6

Transboundary transfers of hazardous and radioactive wastes

Andrew Blowers

6.1 The creation of the problem

At the end of the 1980s a number of incidents drew international attention to the problem of the transportation, management and disposal of hazardous and radioactive wastes. I shall begin with a discussion of three notorious examples of the problem. These examples primarily serve the purpose of identifying some of the issues that arise from the deliberate (legal or illegal) physical international transfers of hazardous and radioactive wastes. They provide an empirical background to the analysis that follows.

Case 1 The Khian Sea

In August 1986 the *Khian Sea,* which came to be called the 'leper of the oceans', left Philadelphia laden with 15,000 tonnes of municipal incinerator ash. Its voyage resembled that of the Flying Dutchman doomed to range the seas in search of a haven to land its cargo. Its various stops included Fort Lauderdale (Florida, USA) Puerto Rico, the Antilles, the Dominican Republic, Jamaica, Panama and the Cayman Islands before it dumped 2000 tonnes on the shore in Haiti in January 1988. The description of the cargo had changed during the voyage from non-hazardous ash to 'general cargo' to 'bulk construction material' and finally to 'top soil ash fertiliser'. This created a strong reaction and led to studies recommending the removal of the dumped material (Hilz, 1992, p. 26). It appears that subsequently the *Khian Sea* wandered the oceans, changed its name twice and dumped the remainder of its cargo presumably in the ocean and eventually arrived off Singapore, unladen and with a new name (*Pelicano)* in November 1988.

This case raises three issues. One is the failure to describe the wastes as hazardous though they may contain hazardous materials. Second is the unclear and false descriptions of the cargo that were given at different times. And third is the problem of ultimately preventing such cargoes from being dumped either on land or at sea. These issues of *falsification* and *dumping* are also clear in the second case.

Case 2 Toxic wastes to Koko, Nigeria

Between 1987 and 1988 shipments amounting to about 4000 tonnes of mixed chemical wastes, including about 150 tonnes of highly toxic PCBs, had been exported to Nigeria from Italy and were stored in drums on a site near the river port of Koko. An Italian businessman had persuaded a local landowner to store them at a cost of US$100 a month. In collaboration with a local firm, health inspectors and customs officers, he was able to gain the necessary documents. Once on site some of the drums began to smell and leak; reports of premature births and deaths from contaminated rice followed. A major risk to health and the environment had been introduced as a result of collusion and corruption involving businessmen and officials.

Nigerian students in Italy revealed the dumping, much to the embarrassment of the Nigerian government which had been prominent in condemning dumping in neighbouring countries and had promoted a resolution against dumping passed by the Organisation of African Unity (OAU). In the wake of a potential political backlash Nigeria announced the evacuation of Koko, imposed the death penalty for importers of toxic wastes, arrested 40 people for conspiring to bring the waste into the country, recalled her ambassador to Italy and seized a Danish ship that had conveyed some of the wastes and an Italian ship in harbour in Lagos. After negotiations conducted against the backcloth of international media attention the mixed and dangerous cargo was transferred from Koko to two ships (causing severe symptoms to some of the dock workers) bound for Italy.

The story did not end there. One of the ships, the *Karin B* (see Plate 6.1) was initially refused entry to Ravenna as a result of strong local opposition. The ship tried

Plate 6.1 Toxic waste carrier Karin B. Photo: Miguel Greino, Environmental Picture Library

unsuccessfully to land the cargo in the Canary Islands and Cadiz, was banned from British ports, prevented from entering French territorial waters before eventually being allowed, with the other ship, the *Deep Sea Carrier*, to unload in Ravenna in December 1988. The wastes were ultimately incinerated in the UK.

Apart from demonstrating the problems of illegal transfer of wastes, this case highlights two other features of the politics of hazardous wastes. One is the *opposition* aroused by such transfers which is both local and fuelled by the media and publicity by NGOs. This has the effect of severely limiting the legal options for disposal of wastes. The other feature is the tendency for wastes to be dumped on poor or powerless communities or countries. In this case the conflict was aroused between the advanced industrial nations (represented by Italy), which produce the bulk of such wastes, and the developing countries which, intentionally or illegally, become the dumping grounds for such wastes (if the price is high enough). The trade in hazardous wastes is a case of *externalities* being exported from richer to poorer countries and it has led to the establishment of international agreements to regulate and control the trade.

Case 3 Radioactive wastes from Sellafield, UK

The international trade in radioactive materials has also had major political implications as the following example demonstrates.

Sellafield, on the coast of West Cumbria in England, is the centre for the UK's main nuclear reprocessing operations. At this complex spent fuel is brought in from power stations mainly in the UK but increasingly from overseas countries, particularly Germany and Japan. Here it is stored and then chemically processed to extract out the plutonium and uranium it contains. The plutonium was initially needed for the weapons programme but subsequently it was envisaged as the fuel input for the new fast breeder reactor programme. With the ending of the Cold War and demilitarisation the military demands have been reduced; with the abandonment of the breeder reactor programme there is no obvious civil market for these products (apart from possible use in mixed oxide fuels, MOX, which in the early 1990s was more expensive than natural uranium fuel). Consequently there is a surplus of plutonium which, along with the continuing production from reprocessing, must be managed in some way. In addition, substantial volumes of radioactive wastes (some of them plutonium contaminated) which arise from reprocessing must also be managed. These problems of managing radioactive materials and wastes have been a major source of political debate and conflict in the UK since the early 1980s.

Moreover, the problem is not confined to the UK. With the need for plutonium and enriched uranium vanished, the main justification for reprocessing has been as a method for managing nuclear waste and attracting foreign customers and income. Thus the £2.5 billion thermal oxide reprocessing plant (THORP) was approved in 1978 at a time when a continuing and increasing demand for plutonium was foreseen. By 1994, when it was finally commissioned, British Nuclear Fuels (BNFL) emphasised the £500 million profits already secured and the potential future earnings that could be achieved through gaining foreign contracts. Sellafield (along with Cap de La Hague, near Cherbourg in France) had become the focus for an increasing foreign trade in plutonium and radioactive wastes.

The transboundary movement of radioactive wastes identifies several issues for international environmental policy making. First, the trade is determined by the

Plate 6.2 Vacated housing at Love Canal

policies of individual nation states and not subject to international agreement or supervision. Secondly, the trade identifies conflicts between environmental interests as expressed by local groups or NGOs and the economic (and, to an extent, military) interests of certain countries. Third, the trade is restricted to a very few industrialised countries (trade from reprocessing is at present only generated in the UK, France and Russia) but its environmental impacts can be far reaching. Fourth, plutonium is now in oversupply and could be regarded as a waste rather than a product. Its existence potentially poses the threat of nuclear proliferation which could lead to greater global political instability. The break-up of the Soviet Union has led to a nefarious trade in plutonium and uranium which may contribute to the nuclear weapon-making capacity of several states or add to the threats of international terrorism. Finally, the problem of managing radioactive wastes may impose risks and costs that are borne by specific communities but which also extend down to future generations. Inequalities in risks raise major policy issues of equity in the management of radioactive materials.

Issues

These examples point to a number of issues. First, they show *trade* in its capacity of a means of transferring environmental problems between countries; and they identify *wastes* as a cause of such problems. Second, they raise questions of *equity* which, in the case of hazardous wastes, have a geographical dimension between North and South or, in the case of radioactive wastes, an additional temporal dimension between present and

future generations. Trade and equity issues create conflicts between environmental and economic interests. The outcome of these conflicts in terms of policy reflects the relative power commanded by different interests.

In this chapter I attempt to throw further light on the key question for this book: *What are the causes of international environmental problems, and what are the conflicts surrounding their definition and potential solution?* To that end I shall analyse the causes of political conflicts over the trade in wastes, the power of the interests involved and the policy outcomes. There are three parts to this analysis. In the first part (section 6.2) I shall define the nature of hazardous and radioactive wastes and distinguish the environmental problems caused by them. In the second part (section 6.3) I shall consider the sources of conflict over the management of hazardous wastes and the interests that are involved. In the third part (section 6.4), the outcomes of conflicts will be evaluated in terms of international agreements that have been reached. The concluding portion of the chapter (section 6.5) returns to the key question for the book and focuses on conflicts of interest and the exercise of political power.

6.2 The anatomy of the problem

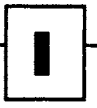
An immediate difficulty with wastes is defining the problem. Waste is usually defined by exclusion, by what it is not. In this definition waste is any material in liquid, gaseous or solid form that is unwanted and unused in the production process. The OECD has defined wastes quite simply as 'materials ... intended for disposal for specified reasons'(OECD, 1988).

Wastes are, therefore, the back-end of the cycle of production whereby energy is applied to transform natural resources into food or into material or non-material (e.g. electricity) products for human consumption. But the definition is not so straightforward as it seems. The distinction between wastes and products is not always clear. This is especially so when it is not clear whether the discarded materials may, at some stage, be reused or recycled. The distinction is often made between wastes for disposal and wastes for recovery. The latter are excluded from international agreements even though there may be little prospect of them being returned to the production process. The ambiguity surrounding definitions of waste makes effective regulation and control very difficult.

The definition of hazardous wastes

The problem is compounded when it comes to attempting to classify wastes. Wastes become a problem when they are harmful to the environment or to human health. They become *hazardous* wastes. These are defined as 'waste that has physical, chemical or biological characteristics that cause or contribute to threats to human health (leading to serious illness or death), or adversely affect the environment when improperly managed' (Cutter, 1993, p.114). There is considerable confusion in vocabulary since hazardous wastes may embrace a range of definitions relating to their nature (e.g. toxic wastes, dangerous wastes, special wastes), their legal category (e.g. controlled waste) or the problems of managing them (e.g. difficult wastes)(see Box 1). This chapter is concerned

Hazardous wastes – definitions and categories



In the UK, *controlled wastes* are so-called because they are subject to control as household, industrial or commercial waste under the Environmental Protection Act of 1990. These wastes are now known as *directive wastes* since the definition of waste under the European Directive 91/156/EEC has been applied to ensure a single definition of waste throughout the EU. This directive defines wastes as 'any substance or object – which the producer or the person in possession of it discards or intends or is required to discard'. The substances included and the exceptions are defined in schedules to the regulations.

It is clear that the directive perceives waste as posing a threat to human health or the environment arising 'from the fact that the producers of the substances or objects concerned will normally no longer have the self interest necessary to ensure the provision of appropriate safeguards'.

