (IAEA), to submit a report to the General Assembly at its forty-fourth session, through the Governing Council of the United Nations Environment Programme, on the effects on the environment of the dumping of nuclear wastes.

2. The present report of the Secretary-General, prepared by IAEA, distinguishes between two types of nuclear waste disposal: (a) controlled disposal, which is performed under appropriate national regulatory controlat and (b) dumping, which is defined as illicit and uncontrolled disposal. National and international procedures and technologies available for the safe execution of controlled disposals of radioactive wastes,

3. In the case of dumping, one or more of the independent barriers of protection used in controlled waste management systems may not be employed and the risk of radiological exposure to man and his environment is increased. The actual degree of environmental contamination and the resulting hazards to man depend on the specific conditions surrounding the dumping of the radioactive wastes, such as: the nature and activity level of the wastes; the physical form of the wastes; the form of waste packaging) the characteristics of the dumping site; and methods applied in handling the packages.

4. Depending on the possible combinations of the above-mentioned conditions, the consequences of dumping could vary from being negligible to exposing whole population groups to significant hazards. There is no existing evidence that any transboundary dumping of nuclear wastes has occurred, and existing international transactions involving nuclear waste are based on bilateral agreements and take place under strict regulatory supervision.

5. As with other industrial activities, the generation of electricity by nuclear fission produces waste products. Wastes are also produced from the application of radionuclids 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.

6. The volumes of radioactive wastes generated from nuclear power production are small when compared to those generated by other energy-producing activities (e.g., generation of electricity from coal-burning plants). Radioactive wastes are very diverse in nature and can only be broadly categorised. This can be done in several ways; the approach more commonly used is as follows, and is based on a classification that characterises the radioactive wastes with regard to their potential haaards and the handling and disposal methods:

(a) Low-level wastes. These wastes contain a negligible amount of long-lived radioisotopes;

(b) Intermediate-level wastes. This category is used in most but not all countries to describe wastes with significant beta/gamma activity and low alpha activity;

(c) High-level wastes. These are wastes arising from the reprocessing of spent nuclear fuel which 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 high-level wastes and should meet the same criteria for disposal:

(d) Alpha-bearing wastes. This category includes wastes that are contaminated with significant amounts of long-lived, alpha-emitting nuclides.

7. 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), from a simple trench to an artificial engineered underground structure. Deep burial in disused mines is also a common practice.

8. High-level and alpha-bearing wastes remain radioactive for several thousand 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.

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

(a) The radioactivity and therefore the hazards associated with radioactive wastes decline with time:

(b) There are large volumes of waste that contain very low levels of radioactivity and that can therefore be safely disposed of as non-radioactive industrial waste. This very low level of radioactivity, sometimes referred to as an '-exempt quantity" or a de minimis level", is usually established by the competent authority in each country;

(c) 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;

(d) 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;

(e) 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.

10. 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 hasard 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 and which include the following steps:

(a) *Minimisation* of the amount of radioactive waste generated)

(b) Treatment of the wastes generated so as to reduce the volumes;

(c) Conditioning (immobilising) and packing the waste to render it chemically and physically stabler

(d) Disposal of the waste at carefully selected sites using technologies and multiple barriers to effectively isolate the waste from man and his environment.

11. The management of radioactive wastes is based on the application of the above-mentioned 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 multi-barrier concept (a system using two or more independent barriers to isolate radioactive waste from the biosphere). For the purpose of the present report, the "dumping" of nuclear waste shall *mean* the "uncontrolled disposal" of radioactive wastes. Uncontrolled disposal may be assumed to eliminate one or more of the multi-barriers of protection and thereby increase the risk of radiological exposure to man.

II. NATIONAL AND INTERNATIONAL STANDARDS AND PROCEDURES FOR WASTE DISPOSAL

12. Over the past 30 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 haaardous 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 means to ensure the safe disposal of radioactive wastes have been develop:".

13. 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 haaardous 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, research and development 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 *'multi-barrier 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:

(a) Waste form - radioactive waste may be incorporated into a solid insoluble matrix such as glass;

(b) Canister/package - the waste form is enclosed in a canister/package designed to withstand corrosion etc., for thousands of years;

(c) Backfill - the canister is surrounded by a water resistant radionuclide absorbing material such as clay (bentonite);

(d) Geological environment - the repository is located in a stable and isolated geological formation with little ground-water flow at a depth of several hundred metres below the surface.

14. For less radioactive waste types, such as intermediate and low-level wastes, the multi-barrier concept is retained, but the nature of the associated hazard is less 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. In such cases, safety may be based on 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 protect the disposal site from uncontrolled access to man and living species. However, it is recognized that it is inappropriate to rely on human surveillance veryfar into the future and therefore only those radioactive wastes types which decay to fairly harmless levels within a few hundred years are considered for disposal in shallow land burial.

