Chapter 1

Introduction
CHAPTER - 1

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1.1. General Background

Since the late forties, the world has witnessed a rapid growth of the nuclear industry, which can be directly attributed to the ever-increasing demands for cheaper fuel as compared to those of coal, gas and oil. From the 1950s when the atom was first harnessed, to date, many efficacious arguments have been made towards the importance and the distinct advantages of nuclear energy over that of other sources.¹

In this regard, a Nobel laureate and a former Chairman of the US Atomic Energy Commission² had remarked:

Human civilisation is rapidly approaching a series of crises that can be managed only through some radical departures in man’s dealings with the relationship between energy and matter. Nuclear energy one key-a crucial one-to the successful resolution of these crises. Without it there is no doubt that civilisation, as we know it would slowly grind to a halt.

Nuclear energy has the capacity to be contained and managed without any attendant pollution whereas a huge amount of greenhouse gases and other noxious gases such as sulphur dioxide and nitrous oxides and other impurities are produced, by burning of fossil fuels. Moreover, the availability of fuel required for

producing nuclear energy is vast and unlimited. It has also been found that at least 60 times more energy can be produced from U-235 and other nuclear raw materials, than wood and other conventional sources.

A comparison of the energy output would show that where 1 kilogram of firewood could generate about 1 kilowatt-hour of (Kwh) of electricity, other fuels could produce 1-kg coal – 3 kWh; 1 kg oil –4 kWh; and 1-kg uranium – 50, 000 kWh (3, 500,000 if recycled).3

To produce the same energy would require as much as 10,000 times of coal or oil. This would mean that a 1000 Mwe power plant would require 2,700,000 tonnes of coal or 2, 000,000 tonnes of oil or just 30 tonnes of uranium annually.4

After experiencing the horrors of the use of nuclear weapons in Hiroshima and Nagasaki, now there is a shift towards the peaceful use of the atom, thanks to the many untiring efforts of the Pugwash movement and other pacifists.5 The first commercial reactor became operative in 1955 and today we have 440 commercial nuclear reactors operating in 31 countries and 284 research reactors producing nuclear energy largely used for production of electricity and other civilian purposes. The output of

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3 From website of World Nuclear Association http://www.world-nuclear.org.
4 ibid.
5 After the “Atoms for Peace”, speech made by former US President Dwight Eisenhower in the UN General Assembly on 9 December 1953 a movement called Pugwash started for calling on governments and political leaders to rid the world of nuclear weapons. The movement had intellectuals of the calibre of Einstein, Bertrand Russell, Joe Szilard and Joseph Rotblat. The latter is a Nobel laureate who left the Manhattan Project setup to prepare the first atom bomb.
these reactors is close to 360,000 Mwe of total capacity, nearly 16 percent of the world’s electricity supply demand.6

The period 1980-2000 also saw sustained efforts towards increased nuclear-power based generation of electricity, so much so that in 2002 the total world production of nuclear power touched 2574 billion kWh.7

There is no gainsaying that such huge amounts of nuclear energy cannot be produced without generating wastes. But before we do that, it would be pertinent to consider the general problem of the radioactive waste produced and the continuing efforts of the international community towards its management and disposal.

1.2. The Problem

The global problem of wastes is the residue of the ever-increasing population and the rapid strides made on account of industrialisation. It is also a statement of the continuing exploitation by man of the Earth’s limited natural resources.8 The huge amount of hazardous wastes generated is largely stored on land surface, but owing to domestic legal constraints and public opinion, the oceans have long been considered the safest dumping ground. The main reasons for this phenomenon can be attributed to the pressures of economic growth, which have led to an

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6 Some of the countries largely dependent on nuclear power for their electricity supply include - France and Lithuania (70 percent); and Belgium, Bulgaria, Hungary, Japan, Slovakia, South Korea, Sweden, Switzerland, Slovenia and Ukraine (25 percent or more).
7 See n.3.
8 See the pioneering work done by Lester Brown’s Earth Policy Institute on the sustaining capacity of the earth.
unabated spate in industrialisation. The residues more often than not, drain into seas and oceans via large number of estuaries and coastal waters which have become receptor zones carrying pollutants comprising heavy metals, organic compounds, petroleum and its by-products, industrial wastes, pesticides, sewage and sludge and radioactive substances.

Apart from seriously risking human life in the coastal regions, these pollutants also choke marine eco-systems, often causing irreversible harm to aquatic life and other marine and benthic organisms, which form an essential chain of the food cycle human life is dependent upon. Moreover, seas from time immemorial have been regarded as pristine environs by all civilisations, which have lived in coastal regions.

Wastes can be categorized into many types—Solid wastes, Industrial wastes, Sewage sludge and dredged spoils and radioactive wastes. Of these industrial wastes account for the most,
owing to the situation of industrial townships along the coasts. Sewage sludge is another major contributor to the pollution of the oceans. Although less hazardous compared to radioactive wastes, the sheer bulk of the disposal is sufficient to cause alarm. But there is no denying that the nitrates and phosphates in the sludge have led to algal blooms causing red tides and have affected marine algae and depleted the concentration of freely available oceanic oxygen so vital for marine life.

