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TRANSPORT REGULATIONS OF DANGEROUS SUBSTANCES
WITH SPECIAL EMPHASIS ON CLASS-7
RADIOACTIVE MATERIAL

by

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PANAMA

A paper submitted to the Faculty of the WORLD MARITIME UNIVERSITY in partial satisfaction of the requirements for the award of a

MASTER OF SCIENCE DEGREE
in
GENERAL MARITIME ADMINISTRATION

The contents of this paper reflect my personal views and are not necessarily endorsed by the University.

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ACRONYMS

U.N. United Nations
WHO World Health Organization
IAEA International Atomic Energy Agency
ICAO International Civil Aviation Organization
IMO International Maritime Organization
ILO International Labour Organization
ISO International Standards Organization
ECOSOC U.N. Economic and Social Committee
COE U.N. Committee of Experts on the Transport of Dangerous Goods
UPU Universal Postal Union
MSC IMO's Maritime Safety Committee
CDG IMO's Subcommittee on the Carriage of Dangerous Goods
IMDG Code International Maritime Dangerous Goods Code
ECE Economic Commission for Europe
ICS International Chamber of Shipping
P & I Club Protection and Indemnity Club
SOLAS Safety of Life at Sea
STCW Standards of Training, Certification and Watchkeeping.
MARPOL Marine Pollution
SAR Search and Rescue
OCTI Central Office for International Rail Transport
RID European Regulations for the Safe Transport of Dangerous Goods by Rail
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADR</td>
<td>European Regulations for the Safe Transport of Dangerous Goods by Road</td>
</tr>
<tr>
<td>ADN</td>
<td>European Regulations for the Safe Transport of Dangerous Goods by Inland Waters</td>
</tr>
<tr>
<td>OECD</td>
<td>Organization for Economic Co-operation and Development</td>
</tr>
<tr>
<td>NEA</td>
<td>OECD's Nuclear Energy Agency</td>
</tr>
</tbody>
</table>
transferred to low-cost (manpower, taxes, etc.) countries.

Goods, industries from developed countries are been
needs of the world population, especially manufactured
commercially, as world production increases to satisfy the
definition of "dangerous" and which are produced in
one hundred thousand chemical substances which fall under
hazardous for transportation. Today we easily reach over
carriage by ships of just a few goods considered to be
national effort of the British Government to regulate the
dangerous goods was made in Maritime Law. As part of the
Almost a century ago (1894), the first reference to

Today and for generations to come,
agencies, holds significant implications for the world of
freedom, services, training institutions and control
manufacturers, contractor terminals and packing centers,
warehouses and terminals, forwarding agents,
competent authorities, ships, ports and port areas.
The adoption of the IMDG Code by administration,

By sea,
manage and regulate the transport of dangerous substances
internationally to achieve a single, practical way to
century of effort by shipping authorities to achieve
ports. The IMDG Code is the culmination of the
shorts of their flag and to all ships calling at their
dangerous goods by sea, and apply its provisions to all
technical code of practice concerning the carriage of
dangerous goods (IMDG Code), which is the principal
implemented the provisions of the International Maritime
80 per cent of world shipping, have adopted and
In 1988, some fifty countries, representing more than

INTRODUCTION
Those production processes are not precisely high-tech-low pollution risk industries, but high pollution emission industries.

The present situation of transport safety in most of ports and waterways of developing countries are said to require considerable improvements. One part of the overall safety of ships and ports is the question of how to manage the safety in transport of dangerous cargoes. How to manage the transport of dangerous substances, specially in the land interface, what the implications are and how they will affect future shipping operations are explore in this paper. The main premise of this paper is that an improvement of safety in this area of port and shipping management would mean a significant enhancement of the general safety situation.

Over the last two decades, ports and shipping have, in the one hand, faced two major influencing factors which had a decisive impact in relation to the safe transport, handling and storage of dangerous cargoes in ports and terminals:

(a) There is the enormous increase in the amount as well as in the different types of chemicals and other dangerous goods carried by sea. Reliable statistics are not available, but the estimated in tons has been in the range of one thousand percent since World War II, and the number of different dangerous goods commonly transported may be anything near the 100,000.

(b) There has been an unprecedented development in marine transport technologies e.g. the
containerization or the specialization in shipping with many different types of ships, requiring special port handling facilities.

In the other hand, managerial philosophy and personal attitudes of port and shipping managers worldwide has change little. Specially in ports and shipping companies of developing countries short-term profitability rules over safety. To make the current financial quarter look better at the expense of the future, to sacrifice the future to make this year bottom line a little more attractive is the goal of managers. Consequently, financial resources and the attention of the management are focused on investments which effect productivity increases. The long-term effects of safety investments on a positive productivity development are not yet appreciated.

The changes in transport technologies have absorbed the bulk of port investments. The port management concentrated in these developments, with safety in transport matters being of secondary interest. The increase in short-term profitability has been the main objective of port management.

The huge growth in the amount and different types of dangerous cargoes has been recorded in industrialized as well as in developing countries. The impact has been stronger in developing countries ports due to:

- higher population growth rates
- the tendency to transfer production plants, specially those with high pollution risks, to low-cost
Due to financial pressures on ports and lower technical training of port personnel, the transport of dangerous goods via ports of developing countries is not matched by the appropriate awareness. This was caused by and resulted in: a) inadequate legal framework and administrative procedures; b) a lack of appropriate port facilities; c) unsafe operational performance; d) non-availability of training programs.

After World War II, developments on the chemical industry have been accelerated and also the seriousness of potential accidents.

In the summer of 1984 M/V Mont Louis with a cargo of UF\textsubscript{6}, (Uranium Hexafluoride) sank in front of the Belgian coast. UF\textsubscript{6} is one of the stages in the nuclear fuel cycle and when enriched it becomes UO\textsubscript{2}(Uranium dioxide), the nuclear fuel. Due to its properties UF\textsubscript{6} does not explode, but in contact with water it reacts and becomes highly toxic. Any breakage of the containments would have caused disastrous effects on marine life and marine environment.

It is estimated that more than six thousand new chemicals are produced in the world each week, although only a small percentage of them are produced commercially ... (yet).

If the forecast for industrial production made by the World Commission on the Environment and Development holds "The world manufactures seven times more goods today than
it did as recently as 1950. Given population growth rates, a five to tenfold increase in manufacturing output will be needed just to raise developing-world consumption of manufactured good to industrialized world levels by the time population growth rates level off next century.

Trade and specially the international sea-borne shipping of cargoes has increased about sevenfold since 1945. and still more relevant dangerous goods transport has grown at least tenfold.

The paper has been divided into two main parts. Part I deals with the transport of dangerous goods in a logical sequence. Chapter one starts with what is understood by dangerous goods and its effect in the human body, the production of chemicals and hazardous substances, some accidents and incidents are described as corollary to the need to regulate the transport of these substances. Chapter 2 describes in some detail the international and national organizations working at present with the transportation of such goods in all modes of transport. Chapter 3 deals with the regulations contained in the 1974 SOLAS Convention, the work of the ECOSOC Committee of Experts on the Transport of Dangerous Goods, and the sea-mode regulations of the subcommittee on the Carriage of Dangerous Goods (CDG) of the MSC of IMO. Chapter 4 deals with the carriage of dangerous goods in packaged form and the provisions of the IMDG Code.

Based on experience gathered during visits to some European ports and a period of on-the-job training, chapter 5 describes an organization for the management of dangerous goods.

Part II of this paper deals specially with the
transport of class 7, Radioactive Materials. The literature on this particular subject is abundant, but some is too technical and the rest is addressed to the general public. An attempt was made in chapter 6 to systematize the international organizations in the field of nuclear trade. Chapter 7 analyses the transport of radioactive material regulations regardless of the transport mode. Chapter 8 deals with the regulations for the sea-leg of the transport of radioactive materials.

In case of nuclear damage to people or property international regimes for third party liability and insurance are described in chapter 9.

Regulations exist and are there to be implemented. Countries adhere to them and still accidents are frequent due to carelessness, negligence or lack of knowledge and training in the handling, storage, segregation and stowage of dangerous substances in all modes of transport. Political will and adequate national laws are needed in order to enforce regulations worldwide.

During 1960's and '70 the debate over the environment and nonrenewable resources has raised our collective consciousness about the dangers of the short-term approach. Fortunately, younger generations have become more sensitive to the longer-range implications of our short term actions.
PART I

TRANSPORTATION OF DANGEROUS GOODS
THE NEED FOR WORLDWIDE REGULATIONS

1. WHAT IS DANGEROUS GOODS?

Many expressions have been in use to describe those freights that can cause injury or damage to people, property and the environment when improperly handled: "dangerous cargoes, hazardous goods, dangerous goods, hazardous substances," etc are just a few.

A general definition of the term "Dangerous Goods" (DGs onwards) is not so simple, however, the following general definition, given by L. Kindhal is taken here as a guideline:

"A commodity or an article possessing chemical or physical properties, by which it itself or in contact with other substances, e.g. air or water, may cause injury or damage to humans, environment, material or other cargo." 1/

The risk for human injuries is always the first criterium used when determining whether a commodity or an article should be classified as dangerous goods. The following are various possible injuries to humans caused by DGs:

Corrosion ........ to the respiratory tract
Corrosion ........ by eye contact
Corrosion ........ to skin
Poisoning ........ by ingestion
Poisoning ........ by skin absorption
Burns .......... from fire
Body injuries .... by explosion
Frost-bite ........ by skin contact
Radiation .......... by radioactive substances

From the above it could be concluded that dangers involved can be subdivided into the following groups:

Fire .... including explosion and oxidation
  i.e., support of combustion.
Poisoning
Radiation
Corrosion

Many cargoes may pose a pollution treat to the environment, specially to the marine environment, where pollution substances are dispersed through the ecosystem by various processes, whereupon they affect the living resources and marine activities such as fishing, amenities, etc. Many of the DGs are also marine pollutants.

In the past many incidents have occurred which involved such substances. The most notorious of the incidents happened, as reported by Brunning, K.,2/ in the summer of 1984 when the ro/ro MV Mont Louis sank after a collision in front of the Belgian coast. She was carrying a cargo of class 7. UF6 (Uranium hexafluoride) whilst being mildly radioactive, also presents a severe corrosivity hazard in the presence of water or moisture.

More recently, in March 13th 1989, the Indonesian-owned M/V Perintis sank 30 miles northwest of the Channel Islands in the English Channel 3/. She was carrying
several consignments of chemicals likely to pose a threat to the marine environment. These included six tonnes of the pesticide "lindane" stowed in a container on deck and one and 0.6 tonnes of the pesticides "permethrin" and "Cypermethrin" respectively stowed in drums in the cargo hold below deck.

Lindane poses a particular hazard to aquatic life. It is one of the almost 400 chemicals listed as extremely hazardous substances by the US Environmental Protection Agency. It is banned in four countries and severely restricted in seven others, it is a persistent pesticide and permeates through the food chain. Two months after the sinking of the Perentis the box containing the Lindane cargo had not been found, in spite of the efforts of the French and English Authorities in which waters the box sank after being towed by a French tug.

For sea transport purposes, substances can be subdivided into:
1. The three states of matter,
2. The forms they are carried in,
3. The type of ships in which they are transported.

The three states of matter are scientifically defined and are: the gaseous, liquid and the solid states. Due to the tremendous volumes gases occupy, they are transported in liquefied form which has been obtained by pressure, by refrigeration or by a combination of both.

2. In principle, the sea transport differentiates between bulk cargoes and packaged cargoes.

- Bulk cargoes are those carried without any interme-
- Packaged cargoes are those which are transported together with their packaging which may be a drum, a box, a bag, etc., but which also include freight containers, portable tanks or similar containments.

3. Bulk cargoes are generally carried on purpose-built vessels, like tankers, gas carriers, bulk carriers, etc. Bulk cargoes in smaller quantities may also be carried on general cargo or container vessels.

Packaged goods are transported on general cargo ships, on ro/ro and container ships or on barge carriers. Mixtures of these ship types are frequent, e.g. the container/bulk vessel or the semi-container ship.

DANGEROUS SUBSTANCES

DANGEROUS GOODS

Are carried in packagings, freight containers, tank containers, portable, road and rail tanks, vehicles, waggons, and barges.

BULK DANGEROUS SUBSTANCES

Are carried mainly in purpose-built ships and/or in fixed tanks and comprise flammable, liquids, dangerous chemicals, liquified gases and dangerous solids.

Thus, after the above classification a more maritime oriented definition of DGs can be given, according to Brunning, K.:
"DANGEROUS GOODS are all those cargoes which are loaded on vessels in an intermediate and non-stationary containment, e.g. a drum, a freight or tank container, palletized cargo or other, and which have defined hazards."  

2. STATUS OF THE PRODUCTION OF CHEMICALS AND OTHER HAZARDOUS GOODS

Recent developments, especially those in the field of chemical technology, have led to a sharp increase in the amount of freight consisting of substances that create a hazard to human health, to property and to the environment if they are allowed to escape during transit.

As the world becomes increasingly industrialized, especially the type of industries in the developing countries, and as industry itself becomes even more complex, in the developed countries, and the amount of industrial waste increases, so the transport of dangerous substances and wastes will continue to rise and the list of cargoes transported will grow.

World trade in chemicals and other hazardous materials is enormous, and it is expanding continuously.

Although, reliable statistics are difficult to piece together some figures which indicate the magnitude of this traffic are available. While the international sea borne shipping of cargoes has increased about sevenfold since 1945, dangerous goods transport has grown at least tenfold.
Not only quantities, but the range of types of hazardous cargoes are increasing rapidly. "... it is estimated that some 6,000 new chemical substances are introduced to the world each week", 6/ although only a small percentage of them is produced commercially.

A few years ago, over 70,000 chemicals were counted which were in daily use, drugs and medicines not included. Today we easily reach over 100,000 chemical substances which fall under the definition dangerous and which are produced commercially. 7/

At the beginning of the 1980's total rail freight traffic worldwide amounted to more than six billion (6x10^12) tonne-km a year, which indicates the magnitude of risks during transit of DGs transported on rail. IMO has estimated that in 1983 approximately 3,600 million tonnes of cargo, about 75 percent of all cargoes exported in the world, were transported by sea, about half of this was classed as dangerous, hazardous and/or potentially harmful to the environment. 8/

The port of Hamburg, FRG, alone handled 200,000 tonnes of packaged dangerous goods and 500,000 of dangerous chemicals in 1979. During 1983, almost 10 million tonnes of dangerous goods passed through ports in Cuba, which represented about 70 percent of all goods handled there.

These are isolated examples. Statistics for other modes of transport and other countries and ports are similar.

This "expansion" of the Chemical Industry production has also brought new developments in the carriage of
goods in all modes of transport and in the functions and dimensions of ships as well as the way ports handle cargoes.

3. THE HAZARDS OF DANGEROUS GOODS

"It is instructive to trace some of these safety precautions back to the original incidents to remind ourselves of the circumstances in which failure to observe simple basic rules and precautions produced great tragedies with enormous loss of life and the devastation of ports and neighbouring communities." 7

There has been numerous occasions when ships loaded with DGs have exploded. These have usually occurred on warships, but several of the worst disasters have involved merchant ships. Safety precautions for DGs in ports are often instinctively accepted as a kind of folklore by harbour authorities, mariners and berth operators, without conscious realisation of the disastrous train of events that led to their adoption.

