International Regulations for Transport of Radioactive Materials, History and Security

R.M.K.EL-Shinawy
Radiation Protection Dept. NRC,
Atomic Energy Authority, Cairo, Egypt.

ABSRACT

International Regulations for the transport of radioactive materials have been published by International Atomic Energy Agency (IAEA) since 1961. These Regulations have been widely adopted into national Regulations. Also adopted into different modal Regulations such as International Air Transport Association (IATA)& International Martime Organization (IMO). These Regulations provide standards for insuring a high level of safety of general public, transport workers, property & environment against radiation, contamination, criticality hazard & thermal effects associated with the transport of radioactive wastes & materials.

Several reviews conducted in consultation with Member States (MS) & concerned international organizations, resulted in comprehensive revisions till now.

Radioactive materials are generally transported by specialized transport companies & experts. Shippers & carriers have designed their transport operations to comply with these international Regulations.

About 20million consignments of radioactive materials take place around the world each year. These materials were used in different fields such as medicine, industry, agriculture, research, consumer product & electric power generation.

After September 11,2001, the IAEA & MS have worked together to develop a new guidance document concerning the security in the transport of radioactive materials. IAEA have initiated activities to assist MS in addressing the need for transport security in a comprehensive manner. The security guidance & measures were mentioned & discussed. The transport security becomes more developed & integrated into national Regulations of many countries beside the safety Regulations. IAEA & other International organizations are working with MS to implement transport security programs such as guidance, training, security assessments & upgrade assistance in these fields.

Key words: ***Transport, Radioactive material, Safety, Security, Training***

INTRODUCTION

The use of radioactive material is an important part of modern life and technology. Radioactive material is used extensively in medicine, industry, agriculture, research, consumer products and electrical power generation. Tens of millions of packages containing radioactive material are consigned for transport each year throughout the world[(1)]. The quantity of radioactive material in these packages varies from very small quantities in

shipments of consumer products to very large quantities in shipments of irradiated nuclear fuel.

The Regulations for safe transport of radioactive material establish standards of safety which provide an acceptable level of control of the radiation, criticality and thermal hazards to persons, property and the environment that are associated with the transport of radioactive material.

These Regulations are supplemented by hierarchy of Safety Guides and Safety Practices including "Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material" IAEA Safety Standards Series No ST-2[(2)]; Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material" IAEA Safety Standard Series No.ST-3;[(3)]" Compliance Assurance for the Safe Transport of Radioactive Material" IAEA Safety Series No.112[(4)]; " Quality Assurance for the Safe Transport of Radioactive Material", IAEA Safety Series No.113[(5)] and others.

The IAEA first published Safety Series No.(6) in 1961[(6)] for application to the national and international transport of radioactive material by all modes of transport. Several reviews, conducted in consultation with Member States and the international organizations concerned, resulted in seven comprehensive revisions being published in 1964, 1967, 1973,1985,1996,2005 and 2009[(7)].

Through the worldwide adoption of the IAEA's Regulations for all modes of transport, a very high level of safety during transport has been achieved.

Nuclear fuel cycle facilities are located in various parts of the world and materials of many kinds need to be transported between them. Many of these are similar to materials used in other industrial activities. However, the nuclear industry's fuel and waste materials are radioactive, and it is these 'nuclear materials' about which there is most public concern.

The highly radioactive wastes (especially fission products) created in the nuclear reactor are segregated and recovered during the reprocessing operation. These wastes were transported using a specially designed ships (Purpose – built ships). See Fig (1).

