DESIGNATION & CLASSIFICATION OF HAZARDOUS WASTES

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ABSTRACT

The background to the development of hazardous waste classification systems in Australia and overseas is provided as an introduction to an outline of current systems used in Australia. A description of the major international systems which need to be used for the export or import of hazardous wastes under the Basel Convention on Transfrontier Movement of Hazardous Wastes, and the OECD system are also provided. The current system used for non-liquid wastes in NSW is outlined.

1 BACKGROUND

1.1 Roles and Responsibilities of Various Organisations in the Management of Hazardous Waste in Australia

In addition to Regulatory bodies at the Commonwealth, State and Local Government levels, there have been a series of ad-hoc taskforces formed through-out the 1980's to the current day, to address specific issues related to hazardous waste. The issues associated with intractable waste (a sub-set of hazardous waste) have received particular attention. A series of reports have been produced and are referred to through - out this paper. These reports on hazardous waste management have influenced the design of hazardous waste classification systems, which has been an evolving process and which is still currently being reviewed. The roles of these groups are outlined below in the hope that confusion between them will be minimised. Readers should use the current version of hazardous waste classification systems, but will need to be aware of the previous versions when reading hazardous waste reports prepared over the past 15 years.

Following the recommendation in the 1983 AEC report (Maunsell, 1983) on the Management and Disposal of Hazardous Industrial Waste in Australia, in which a major recommendation was to establish a high temperature incinerator, a number of State government organisations and one private company attempted to establish a National High Temperature Incinerator. All these individual attempts failed, and in 1987 the first of a series of joint inter-governmental taskforces were formed. In chronological order of formation these were :

- September 1987 : Joint Taskforce on Intractable Waste (often shortened to "Joint Taskforce"), composed of four independent members and reporting to the Ministers for the Environment in Victoria, NSW and the Commonwealth. It produced three major reports, with the Phase 3 report being published in September 1990.
- January 1991 : Independent Panel on Intractable Waste (shortened to "Independent Panel"), composed of a separate four independent members, again reporting to the governments of

Victoria, NSW and the Commonwealth. Their brief was to review the recommendations of the Joint Taskforce and to oversee the EIS for a preferred management method for intractable waste. Their final report was submitted in November 1992. The recommendations in this report were essentially to stockpile intractable wastes (henceforth to be called "Scheduled Wastes") until alternative , non - incineration, treatment technologies could be demonstrated to be effective.

- December 1992 : The Scheduled Wastes Working Group (SWWG) was formed to co-ordinate and oversee the implementation of the Independent Panel's recommendations. This Group is composed of EPA representatives from NSW, Victoria and the Commonwealth, and representatives from trade union and community based organisations. It is currently active and is continuing to develop management plans for each of the scheduled wastes.

These organisations will be referred to by their abbreviated names through - out this paper.

1.2 What Are Hazardous Wastes?

Concern over the management of hazardous wastes first arose in the 1970's when it was discovered that drinking water supplies drawn from unconfined aquifers, largely in North America, were being contaminated by uncontrolled dumping of industrial wastes in landfills and impoundments. How was this situation allowed to develop?

Increasingly stringent air and surface water discharge standards developed in the 1960's led to the introduction of improved air pollution and water pollution control technology in industry. These treatment plants removed contaminants from emissions to the atmosphere and surface waters (either via the sewerage system or directly) and concentrated them in sludges and dusts. These residues were then dumped in solid waste landfills or surface impoundments, either on the site of the generator or, more often, at offsite facilities. These facilities had little control on the nature of residues being accepted and provided little security against leakage to groundwaters. As a result, leachate from these facilities migrated to groundwater and eventually appeared in wells extracting water for town supplies.

Two responses occurred as a result of the discovery of the environmental impacts of the uncontrolled disposal of industrial wastes:

- Programs to clean up contamination from past activities, such as the Superfund (CERCLA) program in the USA.

- Development of comprehensive systems to properly manage industrial wastes so that the ongoing generation of wastes would not continue to degrade environments, particularly groundwaters (eg RCRA legislation in the USA).

This paper is primarily concerned with the development of classification systems for the ongoing generation of hazardous waste and the development of comprehensive management systems. However, there are overlaps with contaminated site remediation and these will be briefly discussed. Contaminated site remediation has developed into a field in its own right, because of the often complex mixtures of contaminants that arose from the uncontrolled disposal of wastes.

1.3 Approaches to Defining Hazardous Wastes

Fundamental to the management of hazardous waste is the need for an adequate definition to provide bounds to the problem. The task of providing an adequate definition is not straight forward because of *"the tremendous scope of adverse human and environmental effects which may be caused by an almost boundless list of environmental contaminants. Against this background, almost any definition will seem simplistic and inadequate"* (Hrudey, 1985).