SUMMARY OF MAJOR PORT INCIDENTS INVOLVING DANGEROUS GOODS

<table>
<thead>
<tr>
<th>Place</th>
<th>Date</th>
<th>No. Deaths</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Santander</td>
<td>1893</td>
<td>510</td>
<td>Detonation of commercial explosives</td>
</tr>
<tr>
<td>Archangel</td>
<td>1917</td>
<td>1,500</td>
<td>Detonation of military explosives</td>
</tr>
<tr>
<td>Halifax</td>
<td>1917</td>
<td>+2,000</td>
<td>Detonation of military explosives</td>
</tr>
<tr>
<td>Bari</td>
<td>1943</td>
<td>+1,000</td>
<td>Escape of mustard gas</td>
</tr>
</tbody>
</table>
Bombay, 1944

The freighter Jala Padmu was carrying 1,400 tons of explosives when she entered Bombay harbour. Her cargo also included a large quantity of cotton. Cotton sounds innocuous enough, but as the IMDG Code points out: "... its is liable to spontaneous combustion, especially when contaminated with oil ..." and several drums of oil had also been loaded on to the ship and were separated from the cotton only by a badly-fitting sheet of tarpaulin.

Fire broke out, perhaps through spontaneous combustion. There were two explosions, as a result of which 1,250 people were killed and 15 ships destroyed or damaged.

Texas City, 1947

Ammonium nitrate, beside being raw material for the production of various explosives, is used as an agricultural fertilizer. In the immediate post-war period
vast quantities were shipped from the United States to Europe.

In April, 1947 the freighter Grandcamp was being loaded with Ammonium nitrate in the port of Texas City. Fire started in one of the holds. Enough water was not available at the moment, a two gallon fire extinguisher was used. This failed to quell the blaze. The ship's master refused to allow a hose to be used on the grounds that the water might damage the cargo. As a result the fire spread and in less than an hour later the ship exploded with such force that two light planes flying overhead were destroyed by the blast. The explosion also blew the hatch covers off another ship, the High Flyer, which was moored 200 yards away and was carrying Ammonium nitrate. She caught fire and consequently blew up.

A total of 468 people were killed, mostly as a result of the first explosion.

Bahrain, 1957

Toe puff, a mixture of cotton or wool impregnated with cellulose, can be very dangerous in the raw state. The substance "... ignites readily. When involved in a fire, toxic fumes are involved. In closed compartments, these fumes may form an explosive mixture with air." (IMDG Code)

That is exactly what happened on board the freighter Siestan as it approach Bahrain. Fire broke out, the ship blew up, killing 57 people.
The Tacoma, 1970

The dangers of gases remaining in the cargo tanks of oil tankers are well known. But many flammable liquids give off explosive gases and the danger is not confined to the ship itself.

The Tacoma was a tank barge which regularly carried 4,000 tons of pyrolysis gasoline along the Manchester Ship Canal. In April 1970, she arrived at the Partington Basin to be unloaded. Gases in the air suddenly ignited. The liquid on the canal itself caught fire, sending flames 50 feet into the air. The Captain and five of the passengers of a small ferry crossing the canal at that moment died in the blaze and other three were badly burnt.

The accident resulted from the accidental discharge from the Tacoma of 84 tons of gasoline which poured across the deck and through the scuppers into the river.

Los Alfraques (Spain), 1978

In July 1978, a road tanker transporting liquefied Propylene sprang a leak as it passed a camp site at Los Alfraques. It was the peak of the summer tourist season and the camp site was crowded.

The leak resulted in some of the liquefied gas escaping and pouring rapidly across the camp site in a huge cloud, which immediately ignited, possibly as a result of coming into contact with flames from one of the many camp stoves in use at the time.

The explosion resulted in a fire ball some 200 yards in
diameter which was so intense that more than 150 people in the camp site were burnt to death. The devastation spread for 400 yards in all directions.

Yet the lorry carried only 43 cubic meters of liquified gas. Some ships carry 125,000 cubic meters or even more.

4. THE NEED FOR REGULATIONS

Transport of Dangerous Goods is a matter of safety, which has to be regulated in order to prevent accidents, as those described above, as far as possible.

The transport of dangerous substances is almost by definition an activity which transgresses national borders and comes within the jurisdiction of different countries. It is therefore, essential to have internationally agreed regulations.

Handling, storage/segregation (on land) stowage/segregation (on board) and the transport of dangerous cargoes must be regulated in order to prevent such cargoes from causing accidents to persons or damage to the means of transport or to other cargoes, or to the environment.

As more chemicals and other dangerous cargoes are moved about the world and attention is drawn to spillages, pollution, accidents and the potential dangers, so public awareness and concern grow, and the pressure on governments and other bodies to reduce the risks increases and leads to new regulations and requirements.

Transport whether is of people, animals, non-hazardous goods or hazardous goods, is inherently dangerous, and
often results in injury, or the death of transport workers or bystanders. Authorities throughout the world therefore exercise controls in an attempt to decrease the number of accidents which occur, and to mitigate their consequences. Such requirements include specifying:

- design requirements for transport vehicles
- and roads and railways;

and ensuring that vehicle drivers and other transport workers know the risks they face, and what to do if an accident occurs.

For the most part, however, the public ignores or is unaware of the potentials for dangers in the transport of hazardous goods. When there is an accident involving such goods, whether or not it results in injury, loss of life, or pollution of the environment, there are calls for more stringent regulations, but the public knows little of the national and international rules and regulations which already exist.

There are rules governing packaging, warning labels, inspections and documentation of consignments and handling. There are restrictions on the modes of transport which may be used for certain materials, and specifications for the training of emergency response personnel and the development of emergency response plans enabling them to identify hazards and respond appropriately if a transport accident involving dangerous goods does occur.

What it seems to be missing is the means and ways to enforce the already existing regulations, either at international or national levels.
NOTES AND REFERENCES


4/ The US Environment Protection Agency publishes, periodically a list of the most hazardous chemicals. Lindane is one of the 366 chemicals in the list.


10/ Idem, *Focus on IMO*, p. 42

11/ Ibid., p. 42-43
12/ Ibid., p. 44

13/ Ibid., p. 44-45

14/ Ibid., p. 45-46


PRINCIPAL ORGANIZATIONS INVOLVED IN INTERNATIONAL REGULATIONS FOR TRANSPORTING DANGEROUS GOODS

Organizations involved in the international regulations for the transportation of hazardous substances are mainly agencies affiliated to the United Nations. There are also others of governmental and non-governmental nature as well as regional organizations. The present paper will deal with the following organizations:

2.1 The UN System
   2.1.1 The Economic and Social Committee;
   2.1.2 The Committee of Experts on the Transport of Dangerous Goods;
   2.1.3 Regional Economic Commissions
2.2 Specialized Organizations of the UN
   2.2.1 IMO
   2.2.2 IAEA
   2.2.3 ICAO
2.3 The Transport of Dangerous Goods by Rail and Road (The European Case)
2.4 Government Organizations
2.5 Non-Government Groups

2.1 THE UNITED NATIONS SYSTEM

As mentioned above, the major effort in the formulation of worldwide regulations for the safe movement of hazardous materials is centered in the United Nations. Figure 1 shows how the UN structure is organized: from the General Assembly and the Economic and Social Council to
the Committee of Experts (COE), whose job is the upkeep of the UN recommendations on the transport of dangerous goods.

The UN system has been wholeheartedly embraced in the regulations governing sea and air transport but the regimes governing rail and road transport have been much slower to incorporate the recommendations because of the dissimilarities in approach. However, road and rail regulations have been greatly revised in recent years and will align, to a great extent, with UN by January 1, 1990.

2.1.1 THE ECONOMIC AND SOCIAL COUNCIL (ECOSOC)

The ECOSOC, Fig. 2, is the main body responsible for the economic and social activities of the U. N. It consults with non-governmental organizations concerned with matters with which the Council deals. The Council works through commissions, committees and various other subsidiary bodies. One of this bodies is the Committee of Experts on the Transport of Dangerous Goods (COE).

2.1.2 THE COMMITTEE OF EXPERTS ON THE TRANSPORT OF DANGEROUS GOODS (COE)

The COE is the competent international body for the setting of worldwide standards on the safe carriage of hazardous substances by sea, air and land including rail, road and inland waterway. These multimodal standards are known as the "Recommendations" and are contained in the "Orange Book". They are not legally binding but, taken onboard by the various international modal transport organisations' own regulations and codes, which over the
years have incorporated the UN standards in varying degrees.

The organizations concerned include: IMO; ICAO; The Economic Commission for Europe (ECE), which is responsible for the ADR regulations governing European road transport and for the ADN and ADNR systems covering inland navigation in Europe and on the Rhine, respectively; and the central office for International Rail Transport (OCTI), which oversees the RID regime.

The COE is composed of experts from Canada, France, Federal Republic of Germany, Iran, Iraq, Italy, Japan, Norway, Poland, Thailand, United Kingdom, United States of America and the Union of Soviet Socialist Republics.

The Committee supervises the GROUP OF RAPPORTEURS on the Transport of Dangerous Goods, and considers the work of the Group of Experts in Explosives. It reports to the ECOSOC of the UN, as their parent body and meets every two years. Much of their technical work is done at intermediate sessions which until recently were divided between meetings of the Rapporteurs Group and those of the Explosive Experts Group.

As for 1989 onwards these two subsidiary bodies will meet jointly as the newly constituted UN sub-committees of Experts on the Transport of Dangerous Goods. This will meet in the summer and winter of one year and then in the summer of the following year. The UN Experts themselves will continue to meet every second December.

There are inter-governmental agencies related to the U.N. by special agreement. Two of these organizations are the a) International Labor Organization (ILO) and b) the
World Health Organisation (WHO). Since one of the functions of the ILO is to improve labor conditions, it is closely associated with the work of the COE concerning regulations for the safe movement of hazardous and dangerous goods. The aims of WHO are the attainment by all peoples of the highest possible level of health. WHO has been participating actively in the work of COE with respect to the transportation of pesticides and toxic substances.

Another world organization which becomes involved in the regulations for the movement of hazardous materials is the International Standards Organization (ISO), which work closely with the U. N. in setting standards for packagings such as gas cylinders and portable tanks.

2.1.3 REGIONAL ECONOMIC COMMISSIONS

The U. N. has four regional Economic Commissions, which study the economic problems of their regions and recommend courses of action to governments on matters concerned with economic development, such as electric power, inland transport, and trade promotion. The Economic Commission for Europe (ECE), the Economic Commission for Asia and the Far East (ECAFE), the Economic Commission for Latin America (ECLAC), and the Economic Commission for Africa (ECA).

2.2 SPECIALIZED ORGANIZATIONS OF THE UNITED NATIONS

There are several specialized agencies which, although officially United Nations bodies, operate autonomously. (Fig. 3).
SPECIALIZED ORGANIZATIONS

Economic and Social Council

IAEA
International Atomic Energy Agency

ICAQ
International Civil Aviation Organization

IMCO
Inter-Governmental Maritime Consultative Organization

IATA
International Air Transport Association

Worldwide Regulations for the Safe Transport of Radioactive Substances

Worldwide Regulations for the Safe Transport of Dangerous Goods by Air

Worldwide Regulations for the Safe Transport of Dangerous Goods by Water
2.2.1 THE INTERNATIONAL MARITIME ORGANIZATION (IMO)

This organization is responsible for the IMDG Code, which was drawn up by IMCO (Now IMO) in implementation of Recommendation 56 of the 1960 SOLAS Conference. This stipulated that governments should adopt a unified international code for the carriage of dangerous goods by sea and that IMO should, in cooperation with COE, pursue studies on an international code of that nature.

Although the IMDG Code is recommendatory and has no binding force, it has gained particularly wide acceptance, having been fully adopted by the majority of countries, owning the greater part of world shipping tonnage. This Code is a prime example of the utilization of the Recommendations prepared by the U.N./COE.

In some areas of its extensive operation, IMO has no statutory power and can only draw up Recommendations and act in an advisory capacity. But among the term of reference under which it operates there is a convention that does have the status of a legal document—The International Conference of Safety of Life at Sea 1974 (SOLAS).

SOLAS 74 Convention contains a section referring to the carriage of dangerous goods by sea. Failure to comply with the terms of this treaty would mean that the case could be taken to the International Court of Justice, at the Hague.

2.2.2 INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)
Recommendations concerning the transportation of radioactive substances are prepared and brought up to date by the IAEA in accordance with the desire expressed by the ECOSOC of the U.N. at its 28th session, 1959. These recommendations are followed in the regulations for the international carriage of dangerous goods.

IAEA has published its regulations under the title: "Regulations for the Safe Transport of Radioactive Materials" (safety series 6) 1985 edition.

2.2.3 INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO)

ICAO is the UN body involved in the safe movement of hazardous materials by air. It passes on conventions of governments concerning all civil aviation matters.

2.3. THE TRANSPORT OF DANGEROUS GOODS BY RAIL AND ROAD

The transport of dangerous goods by European rail and road is regulated by RID and ADR, i.e., the Regulations for the International Carriage of Dangerous Goods by Rail and the European Agreement concerning the International Carriage of Dangerous Goods by Road, respectively, Fig.3.

Aspects of consignments and transport procedures common to the technical annexes of both RID and ADR are considered at biannual, joint meetings of the RID Safety Committee and the Economic Commission for Europe's (ECE) Group of Experts on the Transport of Dangerous Goods.

Decisions of these joint experts meetings must be endorsed by the individual RID and ADR parent bodies, i.e., the RID Committee of Experts and the ECE Working
Party on the Transport of Dangerous Goods, before they can be formally included in their respective documents for implementation. A major development currently underway (June 89) concerns the alignment of RID and ADR with the UN Recommendations on the Transport of Dangerous Goods, which provides the definitive guidance for all the international modal transport organisations. However, unlike the global regulations governing sea and air transport (IMO’s IMDG Code and ICAO’s Technical Instructions), the RID and ADR regimes’ own particular approach has made their harmonization with the UN provisions more complicated and, in consequence, progress has not been as rapid as it might. Nevertheless, a comprehensive revision attempt in recent years has led to considerable alignment of RID and ADR with the UN system.

This harmonization will take another step forward on January 1, 1990 when further amendments to RID and ADR enter into force.

2.4 GOVERNMENT ORGANIZATIONS

Within the various countries of the world there are numerous committees and bureaus set up for the preparation of recommendations and regulations concerning the movement of dangerous goods.

In the USA there is the Materials Transportation Bureau of the U.S. Department of Transportation. In Japan there is the Bureau of Safety of the Ministry of Transport. In Canada there is the Secretariat for the Transportation of Dangerous Goods of the Ministry of Transport.

Within the EEC countries there are the European
Conference of Ministers of Transport (ECMT). Each member country of the EEC belongs to the Central Office for International Railway Transport (OCTI), which in turn administers the CIM and RID regulations. The EEC countries are also members of the ADR (road) treaty, except Denmark and Ireland.

2.5 NON-GOVERNMENTAL GROUPS

2.5.1 International Air Transport Association (ATA)

Regulations concerning the movement of hazardous materials by air stem from the Restricted Articles Board of IATA. IATA is not a UN organization. The first edition of IATA Regulations appeared on January 1, 1956. As a result, an increase quantity of goods have been transported by air throughout the world under appropriate safety conditions. Although IATA is non-governmental its work has had strong government support.

2.5.2 Other Groups

In addition to the international hierarchy of the UN, ECE and EEC, there are a numerous international bodies at a non-governmental level. These are comprise mainly of chemical associations and transport interests.

- CEFIC The European Council of Chemical Manufacturers Federation. (Austria, Belgium, Denmark, Finland, France, Germany, Italy, Norway, Netherlands, Sweden, Switzerland and the United Kingdom).

- CMA - Chemical Manufacturing Association (CMA). Its membership accounts for most of the US
chemical production capacity, and has been representing the US chemical industry over the years.

