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Management of Naturally Occurring Radioactive Material (NORM) in Industry

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Recent restrictions on NORM information from industry – back to 1980's?

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Outline

1. Communications between industry and regulators:
   - Lack of information from the industry, 1980's – early 1990's;
   - A period of industry cooperation, late 1990's – mid 2010's;
   - Restricting access to data, omitting the NORM issue all together – from late 2010's.
2. The problems associated with current situation:
   - Border control equipment easily detects NORM, delays of shipments;
   - The need to lower the regulatory exemption factor for the transport of NORM in bulk.
3. Possible causes and suggested solutions

1980's – early 1990's: Lack of Information

Quotes from the management of different companies at the time:

- ~80 Bq/g of uranium and thorium: *"We must resist with all the strength that we can muster any mentioning of radioactivity in our products and residues"*.
- ~250 Bq/g of uranium and thorium: *"No processing of radioactive material occurs, the only radioactive substances are those that are naturally present at very low concentrations"*.
- ~50 Bq/g of uranium: *"There are only trace amounts of uranium in some of the bags and drums"*.

Almost no participation in national and international conferences.

The radiation safety studies done internally and often not reported.

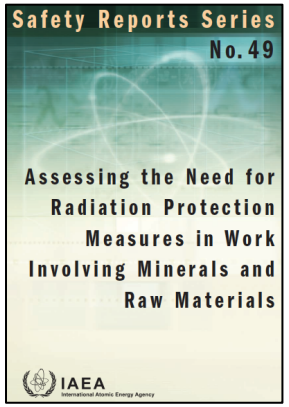
Statutory reports were confidential, workers frequently were not aware of a hazard and of their exposure levels.

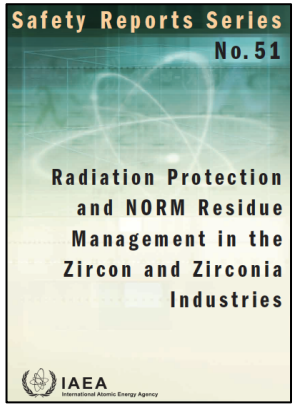
Late 1990's – mid 2010's: Industry Cooperation

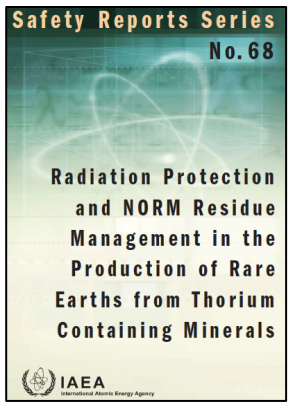
Cooperation and willingness to share information – national level, i.e.:

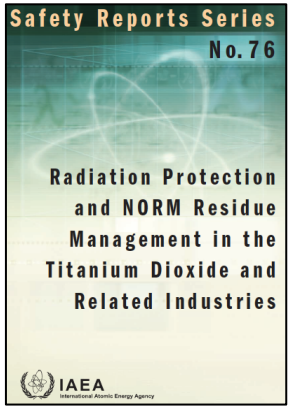
NORM regulations and guidelines introduced in Australia, Canada, China, EU, India, Japan, Malaysia, South Africa, USA… All developed with industry involvement.

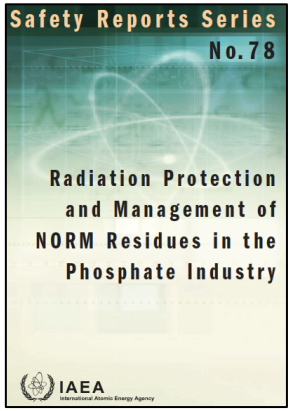
International cooperation:

