Practical cases of dealing with Class 7 dangerous goods in situations where other hazardous materials are also present

Nick Tsurikov
Director, Calytrix Consulting Pty Ltd

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CALYTRIX CONSULTING PTY LTD

Presenter

Nick Tsurikov, Calytrix Consulting Pty Ltd

30 years experience in radiation protection

An international radiation protection consultant with a broad range of projects: from advice to local councils, Aboriginal Corporations, mining and processing industry, government departments in Australia and other countries to participating in international projects (over 20 technical and consultancy meetings at the UN/IAEA).

A Member of the Radiological Council of WA and Radiation Liaison Committee between the Radiological Council and the Department of Mines and Petroleum of WA, an advisor to the several committees of the USA Conference of Radiation Control Program Directors.

Geographical areas of work undertaken:

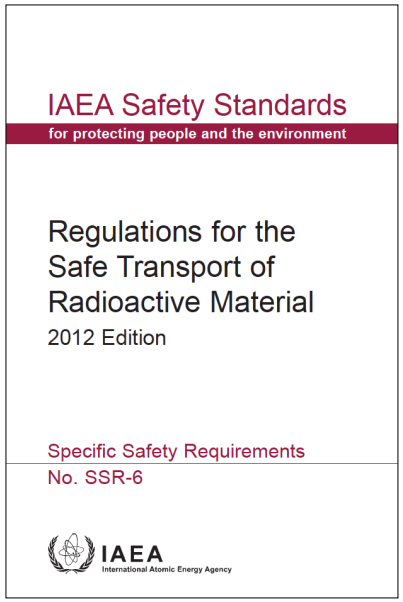
Australia, Austria, Azerbaijan, Brazil, Cameroon, China, Gabon, Greece, Hungary, Japan, Kazakhstan, Kenya, Kyrgyzstan, Malaysia, Mongolia, Namibia, Poland, Singapore, South Africa, Spain, Sri Lanka, Syria, Tanzania, UAE, Ukraine, Zambia.

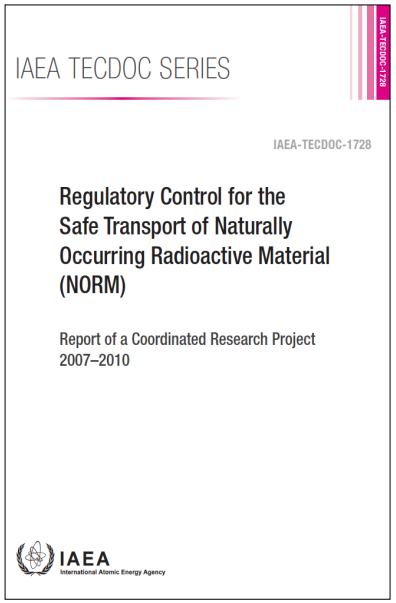
Outline

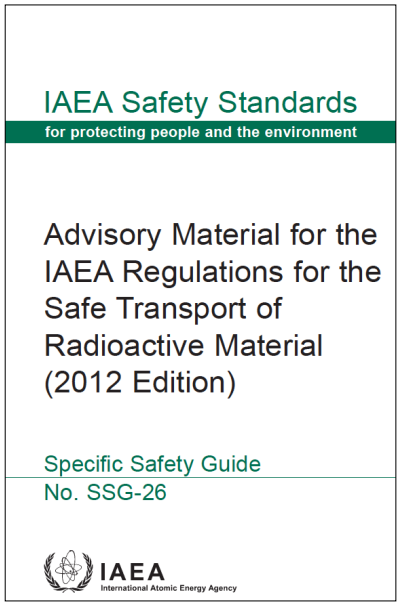
1. Transport of mixed dangerous goods – practical cases