15. 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 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping Convention). 1/ Since that time,, no country is known to have disposed of radioactive waste packages at sea.

16. 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, organisations such as the International Commission on Radiological Protection (ICRP), the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD) and IAEA have provided guidance on the principles and practices of radioactive waste disposal. A detailed description of the waste management programme of IAEA and some of the topics covered in IAEA safety publications in the field of waste disposal are provided in the annex to the present report.

17. Another important series of documents are those of the IAEA concerned with the safe transport of radioactive materials. 2/ These documents establish the internationally accepted rules for the safe transport of radioactive materials, including radioactive wastes and form the basis for national and international regulations on the subject.

III. ENVIRONMENTAL IMPACTS OF THE DUMPING OF RADIOACTIVE WASTES

18. It is first necessary to be clear about the meaning of the terms "dumping" and "environmental impact" as used in the present report, A definition of "dumping" was given in paragraph 7 above. The principal harm that 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 that 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, in the present report, the term "environmental impacts" refers to the effect on man of "uncontrolled" radioactive waste disposal.

19. It is assumed that in the context of Economic and Social Council resolution 1988/174, 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 that 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 wastes present a very small hazard to man, while other types of wastes cannot be handled directly without causing radiation damage to skin and tissues. It is therefore difficult to generalise about the nature of the harm that cm be caused by possible events associated with the uncontrolled disposal of waste drums.

20. 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 per cent 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 haaardous waste types, the high-level and intermediate-level wastes, are not likely candidates for illicit dumping because of the need for special handling and transport facilities and because of the higher level of security normally associated with them.

21. Provided that IAEA rules for the packaging, labelling and transportation of radioactive wastes are complied with (and these rules are incorporated into naticnal regulations in all countries utilizing radioactive materials to any signif icant extent), the direct haaard associated with being in 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 haaard result.

22. To provide some understanding of the possible events that may give rise to radiological hasards 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 generalising on the nature and magnitude of the haaard that 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

23. *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 are placed in shallow ground 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 due to natural weathering processes, could some leakage from the conditioned waste be possible. The leakage would be most likely to occur owing to leaching caused by water. The radionuclides thereby released could *be* transported with ground water or with run-off wrter during periods of rainfall. The radionuclides could eventually *reach a* stream if the run-off is ou the surface or percolate downwards into the soil and possibly reach ground water. It is likely, however, that much of the radionuclide content will have been reduced by absorption 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 haaard to health.

24. 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

25. In this scenario, the same waste container as that considered in scenario A, with its content of conditioned waste, is assumed to be damaged in transit, either accidentally 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 and 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 subsequent 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 clothing, serious injury

could occur. Similarly, serious consequences could result from uninformed tampering with drums containing non-radioactive but harardous toxic wastes.

Scenario C

26. 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 not have an 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.

27. 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.

28. In summary, despite the examples of the illustrative scenarios that have been presented 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.

IV. TRANSBOUNDARY MOVEMENTS OF RADIOACTIVE WASTES

29. The IAEA Regulations for the Safe Transport of Radioactive Materials, 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.

30. 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, one each in France and in the United Kingdom of Great Britain and Northern Ireland. In addition, the Union of Soviet Socialist Republics carries out spent fuel reprocessing for the fuel of Soviet origin used in reactors outside the Soviet Union.

31. 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 transport 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.

32. 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.

V. FUTURE INTERNATIONAL CO-OPERATION IN RADIOACTIVE WASTE MANAGEMENT: ITS IMPACT ON THE TRANSBOUNDARY MOVEMENT OF WASTES

33. The oonoept of an international disposal system for nuclear wastes or regional repositories is one that continues to be pursued and has been strongly advooated by countries having limited land resources. Large, well-organised, well-looated, and well-equipped sites would be preferable to a host of smaller sites. In addition, there are and will be oountriea with very small nuclear programmes and countries without geologically ideal disposal sites.

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

(a) National legislation covering nuclear activities, including radiation protection;

(b) Regulations for waste management and disposal;

(c) Criteria *for* site selection, waste package form and its aooeptanoe for disposal.

35. Suoh approaches were considered as part of regional or international planning of the nuolear 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 waate repository system was organised by the Nuclear Energy Agency of OECD. The 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.