- HMAC - Hazardous Materials Advisory Council (USA)
- AIMS - American Institute of Merchant Shipping.
- NCB - US National Cargo Bureau
- CTAC - US Chemical Advisory Committee
- FIATA - International Federation of Forwarding Agents is an international association of cargo forwarding agents which is constantly alert to hazardous materials regulations internationally.
NOTES AND REFERENCES

1/ Hazardous Cargo Bulletin, March 1989, "Regulations"


In addition to conventions and other formal treaty instruments, IMO has adopted several hundred recommendations in the form of codes, guidelines, standards or recommended practices dealing with a wide range of subjects.

One of the principal codes developed over the years by the Organization is the International Maritime Dangerous Goods Code (IMDG Code).

3.1 THE SAFETY OF LIFE AT SEA CONFERENCE

Regulations 1.3 of part A of chapter VII of the 1974 SOLAS Convention (1983 Amendment), which entered into force on July 1, 1986, prohibits the carriage of DGs except in accordance with the provisions of that part, thereby providing the necessary legal basis for international regulations on the carriage of DGs by sea.

SOLAS 1960

The 1960 SOLAS Conference, Resolution 56 recommended that governments should adopt a uniform international code for the carriage of dangerous goods by sea which should cover such matters as packing, container traffic and stowage, with particular reference to the segregation of incompatible substances and that IMO in cooperation with COGE, should pursue its studies on such an international
code, especially in respect of classification, description, labelling and a list of dangerous goods, and shipping documents.

SOLAS 1960, Chapter VII, deals exclusively with "The Carriage of Dangerous Goods". It applied with a few exceptions, to all ships of 500 gross tonnage or more engaged on international voyages. It envisaged a "unified international maritime code".

The safety of life at sea and the safety of the ship, its cargo and those on board are directly related to the care which is taken with dangerous substances prior and subsequent to their loading and unloading, and during their handling.

This also applies to the situation ashore, in warehouses and on the piers and terminals, i.e. all storage and handling areas.

SOLAS 1974


Part A of Chapter VII, of SOLAS 1974 as amended regulates the Carriage of Dangerous Goods by Sea in packaged form, or classified solid materials possessing chemical hazards:

Reg. 1 prohibits the carriage of dangerous goods by sea except when they are carried in accordance with the
provisions of the SOLAS Convention (Reg. 1.3) and (Reg. 1.4) requires each Contracting Government to issue detailed instructions on safe packing and stowage of dangerous goods which shall include the precautions necessary in relation to other cargo.

With regard to Reg. 1.4, a reference has been included in SOLAS Chapter VII to the International Maritime Dangerous Goods Code (IMDG Code) adopted by the IMO by resolution A.81 (IV), and to the relevant sections and the related parts of Appendix B of the Code of Safe Practice for Solid Bulk Cargoes (BC Code) adopted by IMO by resolution A.434 (XI), as have been or may be amended by the Maritime Safety Committee.

The other regulations deal with the packing, identification, marking, labelling and placarding of dangerous goods, the documents which are to be provided, stowage requirements, and the carriage of explosives on board passenger ships.

Chapter VII of SOLAS 1974 as amended provides the necessary legal basis for the International regulation of the carriage of dangerous goods by sea.

3.2 UNITED NATIONS, ECOSOC, COMMITTEE OF EXPERTS ON THE TRANSPORT OF DANGEROUS GOODS (COE).

In 1956, COE, after considering the international aspect of the carriage of dangerous goods by all modes of transport presented to the ECOSOC a report dealing with: "minimum requirements for the transport of such goods."
The UN Recommendations were based largely on existing regulations and on work undertaken by various organizations concerned with the transport of dangerous goods by a specific mode of transport. They are address to governments and international modal organizations and represent a general framework, broad and flexible enough to allow the development of new, or the revision of existing regulations in order to achieve the maximum international uniformity for the various modes of transport and to allow for unhampered multimodal transport operations.

The international regulations for the carriage of dangerous goods by all modes of transport do not yet exist. The common understanding is that "international transport of dangerous goods" takes place if a transport operation is performed in the territory of at least two states or it crosses national frontiers.

3.3 THE WORK OF IMO. THE CARRIAGE OF DANGEROUS GOODS WORKING GROUP (CDG).

Fig. 1 shows the structure of the IMO regarding regulations for the carriage of DGs.

The requirements of SOLAS 1974 as amended are supplemented by the following IMO's recommendations, guidelines, standards or recommended practices for the transport of DGs by sea:

1. Special Requirements for Ships Carrying Dangerous Goods. (Regulation 54 of chapter II-2 of the Amendments to SOLAS 1974, adopted by MSC.1(XLV) 20 Nov.)
1981, entered into force 1 Sept. 1984 according to Article VIII(b)(vii)2) of the same Convention;

2. The INTERNATIONAL MARITIME DANGEROUS GOODS CODE (IMDG) Code prepared by IMO and amended from time to time in accordance with IMO Assembly resolution A.81(IV);

3. The provisions on the packing of dangerous goods contained in Annex I to the IMDG Code;

4. The Recommended emergency procedures and actions contained in the Emergency Procedures for ships carrying Dangerous Goods (EmS), 1985 edition;

5. The advice given in the IMO/WHO/ILo Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG), 1985 edition;

6. The provisions on the carriage in bulk of classified solid materials possessing chemical hazards contained in the IMO Code of Safe Practice for Solid Bulk Cargoes, 1987 edition;

7. The IMO Recommendations on the Safe Transport, Handling and Storage of Dangerous Substances in Port Areas;


9. The IMO/ILo Guidelines for Packing cargo in freight Containers or vehicles, and
10. The Regulations for the Prevention of Pollution by Harmful Substances carried by sea in Packaged Forms, or in Freight Containers, Portable Tanks or Road and Rail Tank Wagons contained in Annex III to the International Convention for the Prevention of Pollution from Ships, 1973; supplemented by the guidelines for interim measures to protect the marine environment from pollution which might arise from the carriage of harmful substances in packaged forms, or in freight containers, portable tanks, or road and rail tank wagons, contained in IMO MEPC/Circ.78 of 19 September 1979.
NOTES AND REFERENCES


4.1 THE INTERNATIONAL REGULATIONS AND RECOMMENDATIONS

The international regulations controlling the carriage of DGs by sea apply to some 10% of world trade in packaged goods and are intended both to ensure safety and to facilitate trade. As the chemical industry develops so the international trade in packaged DGs, both in volume and in the variety of such goods, and the probabilities for accidents also grow.

The UN Recommendations have world-wide relevance for all modes of transport. In an actual transport situation it is the appropriate modal regulation that needs to be followed i.e. road, rail, sea, air, inland waterway, etc.

The IMDG Code and the ICAO Technical Instructions are based on the UN Recommendations while the RID/ADR regulations are in the process to be aligned with the UN System. New ADR regulations on some DG classes are now based on the UN Recommendations.

4.2 GROUPING 1/

The UN Recommendations, the IMDG Code and the air transport regulations place substances of most classes into Packing Groups I, II, III according to the degree of danger they present. The new RID/ADR regulations use the letters (a), (b) or (c) in a similar but not identical
Packing Group I -------- Highly dangerous
II -------- Medium Danger
III -------- Minor danger

4.3 THE INTERNATIONAL MARITIME DANGEROUS GOODS CODE
(IMDG Code)

The International Maritime Dangerous Goods Code (IMDG Code) adopted by IMO res. A.81(IV), the relevant sections and related parts of Appendix B of the Code of Safe Practice for Solid Bulk Cargoes (BC Code) adopted by IMO res. A.434(XI) and amended from time to time by the MSC, detail the provisions applicable to each individual substance in accordance with the provisions of the SOLAS Convention.

4.3.1 OBJECTIVES OF THE CODE

1. To harmonize the practices and procedures followed in countries engaged in the carriage of Dangerous Goods by sea;

2. Be the basis for national regulations for the Carriage of Dangerous Goods in ships;

3. The IMDG Code lays down basic principles;

4. It contain detail recommendations for individual substances and a number of recommendations for good practice are included in the classes dealing with such substances.
4.3.2 DEFINITIONS

In general the following definitions apply to the terms used by IMO in its codes and recommendations:

DANGEROUS SUBSTANCES means any substance, whether packaged or in bulk, intended for carriage or storage, and having properties coming within the classes listed in the IMO - IMDG Code.

It means any substance shipped in bulk and coming within the IMDG Code classes but which is subject to the requirements of the following instruments:

a. IMO "Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk";
b. IMO "Code for the Construction and Equipment of ships Carrying Liquified Gases in Bulk";
c. IMO "Code for Existing Ships Carrying Liquified Gases in Bulk";
d. IMO "Code of Safe Practice for Solid Bulk Cargoes"

in so far as such a substance may constitute a hazard to those in the port area or the port environment.

BULK DANGEROUS SUBSTANCE means any dangerous substance, carried without any intermediate form containment, in a tank or cargo space which is a structural part of a ship or in a tank.
permanently fixed in or on a ship.

DANGEROUS GOODS covers any dangerous substance contained in a packaging, portable tank, freight container or vehicle. The term includes an empty receptacle, portable tank or tank vehicle which has been previously been used for the carriage of a dangerous substance unless such receptacle or tank has been cleaned and dried or, when the nature of the former contents permits with safety, has been securely closed.

HARMFUL SUBSTANCES For the purpose of Annex III of the International Convention the prevention of pollution by ships, 1973/1978, as amended, "harmful substances" are any substances which are identified as marine pollutant in the IMDG Code.

4.3.3 COMPETENT AUTHORITY APPROVAL

In many instances it is normal to send directly to transport, or offer to a carrier for transport, packaged DGs which comply with the regulations. In other instances the regulations may require that prior approval be obtain from the competent authority; this is normally requested by the shipper from the national Transport Department for the mode of transport involved.

Each of the modal regulations contains a system for competent authorities to permit transport under conditions different from those directly contained in the regulations themselves. For sea transport this is normally done by the
competent authority of one State and accepted by others involved. For air transport such permissions may be granted in some situations by the competent authority of one State; in other situations the agreement of all States involved (of origin, of destination and those overflown) is required.

Attention should be given to section 22 on competent authority approval included in the General Introduction to the IMDG Code Amendment 22-84, which defines: Unilateral Approval, Bilateral Approval and Multilateral Approval.

4.3.4 DESCRIPTION OF THE IMDG CODE

Most maritime States are signatories of the International Convention for the Safety of Life at Sea (SOLAS Convention). The IMDG Code has the status of a Code of Practice augmenting the general provisions of the SOLAS Convention.

The Code has been translated into a number of languages, and amendments are published from time to time. In accordance with an international agreement such amendments enter into force six months after they have been published.

Amendment 24-86, published late 1987, is consequently in forced from 1st July 1988. Amendment to class 7 Radioactive Substances is schedule to come into force in July 1990.
The IMDG Code is divided into six parts:

1. General Introduction
2. Annex I (Packing)
3. Introduction to Classes
4. Individual Entries
5. General Index (Alphabetic)
6. Numerical Index (UN numbers)

The following is an overview of the different parts:

1. GENERAL INTRODUCTION

It concerns all dangerous goods irrespective of class and contains rules and regulations to be applied by a shipper as well as operational rules and regulations to be applied onboard vessels.

This paper will describe in some detail only the following items:

- Classification
- Identification and marking
- Documentation
- Packing and
- Unit transports (containers, trailers, etc.)

CLASSIFICATION

1. EXPLOSIVES
   1.1 Mass exploding
   1.2 Projection hazards, not mass exploding
   1.3 Fire hazard, minor blast or projection hazard, not mass exploding
1.4 No significant hazard
1.5 Very insensitive, mass exploding hazard

2. GASES
   2.1 Flammable Gases
   2.2 Non-flammable Gases
   2.3 Poisonous Gases

3. FLAMMABLE LIQUIDS
   3.1 Flashpoint < -18°C (low)
   3.2 Flashpoint -18 - +23°C (intermediate)
   3.3 Flashpoint +23 - including +61°C (high)

4. FLAMMABLE SOLIDS, ETC.
   4.1 Flammable solids
   4.2 Substances liable to spontaneous combustion.
   4.3 Substances emitting flammable gases when wet.

5. OXIDIZING SUBSTANCES AND ORGANIC PEROXIDES
   5.1 Oxidizing substances
   5.2 Organic peroxides

6. POISONOUS (TOXIC) AND INFECTIOUS SUBSTANCES
   6.1 Poisonous (toxic) substances
   6.2 Infectious Substances

7. RADIOACTIVE SUBSTANCES

8. CORROSIVES

10. MISCELLANEOUS DANGEROUS SUBSTANCES
IDENTIFICATION AND MARKING

Whenever a DG is transported onboard a ship it is important that it can be easily identified in available literature, primarily the IMDG Code and guides published in connection with the Code.

PROPER SHIPPING NAME

The PROPER SHIPPING NAME is considered to be that portion of the entry most accurately describing the goods that is shown in capital letters on the individual entry or in the general index.

The PROPER SHIPPING NAME should be used in shipping documentation and also when marking packages. The trade name of a product may be used in addition to the PROPER SHIPPING NAME, however, trade names alone may not be used.

In the IMDG Code approximately 5000 different substances or articles are listed. They are considered to be the most common ones transported, however, a very great number of other commodities exist, which also have to be classified as DGs.

In order to cover also these commodities or articles the Code contains a number of N.O.S entries—Not Otherwise Specifies, e.g.:

- FLAMMABLE LIQUIDS, N.O.S.
- FLAMMABLE SOLIDS, N.O.S.
- POISONOUS LIQUIDS, N.O.S.
CORROSIVE LIQUIDS, N.O.S.

If a technical name of a commodity is not listed as PROPER SHIPPING NAME in the Code, or if the commodity is not covered by an entry of general nature (e.g. PAINTS, PERFUMES, RESIN SOLUTIONS, ADHESIVES, etc.), that N.O.S entry should be used, which most accurately describes the commodity. Such an N.O.S. entry constitutes the PROPER SHIPPING NAME of the product with one important addition:

If the PROPER SHIPPING NAME is an N.O.S. entry it should be followed by the correct technical name of the product in parentheses. Trade names should not be used for this purpose.

E.g. CORROSIVE LIQUID. N.O.S. (Caprylyl Chloride)

(Caprylyl Chloride is a corrosive liquid, which is not listed in the Code but has to be classified as DG.)

On pages 0017-1 - 0017-3 of the general introduction a list of N.O.S. entries can be found for which the correct technical name of the product is required within parentheses as additional information. A correct technical name should be a recognized chemical name currently used in readily available scientific and technical handbooks.

MARKING

Packages should be marked in such a way that it is clearly indicated that they contain dangerous goods.
The marking consists of:

1. Labels(s) shown on the individual entry in the Code. (In those cases where a label is not required this is also indicated on the individual entry.)

2. The PROPER SHIPPING NAME of the product.


DOCUMENTATION (Declaration of Dangerous Goods)

In principle the same shipping documents should be issued for DGs as for any other cargo.

In addition the shipper is required to submit some fundamental information regarding the hazard involved. Such information should cover: (Specimen of DG declaration are included in Annex ###).

PROPER SHIPPING NAME

IMO CLASS
Sub-class or division
For goods in class 1:
  Compatibility group
  Stowage category

For goods in class 2:
  Additional information, if applicable, such as:
2.1 (Flammable gases)
2.2 (Non-flammable gases)
2.3 (Poisonous gases)
Oxidizing agent
Corrosive

For goods in class 7:
Additional information required
on pages 7028 - 7030 of the Code.

UNITED NATIONS NUMBER (UN No.)

EMPTY, UNCLEANED PACKAGINGS
Empty packagings which contain the residue of DGs should be so identified by placing the words "empty - last contained" before, or "empty" after the sequence - proper shipping name, class and UN number.