Wastes such as dredged spoils, which are disposed in the oceans, result from constant efforts by States to keep harbours, rivers, and other waterways navigable. A large amount of these wastes can be fruitfully used for padding up wastelands as well as production of fertilisers. Alas, its expediency on the part of states that often the easiest and cheapest option available is to dump wastes in the oceans.

Pollution caused by catastrophic oil spills catches the public eye, unlike regular incidental pollution caused by engine oils used in ships. With ever increasing sea traffic, ship-based pollution although regulated by a number of IMO Conventions, continues to cause worry to coastal and maritime States.

Nearly 80 per cent of the oceanic/marine pollution is caused by land-based sources. The Group of Experts on the Scientific

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12 These were the *Torrey Canyon* oil spill in 1967; the *Amoco Cadiz* in 1974 (both off the coast of France) and the *Exxon Valdez* shipwreck of the coast of Alaska in 1992. For an in-depth study of marine pollution caused by oil, see David Abecassis, *The Law and Practice Relating to Oil Pollution from Ships* (London, 1978).
Aspects of Marine Pollution (GESAMP)\textsuperscript{13} in one of its reports of 1990 has clearly brought out the hitherto well known fact that 77 per cent of marine pollution is caused by waterborne and airborne activities and as compared to this figure, dumping, marine transportation and offshore oil pollution amounted to only 23 percent. Further, it also cannot be denied that land-based marine pollution occurring in the North-East Atlantic, the Baltic and of lately in the Asian- African region, the Gulf and Caribbean regions, has severely tested and eroded the depleting capacity of the seas and watercourses to redeem their basic water quality.

1.3. Disposal of Radioactive Wastes

Despite the glowing advantages of nuclear power it cannot be denied that nuclear or radioactive wastes are produced at every stage of the nuclear cycle. Therefore, it is important that a proper management of the different types of wastes be undertaken. To undertake this exercise the criteria for classification of wastes are based on: the time frame during which the wastes shall remain radioactive or its half-life period\textsuperscript{14}; the concentration of the radioactive material in the waste; and whether the waste is one that is heat generating? Depending on these factors, three main


\textsuperscript{14} Half-life period has been defined as the time required for half of the nuclei in a sample of specific isotopic species to undergo radioactive decay (from www.thefreedictionary.com/half-life).
categories of radioactive wastes identified are: low-level waste (LLW); intermediate level waste (ILW); and high level waste (HLW).

LLWs are less radioactive and do not require shielding during handling, transportation and disposal. Such waste, which accounts for the bulk of radioactive waste from the nuclear fuel cycle, consists of paper rags, tools, clothing, filters and other material. These wastes are compacted or incinerated/ burnt to reduce their volume before they are disposed. It is, however, seen that a question would arise how low is LLW? Can it be guaranteed scientifically that LLW’s will not have any effect on human life? What about lower animals and other plants that have a different respiratory and digestive system from human beings? Moreover, there is insufficient information to predict with certainty that lower animals and other plants have the same resilience to withstand radioactive contamination. Has science definitely proved that LLWs are less dangerous than HLWs? What about the growing scientific evidence that low/small dose of nuclear substances injected into the human body lead to mutational changes?

In contrast ILWs are wastes with a higher amount of radioactivity and thus require shielding. They include wastes such as resins, chemical sludge and metal fuel claddings, besides

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contaminated equipment and wastes left behind after decommissioning of a reactor. The treatment and disposal of ILWs largely depends on the half-life period of the waste. If the waste is a short lived one then first, the waste is converted into an immobilised solid, non-reactive material such as cement or bitumen. Later these ILWs are disposed in shallow land-based sites.

The most toxic or hazardous of radioactive wastes are categorised as HLWs. Though they are produced in small quantities in the nuclear fuel cycle, they contain 99 per cent of the radioactive substances. HLWs can be of two types. One, spent fuels which are not intended to be reprocessed; and two, the fission products released after the spent fuel is reprocessed. Owing to the high level of radioactivity and heat generated by HLWs a long cooling period is necessary before the high residual energy within subsides and they are declared fit for disposal.

An essential requirement for HLWs is the mandatory treatment, before undertaking any disposal. Some countries prefer "direct disposal" of spent fuel, because of the huge costs involved in reprocessing and also the complex procedures wherein the fuel is encapsulated in steel or concrete containers. In case of reprocessed fuel, the process involved is called “vitrification”, wherein HLWs are first vitrified or incorporated into solid blocks of a special type of borosilicate glass. It may however, be noted that disposal of both types of radioactive waste would require a mandatory 'cooling
period' which may vary from 20–50 years from the time it is removed from the reactor and its final disposal. Estimates show that the world-wide total of HLWs produced annually is some 4000 cubic meters, equivalent to a cube 15 meters on each side or about 12,000 tonnes. The projected total volume of HLWs to be produced in the next 30 years from the operating power plants would be more than 120,000 cubic meters, equivalent to a cube 50 meters on each side.\(^{16}\)

States have been planning various methods for disposing the collected HLWs. Geological repositories are understood to be the best-suited means available.\(^{17}\) A three stage, multiple, barrier concept in depositing HLWs at a distance of 500 meters in rocks, clay or salt, involves: immobilisation of the spent fuel as ceramic oxide/borosilicate or through vitrification; sealing of HLWs in steel or cement canisters; and finally burial in a solid rock formation.