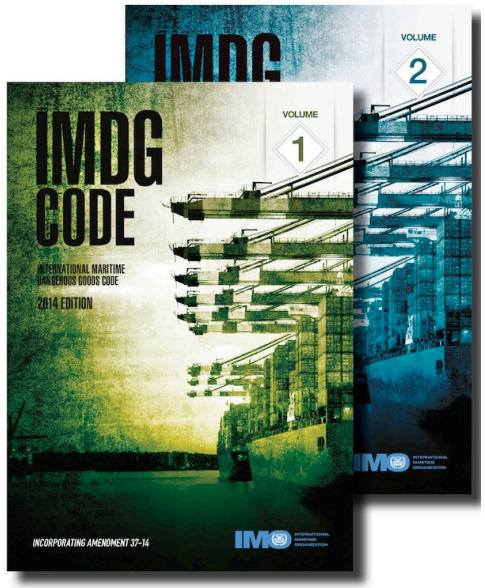
2. The essential advice to the industry

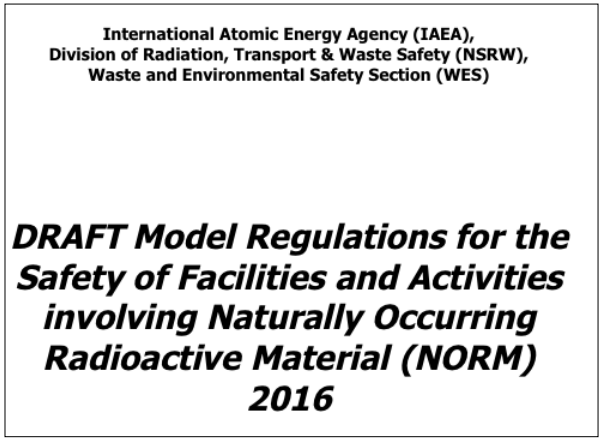
Regulations applicable and other documents