- *Special wastes* is a category of controlled waste statutorily defined as waste which 'is or may be so dangerous or difficult to dispose of that special provision is required for its disposal'. Such wastes may be defined by reference to certain properties such as flammability, carcinogenicity, corrrosivity and toxicity. They are wastes that contain substances that are dangerous to life or have a flashpoint of 21°C or less or are medicinal products available only on prescription.
- *Toxic wastes* is a loose definition referring to those wastes which have toxic properties.
- *Hazardous wastes* are defined under EEC directives as wastes which are hazardous because of their physical or chemical characteristics, the process by which they were produced or their effects on human health and the environment. Among the categories of wastes defined in the directive are contaminated materials, unusable parts, residues of various kinds, adulterated materials, products for which the holder has no further use, ending with the all-encompassing 'any materials, substances or products which are not contained in the above categories' (Directive 91/156/EEC).

Other terms such as *difficult wastes* or *clinical wastes* are also sometimes used but they have largely been subsumed under the more precisely defined regulations and lists presented by the Department of the Environment and the EEC.

Source: BMA (1991).

with hazardous wastes rather than wastes in general or toxic substances used in production, though there is some common ground in dealing with the problems.

Hazardous wastes arise from the manufacture of chemical substances used in a variety of industries. Hazardous wastes may be defined by listing of specific substances. The UK Department of the Environment provides a 'Red List' of substances defined by toxicity, persistence in the environment and bio-accumulation (potential for concentration in the food chain). The EC similarly defines 'hazardous waste' as wastes on a list which takes into account various properties. The OECD gave a rough estimate that in the late 1980s there were 338 million tonnes of hazardous wastes produced, of which 275 million came from the United States and 24 million from western Europe.

Over 50% were chemicals. The major categories of hazardous wastes in Europe were solvents, waste paint, heavy metals, acids and oily wastes.

Various international agreements have attempted to specify the categories and characteristics of hazardous wastes. Nevertheless there remain inherent problems of definition and classification which have the following consequences. First, it is difficult to distinguish between substances which are waste and those which have potential use. Thus, some substances which should be treated as wastes may, instead, be treated as products. In particular under international agreements it is possible to export waste for recycling. Second, there can be inconsistencies in classification leading to incorrect or imprecise labelling of wastes. Third, in order to be inclusive, definitions may become excessively vague. For instance, under the Basel Convention (which will be considered in Section 6.4) hazardous wastes can include any wastes considered hazardous by the domestic legislation of the party of export, import or transit. Again, this can lead to inconsistent approaches to hazardous waste management. Fourth, there may be deliberate false labelling of wastes as in the case of the *Khian Sea* (see case 1 above).

The classification of radioactive wastes

Radioactive wastes are in a category of their own in terms of definition, classification and management. Although hazardous, dangerous and sometimes toxic, these wastes are treated quite separately from all other hazardous wastes. Radioactive wastes arise from the various stages of the nuclear cycle (in particular as tailings from uranium mining, as spent fuel from nuclear reactors and as various waste streams from reprocessing operations). Radioactive wastes can occur in liquid, gaseous or solid forms. There is no common international classification of radioactive wastes; instead there are different national classifications based on sources, disposal routes and levels of radioactivity. However, the classification systems are broadly comparable (see Box 2).

Radioactive wastes are a source of radioactivity which arises from the radionuclides contained in the waste stream. These radionuclides vary in terms of their *longevity* (defined as half-lives to measure the rate of radioactive decay), their *activity* (the number of radioactive emissions per second measured in terms of becquerels – 1 Bq is one spontaneous transformation per second – which have replaced curies as the commonly accepted measurement), their *type* (alpha, beta or gamma) and their *biochemical properties*. For example, one of the most dangerous radionuclides is plutonium-239 which has a half-life of 24,000 years and is an alpha emitter. It is also highly toxic with a propensity to accumulate in the lungs and bone marrow. 'It has been said that it would be fairly safe to sit on a lump of plutonium wearing only a stout pair of jeans. On the other hand, it could be fatal to inhale even a very small particle of it' (HMSO, 1986, p.xvi).

As with hazardous wastes there is a problem in distinguishing radioactive substances which are wastes from those which are potential products. In the UK and France spent fuel is reprocessed as an integral part of the fuel cycle to extract uranium and plutonium. In these countries spent fuel is a resource whereas in the United States and other countries it is regarded as a waste to be disposed of. The same might now be said of plutonium, once a product in high demand. The ending of the

2 Classification of radioactive wastes

Radioactive wastes are defined by the International Atomic Energy Agency (IAEA) as 'any material that contains or is contaminated with radionuclides at concentrations or radioactivity levels greater than the "exempt quantities" established by the competent regulatory authorities and for which no use is foreseen'. The exempt wastes, below regulatory concern (brc), are deemed to represent an insignificant hazard to the environment and health and therefore can be managed as non-radioactive wastes. Radioactive wastes are classified according to:

- *Source* – uranium mining, milling, fuel enrichment and fabrication, power production and reprocessing.
- *Half-life* of the radioisotopes contained in the waste. This is a measure of radioactive decay, the length of time taken for a radionuclide to lose half its radioactivity. The basic distinction is between long-lived with half-lives of over 30 years and short-lived with under 30 years.
- *Concentration* of radioisotopes. This leads to a classification based on activity level giving three categories – high, intermediate or low level wastes.
- *Type of ionising radiation.* The three types are alpha radiation which is the least penetrating but very damaging to living cells, beta and gamma radiation which are very penetrating and which require heavy shielding to prevent them affecting external body surfaces.

The USA classifies wastes according to a combination of source, type and concentration. Most other Western countries use the following broad classification:

- *High-level wastes (HLW)* are heat-generating wastes arising from spent fuel reprocessing in liquid or vitrified form or as solid spent fuel from nuclear reactors. They are long-lived with significant alpha radiation and are highly dangerous. They are low in volume (about 1.5% of the total) and high in radioactivity (around 99% of the total). The proposed method of ultimate management is deep geological disposal.
- *Intermediate-level wastes (ILW)* are created during the process of energy production and reprocessing and include fuel cladding, control rods, filters, sludges and resins. They are subdivided into *long-lived ILW* with half-lives of over 30 years and mainly alpha emitters (requiring deep geological disposal) and *short-lived* (under 30 years half-life and mainly beta and gamma emitters).
- *Low-level wastes (LLW)* are short-lived, high volume wastes arising from contamination of clothing, plastics, paper, debris and other materials during nuclear processes. In the UK it is estimated they account for about 84% of the volume but only around 0.1% of the total radioactivity.

Sources: IAEA (1992); Blowers *et al.* (1991).

Cold War and subsequent disarmament has left a surplus of nuclear warheads. Plutonium is no longer in demand for the fast breeder reactor programmes which have been abandoned in many countries. And, with low prices for natural uranium there is little demand for mixed oxide fuel (MOX) which uses plutonium. Plutonium is now in surplus. Stockpiles, estimated in 1992 at around 300 tonnes in the civil

programme and as much as 1000 tonnes in the military sector, were still being added to by continuing reprocessing. With such a substantial overhang plutonium might be regarded as a waste product. But it remains a product in potential, if clandestine, demand for military purposes. The possibility of the proliferation of nuclear armaments poses a threat to world security and therefore the plutonium surplus must be carefully recorded and securely managed. An underground traffic in plutonium and uranium exists and quantities have disappeared from various stockpiles, notably in the former USSR.

From an international perspective the three key issues which arise from the problems of classifying radioactive wastes can be summarised as follows:

1 the difficulty of securing compatibility among diverse national systems of classification
2 the problem of distinguishing radioactive waste from radioactive resources
3 the danger that, as a result of miscalculation or corruption, radioactive wastes or plutonium may be unaccounted for and diverted for military purposes.

The environmental problems of hazardous wastes

Wastes are harmful when they become pollution. Pollution has been defined as 'The introduction ... into the environment of substances or energy liable to cause hazards to human health and harm to living resources and ecological systems, damage to structures or amenity, or interference with legitimate uses of the environment' (Holdgate, 1979, p.17). There are certain basic differences between the environmental risks from hazardous wastes and those from radioactive wastes.

Hazardous wastes are conveyed through environmental pathways of atmosphere and water or are transported in solid form on land or sea. They have a variety of environmental impacts. They can damage *amenity* through, for example, unpleasant odour or discoloration of watercourses or the dereliction caused by spoil heaps. They may also cause *ecological* damage through the pollution of the air and groundwater and the contamination of soil, rivers and oceans. This poses threats to *resources* and *biodiversity*. Some wastes may have a major impact on ecosystems. CFCs are a good example; they can deplete atmospheric ozone and contribute to the greenhouse effect thus having a major deleterious impact on global ecosystems.

Hazardous wastes also pose threats to human health either directly through contact and ingestion or indirectly through environmental impacts on the food chain. They can cause acute reactions (from mild symptoms such as nausea, dizziness or headache to severe conditions like paralysis and burns) and may, ultimately, lead to death. Some hazardous wastes may have carcinogenic effects or have long-term genetic impacts. But it is extraordinarily difficult to identify the precise causes and effects of hazardous wastes on human health; it is an area of great scientific uncertainty. Among the problems are that hazardous wastes are complex mixtures so that it is difficult to single out the impact of specific compounds; the level of hazard varies over time and place; individual exposures vary widely; the relationship between dose and response is difficult to evaluate and the toxicology is imperfectly understood for many chemicals entering the body.

The risks to human health from hazardous wastes have been underlined by a number of incidents. Two of the most well-known are outlined below.

Minamata Bay, Kyushu, Japan

For several years during the 1950s uncommonly large numbers of patients with neurological disorders (blindness, brain damage) were diagnosed; also by 1974 about 800 cases of poisoning and over 100 deaths had been recorded. In 1959 these cases were traced to fish and shellfish, common in the local diet, which had been contaminated by methyl mercury discharged from a fertiliser plant. The problem was initially brought to light by evidence collected by local doctors.

Love Canal, Niagara Falls, USA

For over two decades from 1930 the Hooker Chemical Company dumped about 21,000 tonnes of hazardous wastes (including benzene, toluene, chloroform, trichloroethylene) into an unfinished canal. The site was 'sealed' and 'reclaimed' and sold to the local school board who sold it in parcels and a new residential development was completed in the 1970s. Toxic fumes from the wastes began to seep up through the soil into the basements of homes, the soil became contaminated and there was great anxiety about the health effects as a variety of complaints, including various cancers, chromosome damage and low birthweight, were attributed to the wastes. The incidence and causes of these various health effects proved very difficult to determine. Nevertheless a vigorous local campaign by residents drew national attention to the issue, the site was evacuated and boarded up and for long remained a silent symbol of the problem of hazardous wastes. By 1990 the homes were being sold off as the area was declared clean and habitable again.