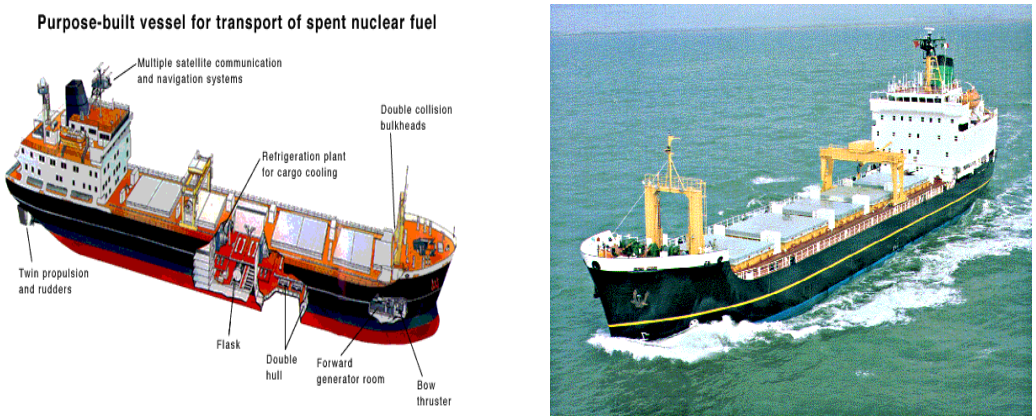


Fig.1

The transport ships are designed to withstand a side-on collision with a large oil tanker. If the ship did sink, the casks will remain sound for many years and would be relatively easy to recover since instrumentation including location beacons would activate and monitor the casks.

The British Company, Pacific Nuclear Transport Ltd, (PNTL) fleet has successfully completed more than 170 shipments over 30 years. About 8 million kilometers were covered without any accident resulting in release of radioactivity.

Except for some fissile materials (also called nuclear material in international instruments), the security of radioactive materials during transport was not a major concern prior to September11, 2001. Normal commercial practices were considered adequate to prevent loss of the material, and there was little concern that anyone would want to acquire the material for malicious purposes. That belief has been disproven by the revelation that adversaries not only have examined the possibility of using radioactive materials for malicious acts, but also have planned such acts and demonstrated a willingness to use all means at their disposal to carry them out. The IAEA and Member States have worked cooperatively to develop a new guidance document "Security in the Transport of Radioactive Material[8] and have initiated activities to assist Member States in addressing the need for transport security in a complete manner.

IAEA REGULATIONS, HISTORY AND DEVELOPMENT

Although radioactive material has been used for more than a century, significant use for beneficial purposes only began in the later 1940s and early 1950s. At that time, since the utilization of this material was increasing dramatically, it was recognized that safe and effective transport arrangements were required in order to properly protect man and his environment.

Since 1957, the IAEA has exerted efforts towards developing and maintaining its Regulations for the Safe Transport of Radioactive Material .

The result of this effort was the publication of the IAEA`s Regulations for the Safe Transport of Radioactive Materials, 1961 Edition, Safety Series No.[6]. This first edition of the Regulations established basic prescriptions in terms of packaging standards and package make-up for the containment of radioactive material and for the prevention of criticality when the material is fissile.

Since the Regulations were first issued, the IAEA has hardly worked with its Member States and relevant international organizations to update the Regulations, taking advantage of experience in the application of the Regulations and of advances in technology and knowledge. Consequently, the IAEA has issued several revisions to the Regulations.

The 1996 Edition of the Regulations was issued with a new nomenclature. It was identified as "IAEA Safety Standards Series, Requirements, No.ST-1[9], " rather than Safety Series No.6. In 2000 a revised edition of ST-1 was issued and was identified as IAEA Safety Standards Series Requirements, No.ST-R-1" (ST-1 Revised)[10].

The Standing Advisory Group on the Safe Transport of Radioactive Material (SAGSTRAM) was established by the IAEA in 1978 to advise on the IAEA`s transport safety programme and on the development and implementation of the Regulations. Safety Standards Committee (TRANSSAC) was formed in 1996 (and renamed to TRANSSC in 2000) replacing the function of SAGSTRAM. This advisory body ultimately endorses the text for a revision to the Regulations, and recommends submission of that text to the IAEA Board of Governors for approval.

Regulations Philosophy

The Regulations are fundamentally based on the philosophy that radioactive material being transported should be adequately packaged to provide protection against the hazards of the material under all conditions of transport including foreseeable accidents.

Therefore, the philosophy of the Regulations is that, as far as possible:

(1) Packages of radioactive material should be dealt with in the same way as other hazardous goods;
(2) Safety depends primarily upon the package and not on operational control;
(3) The consignor should be responsible for ensuring safety during transport through proper characterization of the contents proper packaging of those contents, and proper operational actions.

Regulations Scope and Objective

The scope of the Regulations is clearly specified and applied to:

(1) The transport of radioactive material by all modes on land, water or in the air,
(2) Any transport which is incidental to the use of the radioactive material.

