Core Model for Regulatory Oversight of Transport of Radioactive Material

Transport Safety Unit
Regulatory Infrastructure and Transport Safety Section
Division of Radiation, Transport and Waste Safety
Department of Nuclear Safety and Security
The ambition of a Competent Authority for transport should be to develop its activities and capabilities in each of the 12 elements of a Competent Authority Compliance Assurance Programme (the compliance assurance circle – TS-G-1.5) as appropriate.

It is important that the activities and competences of a Competent Authority directly relate to the industries over which it has responsibilities for regulator oversight.

Networking between Competent Authorities is encouraged to provide the necessary regulator oversight.
The compliance assurance circle – TS-G-1.5

1. Design assessment
2. Witnessing of testing
3. Witnessing of manufacture
4. Examination of maintenance and servicing
5. Monitoring and inspection of operations
6. Enforcement actions and investigation of incidents
7. Emergency planning and exercises
8. Regulatory review and maintenance of effective legal framework
9. Issuing of approvals
10. Training and distribution of information
11. Interdepartmental liaison / cooperation
12. Audits of management systems
The core model introduces key practical elements which provide the starting point of regulatory control for the transport of radioactive material.

Adoption of the core model will enable a framework for regulatory control of transport to be implemented in a short timescale.

• The core model is designed to be achievable by a Member State.
• The core model presented here does not include fissile material.
• The core model presented here is for Member States that use radioactive material in medical, agricultural and industrial applications.
Networking with other Competent Authorities is encouraged to provide the necessary set of competencies for appropriate regulator oversight on a national and regional basis.

Networking will also provide opportunities for ongoing exchange of information and appropriate good regulator oversight practices.

Reference material
IAEA SSR6 (2012) – Regulations for the safe transport of radioactive material
IAEA TS-G-1.4 – The management system for the safe transport of radioactive material
IAEA TS-G-1.5 – Compliance Assurance for the safe transport of radioactive material
UN Recommendations on the transport of dangerous goods - Model Regulations
The core model addresses the following topics:

1. Identify the radioactive material (RAM) in a Member State
2. The import and export control of RAM
3. The Member State requirements for
   i. Package marking and labelling
   ii. Vehicle driver training
   iii. Vehicle placarding
   iv. Documentation
   v. Incident response arrangements (operator)
   vi. Incident response arrangements (National)
4. Identify topics of the core model that will be provided by collaboration with other Member States
   i. How will this be achieved
Key components of core model

a) Transport legislation and regulations (based upon IAEA Safety Standards, eg SSR6 2012 Edition)
b) National Inventory (register) of radioactive material
c) Control of import, export and transiting of radioactive material
d) Documentation: Dangerous Goods Note (DGN), package approval certificates / certificates of conformity, training, operator incident response plan
e) Monitoring of radiation and contamination
f) Package labelling, vehicle loading restrictions and vehicle placarding
g) Training (competent authority staff and operators)
h) Governmental response plans and procedures for transport accidents
i) Consignor and carrier responsibilities - accident response plan
j) Develop and maintain a contact list of Departments / Institutions involved in transport process in your country
k) Agree responsibilities and duties of all parties involved in the components of the core model
l) Identify and collaborate with other Member States when necessary
## Compliance assurance circle vs Core model key components

<table>
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<tr>
<th>Compliance assurance circle</th>
<th>Core model key component</th>
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<td>a, b, c, j, k, l</td>
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<td>11</td>
<td>j, k, l</td>
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<tr>
<td>12</td>
<td>a - l</td>
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Objective of SSR-6 (para 104)

… is to establish requirements that must be satisfied to ensure safety and to protect persons, property and the environment from the effects of radiation in the transport of radioactive material. This protection is achieved by requiring:

- Containment of the radioactive contents;
- Control of external radiation levels;
- Prevention of criticality;
- Prevention of damage caused by heat.
Regulatory approach of SSR-6 (para 106)

A graded approach is applied in specifying the performance standards which are characterized in terms of three general severity levels:

(a) Routine conditions of transport (incident free);
(b) Normal conditions of transport (minor mishaps);
(c) Accident conditions of transport.