To these cases could be added other examples such as the explosion at Flixborough, UK, 1974 that killed 28 people and caused 3000 to be evacuated; dioxins in the air (Seveso, Italy, 1976) killing over 100,000 grazing animals and forcing 1000 people to flee; Cubatao, Brazil, in 1984 where a pipeline exploded killing at least 500; or methyl isocyanate escaping from the Union Carbide plant in Bhopal, India, in 1984, the biggest industrial disaster of all resulting in about 2500 deaths and thousands of injuries.

These incidents have served to draw international attention to the problems associated with hazardous substances whether from routine dumping as waste or from accidents during production. Some incidents are restricted to one country but others involve neighbouring countries, too. Together with the evidence of illegal and routine dumping of unwanted hazards on Third World countries (described at the beginning of the chapter) they have ensured that the issue of hazardous wastes has been politicised to the point where action both national and international is demanded.

The environmental problems of radioactive wastes

In certain respects radioactive wastes are uniquely hazardous. Radioactivity is invisible, pervasive and can be dangerous through proximity as well as through inhalation or ingestion. The risk varies according to type of radionuclide but some of the most dangerous have exceedingly long half-lives, to all intents and purposes remaining dangerous in

perpetuity. Moreover, once radioactivity reaches the accessible environment (i.e. where it comes into contact with people through the food chain or in the air or water) its impacts are inevitable and irreversible.

The links between radioactivity and certain cancers and genetic effects are established though not fully understood. Indeed, the problem of confirming specific cause and effect is beset by a range of seemingly intractable problems. It is difficult to provide studies over sufficient time-scales, to create effective monitoring systems, to identify and isolate potential causes, to comprehend the pathology or to predict the impacts of particular doses on specific populations. An extensive study into the links between Sellafield and the incidence of local leukaemia clusters could only conclude that the link was 'not one which can be categorically dismissed, nor on the other hand, is it easy to prove' (Black, 1984).

Radioactivity occurs naturally as well as from nuclear facilities and weapons. Indeed, it is frequently pointed out (especially, it must be said, by the nuclear industry) that a very small proportion arises from the nuclear industry (just over 1%) with about a fifth coming from medical sources, especially X-rays. Natural background radiation accounts for most of the rest (apart from that occurring naturally within the body) coming from radon gas, cosmic rays and rocks and soils. However, nuclear facilities present a concentration of radioactive risk which is, in principle, avoidable.

It is the public anxiety surrounding radioactivity which places it in a unique category of hazardous activity. Opinion polls of public attitudes to nuclear issues require very careful interpretation. For example, nuclear waste was selected as the most important national environmental problem in Britain in two surveys taken in 1986 by the Department of the Environment (52% of respondents) and 1989 (18%)(HMSO, 1992, p.227). But, in another case, when people were asked to identify major problems, only 11% indicated environmental problems and when asked which kinds of pollution were of concern, only one in five of these mentioned nuclear power or waste (British Nuclear Forum poll, 1992).

How are we to interpret such figures? Obviously much depends on the nature of the questions asked and the context in which the enquiry is set. But, even allowing for this, we need to consider the following factors at least before reaching any conclusion. One is that environmental issues themselves are competing with other problems for attention and, though interest in them rises and falls, the state of the economy or health services tend to claim more consistent public attention. A second factor is that the problem of nuclear waste is very complex and quantitative polls cannot register the range of feelings and attitudes it engenders. They fail to 'capture the more subtle forming influences ... in the public perception of risk and risk-generating institutions' (Wynne *et al.*, 1993, p.24). Thirdly, another aspect of complexity is that both polls and the public fail to distinguish between different aspects of the nuclear industry or between different levels of risk. Thus, public anxiety is aroused by any nuclear facility (reactor, waste facility, reprocessing plant) whatever the level of risk involved. Fourthly, polls are inevitably selective and the information they yield can be used to support particular viewpoints. This is especially so in such a controversial area as the nuclear industry. In support of its case the nuclear industry points out that public support increases with greater familiarity with nuclear processes. On the other hand,

opponents might argue that communities which are most familiar with nuclear power are likely to support it because they are economically dependent upon it.

As with hazardous wastes, anxiety about the nuclear industry has been fanned by a number of incidents. Among the most celebrated have been those outlined below.

Three Mile Island, Harrisburg, USA, 1979

Technicians were working on reactor 2 of the Three Mile Island plant during the night while it was on full power when vital cooling water supplies were cut off and began to drain out through a valve that had opened without being indicated in the control room. Since operators believed the cooling water system was functioning they shut off the emergency pumps, causing the reactor to overheat, coming close to meltdown. Although it was eventually brought under control the accident had caused over 100,000 people to flee from the surrounding area. It was a critical turning-point, undermining confidence in nuclear power and provoking adverse reactions to nuclear power in the USA and Europe.

Windscale/Sellafield, UK

There was a major fire at the Windscale plutonium production plant in 1957 causing considerable radioactive contamination in vegetation and milk supplies in the surrounding area. A catastrophe was averted by most of the radioactivity being trapped in the filter

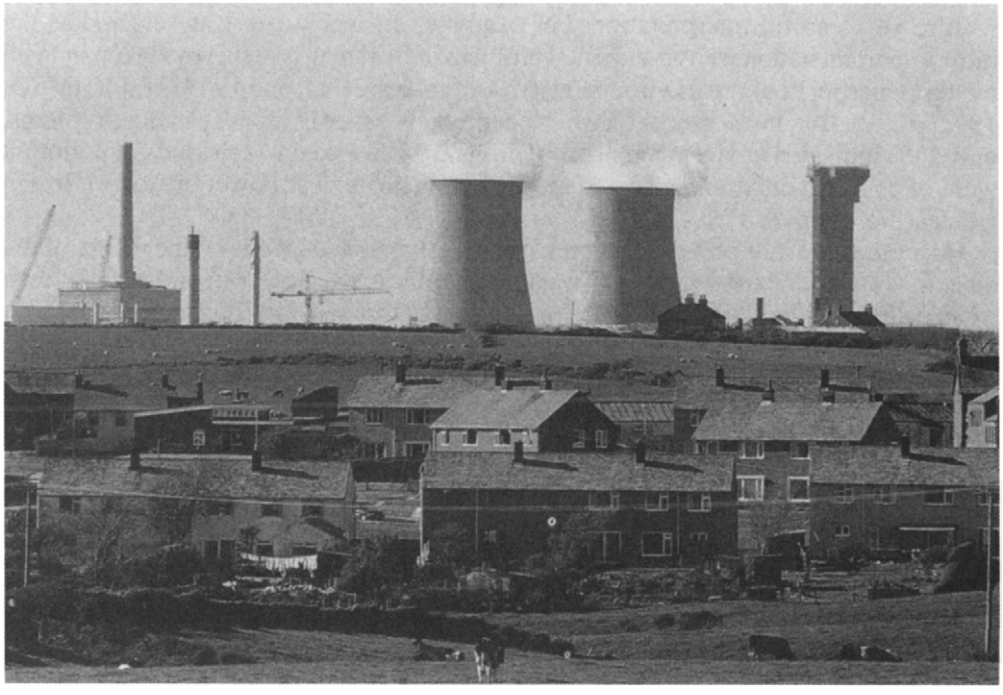


Plate 6.3 Seascale village, with Sellafield nuclear reprocessing plant in the background. Photo: Morgan/Greenpeace

of the chimney at the plant; even so the full scale of the accident was kept from the public and not finally revealed until 30 years later. Since then there have been a number of incidents at the Sellafield complex, notably in 1973 when an old reprocessing plant caused contamination of workers and was shut down. A decade later the accidental discharge of radioactive 'crud' into the Irish Sea was discovered by Greenpeace and led to the closure of a local beach for 24 hours and warnings to the public not to use the beaches 20 miles in each direction for several months. These and other incidents, aside from authorised and routine discharges, were highlighted by the media and anti-nuclear groups, increasing public concern about nuclear operations at Sellafield and drawing international attention to the site.

Chernobyl, Ukraine, 1986

During the night shift on 26 April control rods were pulled out of the fourth reactor as part of a deliberate but unauthorised experiment and efforts to get the situation under control aggravated the problem, causing the reactor to go critical. The top of the reactor core heated up and as the pressure of hydrogen built up the ceiling cracked and the roof of the reactor building lifted off. The graphite in the core had caught fire and melted part of the fuel, propelling radioactive materials 5000 feet into the atmosphere. The radioactive cloud spread rapidly north-westwards, affecting a wide area of the Ukraine, Byelorussia, Russia and Northern Europe. The disaster was not publicised until high levels of radioactivity were recorded in Sweden. It was two days before the local town of Pripyat was evacuated and six before evacuation began at Chernobyl (population 40,000) ten miles away. Altogether nearly 100,000 people were evacuated and a large area was contaminated. The death and sickness toll resulting from the accident is gradually being revealed but the full dimensions cannot be calculated since the impact will extend over a wide area and over many generations. But Chernobyl was a defining moment for the nuclear industry, providing a demonstration of the catastrophic potential of a nuclear accident and also revealing 'the limitations of international policy for containing catastrophic risks, and some of the true costs of nuclear power' (Birnie and Boyle, 1992, p.348).

These (and to some extent other less publicised) incidents have helped to create the international political context for the nuclear industry. There is a recognition that, while the risks of a major accident may be statistically low, an accident, should it occur, can be catastrophic, a threat to health and possibly even survival over wide areas and many generations. Since the impact of such accidents can cross frontiers the safety of nuclear reactors constitutes an international problem.

The incidents have occurred as a result of the production of nuclear energy or reprocessing operations. They illustrate why nuclear risk is regarded with such alarm. They are intrinsically connected to radioactive waste, either as deliberate discharges into the environment (as at Sellafield) or as highly radioactive materials from the reactor core which are unusable and which must be managed (as at Three Mile Island and Chernobyl). The routine transport of nuclear wastes is also an integral part of the nuclear cycle. In some countries, particularly where spent fuel is destined for direct disposal, the complete cycle is contained within national territory (India, USA, Canada). But, in those countries which engage in reprocessing, international trade in spent fuel is encouraged.

The risks of accident, proliferation or routine impact on the environment or human health arising from this trade constitute an international problem.

So far I have examined the environmental problems created by hazardous and radioactive wastes and their international implications. In the next section I shall examine the various methods of dealing with these problems and the conflicting interests that result.

6.3 The management of wastes – conflicting interests

Hazardous wastes – the problem of management

Hazardous wastes are overwhelmingly produced in the advanced industrial countries. OECD estimates indicate that only 16 million tonnes out of a total of 338 million tonnes originated outside the OECD countries and Eastern Europe (OECD, 1991, p.146). Much of this waste is handled within the countries of origin and is either discharged to the atmosphere (through incineration) or the marine environment through pipelines, or landfilled. But these methods of managing wastes have become increasingly difficult.