In this context, transport comprises all operations conditions associated with, and involved in the movement of the radioactive material including the:

(1) Design of the package;
(2) Manufacture, maintenance and repair of the packaging; and
(3) Preparation, consigning, loading, carriage (including in –transit storage), unloading and receipt at the final destination of loads of radioactive material and packages.

In this Regulations there are three general performance levels that relate to the design of the package:

(1) Routine conditions of transport (incident free),
(2) Normal conditions of transport (minor mishaps), and
(3) Accident conditions of transport.

On the other hand, these Regulations do not apply to the following types of material:

(1) Radioactive material that is an integral part of the means of transport (such as depleted uranium counterweights in a aircraft);
(2) Radioactive material moved within an establishment that is subject to appropriate safety Regulations in force in the establishment and where the movement dose not involve public roads or railways;
(3) Radioactive material implanted or incorporated into a person or live animal for diagnosis or treatment (such as a cardiac pacemaker, or radionuclides injected into a person for medical purposes);
(4) Radioactive material in consumer products that have received regulatory approval, following their sale to the end user (such as smoke detectors);
(5) Natural material and ores containing naturally occurring radionuclides which are not intended to be processed for use of these radionuclides provided that the activity concentration of the material dose not exceed certain limits.

The objective of the Regulations is to protect people and the environment from the effects of radiation during the transport of radioactive material.

Protection is achieved by:

- containment of radioactive contents;
- control of external radiation levels;
- prevention of criticality; and
- prevention of damage caused by heat.

The fundamental principle applied to the transport of radioactive material is that the protection comes from the design of the package, regardless of how the material is transported.

PACKAGES, PACKAGING AND CATEGORIES

By package is meant the packaging together with is radioactive contents as presented for transport. Packaging may, in particular, consist of one or more receptacle, absorbing materials, spacing structure, radiation shielding and devices for cooling, for absorbing mechanical shocks and for thermal insulation. There are six types of packaging.

1- Excepted Package

Is a packaging containing excepted radioactive material, empty package and may be transported provided that:

- It is in a good condition and securely closed.
- Any labels which may have been displayed on it, are no longer visible.

2- Industrial packages

These are packages designed to contain low specific activity materials (LSAM) or surface contaminated objects (SCO), are of three different Types, IP-1, IP-2 and IP-3.

3- Type (A) package

It is designed to withstand the normal conditions of transport and minor possible accidents.

4- Type (B) package

It is designed to withstand the normal conditions of transport and severe accident conditions.

There are two classes namely:

- Type $B_{(U)}$, requiring unilateral approval (*competent authority of the country of origin*).
- Type $B_{(M)}$, requiring multilateral approval (*competent authorities of all the countries through or into which the package may pass*).

5- Type (C) package

It is designed to withstand severe crush, puncture and fire tests as well as impact with high speed (90m/sec). It is used to transport large quantities of radioactive material by air.

6- Packages containing fissile materials

These packages must be designed to ensure criticality safety during normal and accident conditions of transport.

Categories For Packages And Overpacks

To protect the public and transport workers against radiation emitted by the material during transport, the radiation level in the vicinity of the packages is limited. With regard to the shielding provided, packages are classified in three categories, I-WHITE, II-YELLOW AND III-YELLOW (see Fig.2&3). Each is associated with specified maximum radiation levels at the external surface of the package (0.005mSv/h), (0.005-0.5mSv/h) (0.5-2mSv/h) and at a distance of one meter from the surface (TI)(0), (0-1) &(1-10) respectively. The TI is determined by multiplying the radiation level at one meter by 100, i.e. RL_{1m} (mSv/h)x100

While most of the pure alpha and beta-emitters could be transported as white packages, it would be economical to transport gamma emitters as yellow packages. Otherwise considerable amounts of shielding would be required to bring the radiation levels to those corresponding to white packages. All fissile materials are packed and shipped in such a manner that criticality cannot be reached under any foreseeable circumstances of transport.