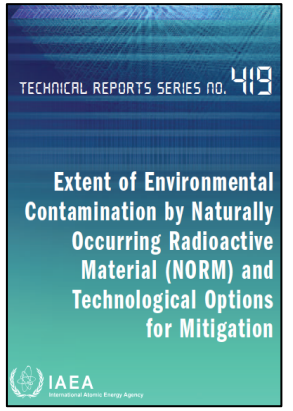


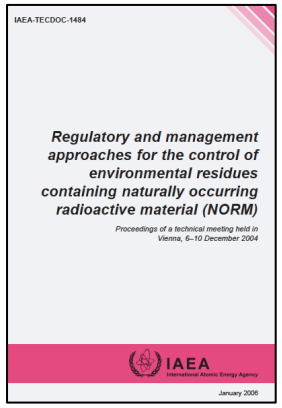


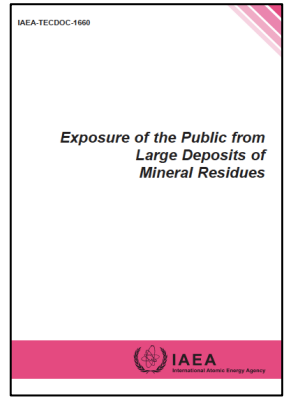


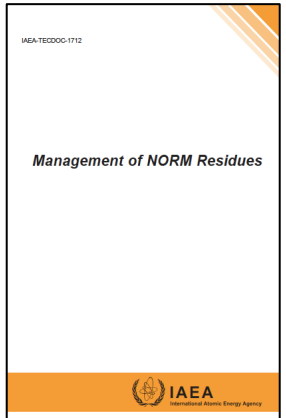


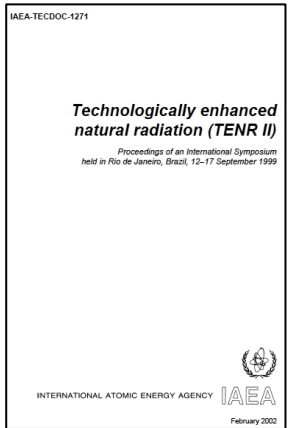


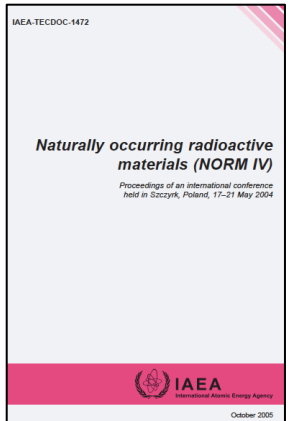


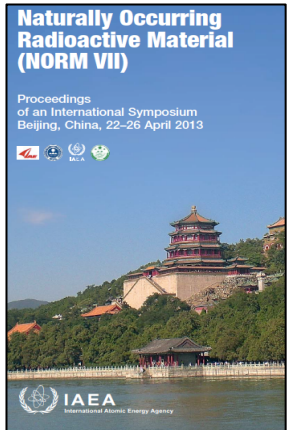


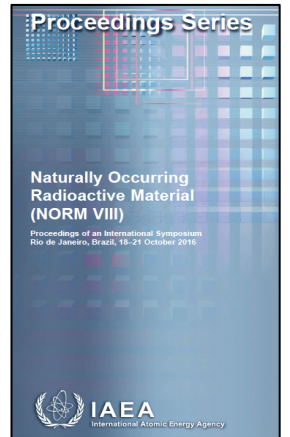












From late 2010's: Restrictions, Lack of Information

The emerging trend that is observed for some companies/industries dealing with NORM:

- Radiation monitoring data is provided only after a certain legislative pressure has been applied to a company and on a condition that a report or any other document is provided for the exclusive use of the regulator only,
- Almost no participation in national and international conferences, no published papers,
- Removing 'radiation-related' documents related to a product from the internet and relevant information from Safety Data Sheets (SDS).

