

WORLD HEALTH ORGANIZATION
REGIONAL OFFICE FOR EUROPE

UNITED NATIONS ENVIRONMENT
PROGRAMME



HAZARDOUS WASTE MANAGEMENT

Report on a Working Group

Garmisch - Partenkirchen
17 - 20 March 1981



WORLD HEALTH ORGANIZATION
Regional Office for Europe
COPENHAGEN

WORLD HEALTH ORGANIZATION
REGIONAL OFFICE FOR EUROPE

UNITED NATIONS ENVIRONMENT
PROGRAMME



HAZARDOUS WASTE MANAGEMENT

Report on a Working Group

Garmisch - Partenkirchen
17 - 20 March 1981



WORLD HEALTH ORGANIZATION
Regional Office for Europe
COPENHAGEN

Original: English

1982

ICP/RCE 402 (1)
4856 K

Note

The issue of this document does not constitute formal publication. It should not be reviewed, abstracted or quoted without the agreement of the World Health Organization. Authors alone are responsible for views expressed in signed articles.

CONTENTS

	<u>Page</u>
1. Summary	1
2. Introduction	1
3. Definitions and health effects	2
3.1 Definition of "hazardous waste"	2
3.2 The problem of hazardous waste	3
3.3 Analysis of waste	3
3.4 Worker safety	4
4. Waste management technology	4
4.1 Choice of technology	4
4.2 Problems of developing countries	4
4.3 Land disposal	6
4.4 Interim storage	6
5. Waste transportation	7
5.1 Intra-country transport	7
5.2 Transfrontier transport	7
6. Planning, administration and control	8
6.1 General policy and legislation	8
6.2 Control and licensing	9
6.3 Planning	9
6.4 Legal liability and insurance	9
6.5 Dissemination of information	10
7. Conclusions	10
8. Recommendations	11
Annex 1 Membership of subgroups	14
Annex 2 List of participants	15

1. Summary

The Group was jointly convened by UNEP and the WHO Regional Office for Europe. Its purpose was to produce policy guidelines and a more technical code of practice. Particular emphasis was laid on the problems developing countries may face as they industrialize or import hazardous waste from developed countries. The discussions were based on a draft code of practice, distributed to the Group in advance. Much of the work was carried out in four subgroups, each looking at a significant aspect of the overall problem.

The first subgroup considered definitions and health effects. Most legal definitions of "hazardous waste" are not valid outside their country of origin. For the purposes of control, pragmatic working definitions were thus preferred, focusing more on the "hazard characteristics" of a waste than on its form or composition.

The second subgroup considered the technological aspects of hazardous waste management, including waste minimization, recovery or reuse, storage, treatment and disposal. Particular attention was given to the level of residual risk posed by a technology to public and environmental health. This was regarded as especially important for landfill disposal, and aspects such as the management philosophy adopted for leachate control and post-closure care were considered. The cost of a technology is also important in deciding on the "best practicable means" for hazardous waste management.

The third subgroup considered waste transportation. For transport within a country, a manifest or trip-ticket system of control was advocated, the aim being to ensure that the waste arrives at its designated destination. Particular attention was given to the special problems of transfrontier transport and of the potential export of hazardous waste from developed to developing countries. Pre-notification to the designated authorities in both the exporting and importing countries was recommended as the basis for control.

The fourth subgroup tackled the problems of planning, administration and control in hazardous waste management. A basic premise for any national policy was considered to be that most (if not all) hazardous waste should have a legal treatment or disposal route within the country. "Cradle to grave" control was advocated for the regulation of hazardous waste management, including the registration of waste producers and the licensing of all facilities for storage, transportation, treatment or disposal. Other topics considered included types of legislation, enforcement, financial responsibility, insurance and manpower training.

The Working Group made a number of recommendations for the development of guidelines and for appropriate mechanisms to control hazardous waste management.

2. Introduction

The Working Group on Guidelines for the Control of Toxic and Other Hazardous Chemical Waste was convened in Garmisch-Partenkirchen from 17 to 20 March 1981 by the United Nations Environment Programme (UNEP) and the WHO Regional Office for Europe, in collaboration with the Government of the Federal Republic of Germany. The meeting was attended by 41 participants, including waste management professionals, environmental scientists, chemists, chemical engineers, civil engineers, toxicologists, physicians, economists, lawyers and administrators from 21 countries (see Annex 2 for list of participants).

The meeting was opened by Mr F. Defregger, Director, Waste Management Division, State Ministry of Environmental Protection, Bavaria, and the participants were welcomed to Garmisch-Partenkirchen by Mr F. Neidlinger, the Mayor. Mr J.P. Lehman was elected Chairman, Mr M.P. Betts, Dr K. Symon, Mr B.A. Szelinski and Dr J. Tadmor, Vice-Chairmen, and Dr D.C. Wilson, Rapporteur. Dr M.J. Suess and Dr J.W. Huismans acted as Co-secretaries.

The Group agreed that the ultimate objective of its deliberations was to produce a set of guidelines in two parts aimed at slightly different audiences. The first part would be "Policy guidelines" aimed at the highest level of policy-makers; the second part would be code of practice, aimed at the highest ranking technical officials within a country.^a

^a Suess, M.J. & Huismans, J.W., ed. Management of hazardous waste: policy guidelines and code of practice. Copenhagen, WHO Regional Office for Europe, 1982 (WHO Regional Publications, European Series, No. 14)(in press).