(IMDG Code PAGE No.)
Though not mandatory, this information is normally given in practice. Attention should be paid to the edition of the Code and the language in which the Code has been translated.

NUMBER AND KIND OF PACKAGES
(PACKAGING GROUP)
This is not mandatory information, however, vessels are much assisted if this information is given in case of commodities for which the packaging group is not directly given in the Code.
QUANTITY OF DANGEROUS GOODS
For goods in class 1:
Net explosive content.

MINIMUM FLASHPOINT (In centigrades)
(Applicable if flashpoint +61 C or below).

ANY OTHER INFORMATION
Other elements of information deemed necessary by national authorities.

The order in which these items appear on documents is left optional, however, PROPER SHIPPING NAME, IMO Class and UN No. should always appear in that sequence. E.g.:

FORMIC ACID, Class 8, UN No. 1779.

Empty, uncleaned packages should be declared as DGs, and the description should contain either the words "empty-last contained" before the above sequence, or the word "empty" after the sequence.

In addition the vessel should be informed of Emergency Procedures (EmS) and Medical First Aid (MFAG) to be observed in case of an accident.

The General Index to the IMDG Code includes reference MFAG Table number and EmS number. For the substances where reference is made to the MFAG and the EmS, the MFAG table number and the EmS number should be inserted in the declaration.
PACKING

Packing of DGs for carriage by sea is regulated in Regulation 3 of Chapter VII of the 1974 SOLAS Convention, as amended.

The U.N. Recommendations for construction, testing, etc. of packings are applied in the IMDG Code, and Annex I contains full details in this respect.

Detail provisions on packing of DGs are contained in section 10 of the General Introduction to the IMG Code.

The types of receptacles, inner packagings, outer packagings, packages and combination packagings recommended in the Code are those which, based on extensive past experience, ensure a high degree of safety.

Packing recommendations for individual commodities or articles will be found either on the respective individual entry in the Code or in the introduction to the class concerned.

Detail specifications and a number of performance tests applicable to a wide range of packaging recommended in the IMDG Code are to be found in annex I of the Code.

DGs of all classes other than classes 1, 2, 6.2 and 7 have for packing purposes been apportioned among three categories - packaging groups - according to the degree of danger they present. The packaging group to which a substance is assigned is given in the individual schedule.

Performance tests should be made, rather than design-
approved only on packagings representative of those to be used in commercial practices. Suitable evidence must be established and kept to enable the fact that the tests have been passed successfully to be verified. Each packaging manufactured and intended for use according to the Code should bear the UN mark specified in section 6 of Annex I.

While the performance tests laid down in annex I to the IMDG Code should be applied to all types and designs of packagings, satisfactory practical use may be accepted as equivalent evidence of safety in existing types and designs until 1 January 1990. Most packages are understood to travel without the UN mark under this provision.

A transitional period has been provided for the industry to adapt to the UN system of using only tested packaging for DGs. Partly due to industry pressure, but also in the light of recent actions taken by ICAO in this regard, an additional 12-month extension was granted to the end of 1990 (GDG 40, Feb. 1988). New RID/ADR regulations are scheduled to enter into effect on May 1, 1990.

The latter means that by the 1 January 1991 all packaging used should have been tested and marked. The equivalence provisions in paragraph 10.3 of section 10 of the General Introduction and in Annex I are retained to allow Administrations to approve those packagings not specifically listed but which meet the safety standards of the IMDG Code.

A summary of packaging provisions for the substances and articles in the various classes of the IMDG Code follows.
Class 1 - Explosives

The diverse properties of goods of class 1 do not permit a method of packing which would be generally applicable, and the requirements are given in the individual schedules.

Class 2 - Gases

This class includes gases carried in compressed state, liquified state or dissolved under pressure, which are always under pressure and require special receptacles.

Class 3 - Flammable liquids

Flammable liquids have for packaging purposes been apportioned among three packaging groups according to the degree of danger they present: Group I- Great Danger, Group II- medium danger and Group III- minor danger. The packaging group to which a substance is assigned is given in the individual schedule.

Class 4 - Flammable solids

Substances liable to spontaneous combustion
Substances which, in contact with water, emit flammable gases.

Class 5.1 - Oxidizing substances

The diverse properties of the substances in these classes do not permit a method of packing which would be generally applicable, and the requirements are given for
each substance in the individual schedule.

Class 5.2 - Organic peroxides

The packaging of an organic peroxide should comply with the general packaging requirements set out in Annex I to the IMDG Code and the performance tests appropriate to the Packaging Group II (UNCOE, Dec. 1988).

The diverse properties of the substances in these class do not permit a method of packing which would be generally applicable, and the requirements are given for each substance in the individual schedule.

Class 6.1 - Poisons

Poisonous (toxic) substances have for packing purposes been apportioned among three packaging groups according to the degree of their toxic hazards in transport:

1. Group I ------- Substances and preparations presenting a very severe risk of poisoning.
2. Group II ------ Substances and preparations presenting a serious risk of poisoning.
3. Group III ---- harmful substances and preparations presenting a relatively low risk of poisoning.
Class 6.2 - Infectious substances

C onsignment of infectious substances, being responsible for the packing of these substances, should ensure that the packages are prepared in such a manner that they arrive at their destination in good condition and present no hazard to persons or animals during conveyance.

The packagings should include the following essential elements:

1. An inner packaging (watertight receptacles and absorbent material placed between receptacles).

2. An outer packaging of sufficient strength to pass the performance tests provided for in the introduction to class 6.2.

Class 7 - Radioactive Materials

Packaging of class 7 materials are designed to:

(a) retain material;
(b) serve as a shield to reduce radiation to an acceptable level;
(c) prevent criticality and
(d) promote heat dispersion.

The packing, stowage and other provisions for each type of radioactive material have been summarized in the detail schedules 1 to 12 in class 7 of the IMDG Code.

The packagings suitable for class 7 materials have been divided into several types according to the containment
system necessary to retain the material. It may consist of one or more receptacles, absorbent material spacing structures, radiation shielding and devices for cooling, for absorbing mechanical shocks and for thermal insulation. These devices may include the vehicle with a tie-down system when they are intended to form an integral part of the packaging. The revision of Class 7 of the IMDG Code will incorporate the 1986 Supplement to the IAEA Regulations for the Safe Transport of Radioactive Materials (Safety Series 6) 1985 edition.

Class 8 - Corrosives

Corrosive substances have for packaging purposes been apportioned among three packaging groups according to the degree of danger they present: Group I- Great Danger, Group II- medium danger and Group III- minor danger. The packaging group to which a substance is assigned is given in the individual schedule.

Class 9 - Miscellaneous dangerous substances

The diverse properties of the substances in these class do not permit a method of packing which would be generally applicable, and the requirements are given for each substance in the individual schedule.

- Unit loads
  (Subsection 10.18 of the IMDG Code)

  This subsection includes:

  (a) Intermediate Bulk Containers (IBCs)
3. Introduction to Classes

Each one of the nine classes has an introduction of its own, containing rules and regulations which are common for all substances and articles allocated to that class. The general content may vary, however, properties, packing and stowage are items which appear frequently.

4. Individual Entries

These entries were originally presented one on each page, however, the Code is presently revised, and in the future there will, in most cases, be two individual entries per page. This has been achieved by moving items which are common for the majority of the entries, like packing and stowage, to the introduction of the class.

5. General Index (alphabetical)

This index is one important "entrance" to the Code, listing all commodities by name and also all alternatives names or synonyms.

6. Numerical Index

This is another important entrance. It gives you the UN number of a commodity.

With a publication of the size of the IMDG Code a system should be developed in order to access the entries
as quick as possible. The following system is hereby recommended when using the Code:

<table>
<thead>
<tr>
<th>Section</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Introduction</td>
<td>0000 - 0130</td>
</tr>
<tr>
<td>Annex I - packing</td>
<td>Special numbering</td>
</tr>
<tr>
<td>Class 1</td>
<td>1000 - 1300</td>
</tr>
<tr>
<td>Class 2</td>
<td>2000 - 2130</td>
</tr>
<tr>
<td>Class 3</td>
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1. DANGEROUS GOODS BOOKING CENTER FOR A SHIPPING COMPANY

The administrative systems for booking DGs within shipping companies vary widely. This paper will propose certain procedures that it is believed can be applied within a company and in the second part it presents the handling and storage of DGs in port areas. Both as an example of such systems.

The proposal is based on observations and personal contacts with several shipping companies and port officials. The job was carried out during the periods of on-the-job training in April 1989 and several field trips during 1988 and 1989.

Regardless of the system use today in Shipping Companies the main objectives of a Dangerous Goods Booking CENTER (DGBC onwards) should be:

1.1 OBJECTIVES OF A DGBC

(a) To collect as much information as possible about the most common cargoes being offered for transport onboard company's vessels. At least the information required by the legislation. Shippers are not always informed about rules and regulations in force, and some of them may not even know their product too well. Therefore the shipping company may have to inform their customers of rules to be observed and keep them updated whenever
changes are made.

The duties of the shipper are fundamental for a safe transport:

- Classification
- Packing
- Documentation
- Marking; labelling.

All subsequent activities, such as information flow, handling, stowage, segregation, possible emergency procedures, etc. are dependent on the information of the shipper.

It is essential to collect not only the information required according to the national legislation of the flag of the vessel and/or country of origin but also all information necessary for the vessel in order to fulfill reporting requirements in intermediate ports of call and at port of discharge.

(b) To evaluate information received from shippers and possibilities for acceptance for the intended voyage.

Information received should be checked and all missing or unclear information should be questioned.

The possibilities for accepting DGs for a particular ship may be limited by:
- Type of vessel (E.G. Cargo/passenger vessel)
- Amount of DGs accepted earlier for the same voyage (stowage/segregation).

- Regulations in intermediate ports and port of discharge (quantity limitations allowed)

(c) To inform vessels concerned about bookings made.

Within modern shipping, particularly for systemized transport in units such as containers, trailers, portable tanks, etc. the turnaround of a vessel in port is normally very quick and the possibility for officers and crew to investigate and collect all necessary information about DGs booked are minimal.

Therefore they have to be supplied with as much information as possible in order to simplify their work and maintain a high standard of safety.

A complete system for information flow from the line administration to the vessel has to be established, and it is essential that all information about DGs booked reaches the vessel prior to commencement of loading.

(d) To inform other parties involved in the transport of that particular cargo.

Normally the Line is represented by agents in the different ports of call, and they can be used for the information flow between the line and local authorities. The agents are also instructed to keep the line well informed of regulations in force and of all amendments to such regulations.
All four main objectives constitute the basis for the safe transportation of DGs by the vessel of the line.

Other aspects are more of a technical nature, such as:

- Education of office staff involved in DGs Administration;
- Education of officers and crew in stowing, segregating, handling of DGs, including emergency procedures.
- Equipment of vessels to highest possible safety standards;
- Informing and instructing agents around the world.

1.2 INFORMATION FLOW

The basic principle of the system is that all request for shipments of DGs have to be approved by a central body, who is constantly informed of the DGs Booking situation for every individual vessel. The information flow is illustrated in Fig. 1. The system can be divided into the following individual items:

- Standard booking application formula
  (usually applied by telex between booking agents and the DGBC).
- List of DGs drawn up by booking agents and submitted to agents at intermediate ports, agents at port of discharge, vessels and the Line.

- DGs list, constituting the full operational information submitted by the DGBC to the central planning and to the vessel.

1.3 BOOKING PROCEDURE

The basic principle of the booking procedure should be the following:

Any offer for shipment of DGs, received by agents, should be referred to the DGBC for approval before the shipment is accepted.

In case there are doubts whether the goods should be classified as DG or not the DGBC should be asked for advice.

A request for booking of a DG from an agent to the DGBC should contain the following information:

1. Name of shipper

2. Vessel prefix, Voyage No., dangerous good request No. (DGR No.)
   DGR No. should consist of the prefix of the place of booking and a serial number for that particular voyage. E.g. Mo 01, the second Mo 02 meaning the first booking from Malmoe, the second
The system can be divided into the following individual items:

Standard booking application formula
(usually applied by telex between booking agents and the booking center)
(Annex 1)

Figure: 1
one, and so on.

3. Type of carriage
   (FCL, LCL, Breakbulk)

4. Port of loading/Place of delivery

5. Port of discharge/ Final destination

6. Number and full description of:
   - Outer packing
   - Inner packing
   - Absorbent material, if used.

7. PROPER SHIPPING NAME
   (Trade name alone is not sufficient).

8. Quantities

   Total gross quantity in Kilos
   Total net quantity in Kilos
   For explosives net explosive content in Kilos.

9. Classification

   IMO classification
   UN Number
   IMDG Code Page No.

10. Flashpoint in Centigrades, if any.

11. Any other relevant information
(Full information regarding Emergency Procedures and Medical First Aid can normally be obtained by the vessel through the references to EmS Numbers and MFAG Table Numbers, which will be indicated by the DGBC). Otherwise, the shipper should either state the applicable number or give proper medical advice in writing.

12. Type and number of units required.

In summary, a DG request is normally sent by telex and it should appear as follows:

1. Molmoe Paint Co Ltd.
2. VEG, 163, Mo 01
3. FCL
4. Kob/Mo
5. Got
6. 50 iron drums
7. PAINTS (primers)
8. Gross 12000
   Net 11500
9. 3.3
   1263
   3149
10. + 28 C
11. MFAG 311
12. 1x 20' DC

The DGBC will confirm or refuse the booking in a simple telex form.

For RADIOACTIVE SUBSTANCES (CLASS 7) special information is required from shippers. Details of such information appear in item 9 on pages 7028 – 7030 of the IMDG Code.
EXPLOSIVES SUBSTANCES (CLASS 1) may be the object of heavy restrictions in certain ports, which could delay vessel’s operation or even make calls impossible.

Booking requests for radioactive and explosives should reach the DGBC well in time to allow thorough investigation with all ports concerned.

1.4 FLOW CHARTS AND INFORMATION PROCESSING

Fig. 2 illustrates the Flow Chart for:

- DGs Declarations (DGD)
  including emergency instructions (EmS, MFAG)
- Additional information, certificates, etc.
- Packing certificates (C/VPC)

A confirmed booking will be entered into the computer lists of bookings. Such lists will be produced by the DGBC one for each port of loading and one for each port of discharge.

The lists will be distributed by the planners, responsible for the vessel(s) via telex or telefax, as follows:

- One copy to the Port of Loading prior to vessel’s arrival. This list should be handed over to ship’s officers on arrival.

- One complete set of lists by Port of Discharge to the final Port of Loading prior to vessel’s departure.
Recommended Flowchart for

- Dangerous Goods Declarations (DGD)
  Incl. Emergency Instructions (EMs/MFAG)
- Additional Information, Certificates, etc.
- Packing Certificates (C/VPC)

**Manufacturer's Freight Shipper/Forwarder**

TO BE FILED

**Shipping Line or Agent**

**To Ship's Cargo Officer**

**In Ship's Mail**

**To Consignee/Forwarder**

Harbour Terminal
Stevedore (Port of Loading)

**Ship (Notice-Board)**

**Stevedore Harbour Terminal** (Port of Discharging)

**Forwarder**

Confirming of Booking and Acceptance of Dang. Goods

Optional Use (e.g. Terminal Operator)
- One list to each Port of Discharge after departure of the vessel from the last Port of Loading.

Agents at Port of Loading should for each individual call fill in a List of DGs Goods.

- One copy to the vessel prior to departure.
- One copy to each agent at Intermediate Ports.
  (The list should be received at least 24 hours to the arrival of the vessel.)
- One copy to agents at Port of Discharge.
  (The list should be received at least 24 hours prior to vessel's arrival.)