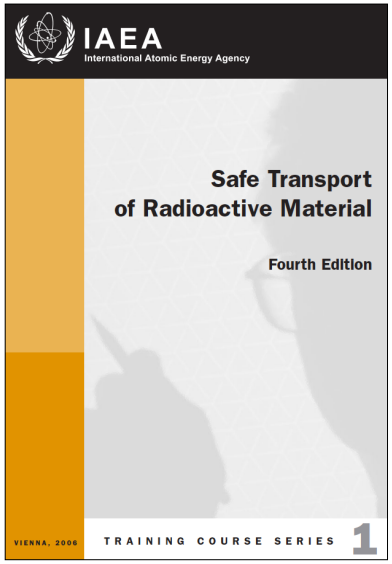


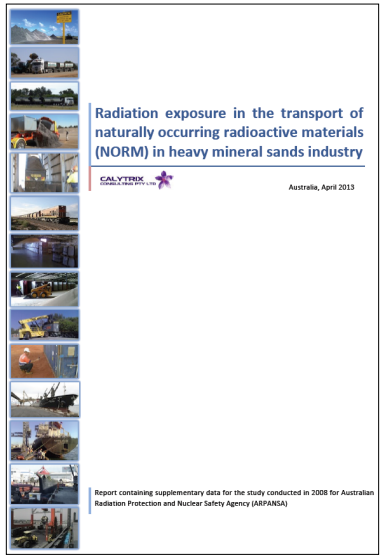












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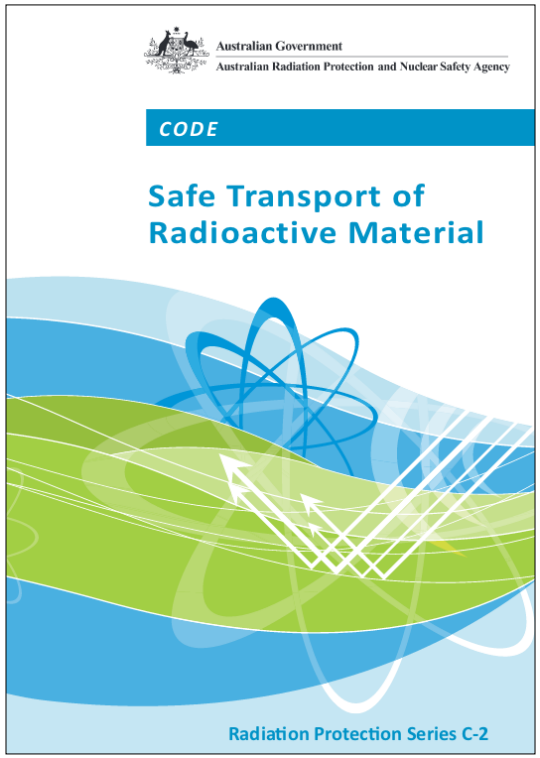
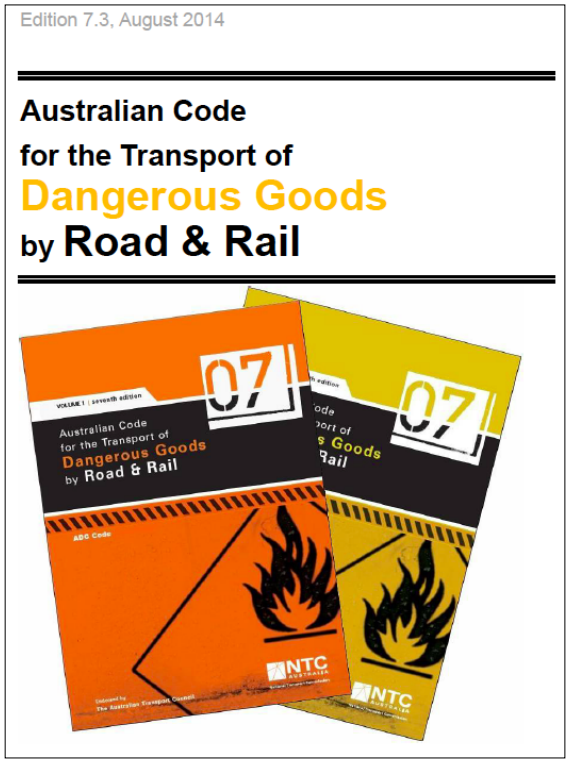
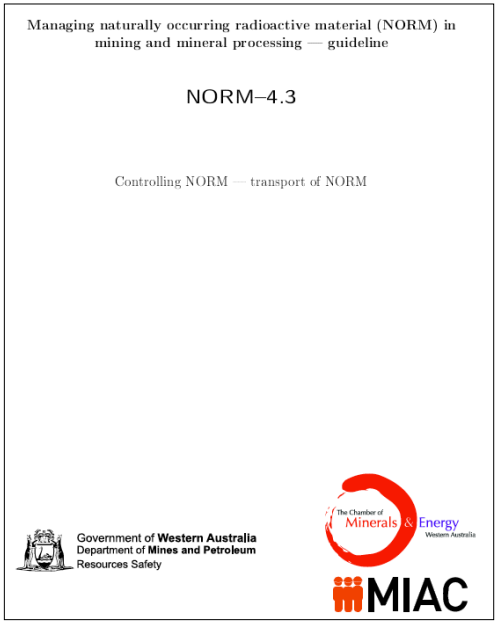
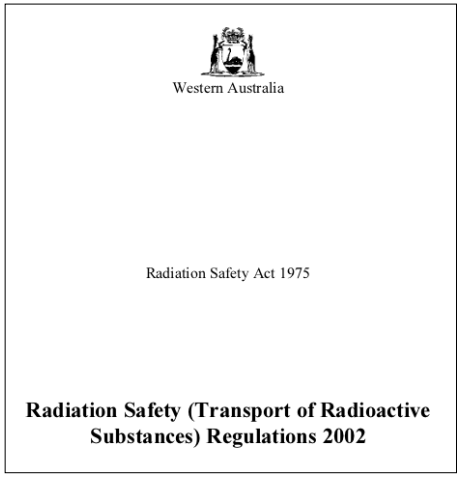
Regulations applicable and other documents