### 1.4. Disposal Methods and Practice of States

It is observed, as we would see that the major nuclear States follow different methods in waste disposal depending upon their local compulsions, domestic regulations, as well as geographical sites available.

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1.4.1. Australia

Australia with no nuclear reactor has developed a spent fuel management strategy to reprocess its spent fuel, which it receives from the United States in its research reactors. In this case it is seen that the fuel of US origin is returned to the US and the wastes generated during reprocessing is sent back to Australia.

As regards LLWs, Australia has identified a near-surface facility in Woomera in South Australia, in May 2003. A multi-barrier approach is proposed for disposal in trenches and boreholes. This facility has started operating in 2004 after the Australian government obtained the necessary environmental impact assessment clearance and radiological certification from required agencies.

With respect to a small level of ILWs produced, Australia does not have a designated site, but is in the process of searching a national aboveground storage facility.

The HLWs produced from its research reactors is being processed overseas and are returned to Australia to be stored in the national storage facility.

1.4.2. Belgium

Belgium has 7 power units and a 5.7 Gwe capacity and nearly 57 per cent of its electricity is generated from nuclear power. It follows the direct disposal method following the decision of the Government to halt all new reprocessing contracts in 1994.
For disposal of LLWs, near-surface and deep geological repository concepts have been considered. Existing sites considered are at Doel, Fleurus, Mol-Dessel and Tihange. To be able to dispose these spent fuels move are afoot to take feedback from the angle of societal acceptability and partnerships with the concerned local authorities.

As regards, ILWs and HLWs deep geological designs, clay and shale layer disposal methods are being followed for waste disposal.

1.4.3. Finland

Finland has 4 nuclear reactors with a total capacity of 2.65 Gwe. Nearly 30 per cent of Finland’s electricity needs are provided by nuclear power. It follows a back-end strategy of direct disposal for spent fuel.

As regards disposal of LLWs there are two near-surface shallow repositories in Olkiluoto (operational since 1992) and Loviisa (operational since 1998).

With respect to ILWs and HLWs, there is a deep geological disposal in bedrock facility in Olkiluoto. Finland has considered nearly 6 other sites from 1987-1999 and taken a decision at the highest level that ILWs and HLWs shall be disposed in Olkiluoto. Such a decision received the full backing and support from the public owing to numerous environmental impact assessments undertaken. In 2001, the Finnish Parliament voted in favour of disposal at the Olkiluoto facility for disposal of ILWs and HLWs. Although such a decision had parliamentary approbation, actual
construction license for construction of the facility will be issued in 2010 and the real disposal operation is scheduled to commence in 2020.

1.4.4. France

France is one of major nuclear power countries and has whopping 58 nuclear reactors with a total capacity of 63 Gwe and close to 78 per cent of the total electricity needs of France are met from nuclear sources.

France follows a multi-pronged strategy towards radioactive waste disposal, which includes reprocessing and recycling of HLWs and also vitrification. There are 20 nuclear power plants in France that accept recycled Plutonium (Pu) as mixed oxidised (MOX) fuel and the excess spent fuel is stored.

As regards disposal of LLWs, a near-surface disposal facility is operational in Centre de l'AUBE, near Troyes, since 1994. It has a capacity of 1000,000 m³. With respect to ILWs and HLWs a decision on deep geological disposal will be taken in 2006. France owing to many obligations under the European Community policy on waste disposal, as well as international obligations has undertaken studies for effects of transmutation on account of long-term storage.

1.4.5. Germany

Germany has 18 reactors with a total capacity of 22 Gwe and 33 per cent of its electricity is provided by nuclear power. It follows the direct disposal method for disposing spent fuel. Nearly
one-third of all spent fuel available in Germany is contracted for reprocessing. However, it should be noted that the German Parliament has decided that no new reprocessing contracts shall be allowed after 1 July 2005.

With respect to LLWs and ILWs, the deep geological disposal option has been chosen. Taking account of the danger posed to the public and rising opposition to nuclear storage and disposal generated by the Green Parties, many sites have been shut down or abandoned. However, the iron ore mine at Konrad remains the only one where LLWs/ILWs, which are not heat generating ones, are allowed to be disposed. In 1978 the Asse salt mine R&D depository was closed down. Likewise, the salt mine storage at Morsleben, was indefinitely abandoned in 2001. The much-publicised Gorleben salt mine site that accepted all categories of wastes was targeted by the Greenpeace activists in 2003, has since been shut down by a self-imposed moratorium.\(^{18}\) A new facility for LLWs and ILWs at Planfeststellungsbeschultz has not yet received its license.

HLWs are to be disposed in deep geological bedrock and in this regard, research is underway as to whether a salt dome can

\(^{18}\) Since 1979 the Gorleben salt dome has been investigated for its suitability as a repository for all types of solid radioactive waste, i.e. also heat-generating waste, since 1979. A final suitability statement for the Gorleben salt dome would be possible only after the underground reconnaissance. The evaluation of all reconnaissance results to date confirms its suitability. In the opinion of the Federal Government, there were doubts concerning the suitability of the salt dome and therefore, the investigation was suspended.
serve the purpose. A site operational on a trial/pilot basis has been opened at Gorleben.