Other Documents:

- Container Packing Certificate
  Those responsible for packing DGs into/on a cargo carrying unit should provide a "Container Packing Certificate" or a "Declaration" as per items 12.3.7 (page 0117-1) of the IMDG Code.

  Such certificates should be collected from shippers and handed over to ship's officers prior to loading.

- Weathering Certificate

  For some substances in the IMDG Code a Weathering Certificate is required. Such certificates should be collected from shippers and handed over to ship's officers prior to loading.

- Local Port Authorities
By Lists of DGs and Computer Lists all agents at Ports of Call should be well informed of all DGs in transit or to be loaded/discharged.

This should enable Agents to inform Local Port Authorities in accordance with regulations in force.

2. HANDLING AND STORAGE OF DANGEROUS GOODS IN PORTS

Economically the port is a service centre which makes a profit, or not, and which is beneficial to the countries' national economy. Geographically and technically the port is the interface between other modes of transport, on the landside the railways, roads and inland waterways transports and on the waterside the sea mode. The increase in quantity and variety of shipments of DGs transported by sea has not only shown considerable impact on the carrying vehicle— the ship— and caused concerned as to its safety, but has also entailed consequences for the ports.

Transport accidents which are triggered off by the cargo transported, happen in most cases at the handling stage. The port is the handling place for transshipment of overseas cargoes. The port is also the main storage place for intermediate storage of cargoes— with administrative or other difficulties sometimes causing considerable delay in the consignee's taking delivery of imports. The ports have been subject to radical changes due to technological transport innovations and the construction of extensions. Situations have developed in many ports all over the world, particularly in ports of developing countries.

Ports in industrialized countries have adapted to this
changes. Safety enjoys a high status, and purposeful management, back up by the required legislation, has become commonly accepted in these ports.

Ports in developing countries are in a more difficult situation. They have to deal with similar amounts of DGs as the ports of industrialized countries, but they do not have the resources (financial, expertise, abilities), as the most advance countries. Naturally this has repercussion on the safety standards of this ports and not few of them have experienced costly accidents which were triggered off or involved DGs. The most difficult situation will be found in ports which solely handle general cargo, but which do no seem to have been touched by the technological changes.

2.1. AVAILABLE FACILITIES IN PORTS

Developing countries and their ports often lack the legislative, educational and administrative structure which would enable them to keep pace with the presently experienced radical changes of technology, even if technically and financially supported by outside sources.

Existing port regulations may include a chapter on DGs. In general, this refers to the transport of explosives and flammable liquids only and is in this and many other respects outdated.

Handling operations and storage are based on outdated regulatory and administrative procedures. In many cases no handling precautions are applied at all and the storage of DGs, break bulk and containerized, is carried out without the necessary care.
2.2. PORT LEGISLATION

In their struggle for short-term profitability, under the pressure of industrial competition, those responsible for safety in ports are sometimes tempted to take avoiding actions which circumvent additional expenses for safety. Thus, the port need a legislative frame and up-to-date regulations and the power to exercise them, and enforced them.

The legislative frame should be established by parliament (Assembly or similar) in form of a port law. It should not be too narrow or specific, but leave the details to port regulations which should be designed by the port authority or the Ministry responsible for the ports.

The UN Recommendations (Orange Book) should be used as the guide for all modes of transport. The relation to the sea mode suggests that the port orientates itself to the international requirements which have been set up by IMO. IMO has published a whole package of regulations and codes of practice which are recommended for application by the shipping industry and for utilization by the port industry. For ports the two most important ones are:

- The IMDG Code and

- The Recommendations on the Safe Transport, Handling and Storage of Dangerous Substances in Port Areas" (IMO Port Recommendations).

The port law, as mentioned above, should leave details
to the port regulations, but should require the closest possible adaptation of the DGs port regulations to the classification and recommendations as suggested by the UN.

The IMO Port Recommendations cover packaged DGs, liquid bulk cargoes and solid bulk dangerous substances. General aspects pertaining to ships, shore installations and handling on board ship and shore are dealt with for each of this types of cargo. In addition special categories are mentioned.

The purpose of the IMO Port Recommendations is to serve as "a standard framework ... for use in the preparation of port regulations to ensure the safe transport, handling and storage of dangerous substances in port areas." (IMO Port Recommendations, p. 7). The IMO Port Recommendations are not supposed to be copied unchanged, since they take into consideration the fact that prevailing special conditions on a local or national level would not allow a totally uniform set of rules. They are a guide, and ports in developing countries should bring their rules in line with the IMO Recommendations.

The regulations should adopt the IMDG Code, as the principal Code of practice which should be used as guide where applicable and be made mandatory where required (e.g. classification, packing, marking, labelling and placarding and documentation). In addition, the regulations should subdivide DGs as:

- to direct delivery,
- special berths
- quantity limitations,
- allocation of storage spaces
- documentary and administrative
requirements
- operational procedures and
- other criteria

New port regulations for DGs need to be discussed with all port users and port related bodies and, after finalization and introduction, a grace period should be allowed before strict measures are taken against offenders. The enforcement of the regulations is a matter for the police or coast guard, and a close cooperation should be established between the port and the executing authorities.

2.3. ADMINISTRATION, DOCUMENTATION AND INSPECTION

Safety management of the port of today requires administrative facilities together with a smooth flow of information.

2.3.1 Information Flow

There are three main streams of information flow:
- from the outside (from shipper/carer)
- within the port (to carrier/consignee)
- safety authorities, emergency organizations and statistical offices.

As a minimum the advance information should be required 24 hours before the arrival of the vessel or of the goods at the port gate. For explosives and radioactive materials a longer period should be introduced. The required information should include those suggested in Appendix I of the IMO Port Recommendations. The port should insist on
receiving shipping papers as recommended in the IMDG Code (DG Declaration, Container Packing Certificate, DG Manifest, etc). (General Introduction to the IMDG Code, Sec.9). Port administrative procedures and the internal flow of information for DGs should be centralized around the safety division.

2.4. ACCEPTANCE OF PACKAGED DANGEROUS GOODS IN PORT

The acceptance of the various types and quantities of DGs depends on the proximity of the population to the port, port facilities, educational level of the port personnel, equipment of the emergency services, etc. The port would have to subdivide DGs according to the dangers they present:

   a) only those goods listed in the IMDG Code
   b) DGs which are not accepted at all.
   c) Acceptance of some highly dangerous goods
       at special loading/discharge areas only,
       subject to direct delivery (Packing group 1,
       explosives, radioactive material).
   d) DGs of high or medium danger permitted in an
       ordinary pier but subject to direct delivery
   e) The remaining DGs would be allowed for
       limited period storage inside the port area.

In addition to the actual dangers of the goods, acceptance conditions may also have to take quantities into account. Particularly the amount of certain explosives and other highly DGs being in a port at the same time should be clearly limited.

Many ports also adopt similar procedures for:
- DGs on board ships which are designated for other ports
- The total rejection of damage DGs. For land modes this principle should be strictly adhered to.
A different situation is given when a ship has to discharge damage DGs. The port as a service centre should assist the ship with all reasonably available means to get rid of the damaged DGs and should not refuse the goods without having examined all possibilities.

2.5. STORAGE OF PACKAGED DANGEROUS GOODS

The question whether packaged DGs should be store:
   a) separately from other cargo or not
   b) in the open or in warehouses
depends on the following factors:
   1. the types of goods store most frequently,
   2. their amount,
   3. the size of the port
   4. the general awarness and trainning of the port employees and
   5. the prevailing climate

Some ports in industrialized countries prefer a system where all DGs are store in one area, segregated by classes as recommended in the IMDG Code. Some other ports prefer to distribute DGs over the port area, according to an established system, avoiding in this way the so called "bomb theory" (storage of DGs in one area forms a bomb-like mixture of substances).

Prevailing conditions in developing countries' ports
(financial, training of personnel, security systems) indicate that these ports should adhere to the allocation of special areas for storage of DGs.

The question whether open air or warehouses or half-open or totally enclosed storage areas is more advantageous depends on various factors:
1. climate
2. average weather conditions,
3. types and quantities of DGs normally shipped,
4. available facilities, etc.

Certain goods require an open air storage (some gases), others need protection from sun rays (plastics). Some explosives require magazine storage, and some DGs need to be kept under controlled temperatures.

When DGs are stored in special areas or in warehouses, segregation of the different classes has to be taken into account. The segregation adopted by the IMDG Code for stowage on board ship should be utilized for this purpose.

Particular care has to be applied when substances or articles of Class 1 (explosives) and Class 7 (radioactive materials) are stored in the ports. This classes need totally separated storage areas with special facilities and special supervision. Radioactive materials stored in the port should be segregated in accordance with the segregation requirements given in Appendix 3 of the IMO Port Recommendations.

2.6. STACKING OF DANGEROUS GOODS CONTAINERS
The transport of DGs in containers has advantages as well as disadvantages: on the one hand the container itself provides an additional protection, on the other the container transport has made the shipment of DGs more anonymous. In principle, ... "the substance(s) packed in a container is (are) known from the placard(s) and UN number, but no indication are given about the share of DGs in case of mixed cargoes packed in one container". 1/

There are multiple approaches among ports as to the stacking of containers with DGs:
- on a special yard;
- or distributed over the whole area (mixed stacking)
Terminals should opt for a separate stacking yard for DGs containers with sufficient space to segregate them according to IMO Classes. The latter has proved to be the most economical solution, though some consideration has to be given to the mixture of DGs within containers where it is possible to be known.

As mentioned before the two IMO Classes 1 and 7 would require separate stacking yards which should be remotely located and well supervised.

3. DANGEROUS GOODS OPERATIONS

ILO has adopted and published instruments concerning the occupational safety and health in dock work - CONVENTION 152, RECOMMENDATION 160, CODE OF PRACTICE 2/ that together with IMO Recommendations in connection with the IMDG Code should be utilized for the safe operations of DGs in ports.
DGs should be handled by specially instructed dock workers who have received a basic training in the safe handling of these goods. The operation itself should be carried out under the supervision of a safety officer or a knowledgeable foreman. In case of DGs which pose a great danger, it is advisable to inform the fire brigade and to have it on a stand-by. Certain precautions will also have to be considered when cargo is worked over DGs in transit which are stowed on deck on the hold of a ship.

The responsibility for all operations at the special DGs storage area or warehouse should be given to one operations contractor only. He should also be liable to a regular inspection and supervision by the safety division, in order to ensure that all relevant regulations are observed at all times and that cargo operations are carried out in the safest way possible.

The application of the hazard diamond placard for DGs stored inside the port area serves as warning sign to those permanently fixed on floors and walls and the cargo itself. This system provides a quick identification of the actual dangers and will easily be understood by everybody.
NOTES AND REFERENCES


2/ ILO Code of Practice on Safety and Health in Dock Work.


4/ IMO. Recommendations on the Safe Transport, Handling and Storage of Dangerous Substances in Port Areas.


PART II

REGULATIONS FOR THE TRANSPORT OF CLASS 7 RADIOACTIVE MATERIAL
INTRODUCCIÓN

The safe transport of radioactive materials has become an important part of national and international programmes for the use of radioactive materials in medicine, agriculture, industry and research, and the generation of nuclear power, and it is thus generally agreed that there is ample justification for such uses of radioactive material.

Radioactive materials transport account for a small fraction of the total sea-borne trade. Nevertheless, it is estimated that more than 10 million packages containing radioactive materials are transported each year throughout the world. Most contain only small quantities of radioactive materials which are used for an enormous variety of purposes.

The why of regulations for the transport of class 7 materials is to be found in the fact that radiation, ionizing (and non-ionizing) offers specific dangers to men, animals, plants and goods.

All regulations on the uses of radiation for medical, industrial, technical and scientific purposes, are based on the necessity to protect against these dangers.

Chapter 9 described the regulations on insurance for third party liability which have been designed to cover those risks.

Chapter 7 analysis the requirement of the optimization component of the system of dose limitation which
establishes that planning, designing, using or operating of sources and practices shall be performed in such a manner that exposures are as low as reasonably achievable, economic and social factors being taken into account.

The basic safety standards, as designed by the IAEA, include differential cost-benefit techniques as a practical form of guidance for performing optimization of radiation protection. They also suggest that, in any further reduction in exposures economic and social factors should be taken into account so as to ensure the best use of available resources in bringing about that reduction. With regard to protection in the transport of radioactive materials, consideration must be given to optimization of

(1) requirements related to package design and test requirements including quantity and external radiation level limitations; and

(2) operational requirements for the implementation of, and compliance with, the Agency's Regulations.

The specific provisions of the IAEA Regulations deal primarily with requirements related to package design and test requirements. As the regulations has evolved, consideration has consistently been given to the principle of keeping radiation exposures as low as practicable. As international experience shows compliance with IAEA Regulations ensure a high degree of safety.

However, the new emphasis on optimization in the 1985 edition of the Basic Safety Standards for Radiation Protection made it necessary to re-examine the provisions of the Transport Regulations and provide a more definite
determination that appropriate consideration has been
given to optimization of such provisions. This requires
data on exposures levels to workers and the public that
have been incurred under existing provisions of the
Regulations, and on differential costs and benefits for
various alternatives to present provisions, as well as
further development of the methodology that should be
applied in the optimization of protection in the transport
of radioactive materials.
INTERNATIONAL ORGANIZATIONS IN THE FIELD OF
NUCLEAR TRADE

A. INTERGOVERNMENTAL ORGANIZATIONS

It was recognized very early in the use of radioactive materials that a uniform set of regulations to ensure their safe packaging, shipment—often across local, regional and national boundaries and intertransit handling and storage would be required. International bodies were, inevitably involved.

1. INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)

In his famous speech "Atoms for Peace" delivered on 8th December 1953 before the General Assembly of the United Nations, the President of the United States, Dwight D. Eisenhower, proposed that the countries most advanced in nuclear technology should make available part of their stocks of uranium and special fissionable materials and entrust an international agency, to be set up, with the task of using these materials in peaceful installations in such a way as to satisfy the needs of humanity. Negotiations were then conducted, first between the USA and the USSR, then with other States, which lead to the adoption, on 23rd October 1956, of the Statute of the International Atomic Energy Agency (IAEA); the Statute entered into force on 29th June 1957.

The creation of the IAEA is thus not the result of a Resolution of the General Assembly of the United Nations.
but of a Statute which has the characteristics of an international treaty. Consequently, the Agency does not strictly speaking form part of the United Nations' system and, in particular, its activities are not subject to the Security Council’s right of veto. 1/ Nevertheless, the Agency is required, under its Statute, "to establish close links with the UN Organisation and its specialized agencies and organs, in particular by submitting reports" (Article VI.J).

An international interstate organisation based on the principle of sovereign equality, IAEA enjoys, on the territory of each of its members, the legal capacity and privileges and immunities required to carry out its functions. The Agency’s headquarters are in Vienna, and its members today number 113.

The chief objectives of the IAEA, laid down in Article II of its Statute, are:

A) to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world,

B) to ensure, as far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose.

The organs of the IAEA are:

1. General Conference
   (Article V) The General Conference consists of representatives of all member States.
2. Board of Governors (Article VI).

3. Director General (Article VII).

The Statute entrust the IAEA with various tasks of general nature such as:

a. (Art.III A.3) to foster the exchange of scientific and technical information on peaceful uses of atomic energy.
b. (Art.III A.4) to encourage the exchange and training of scientists and experts in this field.
c. (Art.III a.6) to establish standards of safety for protection of health and minimisation of danger to life and property.
d. (Art.III A.1) to encourage and assist, throughout the world, the development and practical application of atomic energy for peaceful uses.

Following a recommendation of ECOSOC of the UN, the IAEA undertook to develop widely applicable safety rules for the transport of radioactive materials, covering all modes of transport. The IAEA worked in close cooperation with other international bodies such as: the Central Commission for the Navigation of the Rhine, the Central Office of International Railways, the European Atomic Energy Community, IMO, IATA, ICAO, ILO, ISO, Universal Postal Organization, World Health Organization.