The Group considered two working documents. One was a draft code of practice prepared by Messrs Mills, Nels and Szelinski. The discussions concentrated on this document, and much of the Group's output consisted of detailed comments and recommendations for its improvement. The second document, presented by Mr Finnecy, outlined the significant subject areas which the final policy guidelines needed to address.

Much of the Group's work was done in four subgroups, each of which considered a significant aspect of the overall problem.

The remainder of this report will consider the four subject areas in turn, reflecting not only the opinions of the various subgroups but also of the entire Group, as expressed in plenary discussion.

3. Definitions and health effects

3.1 Definition of "hazardous waste"

A comprehensive and balanced definition of toxic and other hazardous waste which is acceptable to the international community has not yet been achieved, and much discussion in the Group was devoted to this topic. Indeed, even the appropriate terminology posed some difficulties, but eventual agreement was reached that the term "hazardous waste" should be adopted in preference to either "toxic and other hazardous waste" or "toxic and other hazardous chemical waste".

A "waste" is generally understood to be something which the owner no longer wants at a given place and time and which has no market value. However, a precise definition can only be attempted within a specific cultural and legal framework, and definitions current in any one country are seldom acceptable elsewhere.

For "hazardous waste" the problems of definition are even greater. Many national definitions are based on the form or content of a waste, or on the industrial process from which it originates. Several lists of hazardous wastes were given as examples in the two working documents before the Group, and the usefulness of such listings was discussed. In general, the Group felt that the listing of wastes was a reasonable, pragmatic approach to the problem of definition. In any case, the availability of good information on the quantities, nature and origins of hazardous waste is an essential requirement for developing a proper system of management and control. However, the Group felt that the listing of chemicals was less helpful. Hazardous waste is generally a complex mixture, and many waste streams will contain a range of potentially toxic chemicals as "trace contaminants". Thus, a list of chemicals needs to be complemented by a list of significant concentrations, implying that almost every waste needs to be analysed for a wide variety of determinants. The problems which such analysis poses are considered in section 3.3.

In general, the Group felt that the effects of a waste, or its "hazard characteristics", are more important than its form or composition in framing pragmatic working definitions for the purposes of control. The Group agreed that attention needs to be given to the effects on health and on the environment, as well as to short-term, acute hazards and to longer-term, more insidious effects such as groundwater pollution.

Hazardous waste may be categorized in various ways, and such categorization can aid management control. For example, hazardous waste may be categorized with respect to:

- suitability for various treatment processes;
- suitability for various disposal methods;
- compatibility with other types of waste;
- potential acute hazards such as flammability, corrosiveness or toxicity; and
- physical form, such as solid, liquid or sludge.

To summarize, the Group believed that formal, legalistic definitions of terms such as "hazardous waste" should not be attempted in the context of international guidelines at this time. It agreed that the guidelines should not cover radioactive waste or hospital waste in any detail (both topics being discussed by separate working groups). The recent publication of a glossary of terms in solid waste^a was noted, and the Group agreed that this glossary should be followed as far as possible.

^a Patrick, P.K. Glossary on solid waste. Copenhagen, WHO Regional Office for Europe, 1980.

3.2 The problem of hazardous waste

The scope of the hazardous waste problem was also discussed, and in particular the question of whether or not discharges to watercourses or the atmosphere should be considered. While no attempt was made to define the interface between the present activity and the more traditional areas of air and water pollution, the Group agreed that the activities are nonetheless distinct.

The purpose of the guidelines being prepared by the Group was generally agreed to be the proper management of present and future arisings of hazardous waste. The problems of abandoned, uncontrolled dumps or landfill sites, colloquially described as "cleaning up the sins of the past", are being addressed through other international initiatives, at least in the developed countries. However, a request was made for WHO and/or UNEP assistance to developing countries in the identification and reclamation of such sites. Guidance is also required on approaches to close existing inadequate or potentially hazardous dumps in order to prevent future problems.

3.3 Analysis of waste

Comprehensive analytical data on the composition of many wastes can be extremely difficult to obtain. In addition, such data may be misleading and confusing if not obtained by verified protocols and methods; reliable, analytical facilities in many countries are likely to be limited in availability and overcommitted. Furthermore, waste composition from a single source may vary over time.

For such reasons, the analytical information on waste composition for the control system should be limited to that which is necessary to evaluate the inherent risks, to decide upon appropriate management methods and to ensure that waste is what it is claimed to be. The responsibility for providing information on composition should rest primarily on the waste producer or on his selected waste contractor, with the role of the controlling authority being essentially one of verification and enforcement.

WHO may consider elaborating some simple, relatively straightforward methods of analysis for hazardous waste to be appropriate. Methods which have already been used and verified and which do not require expensive, sophisticated instrumentation could be very helpful to those countries just developing a hazardous waste management programme.

3.4 Worker safety

Requirements for worker safety in the handling of hazardous waste are better met within the context of general legislation for worker protection than by more specific measures. For most hazardous wastes, the risk to workers under normal handling conditions is minimal. Those wastes which pose a significant risk to workers unless special handling precautions are taken should be clearly distinguished. As a basic rule of thumb, the handling precautions for a waste containing significant quantities of a hazardous substance should be at least as stringent as for the pure material, unless the risk from the waste can be shown to be significantly less.

4. Waste management technology

4.1 Choice of technology

Many technologies are currently available in developed countries for hazardous waste management. A simple classification is given in Table 1.