In the first place, the siting of waste management facilities is almost always a source of local conflict. Opposition from environmental groups and local communities has made it increasingly difficult for existing facilities to remain open and almost impossible for new sites to be achieved for managing hazardous wastes. In the UK there has been continuing controversy over incineration of toxic waste which contributed to the shutdown of Rechem's plant at Bonnybridge in Central Scotland in 1984, prevented the development of Leigh International's proposed plants near Doncaster and at Trafford in England and continues to beset existing plants, notably the Rechem incinerator at Pontypool in Wales.

The UK has typically used landfills to dispose of much of the hazardous waste with the most toxic wastes being handled at a few sites such as Pitsea in Essex. Public concern has been developing over the dangers lurking in abandoned landfills. In 1990 a report drew attention to the 1300 sites from which toxic materials could be leaking into groundwater and identified 59 from which there was a serious risk of contamination (Friends of the Earth, 1990). Another report suggested there were 50,000–100,000 sites potentially contaminated and observed that there was no reason 'to be complacent about the quality of waste management in this country' (House of Commons Environment Committee, 1989–90, para 25).

Public concern has also contributed to a progressive tightening of legislation. In Germany, Sweden and the UK, for example, legislation to control hazardous wastes was initiated during the 1970s. In the UK the Environmental Protection Act of 1990 was a comprehensive (part consolidation and part initiation) piece of legislation which, among other things, embraced the concept of *integrated pollution control* (IPC). This introduces a cross-media approach bringing together the hitherto separate inspectorates for air pollution, radioactive substances, hazardous wastes and water quality. It inaugurates a much tougher regime of waste disposal including a 'duty of

care' from cradle to grave binding all holders of waste to take all reasonable measures 'for ensuring that it does not escape from control, that it is transferred only to an authorised person and that it is adequately described to enable proper handling and treatment' (Department of the Environment, 1990). Meanwhile the EC had introduced a range of directives on waste from the early 1980s covering the reduction, recycling and safe disposal of wastes, asserting the polluter pays principle and ensuring adequate control of wastes during both transit and disposal. The EC was also intent on eliminating the co-disposal of liquid and hazardous wastes with domestic wastes in landfills, a common practice in the UK. Local, national and international pressures were combining to place a premium on hazardous waste disposal facilities.

These pressures inevitably helped to increase the costs of disposal. Costs have been increasing as a result of more rigorous monitoring and control and the costs of clean-up, as well as the shortage of suitable landfill sites and other disposal facilities. In the late 1980s it was estimated that the cost of disposing of domestic waste in New York was £80 per tonne, in Philadelphia £26.50 but in England and Wales with greater landfill availability the cost was only £5. The differences between industrialised and developing countries were even greater. For example, one estimate for the treatment of hazardous wastes, including PCBs, gives costs of up to US$3000 per tonne in the industrial countries but as little as US$2.50 per tonne when exported to developing countries. Such enormous differentials combined with diminishing availability of disposal facilities provide a singular incentive for waste producers in industrial countries to seek solutions elsewhere. Despite this, most hazardous waste is still handled within the industrialised world, the majority of it within the countries of origin (see Box 3).

Of the total trade one estimate suggests that as much as 80% is within the OECD countries. As much as 90% of the US export is estimated to go to Canada and 80% of West European trade is within Western Europe. For example, the UK with its sophisticated incineration plant and landfill capacity is a net importer of hazardous wastes coming from Switzerland, Belgium, Ireland, The Netherlands, Italy, Austria and other West European countries.

This trade among industrialised countries is justified on the grounds that it makes common sense for those countries (like the UK) with appropriate facilities to deal with hazardous wastes, especially from smaller countries which do not have the volumes to justify investment in appropriate facilities. But the trends are towards the reduction of such trade. One reason for this is public concern. This was demonstrated, for example, in 1989 when the attempted export of PCBs from Canada to Britain in Russian freighters was blocked after protests from Greenpeace. Another reason is the possibility of accidental releases. In Europe three such releases have had a significant impact on legislation. The Flixborough accident in 1974, mentioned earlier, led to reports that influenced the control of manufacture of dangerous chemicals. The 1978 accident at Seveso in Italy, when a cloud of poisonous chemicals was released and drums of waste disappeared, led to the EC's so-called Seveso Directive which laid down the controls necessary to prevent such accidents and to control the movement of wastes across borders. A decade later a fire at a chemicals plant in Basel caused 30 tonnes of poisonous chemicals to flow down the River Rhine and led to tighter controls on the storage of chemicals.

As concern about the implications of transboundary hazards has grown so the EC has moved towards asserting the *proximity principle* whereby 'waste must be disposed

3

Trade in hazardous wastes

According to OECD figures, in the late 1980s the largest exporters of hazardous waste were as follows:

	in tonnes	% of total produced in country
Germany	1,058,000	18
Netherlands	189,000	13
USA	127,000	n/a
Switzerland	108,000	27
Canada	101,000	3

Within the OECD the UK, France and Canada were among the net importers of hazardous wastes. The high German total of exports reflects trade to the neighbouring former GDR. Since reunification this trade is, of course, all within Germany. The major sources of UK imports in 1990/91 were as follows:

	in tonnes
Switzerland	13,550
Belgium	9,229
Ireland	3,986
Netherlands	3,949
Italy	3,583
Austria	2,912
Others (including Sweden, Spain, Portugal, Germany)	6,746
Total	43,955

Sources: OECD (1991); Environmental Data Services, June 1992.

of in the nearest suitable facility while making use of the most appropriate technologies to guarantee a high level of protection for the environment and public health' (European Parliament, 1990). However, this appears to conflict with the principle of the internal market which asserts the free movement of goods within the common market. The emphasis would therefore be on the prevention of waste, maximum recycling and the creation of an EC-wide infrastructure for safe disposal.

Hazardous waste – political conflicts

Despite these efforts there remains a volume of hazardous wastes that is not managed within the advanced industrial countries but which has been disposed of in one of two

ways. One is by discharging wastes into the marine environment either from land-based sources by pipeline or by incinerating or dumping by ship in the ocean. This pollution of the global commons has provoked considerable international attention leading to the development of international policies. The interests of a few industrialised nations (and the companies which produce the wastes) in discharging unwanted wastes into the ocean directly conflicts with the common interest in preventing risks to the marine environment to present and future generations. This conflict of interests provides the motivation for attempts at international action to regulate, and possibly eliminate, the disposal of hazardous wastes in the marine environment which is the subject of section 6.4 of this chapter.

The second disposal route for hazardous wastes that are not managed within the advanced industrial countries, has been to export it for land disposal elsewhere. Reference was made earlier to this trade and examples were given at the beginning of this chapter. There have been basically two major trading flows of hazardous wastes. One has been from West to East and the extent of this trade has only recently been revealed with the collapse of the centrally planned regimes of Eastern Europe. According to one estimate, around 10–15% of West European export finds its way to Eastern Europe. Since the major recipient was East Germany, now incorporated into Western Europe, reunited Germany has inherited a substantial problem of toxic waste contamination.

The developing countries receive the remainder of the exported waste. The need for the rich countries to get rid of a problem matches the desire for profit by waste handlers

Plate 6.4 German pesticide waste on a train in Bazje, Albania.An example of waste dumped as 'humanitarian aid'. Photo:Vielmo/Greenpeace

and the need for economic investment in the poor countries. Estimates of total quantities vary and there are, of course, hazardous waste imports that go unrecorded. This export trade has been vilified as 'garbage imperialism' and is a clear example of the process of uneven development. Box 4 gives some examples of the export trade to developing countries.

The disposal of hazardous wastes into the marine environment or on land in developing countries have become matters of international conflict of interests. There

4

Exporting hazardous wastes

The case of dumping of toxic wastes in Nigeria from Italy carried by the *Karin B* is described at the beginning of the chapter. Some other cases include the following countries:

- *Benin.* In late 1980s shipments of up to 5 million tons of toxic and mixed wastes were proposed at $2.50 per ton with a total value of $12.5 million to the economy. Radioactive wastes from the former USSR were discovered illegally buried below an airfield. Agreement was reached with France to undertake nuclear waste burial in exchange for cash and assistance.
- *Guinea.* In 1988 15,000 tonnes of toxic incinerator ash were received from the USA but returned after international protest.
- *Guinea-Bissau.* A $120 million contract (more than the country's annual budget) to store industrial wastes was rescinded after public outcry. A deal to take wastes from the USA and some European countries worth $600 million was also postponed.
- *Djibouti* was the initial destination of 2400 tonnes of toxic waste from Italy in 1988. After refusal the cargo was transported to Venezuela and Syria, thence back to Italy and was finally incinerated in the UK.
- *Gabon* has received nuclear wastes from Canada and the USA.
- *Johnson Atoll* in the Pacific has become the site for the incineration of chemical weapons from the USA.

There are many other examples of such trade. Dumping by West European countries on their less developed East European neighbours is also commonplace. For example:

- *Rumania, 1988.* Over 4000 tonnes of hazardous wastes containing PCBs from Italy, The Netherlands and West Germany were illegally dumped and leached into the Danube delta.
- *Poland, 1988–9.* Incorrectly labelled barrels containing cyanamide, chlorinated solvents and PCBs were dumped by Austria.
- *Germany.* The Schoenberg dump in former East Germany has received over 2 million tonnes of hazardous wastes each year since 1979 from West Germany, Austria, Italy and other European countries.

Dumping in Western countries is not unknown, as the following example indicates:

- *Belgium, 1983.* 27,000 tonnes of toxic wastes were illegally dumped by a West German firm into an abandoned quarry at a considerable saving over disposal costs in Germany or France.

Sources: Blowers (1993), p.76; Cutter (1993), pp.137–8.

are various dimensions of conflict. The use of the oceans for dumping involves the global commons and a conflict between private, commercial or national interests in profit against the common interest in a healthy environment. It is a problem of global significance requiring international action in which conflicting interests must be reconciled. The dumping of wastes on developing countries also involves a variety of interests – private, national, local, global – in conflict. It also raises issues of development and distribution. While the environmental problems may be localised they have global ramifications, bringing the interests of the wealthy North into conflict with the poorer nations of the South. They may be seen as part of a broader, structural conflict that both reflects and reinforces patterns of uneven development. I shall return to these issues in concluding section of this chapter. By contrast, conflicts over radioactive waste are, to a large extent, still confined to the advanced industrial countries.