Marking, Labelling And Placarding

1- Marking

- Each package of gross mass exceeding 50kg shall have its permissible gross mass legibly and durably marked on the outside of the packaging.
- Each package which conforms to a type A package design shall be legibly and durably marked on the outside of the package with "Type A".
- Each package conforms to type B package design shall be legibly and durably with identification mark allocated to that design by the competent authority, serial number of the design and marked with either Type $B_{(U)}$ or Type $B_{(M)}$ as required.
- Each package marked type $B_{(U)}$ or type $B_{(M)}$ shall be plainly marked by embossing, stamping or other means resistant to the effect of fire and water with the trefoil symbol.

2- Labelling:

- Each package, overpack, tank of freight container bear labels according to the appropriate category (see Fig 2&3). Any labels which do not relate to contents shall be removed or covered. Additional labels describing other dangerous properties shall be added.
- The labels shall be affixed to two opposite sides of the outside of a package or overpack or on the outside of all four sides of a freight container or tank.
- Each label shall be completed with, Contents., Activity Curies (Ci) or Becquerels, (Bq) or in units of grams (g) for fissile material, A criticality safety Index, (CSI) is used.

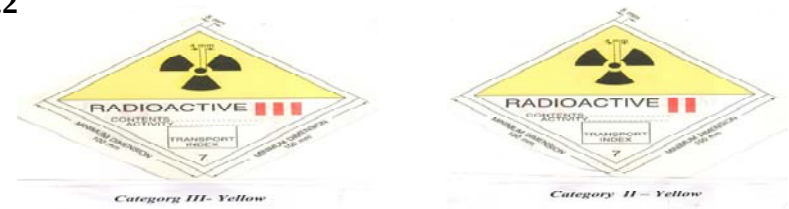
3- Placarding

- Large freight containers carrying packages other than excepted packages and tanks shall bear four placards (see Fig.3).
- The united Nations Number (UNN) for the consignment shall also displayed on the placards (lower half) or on a separate one shown in Fig.(4) which shall be affixed adjacent to the main placard in all four sides of the freight container.

Fig.2

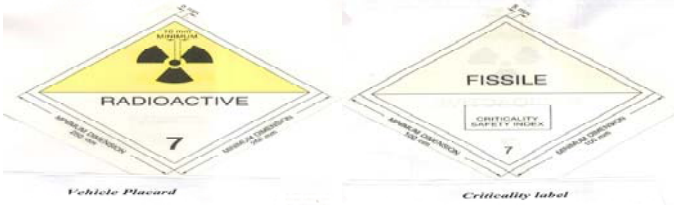
Category I- White

Fig.3

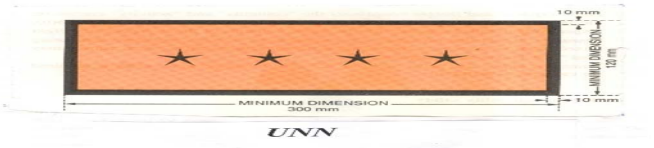


Category III- Yellow *Category II – Yellow*

Fig.4



Vehicle Placard *Criticality label*



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STORAGE OF RADIOACTIVE MATERIALS

Radioactive materials except those in category I-WHITE packages, shall be kept separated from living accomodations, from regularly occupied working spaces that may be continually occupied by passengers or the public. A dose of 5mSv/h and 1mSv/h were used for calculation of the segregation distances for transport workers and general public respectively. They shall also be separated from undeveloped photographic films or plates so that these are not expected to be more than 0.1mSv/h consignment. The appropriate segregation distance shall be derived on the basis of these assumptions.

Packages of radioactive material shall not be stored near dangerous goods with which common loading or storage is prohibited. The number of category II-YELLOW and III-YELLOW packages stored in one place, shall be so limited that the total sum of the transport indices in any individual group of such packages dose not exceed 50. Undelivered packages shall be placed in a safe location and the appropriate competent authority shall be informed as soon as possible and a request made for instructions on further action.

CUSTOMS OPERATIONS

Customs operations involving examination of the contents of a package containing radioactive materials should be carried out in a place where adequate means of radiation exposure control are provided, and in the presence of persons qualified to deal with radioactive materials. Any packages opened on customs should, before being forwarded to the

consignee to its final instructions destination, be restored to its original packaging specifications so that all radiation protection requirements are restored.