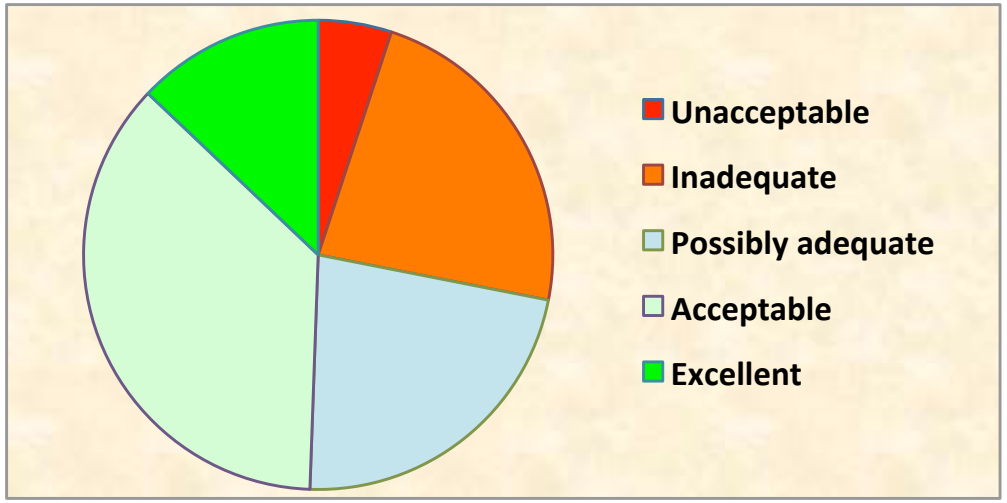
Quotes from the management of different companies recently:

- ~25 Bq/g of uranium: *"We are a member of an industry association, let them talk, we do not want our company's name to be publicly associated with anything radioactive"*.
- ~30 Bq/g of thorium, an actual situation at a community meeting:
  1. Company public relations manager, proudly: *"Our material is not radioactive at all"*.
  2. Member of the public: *"Really? Our Member of Parliament says it is"*.
  3. Company public relations manager (after consulting with the technical specialist), sheepishly: *"Ah, yes, it is actually radioactive, I've forgotten about that"*.

Restrictions of data: An Example of SDS

Reference: A Safety Data Sheet (SDS, formerly called Material Safety Data Sheet) is a detailed document prepared by the manufacturer or exporter/importer of a hazardous substance and describes the physical and chemical properties of the product, together with occupational health and environmental protection considerations.

Over 350 of Safety Data Sheets (SDS) for the materials that may or do contain NORM were analysed in 2019 in the course of work for the IAEA Coordinated Research Project on Improved Assessment of Initial Alarms from Radiation Detection Instruments.



Over 27% of these documents were found to be inadequate, out of which 5% were considered unacceptable, as the materials definitely contain detectable concentrations of NORM, but this information was intentionally or unintentionally omitted.

Restrictions for data: Examples of SDS changes

The comparison between SDS from the same companies at different times

Rare Earth concentrate

2012 SDS, developed by the company:
Considered to be **excellent**, contained detailed data for the concentrations of radionuclides and prediction of possible radiation exposures.

2018 SDS, developed by the 'third party' provider:
Considered to be **inadequate**, the detailed data for NORM concentrations was replaced with the "<" sign and all considerations of possible radiation exposures were deleted.

Zircon

2008 SDS, developed by the company:
Considered to be **excellent**, contained detailed data for the concentrations of radionuclides and prediction of possible radiation exposures.

2018 SDS, developed by the 'third party' provider:
Considered to be **unacceptable**, all information on NORM and even the mentioning of radioactivity has been removed from the document.

Another Example – The SDS for Ceramics

The absence of any radiation-related data in the SDS for certain types of ceramics cannot possibly be explained rationally. The annual summary of border alarms from one of the EU countries illustrates the situation.