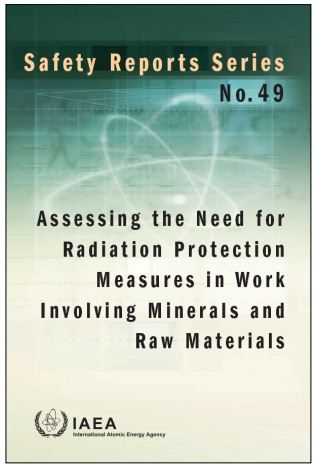


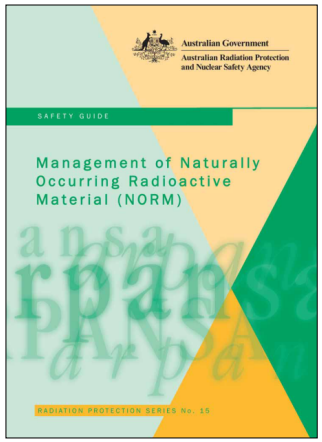






Which industries are of a concern?





In addition to uranium mining and processing, the following industry sectors have been identified, roughly in descending order of priority, as being most likely to require some form of regulatory consideration:

1. Extraction of rare earth elements;
2. Production and use of thorium and its compounds;
3. Production of niobium and ferro-niobium;
4. Mining of ores other than uranium ore;
5. Production of oil and gas;
6. Manufacture of titanium dioxide pigments;
7. The phosphate industry;
8. The zircon and zirconia industries;
9. Production of tin, copper, aluminium, iron and steel, zinc and lead;
10. Combustion of coal;
11. Water treatment.

<u>Australian addition (2008)</u>

- Production of tantalum
- Production of mineral sands
- Scrap metal recycling
- Geothermal energy generation

<u>Another possible addition:</u>

- Hydraulic fracturing for oil and gas (being extensively studied in the USA)

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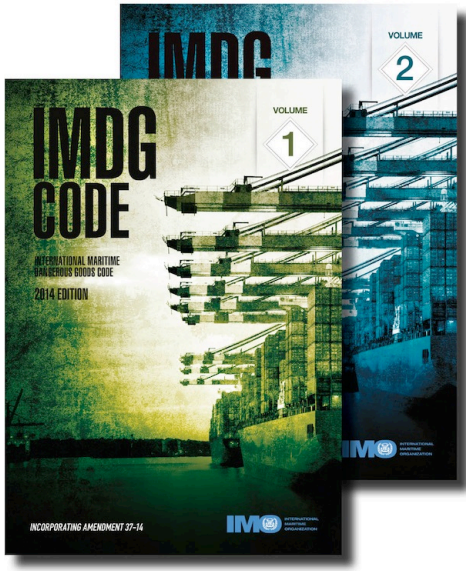
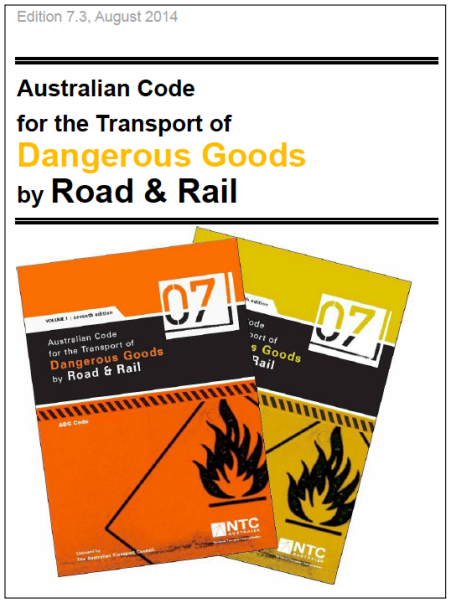
The following rule is often ignored





5.1.4 Mixed packing

When two or more dangerous goods are packed within the same outer packaging, *the package shall be labelled and marked as required for each substance*.

Subsidiary risk labels need not be applied if the hazard is already represented by a primary risk label.