Radioactive wastes – the problem of management

Radioactive wastes pose somewhat different management problems. Once nuclear fission occurs, radioactivity is inevitable and constitutes a hazard in operating power stations, through the possibility of accidental emission and through the waste that is produced. Moreover, when a nuclear power station, reprocessing plant or other facility ends its useful life it must at some point be decommissioned and then itself adds to the accumulated burden of radioactive waste. After shutdown the spent fuel may be removed but the rest of the plant may be left to allow some radioactive decay so that dismantling may be safer. In the case of British nuclear power stations a period of up to 135 years has been considered before final decommissioning. Given the long time-scales involved in developing, operating and decommissioning nuclear plant, nuclear waste management raises questions of how we should deal with the problem of consigning present problems to future generations. Once we take into account the extremely long time periods over which radioactive decay takes place (in the case of some radionuclides sometimes stretching into many thousands, even millions of years) we are dealing with risks that are, to all intents and purposes, permanent. It is necessary, in the interests of sustainable development, to safeguard against such risks as far as possible. In short, these wastes pose a critical problem of how present society deals with the future. This is often called the problem of *intergenerational equity.*

Conventionally this problem is approached through the process of *discounting.* Discounting is both an accounting and an ethical issue and a subject of much debate. In accountancy terms it is a method of calculating investment preferences over time: it is a means of evaluating the opportunity costs of alternative investments. It does so by providing a measure of the present value of an investment needed in the future. In other words, it estimates what would have to be invested now to achieve a specified amount at a specified future date. The calculation is based on the recognition that present money values depreciate through inflation, so will be less in the future. To account for this a *discount rate* is applied. If an investment achieves a higher rate of return than the discount rate it will be deemed profitable and hence financially efficient.

The calculation will, of course, depend upon two judgements: one on the *time period* for the investment and the other the *discount rate* chosen. For example, at a 10% discount rate the present value of £1000 worth of costs or benefits three years ahead

will be £729 (£1000 × 0.9^3), whereas at a lower discount rate, say 5%, it will be higher (£1000 × 0.95^3 = £857). If a longer time period is chosen the present value will also be lower. Using our example, over six years at a discount rate of 10% the value will be £478 (£1000 × 0.9^6) and at 5% it will be £698 (£1000 × 0.95^6). So, the higher the discount rate or the longer the time span, the less the future investment or cost is worth in present values. Thus for very long-term projects such as decommissioning a nuclear power station the present values are very low. If a typical power station in the UK is decommissioned after 135 years after shutdown (to allow for cooling, demolition of plant and removal of the reactor core prior to site restoration) the undiscounted costs of £370 million would be reduced to only £25 million if a 2% discount rate were used (working backwards, that is £25 million × 1.02^{135} = £370 million). The idea behind discounting the cost of decommissioning is to ensure that the present generation puts in place sufficient resources for the future generation to pay for the decommissioning when it falls due.

Over such long time-scales it seems clear that the future is literally discounted, i.e. valued much less than the present. This introduces ethical considerations. Long-term discounting could be justified on the basis that the future generations will be wealthier and have the technology able to cope with the problem more easily. They will gain the benefit of a technology whose research and development costs have been borne by the present generation. Conversely, it can be argued that there is no certainty that economic growth will be sustained even at the level of 2% necessary to ensure the funds will accumulate. Over such a long time span political stability cannot be assumed; in any case it is likely that the present institutional structure responsible for the nuclear industry will have changed or disappeared. Moreover, it is quite possible that nuclear technology will have been abandoned and thus the expertise involved in dealing with the problem will have been lost. In terms of sustainable development it would seem preferable, as far as possible, to avoid bequeathing incalculable risks to future generations. Over long time-scales it can be argued that the rational economic calculations involved in discounting procedures should surrender to the observation of ethical principles based on considerations of environmental safety and social equity.

Ethical considerations are also raised when it comes to the question of how to manage the total volumes of radioactive wastes arising. Certain management routes have already been effectively ruled out for environmental reasons. For a long time during the years when the nuclear industry was rapidly developing in advanced countries as a means of providing cheap, clean and safe electricity, the management of radioactive wastes was not an issue and, if it was considered at all, it was regarded as a technical matter. For many years nuclear wastes were left *in situ* or dumped in the oceans. The environmental legacy of inadequate storage on land is now evident in the risks of land contamination or threats to aquifers on the major military installations in the United States, at Hanford in Washington State and the Savannah River in South Carolina. Similar problems may be found in other countries and the extent of radioactive contamination of areas in the former Soviet Union has only recently come to light (see Box 5).

As the volumes of radioactive wastes accumulated and as environmental concerns began to develop so the issue of radioactive waste management became politicised and, one by one, options were cut off. First, *sea disposal* was abandoned. The United States,

Some radioactive waste problems

5

Problems with nuclear power or reprocessing plants such as at Sellafield, UK, Three Mile Island, USA, and notably at Chernobyl, Ukraine, have been well publicised. But there have also been problems involving nuclear waste.

- *Hanford, Washington State, USA.* Hanford is a large complex and the major centre for the production of nuclear weapons in the USA. There have been several incidents here. In the 1940s and 1950s Hanford routinely released radioactive iodine substantially above levels considered to be safe. In 1949 the 'Green Run' experiment caused the deliberate release of 5500 curies of iodine and other fission products creating a 200 x 40 mile plume over the area, hundreds of times above the accepted tolerance levels. There have been many other incidents and there are fears of leakage of high-level wastes finding their way into the Columbia River.
- *Chalk River, Canada.* A reactor accident in 1952 led to a major clean-up problem and the danger of radioactive ash and dust being dispersed from the site.
- *Windscale, Sellafield, UK.* There have been a series of incidents at this site. Two of the most well known were described earlier.
- *Chelyabinsk, USSR.* A major incident, kept secret for two decades, involving an explosion at a reprocessing plant killed an unknown number of people and contaminated an extensive area around Kyshtym in the Urals.
- *Goiania, Brazil.* Medical radioactive waste was abandoned, causing four deaths.

Sources: Blowers *et al.* (1991); Cutter (1993).

acknowledging environmental objections, ceased ocean dumping (mainly in the North Atlantic) in 1970. By the late 1970s the UK, which conducted annual sea dumps in the North East Atlantic for its own wastes and those from The Netherlands, Belgium and Switzerland, also ran into concerted opposition from scientists, national governments, non-government organisations, the media and trade unions. Scientific opinion was divided on the level of risk. It has been argued that 'the strongest defenders of the pro-dumping lobby have been not government regulators or industrialists intent on cheap options, but marine scientists with a lifelong record of involvement in dumping programmes' (Stairs and Taylor, 1992, p.123).

Some scientists, however, were maintaining that radioactivity could be concentrated in marine organisms and particles and eventually enter the food chain. The direct action campaign begun by Greenpeace in 1978 included a celebrated film of their inflatable dinghies trying to halt the dump, which drew considerable media attention. But they also lobbied the London Dumping Convention (LDC), which was a global treaty established in 1972 to regulate the disposal of wastes, including radioactive wastes, at sea. Granted observer status on the Convention in 1981 Greenpeace was in a good position to deploy its lobbying and scientific expertise to influence national government delegations to the LDC. In particular two small Pacific island states, Kiribati and Nauru, stimulated action which led to a moratorium on dumping radioactive wastes at sea being carried against the objections of the US, UK, Japan, Netherlands, South Africa and Switzerland. Finally, by 1983, as protests and demonstrations

reached a crescendo, the transport trade unions took the decisive action of refusing to sanction the annual British sea dump. Although the UK has not formally abandoned sea dumping, the LDC moratorium has been observed and renewed.

The ending of sea dumping demonstrates the success of an alliance between threatened nation states, an environmental NGO and trade unions. These organisations were able to deploy sufficient expertise, influence and effective power to defeat a combination of scientific experts, nuclear interests and nation states with a high stake in sea dumping. The outcome was a ban on sea dumping reflecting the assertion of the common interest in the protection of the global commons against more narrow commercial and national interests.

On *land*, too, it has become increasingly difficult to secure politically acceptable management options. In the UK, for example, efforts to identify sites for a possible deep repository for the disposal of high-level wastes (HLW) were abandoned in 1981 after protests from local groups at the proposed sites. Similarly, plans to use an abandoned anhydrite mine at Billingham on Teesside for intermediate-level wastes (ILW) were defeated by the strength of local protest in 1985. Shortly afterwards four sites in Eastern England were selected for comparative analysis as prospective shallow burial facilities for low-level wastes (LLW) and short-lived ILW. Again, a co-ordinated campaign of lobbying, protests and scientific expertise forced a government withdrawal in 1987. As all these options became eliminated there was a retreat to Sellafield as the prospective site for a deep repository for ILW and LLW. The decision was essentially a pragmatic response to political conflict.

In other countries, too, the search for management options for radioactive wastes has demonstrated the need to secure political acceptability. In the United States a whole series of potential sites for a deep repository for HLW have been abandoned since the mid-1970s. It has proved so far politically impossible even to nominate potential sites in the Eastern states and in the West a rigorous process of comparative site characterisation was jettisoned in favour of selecting Yucca Mountain in the Nevada desert in order to minimise costs and opposition. Meanwhile, in another desert location an underground repository for military nuclear wastes has been excavated at Carlsbad, New Mexico, but has endured continuing opposition to prevent its opening. Elsewhere the determination of three states (South Carolina, Nevada and Washington) to close their LLW disposal facilities led to a policy whereby groups of states must form compacts and identify a LLW site to receive their wastes. Not surprisingly the search for new sites has frequently met with determined local resistance.

In Canada a protracted period of research is being undertaken before the search for disposal sites for HLW begins. In Germany, sites in Lower Saxony for radioactive waste disposal have met with determined opposition. In Sweden, where a phasing out of the nuclear industry was agreed, it was politically possible to excavate a sub-Baltic repository in crystalline rock, but there remains the problem of finding an acceptable deep repository for HLW. In France, the most pro-nuclear of Western countries, opposition at four rural locations selected as potential sites for a deep repository precipitated a major shift in policy with the announcement in 1991 that two sites would be selected for a 15-year period of research into the management of HLW. Selection would take place on the basis of discussion with potentially interested areas. This mediative approach has slowed down the programme.

Plate 6.5 Crew on board the Greenpeace boat *MV Greenpeace* tracked down the Russian dump ship *TNT 27* and documented its activities as it dumped nuclear waste into the Sea of Japan. Photo: Hiroto/Greenpeace

Proposals for land disposal have, in almost every case, provoked conflicts between environmental interests and the nuclear industry which have local and national dimensions. So far there has not been a markedly international dimension to these conflicts. But, as the transfer of nuclear materials between countries increases, and as networks of protest are built up by organisations spanning several countries, so wider, international interests will impinge on national policy and local siting proposals.