GENERAL ACCIDENT PROVISIONS

In the event of a package of radioactive materials breaking or leaking, or becoming involved in a crash or fire, the affected area should be suitably segregated and no person should be allowed to enter or to remain within the segregated area until qualified persons are available to check radiation and contamination levels and supervise subsequent operation including salvage operations. However, the presence of radioactive materials should not be considered to prevent rescue operations or fighting of fires by qualified persons. All persons who may have become contaminated with radioactive materials should be subject to immediate examination and appropriate decontamination measure.

Any conveyance, building, location equipment or part thereof which has become contaminated as a result of an accident in the course of transport of radioactive materials should be decontaminated by qualified persons as soon as possible. Finally, a complete accident report should be submitted to the competent authority for further actions.

TRAINING

As one means of promoting safety in transport as well as encouraging harmony in regulatory control, the IAEA has from time to time organized training courses with the co-operation of Member State Governments and Organizations. These have been aimed at individuals from developing countries with appropriate responsibilities in the area of the transport Regulations and their implementation. The programme started with individual training courses to specific Member States in the early 1980 and regional training course for other countries in 1984. Beginning in 1987 formal regional and interregional training courses have been held about once per year at different Member States.

In order to encourage further training, the IAEA found it desirable to develop a basic course text on the safe transport of radioactive material it was therefore decided that the lecture notes from the 1987 course would form the basis of this text, and that it would be focused on the 1985 Edition of the Regulations [(11)]. The result was the IAEA`s Training Course Series No.1 which was updated to a second edition in 1991[(12)] because the consignor has overall responsibilities for the proper packaging and preparation of radioactive material for transport, detailed knowledge of the Transport Regulations is imperative. The IAEA has an in-depth training course available that can assist Member States and other involved in the transport of radioactive material in understanding and applying the Transport Regulations[(13)] While the course is primarily intended for regulatory authorities, it can also assist consignors and carriers in recognizing their responsibilities and provide them with a detailed understanding of how to comply with the Transport Regulations.

The purpose of a regional or inter-regional training course is to provide guidance to regulatory and key industrial personnel on the Regulations and practices for the safe transport of radioactive material. The objective of each IAEA training course is to ensure that the participants thoroughly understands the philosophy principles, and application of the of the provision of the transport Regulations.

The purpose of the training is to provide a rational method for convening a training course and to foster high quality training. The manual serves as a tool for instructors to use in

presenting subjects pertaining to the Regulations in a logical and understandable manner. It also allows training course participants to become knowledgeable about the Regulations.

TRANSPORT SECURITY

Security of nuclear (fissile) material, including during international transport, has been addressed since 1979 under the umbrella of the Convention on the Physical Protection of Nuclear Material[14]. States that are party to the Convention are obligated to abide by the security provisions specified in it. However, the same situation dose not exist for security of non-fissile radioactive material during transport. Heightened awareness of the need to secure such materials during transport has led to a series of developments aimed at defining and supporting uniform implementation of transport security requirements.

DANGEROUS GOODS TRANSPORT SECURITY

Recognizing the need for increased security following the events of September 11,2001, the UN Committee of Experts introduced measures to enhance security for the transport of all dangerous goods in the 12th revised edition of the Model Regulations.

RADIOACTIVE MATERIAL AS CLASS 7 DANGEROUS GOODS

Beginning with the early versions of the Transport Regulations, there has been a threshold for denoting what constitutes a "large quantity" of radioactive material. In the current Transport Regulations, this is 3,000 A_1 for special form material and 3,000A_2 for non-special form material, with the observation that the dangerous goods security requirements should not apply to nuclear (fissile) material that is already subject to physical protection requirements during transport as a result of the Convention on the Physical Protection of Nuclear Material and the supporting guidance in INFCIRC/225[15]. These recommendations provided the basis for the Class 7 (radioactive material) requirements in the Model Regulations.