However, little can be achieved until a workable definition is agreed to.

Currently (1997), there are significant changes occurring in the administration of environmental controls in a number of States and at the Federal level. This includes extending the geographic extent of control over hazardous waste and the revision (or design of) hazardous waste regulations. A thorough appreciation of the background to current classification systems and a critical review of them is essential for the design of

new and more comprehensive systems. These new systems are currently being develped and it hoped that this paper will provide a constructive input to their develpment.

With this in mind, this paper aims to:

- provide an understanding of the constraints on the design of designation and classification systems and to explain how current systems have evolved.
- provide the background and a framework on which future more rational classification systems can be based.
- describe current systems and possible future changes to these systems.

2 DESIGNATION AND CLASSIFICATION OF HAZARDOUS WASTE

In this paper, “designation” of a waste as a hazardous waste refers to the regulatory procedure that legally determines that a particular waste is caught in the hazardous waste control system for a particular region; it is normally written in Regulations under an Act controlling the management of wastes. “Classification” of hazardous wastes is the system that facilitates the monitoring of wastes after they have been caught in the hazardous waste control system by the designation procedure. The approaches to designation and classification systems are reviewed in the following section before this distinction is revisited in more detail. (Wynne, 1987).

Three approaches, and sometimes a mixture of these approaches, have been used in the development of designation and classification systems, namely:

- generalised definitions
- exclusionary definitions
- inclusionary definitions.

The application of these approaches to designation and classification systems are explained in this section.

2.1 Hazardous Waste Designation Systems

2.1.1 Generalised Definitions

Generalised definitions are often provided in legislation and guidelines on hazardous waste management. They are important in providing a succinct description of the scope of the legislation/guidelines, but have limited immediate usefulness for the administration of hazardous waste systems or the conduct of research and development. They must be interpreted in order to build up a workable list of wastes which are hazardous, as will be shown in later sections of this paper. General definitions of interest to waste managers in NSW are ;

"A hazardous waste is thus defined as any waste, excluding domestic and radioactive waste which, because of its quantity, physical, chemical or infectious characteristics, can cause significant hazards to human health or the environment when improperly treated, stored, transported or disposed" (WHO, 1987).

"Hazardous waste means any waste other than radioactive waste considered as hazardous or legally defined as hazardous in the country where it is situated or through which it is conveyed, because of the potential risk to man or the environment likely to result from an accident or from improper transport or disposal." (OECD, 1990)

“*Hazardous wastes ..(are)..(a) wastes that belong to any category contained in Annex 1, unless they do not possess any of the characteristics contained in Annex III*”.(Basel Convention, 1992)

"*Hazardous waste : Any waste that is classified or assessed as hazardous in accordance with Section 3 or Technical Appendix 1 of these guidelines ..(in general)..this waste contains contaminants listed under (iii) above (ie ..the release of liquids (leachates) containing chemical contaminants such as heavy metals and human made chemicals, that if allowed to contaminate soil, groundwater or surface waters may result in undesirable effects on the health of humans, animals, plants or other living organisms) at levels high enough to require treatment to render them safe before disposal*." (NSW EPA, 1997)

From these examples, it can be seen that generalised definitions of hazardous waste consist of one or more of the following components:

Hazardous waste is a waste, which:

- may adversely affect human health
- may adversely affect other living organisms
- may damage property.

All these definitions require a definition for waste. This is sometimes not well defined in legislation, and definitions encountered in the above hazardous waste definitions are :

> "*Wastes are substances or objects which are disposed of or are proposed to be disposed of or are required to be disposed of by the provisions of national law."* (Hazardous Waste Act)
>
> "*waste includes:*
> *(a) any substance (whether solid, liquid or gaseous) that is discharged, emitted or deposited in the environment in such volume, constituency or manner as to cause an alteration in the environment, or*
> *(b) any discarded, rejected, unwanted, surplus or abandoned substance, or*
> *(c) any otherwise discarded, rejected, unwanted, surplus or abandoned substance intended for sale or for recycling, reprocessing, recovery or purification by a separate operation from that which produced the substance, or*
> *(d) any substance prescribed by the regulations to be waste for the purposes of the Act.*
> *A substance is not precluded from being waste for the purposes of this Act merely because it can be reprocessed, re-used or recycled*. " (NSW Waste Minimisation and Management Act, 1995)

A short- hand description of waste by the author is that waste is a material which has negative value for the current owner, ie it currently costs the owner to manage the material at this time in its current location (this does not preclude the material having value to someone else at another location and/or at a future time - these are important issues for the management of the material which are beyond the scope of this paper).