A particular technology is usually not appropriate for all hazardous waste. The choice of appropriate technology for a particular waste depends on many criteria including: waste characteristics; facility availability; distance to the site; local factors such as geology, hydrogeology, hydrology, climate and population density; political factors such as the standards of safety required by society and the demands of public opinion; and the costs. In general, absolute safety does not exist, and any technology will have an associated level of residual risk. The greater the impact of a technology, the lower the residual risk - and the higher the cost.

The choice of appropriate technology in a particular case should be based on the concept of "best practicable means". This choice may vary from country to country. Therefore, it would not be appropriate for an international guidelines document to make strong recommendations on the subject; rather, it should provide a list of the pros and cons of the alternatives to enable the decision-makers to form their own judgements.

Table 1. A simple classification of hazardous waste management technologies

Category	Examples
Waste avoidance, minimization or reduction	<ul style="list-style-type: none"> - low-waste or "clean" technology - plant, process or raw material changes - product substitution
Segregation of waste for recovery or reuse	<ul style="list-style-type: none"> - recycling for original application - reclamation for lower-grade application - reclamation for new application - recovery of energy values - waste exchange
Short-term storage prior to recycling, treatment or disposal	<ul style="list-style-type: none"> - storage at the point of generation - storage at local or regional waste collection centres pending transport to central facility - storage pending accumulation of sufficient waste to make subsequent recycling, etc., more economic
Treatment aimed at detoxification	<ul style="list-style-type: none"> - thermal treatment by incineration on land or at sea - chemical treatment by neutralization, oxidation, reduction, etc. - biological treatment, either aerobic or anaerobic
Treatment aimed at volume reduction	<ul style="list-style-type: none"> - precipitation - dewatering - phase separation
Treatment aimed at immobilization of the toxic components	<ul style="list-style-type: none"> - solidification processes
Disposal	<ul style="list-style-type: none"> - landfill - land farming - mineshaft disposal - deep-well injection - shallow-sea disposal - deep-sea disposal
Long-term storage	<ul style="list-style-type: none"> - land mines

A high-impact technology derives its power, or an "adequate" technology its adequacy, only from the people responsible for managing and operating the facility. All personnel for hazardous waste management at the policy, management or operational levels must be properly trained.

Scientific understanding of the behaviour of hazardous waste in the environment is in its infancy; further research and development of many aspects of hazardous waste minimization, recovery, storage, treatment and disposal are urgently required. Technological progress over the last decade has been considerable, but the awareness that the best technology today may not remain so in a few years must always be borne in mind.

The Group felt that keeping the guidelines document reasonably short and concise was important but conversely saw that the availability of adequate documentation on current technologies was essential, in particular to developing countries. Therefore, an international bibliography of publications on hazardous waste management should be compiled with all participants invited to contribute. In addition, the recommendation was made that further, detailed documentation on specific technical aspects should be produced by WHO as a future activity.

The costs of alternative technologies for hazardous waste management are often difficult to ascertain, but an effort is being made to compile international data, mainly supplied by participants.

4.2 Problems of developing countries

Much is known about the technologies for hazardous waste management in developed countries, but rather less where developing countries are concerned. Uncontrolled or open dumping is an unsatisfactory method of disposal for hazardous waste, not least because scavenging is a widespread practice. An urgent priority in many countries will be the rapid phasing out of open dumps, but this action will often only be possible when appropriate, perhaps interim, technologies are available which offer significant environmental improvements at a reasonable cost. The "best available technology" might potentially reduce the risks by a factor of 100, but at a cost which cannot be met in developing countries: the overall result would be that nothing is done. The "best practicable means", on the other hand, might be a less sophisticated methodology which would reduce the risks by a factor of perhaps 10 at a fairly modest cost: the result could be a significant improvement in environmental quality. Little is known about the basic characteristics of the hazardous waste problem in developing countries, with regard either to the nature and geographical distribution of the waste or to the effect of extreme climatic conditions such as aridity, drought, extreme heat, high humidity or flooding on disposal options. Research and development work are urgently required to define the nature of the problem and to develop technologies appropriate for both short- and long-term efforts. Another area of concern is the handling of existing open dumps containing hazardous waste: how can these dumps best be closed without posing problems in the future?

4.3 Land disposal

Land disposal merits special mention here for several reasons. It is currently the major management method for hazardous waste in many countries and is likely to remain so on a worldwide basis for many years. It is also controversial, giving rise to considerable differences of opinion between developed countries. In addition, recently discovered problems associated with certain former land disposal sites such as Love Canal (USA) and Lekkerkerk (Netherlands) have highlighted the need for post-closure care of all such sites and have intensified public opposition to them.

Use of a modern, properly engineered and managed hazardous waste landfill site should be clearly distinguished from the unacceptable practice of open dumping. Landfill cannot be regarded as suitable for all hazardous waste, but conversely, many such wastes can safely be disposed of at a well-selected and managed site with minimum impact on the environment.

Opinion currently diverges on the selection of suitable sites for hazardous waste landfill, particularly with regard to the protection of groundwater resources. One view holds that the only suitable sites are those capable, on the basis of their geology and hydrogeology, of containing deposited materials and waste leachate (the philosophy of "concentrate and contain"). An opposite view is that sites which permit the slow migration of leachate may be preferable for certain waste: natural processes of attenuation and dispersion within and beyond the site may reduce the concentrations of polluting species to acceptable levels (the philosophy of "dilute and disperse"). Preliminary research results and site experience suggest that the attenuation philosophy may have certain environmental and technical advantages; however, it is still viewed with suspicion in some countries.