Case 1 – radioactive and toxic material

Transport of uranium concentrate, Africa

- The drums and containers signposted appropriately

Radioactive material
→ ALSO
Environmentally hazardous substance

Case 2 – radioactive and corrosive material

Chemically and thermally processed radioactive mineral concentrate (initial pH=1), Australia

•Was only signposted as ‘radioactive’ before transport for reprocessing, additional sign ‘corrosive’ was added on the lined container before transport

Case 2 – radioactive and corrosive material

Another example of correct signposting

Case 3 – radioactive and biological material

Water treatment sludge, Asia

- Was considered to be a biological hazard only, until high levels of radium-226 were found in the material.
- ‘Radioactive’ sign was added

Case 4 – radioactive and flammable material

Oil sludge – Middle East

- The drums and containers signposted appropriately

Radioactive material
→ ALSO
Flammable material

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Case 5 – radioactive and toxic material

Pipes from oil production – Asia

- Were considered to be containing radioactive material only, until high levels of mercury were found in the material.
- ‘Toxic’ sign was added

The essential knowledge for transport managers

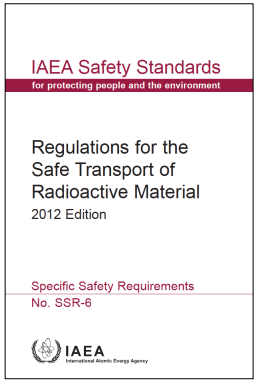
What is classified as radioactive?

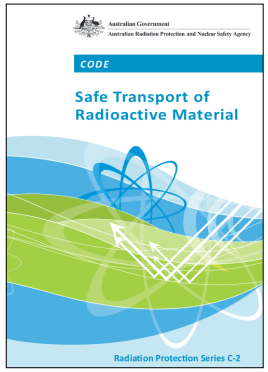
Too long and complex for this presentation – details in the paper

The analysis of minerals and other materials only for uranium and thorium is no longer sufficient. *"…For natural materials and ores containing naturally occurring radionuclides that are not in secular equilibrium the calculation of the activity concentration shall be performed…"*

The analysis for all radionuclides (radium, polonium, lead, etc) is required when the following was done:

- Any chemical processing of the material, such as leaching or adding flotation agents to the process,
- Any thermal processing of the material (the value of 250-300^{o}C is suggested as a general guide),
- Any combination of chemical and thermal treatment of ores and minerals.





Applicability of regulations to NORM in transit

- From one side, the material could be considered to be “in transport”, but
- From the other side, the almost permanent storage of material in a certain location may need to be regulated.

There is a provision (Regulation 28A) in the Western Australian Radiation Safety Regulations that puts a 24-hour limit for exemption from registration for the material in transport.

Therefore, if NORM containing *U(nat)* and *Th(nat)* in concentrations between 1 Bq/g (Table 2 of SSR-6) and 10 Bq/g (’10-times’ exemption for NORM) is stored at any transit location for more than 24 hours, the regulation 28 of the Radiation Safety Regulations (conditions on registration of premises) would apply and the transit location must be registered for storage of radioactive substances with the Radiological Council of WA.

Detection of radioactivity from NORM at border crossings

Relevant to the transport of all NORM, whether it is exempted from the Transport Regulations or not.