2.1.2 Exclusionary Definitions

In general terms, hazardous wastes can be defined on an exclusionary basis i.e. they are wastes which are excluded from being disposed of to conventional waste management systems of:

- Municipal solid waste landfills,
- Sewerage systems.
- Natural environmental systems (air, land water)

These conventional systems often have discharge acceptance criteria (trade waste discharge criteria for sewers, lists of excluded wastes for municipal solid waste landfills, clean waters regulations etc) and hence any wastes which are not allowed to be disposed by these routes become, by this definition, hazardous wastes. In some countries (Canada, U.K.), these wastes are known as 'Special Wastes', which avoids the problem of whether they are actually hazardous or not.

While the exclusionary basis is logically comprehensive, it is a difficult means for Regulators to employ in controlling the generation and fate of hazardous wastes. While this exclusionary definition was used in the U.K. for a time, it is not now generally used in practice. It remains, however, a useful concept to aid in the appreciation of where hazardous wastes fit in the overall picture of waste management. Until the liquid waste environmental guidelines are completed in NSW, it is a method which could be used in Sydney for designating hazardous liquid wastes.

2.1.3 Inclusionary Definitions or Designation

Inclusionary definitions seek to define hazardous wastes by providing criteria or an inclusionary list which, if wastes satisfy these, designates them as hazardous wastes. There are three types of inclusionary definitions:

- Generic definitions
- Constituent definitions
- Characteristic's definitions

Most Regulatory agencies in Australia use a combination of the first two, the US EPA (CFR40, 1990) and the Basel Convention (UNEP, 1989) use a combination of all three. The draft proposal for designation of non-BAT wastes in N.S.W. used a combination of all three along the lines of the Basel Convention (Joint Taskforce on Intractable Wastes, Phase 3 report).

Generic definitions are based on a description of the process from which the waste arises. For instance, sludge from the bottom of oil storage tanks, and distillation bottoms from solvent recovery plants.

Constituent definitions designate wastes as hazardous if they contain measurable concentrations of certain hazardous compounds. For instance, wastes which contain arsenic, or chlorinated solvents, or lead. In Australia the concentration or mass load of a constituent is sometimes not employed in the definition - whether or not the concentration of a constituent is of concern is left to the judgement of the Regulator. North American and European practice is to include the concentration and mass of the constituent that makes the waste hazardous. The inclusion of concentrations (and sometimes mass of constituents) is now being employed in the N.S.W. Chemical Control Orders for chemical wastes, the definition of Scheduled (formerly intractable) Waste, and the Environmental Guideline : Assessment, classification and management of non-liquid wastes (NSW EPA, 1997).

Wastes can also be designated as hazardous if they exhibit one or more of the following **hazardous characteristics:**

- Toxicity
- Flammability
- Reactivity
- Corrosivity.

The tests for determining each of these characteristics are not yet fully developed. Tests for toxicity characteristics are subject to the greatest debate (Francis et al, 1989). The test gaining acceptance in Australia is the US EPA Toxicity Characteristic Leaching Procedure (TCLP), which, in Australia, designates a waste as hazardous if the leachate from the waste has concentrations of toxic constituents greater than Maximum Allowable Concentrations. Standards Australia has modified this test for an Australian Standard which is likely to become a component of a number of Australian regulations defining hazardous waste. The NSW EPA (1997) uses the US EPA standard, while the Hazardous Waste Act is developing guidelines which are likely to use the Australian Standard.

While most inclusionary definitions are simple lists with a combination of the above three approaches, the latest definitions developed for the Hazardous Waste Act (Basel Convention) follow a more rigorous rationale; namely:

Hazardous wastes are wastes that belong to any category contained in Annex 1 (a generic and constituent list), unless they do not possess any of the characteristics contained in Annex III (a characteristics list).

This designation allows the generators to *de-List* their wastes by demonstrating that they do not exhibit, according to standard agreed tests, any hazardous characteristics. Dilution of constituents to achieve this state is not allowed. However, there are practical difficulties associated with the non-availability of tests for some characteristics such as ecotoxicity, which would mean that few generators would attempt to de-List their wastes.

the NSW EPA non-liquid waste guidelines(1997) use a constituent approach for designation, but retain the mixture of approaches currently contained in the ANZECC classification system (1994).

2.2 Hazardous Waste Classification Systems

The discussion above has outlined how hazardous wastes are defined or designated, i.e. a means whereby the wastes so identified can legally be required to be controlled by the hazardous waste management system. A separate concept is that of classification systems which are used to categorise hazardous wastes to facilitate data collection and their management. Classification systems are sometimes coarser than designations and are often easier to apply in practice, and sometimes contain additional useful information not required for the legal purposes of the designation system. However they can also be derived from, or incorporate, the designation lists and criteria.