No routeing or physical protection controls are specified - these may be implemented for reasons other than radiological safety (SSR6 para 108)
‘Transport’ (SSR-6 para 106)

… Transport comprises all operations and conditions associated with, and involved in, the movement of radioactive material; these include the design, manufacture, maintenance and repair of packaging, and the preparation, consigning, loading, carriage including in-transit storage, unloading and receipt at the final destination of loads of radioactive material and packages.

Radioactive material (SSR-6 para 235)

…..any material containing radionuclides where both the activity concentration (Bq/g) and the total activity in the consignment (Bq) exceed the values specified in paras 402 - 407

Packaging (SSR-6 para 232)

*Packaging* shall mean one or more receptacles and any other components or materials necessary for the receptacles to perform the containment and other safety functions.

Package (SSR-6 para 231)

….. shall mean the *packaging* with its *radioactive contents* as presented for transport

Transport Index (SSR-6 para 244)

TI is a number used to provide control over radiation exposure

TI is assigned to a *package, overpack* or *freight container*, or to unpackaged LSA-I or SCO-I

*Consignment* (SSR-6 para 211) shall mean any *package* or *packages*, or load of *radioactive material*, presented by a *consignor* for transport.

*Shipment* (SSR-6 para 237) shall mean the specific movement of a *consignment* from origin to destination.

*Consignor* (SSR-6 para 212) shall mean any person, organization or government which prepares a *consignment* for transport.

*Carrier* (SSR-6 para 206) shall mean any person, organization or government undertaking the carriage of *radioactive material* by any means of transport. The term includes both *carriers* for hire or reward (known as common or contract *carriers* in some countries) and *carriers* on own account (known as private *carriers* in some countries).

*Consignee* (SSR-6 para 210) shall mean any person, organization or government which is entitled to take delivery of a *consignment*.
Conveyance (SSR-6 para 217) ... shall mean
for transport by road or rail: any vehicle,
for transport by water: any vessel, or any hold, compartment, or defined deck area of a vessel
for transport by air: any aircraft

Exclusive Use (SSR-6 para 221) ... shall mean the sole use, by a single consignor, of a conveyance or of a large freight container, in respect of which all initial, intermediate and final loading and unloading is carried out in accordance with the directions of the consignor or consignee
Competent Authority (SSR-6 para 207) … shall mean any national or international regulatory body or authority designated or otherwise recognized as such for any purpose in connection with these Regulations

Unilateral approval (SSR-6 para 205) shall mean an approval of a design which is required to be given by the competent authority of the country of origin of the design only

Multilateral approval (SSR-6 para 205) shall mean approval by the relevant competent authority of the country of origin of the design or shipment, as applicable, and also, where the consignment is to be transported through or into any other country, approval by the competent authority of that country

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b. National Inventory of radioactive material

b.1 It is essential to know what radioactive material is currently in your Country

i. Who is responsible / the owner of the material?

ii. Specification of material
   • Solid or liquid
   • Isotopes
   • Composition
   • Activity
   • Number of sources / quantity of radioactive material

iii. Where is the material?

iv. In what ‘Type’ of package will the material be transported

v. What safety and security measures are being used to store the material
b. National Inventory of radioactive material

b.2 Create a national inventory (register)
   i. Identify potential operators
   ii. Send questionnaire
   iii. Follow up responses and no those that do not respond
   iv. Example of questionnaire available from IAEA

b.3 Create a process to manage the inventory (register)
   i. Identify responsibility in regulator body for maintaining register
   ii. Establish a procedure to maintain inventory (register)

b.4 Issue formal notification to operator of their records on the national inventory
c. Control of import, export and transiting of radioactive material

- Transit
- National Inventory (register)
- Import
- Export

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c. Control of import, export and transiting of radioactive material