The first edition of the Agency's recommended Regulations for the Safe Transport of RAM (Safety series No.6) was published in 1961. Revised editions, taking into account developments in technology and shipping practices were issued in 1964, 1967 and 1973. A comprehensive review
of the Regulations was issued in 1985.

The 1985 edition takes into account the IAEA's Basic Safety Standards for Radiation Protection (Safety Series No.9), the latest edition of which was issued in 1982. These standards, which were sponsored jointly by the IAEA, ILO, NEA/OECD and UN/WHO are based upon the latest recommendations of the International Commission on Radiation Protection (ICRP).

Some of the international organizations which have incorporated the IAEA Regulations are:

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2. ORGANIZATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT
(OECD)

The activities of the OECD relating directly to the regulatory aspects of the use of nuclear energy are, for the most part, conducted by its Nuclear Energy Agency (NEA).

2.1 OECD's NUCLEAR ENERGY AGENCY (NEA)

Studies undertaken in the mid-1950's within the Organization for European Economic Co-Operation on the problem of Europe's energy supply led, in December 1957, to the creation of a European Nuclear Energy Agency (ENEA), the decision entered into force on 1st February 1958. The Agency, composed of the seventeen Member countries of the Organization participating in the decision to create the Agency was given the task of furthering and developing cooperation, among all the countries of Western Europe, with regard to the use of nuclear energy for peaceful purposes.

Following the admission of non-European countries at the beginning of the 1970's, the Agency was, in 1972, renamed the OECD Nuclear Energy Agency (NEA), and now comprises most industrialised market-economy countries. The tasks entrusted to it are implemented, under the authority of the OECD Council, by the Steering Committee for Nuclear Energy, assisted by an international staff.

3. THE EEC AND THE EUROPEAN ATOMIC ENERGY COMMUNITY (EURATOM)

Formal negotiations leading to the two Treaties signed in Rome on 25 March 1957 were conducted at a Conference in
Messina in 1955. The first of these Treaties set up the European Economic Community (EEC), which covered goods and services as a whole. The second Treaty setting up the European Atomic Energy Community (EUROTOM) took up the idea of sectorial integration already adopted with respect to the European Coal and Steel Community (ECSC), in the hope that, applied to an industry then in its infancy, such integration could be achieved more extensively and more quickly than that envisaged by the EEC Treaty.

Objectives of Euratom

Article 2 laid down the main objectives of EURATOM:

a. ensure that all users in the Community receive a regular and equitable supply of ores and nuclear fuels.
b. make certain, by appropriate supervision, that nuclear materials are not diverted to purposes other than those for which they are intended.
c. exercise the right of ownership conferred upon it with respect to special fissile materials.
d. ensure wide commercial outlets and access to the best technical facilities by the creation of a single market in specialized materials and equipment, by the free movement of capital for investment in the field of nuclear energy and by freedom of employment for specialists within the community.

4. COUNCIL FOR MUTUAL ECONOMIC ASSISTANCE

SEV (Russian), CAEM (French), COMECON (English), CAME (Spanish) this Council was established in January 1949
following a conference of representative of the USSR and several Eastern European countries. Other Socialist countries from other continents has joint since the Council. Its statutes were amended in 1962, 1974 and 1979 with a view to increasing the economic integration of Member countries.

In its scientific and technical mutual assistance program, the development of nuclear energy is given the role of a locomotive for the economy as a whole, leading to an improved electricity supply and a restructuring of the energy sector by reducing consumption of organic fuels. Hence, COMECON has proposed projects for concerted action for: the construction of power plants, in interested states (made possible by the standardization of equipment), projects relating to the various stages of the fuel cycle, and the interest in dual-purpose power plants (electricity and heat) as well as in fast-breeder and high temperature reactors.

B. JOINT UNDERTAKINGS AND SIMILAR ENTERPRISES

1. Eurochemic

The rules governing the European Company for the Chemical Processing of Irradiated Fuels are to be found in the first place in a Convention signed on 20th December 1957 by the governments of twelve of the Agencies' Member Countries and in the second place, in a statute for a commercial company with a share capital, approved by these governments, but signed by the shareholders, of whom certain were private electricity companies.
The objectives of the Company were:
- to conduct research activities concerning the reprocessing of irradiated nuclear fuel, and to train specialists in this field;
- to build and operate a reprocessing plant.

This plant was constructed at Mol in Belgium.

Other Joint Undertakings within the European Countries include:

2. OECD Halden Reactor Project
   A heavy boiling reactor located in Halden, Norway.

3. High-Temperature Gas-Cooled Reactor Project (Dragon)
   Located at Winfrith in the United Kingdom is managed by the United Kingdom Atomic Energy Authority.

4. URENCO/CENTEC

5. EURODIF

C. NON-GOVERNMENTAL ORGANIZATIONS

1. THE URANIUM INSTITUTE

The Institute is an international industrial association based in London; its main objectives are:
- to promote the use of Uranium for peaceful purposes;
- to conduct research into uranium requirements,
uranium resources and uranium production.

2. ORGANIZATION OF NUCLEAR ENERGY PRODUCERS (OPEN)

3. EUROPEAN ATOMIC FORUM (FORATOM).
NOTES AND REFERENCES


3/ IAEA's Statute.
TRANSPORT REGULATIONS ON RADIOACTIVE MATERIALS

Regulations for the safe transport of radioactive materials, as indeed is the case for any regulation for the transport of dangerous goods, may be considered at two levels.

1. The national level, i.e., regulations in force have jurisdiction within a particular country.
2. The international level; meaning regulations for shipments of radioactive materials between two countries, potentially transiting one or more other countries.

There is also a third level, or aspect, relating to Radioactive Material Transport Regulations, and that is the considerations that go into the process or processes of developing such regulations. 1/ The present paper will mainly be concerned with this third aspect, as well as its inter-relationship with national and international regulations. Next chapter will consider the objectives of the transport regulations regarding the sea mode.

7.1 SCOPE OF THE REGULATIONS

There are two considerations involved in the processes of developing transport regulations for radioactive materials that reflect the particular characteristics of such materials:

1. One concerns radiation protection and
2. The other concerns nuclear, or criticality, safety.
Other considerations do indeed apply, and they may broadly be identified as falling into the following three categories:

- Industrial Safety,
- Administrative Arrangements, and
- Modal Aspects

Specific to Radioactive Materials Transport Regulations is the concept of a PACKAGE. A package is defined as: the packaging ('container ') together with its radioactive contents. The reason why this concept is specific for Radioactive Materials Transport regulations is that, regularly, dangerous goods transport regulations address characteristics, or requirements, on the packaging for a defined sub-set of dangerous goods. Performance criteria given in the current International Radioactive materials Transport regulations relate to the package rather than the packaging.

In term of scope an additional observation needs to be made. Some radioactive materials also have other dangerous properties; e.g. toxic, inflammable, corrosive, etc. The Radioactive Transport Regulations do not include any provisions taking those properties into account. Needless to say that toxicity be forgotten; it simply means that such provisions are not included in and amongst the Radioactive Materials provisions.

7.2 DEVELOPMENT OF THE REGULATIONS

Shipment of radioactive materials have, from the early phases, not been limited to solely domestic shipments. Particularly, when radioactive materials (other than radium), started to be used on a regular basis outside the
domains of scientific and medical institutions, international trade with such commodities grew. Again in the early stages transport safety was governed by codes of practice or regulations originating in the major producing or using countries, but little steps were taken to harmonize the codes or regulations.

About 25 years ago the United Nations referred the matter of developing the material contents of International Radioactive Transport Regulations to one of its specialized agencies, The International Atomic Energy Agency (IAEA). The IAEA, being a forum for international cooperation in the field of nuclear energy can not, in the legal sense, issue regulations. What the IAEA more precisely does is to publish what formally is recommendations on the safe transport of radioactive materials. 3/

Over the years during which this development task has been carried out by the IAEA, the organization has become the leading international authority in the matter. This fact has resulted in significant impact. Currently all international (all modes of transport included), and almost all nations, Radiactive Materials Transport Regulations are based on IAEA Transport Regulations.

The reason why the impact is significant is two-fold:
- First the international community has agreed to adopt the radiation protection and nuclear safety philosophy contained in the IAEA Transport Regulations.
- Second, international trade is greatly assisted by the fact that regulations in force in different countries are harmonized.
Development of the IAEA Radioactive Materials Transport Regulations is based on the following purpose:

"The purpose of these regulations is to establish standards of safety which provide an acceptable level of control of the radiation hazards to persons, property, and the environment that are associated with the transport of Radioactive material. Control instituted for other reasons, such as economics and physical protection, shall not detract from the standards of safety which these Regulations are intended to provide."

Regulations, in a formal sense, are issued by modal international organizations. Such regulations apply to a specific mode, e.g. air, sea, and land, and they are related to an international convention, or regional or agreement between states.

Regulations for the safe Transport of Radioactive materials are a component part of the DANGEROUS GOODS TRANSPORT REGULATIONS. The radioactive materials are all included in Class 7 of the UN Recommendations (orange book). Transport safety in terms of other dangerous properties is covered by regulations for the accompanying classes (e.g. corrosives, inflammable, toxic substances, etc.).

Examples of International modal regulations are:

- ICAO Technical Instructions for air mode
- IMO International Maritime Dangerous Goods Code, for sea mode.
- RID/ADR European Rail/Road Regulations.
7.3 REGULATORY APPROACH

Regulations for the safe transport of radioactive materials are based on two main considerations:

a. One is based on radiation protection considerations and is concerned with limits of different kinds. From the point of view of operational practice those limits include package contents, external radiation levels, and surface contamination limits.

b. The other main consideration relates to safety, and is concerned with the function of containment (of the radioactive contents) and the mechanical integrity of the various components forming a package, as well as of the package itself.

Interwined amongst, and inherent in, these main considerations are the criticality aspects. Mechanical integrity of a given package, proper selection and physical arrangement of defined package components (e.g. neutron absorbers), content limitations etc., are of essential importance in ensuring criticality safety. These paper will not discuss criticality safety in any detail.

The regulatory requirements are in most cases functional; i.e. they prescribe that certain quality be present or maintained. This means that the regulations do not prescribe how to achieve this particular quality. As an example limitations on external radiation levels may be mentioned. The regulations allow virtually any freedom in choosing how to actually comply; e.g. by providing
suitable shielding material (conceptually any material may be used, as long as it does the job without getting into conflict with other regulatory requirements), or by providing appropriate distance between the contents and the package surface.

Some regulatory requirements are, however, absolute in nature. Reference is made to contents limits.

As has been mentioned above the regulations are oriented towards package, and package behaviour. An important safety consideration is inherent in the approach taken. In so far as it is practically achievable safety is so to say built into the package. What is meant is the following: the resultant level of safety in transport operations - cargo terminal handling, in-transit storage, and physical transport - should depend as little as possible on requirements specific to the radioactive properties of the package contents. 5/

The radioactive material transport regulations have, in other words, been drafted with due consideration of what constitutes established working patterns in handling and transporting cargo - essentially based on common sense in terms of a combination of industrial safety, and the fact that anybody who presents a piece of cargo for transport will reasonably assume that it will arrive undamaged at its destination.

One result of this effort is that the regulations are, essentially, mode independent. This is an important result in that different package regulatory requirements need not (in the vast majority of situations) be complied with when transport route includes a transfer from, say, the land
mode to the sea mode. An exception from this general observation related to air shipments, where additional to land and sea mode based requirements, the containment system needs to withstand the added strain caused by the 'surface to high altitude' pressure differential.

Operational differences, specific to a particular mode of transport rather than the radioactive characteristics of package contents, may also apply. Tie downs may be mentioned as an example. There is a difference between providing adequate tie downs for a sea shipment as oppose to a road shipment. On the other hand, such differences are specific to establish/working practices associated with any particular mode of transport, and are not necessarily governed by package contents.

The above discussion has indicated that certain portions of the transport regulations are specifically directed to
- the consignor (who presents a package for transport),
- while other portions are directed towards the carrier.
There are still other portions of the regulations that are specifically directed. One example relates to the design of packages. The designer needs to know against which functional requirements to design a package. Anybody who uses a package manufactured to that design will need to know that, and how, the functional requirements have been complied with. 6/

In terms of the transport regulations it is the consignor who is responsible for the preparation of a package to be presented for transport, including that the package design, as well as the individual specimen, complies with the regulations. The consignor always has
this responsibility, irrespective of whether he has designed and manufactured the individual package or has been otherwise provided with it.

7.4 IAEA TRANSPORT REGULATIONS

The following sub-sections will describe (discussed) a selection of detail aspects of the 1985 Edition of the IAEA Transport Regulations, series 6. (Regulations On wards)

The requirements provided by the REGULATIONS are in most cases functional, i.e., they define WHAT must be achieved. How to actually go about to achieve this end is not deliberated on the REGULATIONS.

The IAEA has published a document to accompany the regulatory text under the title of ADVISORY MATERIAL. This document provides advice on How certain regulatory requirements can be met.

It is important to stress that the ADVISORY MATERIAL is providing advice only, and that such advice is illustrating one way in which to meet the requirements. It is not necessary to follow the advice; other methods may well be equally suitable.

There is also a third accompanying document to the REGULATIONS, the EXPLANATORY MATERIAL. The purpose of this publication is to explain the basis – the WHY – of certain regulatory requirements.
7.4.1 PACKAGE TYPES

The Radioactive Material Transport Regulations provide differentiated package requirements. The basis for this differentiation is the level of risk, associated with transport operations. The performance standards, in terms of retention of integrity of containment and shielding, depend upon the quantity and nature of the radioactive material transported.

The performance standards applied are graded to take into account conditions of transport characterized by the following severity levels:

a. Conditions likely to be encountered in routine transport (incident-free conditions),
b. Normal conditions of transport (including minor mishaps), and
c. Accidents conditions of transport.

The performance standards include design requirements and tests.

There are basically four types of packages:

<table>
<thead>
<tr>
<th>TYPE</th>
<th>DESCRIPTION</th>
<th>REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Excepted Package</td>
<td>Need to meet minimal requirements only.</td>
</tr>
<tr>
<td>2</td>
<td>Industrial Package</td>
<td>Need to meet minimal-plus requirements, essentially of the 'keep the juice in can' kind</td>
</tr>
<tr>
<td>A</td>
<td>Type 'A' Package</td>
<td>Need to meet requirements derived from normal conditions of transport</td>
</tr>
<tr>
<td>B</td>
<td>Type 'B' Package</td>
<td>Need to meet requirements derived from accident conditions of transport.</td>
</tr>
</tbody>
</table>
It is essential to recognize that the above performance standards, as related to package type, apply to the capability of retaining the integrity of containment and shielding only. There are not concerned with what might be termed the definition of operational limits on, say, external radiation in the absolute sense.

Although not defined as a separate Package, specific requirements apply to packages containing fissile material. In practice, any of the Industrial, Type A or Type B Packages are used for the transport of fissile materials.

7.4.2 PACKAGE CONFIGURATION

There is not necessarily any pre-determined package configuration associated with a particular consignment. The reason why it is so is that the Regulations define functional requirement; i.e., the consignor is at some liberty to decide how to actually configure his package; in so far as to properly comply with the functional requirements.

There are, however, a number of typical package configurations (see annexes). A limited number of those will be identified.

7.4.2.1 TYPE 'A' PACKAGE

A Type A Package may typically be composed of the following components:

- Consider some radioactive material in liquid form.
  It might be contained in a vial, which, for shielding
purposes, be placed in a lead pot. Because of the liquid form, and the possibility of the vial being broken, there would be some absorbent material outside the lead pot.