In nearly every country with a nuclear industry the options for disposal have narrowed. With sea dumping effectively ruled out and new greenfield locations almost impossible to secure against intense opposition, the nuclear industry has had to undertake a pragmatic retreat to those locations where least political opposition and greatest public acceptability can be anticipated. But, even in these locations – Sellafield, Nevada, Carlsbad and the rest – there is neither undivided political support nor unequivocal scientific and technical agreement that the appropriate solution has been found.

Even if agreement could be reached on appropriate sites, there is considerable disagreement as to whether the disposal of wastes is the appropriate solution at the present time. The debate has political, economic and ethical dimensions. Politically the difficulty of securing disposal sites leads to consideration as to whether continued storage above ground is a desirable option. Surface storage may be favoured on other grounds, too. Environmental groups have long argued that disposal is a final solution

that may consign major problems to future generations (perhaps thousands of years hence) if radionuclides should find their way through engineered and geological barriers and into the accessible environment. Furthermore, they argue that storage, surveillance and monitoring is a better guarantee against the risk of proliferation. They have for example in Germany found unlikely allies in some nuclear generators, like Scottish Nuclear, who favour dry surface storage for commercial reasons.

All these arguments are countered by those interests favouring deep geological disposal. They claim that the present generation should deal with the problems it has created; that routine monitoring cannot be carried on indefinitely; that deep disposal in engineered repositories in suitable geological formations represents the safest option; that surface storage increases risks to workers; and that the dangers of proliferation will be multiplied by a large number of dispersed storage sites.

Radioactive wastes – political conflicts

The specific conflicts over sites and over storage or disposal are not simply conflicts within the nation state. Quite aside from land-based discharges to water or atmosphere that may be transboundary, the problem of nuclear waste management has become international in two particular respects. One is through international co-operation in seeking solutions to the problems of management. There is considerable international discussion, research and development of options. For example, the deep underground research facilities at Stripa in Sweden and at Lac du Bonnet in Manitoba, Canada, are international scientific projects designed to investigate suitable hydrogeological formations, conduct experiments on engineered barriers and examine methods of waste emplacement. Although there is as yet an absence of internationally agreed criteria and standards for radioactive waste management, individual national governments will draw on this research experience. The second reason why radioactive waste management has become a major international environmental and political issue is the increasing transboundary movement of radioactive materials. This has been largely a result of the reprocessing industry.

Reprocessing

The main reasons for conflict over reprocessing were outlined in section 6.1 using the example of the THORP plant at Sellafield. Two Western countries (Britain and France) are committed to commercial reprocessing, Japan is developing facilities and reprocessing is an integral part of the fuel cycle in Russia and India. The United States maintains separate reprocessing facilities for military purposes (though much run down following the end of the Cold War) but since the mid-1970s commercial reprocessing has been abandoned there on grounds of cost and proliferation risks.

In the case of Britain and France, reprocessing is undertaken both to complete the domestic fuel cycle but also to win foreign contracts. (Russia's reprocessing facilities are an integral part of the fuel cycle which previously processed spent fuel from within the USSR and its East European allies.) The case for reprocessing has changed with more emphasis on it as a means of dealing with wastes and less as a source of plutonium and fuel. In the case of THORP it was emphasised that the project would support over

5000 jobs with over 3000 locally in an area of high unemployment. It was also justified in terms of foreign earnings with profits from THORP estimated by the operating company, British Nuclear Fuels, to be about £500 million during the first ten years of the plant's operation.

It is this foreign trade that causes an international political problem. Since under the contracts all wastes arising from reprocessing must be returned to the country of origin, there is a potential trade in radioactive wastes as well as in the reprocessed plutonium. This contradicts the proximity principle that countries should move towards self-sufficiency in the final disposal of their wastes. The problem that must be faced was indicated at the end of 1992 when a shipment of 1 tonne of plutonium from the French reprocessing plant at Cherbourg to Japan attracted significant publicity and several countries barred it from their waters. Two years later, amid protests, a shipment of radioactive waste was successfully sent from France to Japan thereby inaugurating a continuing international trade in hazardous materials.

Under substitution arrangements foreign governments may have an interest in receiving back smaller volumes of substituted HLW leaving in the UK ILW and LLW of equivalent radioactivity but of much higher volume. Although substitution is neutral in terms of radioactivity it would mean the UK would become the final resting place for the bulk of the wastes arising from foreign contracts.

Reprocessing has become controversial for several reasons. One is that it allegedly creates greater volumes of waste. One calculation suggests that the volumes of ILW and LLW (if decommissioning wastes are included) amount to 189 times the volume of the original fuel assembly (Large *et al.*, 1992). On the other hand reprocessing reduces and concentrates the volumes of HLW. And it can be argued that the alternative to reprocessing, using natural fuel, would create much larger volumes of uranium mill tailings. A second problem is that the facilities for dealing with the volumes of wastes from reprocessing are not always available. If substitution goes ahead the UK may need extra capacity to manage foreign wastes in perpetuity. The proposed repository at Sellafield is unlikely to be ready (if it is eventually approved) until well into the next century.

The third problem is the changing pattern of reprocessing. The major customers for Sellafield, Germany (where reprocessing has been vigorously opposed and which is likely to cease exporting for reprocessing when current contracts are fulfilled) and Japan (which is constructing its own reprocessing facilities) are likely to disappear, leaving France and the UK to seek alternatives. The possibilities of new markets in countries like South Korea, which are in politically unstable parts of the world, would increase the risks of proliferation. Opponents of reprocessing argue that the dangers of accidents, sabotage, theft or diversion of shipments of plutonium and wastes are likely to increase with the long routes to dispersed markets. Although reprocessing remains a matter of national policy it gives rise to trade in hazardous materials which constitutes an international problem.

Management of radioactive wastes – some conclusions

Radioactive wastes pose environmental hazards that can affect large areas and extend down the generations. There are, perhaps, three levels of conflict that arise over radioactive wastes. First is the conflict over the global commons, the fear that

radioactivity may enter the marine environment and pose widespread risks. This has already led to the cessation of sea dumping but seaward discharges and seaborne trade in radioactive materials still continue.

The second level of conflict is over the management of wastes on land. Where the waste is in the form of spent fuel the question is whether to continue storage or to seek disposal facilities. The intense local conflicts over siting of proposed repositories in all countries have had two effects. One is to deny, delay or defer decisions over specific sites. The other is to ensure that the nuclear industry seeks out politically acceptable solutions which nearly always are found in existing nuclear locations, the so-called 'nuclear oases' (Blowers *et al.,* 1991). These are frequently remote, economically marginal communities which bear a disproportionate share of environmental risks (an aspect of uneven development we shall return to at the end of the third book in the series.) The search for acceptable sites has led to discussion (at present little more than speculation) of the possibilities of developing remote international repositories, possibly in Eastern Europe or developing countries.

The international context of radioactive waste management is clear in the case of commercial reprocessing which produces plutonium and generates large volumes of wastes which must be repatriated (possibly in substituted form). This creates conflicts over the transportation and trade in dangerous substances, involving environmental groups and governments concerned about environmental risks and nuclear proliferation.

The third level of conflict is between present and future. The problem here is to prevent irreversible damage to the environment and to avoid risks to future populations. The requirement of avoiding future burdens invokes the precautionary principle but this is difficult to interpret. One view might be that it is better to take action now (by building repositories, etc.) and thus remove the burden from the future. The opposite view is that it is better to wait until there is greater scientific certainty about the technology and safety measures, thus avoiding placing a burden of risk on the future. These are ethical as well as practical questions.

These conflicts, and those over hazardous wastes too, can also be viewed in terms of different dimensions of power. At one level they can be interpreted as bringing into opposition a range of actors representing a variety of interests who derive their power from different sources. Thus the scientific community deploys expertise to influence the course of conflict; environmental groups use their ability to lobby, to influence the media and to build up coalitions; the nuclear industry provides jobs and wealth and its military connections provide it with close, often secretive, ties with government. Essentially each interest seeks to influence policy makers by exerting its power in critical ways at critical times. The outcome of conflict is not predestined but reflects the varying capacities of the different actors to influence events which vary over time and space. This analysis is applicable to individual conflicts.

At a more general level it may be argued that power relations are structured in such a way that certain powerful forces – countries, classes – exert such economic and political dominion that the outcomes of conflicts inevitably reflect their interests. Such an explanation is helpful (to some extent) in the case of hazardous wastes where there is a clear North-South conflict and evidence of dominance and dependence, but it is less useful for radioactive wastes, which are largely confined to the developed

countries. However, with the break-up of the former Soviet Union there are signs that Western interests will assert their economic power to shape global nuclear policy both at a military and commercial level.

Radioactive waste management is a subject of considerable scientific uncertainty and political conflict. Although international action has been taken to suspend ocean dumping, nuclear waste is, by and large, an issue that is left to national governments. Countries are relatively free to pursue their own policies on the nuclear fuel cycle, on the methods of storage and disposal and on the transport of wastes. Nuclear waste has remained relatively low on the agenda for international governmental action but it is an issue that has attracted considerable attention from environmentalists and peace campaigners. Given its indivisible links with the military and the problems of proliferation radioactive waste is now a key element in a much wider international issue.

6.4 The search for solutions

I now turn to examine the principles that have influenced international action to prevent or control the environmental risks arising from transboundary movements of hazardous and radioactive wastes. So far we have looked at the international problems that are created by these wastes and at the nature of the conflicts to which they give rise. Now I shall focus on potential solutions and the problems of achieving them. As before I shall deal with hazardous and radioactive wastes in turn.

Hazardous wastes – from problem to policy

The various international attempts to control the dumping and trade in hazardous wastes have certain features in common. They combine:

> ... an increasingly strong preference for elimination or disposal at source of toxic, persistent, or bio-accumulative waste wherever possible, with, in other cases, a regime of regulation, monitoring, prior environmental impact assessment, or prior consent designed to minimize the risks of disposal and provide for the protection of other states and the environment of common spaces (Birnie and Boyle, 1992, p.302).

But the degree to which international agreements have achieved these principles varies according to the types of transboundary problem.

There are three types of transboundary problem that arise. These are discharges into the marine environment from *land-based sources* which account for the bulk of wastes; *dumping at sea*; and *international trade* in wastes. The first two affect the global commons while the third involves the transfer of the problem of managing wastes from one country to another.