In summary, designation methods determine whether or not a waste is hazardous; once it is determined to be hazardous, the hazardous waste classification system tends to be used to identify the waste, collect statistics on its occurrence, provide additional information on the waste's characteristics to assist in its management, and to track its movement.

A classification system was developed by the Australian Environment Council in 1986 (now the Australian and New Zealand Environment and Conservation Council, ANZECC). ANZECC has prepared a revised system (ANZECC, 1994) which is used in the National Waste Manifest system which is used for inter - state movement of hazardous wastes. This waste type classification system is provided in Appendix III. This classification system is also used within NSW and SA. A further revision to this classification system is being prepared by the NEPC, and it is planned to release the work in late 1997.
Brisbane and Western Australia have simplified versions which can be converted to the ANZEC system if required.

3 NSW HAZARDOUS NON-LIQUID WASTES

Guidelines for liquid hazardous wastes are currently being developed. In simple terms, liquid wastes are not allowed to be disposed to landfill, and if they are not allowed to be disposed to waterways or the sewer under Clean Waters Act (also currently being reviewed by the Protection of the Environment (Operations) Act) and Trade Waste Discharge regulations, then the liquid waste should be considered a hazardous waste. It should be transported by licensed transporters to licensed off-site treatment and disposal facilities.

Non-liquid wastes are classified in the Environment Guidelines: Assessment, Classification and Management of Non-Liquid Wastes (NSW EPA, 1997) as :

- Inert waste - this waste type is the least likely to undergo environmentally significant transformations and, therefore, should not release significant quantities of greenhouse gases or leachates contaminated with nutrients an/or chemicals.
- solid waste - this waste type can include putrescible waste, is likely to release higher quantities of the contaminants listed under (iii) above (chemical contaminants which may have adverse effects on organism health) than inert waste and consequently needs to be managed with greater care.
- industrial waste ; this waste type may contain somewhat higher (four times) levels of the contaminants listed under (iii) above than solid waste and needs o be managed with more stringent environmental controls than solid waste.
- hazardous waste - this waste type contains contaminants listed under (iii) above at levels high enough to require treatment to render them safe before disposal.

Some wastes have been assessed and listed as particular classes, as follows (refer Appendix III) :

- Table 1 : Waste that is classified in the Regulations as inert or solid, eg ashpalt waste is calssified as inert.
- Table 2 : Waste types that are classified in the Regulations as industrial or hazardous; eg special clinical waste (infectious etc.) is hazardous waste, radioactive substances listed in the Radiation Control Regulation 1993 is hazardous
- Table 3 : Waste for which the immobilisation of specific contaminants has been achieved; eg CCA treated timber, creosote treated timber, cattle dip contaminated soil.

These tables should be checked before applying the assessment method described below.

In general :

- waste classified as inert waste using the assessment procedure must also satisfy the criteria of not capable of environmentally significant physical, chemical or biological transformation;
- the person carrying out the assessment must decide which of the chemical contaminants in the lists are in the waste, and then assess these against the criteria provided;
- should the waste contain potentially toxic and/or ecotoxic contaminants not listed in Tables A2 and A3, the person carrying out the assessment must request the EPA to provide assessment criteria for these contaminants and the assess the waste against these criteria as well.
- Dilution without achieving immobilisation of contaminants is not an acceptable waste treatment option.
- Contaminant threshold (CT) values have been used in Table A2. These “were calculated from the corresponding leachable concentration (TCLP) values by multiplying then by 20. This is because for every gram of waste subjected to extraction in the TCLP test, 20 millilitres of leachant is used. This means that if 20mg/kg of a contaminant is present in the waste and is completely leached out in the test, the TCLP test result will be 1mg/L. Thus if the total concentration for a contaminant is less than or equal to a particular contaminant threshold (CT1, CT2, CT3) limiting value, then it is certain that if the leachable concentration value were to be determined for that contaminant, it could only be less than or equal to the corresponding leachable concentration (TCLP1, TCLP2, TCLP3) limiting value “

Table 4 in Appendix III provides the rules for classifying a waste into one of the four classes. Values for Contaminant Threshold (CT) values are provided in Table A2, and limiting values for Specific Contaminant Concentration and TCLP are provided in Table A3. It is normal to try to classify the waste in the least hazardous class. If the criteria for inert and solid waste are failed; then the criteria for industrial waste are :

- If the Specific Contaminant Concentration (SCC) <or = CT3, then the waste can be classified as industrial, and the TCLP test is not required (ie from the above explanation, it will not have a TCLP > TLCP3 (which could put it into the hazardous waste class) and it will not have a SCC > SCC3 as SCC3 is always > CT3).
- If the TCLP2<TCLP test value<TCLP3 and SCC2<SCC test values<SCC3.
- If TCLP2<TCLP test values<TCLP3 and SCC test values > SCC3 and Immobilisation is EPA approved.