Another difference of opinion concerns the management of hazardous waste landfill. Some countries actively encourage the joint-disposal of hazardous waste with domestic refuse, while other countries prefer to segregate hazardous waste in separate sites. Preliminary research results and site experience show that chemical and physicochemical reactions within a domestic refuse landfill can at best prevent, or in many cases substantially reduce, the potential hazard of the deposited waste. However, the fact must be emphasized that the effectiveness of joint-disposal depends on proper management to ensure that the natural attenuation capacity of the refuse is not exceeded. In principle, joint-disposal should make some landfill sites available for hazardous

waste which would otherwise be deemed unsuitable. Various factors, however, may prevent this approach from being implemented; for example, local public opposition may be raised. In such cases, filling the few available hazardous waste landfill sites with non-hazardous waste may not be prudent.

When a landfill site containing hazardous waste is closed, continued monitoring, for example, of groundwater quality around the site, may be necessary for many years to provide early warning of any potential pollution. If a containment site has been used, the continued collection and treatment of leachates will often be required, depending on the climate and on the design of the final cover. Use of pollution control devices (such as landfill cover) should be continued. Proper controls over the subsequent use of the land reclaimed by filling are also essential to prevent future risks to public health from the hazardous waste beneath. In the long term, the only adequate way to ensure that the potential problems are recognized and that inappropriate redevelopment is avoided is to require by law that the use of a site for disposal of hazardous waste be stated in the ownership deeds of the land and that detailed records showing the distribution of waste within the site be preserved. One further step would be to restrict by law the future use of the land. For example, a site known to be significantly contaminated with hazardous materials could not be used for housing, schools or hospitals.

4.4 Interim storage

Interim storage of hazardous waste is an important but often overlooked aspect of the overall management cycle. Some storage facilities will usually be necessary both at the point of waste generation and at the waste treatment plant. In addition, local or regional collection centres (or transfer stations) form an important part of efficient hazardous waste management systems in several countries. The need for adequate technology and for proper management and control is at least as great in storage as in treatment or disposal facilities. Indeed, as liquid waste is often mixed in storage tanks, the need may be even greater as the risks of mixing incompatible wastes must be minimized. In addition, several instances have occurred where interim storage facilities were turned into ad hoc disposal sites, usually because the operator encountered financial problems.

5. Waste transportation

5.1 Intra-country transport

Transport of hazardous waste within national borders is best controlled in the context of general regulations on the transport of dangerous goods. For example, the nature of the hazard can often be expressed in terms of the standard categories for dangerous goods. However, hazardous waste poses certain additional problems. For example, waste in general has no perceived value to the generator. Therefore, additional safeguards are required to ensure that a hazardous waste actually arrives at its destination and that this destination is a facility appropriate for its disposal. Furthermore, as has been noted, hazardous waste is in general a complex mixture of substances, and its chemical and physical properties may not be precisely known. Thus incompatible wastes may be mixed for convenience in transit, thereby creating an acute hazard, either immediately or during treatment and disposal.

To ensure the safe transport of hazardous waste, the following principles were outlined by the Group.

- (1) Hazardous waste should be covered by regulations governing the transport of dangerous goods, using wherever possible the existing categories to describe the hazard. All vehicles should be properly labelled and should carry instructions for appropriate action in case of accident.
- (2) Sources (producers) of hazardous waste should be registered, and all interim storage, treatment and disposal facilities should be licensed.
- (3) A contractual agreement should first be negotiated between the waste producer and the operator of the receiving facility.
- (4) A manifest or trip-ticket system should be used to ensure that the waste arrives at its designated destination. The exact working of the system will vary from country to country, but the basic principle is that dispatch and receipt copies of the manifest should be matched by the waste producer and/or by the controlling authority to ensure that the load has arrived.

(5) Transportation contractors should be licensed to ensure adequate standards of equipment and personnel training. Drivers should be familiar with the hazards of the waste they are conveying, particularly its potentially adverse interactions with other wastes.

5.2 Transfrontier transport^a

As a general principle, nations desire to organize matters so that they can safely store, treat or dispose of all the waste within their own jurisdiction. However, where suitably safe facilities for certain wastes do not exist or cannot be provided within a country, international trade in wastes would need to take place. Where legislation and control of waste management are fully developed in both the exporting and importing countries, the problem is one of ensuring a proper control system for transfrontier transport. Similarly, the export of hazardous waste to specialized treatment facilities in a country with a fully developed system of control appears straightforward. Ethical problems become relevant only when a proposal to export waste from a country with a proper hazardous waste management system to one without such a system appears motivated more by the other country's lack of control over disposal, and hence lower disposal costs, than by the availability of specialized treatment facilities in that country. The proposed system of control outlined below is generally adequate to cover all these situations, ensuring in the latter case that the governments of both the exporting and importing countries are alerted to the potential problems.

The following principles of control were outlined by the Group.