IAEA TRANSPORT SECURITY GUIDANCE

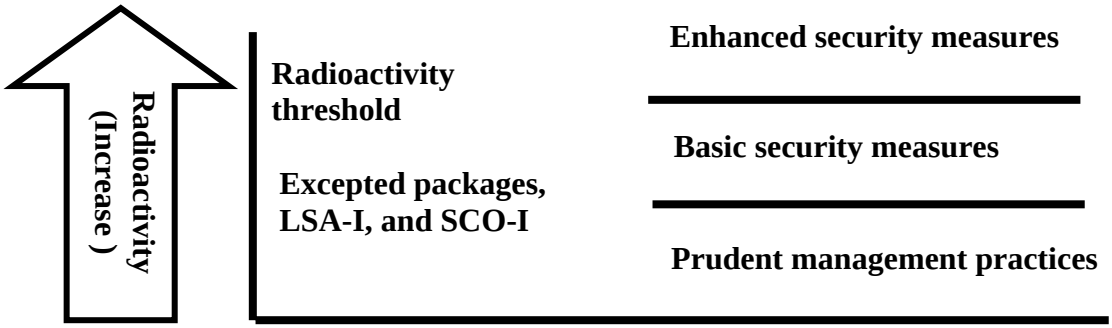
Although the security measures and definition of high consequence radioactive material added to the Model Regulations were recognized as a very positive step, the IAEA initiated a review of these provisions to ensure they were technically sound and consistent with other approaches used in nuclear and radioactive material security.

The recommendations of the Technical Meeting to Review Guidance for Security in the Transport of Radioactive Material held at the IAEA headquarters in Vienna, provided a good summary of the conclusions of this series of meetings.

1. Some radioactive materials, such as excepted packages, low specific activity materials, and surface contaminated objects that can be shipped unpackaged, do not warrant security measurers above prudent management practices.
2. Two categories of security measures, basic and enhanced (differentiated by a radioactivity threshold) are sufficient for specifying appropriate measures and are consistent with the approach used for other dangerous goods in the UN Model Regulations.

3. The threshold for high consequence radioactive material should be revised to take into account analyses done on the consequences of intentional dispersal and developments in the safety and security of radioactive sources.
4. While the security requirements in the Model Regulations are an adequate set of baseline measures, there are additional measures that Member States might wish to consider when the national Design Basis Threat indicates it might be appropriate, in situations of increased threat, or for particularly attractive material.

These recommendations result in three groups of security measures which are illustrated in as follows:



Exceptions from security requirements

Malicious use of radioactive material could involve exposure to radiation (a radiation exposure device) or dispersal of the radioactive material (a radiological dispersal device). Small quantities of radioactive and low activity concentration material would not be very effective in such applications because the consequences of their use would be low. Therefore, the draft guidance recommends that no transport security measures above prudent management practices be required for the following:

- excepted packages with contents limited to the activity allowed for non-special form material,
- low specific activity material in category LSA-I that can be shipped unpackaged, and
- surface contaminated objects in category SCO-I that can be shipped unpackaged.

Two categories of security measures

Radioactive materials present a very wide spectrum of attractiveness for malicious use. Materials and packages with potentially significant but limited consequences such as Type A packages, LSA-II, LSA-III, and SCO-II have some attractiveness. By contrast packages containing high activities such as large sealed sources or large quantities of radionuclides (especially in dispersible form) could be very attractive for malicious use.

Tow security categories were recommended-basic level and enhanced level. The specific security measures recommended for each level were drawn from the model Regulations and, where necessary, tailored for application to radioactive material shipments.

At the basic level the security measures include security awareness training and periodic retraining, maintenance of training records, use of known or identified carriers, and use of properly secured in transit storage areas.

Enhanced level security measures include recommendations that consignors, carriers, and others develop, adopt, implement, and comply with a security plan that addresses the following:

- allocation of responsibilities and authority to fulfill these responsibilities;
- material transport records;
- reviews of operations and assessments of vulnerabilities;
- clear statement of measures to be used to reduce security risks;
- procedures for reporting and dealing with security threats, breaches, and incidents;
- testing, periodic review, and updating of security plans; and
- security of information including limiting distribution of it.

Threshold for enhanced level of security

Extensive discussions were held on how the threshold for the enhanced level of security should be defined. From a strict security standpoint, there are advantages to using per-conveyance basis as this best identifies conveyances that are carrying a total quantity of material that should be protected. From an operational standpoint, a per-package basis is much more feasible to implement because it dose not require carriers to keep a record of the activity on the conveyance. It was concluded that the per-package basis was acceptable, and a radioactivity threshold was then defined to identify those packages that should be subject to the enhanced security measures.

