International Regulations for Transport of Radioactive Materials, History and Security

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* Transport of radioactive materials (TRAM) embraces the carriage of radioisotopes for different fields by all modes:
  - Agriculture
  - Industrial (Consumer products, Electric Power Generation)
  - Medical
  - Research and education
  - Radioactive waste
  - Nuclear fuel cycle materials
* Estimated number of packages transported allover the world 18-32 million/year (form small amounts to very large quantities)
* Transport Regulations are useful and used for national and international transport bodies.
* Regulations act as the basis for national and international Regulations for interested organizations.
Based on, RAM should be packaged to provide protection against their hazard under all conditions of transport (including major accident).

Safety is a priority in the package design requirements (consignor & carrier).

Packages treated as hazardous goods.

Safety depends on package and not on operational control.

Consignor is responsible for ensuring safety:

- Adequate communications, shipping papers, marking, labeling, placarding, proper shipping name and UN numbers.
The transport Regulations objective is to protect persons, property and the environment against effect of radiation and contamination.

Protection is achieved by:

- Containment of radioactive contents,
- Control of external radiation levels,
- Prevention of criticality, and
- Prevention of damage caused by heat.

These requirements are satisfied by applying different approaches (content limits, package designs, maintenance of packaging and administrative controls).
The Regulations scope is applied to the transport of radioactive materials by all modes on land, (Road 58%) (Railway 19%) air (22%) or waterways (Sea or River 1%).

Transport means all operations and conditions associated with the movement of radioactive material, preparation, consigning, loading, carriage, in-transit storage, unloading and receipt at final destination.

There are three general severity levels during transport:

- Routine conditions of transport (incident free).
- Normal conditions of transport (minor mishaps).
- Accident condition of transport.
IAEA Regulation do not apply to:

* RAM which is part of means of transport (depleted U counterweights in aircraft).
* RAM moved at nuclear establishment that is subject to appropriate safety regulations.
* RAM implanted into person or live animal (cardiac peacemaker).
* RAM in consumer products (smoke detectors).
* Natural material and ores containing NORM (dose not exceed certain limits).
* These Regulations are useful to government authorities, regulators, operators of nuclear and radiation facilities, carriers, users of radiation sources and cargo handling personnel.
* The Regulations were first issued by International Atomic Energy Agency (IAEA) as safety series No 6, (1961).

* The IAEA has worked with its Member States (MS) and other relative international organizations to update and review the Regulations.

* The IAEA has issued the following editions of the Regulations:
  - 1964 Edition
  - 1967 Edition
  - 1973 Edition
- 1973 Edition (As Amended 1979)
- 1985 Edition (as Amended 1990)
- 1996 Edition


- 2005 Edition


- 2009 Edition

The IAEA issue different supporting documents for STRAM Regulations as follows:

- Advisory Material for the IAEA Regulations
- Planning and Preparing for Emergency Response to Transport
- Radiation Protection Programme
- Management Systems for the IAEA Regulations
- Compliance Assurance
• Excepted package.

• Industrial package.

• Type (A) package.

• Type (B) package. \{ B_U & B_M \}

• Type (C) package.

• Fissile Material package.
• The radiation level in the vicinity of packages is limited.

• With regard to the shielding, packages are classified into three categories:

  I - White   (0-0.5 mrem/h) [0-0.005mSv/h]
  II- Yellow (0.5-50 mrem/h) [0.005-0.5mSv/h]
  III- Yellow (50-200 mrem/h) [0.5-2mSv/h]

• Alpha and Beta – emitters transported in white packages.

• Gamma emitters transported in yellow packages.
**Marking**

- Packages over 50Kg, the weight shall be marked.
- Packages belongs to type \((A)\), shall be marked type \((A)\).
- Type \((B_U)\) or \((B_M)\) shall be marked by means of resistant to fire and water with the trefoil symbol.

**Labelling**

- Each package shall bear the appropriate category of labels. See figures.
- Additional labels, for other dangerous properties.
- Removal of labels which do not relate to the content.
- Labels shall be affixed to two opposite sides of the package.
Fig. 2

Category I - White

Category III - Yellow

Category II - Yellow
• Labels shall be affixed to four sides of freight container or tank.

• Each label shall contain:
  - Content.
  - Activity (Ci or Bq or g for fissile).

* Placarding
  - United Nation Number (UNN) shall be displayed on the placards (Fig4).
• The IAEA Director General is authorized to apply IAEA Transport Regulations.

• IAEA Regulations have been adopted worldwide by MS & Interested organizations.

• Purpose of the TC is to provide guidance to Regulators and transport workers.

• Objective of TC is to ensure that they understand the philosophy and provision of the TRAM.

• TC manual serves as a tool for instructors & as a reference for students.
To promote safety in transport

- IAEA organize training courses (TC) with the Co-operation of MS Government to promote safety in transport.
- Training course directed to individual responsible for TRAM.
- National, Regional and Inter-regional training courses were executed about once a year.
- IAEA develop basic course text.
- Training course series # 1 was:
  - issued in 1996.
  - updated in 2006. (with the latest version of the Regulations (TS-R-1)).
* While the TRAM is regulated to provide high degree of safety.
* The transport security recommendations have only recently been developed.
* Security of nuclear (fissile) material, has been addressed since 1979, under the convention on the Physical Protection of Nuclear Material.
* After 11 September, 2001 events, measures were taken to enhance security for the transport of all dangerous goods.
* IAEA at its early versions for TRAM, there has been a threshold for denoting what Constitutes a large quantity of RAM.
* In the current Regulations, this is $3000 A_1$ for (special form material) and $3000 A_2$ for (non-special from material), IAEA agreed that this was suitable threshold for identifying radioactive material.