- (1) First, a contractual agreement should be negotiated between the waste producer and the proposed storage, treatment or disposal site operator.
- (2) The producer should apply for an export licence to the appropriate authority in his own country. This application should specify the following: nature and quantity of the waste, restrictions regarding the storage, treatment or disposal of that waste in the country of origin, proposed mode of transportation, and precautions to be taken, proposed receiving facility, and the reasons why export to that particular facility are being sought.
- (3) The authority should certify that the information in the licence application is correct and pass it on to the relevant authority in the receiving country.
- (4) The receiving country should have the responsibility to ensure that imported waste is transported, stored, treated and disposed of according to national standards.
- (5) An export licence should be issued by the originating country only on receipt of an import licence from the receiving country's authority.
- (6) Each shipment of waste should be accompanied by a manifest, in an analogous manner to that described above for internal transport.
- (7) Customs authorities should be responsible for ensuring that import and export licences are in order and for checking the manifest.
- (8) Further attention should be paid to the problems of developing countries whose authorities may not have the expertise to evaluate the technical feasibility or environmental safety of a proposed storage, treatment or disposal facility in their territory. Assistance in dealing with these problems may be sought by such countries from appropriate international agencies such as UNEP and WHO.

6. Planning, administration and control

6.1 General policy and legislation

The creation of a management scheme for the control of hazardous waste will be influenced not only by technical and scientific factors but also by political and socioeconomic considerations. The solutions developed by various countries to the hazardous waste problem will thus differ according to their individual constitutions, legislative structures and geographical situations. The important geographical criteria to be considered include: geology, hydrogeology, climate, population density, availability of land, state of industrialization and existing infrastructure.

^a The Group substituted the term "transfrontier transport" for the previously proposed "transboundary transport".

Control of hazardous waste can be seen as comprising measures at a number of levels:

- general legislation for environmental protection;
- general legislation for waste management;
- specific legislation for hazardous waste;
- regulation (licensing) for specific activities; and
- guidelines and advisory documentation.

The general environmental protection laws which countries have, or are planning to promulgate, should stipulate appropriate institutional measures for the management of hazardous waste.

The production of some hazardous waste is an inevitable by-product of any, even partly, industrialized society. A national environmental protection policy should therefore allow for the legal transport, storage, treatment or disposal of hazardous waste in such a way as to minimize unacceptable effects on public health or environmental quality. Waste avoidance, minimization or recycling and the use of "clean" technology should be encouraged wherever possible. A national policy which does not establish legal treatment and disposal routes for a sizeable quantity of hazardous waste will encourage improper disposal. It may also encourage the use of inadequate interim storage facilities as ad hoc disposal sites in the hope that recycling, treatment or disposal at a reasonable cost may become possible at some time in the future. In fact, several of today's uncontrolled or problem hazardous waste sites are yesterday's poorly operated interim storage facilities.

Government should be responsible for providing an adequate system of laws, controls and administrative procedures for hazardous waste management. Legislation and regulations may take many forms, being based for example on environmental discharge standards, environmental quality objectives, technical design and operating standards, economic incentives and disincentives or a combination of any of these. Administration and control of hazardous waste management should be vested in designated public authorities. Depending on the administrative system of the country, such authorities may be at a national, regional or local government level or, indeed, at all three. The right of appeal against the decisions of the competent authorities should be safeguarded.

As an interim measure prior to the development of a comprehensive control system in a developing country, safety in hazardous waste management may be greatly enhanced by giving technical responsibility for advice and guidance to an appropriate technical unit, preferably one already in government service. This unit should be able to draw on international experience and the services of specialists through international organizations, such as WHO.

6.2 Control and licensing

Administrative control of hazardous waste management should be vested in appropriate public authorities. The principle of regulation should be control from "cradle to grave" (or where incineration is practised, from "cradle to cremation"). Thus, sources (producers) of hazardous waste should be registered, and all collection, interim storage, transport, treatment and disposal facilities should be licensed. A manifest or trip-ticket system should be used to ensure that the waste arrives at its designated destination. The most appropriate public authority to administer the registration, licensing and manifest systems is probably one at a local or regional level.

A licence for any waste management activity should only be issued to an operator who demonstrates technical, financial and managerial competence and who employs a properly trained staff. The licence should specify the waste which a facility can receive, the operational conditions which must be met, the monitoring and control procedures which must be carried out, the records which must be kept and the reports which must be made to the controlling authority. Any licence must stipulate the right of legitimate access for the authorities, and all records must be available for their inspection. If a storage, treatment or disposal facility has seriously violated the licence conditions, the licence should be revoked. If significant pollution has occurred, the licence holder should carry out the necessary remedial work at personal expense. If the licence holder is unable or unwilling to take such action, the controlling authority should have the duty and the power to carry out the work and to recover the cost from the licence holder. The point should be made that a producer of hazardous waste who wishes to treat or dispose of the waste within his own premises should be required to seek a licence to do so.

A central requirement for the efficient control of hazardous waste management is the availability of properly trained staff at all levels of policy, management and operations in public authorities and in industry. Priority should be given to organizing training programmes, particularly in countries where hazardous waste management is still at an early stage.

6.3 Planning

Control of hazardous waste management will be largely ineffective without the parallel activity of forward planning. Planning may be carried out at national, regional or local levels, the first two being perhaps most appropriate for hazardous waste. At an early stage, a waste survey should be carried out by a suitable body to gather information on the nature and quantities of hazardous waste in the area and on currently used management practices. Note should be made that the use of a manifest or trip-ticket system for controlling waste transport and the keeping of records under the terms of a site licence will, in the longer term, provide valuable statistical information in planning.

A plan for hazardous waste management should include reference to:

- quantities and types of waste generated now and expected in the future;
- current management practice;
- preferred future management practice;
- overall planning of facilities (number, type, size, location and distribution);
- need for collection centres or transfer stations (with or without facilities for interim storage); and
- direction of certain particularly difficult waste to specific facilities.