C.1 Identify if import, export and transit authorisations are issued

i. Identify government departments involved in import/export processes

ii. Develop a protocol for import/export/transiting processes

iii. Begin process of adopting import and export authorisation processes by involving appropriate government departments (port, airport authorities, border control officials, police, government departments)

iv. Use import, export and transit authorisations to maintain your national inventory
c. Control of import, export and transiting of radioactive material

c.2 Notifications (or application for import / export approval as appropriate):
   - Details of Consignor, Consignee, Carrier (by road from airport / seaport)
   - Dates, routes, final destination
   - Air (carrier and flight details)
   - Sea (carrier and vessel details)
   - Incident response arrangements for road transport
   - Package types (Industrial, Type A, Type B)
   - Details of radioactive material – isotopes, activity, number/quantity

c.3 Certificates
   - Competent Authority Approval certificates for Type B packages
     • Validation certificates for Type B(M)
   - Dangerous Goods Note (DGN)

c.4 Inspections
   - What inspections are required, if any?
     • Consignee
     • Carrier
In many countries if the Dangerous Goods Form complies with the modal regulations for air and sea transport then it is considered to be acceptable for road transport.

A template for a Dangerous Goods Form is provided in the UN Model Regulations, Section 5.4.4, Figure 5.4.1.

The information contained in the Dangerous Goods Form is prescribed in SSR 6 paras 546 - 553.
In IAEA SSR6 the following categories are defined [requires CA approval]:

- Excepted packages
- Industrial packages Type (IP-1, IP-2, IP-3) [IF for fissile material]
- Type A package [AF for fissile material]
- Type B(M), Type B(U) package [B(U)F and B(M)F for fissile material]
- Type C package [CF for fissile material]
- Type H(U) [H(U)F for fissile material]
- Type H(M) [H(M)F for fissile material]
- Certain Shipments (T)
- Special arrangement (X)
- Low specific activity (LSA-I, LSA-II and LSA-III)
- Surface contaminated objects (SCO-I, SCO-II)
- Special Form (S)
- Low Dispersible Radioactive Material (LDRM)
- Calculation of alternative activity limits for an exempt consignment of instruments or articles (AL)
In IAEA SSR6 para 802 competent authority approval is required for some designs including:

- **Type B(M), Type B(U) packages**

- **Shipment approval (T) SSR6 paras 825 - 831**
  - For shipments approved under special arrangements
  - For Type B(M) packages containing the lowest value of >3000$A_1$ or $A_2$ or 1000 TBq

- **Special arrangement (X) SSR6 paras 829 - 831**

- **Special Form (S) SSR6 paras 602 – 604, 803, 804**
  - Special form radioactive material shall mean either an indispersible solid radioactive material or a sealed capsule containing radioactive material.
d.2 Documentation: Evidence of conformity

SSR6, para 801
For package designs not requiring competent authority approval the consignor shall, on request, make available for inspection by the competent authority, documentary evidence of the compliance of the package design with the applicable requirements

This applies to the following:
- Excepted packages
- Industrial packages Type (IP-1, IP-2, IP-3)
- Type A package
- Low specific activity (LSA-I, LSA-II and LSA-III)
- Surface contaminated objects (SCO-I, SCO-II)
e.1 Monitoring of radiation - package

Permitted Package dose rates

<table>
<thead>
<tr>
<th>Package type</th>
<th>Dose rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surface**</td>
</tr>
<tr>
<td>Excepted</td>
<td>5μSv/h</td>
</tr>
<tr>
<td>IP-I, II, II</td>
<td>≤0.1 mSv/h</td>
</tr>
<tr>
<td>Type A</td>
<td>≤2 mSv/h</td>
</tr>
<tr>
<td>Type B</td>
<td>≤2 mSv/h</td>
</tr>
<tr>
<td>Type C</td>
<td>≤2 mSv/h</td>
</tr>
</tbody>
</table>

