



**IAEA**

International Atomic Energy Agency

# International regulatory framework for the transport of naturally occurring radioactive material

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NORM and its Challenges



# Overview



- UN framework for international transport regulations
- UN Model Regulations - Recommendations on the Transport of Dangerous Goods (commonly referred to as the UN Orange Book)
- Incorporation of IAEA Transport Regs into Model and Modal Regulations
- Requirements concerning whether the transport of NORM is subject to IAEA Transport Regs
- Activities/industries that may involve shipments of NORM that are subject to IAEA Transport Regs
- Requirements of IAEA Transport Regs for shipments of NORM
- Challenges
- Proposals for changes to IAEA Transport Regs

# IAEA Statute: Safety Mission

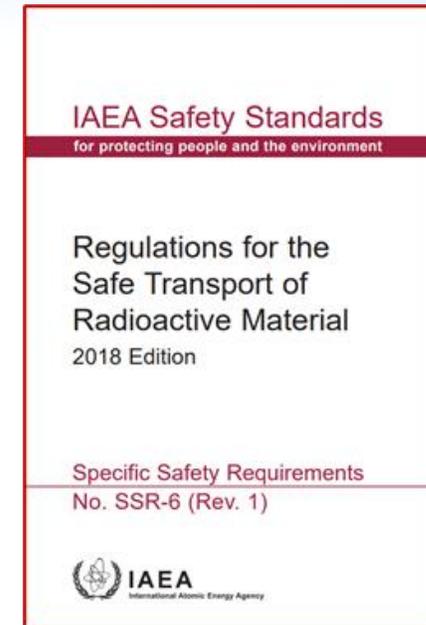
**“To establish ... standards of safety ... and to provide for the application of these standards ...”**



# Objective of IAEA Transport Regulations

The objective of the IAEA Transport Regulations is to **protect persons, property and the environment from the effects of radiation during the transport of radioactive material**. This protection is achieved by requiring:

- containment of the radioactive contents
- control of external dose rate
- prevention of criticality (for fissile material)
- prevention of damage caused by heat



# Structure of IAEA Transport Regulations



- SECTION I. INTRODUCTION
- SECTION II. DEFINITIONS
- SECTION III. GENERAL PROVISIONS
- SECTION IV. ACTIVITY LIMITS AND CLASSIFICATION
- SECTION V. REQUIREMENTS AND CONTROLS FOR TRANSPORT
- SECTION VI. REQUIREMENTS FOR RADIOACTIVE MATERIAL AND FOR PACKAGINGS AND PACKAGES
- SECTION VII. TEST PROCEDURES
- SECTION VIII. APPROVAL AND ADMINISTRATIVE REQUIREMENTS

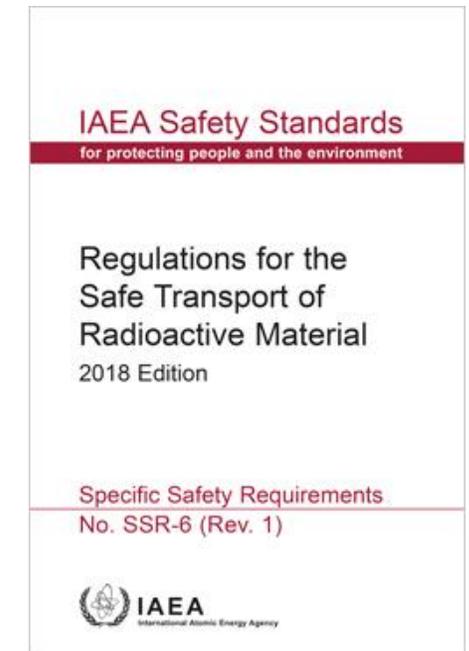
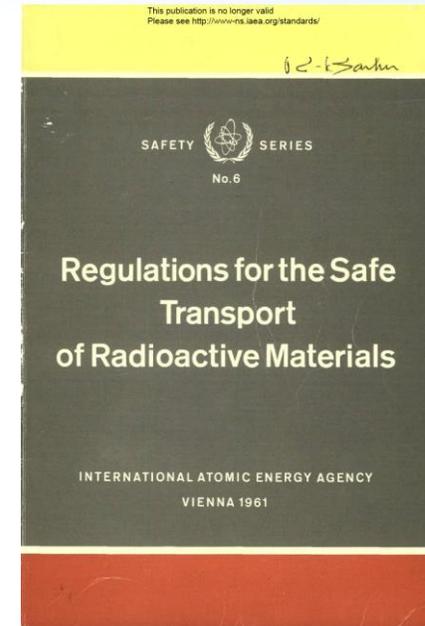
# IAEA Transport Regulations

The IAEA Transport Regulations (SSR-6) are:

- Used worldwide
- Not binding (recommendations) except in relation to IAEA operations
- Binding once incorporated into other international regulations which are backed by a treaty or convention
  - E.g. They are binding for international land transport for signatories of ADR, RID and ADN.
- Incorporated either directly or indirectly in national transport regulations
- One of only a few IAEA Safety Standards used directly or indirectly world-wide

# History of Transport Regulations

- IAEA first published Regulations for the Safe Transport of Radioactive Materials in 1961
- Multiple new Editions and Amendments have been published
  - Since 1961 transport regulations have been comprehensively revised five times (1964, 1967, 1973, 1985, 1996, 2005, 2009, 2012, 2018)
  - Other less significant amendments have been published
  - The most recent publication is SSR-6 (Rev.1), 2018 Edition



# Development of Transport Regulations

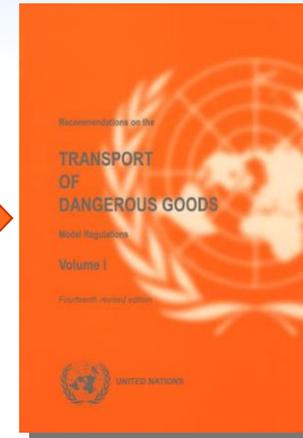
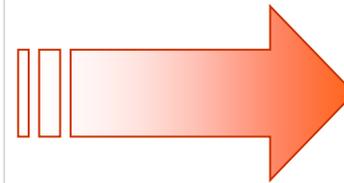
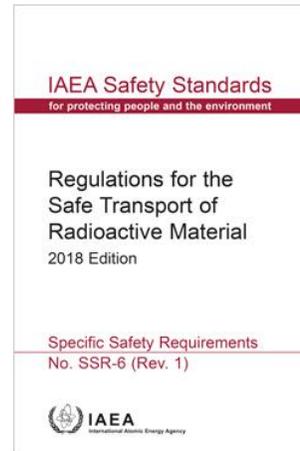
- IAEA reviews the transport regulations every two years based on feedback from member states
- Based on this review IAEA determines if there is a need to revise their regulations
- IAEA consults with and closely collaborates with other UN agencies in the review of their transport regulations including:
  - UN Subcommittee of Experts on the Transport of Dangerous Goods (SCETDG)
  - International Civil Aviation Organization (ICAO)
  - International Maritime Organization (IMO)
  - UN Economic Commission for Europe (UNECE) serving also as Secretariat for SCETDG



# IAEA Input To International Transport Regulations

Consistent with ECOSOC Resolutions of 1959 and 1997, IAEA provides the transport regulations (SSR-6) to the UNECE

UNECE incorporates the radioactive material transport regulations into the UN Model Regulations Recommendations for the Transport of Dangerous Goods (commonly referred to as the UN Orange Book)