Methods for financing and implementing the plan will vary country to country; the principle of the "polluter must pay" would indicate that the major share of the costs should be borne by the waste producers.

6.4 Legal liability and insurance

Hazardous waste management must be based on the premise that the waste generator will be held responsible for ensuring that his waste is safely transported, stored, treated and disposed of. This obligation may be delegated to a competent, licensed contractor. In some instances, a waste generator will need to seek advice outside his own competence in order to discharge his responsibility.

Therefore, the most effective means of enforcing the law on hazardous waste management will often be the application of the principle of individual or corporate liability. Thus, both individuals and the corporate bodies employing them should be held liable for the consequences of any proven malpractice or negligence occurring at any point in the life cycle of hazardous waste within their management responsibility.

The costs of cleaning up environmental pollution may be extremely high, and legal liability for them is likely to be helpful only if adequate insurance is available. The holding of the necessary insurance coverage should be a condition for granting the facility a licence. It should include both normal accident and sudden event coverage, which is already commonly available, as well as the more novel environmental damage insurance. The latter is a highly specialized measure on which expert advice should be sought. For example, statistics are insufficient for accurate actuarial risk assessment. In general, private insurers will not accept unlimited liability, and environmental damage claims could be extremely high. Furthermore, a tendency exists to move towards strict liability judgements (i.e. proving negligence is not necessary for a damages award to be made). The establishment of either a state insurance scheme or a special state fund may be necessary to meet the costs of environmental damage when they exceed the extent of cover available through private insurance.

6.5 Dissemination of information

The public can play an important part in hazardous waste management. Unfortunately, this role is currently often a negative one: local communities have vigorously opposed most proposals to establish a facility for hazardous waste management, especially if it is a regional, national or even international facility. Public involvement in planning for hazardous waste management should be encouraged, and material suitable for educating the layman should be made widely available. UNEP and WHO involvement in such activities could be helpful.

A wide variety of national ministries deal with hazardous waste management. Therefore, dissemination of information on current UNEP and WHO activities and the eventual guidelines to all appropriate agencies is important. Included should be ministries of commerce and transportation as well as those concerned with the environment and health.

The specific problems of developing countries have been frequently mentioned in this report. Appropriate mechanisms should be developed whereby an international organization, such as UNEP or WHO, could provide assistance to any country requesting help in implementing the guidelines in order to institute a system of control for hazardous waste management.

7. Conclusions

Planning

(1) One of the early requirements for development of a proper system of hazardous waste management is the availability of reliable information on the quantities and nature of waste and on currently used management practices.

Definitions and health effects

(2) For the purpose of the Group's discussions, the term "hazardous waste" was preferred to either "toxic and other hazardous waste" or "toxic and other hazardous chemical waste". Neither radioactive nor hospital waste was specifically considered by the Group.

(3) When considering the problems of managing hazardous waste, attention needs to be paid to the effects on health and the environment, with respect to both short-term, acute effects and long-term, more insidious effects, such as groundwater pollution.

(4) With regard to worker protection, a clear distinction should be made between "hazardous" waste, which poses minimal risk to the worker, and that which presents a significant risk unless special safety precautions are taken. In general, the handling precautions for the waste should be at least as rigorous as for the corresponding pure substance, unless the risk from the waste is shown to be significantly less.

Technology

(5) Many technologies are currently available for hazardous waste management. A particular technology is usually not appropriate for all wastes. In general, when a waste can be dealt with in several ways, the more "powerful" the technology and the lower the residual risk, the higher will be the cost. The appropriate technology in a particular case should be based on the concept of "best practicable means". The choice of appropriate means is not static and may change as technology develops and as society demands. Research and development are required in many aspects and should be encouraged.

Transport

(6) Transport of hazardous waste is best controlled in the context of general regulations on the transport of dangerous goods. Hazardous waste may present additional problems, however, because it has no perceived value to the generator or transporter, its composition may not be precisely known and the mixing of incompatible wastes for convenience in transit may create a hazard.

General policy and legislation

(7) A national policy for hazardous waste management should be such that hazardous waste will have a legally acceptable transport, storage, treatment or disposal route. Otherwise, the policy will encourage improper disposal.

(8) Hazardous waste management legislation can take many forms, depending on the legal system and other factors in the country. Legislation and regulations may be based on environmental discharge standards, environmental quality objectives, technical design and operating standards, economic incentives and disincentives - or a combination of any of these.

(9) Socioeconomic and political aspects must be considered within the context of hazardous waste management.

Legal liability and insurance

(10) Hazardous waste management must be based on the premise that the waste generator will be held responsible for selecting licensed contractors capable of providing safe transport and adequate storage, treatment or disposal of the waste. In some instances, a waste generator will need to seek advice outside his own competence in order to discharge this responsibility.

(11) Where permitted by the legal system of the country, both individuals and the corporate bodies employing them should be accountable for the consequences of any proven malpractice or negligence occurring at any point in the life cycle of the hazardous waste within their management responsibility. Laws should be framed to permit their prosecution.

(12) "Sudden and accidental" insurance coverage for hazardous waste management facilities is commonly available and often required by existing control programmes. Environmental damage insurance is an important but highly specialized measure. Adequate (or unlimited) insurance of the latter type may not be available unless a state insurance scheme is instituted.

8. Recommendations

General

(1) UNEP and the WHO Regional Office for Europe should jointly produce documentation, including both policy guidelines and a code of good practice, which will serve as a guide to decision-makers with responsibility for the management of hazardous waste. Many detailed recommendations on the form and content of such documentation were made by the Group.