1.4.6. Japan

Japanese nuclear reactors have a total capacity of 46Gwe and 35 per cent of its electricity consumption is provided by nuclear power. It adopts only the reprocessing options whereby it sends overseas its spent fuel.

The Nuclear Waste Management Organisation of Japan, (NUMO) - was established in October 2000 to promote the implementation of disposal of high-level waste (HLW) originating from nuclear power generation.

With respect to disposal of LLWs and ILWs, an underground disposal facility is operational since 1992 at the Low-Level Disposal Centre at Rokkasho village, in the Aomori Prefecture.

As regards HLWs and other spent fuel, deep geological disposal is the preferred option and efforts are on to select a final repository.

1.4.7. The Netherlands

The Netherlands has only 1 reactor with a capacity of 450 Mwe capacity and close to 3.55 per cent of its electricity needs are met by nuclear energy. It undertakes reprocessing of its spent fuel as opposed to direct disposal.

Disposal of LLWs and ILWs is not undertaken, instead in 1984 a decision was taken by the Dutch Parliament to store all waste at a central Interim Storage Facility for a period of 50 to 100
years. The waste generated is further processed and stored at the Central Organisation for Radioactive Waste (COVRA). It is the only company in the Netherlands that is qualified to process radioactive waste. Any company in the Netherlands, licensed to work with radioactive materials under the Dutch Nuclear Energy Act, is bound by law to tender its waste to COVRA.

With respect to HLWs, the Netherlands adopts the "retrievable disposal concept", whereby spent fuel elements from the nuclear plants at NPP Dodewaard and Borsele are reprocessed in facilities abroad. Thereafter the waste is sent back to Netherlands and stored at COVRA.

1.4.8. Sweden

Sweden has 11 reactors and total capacity of 9.5Gwe, which meets 46 per cent of its electricity needs. It has adopted the direct disposal method of spent fuel in crystalline bedrock.

As regards disposal of LLWs and ILWs, a final repository for radioactive wastes is operational in Forsmark, since 1988, which contains 4 underground caverns and also a silo. The Swedish Nuclear Power Inspectorate is called the Klarabergsviadukten.

To date Sweden has undertaken feasibility studies of 8 sites on the issue of disposal of HLWs. Two sites at Forsmark and

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19 All kinds of radioactive waste will be stored above ground for a period of at least 100 years. After 100 years' storage, consideration will be given to that part of the waste that is still radioactive can be disposed of in deep underground sites in the Netherlands. It is hoped that perhaps by that time international solutions will be available or new techniques might have been developed.
Oskarshamn have completed site investigations and are on the anvil to be approved.

1.4.9. Switzerland

Switzerland has 5 nuclear reactors with a capacity of 3 Gwe, which suffices 40 per cent of the electricity requirement of the country. It keeps both options of direct disposal as well as reprocessing open.

The Swiss Government and utilities co-founded the National Co-operative for the Disposal of Radioactive Waste (NAGRA) to manage radioactive waste disposal. Switzerland has several interim storage facilities for low-level radioactive wastes. For a permanent low-level radioactive waste facility, NAGRA plans to develop a horizontally accessed rock cavern to house corrosion-resistant waste containers. It is studying a multi-barrier approach to waste containment.

The spent nuclear fuel is stored for 1-10 years in water pools at Swiss reactors. An industry-owned organisation, ZWILAG, built and operates Switzerland’s centralised interim storage facility for spent nuclear fuel, high-level radioactive waste, conditioning low-level radioactive waste, and for incinerating wastes. Other interim storage facilities predating ZWILAG continue to operate in Switzerland.

For permanent high-level radioactive waste and long-lived low-level radioactive waste disposal, two host rock repository options are under consideration: one, a deep repository in
crystalline rock and the other is made of Opalinus clay. Construction of a repository is not foreseen until well into this century.

As regards the disposal of LLWs, a site for disposal was selected at Wellenberg by the implementing agency NAGRA, but the same was rejected by a public referendum held in 2002.

Switzerland favours a crystalline and clay encapsulation of its HLWs. Various feasibility studies have been undertaken by the governmental agencies on a preferred site located at Zurcher Weinland. However, Switzerland has kept the international option of sending wastes for reprocessing open and has contracts for reprocessing its spent nuclear fuel to France and the United Kingdom.

1.4.10. United Kingdom

The UK has 33 nuclear reactors with a capacity of 12 Gwe to meet 21 per cent of its electricity needs. It prefers all options—reprocessing of both oxides and magnox (MOX) fuels.

On 1 April 2005, the Nuclear Decommissioning Authority (NDA) took strategic responsibility for the decommissioning and cleans up of all 20 of the UK’s civil nuclear sites. Established by the Government under the Energy Act 2004, the NDA will not itself undertake remediation. On the sites previously under British Nuclear Fuels Ltd. (BNFL) ownership, the work would initially be contracted out to the various businesses under the BNFL Group. In
the future, these contracts will be subject to fair and open tenders from suitably qualified organisations.