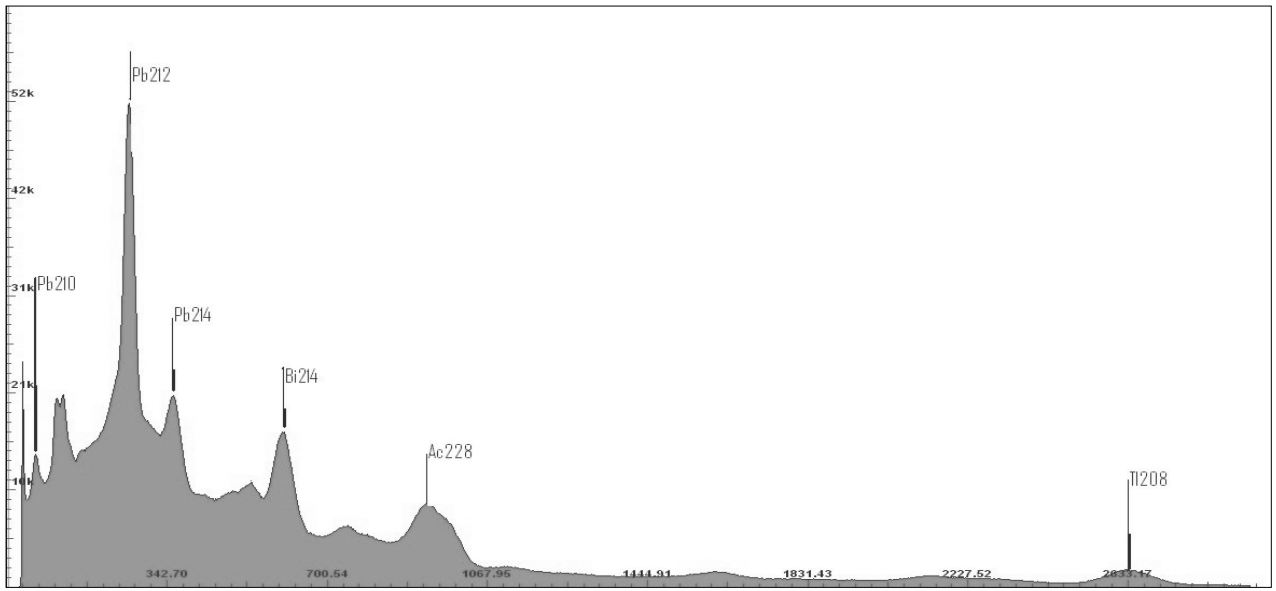
•Even if a material is exempt from the requirements and the associated signposting, the concentrations of radionuclides may cause gamma radiation levels outside the packages (e.g. sea containers) that are easily detectable by the equipment that is commonly used at border crossings and in ports worldwide.

•The transport documentation for a particular material must contain detailed information about the concentrations of naturally occurring radionuclides in this material, irrespective of its classification.

Detection of radioactivity from NORM at border crossings

It is suggested MSDS contains not only detailed information on concentrations of naturally occurring radionuclides but also an example of gamma-spectra for a particular material, in the form of either table or a chart – an example of the gamma-spectra for the concentrate of a rare earth mineral monazite attached to the MSDS by one of the producing companies is presented below.

Whilst not absolutely necessary, this information would assist in the process of clearing a particular NORM through the radiation detection equipment at international border crossings.



Build-up of radon concentrations in containers and hulls of ship

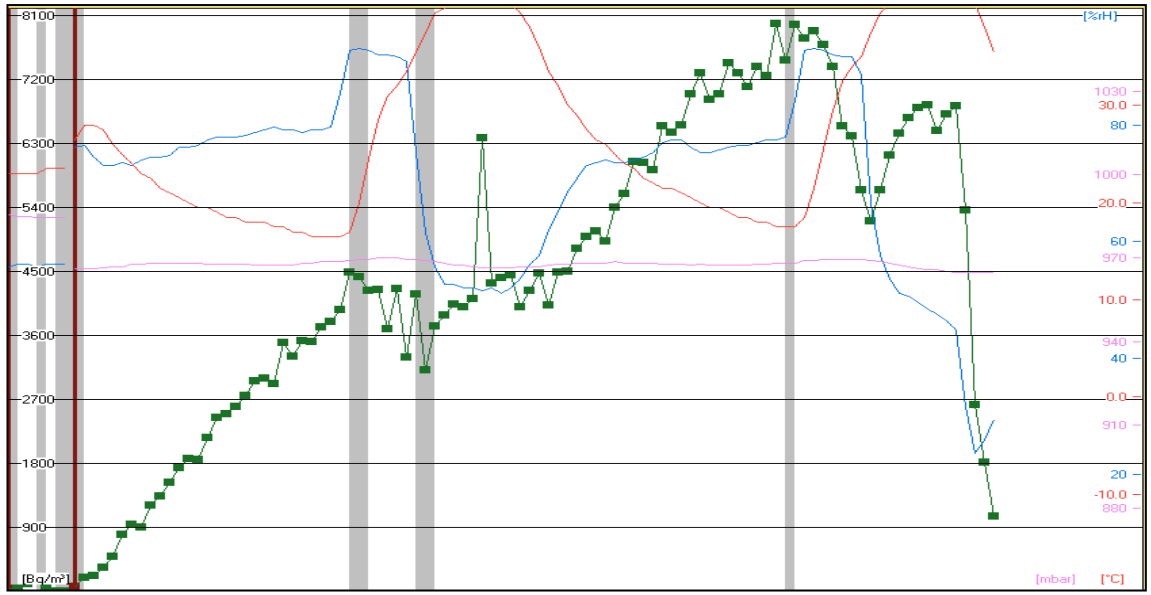
<u>Relevant to the transport of all NORM</u>, whether it is exempted from the Transport Regulations or not