(2) After completion of the current activity WHO should produce much more detailed background information and documentation on certain (mainly technical) aspects of the overall hazardous waste problem.

Definitions and health effects

(3) Formal, legalistic definitions of terms such as "hazardous waste" should not be attempted in the context of international guidelines at this time. The best way forward is to adopt pragmatic, working definitions which focus more on the hazard characteristics of the waste than on its form or composition.

(4) Comprehensive, analytical data on the composition of many wastes are often extremely difficult to obtain. Therefore, requirements for analytical information on waste composition should be consistent with the necessity to decide on appropriate management methods and to evaluate inherent risks. Such analysis should use verified protocols and methods. WHO should consider compiling simple analytical methods suitable for use by countries just developing a hazardous waste management programme.

Technology

(5) Much is known about technologies for hazardous waste management applied in developed countries, but rather less is known where developing countries are concerned. Considerable attention in the ongoing UNEP and WHO activities should be given to identifying, and developing guidance on solving, the specific hazardous waste problems of developing countries. Research and development work should be encouraged.

(6) Uncontrolled dumping is an unsatisfactory method of disposal for hazardous waste and should be phased out. However, specific guidance should be given to developing countries, both on alternatives and on adequate procedures for closing existing dumps, so that they do not pose problems in the future.

(7) Post-closure care of sites that have been used for the disposal of hazardous waste should include appropriate monitoring for potential pollution, maintenance of control devices (such as landfill cover) and measures aimed at preventing inappropriate use of the land in the future. The fact that a site has been used for land disposal of hazardous waste should be recorded in the ownership deeds.

(8) UNEP and WHO should develop methods both for locating abandoned dumping sites containing hazardous waste and for their reclamation, specifically to guide the developing countries.

Transfrontier transport

(9) Transfrontier shipment of hazardous waste should be regulated on the basis of pre-notification to the designated competent authorities of both the exporting and the receiving countries. The receiving country should be responsible for ensuring that the waste is transported, stored, treated and disposed of according to its standards. However, specific attention needs to be given to the

problems of developing countries, whose authorities may not have the expertise to evaluate the technical feasibility or environmental safety of a proposed hazardous waste disposal facility in their country.

General policy and legislation

(10) The general environmental protection laws which countries have, or are planning to promulgate, should stipulate appropriate institutional measures to be included for hazardous waste management.

(11) Government should be responsible for providing an adequate system of laws, controls and administrative procedures for hazardous waste management. Other governmental responsibilities will vary according to the constitution and practices in the individual country. The right of appeal against decisions made by the competent authorities should, however, be safeguarded.

Control and licensing

(12) In the interim period while a comprehensive control system for hazardous waste management is being established in a (developing) country, responsibility for advice and guidance on technical aspects should be given to an appropriate technical unit, preferably one already in government service, with support as appropriate from the international organizations.

(13) Hazardous waste management should be regulated on the basis of "cradle to grave" control. Sources (producers) of hazardous waste should be registered, and all interim storage, transport, treatment and disposal facilities should be licensed. A manifest or trip-ticket system should be used to ensure that the waste arrives at its designated destination. The registration, licensing and manifest systems should be administered and monitored by a suitable public authority which, depending on the country, may be at a national, regional or local level.

(14) A licence for a waste storage, treatment or disposal facility must stipulate the right of legitimate access for the competent authority, and must allow it to carry out works necessary to remedy the effects of malpractice at the licence holder's cost if he cannot or will not take remedial action himself.

Training

(15) All personnel involved in hazardous waste management, including those at the policy, management, control and operational levels, should be suitably qualified and properly trained. Training programmes need to be developed, particularly in countries where hazardous waste management is still at an early stage.

Dissemination of information

(16) Public involvement in hazardous waste management activities should be encouraged, and education on this subject should be undertaken, which may require the preparation of material for public education.

(17) Reports and papers relating to the present discussions and to further work in the same field should be distributed to national ministries concerned with commerce and transportation, in addition to those concerned with the environment and health.

(18) Appropriate mechanisms should be developed by UNEP and WHO to enable them to provide support to any country requesting help in implementing the guidelines in order to institute a system of control for hazardous waste management.

Annex 1

MEMBERSHIP OF SUBGROUPS

Subgroup I on definitions
and health effects

Dr Dean (Rapporteur)
Mr Hatayama
Dr Kempa
Dr Liotchev
Dr Orhon
Dr Pleština
Dr Simmler
Dr Symon (Leader)

Subgroup II on waste
management technology

Dr Buekens (Rapporteur)
Dr Coleman
Dr Eigenmann
Mr Jager
Mr Mills
Mr Mooij
Dr Pojasek
Dr Subrahmanyam
Dr Tadmor (Leader)
Mr van Veen
Dr Wellings

Subgroup III on
waste transportation

Mr Betts (Leader)
Mr Cochrane (Rapporteur)
Mr Belle
Mr Lieben
Mr Mayhew
Mr Mazerolle
Dr Nay Htun
Mr Nels

Subgroup IV on planning,
administration and control

Mrs Appelberg
Mr Finnecy (Rapporteur)
Dr Schönfeld
Mr Snuverink
Mr Sveen
Mr Szelinski (Leader)
Mr Tacoronte
Dr Vassilopoulos
Mr Willox