The criteria for hazardous waste are :

- TCLP test values > TCLP3
- TCLP test values <TCLP3 and SCC test values >SCC3 and immobilisation is not EPA approved.

A number of examples are provided in the appendices to the EPA Guidelines. Issues dealing with appropriate disposal are not covered in this paper. After being designated as either an industrial waste or a hazardous waste, manifest documents (now the responsibility of generators, transporters and treatment/disposal facilities) must use the Waste Type table developed by ANZECC for classification, as shown in Appendix III.

4 THE HAZARDOUS WASTE ACT / BASEL CONVENTION

Australia is a signatory to the Basel Convention on Transfrontier movement of Hazardous Wastes and must use the Basel Convention classification system on documentation associated with the import and export of hazardous wastes from Australia. The Hazardous Waste Act was amended in November 1996 and fully

implements the Convention in Australia. Agreements between countries are allowed under the Convention and the OECD has made a Decision controlling transfer of wastes between OECD countries. Here, Environmentally Sound Management is accepted as being complied with, because member countries need to satisfy some entry “rules” in this regard in order to be accepted to the OECD.

4.1 Hazardous Waste Designation

The Hazardous Waste Act / Basel Convention designation of hazardous waste, for the purpose of defining those wastes subject to the Convention, is provided in Article 1 of the Convention :

> *1. The following wastes that are subject to transboundary movements shall be "hazardous wastes" for the purposes of this Convention :*
>
> *(a) Wastes that belong to any category contained in Annex I, unless they do not possess any of the characteristics contained in Annex III; and*
>
> *(b) Wastes that are not covered under paragraph (a) but are defined as, or are considered to be, hazardous wastes by the domestic legislation of the Party of export, import or transit.*

Annex I and Annex III are provided in Appendix I. Annex I is made up of two parts :

- "Waste streams" which largely follow the generic approach described above, and
- "Wastes having as constituents" which follows the constituent approach described above.

Annex III is a list of hazardous characteristics, the third approach described Section 2.1.3.

4.2 Hazardous Waste Classification

The Basel Convention requires the completion of two forms that are similar in intent to the conventional waste manifest four docket system, and requires waste classification information to be provided in those forms, namely :

- Information to be Provided on Notification :
  - "Y" number (part of the designation system from Annex I, refer Appendix I)
  - Physical description (liquid, sludge, solid)
  - UN Number (the UN code number for waste dangerous goods, per List 2 of the 1986 AEC Guidelines)
  - Composition (nature, eg toxicity, and concentration of the most hazardous components)
  - "H" Code number from Annex III, refer Appendix I
  - Method of disposal, per Annex IV, refer Appendix I

  This information is essentially a six field classification system.

- Information to be Provided on the Movement Document :
  - "Y" number from Annex I
  - Physical state of the waste
  - UN Number
  - "H" Code number from Annex III

  ie a four field classification system which is a derivative of the classification system used for the Notification document.

It can be seen that the Basel Convention classification system (even though it is not explicitly described as such) has used most of the designation system, and added fields to it, to provide more information about the waste in a convenient form that facilitates the management of the waste, particularly in the case of a spill.

4.3 Guidelines under the Hazardous Waste Act

The Minister for the Environment, Senator Hill, makes decisions on the issuing of permits for the import and export of hazardous waste. The Hazardous Waste Act is seen to require clarification on the meaning of waste, of what makes a waste hazardous and what is meant be environmentally sound management. The Minister is advised by a Technical Group, which is supported by the Hazardous Waste Unit in Environment Australia on these issues. The Minister's decisions may be appealed by any party in an Administrative Appeals Tribunal. The remainder of this section covers the work undertaken by the Technical Group and the Hazardous Waste Unit on these three issues, and is drawn from a more detailed paper by Moore and Thompson (1997). The publicly available versions of these Guidelines may be obtained from the Hazardous Waste Unit in Environment Australia.

4.3.1 Waste/non-Waste

A stepwise set of questions has been developed, and in general all questions need to be answered before a recommendation can be made. The questions come in two groups, a diagnostic set with yes/no type responses leading directly to a determination; and a second indicative set which provide a general understanding of the issues involved. The Convention's meaning of disposal (ie disposal and recovery) is used, and the OECD "Q List" of reasons explaining why a material is being sent for to a disposal operation is considered. A series of examples illustrating how the questions might be answered in Australian based case studies aids in clarifying the questions. The allowance for importing Parties to define a material as a hazardous waste is recognised as having an over-riding influence on the determination.