The vial, lead pot, and absorbent material is then usually contained in a metal canister, very similar to what is used to hold canned food.

So far the package configuration provides containment, a certain amount of shielding, and - because radioactive material in liquid form is considered - absorbent material.

In order to protect the contents from impact forces, and, possibly, also to provide any necessary reduction in external radiation levels, the can is frequently fixed inside a cardboard box. The distance between the outer surface of the can, and the box wall, needs to be determined in order to provide a measure of impact energy absorption, as well as to provide for any necessary reduction in external radiation levels.

7.4.2.2 TYPE 'B' PACKAGE

A Type B Package configuration is regularly determined by a higher activity than allowed in a Type A Package.

- If, for instance, irradiated nuclear fuel forms the package contents, any decay heat generated needs to be properly dissipated. The manner in which this is regularly performed is by utilizing the temperature differential between the package 'inside' and 'outside'. i.e., the Regulations also put requirements on permitted ambient conditions. Typically, one would
see cooling fins in a cask intended for the carriage of spent fuel. (See Annex).

Shielding requirements, as well as more stringent requirements to withstand (i.e. absorb) any impact energy, result in quite different designs as compared to designs for Type A Packages.

Containment may typically be provided by a combination of some inner containment (e.g. the fuel cladding), and defined sealing arrangements in terms of the packaging. Shielding requirements are reasonably simple to satisfy; it is essentially a matter of providing 'enough' of any suitable shielding material.

A particular aspect of a Type B Package is its capability to withstand accident conditions. These accident conditions are defined by test standards, including mechanical and thermal tests. Thermal insulation, as well as extra shock absorbers, may need to be provided. In very general terms a Type B Package is thus much more robust than is a Type A Package.

7.4.3 CONTENTS LIMITATIONS

Limits on activity contents are given by the Regulations in a more or less explicit manner for the three first package types as identified in the previous section. The regulations do no provide an upper activity limit for the contents of a Type B Package. On the other hand, any Type B Package needs a Competent Authority Package Design Approval Certificate (See annex) in order to qualify as such. Appropriate limits on the radioactive contents are provided in the Approval Certificate.
In summary, the contents limitations for each of the Excepted, Industrial, and Type A Packages are defined in a manner such that, should a transport incident/accident happen, the resultant radiation dose accrued by rescue workers and members of the general public be essentially the same. On the basis of more stringent performance standards required when going from an Industrial Package to a Type A Package a higher activity limit applies to Type A Packages.

With regard to Type B Packages specifications on contents limitation provided by the Competent Authority in the Approval Certificate is based on a review of the Safety Analyses Report filed in support of the application.

For packages intended for the carriage of fissile materials a similar process of filing and reviewing a Safety Analysis Report is involved in determining the permitted contents.

7.4.3.1. CONTENTS LIMITATIONS FOR TYPE 'A' PACKAGES

In the context of activity contents limits for Type A Packages the so called A1/A2 system plays an important role. (For discussion on A1/A2 System, see IAEA Transport Regulations, Serie No.6) This system, providing values, or limits, for individual radionuclides, is also used elsewhere in the Regulations for the purpose of expressing activity limits.

In terms of Type A Package contents limits a distinction is made between:
- contents in the form of solid, or
encapsulated, radioactive material, and
- material in loose form, e.g. powder.

In the first case, given that certain conditions apply, the radioactive material presents essentially only an external radiation exposure risk, should the package be damaged in a transport accident. The point being made is that contamination of the accident site, or of components scattered over the accident site, will not result if the sealed source constituting the radioactive contents remains intact. The qualifier is an appropriate definition of the requirements on the characteristics of this sealed or solid source.

If, on the other hand, the Type A Package contents is not a sealed source, surface contamination on the accident site is a likely result in case of loss of package containment integrity.

Limitations of the package contents must take into account both:
- the physical characteristics of the radioactive material
- and the exposure pathway.

If the material is a sealed source the task of defining a limit is reasonably simple; if not a sealed source, the task is much more complex. The IAEA A1/A2 System provides an integrated approach to the necessary answers. The radiological protection considerations forming the basis for this system is the following:
- For Sealed Source only external radiation can contribute to the resulting dose. On this basis the A1 value, i.e., the external exposure, is determined. This is the package contents limit for the sealed source discussed above. In order to qualify as such a "sealed source",

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the radioactive material must meet the requirements of what the regulations call Special Form Radioactive Material. A Competent Authority Approval Certificate is the necessary evidence of the material being of Special Form.

- For a Non-Sealed Source a number of exposure pathways must be considered.
- First, a measure of how much of the original package activity contents is released in the accident is needed.
- Second, a similar measure of how much of this released activity will be taken up by a bystander is needed.
- Third, derived: those limits must be established in order to calculate the appropriate contents limit; in this case the A2 value.

Considerations concerning the exposure pathways used in the derivation of individual A1/A2 values are based on the following assumptions:
- The effective, or commited effective, dose equivalent to a person exposed in the vicinity of a transport package following an accident should not exceed the annual dose limit for the radiation workers, i.e., 50 mSv.
- The dose, or committed dose, equivalent received by individual organs, including the skin, of a person involved in the accident should not exceed 0.5 Sv, or in the special case of the lens of the eye, 0.15 Sv.
- A person is unlikely to remain at 1 m from the damaged package for more than 30 minutes.
- Activity release fraction is in the range 10^-2 to 10^-3.
- Uptake factors range from 10^-3 to 10^-4.

Based on the above fundamental assumptions radionuclide
specific values for A1 and A2 have been calculated, and they appear in the REGULATIONS providing specific information on activity limits for the contents of a Type A Package.

7.4.4 EXTERNAL RADIATION LEVELS

For the purpose of limiting external radiation from a package containing radioactive material a set of limiting levels have been developed. These limiting levels apply to any Package Type.

The limiting levels were developed 25 years ago, based on studies of the then current cargo handling practices. These limiting levels have, essentially, undergone no change since then.

Associated to the limiting levels is the concept of Package Categories. The following table applies:

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>Dose Rate at 1m from External Surface (mSv/h)</th>
<th>Dose Rate at Surface (mSv/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-WHITE</td>
<td>DR=0</td>
<td>DR &lt; 0.005</td>
</tr>
<tr>
<td>II-YELLOW</td>
<td>0 &lt; DR &lt;=0.01</td>
<td>0.005&lt;DR&lt;=0.5</td>
</tr>
<tr>
<td>III-YELLOW</td>
<td>0.01&lt;DR&lt;=0.1</td>
<td>0.5&lt;DR&lt;=2</td>
</tr>
</tbody>
</table>

Source: Based on the IAEA Regulations.

The above table is simplified in that the dose rate limit at 1m in the Regulations is merged together with criticality safety considerations into what is termed Transport Index (TI). In the table only the radiological
The protection component has been extracted. Furthermore, for III-YELLOW, in the special case of shipment under what is called Exclusive Use, a higher TI and surface dose rate may be permitted.

The way in which the regulatory requirements are defined a consignor has considerable freedom in selecting the Package Category, i.e., for most individual consignments, the consignor may choose to assign the package to any of the Categories.

For the health physicist wanting to apply the ICRP concept of optimization in transport safety this fact may seem strange, if not wrong. But one has to keep in mind that the distribution of packages over the three Categories has resulted in radiation doses accrued by transport workers that cause no concern.

7.5 ADMINISTRATIVE PROCEDURES

As has been mentioned above compliance with specific regulatory requirements need to be demonstrated by a review and approval procedure. The REGULATIONS identify in detail when, and what kind of, approval is required, and they also introduce the (national) Competent Authority as the appropriate body to perform this function.

The REGULATIONS provide detailed information on aspects such as:
- What need be included in an application for approval,
- Contents of an Approval Certificate and
- The terminology that should be used.
The types of approval required by the REGULATIONS are:

- Special Form radioactive material
- Type B Package design
- Package design for fissile material
- Shipments (over a threshold defined in the REGULATIONS).

**UNILATERAL APPROVAL**: Some of the approvals required may need to be performed by only one national Competent Authority. A Special Form approval is an example of a unilateral approval. In this case the approval should originate in the country of origin; i.e., the country in which the Special form design was made. In the concept of Unilateral Approval is included a meaning, or interpretation, that any other country in which, in this case material in full conformity with the approved Special Form be shipped, will not require additional review and approval.

**MULTILATERAL APPROVAL** is required by the REGULATIONS when when a defined set of the overall Type B requirements are not completely comply with. In this situation the REGULATIONS still allow the design to be approved, but in order to be able to use any specimen manufactured to such a design, approval is required both from the COMPETENT AUTHORITY of the country of origin of the design, and of each country through or into which the package is to be transported.

A Type B Package Design Approval may be either a UNILATERAL APPROVAL, (Type B(U) Package), or a MULTILATERAL APPROVAL, (Type B(M) Package).

Packages being either of Type A or of Industrial Type
need no Competent Authority Approval. In this case, the REGULATIONS place the responsibility that any package put to operational use complies with the regulatory requirements on the CONSIGNOR. Although a formal Approval Certificate is not required, any consignor is well advised to maintain any necessary evidence of compliance. The REGULATIONS encourage the COMPETENT AUTHORITY to engage in compliance assurance activities; e.g. requiring a review of the evidence of compliance.

Each package design for FISSILE MATERIAL shall require MULTILATERAL APPROVAL.
NOTES AND REFERENCES


5/ Idem, Regulations, Series No.6

6/ Idem, Regulations, Series No.6


TRANSPORT OF RADIOACTIVE MATERIALS BY SEA

At the origin of regulations in this field, the 1960 SOLAS Convention accomplished the following:

- it laid down, in Chapter VII of SOLAS a general framework for the transport by sea of dangerous goods;
- it entrusted IMO with the task of drafting a single international Code for the transport by sea of dangerous goods (IMDG Code) and recommended government parties to the Convention to adopt this Code.

The above-mentioned SOLAS Convention of 17th of June 1960 was repealed and replaced by a new Convention dated 1st November 1974 and entered into force in 1980, and a revised version of Chapter VII of this Convention was adopted by the Maritime Safety Committee (MSC) of IMO in 1983 and entered into force 1st July 1986.

There are therefore two texts which need to be considered: The SOLAS Convention and its Annexes, and the IMDG Code.

1. The SOLAS Convention

The SOLAS 1974 Convention applies to ships authorized to fly the flag of a Contracting State, and the Contracting Parties undertake to issue all laws and regulations and to take any other measures necessary to give full and complete effect to the provisions of the Convention.
Chapter VII, relating to the carriage of DGs, specifies that it applies to DGs classified under regulation 2 (e.g., Class 7, radioactive materials) which are carried in packaged form or in solid form in bulk in all ships to which the regulations apply, i.e., to ships (other than warships, troop carriers, sailing ships, fishing boats, etc.) making an "International Voyage" means a voyage between a country to which the Convention applies and a port situated outside the country in question, or vice versa.

Lastly, it will be noted that the Contracting Parties must communicate to IMD the text of any Acts, decrees, etc. they promulgate concerning matters falling within the scope of the Convention. This obligation covers special rules established by agreement between all or only some of the Contracting Parties.

National governments may also allow the promulgations of provisions different from those prescribed by the Convention, on condition that they are at least as effective.

2. The International Maritime Dangerous Goods Code (IMDG Code)

The IMDG Code was drafted by the MSC of IMO; the first version, published in 1965, was re-issued in a new edition in 1986, which incorporate all amendments up to and including Amendment No. 22-86 which came into force on 1 July 1986, also amendment No. 23-86 which came into force on 6 April 1987.

The IMDG Code lays down the basic principles. Detailed recommendations relating to each type of material and a
number of good practice recommendations are contained in the classes corresponding to this material. The note corresponding to any given material can be found with the aid of a technical index. Chapter 4 presents a detailed description of the Code. MSC of IMO drafted a complete newer version of Class 7 of the IMDG Code in April 1988, (Amendment No. 25(6) (CDG 40/17/Add.9). This new version will incorporate the 1986 Supplement to the IAEA Regulations for the Safe Transport of Radioactive Materials (Safety Series 6) 1985 edition and it will entered into effect in the middle of 1991.

IMDG Code is presented in the form of recommendations which Contracting States are invited to adopt. As a rule, these recommendations apply only to the ships covered by the Convention. However, IMO feels it desirable for manufacturers, packers and carriers to follow the advice given as to terminology, packaging and labelling; and for road, rail and port services to adopt the provisions relating to classification and labelling and to separate the various classes of goods into loading and unloading zones on the basis of the Code's recommendations.

3. SPECIAL RECOMMENDATIONS RELATING TO CLASS 7

The Regulations of the IAEA are concerned only with the radioactive and fissile properties of materials; it is necessary for consignments of radioactive material to comply with transport regulations applicable to other hazardous properties which such material may possess. This is in fact specified in the IAEA Regulations in paragraphs 105, 406 and 407. In this respect, the IAEA Regulations also elaborate two specific restrictions:

(a) Account shall be taken of the formation of other
dangerous substances which may result from the reaction between the contents of a consignment and the atmosphere or water in the event of breaking of the containment caused by an accident (paragraph 208 of IAEA Regulations); and

(b) Liquid pyrophoric radioactive materials shall not be transported by air (paragraph 474 of IAEA Regulations).

In practice, radioactive material consisting of one or more radio-nuclides, alone or associated with small quantities of non-radioactive material, transported in accordance with the IAEA Regulations will be satisfactorily covered in respect of any other hazardous properties possessed by them. 3/

However, it is emphasized that, except for radioactive material in special form, as defined by the IAEA Regulations, radioactive material transported in accordance with those Regulations may be associated with a comparatively large quantity of non-radioactive material (particularly a liquid or a gas) which may possess other hazardous properties requiring additional consideration in that respect. This should be borne in mind particularly for those radioactive materials which are partially exempted from certain of the provisions set down in the IAEA Regulations, namely:

(a) Limited quantities of radioactive material in excepted packages, defined in paragraph 134(a) as provided for in section IV, paragraph 419 of the IAEA Regulations;
(b) The low specific activity materials as defined in
Section I, paragraphs 131 (b) (ii) and 131 (c) of the IAEA Regulations; and

(c) The surface contaminated objects as defined in Section I, paragraph 144 of the IAEA Regulations.

A full list of radioactive nuclides is included in Section III, Table I of the IAEA Regulations.

General principles for radiation protection of transport workers and the general public are included in Section II of the IAEA Regulations. Compliance with the IAEA Regulations, which implement the basic Safety Standards for Radiation Protection, IAEA Safety Series No. 9, 1982 Edition, will ensure a high degree of safety.

OBJECTIVES OF THE TRANSPORT REGULATIONS

The objectives of the IAEA’s recommended Regulations for the Safe Transport of Radioactive Materials is to protect the public, transport workers, and property from both the direct and indirect effects of radiation during transport. Protection is achieved by limiting the nature and activity of the radioactive material which may be transported in a package of a given design, specifying design criteria for each type of package, and recommending simple rules for handling and stowage during transport.

The Regulations aim to guard against:

- the dispersion of radioactive material and its possible uptake by people nearby during normal transport or in the event of an accident.
- the hazard due to radiation emitted from the package;

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and/or
- the possibility that the chain reaction (criticality) may be initiated in the material contained in the package.

These objectives are achieved by:

1. ensuring that the containment of the RAM is adequate to prevent its dispersion and uptake - the design and strength of the package, and the activity and nature of its contents are all taken into account.

2. controlling the external radiation level and providing warning of contents of package - the maximum radiation level at the surface of a package, its labelling and marking and requirements for stowage during transport are all considered.