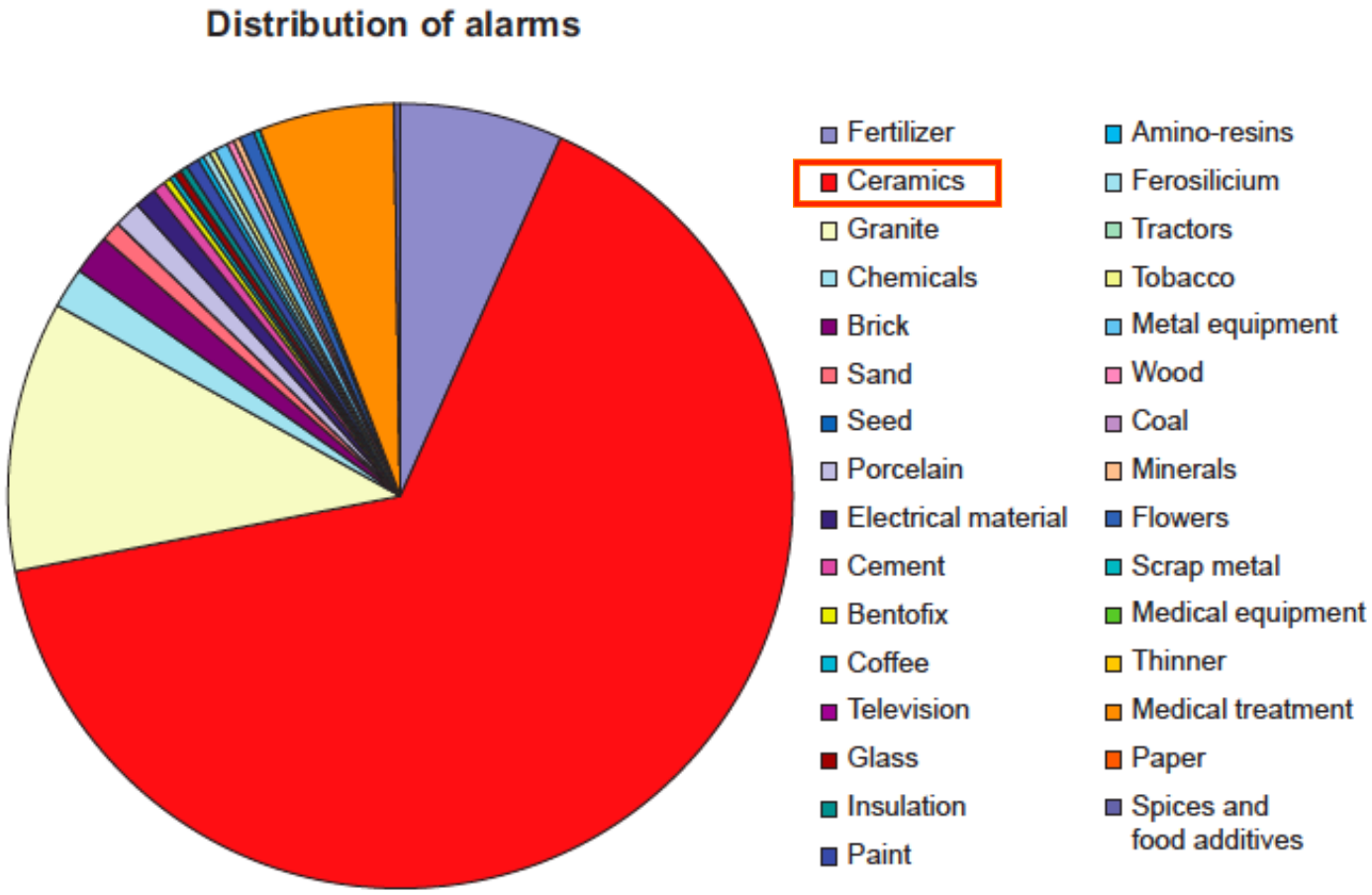


FIG. 1. Distribution of alarms according to commodity type.

Restrictions: There are no Plausible Reasons

This trend is inexplicable, taking into account the use of radiation control equipment at all ports and border crossings, where the gamma radiation readings or gamma spectrometry data can be easily clarified, if necessary, by referring to the SDS that is accompanying every shipment.

The problem is exacerbated by almost complete absence of interest from the industry in the regulatory developments, in contrast to the period prior to mid-2010's:

- In 2015 the possible implications of new transport regulations were communicated to the industry with no response;
- Three months ago the need for the decrease in the exemption factor for bulk NORM shipments was communicated, but there was zero response to this as well – despite the fact that a significant proportion of bulk NORM shipments may become classified as "Dangerous Goods Class 7 – Radioactive" across the world in not so distant future;
- Despite a very substantial promotion of this Conference to the industry, a brief assessment of the abstracts received indicated that less than 5% of them actually came directly from the industry personnel, with over 80% being from government departments and associated research institutions.