VI. ISSUE OF ALLEGED DUMPING OF RADIOACTIVE WASTES

36. The Organisation of African Unity (OAU) resolution on the dumping of nuclear and industrial wastes in Africa (CM/Res.1153 (XLVIII)) (see A/43/398, annex) was brought to the attention of the Director General of IAEA by the OAU Secretary-General's letter of 17 June 1988. In his reply, dated 12 July 1988, the

Dirsotor General stated the Agency's readiness to give priority consideration to requests by Afrioan member States for assistance in solving ra dactive waste-related problems, To date, the IAEA secretariat has no evidence that any "dumping" of nuolear wastes hae occurred. A faot-finding mission by IAEA at the request of an Afrioan member State revealed that the "suspect wastes" were not radioaotive,

VII. CODE OF PRACTICE FOR INTERNATIONAL TRANSACTIONS INVOLVING NUCLEAR WASTES

37, The issue of transboundary movements of radioactive wastes has attraoted public concern, following reports of illicit exports and disposal of haaardoue wastes in doveloping countries. In May 1988, the Summit Conferenoe of OAU adopted a rrrolution whiah, inter alia, condemned suoh praotioes and requested IAEA, the United Nations Environment Programme (UNEP), the Eaonomio Commission for Afrioa (ECA) and other concerned organisation6 to assist African countries to establish appropriate mechanisms for monitoring and oontrolling the movement and disposal of radioaotive 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. Eleventh Summit of the Eaonomia Commission of Western Afrioan States, held at Lomé in June 1988; the meeting of the Zone of peace and ao-operation of the South Atlantic, held at Rio de Janeiro, Brazil, in August 1988; the Foreign Ministers' Conferenoe of the Non-Aligned Movement, held at Nioosia in September 1988; the United Nations Committee on Crime Prevention and Control; the forty-third session of the United Nations General Assembly).

38. At the request of Nigeria, the issue of traneboundary movement and "dumping" of radioaotive wastes was a subject of discussion at the June 1988 session of the Board of Governors of IAEA. At the thirty-second session of the IAEA General Conf erenc , 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 nuolear was tes".

39. Resolution QC (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) whiah 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".

40. 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 IAEA is requested to report to the General Conference at its thirty-third session (1989) on the implementation of the resolution.

41. According to the resolution, the Code of Praotioe should be based on, inter alia, a review of current national and international laws and regulations on radioaotive waste disposal. *Other* regulations and rules relevant to the development of the code will be considered. Thin inclu s, notably, international conventions and agreements covering other types of haaarous waste that are being developed within the framework of international organizations.

42. In implementing this resolution, the Director General of IAEA has invited a group of experts to meet at the Agency's headquarters from 22 to 26 May 1969 for its first session. The Agency 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 b/ the General Conference of the IAEA at its thirty-fourth session in 1990.

Notes

1/ United Nations, Treaty Series, vol. 1046, No. 15749, p. 120,

2/ IAEA Safety Series No, 6 is the basic document. It wL first published in 1961 and subsequently revised in 1964, 1967, 1973 and 1985.

ANNEX

International Atomic Energy Agency Waste Management Programme

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

Waste disposal programme

2. During the last 12 years, the underground disposal programme of IAEA extensively covered all aspects of low-level and intermediate-level wastes in shallow ground. This has now reached a stage where moat of the aspects of regulation, criteria, siting, design construction, closure, surveillance and safety assessment have been covered. Considerable information hae been generated for *the* various *options* and alternatives available for disposal and for the procedures for site aelection and assessment of safety. Baaed on the experiences of member States in the operation of shallow ground repoaitoriea, *IAEA* has reached the conclusion that repoeitoriea for disposal of low-level waste in shallow ground can be sited, designed, constructed and operated safetly without any harmful effects to *man* and his environment,

3. While *the* safety of the 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 radionuclidea 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.

4. The experience of 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. Relevant IAEA publications *on* waste disposal are listed in tables 1 and 2 below.

Responding to the needs of member States

5. The Agency has assisted its developing member States through training, technical co-operation, by providing assistance in starting and building necessary infrastructures, providing fellowships and financial support through research contracts for carrying out basic research in the nuclear energy field and nuclear applications. Emphaeie 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 t.o 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.

Waste Management Assessment and Technical Review Programme

6. 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. Upon request from member States, the Agency will arrange 40 assemble teams of international experts to provide critical reviews and assessment on aspects of national waste management programmes. This service provides member States with the facility for having independent international reviews of national plans and projects and may be seen as a way of improving public confidence in national arrangements,

Waste Management Advisory Programme

7. The 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. Under the auspices of IAEA, teams of experts in various waste management disciplines visit a member State upon its request for a comprehensive overview of waste management needs, practices, procedures, and institutions.

8. Missions began in 1987, building upon the traditional base of information and expertise established within IAEA. Some 18 missions have been organised so far, with 8 more scheduled in 1989. The 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.

Waste Processing and Storage Facility

9. Many of the requests that IAEA receives for technical assistance in the field of processing radioactive wastes are similar in *project* scope and objectives. The volume, 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, 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. The design package would be engineered so that the basic waste management processing and atorage needs of member States without nuclear power plants could be met by the construction of the reference plant.

Relevant IAEA publications on waste disposal

Table 1. High-level radioactive waste disposal

Safety principles and standards (in preparation)
Site investigation techniques (1985)
Rear-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 2. Low-level and intermediate-level radioactive waste disposal

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