Diagnostic questions consist of :

- Are the materials proposed for disposal as listed in Annex IV, Table A ? If yes, then the material is a waste, but not necessarily a hazardous waste.
- Are the materials proposed for recycling/recovery, as listed in Annex IV Table B ?If yes, then the material is a waste, but not necessarily a hazardous waste. A difficult question that arises is whether the proposed process to which the material is going is a recovery operation or a "normal" processing plant for raw materials. The nature of the unit operations is often little different between the two, and reference to the "OECD Q List" may be necessary to clarify the distinction.

Indicator questions consist of :

- Is the overall economic value of the material negative ? Negative economic valued materials are usually currently wastes, but positive economic value does not necessarily mean the material is a non-waste. Cross-subsidies are possible, but are difficult to delineate.
- What is the origin and nature of the material ? This consists of a series of questions aimed at identifying how closely the material might resemble an intentionally produced material required by the market :
    - Is the material produced intentionally?
    - Is the production of the material subject to quality control?
    - Does the material meet will developed nationally and internationally recognised specifications/standards ?
    - Do these standards include environmental considerations, in addition to technical or economic considerations ?
    - Is the material made in response to market demand ?
    - Is the material no longer part of a normal commercial cycle or chain of utility ?
- Is a recovery operation necessary ? this consists of four questions which consider whether the material can be used an a normal economic input to processes or uses, or whether some form of recovery operation is required in order to convert the material into a directly useful material :
- Is the material still suited to its originally intended use ? Here the materials or goods are continuing to be lawfully used, and would not be considered wastes. Used cars and computers exported to another country for use as cars and computers would be included here.
- Is the material to have a direct re-use or alternative use ? This question asks if the material can be used in an alternative way, or can be used as an input to a process with similar environmental outcomes as using the normal raw material.

If a material is considered to be a waste, then it will only cease being a waste after it has been transformed to another material by some of the activities listed in the indicative questions, ie the transformed material can be used without further recovery processing, and can be used in the same way as a material which has not been defined as a waste.

4.3.2 Hazard Assessment of Wastes

If a material has been determined to be a waste will be a hazardous waste if it belongs to any category contained in Annex I, unless it does not possess any of he characteristics contained in Annex III of the Convention. Guidelines on hazard assessment of wastes has been undertaken for a materials that are being traded by Australia, and which may be Basel hazardous wastes, including :

- Y31 lead and lead compounds
- Y23 Zinc compounds
- Y22 Copper compounds
- Nickel compounds (not listed in Annex I, but may be regarded as a hazardous waste under Australian regulations).

Three lists have been determined by the CoP to list specific materials which :

- List A : are definitely a hazardous waste, eg zinc ash containing concentrations of lead and cadmium causing Annex III hazards;
- List B : are definitely not a hazardous waste, eg zinc dross in metallic form;
- List C : are still being considered, and have not yet been assigned to List A or B.

These lists should first be checked to see if the hazard assessment has already been provided. Then, the physical form needs to be considered - is the material in dispersive (more hazardous) or massive form ? A preliminary size of 10mm has been chosen to separate materials into these two groups. The hazard characteristics in Annex III then need to be considered as outlined below:

Group A : Human health hazards, H6.1, H6.2, H11, with the following questions being used to assess whether the hazard exists :

- Is the substance hazardous to human health according to the Transport of Dangerous Goods Code ?
- What is the concentration cut-off levels for the substance using the technical criteria outlined in the National Occupational Health and Safety Commission (NOHSC) list of designated hazardous substances ?
- Are there any reasons for classifying the waste as H6.2 infectious ?
- Are there any toxic delayed or chronic effects of the waste ?

Group B : Other hazardous properties :

- Does the material fall into hazardous categories H1, H3, H4, H5, H8 or Dangerous Goods Class 9 ?
- Can Maximum Acceptable Concentrations be established for these characteristics ?
- Does the waste contain explosive devices ?

Group C : Category H10, H12, H13 ;

- Is the waste, by interaction with air or water, liable to give off toxic gasses in dangerous quantities ?
- Does the waste contain substances listed in the Australian Water Quality Guidelines for a range of beneficial water uses, or does it exhibit any of the risk phrases R50 - R59 (ecotoxic) in the NOHSC list?
- Are there other toxic effects on organisms ?
- Outline any ways by which the waste could be construed as hazardous after disposal.
- What are the environmental and health risks of various physical forms of the substance ?
- In establishing concentration cut-off levels for the waste, is there a combination of mixtures in the waste which, collectively, exceed concentration cut-off levels ?
- What are the concentration cut-off levels in other countries ?

For example, for zinc compounds, is the waste from a process such as hot dip galvanising, in a dispersible form, and does it have high lead or cadmium levels so that it exhibits hazardous characteristics ? If yes, then it is a hazardous waste.