As regards disposal of LLWs, a near surface disposal facility is located at the engineering vaults at Drigg in Cumbria and is operational since 1959.

The UK Government has set up a Nuclear Decommissioning Authority (NDA) which will be responsible for managing public sector civil nuclear liabilities.

With respect to ILWs, the UK Government has initiated a consultation process with all the actors involved for a review of the decision to reject the proposal for construction of a Rock Characterisation Facility (RCF).

On disposal of HLWs, no sites have been identified and the UK Government is currently reviewing the various concepts available for disposal.

1.5. Response of the International Community

As seen earlier, the fallout of an ever increasing nuclear arms race coupled with large-scale civilian use of nuclear energy led to production of unmanageable amount of radioactive waste. Moreover, given the problems of land-based nuclear waste storage facilities, the vast expanse of the oceans appeared as the most logical and easily available site for dumping. From 1945, when the first dumping exercise was reported to have been undertaken\textsuperscript{20} to

\textsuperscript{20} The first reported dumping operation took place in the North-East Pacific Ocean, eighty kilometres south of California.
the early eighties the United States, the United Kingdom, France, erstwhile Soviet Union (now Russian Federation), Germany, Japan, Netherlands, Switzerland, Belgium, Italy, Sweden and South Korea have undertaken dumping of radioactive wastes at sea.21

Despite these practices many continue to view the oceans as a pristine place, worthy of worship and absolute protection. Towards this end, a number of international efforts have been undertaken opposing radioactive dumping into the sea. Besides, this aspect of sanctity, it is believed that human control over radioactive wastes is well impossible, once dumped into the oceans.

1.5.1. Institutional Response


Every State shall take measures to prevent pollution of the seas from the dumping of radioactive wastes, taking into account any standards and regulations which may be formulated by the competent international organisations.

Owing to various reasons, but mainly due to the intransigence of developed States the debate of radioactive waste dumping has continued unabated. There was a growing feeling among States that genuine human development required equal respect for the protection of the environment and earth’s resources.

The United Nations Conference on Human Environment (UNHCE) held in Stockholm in 1972,\(^{22}\) a culmination of these efforts adopted a Declaration on Human Environment and Development. Principle 7 of the Declaration reads:

States shall take all possible steps to prevent pollution of the seas by substances that are liable to create hazards to human health, to harm living resources and marine life to damage amenities or to interfere with other legitimate uses of the sea.

This definition placed a general duty on all States to prevent marine pollution. The definition owes its origin to the IMCO/FAO/UNESCO/WMO/WHO/IEA/UN Joint Group of Experts on the Scientific Aspects of the Marine Pollution (GESAMP).\(^{23}\) This body coined a comprehensive definition of marine pollution, which stated:

[Pollution] is the introduction by man directly or indirectly, of substances or energy into the marine environment (including estuaries) resulting in such deleterious effects as harm to living resources, hazards to human health, hindrance to marine activities including fishing impairment of quality for use of sea water and reduction of amenities.


\(^{23}\) GESAMP Report Study No. 39; Also see generally GESAMP, *The State of the Marine Environment* (London, 1990).
Although it is widely accepted that Stockholm was less anthropocentric than Rio, it was Principle 21 of the Stockholm Declaration that guaranteed the rights to the developing world, even as they resolved to protect the global environment. It read:

States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other states or of areas beyond the limits of national jurisdiction.

It basically provided the right to each state to exploit its natural resources, but with due regard to ensure that activities within their control do not cause damage to the environment of other states. This element of due regard is of fundamental importance in terms of ensuring the protection of coastal states’ interest and also “commonly shared resources of the high seas”.

More specific to the study at hand, it may also be recalled here, that it was the Stockholm Conference that called for drawing up a registry of radioactive emissions and increased international co-operation for radioactive waste disposal. Recommendation 75 on ‘Identification and Pollutants of Broad International Significance’ provided that without reducing in any way their attention to non-radioactive pollutants, Governments should:

(a) Explore with the IAEA and the WHO the feasibility of developing a registry of releases to the biosphere of significant quantities of radioactive materials; (b) Support and expand, under the IAEA and appropriate
international organisations international co-operation on radioactive waste problems.

1.5.2. Normative Response

Though the study of "the international law of environment" is a recent offshoot of the main body politic of international law proper, rudimentary elements are found in the general principles of law and judicial decisions reflective of customary international law.

Customary international law prohibits transboundary damage to another state through the principles of sic utero tuo ut alienam non laedas (do not keep substances under your control in such a way that it may cause harm to your neighbour), good neighbourliness, good faith and other general principles of international law. These customary proscriptions are dealt in detail in Chapter I of the study.

Pollution has been characterised as a abuse of rights or disregard of one's legitimate rights. Based on the principle of "no harm", customary international law offers few illustrations, which have upheld the environmental integrity and territorial sovereignty of States.