Restrictions: There are no Plausible Reasons

This lack of interest has so far resulted in:

- The ‘quarantine’ of numerous NORM shipments for months at different locations around the world, due to the lack of necessary information about NORM in the transport documentation – particularly the analyses for radionuclides other than uranium and thorium;
- The return of some mineral shipments to the point of origin, as the required information was not provided by a company on time; in one case due to the need to obtain several approvals from the multi-level corporate structure for the release of the documents that were deemed ‘confidential’.

It should be noted that some industry associations (i.e. zirconium and tantalum/niobium) are very well aware of the relevant issues and are encouraging their member companies to be open and responsible – the issue is with the individual companies that may not be a part of these or other industry groups.

For example, it cannot be explained why some SDS for tungsten electrodes containing up to 170 Bq/g of ^{232}Th do not mention ‘radioactivity’ or ‘thorium’ at all.

Possible Reasons for the Recent Trend

Possible reasons for recent trend could be summarised as follows:

a) Intentional (possible): to minimise the possibility of the 'denial of shipment' events and excessive costs of shipping of a material that may be deemed "radioactive" by a shipping line / transport company;

b) Unintentional (very likely): outsourcing the development of SDS documents to the "third party providers", which have little or no understanding of radioactivity and NORM and then issuing the developed SDS documents without a detailed assessment.

And, importantly:

c) A generational change in the management of some of the companies;

d) A change in employment practices.

Possible Reasons for the Recent Trend

The generational change may be a primary cause, as people over 65 are leaving and are being gradually but steadily replaced with the 50+ generation people who, in many (but not all) cases:

1. Have no idea and/or interest of what was the situation before (*"old geezers rubbish, no one's interested now"*);
2. Almost exclusively non-technical people: lawyers, financiers, etc. (there is frequently a question *"are we going to make any profit or loss from this"* and a point *"we will not spend anything above minimum required compliance"*);
3. Often afraid of making the decisions, resulting in endless and pointless meetings;
4. Typically do not read anything above 256 characters (*"too many letters, explain this in one sentence, I only have a minute"*);
5. More concerned with the company image in the media than with the compliance with duty of care towards the safety of the public. Before it was, quite correctly, '*safety above production*'. The recent trend is for '*virtue signalling above production*', '*employee wellbeing and work/life balance above production*'… Very soon every worker will require 2-3 days of stress leave after his football team loses, if that trend continues…

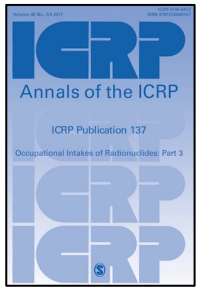
Possible Reasons for the Recent Trend

Another apparent cause is the change in employment practices. Some companies (and government departments as well) would not employ a person in a managerial position that has the best skills for the job. Instead the person must be of the proper "*background*" to "*create a correct balance in the workplace*". The actual consequences of this change at mining and processing sites:

1. Safety manager with zero knowledge of occupational hygiene: almost complete hearing loss of over a dozen workers;
2. Project manager with only a rudimentary understanding of the local language: fatal accident;
3. Radiation safety officer with the 'X-ray background': overexposure of workers to dust and radon;
4. HR manager visibly favouring workers from her ethnic background: tribal riot and destruction of property on a mine site;
5. Mining engineer who cannot drive a vehicle with manual transmission and, thus, not able to travel by himself on a mine site: serious accident (wall slip) in the mining pit;
6. Underground works manager afraid/unwilling of going underground: several serious injuries;
7. Environmental manager with no understanding of NORM: large areas outside site boundaries became "radiologically contaminated".

The need to lower the exemption factor of 10

IAEA TECDOC-1728, 2013: Based on ten reports, exemption factor of 10 (§107(f) of IAEA SSR-6) was appropriate for NORM shipments.



ICRP Publication 137, 2017: The dose coefficients for NORM dusts and ^{222}Rn doubled, for ^{220}Rn – tripled.