Because the transport of nuclear (fissile) material is already subject to security requirements as specified in the Convention for the Physical Protection of Nuclear Material and the supporting guidance in INFCIRC/225[15], there is some overlap between the two sets of recommendations. A comparison of INFCIRC/225 and the draft transport guidance shows that for :

- *Category I nuclear material*, the security measures of INFCIRC/225 are more stringent than the enhanced security measures (e.g., requiring escorts), but this is appropriate given the much greater potential consequences that an improvised nuclear device could have when compared to a radiological dispersal device;
- *Category II nuclear material*, the security measures of INFCIRC/225 are roughly comparable to the enhanced security measures; and
- *Category III nuclear material*, the security measures of INFCIRC/225 are roughly comparable to the basic security measures.

Consequently, if Category III nuclear material with an activity per package that exceeds the radioactivity threshold for the enhanced level of security is being transported, the shipment should meet the enhanced measures because of its radiological potential for malicious use.

The IAEA Code of Conduct on the Safety and Security of Radioactive Sources (the Code)[16] is being implemented by many countries. Ninety-two countries have notified the IAEA of their intent to implement the Code. Among other requirements, the Code and its supplement, Guidance on the Import and Export of Radioactive Source[17], require certain measures such as notification and consent before the import or export of Category I and II radioactive sources.

Additional Security Measures

While the basic and enhanced security measures are generally consistent with the Model Regulations, there may be instances when a country feels that the security situation calls for additional measures. For example, additional measures may be warranted in elevated threat conditions, when the Design Basis Threat for the country indicates measures are appropriate,

or when the attractiveness of the material is high. The guidance document provides a list of possible additional security measures that countries might wish to consider imposing when appropriate. Such measures include:

- additional training for transport personnel,
- licensing of transport operators,
- real time tracking of shipments and the use of a transport control centre,
- guards,
- specially designed conveyances, and
- additional measures to protect the confidentiality of information.

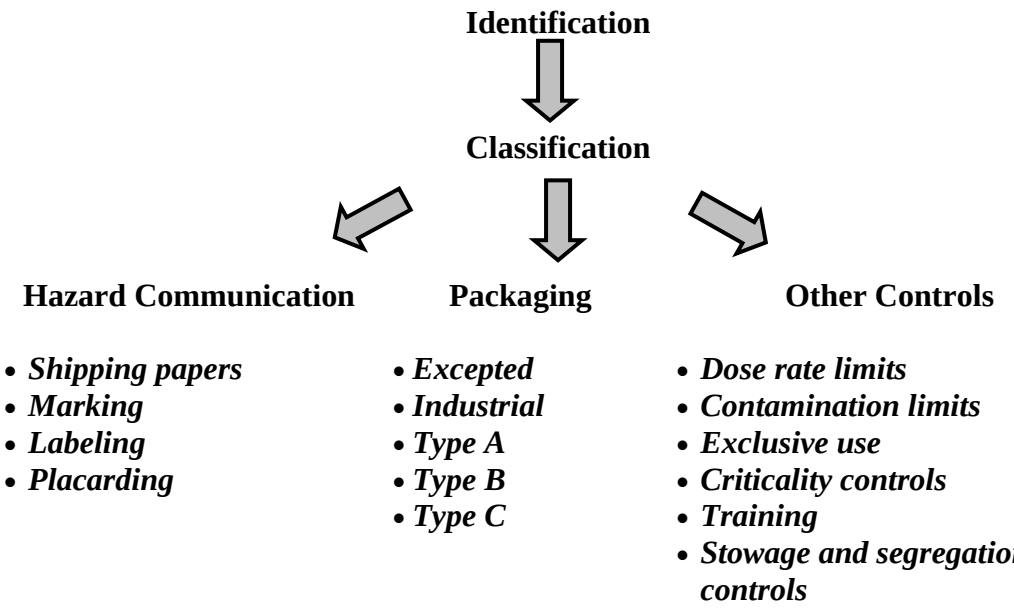
TRANSPORT SAFETY AND SECURITY INTERFACES

Transport safety is a deterministic based discipline. Specific tests and limitations are applied on the assumption that certain conditions and events may occur during transport. It is not assumed these will occur during any given transport, but each package must be designed, tested, and prepared for transport as if it is expected that they will occur .