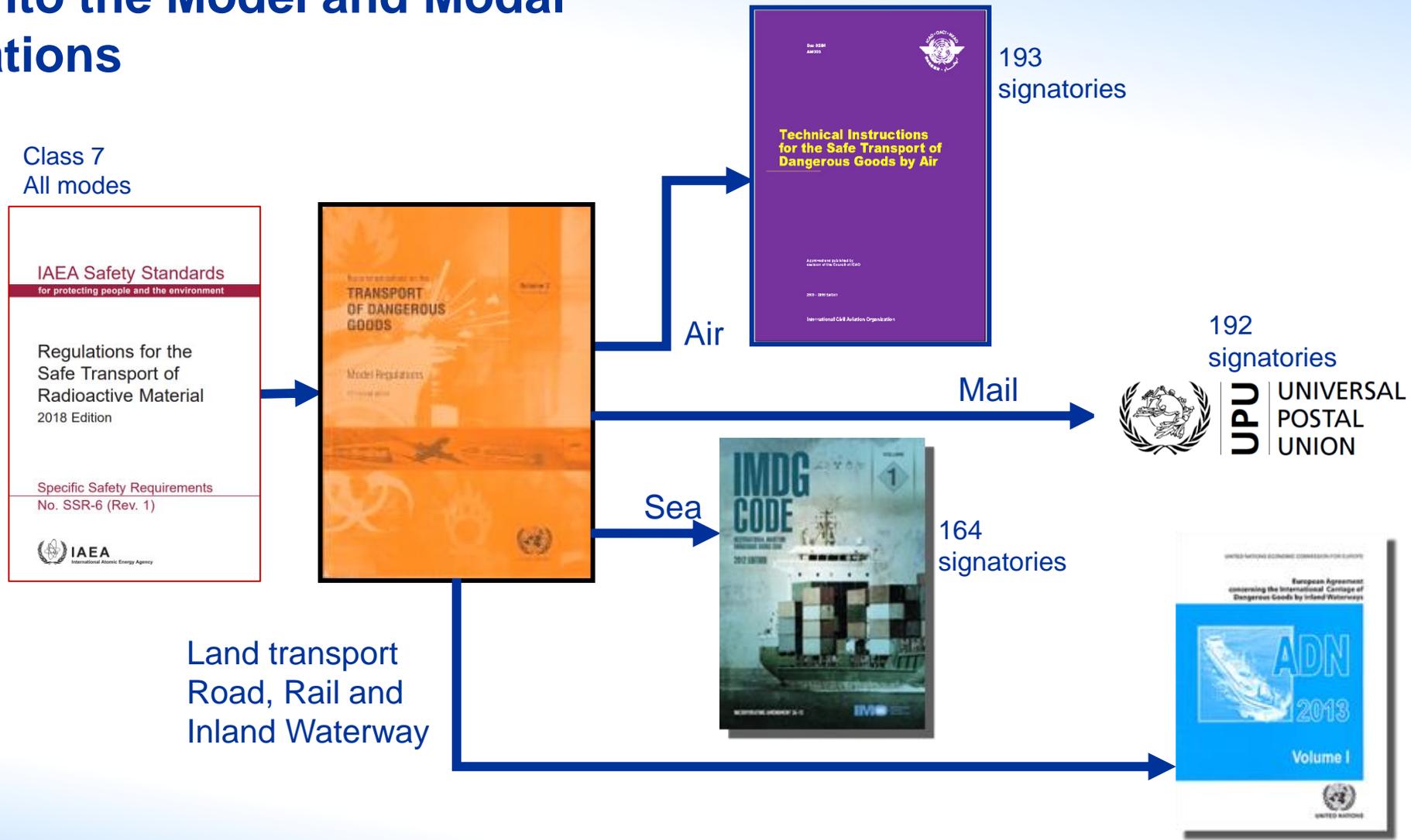
The UN Orange Book forms the basis for a wide variety of modal regulations

- Provides recommendations that will allow uniform development of international and national regulations governing the various modes of transport of dangerous goods
- Provides non-mandatory ‘Recommendations on the Transport of Dangerous Goods’ for all modes of transport
- Is written in the form of ‘Model Regulations’ for international and national use
  - UNOB does not provide guidance so regulatory text needs to be broad and comprehensive
    - Note: SSR-6 (Rev. 1) is supplemented with six Safety Guides including the Advisory Material (SSG-26) that provides extensive implementing guidance for SSR-6 (Rev. 1)

# UN Orange Book

- The UNOB covers all modes of transport (air, water and land) for all classes of dangerous goods
- Dangerous goods are categorized in nine classes:
  - Class 1 – explosives
  - Class 2 – gases
  - Class 3 - flammable liquids
  - Class 4 – flammable solids
  - Class 5 – oxidizing substances and organic peroxides
  - Class 6 – toxic and infectious substances
  - **Class 7 – radioactive material**
  - Class 8 – corrosive substances
  - Class 9 – miscellaneous dangerous substances and articles

# Incorporation of IAEA Transport Regs into the Model and Modal Regulations



Regional: MERCOSUR/MERCOSUL (5) ADR (52), RID (51), ADN (20)

## History of Exemption Criteria for NORM in IAEA Transport Regulations



- In 1985 Edition (updated 1990) of the TR, 70 Bq/g was the exemption limit, irrespective of the radionuclide
- 1996 Edition of TR introduced radionuclide values and the '10X Rule' for 'natural material and ores containing naturally occurring radionuclides which are not intended to be processed for use of these nuclides'
- The effect was to change the exemption limit for Th (natural) and U (natural) from 70 Bq/g taking into account each individual radionuclide to 1 Bq/g for the head of the chains with potential use of the '10X Rule'

# Regulatory Control for the Safe Transport of NORM

## CRP 2007-2010 (TECDOC-1728)



- CRP initiated to research the full impact and technical basis of the '10X Rule' exemption
- CRP evaluated various technical topics related to the regulatory control of the transport of NORM, e.g. doses to transport workers and the public; typical loading of packages and types of packages used to transport NORM, and consideration of validity of exemption and exclusion levels
- Conclusions (partial list):
  - Doses to transport workers were within 'the range described in the regulatory context'
  - Doses to the public were found to be an order of magnitude lower than those of workers; the '10X rule', when considering public doses may be considered conservative; however, it was considered adequate to exempt NORM in secular equilibrium.
  - For U-nat and Th-nat, a basic activity concentration of 1 Bq/g, together with the '10X rule', is 'both appropriate and necessary'