* The dangerous goods security requirements should not apply to nuclear (fissile) material, which subjected to physical protection requirements.

* These recommendations provided the basis for class 7, (Radioactive Material).
IAEA initiated a review of these provisions to ensure they were sound and consistent with other approaches used in nuclear and radioactive material security.

IAEA meeting to review guidance for TRAM security provide a good summary as follows:

- Excepted packages, low specific activity materials (LSA) and surface contaminated objects (SCO) shipped unpackaged do not need warrant security measures.
- There are two categories of security measures, Basic and Enhanced (according to the threshold).
- The threshold for high consequences radioactive material should be revised taking into account results of dispersal and developments in the safety and security of radioactive sources.
- While the security measures (in Modal Regulations) are an adequate set of baseline, there are additional measures that MS wish to consider in situation of increased threat or for particularly attractive material.
* These recommendations results in 3 groups of security measures as follows:

- **Excepted from security requirements & no security measures above prudent management practices be required for the following:**
  - Excepted packages.
  - Low specific activity material (LSA-1), unpackaged.
  - Surface contaminated object (SCO-1) unpackaged.

- **Basic Security Measures**
  - This basic level included security awareness training, training records, use of known carriers, use of secured in – transit storage area.
• Enhanced Security measures.
  - allocation of responsibilities;
  - material transport records;
  - reviews of operations and assessment of risks;
  - procedures for reporting and dealing with security threats;
  - testing, periodic review and updating of security plans, and
  - security of information including limiting distribution of it.

* Thresholds for enhanced level of security
  - From security standpoint the threshold for enhanced level of security is the total quantity of material in a conveyance.
  - From operational standpoint the threshold level of security is on the per-package basis.
  - It was concluded that the per-package basis was accepted for packages to be subjected to enhanced security measures.
To compare the security requirements in convention of physical protection, with the supporting guidance in (INFCIRC/225), there is some overlap as follows:

**Category I Nuclear Material**
- The security measures of *INFCIRC/225* are more stringent than enhanced security measures (requiring escorts).

**Category II Nuclear Material**
- The security measures of *INFCIRC/225* are roughly comparable to the enhanced security measures.

**Category III Nuclear Material**
- The security measures of *INFCIRC/225* are roughly comparable to the basic security measures.

* Notification and acceptance before import or export of category I and II is required and important.
- May be assured in elevated threat conditions (specially when the material is highly attractive);

- Additional training for transport personnel;

- Licensing of transport operators;

- Tracking of shipments;

- Guards;

- Specially designed conveyances and

- Additional measures to protect information
Transport Safety

*Is a deterministic based discipline;
- Tests and content limits are applied;
- Accidents may occur during transport.

Transport Security

*Is a threat based discipline;
- Is not suitable to establish a single set of security, suitable for all situations;
- It is very costly and ineffective.

*There are avoidable interaction between some safety and security measures in transport planning, preparation and operations. Some measures provide benefits in both cases, and some may benefit one while having a highly adverse effect on the other, which requires attention by:
- Regulatory authorities;
- Consignors; and
- Carriers

By developing appropriate levels of protection in each area.
* Identification
  - The material identification being transported is required for both safety and security. It is necessary to determine what specific safety or security provisions apply.

* Classification (hazard communication / packaging / other Control)
  - Higher hazard radioactive materials require more safety & security measures.

* Hazard Communication (shipping papers/ Marking/ labeling/ Placarding)
  - Hazard communication (safety) & information security (security have different objectives).
  - Warning of workers, public and others of the presence of radioactive material.
- Marking, labelling, placarding and shipment documentation are very important to prove the presence of radioactive material and degree of caution to be taken.

- Escort accompany a shipment can provide the communication to emergency responders as placarding do.

* Packaging (*Excepted / industrial / Type A / Type B / Type C*)
  - Large, heavily shielded Type “B” packages give security benefits through delay (*increasing the adversary task time*) and sabotage resistance.
  - Lightweight (*drum type*) Type “B” packages may contain material of very high radiological consequences and yet be easily moved by a person (*well logging sources and radiography cameras*) Therefore, a specific security measures are needed.
* Other Controls (Dose rate limits/Contamination / limits /Exclusive use / Criticality Controls / Training/ Stowage and segregation control)

- Most of the other transport safety controls have little bearing on security. These controls are focused on radioactive protection (dose rate/contamination limits… etc) security must address both access/removal of the package from the conveyance.

- The consignor should consider the possible impact of security measures on the safety measures required by Transport Regulations.
IAEA Regulation for safe transport of radioactive material (STRAM) are widely adopted and provide standards for ensuring a high degree of safety.

transport safety and security for RAM have very different histories and approaches to ensure achievement of their objectives.

The transport security becomes fully developed and integrated into national regulations of most countries, consignors, carriers and receivers of RAM shipments.

IAEA and other international partners are working with MS to implement transport security programs such as training, guidance assessment and upgrades.