Annex 2

LIST OF PARTICIPANTS

TEMPORARY ADVISERS

- Mrs M. Appelberg
Administrator, The National Swedish Environment Protection Board, Solna, Sweden
- Mr R. Aurola^a
Chief, Office of Environmental Hygiene, National Board of Health, Helsinki, Finland
- Mr M.P. Betts
Director, Environmental Resources Ltd, London, United Kingdom (Vice-Chairman)
- Dr A.G. Buekens
Professor, Department of Industrial Chemistry, Free University of Brussels, Belgium
- Mr C.A. Cochrane
Environmental Consultant, Villeneuve de Berg, France
- Dr A.K. Coleman
Managing Director, Re-Chem International Ltd, Southampton, United Kingdom
- Dr R.B. Dean
Environmental Consultant, Copenhagen, Denmark
- Dr G. Eigenmann
Central Function Technology Group, Ciba-Geigy Plant, Schweizerhalle, Switzerland
- Mr E.E. Finnecy
Head, Industrial Waste Information Bureau, Hazardous Materials Service, Harwell Laboratory,
Harwell, Oxford, United Kingdom
- Mr H.K. Hatayama
Waste Management Engineer, Hazardous Materials Management Section, Department of Health
Services, State of California, Berkeley, CA, USA
- Mr M. Helle
Chemist, State Pollution Control Authority, Oslo, Norway
- Mr J. Jager
Chemist, Institute of Environmental Protection Technology, Berlin Technical University,
Berlin (West)
- Dr E.S. Kempa
Professor, Institute of Environmental Protection Engineering, Technical University, Wroclaw,
Poland
- Mr J.P. Lehman
Director, Hazardous and Industrial Waste Division, Office of Solid Waste, US Environmental
Protection Agency, Washington, DC, USA (Chairman)
- Mr P. Lieben^a
Principal Administrator, Environment Directorate, Organisation for Economic Co-operation and
Development, Paris, France

^a Part-time participation only

- Dr I. Liotchev
Senior Scientist, Institute of Hygiene and Occupational Health, Sofia, Bulgaria
- Mr J.J. Mayhew
Manager, Solid Waste Programmes, Chemical Manufacturers Association, Washington, DC, USA
- Mr P. Mazerolle
Waste Management Branch, Environmental Protection, Environment Canada, Ottawa, Canada
- Mr D.A. Mills
Principal Chemist, Department of the Environment, London, United Kingdom
- Mr H. Mooij
President, Solid and Hazardous Waste Management Engineering, H. Mooij and Associates Ltd,
Kingston, Canada
- Mr C. Nels
Assistant Head, Waste Management Technology, Federal Environmental Agency, Berlin (West)
- Dr D. Orhon
Associate Professor, Environmental Engineering Division, Engineering and Architecture
Department, Technical University of Istanbul, Turkey
- Dr R. Pleština
Senior Research Associate and Associate Professor, Institute of Medical Research and
Occupational Health, Zagreb, Yugoslavia
- Dr R.B. Pojasek
Vice-President and Technical Director, Roy F. Weston, Inc., Woburn, MA, USA
- Dr A. Schönfeld
Carl Duisberg Gesellschaft (CDG), Berlin (West)
- Dr W.F. Simmler
Manager, Development and Information, Environmental Protection, Bayer AG, Leverkusen, Federal
Republic of Germany
- Mr A.M. Snuverink
Ministry of Public Health and Environmental Affairs, Leidschendam, Netherlands
- Dr P.V.R. Subrahmanyam
Assistant Director, National Environmental Engineering Research Institute (NEERI), Nagpur,
India
- Mr B. Sveen^a
Consultant, Section of Environmental Affairs, Federation of Norwegian Industries, Oslo, Norway
- Dr K. Symon
Professor and Head, Chair of General and Environmental Hygiene, Medical Faculty of Hygiene,
Prague, Czechoslovakia (Vice-Chairman)
- Mr B.A. Szelinski
Head, Legal Affairs of Waste and Water Management, Federal Environmental Agency, Berlin (West)
(Vice-Chairman)
- Mr E. Tacoronte
Division of Environmental Health, Ministry of Health and Social Security, Madrid, Spain
- Dr J. Tadmor
Professor, Soreq Nuclear Research Centre, Atomic Energy Commission, Yavne, Israel
(Vice-Chairman)
- Mr F. van Veen^b
Head, Department of Chemical Technology, Institute of Waste Disposal, Hoevelaken, Netherlands

^a Part-time participation only

^b At present with BV Infra Consult, Deventer, Netherlands

Dr M. Vassilopoulos
Chemical Engineer, Secretariat of the National Council for Physical Planning and the
Environment, Ministry of Coordination, Athens, Greece

Dr R.A. Wellings
Senior Chemist, Balfours Consulting Engineers, London, United Kingdom

Mr J. Willox
Research Worker, Free University of Brussels, Belgium

Dr D.C. Wilson
Head, Waste Research Unit, Harwell Laboratory, Harwell, Oxford, United Kingdom (Rapporteur)

SECRETARIAT

United Nations Environment Programme

Dr J.W. Huismans
Director, International Register of Potentially Toxic Chemicals (IRPTC), Geneva, Switzerland
(Co-Secretary)

Dr M. Nay Htun
Senior Programme Officer, Industry and Environment Office, Paris, France

World Health Organization

Dr M.J. Suess
Regional Officer for Environmental Hazards, Regional Office for Europe, Copenhagen, Denmark
(Co-Secretary)