Land-based discharges constitute by far the biggest volumes of waste products entering the marine environment and include bulky materials (sewage sludge, inert materials, etc.) which may be harmful but are not strictly speaking hazardous wastes. Regulation of these discharges has depended upon regional agreements which have tended to be voluntary and depend heavily on the willingness of national governments

to take action. There has naturally been resistance on the part of some governments to controls since these would affect industrial policy and could be seen as an infringement on sovereignty. Conversely, there has also been pressure to clean up discharges which have a detrimental environmental and economic effect on neighbours. For instance, Sweden pressed for controls over chlorine discharges into the Baltic because Finnish pulp and paper plants were not only creating an environmental problem but were also enjoying a competitive advantage through less stringent regulation. Economic interests tend to be prominent in agreements on land-based sources.

There is no global treaty on land-based sources. Although the UN Convention on the Law of the Sea (UNCLOS) provides a general framework, it tends to respect economic considerations and hence to rely on regional co-operation as a means of achieving ecological protection. Major regional agreements have emerged in the Mediterranean, Baltic and the North Sea with others covering the south-east Pacific and the Persian Gulf. The North Sea is protected by a number of institutions including the Paris Commission and the International North Sea Conference. These have had some impact (for example, the agreement to end dumping of sewage sludge in the North Sea by the end of the century or the reduction in the disposal of lead and cadmium), but in general the pace of progress is determined by national interests. These regional agreements, though often general in character, have generated a number of specific commitments with mechanisms designed to ensure clean-up.

Coastal and near-shore areas are highly vulnerable. It is here that human populations are most thickly concentrated. Coastal environments 'are often the most complex and sensitive to pollution because of slow water renewal and generally limited depth .... It is in these regions that the most detrimental ecological effects have been observed' (OECD, 1991, p.81). But it is in coastal areas that the conflicts between national and common interests are most acute.

However, when it comes to *dumping of wastes at sea* international action has been more vigorous and effective. The third UN Convention on the Law of the Sea (UNCLOS III), which concluded in 1982 and came into legal effect in November 1994 following ratification by 60 countries, establishes a whole range of hortatory restrictions, including dumping of wastes on the high seas and urging co-operation among states to prevent pollution and to clean up damage. While this convention provides an overall set of principles, of more significance have been those treaties which address specific issues and which are binding on the participants. These include the International Convention for the Prevention of Pollution from Ships (MARPOL) which covers marine pollution from ships which are responsible for about 10% of the total pollution discharged into the oceans. MARPOL sets limits to operational discharges, refuse and noxious substances and applies stowage standards to prevent accidental releases.

The London Dumping Convention (LDC, officially the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Materials), established in 1972, has proved generally effective though it has obvious weaknesses. Resolutions are not binding on non-concurring parties so that, if it decided to do so, the UK could resume dumping of radioactive waste with impunity. The 'only effective forces for compliance at present are reasoned argument and the embarrassment factor' (Stairs and Taylor, 1992, p.117). The strength of the LDC lies in the fact that it is a global treaty which has been widely ratified. It applies minimum standards and bans certain

activities altogether. For example, as we saw earlier, radioactive waste dumping at sea is effectively ruled out and incineration is severely restricted. The LDC has asserted the principle 'that dumping should be eliminated unless there are no alternatives and it can be proven harmless, a significant reversal of the burden of proof' (Birnie and Boyle, 1992, p.322). It also has a consultative supranational supervisory body, composed equally of industrial and developing nations, which meets regularly to review and develop its regime. Its success can be measured in the reduction of industrial waste dumped at sea, down from 17 million tonnes in 1979 to 6 million in 1987.

The relative success of the LDC in developing an anti-dumping regime can be attributed to two factors in particular. One is that the composition of the LDC means that it is difficult for a few industrial nations to impose their interests against a general presumption that the global commons should be protected in the general interest and for future generations. A second is that the LDC has been strongly influenced by the lobbying, scientific advice and publicity generated by NGOs, notably Greenpeace. This has opened up the process of negotiation, providing counter-expertise and mobilising opposition to pro-dumping lobbies and arguments. The success of the LDC could lead to unintended consequences that might be environmentally detrimental such as greater pressure for on-land dumping, illegal dumping at sea or blanket policies (e.g. bans of sewage dumping at sea) which may benefit some areas (e.g. North Sea) while causing problems elsewhere (e.g. encouraging offshore disposal by pipelines in developing countries).

International trade in toxic and hazardous wastes is covered by treaties that attempt to reconcile conflicts and deal with problems of monitoring and compliance. International action is in a period of transition as the movement to secure a ban on all forms of trade in such wastes gathers momentum but is resisted by powerful national interests. Both sides of the argument claim scientific support and environmental justification for their position. At the heart of the conflicts are issues of inequality as wealthy nations seek to find ways of dealing with the problems which may ultimately mean imposing them on poor developing countries.

There are various bilateral, regional, interregional and global agreements designed to control and regulate the trade. Among bilateral treaties are those between the United States and Mexico and Canada whereby shipments must be notified and approved by the importing state. The OECD has played a significant role in creating an international framework of law and legislation on hazardous wastes. At the regional level the EC has derived its own legislation from OECD directives (see Box 6).

The intention of the EC legislation is to minimise waste volumes, to emphasise the proximity principle and to ensure that any residual trade between member countries is fully documented. Thus it does not ban trade altogether. While this may encourage management in appropriate facilities it may also lead to dumping in the least developed parts of the EU. Other weaknesses of the directives lie in the problems of classification which omit certain important categories (e.g. radioactive wastes) and in definitions of safe management which leave the determination of methods to the individual countries.

Regional and bilateral treaties among industrialised countries may encourage export to developing countries. The dumping of wastes in African countries (described at the beginning of the chapter) provoked retaliatory action in the late 1980s in the form of an outright ban on the trade. The 1991 African Convention on Transboundary

6 EC Directives on hazardous wastes

1978 Directive on Toxic and Dangerous Wastes replaced by *1993 Hazardous Wastes Directive*. These provide definitions, introduce the preventative principle (i.e. that waste generation should be minimised and wastes disposed of safely) and apply the polluter pays principle.

1984 Directive on the Transfrontier Shipment of Hazardous Wastes. This introduced control of movement between member states and between the EC and other countries. It applied the principles of notification and consent and provided a core list of hazardous substances to which individual member states could add those they considered hazardous. It will eventually be replaced by a regulation implementing the Basel Convention (see below).

Movements of Hazardous Wastes (the Bamako Convention) prohibits imports and regulates trade among African countries. An interregional agreement between the EEC and 68 African, Caribbean and Pacific states, known as the Lomé IV Convention and signed in 1989, bans exports and imports of hazardous wastes, including radioactive wastes, between the signatories.

These agreements go further than the global Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (the Basel Convention) adopted by 116 countries and the EEC in 1989. This emerged from work undertaken by the OECD in the early and mid-1980s. While not banning trade, once ratified it will recognise bans imposed by other agreements and permit trade only where this enables safe management to be undertaken in appropriate facilities. Prior informed consent is required before trade occurs and environmentally sound management must be undertaken. Illegal exports must be repatriated. The Basel Convention has a number of weaknesses. It is limited to wastes for disposal and does not therefore include materials for reuse or recycling. Environmentally sound management is vaguely defined as 'taking all practicable steps to ensure that hazardous waste or other wastes are managed in a manner which will protect human health and the environment against the adverse effects which may result from such wastes'.

At a global level a compromise has been struck. If the regime proves too tough it will offend the interests of certain countries and so delay the chances of ratification. Further, it may stimulate illegal trade and poor management practices on land. The need for proper enforcement, adequate financial resources and stronger institutional capacities to deal with problems is recognised in Chapter 20 of Agenda 21 (United Nations, 1992a).

Hazardous wastes – the principles of policy

Although policy making for the international control of hazardous wastes is slow to evolve, certain principles have been established. The key one is the *precautionary principle*, which is both vague and all-embracing but covers the need to minimise production of waste in the first place and to manage it so that, so far as possible, it does

not offend the environment for present or future generations. It embraces the principle of *environmentally sound management* which places emphasis on care in handling the transportation, storage and disposal of wastes. To achieve this two further principles must be observed. One is the principle of *prior informed consent* so that all trade is based on open declaration and agreement. The other is the *proximity principle* which urges that wastes should be managed as close to their source as is possible, consistent with environmentally sound management.

These principles have led to the progressive banning of sea dumping of wastes and bans to trade in various parts of the world. It has not eliminated trade altogether and the illegal trade may cause 'serious threats to human health and the environment and impose a special and abnormal burden on the countries that receive such shipments' (United Nations, 1992, p.205). Where the national economic interests of the industrial countries are most threatened, as in the case of land-based disposal which covers the bulk of hazardous wastes, progress in reaching binding agreements has been feeble. Conversely, import bans have been introduced by African countries which are no longer prepared to secure economic advantages at the price of environmental contamination and threats to health. The bans are part of a much wider conflict over environment and development and between national and global interests which surfaced prominently at the UN Rio Conference. Most progress has been made where national economic interests are least threatened. The banning of sea dumping covers a relatively small volume of hazardous wastes (about 10% of the total) and covers the high seas where international jurisdiction is paramount.

In the case of hazardous wastes international regulation has been consistently developed. In contrast radioactive waste regulation and control remains substantially in the hands of the nuclear nations.

Radioactive wastes – the limits of international action

Given the potential scale of disaster that could result from an accident involving nuclear materials, including wastes and plutonium, the weakness of international safeguarding regimes may seem surprising. For instance, when the Chernobyl accident occurred there was no obligation of notification and it was not until Swedish authorities registered the fall-out nearly two days later that the scale of the disaster was first realised. Throughout the history of the nuclear industry states have been unwilling to accept international controls over their activities.

It is the weakness of international regimes over the nuclear industry rather than their absence that is most evident. As we saw earlier, an indefinite ban on the dumping of nuclear materials at sea has been agreed. The Bamako and Lomé Conventions include the banning of the import of radioactive wastes. At the strategic level since 1963 tests of nuclear weapons have been periodically observed by some nuclear powers and the 1968 Nuclear Non-Proliferation Treaty provides for an inspection system to ensure compliance among signatories.

There are also advisory standards produced by the International Atomic Energy Agency (IAEA). Established in 1956, its original purpose sought to stress the peaceful rather than military purposes of nuclear power. Its objective was 'to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout

the world'. Radioactive waste was initially almost an incidental concern but attention to the problem gradually increased and accelerated after Chernobyl. The IAEA has published a whole series of standards covering installation, transportation, handling, conditioning and disposal of radioactive wastes and codes of practice, including one for transfrontier transport. The standards are set to conform to the radiological protection limits recommended by another international body, the International Commission for Radiological Protection (ICRP). Within the OECD countries the Nuclear Energy Agency also fulfils an advisory role, disseminating information and sponsoring research. At the EU level the nuclear agency Euratom does provide legal obligations over nuclear safety and oversight of radioactive waste plans but has tended to focus more on the research and development of nuclear energy. Birnie and Boyle conclude that 'It is not a good advertisement for the performance of the European Community in environmental matters' (1992, p.357).