3. preventing damage by heat - the maximum temperatures of contents and packaging are controlled through proper design and instructions on stowage to provide for the safe dissipation of heat; and

4. preventing criticality - very conservative assumptions are made concerning the packaging and what may happen to its contents in accident conditions.

The intentions is to ensure that as far as possible each package may be dealt with in the same way as other potentially hazardous goods that are carried by conventional means of transport and handled by workers with no specialized training. For safety's sake reliance is therefore placed principally on the package design, or built-in safety, rather than in operational control.
The underlying philosophy is that as far as possible the consignor should be responsible for ensuring safety during transport. Those who prepare each package for shipment are responsible for ensuring that regulatory requirements are met. This minimizes the contribution required from carriers, and allows consignments of RAM to be transported with minimal special handling: transport industry workers are expected to treat RAM consignments with care, but with no more care than that accorded to other dangerous goods.

In the Regulations, requirements concerning package strength are expressed as PERFORMANCE standards rather than specification for design, such as wall thicknesses, details of joints and closures and so on. In other words, the Regulations prescribe what must be achieved, rather than what shall be done.

The inner vessel which contains RAM may be protected in various ways against damage which may occur during transport. E.g. outer layers of packing material may be used. Large flasks of the sort used to transport irradiated nuclear fuel (see annex) are often fitted with energy absorbing devices to protect them in the event of an accident. Additional shielding may be necessary to reduce the radiation levels around a package to acceptable values.
NOTES AND REFERENCES


THIRD PARTY LIABILITY AND INSURANCE

International nuclear trade, whether it be the export of source materials and equipment, the international transfer of nuclear material for various purposes such the enrichment or reprocessing of fuel, or simply the transport of radioisotopes, give rise to many different problems of liability and insurance. A desire to subject such activities to a uniform system of law is the main reason behind the adoption of several international conventions on nuclear third party liability.

As the accident at Chernobyl illustrated, the geographical scope of damage caused by a nuclear accident is not confined to national boundaries. In the event of a nuclear accident causing damage in more than one country, it is desirable that the protection accorded to victims by a third party liability regime be accorded equitably among affected countries. Although the high safety standards of the nuclear industry, as noted by the IAEA, mean that the risk of an accident is very low, it is also true that the possible magnitude of damage from a nuclear accident is such that insurance coverage of liability requires international collaboration between national insurance pools. 1/  

These considerations were recognised in the early years of the nuclear power industry and inspired States to develop the existing international regimes. Furthermore, there is a significant amount of transboundary transport of nuclear materials. Such international movement is both
better-regulated and facilitated by being subject to one uniform regime.

9.1 INTERNATIONAL REGIMES FOR NUCLEAR THIRD PARTY LIABILITY

There are two basic international regimes for nuclear third party liability:

9.1.1. The Paris Convention. Convention on Third Party Liability in the Field of Nuclear Energy was established on 29th July 1960 under the auspices of the OECD Nuclear Energy Agency (NEA) and covers most West European countries, it entered into force on 1st April 1968.


9.1.3 The Vienna Convention. Convention on Civil Liability for Nuclear Damage was established on 21st May 1963 under the auspices of the International Atomic Energy Agency (IAEA) and is worldwide in character. This Convention entered into force on 12th Nov. 1977.

The Paris Convention regime is supplemented by

The Paris Convention and the Brussels Supplementary Convention have both been twice amended:

The 1982 Protocol amending the Brussels Supplementary Convention is not yet in force (July 1989).

More recently, the Paris and Vienna Conventions have been linked by:


In relation to Maritime Transport, the Paris and Vienna Conventions are supplemented by:


9.2 PARIS CONVENTION AND VIENNA CONVENTION

The drafters of the Paris and Vienna Conventions were concerned both to provide adequate protection to the public from possible damage, the risk of which were small but the possible gravity, very high, and to ensure that the growth of the nuclear industry, from which this same public would benefit, would not be hindered by bearing an intolerable burden of liability. To satisfy these two potentially conflicting aims, these two Conventions have promoted special regimes founded on a number of important principles:
A. The operator of a nuclear installation is exclusively liable for accidents at and in relation to that installation, including in the course of the transport of nuclear substances.

B. This liability is "absolute". This is to be contrasted with general tort law based on fault or negligence. Under the Conventions, the operator of a nuclear installation is liable, regardless of whether fault can be established.

C. While the liability imposed upon the operator is exclusive and absolute, it is limited in both amount and time.

- Under the Paris Convention, the maximum liability of an operator is 15 million SDRs. However, a Party may take into account the possibilities of obtaining insurance or other financial security, establish a greater or lesser amount by legislation to a lower limit of five million SDRs. Under the Vienna Convention, the liability of an operator may be limited to not less than US$5 million.

- With respect to time, the basic rule under both Conventions is that the right to compensation expires if an action is not brought within ten years of the nuclear accident. In addition, States may limit liability to no less than two years (under the Paris Convention) or three years (under the Vienna Convention) from the time when the damage and the operators liable have become known to the victim.

- The operator must have insurance or some other financial security to cover its liability; i.e., the
operator must hold financial security equivalent to the amount of its liability.

- The provisions of both Conventions and national legislation pursuant to the Conventions are to be applied without any discrimination based on nationality, domicile or residence.

- Unity of jurisdiction: competence with respect to actions for compensation under the Conventions is restricted to the courts of the Party in whose territory the accident occurred.

9.3 BRUSSELS SUPPLEMENTARY CONVENTION

Soon after the adoption of the Paris Convention, a number of Signatories developed a supplementary compensation regime to provide public funds, should the compensation under the Paris Convention prove insufficient to cover damage caused by a nuclear accident. These public funds are to be provided, not only by the state where the installation of the nuclear operator liable for the damage is located, but also by contributions from all Parties to the Brussels Supplementary Convention. The Brussels Supplementary Convention is thus based on a strong bond of financial solidarity between its Parties.

The Paris Convention and the Brussels Supplementary Convention, together with their respective amending Protocols signed in 1982, provide for compensation to a maximum of 120/300 million SDRs. 5/

This compensation is comprised of three tiers: 6/
- The first tier. Each Party to the Paris Convention is required to establish by legislation an amount of at least 5 million SDRs, to be provided by insurance or other financial security.
- The second tier provides for compensation beyond that provided by the first tier up to a total of 70/175 million SDRs. This compensation is to be provided from public funds to be made available by the Party in whose territory the nuclear installation is situated.
- In so far as the damage exceeds this level, the third tier provides a further amount of 50/125 million SDRs out of public funds to be contributed jointly by all the Parties to the Brussels Supplementary Convention.

9.4 MARITIME TRANSPORT: THE 1971 BRUSSELS CONVENTION

One of the main features of the Paris and Vienna Conventions is the channelling of the liability onto the operator, including for accidents occurring during the transport of nuclear substances. Under the 1971 Brussels Convention, developed under the auspices of the IMO, the IAEA and the OECD, any person who might be held liable, by virtue of an international convention in the field of maritime transport, for damage caused by a nuclear accident is to be exonerated if the operator of a nuclear installation is liable under the Paris or the Vienna Convention.

9.5 REGIMES APPLICATION

9.5.1 Nuclear Damage
The Paris and Vienna Conventions provide for compensation for damage to, or loss of life of any person, and for damage to, or loss of, any property caused by a nuclear accident in a nuclear installation or during transport of nuclear substances to and from installations. This does not, however, include damage to the nuclear installation itself.

9.5.2 Nuclear Installations

Nuclear installations are installations such as reactors (other than those comprised in any means of transport); factories for the manufacture or processing of nuclear substances, for the enrichment of uranium and for the reprocessing of irradiated nuclear fuel; and facilities for the storage of nuclear substances.

9.5.3 Transport

As in the case of installations, the special regimes of the Paris and Vienna Conventions need not apply to the transport of substances which do not involve high levels of risk. Thus, the large volume of transport of radioisotopes directly usable for industrial, commercial, agricultural, medical or scientific purposes is excluded from the scope of the Conventions.

9.5.4 Nuclear Operator

Compensations under the Paris and Vienna Conven-
tions is paid by the liable nuclear operator. This is the person designated or otherwise recognised, in advance, by the relevant national authorities as the person who would be liable should an accident occur at that installation or in the course of transport to or from that installation. This person will be responsible for holding the insurance or other financial security to cover the maximum level of liability prescribed by the national legislation under the relevant Convention.

In the case of the transport of nuclear substances, it is necessary to determine whether the sending or the receiving operator will be liable. The same solution is adopted in the Paris and Vienna Conventions. Liability is, in principle, imposed on the operator sending the nuclear substances because it is the sending operator who will have the responsibility for the packing and containment. This liability passes to the receiving operator upon the assumption of liability by that operator pursuant to the express terms of a written contract or, failing such a contractual provision, when that operator takes charge of the materials. In the case of transport to or from operators in States which are not Parties, special provisions apply to ensure that an operator to which the Convention regime applies will be liable.

9.5.5 Territorial Scope

Both the Paris Convention and the Vienna Convention are first intended to benefit their
Parties. Accordingly their application is subject to certain territorial limitations. The Paris Convention applies when an accident causing damage occurs in the territory of a Party and in so far as damage from this accident is suffered in the territory of a Party. Territory includes territorial sea. Parties have the option of extending the territorial scope of the Convention by national legislation and this has been the object of recommendations by the Steering Committee. By contrast, the Vienna Convention does not specifically define its territorial scope. The general view is that, like the Paris Convention, it covers damages in the territories of states which are Parties, but it does so regardless of where the accident occurs.

Of course, under the Paris and Vienna Conventions, their application to accidents occurring in States which are not Parties to the relevant Conventions will be limited to accidents occurring in the course of transport where the liable operator is the operator of a nuclear installation in a State which is a Party to the relevant Convention.

9.6 The Joint Protocol

One must not be misled by the similarity between the Paris and Vienna Conventions to believe that together and without further steps, they in fact provide one generally uniform third party liability regime for all countries which are Parties to either Convention. Until now, the victims in the territory of the Parties to one Convention
were left without protection if an accident occurred at an installation in the territory of a Party to the other Convention. (No State is a Party to both Conventions due to the potential conflicts involved in their simultaneous application.)

This significant gap in the protection of victims has now been resolved by the adoption of a JOINT PROTOCOL which links the two Conventions. This Protocol was opened for signature at a Diplomatic Conference in Vienna on 21st September 1988.

When it enters into force, the Protocol will treat Parties to the Joint Protocol as though they were Parties to both Conventions. The liability of an operator and the amount of that liability will remain determined by the Convention which covers the State where the operator's installation is located. The protocol will also resolve potential conflicts between the two Conventions, particularly in the case of transport, by ensuring that only one Convention applies to any accident.

9.7 Number of States Parties

<table>
<thead>
<tr>
<th>Paris Convention Parties</th>
<th>Vienna Convention Parties</th>
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<tbody>
<tr>
<td>Belgium*</td>
<td>Argentina</td>
</tr>
<tr>
<td>Denmark*</td>
<td>Bolivia**</td>
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<tr>
<td>Federal Republic of Germany*</td>
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<td>Finland*</td>
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<td>Peru**</td>
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<td>Netherlands*</td>
<td>Philippines</td>
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While the Joint Protocol will resolve the question of the harmonization of the Paris and Vienna Conventions, many States are not Parties to either Convention, including several countries with significant nuclear industries, such as the United States, Canada, Japan and the USSR. It was for this reason that, in the face of the first major accident at a nuclear installation, the accident at Chernobyl, the benefits of these Conventions were unavailable. Indeed, of the over 400 nuclear power plants world-wide, over two thirds do not come under the provisions of either Convention. These non-Party States are being strongly encouraged to join one of the two Conventions.

9.8 Limitation of Liability

As stated above, the maximum amount of liability established by the Paris Convention is, in principle, 15 million SDRs. This amount was established, at the time the Convention was developed, by reference to the capacity of the insurance market of the time. Since then, this capacity has increase significantly. The Convention has never been modified in this respect. Although the maximum liability indicated by the Paris Convention remains unchanged, many States Parties have recognised the
availability of higher levels of private insurance and have increased the amount of the operator's maximum liability pursuant to their national legislation. (see annex).
NOTES AND REFERENCES


3/ SDR or Special Drawing Rights as defined by the IMF. This unit of account is calculated on the basis of a basket of currencies of five of the most important trading nations. As at mid-October 1988, 15 million SDRs was approximately to US$20 million.

4/ Defined by reference to its value in terms of gold on 29th April 1963, i.e. US$35 per one ounce of fine gold.

5/ The 1982 Protocol to the Brussels Supplementary Convention (not yet in force) increase the available compensation. Figures are given for before and after the entry into force of this Protocol.


7/ Idem. NEA ISSUE BRIEF, No.4, p.3


12/ Sweden has risen its insurance coverage for every consignment of RAM type 'B' packaged to 500 million SEK (Specimen shown in the annex).
CONCLUSIONS

The most important element contributing to the safe handling and transport of Dangerous Goods is a good organization and good management.

The definition of good management is one that ... "appreciates the risks, ensure compliance with laws, international recommendations and good operating procedures, and will ensured the business is furthered by competent staff in all grades likely to apply common sense".

With the rapid expansion of trade and transport of Dangerous Goods the importance of having internationally accepted regulations or standards and guidelines for their transport, handling, storage, etc becomes obvious.

Whereas for maritime transport the requirements in SOLAS Convention and the provisions of the IMDG Code, its annexes and Supplements were initially very much directed at the specific maritime link of the transport chain, the majority of these provisions are pertinent also to dangerous goods in port and port areas, particularly those concerning safety aspects. (e.g. stowage, segregation, safe handling, emergency response procedures, first aid and medical treatment).

In addition, it would appear to be self explanatory that the better and more comprehensive knowledge of these subjects port authorities and administrators possess, the better will be the possibilities of enhancing an effective and efficient treatment of dangerous substances, thus
aiding a speedy turnaround of ships and other conveyances transporting such substances.

The obligations of an administration arising from the ratification of the SOLAS Convention, the adoption and implementation of the IMDG Code with its references to competent authorities would in most cases require that a standing advisory committee of experts be set up to advise the regulatory bodies in an administration to resolve the problems which may arise in operational practice.

It is also possible for administrations to delegate responsibilities to subsidiary bodies, such as classification societies, national testing institutions of all kinds, government laboratories, safety control inspection services, etc.

It is finally recalled that efforts are being directed, inside and outside the UN System, at harmonizing the requirements pertaining to the transport and handling of dangerous goods of the various modes of transport with the long term view of reaching an international agreement on an International Convention for the Safe Transport of Dangerous Goods, covering all modes of transport.


4. Recommendation on the Safe Transport, Handling and Storage of Dangerous Substances in Port Areas. (Adopted by the MSC at its 43rd Session), IMO Doc 288.81.16.E.


34. Sax, N. Irving. Dangerous Properties of Industrial
Materials/ N. Irving Sax, assisted by Marilyn Bracken... [et al], 5th ed. N.Y. Van Nostrand Reinhold, 1979


rions Type A packages, widely used for pharmaceuticals, radiochemicals, and all radiation sources.

edit: Amersham International plc)
Här ses några av de typer av avfallskollin som ska transporteras till SFR. Det läg­aktiva avfallet transportereras i containers. Dessa kan t ex innehålla avfall som för­packats i plåttå­dor.

Det medelaktiva avfallet kommer i plåttat, plåttå­dor, betongtankar och betongko­killar. Dessa transportereras i särskilda strålsäk­rande behållare med plats för 12 kokiller, 72 fat eller 3 betong­tankar.
During transport, the transport casks are firmly secured on a transport frame.

The terminal vehicle is driven in under the transport frame and lifts it hydraulically.

The same type of heavy vehicle will be used for transport of steel containers with low- and intermediate level waste.