* unshielded radioactive contents

** ≤10 mSv/h for packages under exclusive use (except by air which is limited to ≤2 mSv/h)
e.1 Monitoring of radiation – Transport Index

Transport Index (TI) for a package, overpack or freight container, or unpackaged LSA-I or SCO-I, shall be (IAEA SSR-6, para 523):

(a) Maximum radiation level (mSv/h) at a distance of 1m from the external surfaces of the package, overpack or freight container, or unpackaged LSA-I or SCO-I

Multiplied by 100

(b) For tanks, freight containers and unpackaged LSA-I or SCO-I the value derived in (a) is scaled up according to size, namely

<table>
<thead>
<tr>
<th>Size of load*</th>
<th>Multiplication factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of load ≤ 1m²</td>
<td>1</td>
</tr>
<tr>
<td>&gt;1 m² ≤ 5 m²</td>
<td>2</td>
</tr>
<tr>
<td>&gt;5 m² ≤ 20 m²</td>
<td>3</td>
</tr>
<tr>
<td>&gt; 20 m²</td>
<td>10</td>
</tr>
</tbody>
</table>

* Largest cross-sectional area of load
### e.1 Monitoring of radiation – Transport Index

Transport Index (TI) limits for conveyances not under Exclusive Use

<table>
<thead>
<tr>
<th>Type of conveyance</th>
<th>Limit on sum of TIs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freight container (small, large)</td>
<td>50</td>
</tr>
<tr>
<td>Vehicle</td>
<td>50</td>
</tr>
<tr>
<td>Aircraft</td>
<td>50</td>
</tr>
<tr>
<td>Passenger</td>
<td>50</td>
</tr>
<tr>
<td>Cargo</td>
<td>200</td>
</tr>
<tr>
<td>Seagoing vessel</td>
<td></td>
</tr>
<tr>
<td>Hold, compartment or defined deck area:</td>
<td></td>
</tr>
<tr>
<td>Packages, overpacks, small freight containers</td>
<td>50</td>
</tr>
<tr>
<td>Large freight containers</td>
<td>200</td>
</tr>
<tr>
<td>Total vessel</td>
<td></td>
</tr>
<tr>
<td>Packages, overpacks, small freight containers</td>
<td>200</td>
</tr>
<tr>
<td>Large freight containers</td>
<td>No limit</td>
</tr>
</tbody>
</table>
e.2 Monitoring of contamination

**Non-fixed contamination** on the external surfaces of a package under routine conditions of transport shall not exceed: (IAEA SSR-6 para 508)

(a) 4 Bq/cm$^2$ for beta and gamma emitters and low toxicity alpha emitters
(b) 0.4 Bq/cm$^2$ for all other alpha emitters

These limits apply when averaged over 300 cm$^2$ of any part of the surface

**Fixed contamination**

(c) Radiation level shall not exceed 5 µSv/h at the surface

Non-fixed contamination on the external and internal surfaces of overpacks, freight containers, tanks, IBCs and conveyances shall not exceed (a) and (b) except:

If equipment is dedicated to the transport of unpackaged radioactive material under exclusive use – (a), (b) and (c) do not apply to the internal surfaces (IAEA SSR-5 para 514)
f. Package labelling, vehicle placarding and vehicle loading restrictions

Package labelling
The labels on a Package depends upon the UN number that is assigned. Details of labelling can be found on the following website which refers to the IMDG regulations for transport by sea:

http://www.wnti.co.uk/media-centre/interactive-software-for-labelling-and-documentation.aspx

Vehicle placards
For all dangerous goods it is important that vehicles are placarded to indicate what dangerous goods they are carrying so that in the event of an accident the emergency responders (Police, Fire Rescue and Medical Teams) are informed so they can plan their response

Vehicle loading restrictions
The number of packages carried by a road vehicle is limited due to dose rate considerations