4.3 Environmentally Sound Management

The Guidelines for Environmentally Sound Management are still being developed. Considerations will include :

- the nature of the waste from an environmental and economic viewpoint;
- details of the recovery process, including the capacity of the facility, the details of the process and means to avoid pollution;
- the details of the nature and management of wastes and residues from the recovery process;
- the details of transport and storage of the waste;
- a history of any accidents and environmental problems at the recovery facility;
- Information on the regulatory framework controlling the operation of the recovery facility, and
- Information on any environmental management systems prepared for the facility, or results of audits undertaken on the facility's EMS.

5 OECD ENVIRONMENT MONOGRAPH No 34

As noted above, this is an agreement among OECD countries which is in accordance with the provisions in the Basel Convention.

5.1 Hazardous Waste Designation

For the purposes of the OECD Decision on Transfrontier Movement of Hazardous Waste, wastes are designated as hazardous wastes if they appear in a Core List or are defined as such by member country legislation, namely :

> *For the purposes of this Decision* (Decision on transfrontier movements of hazardous waste, C(88) 90 (final)) *those wastes which belong to any of the categories described in Table Y shall be controlled unless such wastes do not possess any of the hazardous characteristics listed in Table 5*; and
>
> *all other wastes which are considered to be or are legally defined as hazardous wastes in the Member country from which these wastes are exported or in the Member country into which these wastes are imported.*

The Core List, or Table Y is provided in Appendix II and can be seen to be very similar to , but not exactly the same as, Annex I from the Basel Convention. Table 5 in the OECD monograph is similar to Annex III in the Basel Convention, and is provided in Appendix I.

5.2 Hazardous Waste Classification

The OECD Decision is explicit in providing a separate complete characterisation of hazardous wastes to assist in their management after the waste has been caught within the controls of the Decision. The International Waste Identification Code (IWIC) consists of :

- *Table 1* : One or two descriptors from the table of "reasons why materials are intended for disposal" - this is a very general generic type approach to classifying waste. Refer Appendix II.
- *Table 2* : One descriptor from the table of disposal and recycling operations. Details of the location of the disposal facility would be provided on transport documents, the main use of this field in the classification system would be in extracting information from a database on the fate of different types of hazardous wastes, and to track trends over time. Refer Appendix II.
- *Table 3* : One descriptor from the list of generic types of hazardous wastes, with a prefix of L (liquid), P (sludge) or S (solid). The first 17 of these are the same as Table "Y" used in the

designation and for the Basel Convention; the remaining 23 are additional generic waste descriptors that are suggested for use provided they also contain constituents of concern as listed in Table 4 of the OECD monograph. Refer Appendix II.

- *Table 4* : Zero to three hazardous constituents in order of decreasing concern. This list is more extensive than the Basel Convention. Refer Appendix II.
- *Table 5* : One or two descriptors of hazard characteristics from this table, which is similar to Annex III from the Basel Convention. *Table 5* is also used in the designation of hazardous wastes. Refer Appendix II.
- *Table 6* : One of the activities generating the waste should be selected from this table of Standard Industry Codes. Refer Appendix II.

The IWIC can be conveniently expressed in a single line with double oblique line field separators :

Q----+----//D,R----//L,P,S----//C----+----+----//H----+----//A----

This provides a very comprehensive characterisation of the waste and facilitates monitoring and management of the waste once it is designated as a hazardous waste under the Decision. It can be seen that the designation system is incorporated into the classification system.

6 FUTURE DEVELPMENTS

6.1 Revised NEPC Classification System

The National Environment Protection Council is currently reviewing the ANZECC waste type classification system for interstate manifest records. This will be based on the ANZECC system and is likely to be released in late 1997. Copies of drafts and the final version are available from the NEPC office in Adelaide at

NEPC Service Corporation
Level 5, 81 Flinders St
ADELAIDE SA 5000

Tel: (08) 8419 1202
Fax: (08) 8224 0912
e-mail: mmertin@nepc.gov.au

6.2 Australian Waste Database

6.2.1 Aim and Objectives

The aim of the project is to establish a database on waste generation in Australia which can be used by State and Commonwealth environmental and waste management agencies, and other interested organisations to set and monitor the achievement of national waste minimisation targets.

To achieve this aim, the following objectives were met:

(a) Review and establish nationally agreed classification systems for various groups.
(b) Establish a protocol for sampling and characterising urban solid wastes.
(c) Establish a national waste generation database to provide fundamental information on the generation of different types of waste by region and in relation to relevant parameters.