In the Trail Smelter Arbitration involving a dispute between Canada and United States over escape of noxious fumes from the

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26 3 UNRIA, 1905 (1938 and 1941).
United States, the Tribunal *inter alia* observed that under principles of international law, as well as that of the United States:

...No State has a right to use its territory in such a manner as to cause injury by fumes in or to the territory of another or the property or persons therein, when the case is established by clear and convincing evidence.\(^{27}\)

In another celebrated case, the *Corfu Channel Case*,\(^ {28} \) that came before the International Court of Justice (ICJ) involving a dispute between United Kingdom and Albania, wherein Albania had placed mines in its territorial waters, the Court held “that every State has an obligation not to allow its territory to be used for acts contrary to the rights of other States”. Commenting on the ICJ judgement in the *Nuclear Test Cases*\(^ {29} \) (*Australia and New Zealand v. France*) in (joint and separate applications) Judge Jimenez de Arechaga held that “A state substantially affecting other States by emanations from within its borders - nuclear tests, fumes, air or water pollution, diversion of waters – is not abusing its own rights, but interfering with the rights of the another, for it is the integrity and inviolability of the territory of the injured state that is infringed”.\(^ {30} \) And lastly in the *Lake Lannoux Arbitration*\(^ {31} \) involving a dispute between Spain and France over the feeding of the waters of River Carol for agricultural and hydro-electric generation

\(^{27}\) Ibid., p.1965.
\(^{28}\) *International Court of Justice (ICJ) Reports*, (1949), p. 4.
\(^{29}\) *ICJ Reports* (1973) and (1974).
\(^{31}\) 24 *International Law Reports (ILR)*, 1957, pp. 101, 130, 132 and 138-139.
purposes, the Arbitral Tribunal called upon both the Parties to undertake good faith consultations to resolve their differences.

Despite the time-tested usefulness of these decisions regulating transboundary pollution, one is often sceptical whether these judicial decisions have contributed to the customary evolution of the principle of 'no harm'? This is not to deny that they have in many ways influenced the views of the international community wherein many of the rationae materiae finds reflection in domestic judicial decisions and also various principles found in international treaties and multilateral environmental agreements.

However, the greatest contribution of these judicial decisions has been in setting a normative standard for international decision-making, whereby new principles of environmental law evolved. For example, the Trail Smelter ratio of using one's own territory in such a way that it causes no detriment to others finds reflection in Principle 21 of the Stockholm Declaration, which similarly provides a normative basis for exploitation of one's own resources without causing damage to environment beyond national boundaries. This principle, which is recognised by many as reflective of customary law was further strengthened by the norm of "sustainable development" coined by the Brundtland Commission at the Rio Conference in 1992.

Sustainable development could be an apt remedy for controlling ocean dumping of radioactive wastes as it proposes
"development in such a way that you do not jeopardise the needs of future generation".

The evolving principles of international environmental law have further strengthened this normative prohibition for transboundary damage. These include the precautionary rule, duty of prevention, polluter pays principle as well as the principle of inter-generational equity. Chapter II of the study is exclusively devoted to the evolution of these customary rules as well as general principles of international environmental law.

These principles have also given a new dimension to the understanding of 'development', which is relevant to lesser developed and developing countries who being late entrants in the field of industrialisation, have taken a much longer period to cope with their basic developmental problems. While we witness to an extent and experience the economic benefits of increasing globalisation and liberalisation, it cannot be denied that a global village has created two unequal worlds.

One, enjoys the benefits of unabated economic growth because of technological advancement and the other, lives in stark hunger burdened with pressures of ever-increasing population growth and attendant poverty. A large number of developing countries have been unable to undertake structural adjustments with the market driven forces of globalisation, resulting in widening the inequalities of income and growth. The main priorities of these countries were and remain supply of the necessities of life, health
and education. While undertaking poverty alleviation programmes, they have been often forced to overlook concerns of sustainable development.

1.6. Scientific Understanding on the Effects of Dumping

The International Atomic Energy Agency (IAEA)\textsuperscript{32} is the competent international organisation under the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (hereinafter the London Convention).\textsuperscript{33} Such competence involves “responsibility for defining high level radioactive wastes or other high level radioactive matter which is unsuitable for dumping at sea (Annex I of the London Convention) and for making recommendations to Contracting Parties about the issue of permits for dumping radioactive waste or other radioactive matter (Annex II of London Convention). It defined HLWs as:

For the purposes of Annex I to the LDC, HLWs or other high levels radioactive matter unsuitable for dumping at sea as follows:

(1) Irradiated reactor fuel; liquid wastes from the first solvent extraction cycle of chemical processing of irradiated reactor fuel; or equivalent processes; and solidified forms of such waste; and

(2) any other waste or matter of activity concentration exceeding:

\begin{itemize}
  \item a. $5 \times 10^{-5}$ TBq.kg\textsuperscript{-1} for alpha emitters;
\end{itemize}

\textsuperscript{32} See generally, IAEA, ed., Nuclear Law for a Developing World (Vienna, 1969); also See S. Bonotto, Ten Years of Investigation on Radioactive Contamination of the Marine Environment, (IAEA, Vienna, 1981).

\textsuperscript{33} International Legal Materials (ILM), vol. 11 (1972), pp. 262 -315.
b. $2 \times 10^{-2}$ TBq.kg$^{-1}$ for beta/gamma emitters with half-lives of greater than one year$^1$ (excluding tritium); and

c. $3$ TBq.kg$^{-1}$ for tritium and beta/gamma emitters with half-lives of one year or less.