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f.1 Package labelling

- Examples of package labelling
## f.1 Package labelling

<table>
<thead>
<tr>
<th>Transport index (TI)</th>
<th>Maximum radiation level on external surface mSv/h</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>≤ 0.005</td>
<td>I - WHITE</td>
</tr>
<tr>
<td>&gt; 0 ≤ 1</td>
<td>&gt;0.005 ≤ 0.5</td>
<td>II - YELLOW</td>
</tr>
<tr>
<td>&gt; 1 ≤ 10</td>
<td>&gt; 0.5 ≤ 2</td>
<td>III - YELLOW</td>
</tr>
<tr>
<td>&gt; 10</td>
<td>&gt; 2 ≤ 10</td>
<td>III – YELLOW *</td>
</tr>
</tbody>
</table>

* Under exclusive use

II-YELLOW and III-YELLOW shall not be carried in compartments occupied by passengers (IAEA SSR-6 para 563)

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f.1 Package labelling

Package labelling
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Further details on package labelling can be found at:

http://www.wnti.co.uk/media-centre/interactive-software-for-labelling-and-documentation.aspx
For all dangerous goods it is important that vehicles are placarded to indicate what dangerous goods they are carrying so that in the event of an accident the emergency responders (Police, Fire Rescue and Medical Teams) are informed so they can plan their response.

**SSR6 para 566(a)**

• For road transport, the maximum Transport Index for a vehicle shall be limited to 50.
• The transport index (TI) for the road vehicle is the sum of all the TIs of the packages carried by the vehicle.
• If any package has a TI greater than 10 it shall be transported under ‘exclusive use’ – see definitions in Core Model (a).
f.3 Vehicle placarding

For all dangerous goods it is important that vehicles are placarded to indicate what dangerous goods they are carrying so that in the event of an accident emergency responders can plan their response accordingly.

The UN numbers applicable to radioactive material transport are listed in SSR6 para 401, Table 1.

The UN number and the Proper Shipping Name will be recorded on the transport documentation (SSR6 para 546):

The UN number relating to the package(s) being transported shall be identified in the following placard (UN 2915 is shown as an example):
Vehicle placarding

The UN number relating to the package(s) being transported shall be identified in the following placard (UN 2915 is shown as an example):

UN2915
Training and job related skills TS-G-1.5 para 4.103

The duties and responsibilities of employees of competent authorities, independent inspectors and emergency personnel, should be specified so that the necessary training can be determined and provided.

A training programme covering the activities a-l of the core model, to the level appropriate for the Member State, would provide the necessary competences and refresher training should be included.

National training programmes should be established for

- First Responders (Police, Fire, Medical)
- Radiation Workers
g.2 Training - operators

Scope of training SSR6, para 311, 312
Individuals shall receive training in radiation protection (precautions to restrict their occupational exposure and exposures of other persons) and the contents of SSR6 commensurate with their responsibilities.

Individuals to receive training SSR6, para 313
Those individuals who shall receive training are as follows;
– Classify radioactive material
– Pack, mark and label radioactive material
– Prepare transport documents
– Offer or accept radioactive material for transport
– Carry or handle radioactive material in transport
– Mark or placard or load or unload packages into or from transport vehicles, bulk packagings or freight containers
– Others who are otherwise directly involved in the transport of radioactive material as determined by the competent authority.
Scope of training SSR6, para 313
The scope of the training provided shall be as follows:
(a) General awareness and familiarisation training
(b) Function specific training
(c) Safety training

Training records SSR6, papa 314
Records of all safety training shall be kept by the employer and made available to the competent authority upon request

Provision of training SSR6 para 315
Training shall be provided or verified upon employment and shall be periodically supplemented by retraining as deemed appropriate by the competent authority
g.2 Training – operators

TS-G-1.4 section 4.2 – 4.6
The objective of training should be to provide individuals with the necessary knowledge and skills that, together with attitudes and experience, will enhance their competence

TS-G-1.5 para 4.103 - 4.107
Only appropriately trained persons are permitted to be engaged in the transport of radioactive material
h. Governmental response plans and procedures for transport accidents