The international regimes covering nuclear facilities are advisory and therefore states are relatively free to develop their own standards, to locate nuclear facilities where they please and to decide on levels of discharge of radioactive materials on their territory and into the neighbouring coastal areas. They are also free to determine the methods of radioactive waste management and to decide whether or not to reprocess spent fuel. They may also engage in trade in nuclear materials and wastes provided that they abide by non-proliferation requirements.

This paradox of a high potential risk and a liberal international regime may be explained in several ways. In the first place the nuclear industry is relatively restricted to about 25 countries mainly in North America, Western and Eastern Europe and Japan. The movement of nuclear materials between them has been mutually acceptable. A second reason is a general presumption among these nuclear states that each is competent and willing to ensure high safety standards and to accept at least the minimum standards recommended by international bodies. Thirdly, the nuclear industry is shrouded in secrecy arising from its military origins and continuing links to nuclear weapons. Except in the case of inspection to prevent proliferation, national security serves to justify unilateral nuclear policy making.

This national approach to nuclear policy is open to challenge on several fronts. Within most nuclear nations there is growing concern about the risks of accidents from nuclear facilities and anxiety about the health risks to present and future generations. It is becoming increasingly difficult to secure sites for nuclear projects, including waste repositories, and more and more the nuclear industry is forced back to sites where it already has a significant presence. At an international level opposition is also developing to the trade in nuclear materials, notably plutonium, but it is likely to affect nuclear waste once shipments begin. Opposition to the nuclear industry brings together a diverse assortment of interests including local communities (against nuclear facilities in their own area though not necessarily against nuclear energy), peace campaigners and environmental groups intent on closing down the nuclear industry worldwide. It is further complicated by the different stages in the nuclear cycle. Thus reprocessing may be opposed by countries such as the United States which are concerned about proliferation risks or by those (including some nuclear utilities and governments) who consider reprocessing to be more expensive than alternatives such as dry storage.

It is because nuclear energy (and the risks to which it gives rise) is so contentious and divisive that international agreements are unlikely to develop. Radioactive waste management has had a low priority on the international agenda for action. The convoluted and timid pronouncements in Agenda 21 make this much clear, as the extract in Box 7 shows. Unlike all other hazardous wastes, radioactive wastes are dangerous through proximity and, if not properly managed, can inflict serious harm on substantial areas, harm that may not transpire for thousands of years. Moreover, they are indivisibly linked to an industry that has the potential to cause widespread and catastrophic destruction, as Chernobyl has shown. They are also linked to the production of plutonium through reprocessing which has the capability of global destruction. With the ending of the Cold War proliferation has become increasingly difficult to control.

7

Extract from Agenda 21 on safe and environmentally sound management of radioactive wastes

States, in co-operation with relevant international organisations, should:

> ... not promote or allow the storage or disposal of high-level, intermediate-level and low-level radioactive wastes near the marine environment unless they determine that scientific evidence, consistent with the applicable internationally agreed principles and guidelines, shows that such storage or disposal poses no unacceptable risk to people and the marine environment or does not interfere with other legitimate uses of the sea, making, in the process of consideration, appropriate use of the concept of the precautionary approach.

Source: United Nations (1992), p.216.

Thus the stakes are high. For the opponents of the nuclear industry it is not a matter of securing better international management regimes. It is a matter of destroying the industry itself. For the nuclear industry and its supporters a solution to the problems of nuclear waste has become a necessary condition of legitimating continued expansion. In this respect the conflict over radioactive waste management is literally a part of the conflict over the survival of the nuclear industry.

6.5 Conclusion

In this chapter I have used the example of hazardous and radioactive wastes to explore the main question for this book, *What are the causes of international environmental problems, and what are the conflicts surrounding their definition and potential solution?* Some of the major differences between conflicts over hazardous and radioactive wastes have been identified. In particular trade in hazardous wastes has

underlined problems of uneven development in terms of North-South conflicts whereas radioactive wastes are still largely a problem confined to Northern nuclear nations (though inequalities between the West and the former Soviet bloc in the East are beginning to emerge). The existence and the threat of dumping hazardous wastes in the oceans or on the territory of developing countries has provoked conflicts which have led to significant international agreements, some of them of global dimensions. By contrast, although the trade in radioactive materials and the problem of disposing of wastes pose increasing international problems, so far policy making has been firmly controlled by individual nation states and international action, in so far as it exists at all, has tended to be advisory.

Aside from these differences both hazardous and radioactive wastes provide evidence for some brief general conclusions on the nature of the conflicts, the interests involved, the sources of power to determine outcomes and the policy implications.

Conflicts

As with many other transboundary problems the basic cause of international conflict over hazardous and radioactive wastes is the externality effects brought about by transboundary transfers. These wastes can be detrimental both to the environment and to health and are, therefore, unwanted. Indeed, proposals to dump or manage wastes arouse local opposition and, as we have seen, dumping on developing countries has been much resented. Wastes may also infiltrate the global commons of the oceans and seas and, here again, the potential dangers have led to bans on sea dumping and control over land-based discharges.

The conflicts occur at different levels. At one level they are intensely *local* as the campaigns to prevent radioactive waste facilities, hazardous waste incinerators or other processing plant amply demonstrate. It is difficult to find sites since such facilities deal with wastes from far afield and bring few benefits to the locality. This concentration of risk and dispersal of benefits relates the problem of site selection to national and even international policy making. Here we see once again the relationship between the local and the global.

Conflict also occurs *over time* between generations. The notion of sustainable development and its related precautionary principle suggest that the present generation should not pass down risks greater than those accepted today nor should we bequeath a degraded environment or depleted resource base. Action must be taken now to prevent unacceptable burdens on the future. This responsibility has been embodied in agreements to protect the global commons such as the ban on sea dumping of nuclear and other hazardous wastes. Discounting has been used as a means of ensuring that future generations have the necessary resources to deal with any problems arising from the present, for example, decommissioning nuclear facilities. But, discounting depends on continuing technology and on institutional, economic and political stability, conditions that becomes less plausible the further we look into the future. Over much longer time spans we cannot even assume climatic or geological stability and yet some of the most persistent substances will remain dangerous over thousands, in some cases millions, of years. Looked at in this way, assumptions about the safety of nuclear repositories have a heroic, not to say fantastic, quality about them.

Interests

Conflicts represent a clash of opposing interests. These interests have both an ideological content and an organisational context. Ideologically the opposing interests can be broadly categorised as environment versus development, private versus public, national versus global and so on. They are not necessarily mutually incompatible. For instance, the whole point about sustainable development is to try to reconcile the disparate goals of environmental sustainability and economic development. In the longer term private interest in economic gain is best satisfied by protecting the environment in the public interest. Similarly, national ideologies of sovereignty and economic growth may increasingly contradict the need for agreement to protect resources and conserve the environment. In short, interests are not always discrete and single-minded but diverse, overlapping, interconnected and varying over time.

Interests are usually advanced through organisations though organisations vary markedly in their degree of coherence, longevity or formal structure. Environmental interests have been advanced by communities of scientists, by NGOs and by environmental movements of local communities and networks of interest groups. Typically they find themselves in conflict with business organisations which produce, trade and manage hazardous materials. But, it is not always a simple contest between single-minded opposing organisations. Scientific communities, often very loosely organised if organised at all, provide conflicting evidence and, in the face of the empirical and theoretical problems posed by environmental factors, maintain what Yearley (1991) analyses as a case of *pragmatic uncertainty* in which knowledge is provisional and depends on judgement and so may offer comfort to both sides in a dispute. Protest groups often hold together as uneasy alliances, dissolving quickly once their objective is achieved. For instance, local nuclear protest groups include both supporters and opponents of nuclear power and bring together people of widely differing ideologies united only in their determination to prevent nuclear facilities being developed in their locality. Nor is the business community unilaterally hostile to environmental movements, as the so-called greening of many companies testifies.

Power and policy

The success of interests in securing objectives depends on the effective power they are able to deploy. There are different views on the question of power (Lukes, 1974; Blowers, 1984). One view (known in social science as a *pluralist view*) holds that there are many interests that are in competition, each seeking to influence relevant decision makers. The resulting conflicts are settled usually by negotiation, consensus and compromise. This view assumes that government is responsive, open and capable of resolving conflicts of this kind. A variant of this view (known as *elitism*) argues that competition among interests is unequal since some have greater access to decision makers than others and are able to achieve their objectives through suppression, control or manipulation of information.

These approaches may be broadly applied to international decision making on hazardous and radioactive wastes. A pluralist approach perhaps best serves the case of hazardous wastes where environmental NGOs have used scientific evidence, publicity

through the media, organisation of local protests and lobbying of governments to draw attention to the dangers of trade. Governments have responded by banning dumping and establishing control regimes. Nuclear waste, with its connections to the military, close relationships between the nuclear industry and government and tendency towards secrecy, evinces a more elitist interpretation of power. Yet the ability of NGOs and other protest groups to force the issues into the open, to orchestrate alliances and coalitions, to lobby opinion and governments and, on occasion, to succeed in their objectives (as over sea dumping or repository siting) suggests that access is not one-sided and that deployment of pluralist politics can prove successful. At the same time, some environmental NGOs are gaining privileged access to government while the nuclear industry must increasingly look for public support.

Against this type of analysis there is the view that power is not distributed among a range of interests competing for influence over policy makers, not even unequally, but rather that power is deeply embedded in the economic and political structure. Economic power is reflected in political power. The powerful – social groups, nations – are able to exploit their position and dominate the powerless. As Gaventa puts it, 'Power seems to create power. Powerlessness serves to reinforce powerlessness. Power relations, once established, are self-sustaining' (1980, p.256). This view would explain the tendency for environmental risks to be concentrated in remote, often economically dependent 'peripheral' locations (Blowers and Leroy, 1994). Sites for radioactive wastes are usually associated with remote areas dependent on the nuclear industry. In a similar way the dumping of hazardous wastes in developing countries reflects the pattern of economic domination and dependence that is a structural feature of the contemporary world.

The different views of power each shed light on aspects of contemporary conflicts over hazardous and radioactive wastes. They suggest that policies will need to incorporate concepts of equity and methods of compensation if they are to be successfully implemented. The constraints and opportunities for policy making will be a major theme of the third book in this series (Blowers and Glasbergen, 1996).