The above activity concentrations shall be averaged over a gross mass not exceeding 1000 tonnes. Materials of activity concentration less than those in para 2 shall not be dumped, except in accordance with the provisions of the Convention (Annexes II and III thereto) and the recommendations set out in this document. The maximum dumping rate into a single ocean basin of volume $10^{17}$ m$^3$ shall not exceed $10^8$ kg per year.

This quantitative definition of radioactive wastes suitable for disposal was severely criticised. The logic in defining this upper limit on the basis of toxicity and radioactive longevity, it was felt, was purely scientific, although it cannot be denied that the IAEA, the International Commission for Radiological Protection (ICRP) and the London Convention comprising powerful States have some form of symbiotic relationship.

One of the issues that has been left unconvered is that of "dose upper bound"$^{34}$. It may be noted that although dosage of 1 milli seivert (1 mSv.a$^{-1}$) to individuals who was used for arriving at a quantitative definition of the wastes unsuitable for dumping, there does not exist and internationally accept definition of dose upper

$^{34}$ The concept of upper bound and the principles underlying their derivations are discussed in IAEA Safety Series No. 77, *Principles for Limiting Releases of Radioactive Effluents in to the Environment*, (Revision of Safety Series, No.45).
bound. For these reasons, apart from dosage receive from ocean dumping, the public also be exposed to radioactivity from other sources. Therefore, there arises a need for superscribing or placing an upper limit/upper bound for dosage received from ocean dumping.

However, as such dose upper bound for ocean dumping has not been established, it would be necessary for national authorities to establish an upper bound substantially lower than 1 milli seivert. This remains the most challenging task as lack of an international standard for dosage upper bound could lead to a situation where each country would have differing dosage upper bounds.

A more convincing argument was that the safety of radioactive waste disposal was more dependent on the Recommendations on Nuclear Safety provided by the IAEA. The oceanic models prepared by the GESAMP and the IAEA had provided the basis for the recommendations of the IAEA, on which national authorities were able to make assessments required for being able to issue special permits for dumping. A broader discussion on the “IAEA Recommendations on Safety and Dose-upper Bounds” is undertaken in Chapter III of the study.

The IAEA recommendations are based on the radiological certification given by the ICRP, which is the competent

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international body that recommends the principles of radiation protection. These principles among others include the primary objective to protect humans and their environment, both now and the future from potential hazards arising from such wastes.

The Joint Convention on the Safety of Spent Fuel Management and Radioactive Waste Management, 1997 provides that radioactive wastes should:

- Limit the risks to humans at an acceptable level;
- Risks to humans beyond national borders would not be greater than those acceptable in the country of release;
- Provide protection to the environment;
- Limit the radiological burden on future generations; and
- Ensure putting in place appropriate legal and institutional framework for regulation of nuclear industry.

However, it is seen, that scientific bases alone do not solve the issue in lay minds. A large number of smaller donee i.e. waste receiving States like the Pacific Island states, also demanded a social, economic and legal understanding of the implications arising out of waste dumping.

The major causes for human anxiety can be commonly traced to (a) pre-existing images of the holocaust caused by the atomic bombs dropped on Hiroshima and Nagasaki; (b) the unwillingness to accept as foolproof the fail safe methods of ocean disposal of radioactive wastes; and (c) lastly, the uncertainty and inability of the scientific community to accurately forecast the

immediate and long term effects of radionucleides on human and non-human genetic processes.

Scientists have long held the view that public fear and wariness cannot be eliminated by a rational probabilistic assessment of risks caused by radioactive waste dumping. Mathematical and scientific explanations or assurances of safety mean little to the common lay mind. The clear bottom line is do not dump if you are not sure of the consequences.

Bearing in mind that eventually the dumping of radioactive wastes at sea will lead to the release of radioactive material into the marine environment, the London Convention Expanded Panel of Experts on Disposal of Low-level wastes setup in 1985, had recommended that the IAEA should evaluate the comparative assessments, submitted by Contracting Parties, of the disposal on land and dumping at sea options for the management of LLWs. In response, the IAEA issued IAEA-TECDOC-562 largely based on the effects of radiation on human beings and the marine ecosystem as a whole and justified dumping of low level wastes at sea.

Besides, the (GESAMP) too was requested by the London Convention to undertake an examination of the parallel between land-based as well as ocean based disposal of radioactive wastes in the marine environment. In response, the GESAMP like the IAEA followed the human based radiation effect approach and did not take into consideration the effects of radioactive material on the marine life, plants and the marine eco-system as a single unit. It
would suffice to say that the two scientific bodies did not take into consideration the precautionary approach provided under the London Convention and general international law and largely relied on a cost benefit analysis wherein harm to the oceans as well as the assimilative capacity of the oceans could be minimised by human intervention. These aspects have been dealt in greater detail in Chapter III of the study.

Based on the international public opinion generated at the Stockholm Conference, soon thereafter, the London Convention was adopted and entered into force in 1975. It defined “dumping as the deliberate disposal of wastes or other matter from vessels, aircraft, platforms or other man-made structures and does not include disposal to the sea from land-based sources”.