SSR6, para 304, TS-G-1.2 para 3.8 – 3.9

In developing plans and procedures for transport accidents involving radioactive material, the relevant government bodies:

– Should establish legislation to define areas of responsibilities and functions
– Should define the responsibilities of national, provincial and local governments
– Should establish radiation protection services [perhaps involving academia, hospitals and industry as appropriate]
– Should identify the authorities to be notified and establish communications and notification systems
– Should determine and periodically review and test the adequacy of plans
– Should establish, where appropriate, liaison with Authorities in neighbouring States
h. Governmental response plans and procedures for transport accidents

- Should define the responsibility for public information regarding transport of radioactive material
- Should establish (or ensure establishment of) appropriate training programme
- Should provide the resources to implement the plans

The collaboration with other Member States in the region is promoted to provide the necessary specialist resources in appropriate response times. All collaboration models should be tested at intervals that ensure the capability remains viable.
i. Consignor and carrier responsibilities - accident response plan

SSR6, para 304, TS-G-1.2 para 3.10 – 3.15

The primary responsibility for ensuring preparedness for each shipment of radioactive material in principle should rest with the consignor.

The carrier also has responsibilities for safety during transport and for the proper reaction in the event of an accident.

Both the consignor and the carrier should be prepared to respond to an accident and provide the appropriate technical assistance to emergency responders.

The consignor should make available to the carrier the appropriate emergency instructions and other information concerning emergency response.
i. Consignor and carrier responsibilities - accident response plan

The carrier should ensure that proper emergency instructions are carried on-board the transport unit.

The carrier should make all efforts to ensure that applicable emergency information is provided to the first on the scene personnel.

Carrier personnel should be instructed that immediately after an accident, if they are able to do so, they should inform the police (or another appropriate emergency agency), the consignor and other appropriate authorities.

- They should also be instructed to act according to the relevant emergency procedures
j. Develop and maintain contact list of departments / institutions involved

- To provide the scope of activities in a regulator oversight model, a competent authority may have formal agreements between government departments, agencies and institutions.

- The points of contact should be identified (office hours and 24 hours as necessary).

- The list of contacts should be made available to all named contacts on the list.

- The list of contacts should be periodically reviewed.
k. Agree responsibilities and duties

It is important that all those named as being involved in the transport of radioactive material clearly understand their role and responsibilities.

Clarity is important for those activities that provide control to the transport process (e.g., import/export authorisations, package approval, enforcement, incident response).

Clarity of roles and responsibilities when responding to an incident are important as it will involve a group of people who do not routinely work together.
I. Identify and collaborate with other Member States

It is important to recognise that in the early stages of developing the scope of competent authority activities necessary to provide the necessary regulator oversight, some Member States may need the help of other neighbouring / regional Member States who have already developed their specific technical skills.

This should not be seen as a weakness.

If developed carefully, a collaborative approach can provide significant benefits of regional confidence and a resilience to changes that may affect an individual Member State.

The mutual understanding of strengths and weaknesses can provide a basis of an effective gap analysis which can then inform agreements for collaboration and partnerships. This is particularly helpful when the transport route involves more than one Member State in a region.
The Strategy

- Plan and adopt the core model to meet national needs and ambitions of your country which recognises the importance of control and inspection
- Include ways to measure performance / progress
- Negotiate and implement network collaborations and continue to develop
- Implement training and develop competences as an ongoing activity
- Remember and pursue the ambition, in a reasonable and achievable timescale, to move from

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<td>10</td>
<td>a, b, c, j, k, l</td>
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<tr>
<td>11</td>
<td>j, k, l</td>
</tr>
<tr>
<td>12</td>
<td>a - l</td>
</tr>
</tbody>
</table>

To meet the national needs and ambitions of your country
The IAEA will support you – but success will depend on your commitment

Thank you

Stephen Whittingham
Head of Transport Safety Unit
Division of Radiation, Transport & Waste Safety
Department of Nuclear Safety and Security
email: s.whittingham@iaea.org