## Exemption from the requirements of IAEA Transport Regs

- Material in which both the activity concentration and the total activity in the consignment are greater than the exemption values in Table 2 of SSR-6 (Rev. 1) are subject to the requirements of SSR-6 (Rev. 1)
- For NORM, usually, the activity concentration will determine whether material is subject to the requirements of SSR-6 (Rev. 1)
- Table 2 of SSR-6 (Rev. 1) lists values for Th (natural) and U (natural), which assume secular equilibrium
- If not in equilibrium, each of the progeny must be evaluated individually
- According to para. 405 of SSR-6 (Rev. 1), effectively, the law of fractions applies to the determination of the basic radionuclide values for mixtures of radionuclides

## Exemption from the requirements of IAEA Transport Regs

- However, under para. 107(f), ‘Natural material and ores containing naturally occurring radionuclides, which may have been processed’ are subject to the ‘10X Rule’, so the activity concentration values that apply are 10 times higher than those listed in Table 2:

Radionuclide	Activity concentration limit for exempt material	Activity limit for an exempt consignment
Th (natural)	$1 \text{ Bq/g} \times 10 = 10 \text{ Bq/g}$	$1 \times 10^3 \text{ Bq}$
U (natural)	$1 \text{ Bq/g} \times 10 = 10 \text{ Bq/g}$	$1 \times 10^3 \text{ Bq}$

# What activities/industries may involve shipments of NORM that are subject to IAEA Transport Regs? \*\*



- Probably:

- Extraction of rare earth elements
- Production and use of thorium and its compounds
- Production of niobium concentrates and compounds
- Production of tantalum concentrates and compounds
- Industries that involve zircon and zirconia
- Mining and milling of uranium and compounds

- Possibly:

- Water treatment residues
- Mining of ores other than uranium ore
- Production of oil and gas, including hydraulic fracturing
- Manufacture of titanium dioxide pigments
- Activities related to the phosphate industry, including production of fertilizers, thermal phosphorus and phosphoric acid
- Production of tin, copper, aluminium, zinc, lead, iron and steel
- Combustion of coal
- Geothermal energy generation
- Production of cement
- Paper and pulp production
- Scrap metal recycling
- Production of precious metal slimes as a byproduct of mining and processing
- Off gas scales that result from the heating, burning and/or smelting of material

\*\*These lists are not exhaustive.

# IAEA Transport Regs: Classification of the material

UN Number	Proper Shipping Name	Further information
UN 2910	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE-LIMITED QUANTITY OF MATERIAL	Small quantities of material, e.g. mining samples
UN 2912	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-I)	uranium and thorium ores and concentrates of such ores; other LSA with concentration up to 30 X exempt concentration limits
UN 3321	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-II)	LSA material that does not qualify as LSA-I for which the concentration does not exceed specified limits
UN 2913	RADIOACTIVE MATERIAL, SURFACE CONTAMINATED OBJECTS (SCO-I, SCO-II or SCO-III)	the object itself is not radioactive, but it has radioactive contamination on it

# IAEA Transport Regs: Packaging of the material

LSA and SCO in groups LSA-I, LSA-II, LSA-III and SCO-I may be transported in various types of industrial packages

LSA and SCO in groups LSA-I, SCO-I and SCO-III may be transported unpackaged if the conditions of para. 520 are met



IP-1 'bulka bags'

# IAEA Transport Regs: Other requirements

- Categorization of the package
- Labelling the package
- Placarding the conveyance
- Dose rate and contamination limits
- Determining the transport index
- Exclusive use
- Radiation Protection Programme
- Transport documents
- Training
- Management system
- Emergency preparedness and response

# Challenges

- Operators of facilities may not be aware that NORM is present if their facility is not regulated on the basis of radiation protection
- Determining whether material is exempt from SSR-6 (Rev. 1) and classifying it is challenging
- SSR-6 (Rev. 1) (IAEA Transport Regs) is a complex publication
- IAEA Transport Regs are reviewed every two years and potentially revised
- NORM that is exempt from the requirements of SSR-6 (Rev. 1) may be detected at portal monitors
- Differences in requirements and the enforcement of requirements between States
- Lack of adequate training and education of operators of facilities and members of competent authorities for the transport of radioactive material
- Denial of shipment

## Proposals for Change – 2021 Review Cycle of SSR-6 (Rev. 1)



- New definitions of ‘naturally occurring radioactive material’ and ‘naturally occurring radionuclides’
- Increase the ‘10X Rule’ for exemption of NORM in para. 107(f) to ‘30X’ for packaged NORM
- Clarification that the definition of LSA-I applies to all NORM
- Simplification of the ‘Mixtures Equation’ in para. 405
- Mixed packing of LSA Material with SCO in an industrial package (IP)



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Principal Radiation Protection Specialist at National Nuclear Regulator in South Africa

**Thank you for your attention!**  
**Any questions?**