Even if a material is exempt from the requirements and the associated signposting, the concentrations of radionuclides may cause significant concentrations of radon inside the sealed shipping containers and hulls of ships used to transport minerals in bulk.

An example can be made of the build-up of radon concentrations in a container where the mineral concentrate that is exempt from the requirements of Transport Regulations was stored in double-layered 2-tonne bulka-bags.

Build-up of radon concentrations in containers and hulls of ship

Build-up of ^{222}Rn in the container, material – 6 Bq/g ^{232}Th, 1 Bq/g ^{238}U
No signposting required unless concentration above 10 Bq/g, BUT:



Measurements over 48 hours, in 30-minute intervals, last four readings show rapid decrease after the doors of the container are opened.

At the highest measured level (^{222}Rn ~8000 Bq/m^3) a worker would exceed the public exposure limit (1 mSv/year) in just over 22 hours and a “radiation worker limit” (20 mSv/year) in ~450 hours.

Specific case where only part of a decay chain is present in NORM – ^{210}Po dust

The dust collected by electrostatic precipitators at different smelters (iron, nickel, copper), may contain significant concentrations of ^{210}Po, with ^{210}Pb concentrated elsewhere in the process.

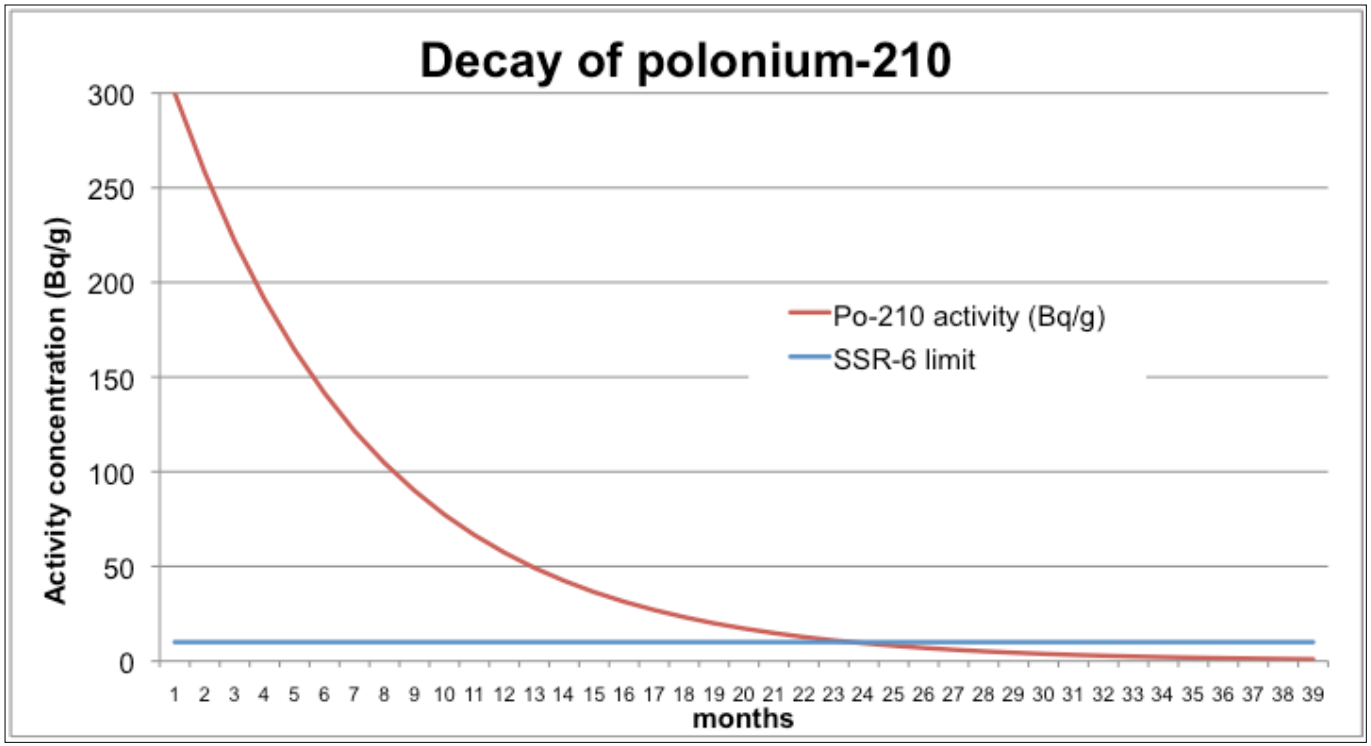
In this case the limits in the transport regulations specific for ^{210}Po:

- 10 Bq/g for activity concentration, and
- 10,000 Bq for total activity in the consignment.

In cases where this dust does not contain other toxic contaminants and radioactivity concentration of ^{210}Po is the only limiting factor for the disposal of this material at the industrial landfill, the “delay and decay” approach is typically taken, as illustrated on the following slide.

Specific case where only part of a decay chain is present in NORM – ^{210}Po dust

The dust containing 300 Bq/g of ^{210}Po will be exempt from the Transport Regulations in 8 months, will contain less than 10 Bq/g of ^{210}Po in 22 months, and will be exempt from radiation safety regulations in accordance with the IAEA Basic Safety Standards (less than 1 Bq/g) in just over three years.



Similar example relevant to radium-228 is presented in the associated paper

Additional cases

The following cases are also presented in the associated paper:

- Transport of mineral exploration samples,
- Correct calculation of thorium and uranium concentrations,
- Applicability of surface contamination limits,
- Adjustments to Transport Indexes for bulk shipments,
- Lack of communications in international trade:
- Containers held in port due to the lack of documentation,
- Applicability of country-specific guidelines and standards,
- Transit through international ports

Associated legal issues

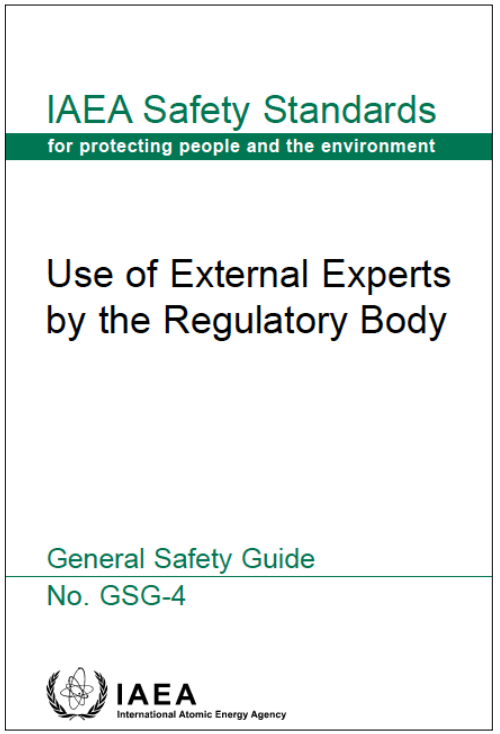
Companies may become involved in legal challenges without actually transporting radioactive material or exposing workers and/or general public to any levels of radiation.

Two legal cases are covered in the associated paper:

- Diminution of property values due to the proximity of the route on which radioactive material was planned to be transported, and
- Workers compensation due to the exposure to a mistakenly labelled container.

Conclusions

- The transport of mixed dangerous goods may be very complex;
- It is expected that the specialist advice will be required to adhere to all relevant regulations and guidelines;
- Both companies and government departments may need such advice, in absence of qualified personnel familiar with **all** requirements;
- There is a Safety Guide for this process:




Thank you for your attention!