Transport security is a threat based discipline. It is not feasible to establish a single set of security measures that are suitable for use in all situations without seriously overdesigning the security system for anything but be highest threat conditions. This would be very costly and ineffective. Instead, the recommendations are intended to provide an appropriate level of security under normal threat conditions, and provisions are included that allow the adjusting of the measures to meet current threat conditions.

There are avoidable interactions between some safety and security measures in transport planning, preparation, and operations. These can be categorized on the basis of whether they are complementary or potentially conflicting. That is, some measures provide benefits in both areas, whereas some measures may benefit one while having a potentially adverse effect on the other, requires which careful consideration by the regulatory authorities, consignors, and carriers to develop approaches that provide appropriate levels of protection in each area.

This can be illustrated with the major components of transport safety as follows:



Identification

Identification of the material being transported is required for both safety and security. This step collects information on the material being transported that is necessary to determine what specific safety or security provisions apply based on the hazards (safety) or potential adverse consequences of malicious use (security).

Classification

In general, higher hazard radioactive materials require more stringent safety and security measures. However, this is not always the case. For example, a special form capsule of an alpha-emitting radionuclide presents a low safety hazard because the encapsulation is robust (containment), and no shielding is needed. At the same time, this material may be very attractive to an adversary because of its potential use in a radiological dispersal device. Consequently, safety and security need to be considered separately to determine what set of measures should be applied.

Hazard Communication

Hazard communication (safety) and information security (security) have conflicting objectives. From a safety perspective, it is desirable to warn workers, the public, and emergency responders of the presence of radioactive material. Marking, labeling, placarding, and shipment documentation are designed to clearly indicate the presence of radioactive material and the degree of caution that should be exercised. This can also be considered as advertising to adversaries " here is the good stuff" and is contrary to maintaining a key element in transport security- unpredictability in when and where shipments are being made.

Some countries have developed pragmatic approaches to ensuring security while also ensuring that the functions supported by hazard communication can still be performed. For example, when escorts accompany a shipment, they can provide the communication to emergency responders that placards ordinarily do.

Packaging

Packaging is an area in which safety may or may not provide substantial security benefits. For example, large, heavily shielded Type B packages provide security benefits through delay (increasing the adversary task time) and sabotage resistance. The mass and construction of the packages provide protection of the contents, and the robust closures often require specialized tools and techniques to open the packages. However, lightweight drum-type Type B packages may contain material with the potential for very high radiological consequences and yet be easily moved by a person. Some transport packages are internationally designed for portability (well logging sources and radiography cameras). In these cases specific security measures are needed that take into account the speed and ease with which an adversary could complete acquisition of a package.

Other Controls

Most of the other transport safety controls have little bearing on security. An exception is when exclusive use of the conveyance is required for safety purposes as this gives the consignor control over loading and unloading, routing, scheduling, and other operational aspects of the transport. While these safety controls are primarily focused on radiation

protection (dose rate, contamination limits, etc.) security must address both access removal of the packages from the conveyance and the seizure of the conveyance.

The Transport Regulations specify that " These Regulations do not specify controls such as routeing or physical protection which may be instituted for reasons other than radiological not detract from the standards of safety which these Regulations are intended to provide. " Thus, a consignor should consider the possible impact of security measures on the safety measures required by Transport Regulations, and vice versa.

CONCLUSION

Transport safety and security for radioactive material have very different histories and often require differing approaches to ensure accomplishment of their objective.
The IAEA Regulations for safe transport of radioactive material (STRAM) are widely adopted and provide standards for insuring a high a high degree of safety. As transport security becomes more fully developed and integrated into the national regulatory frameworks of more countries, the regulatory authorities, consignors, carriers, and receivers of radioactive material shipments will be challenged to fully implement programs that address not only the well recognized requirements for safety, but also those for security. The IAEA, and other international partners are working with Member States to implement transport security programs and resources such as guidance, training programs, security assessments, and upgrades assistance are available. The international community can ensure that this critical need is addressed if working together.

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