The Database covers both solid waste (non-hazardous waste arising from municipal, commercial, industrial, building and demolition activities) and hazardous waste (generally liquid industrial wastes which are precluded from disposal to the sewerage system) disposed to off-site treatment and disposal facilities. Details of the solid waste component are provided in a recent paper by Moore et al (1997). Database activities related to the hazardous waste field are described in the remainder of this section.

6.2.2 Hazardous Waste Component of the Australian Waste Database

Hazardous wastes for the purpose of the National Waste Database are those wastes which are not allowed to be disposed of to the sewer or to municipal solid waste landfills, and if the generator has no means or treating and disposing of them on-site, they must be tankered to an off-site treatment plant. Most of the major metropolitan areas in Australia have established manifest systems which track and record the transport of these hazardous wastes from the generator to the treatment plant, and in so doing build up a database of information on their generation; these will gradually be extended nation wide.

The Australian Waste Database project, in the hazardous waste field, has collected data from Perth, Adelaide, Victoria and Sydney, generally for the period 1990 to 1996. Reports have been produced on waste type generation, waste types generated by different industry groups, and waste types produced by emplyee in different manufacturing industries. These standard reports are available on the Internet at :

http://www.erin.gov.au/portfolio/epg/env_sust.html

under Waste Minimisation, then under Australian Waste Database.

More detailed reports by particular waste type or industry group are available from the RDMS. Requests should be made to the author of this paper after viewing the standard reports available.

6.2.3 Linkages to Other Databases

The hazardous waste database will be a sub-set of the proposed National Pollutant Inventory (NPI), which will attempt to record all emissions from facilities in a similar manner to the US EPA Toxics Release Inventory. NPI data will have to be aggregated by region to enable it to be complementary with data from the National Waste Database. This will be easily achieved as the NPI will know either the exact location of the facility (from a GIS) or at least its postcode.

An important link to the extensive ABS database is via the ASIC code. This will enable relationships between waste generation and a range of standard economic and demographic statistics to be investigated.

Links to waste data from other countries is provided by a series of hot links in the Australian Waste Database web site.

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The Technical Group for the Hazardous Waste Act and the Hazardous Waste Unit of Environment Australia developed the guidelines supporting the Hazardous Waste Act; their permission to describe the currently draft documents developed is appreciated. Current publicly available documents should be obtained from the Hazardous Waste Unit.

Abbreviations

AEC	Australian Environment Council
ABS	Australian Bureau of Statistics
ANZECC	Australian & New Zealand Environment & Conservation Council
ASIC	Australian Standard Industrial Classification
CEPA	Commonwealth EPA
CRCWMPC	Cooperative Research Centre for Waste Management & Pollution Control
ESD	Ecologically Sustainable Development
EQI	Environmental Quality Index
GIS	Geographic Information System
IGAE	Intergovernmental Agreement on the Environmental
NPI	National Pollutant Inventory
UNCED	United Nations Conference on Environment & Development

References & Bibliography

AEC; National Guidelines for the Management of Hazardous Waste, November 1986.

ANZECC; National Manifest System, 1994.

Francis, C.W.; Maskarinec, M.P.; Lee, D.W.; Physical and Chemical Methods for the Characterisation of Hazardous Wastes; in the Landfill, Reactor and Final Storage, Springe Verlag, Berlin, 1989.

Moore, S.J.; Worrall, M.J.; Waste Management Plans for Major Industries, in Waste Technology and Management, DITAC, 1991.

Moore, S.J.; et al; The Australian Waste Database : A tool for improving regional solid and hazardous waste management, Pollution Control 97, Bangkok, Nov 1997.

Moore, S.J., Tu, S-Y; Unit Production Indices of Hazardous Waste Generation for Measuring Environmental Performance, Munro Center for Civil & Environmental Engineering, University of NSW, Seminar, 14 July 1993.

Moore SJ and Thompson G, 1997; Implementing the Basel Convention on Transfrontier Movement of Hazardous wastes ; Australian Experience; Pollution Control 97, Bangkok, November 1997.

NSW EPA, Waste Minimisation and Management Act.

NSW EPA, 1997; Environmental Guidelines : Assessment, Classification and Management of Non-Liquid Wastes.

UNEP; Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, Final Act, 1989.

US EPA; 40 CFR Part 148 et al, Land Disposal Restrictions for Third Scheduled Wastes, June 1990.

US EPA, 1992; Test Methods for evaluating solid waste, physical/chemical methods, SW-846, 1986 and updates I & II.

APPENDIX I

Basel Convention on Transfrontier Movement of Hazardous Wastes Extracts

APPENDIX II

OECD Decision on Transfrontier Movement of Hazardous Wastes Extracts

APPENDIX III

Extracts from NSW EPA Guidelines : Assessment, Classification and Management of Non-Liquid wastes
Tables 1,2,3,4,A2,A3, ANZECC Waste Type Classification