The principal aim of the London Convention is to provide a comprehensive international legal framework for preventing marine pollution by dumping. However, it does not provide an international compliance mechanism like the one in Montreal Protocol on Depletion of the Ozone Layer. It calls upon national authorities to issue permits before any hazardous material can be declared fit for dumping. It provides for a listing system of black, grey and white lists on the basis toxicity and bio-accumulative capacity of radioactive substances. The London Convention also provides an institutional mechanism of the Meeting of Consultative Parties, which is the highest policy making body.

Owing to reports of radioactive pollution of the seas, as well as the influence exerted by the United Nations Conference on Human Environment, dumping of HLWs was prohibited by a self-imposed moratorium in 1983.

The Convention underwent further changes when a Protocol was adopted in 1996 (not yet in force) which provides for a reverse listing system implying that all dumping is prohibited, unless explicitly permitted by the precautionary approach embedded in the Protocol. In 1993, the IGPRAD unanimously adopted an amendment to the London Convention banning dumping of radioactive wastes and other wastes. In their "final and comprehensive statement" the IGPRAD stated that:

The diffusibility of the wastes and radionuclides in the sea water which could result in transboundary transfer of these radioactive materials, as well as the comparative difficulty of monitoring radioactive wastes packages dumped at sea...consideration of these characteristics, together with the relative difficulty of retrieval, a necessary part of any assessment of sea disposal option.

The London Convention has also influenced by Part XII of the United Nations Convention on the Law of the Sea, 1982, wherein it provides a comprehensive framework prohibiting pollution by

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39 Resolution LC.51 (16) Concerning Disposal at Sea of Radioactive Wastes and Radioactive Matter. France, the United Kingdom, Belgium and China abstained but later accepted it. The Russian Federation has also abstained and not accepted Resolution LC.51 (16) although they announced in November 1997 that they would lift their reservation very soon. On 17 May 2005, the Russian Federation informed the Secretary General of the IMO that they had accepted the amendments to the Convention contained in resolution LC. 51(16).
40 See n. 4, pages 6 and 7.
dumping and calls upon States to adopt national legislation consistent with international standards and rules.

Along with this international legal framework, a number of regional agreements governing ocean dumping have been adopted by the UNEP Regional Seas Programme comprising different regions of the world. Chapter IV of the study will devote greater attention to the role played by the United Nations Environment Programme (UNEP) and its programmes towards regulation of radioactive dumping of wastes by regional conventions.

Even as a global regime to regulate dumping of radioactive wastes disposal is put in place, the available choice of disposal options continues to be a hotly debated topic. States zealous of their sovereignty, as well as aware of their domestic concerns continue to search for the ocean-based disposal options for radioactive wastes. Although there is a moratorium in place, some states have kept their option open for continuing disposal of ILWs and LLWs at sea. The conclusion of the work of the IGPRAD has to a large extent brought this debate to a successful end.

For the purpose of this study, at least five major lacunae or flaws in the understanding of the international community have been identified, which include:

(i) dumping is a deliberate act and its effects continue to be viewed in an anthropocentric manner;

(ii) the existing legal framework does not provide for remedial measures by means of liability or
compensation for present and future damage to man and environment;

(iii) right to life as well as right to clean and healthy environment are non-derogable in nature;

(iv) although global rules exist, regional efforts continue to adopt different standards and there is a lack of harmonisation of international rules and standards; and


1.7. Scope and Objective of the Study

It is against this backdrop, that the study undertakes: (a) a study of an institutional response of ocean based dumping, especially the London Convention; (b) an evolution of regional and an international regime governing ocean dumping of radioactive wastes; and (c) an analysis of the various liability regimes available, including damage caused to the global commons (oceans).

The study would only concentrate on the regulation of radioactive wastes generated through civilian use of nuclear energy. It would be extremely difficult to include military wastes, for the simple reason that global and regional rules govern civilian use and information on military use is largely classified and not available.

1.8. Methodology

The present study would follow a historical, legal and policy-oriented approach to the study of ocean dumping. During the course of study original sources such as UN documents and other
documents pertaining to the International Maritime Organisation (IMO), International Atomic Energy Agency (IAEA), International Law Commission (ILC) and other organisations is examined.

While probing into customary law proscriptions, the institutional functioning of the IMO, as well as the London Convention is examined.

1.9. Chapterisation

For the sake of convenience, the present study is divided into six chapters.

Chapter 1 provides an introduction to the problem of waste disposal and a summary of the international community response to ocean dumping of radioactive wastes.

Chapter 2 deals with the international law, both customary proscriptions and conventional, which regulate ocean dumping as a deliberate polluting act.

Chapter 3 analyses the growth of the London Dumping Convention and the various institutional efforts of the Consultative Parties to establish an Intergovernmental Panel of Experts on Radioactive Waste Disposal at Sea.

Chapter 4 deals with the regional efforts at combating ocean dumping of radioactive wastes, which essentially involves the role of the UNEP Regional Seas Programme.

Chapter 5 looks at the international liability regime that exists and futuristic models that address radioactive pollution of the oceans.
In the light of the views proffered in the study, the final Chapter 6 draws conclusions on the future of ocean dumping as a policy measure.