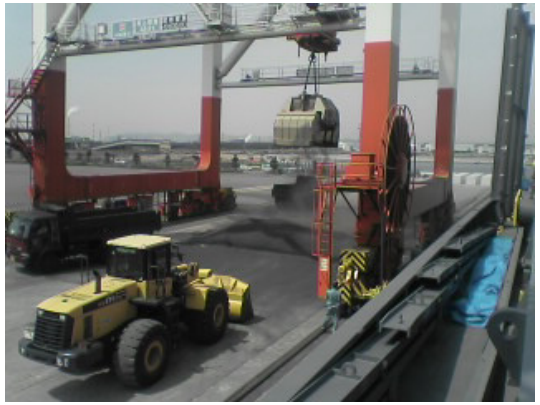
All reports on which the TECDOC-1728 was based were re-assessed using new ICRP dose coefficients. For the transport workers not to be "occupationally exposed" (doses over 1 mSv/year):

- The factor of 10 is still valid for packaged NORM (drums, containers) and may be increased to 15 or 20;
- The correct factor for the bulk NORM shipments is between 6 and 7. Taking into account §I.2 of the Schedule I of the IAEA Basic Safety Standards on the exemption, the correct factor is **5** ("*To take into account low probability scenarios, …the effective dose expected to be incurred by any individual for such low probability scenarios does not exceed 1 mSv in a year*").

The need to lower the exemption factor of 10

Examples of relatively high internal exposures (dust, ^{222}Rn, ^{220}Rn):

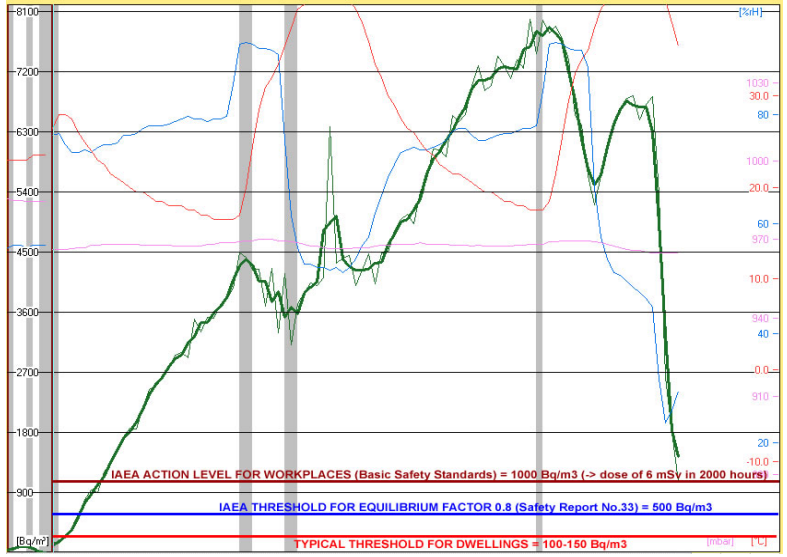
Unloading of bulk minerals



Cargo hold cleaning

^{222}Rn issue:

^{238}U and ^{226}Ra contained in minerals may cause significant concentrations of radon inside the sealed shipping containers and in the hulls of ships when minerals are transported in bulk or in bags, up to and above 10,000 Bq/m^3 of ^{222}Rn.



The need to lower the exemption factor of 10

If the conclusion of lowering the NORM exemption factor from 10 to 5 is confirmed by more research and theoretical assessments (if there will be no serious effort in the industry to make actual measurements), there are two suggestions of how this change may be accommodated in the subsequent edition of the IAEA SSR-6:

1. Make a clear distinction between “bulk” and “packaged” NORM and have the factor of 5 apply to the former and 15 to the latter; or
2. Apply the factor of 5 (using the sum of ^{238}U and ^{232}Th) to bulk NORM, but relax the factor for packaged NORM: use the factor of 10 to <u>each</u> decay chain <u>separately</u> (i.e. if ^{238}U is ~8 Bq/g and ^{232}Th is ~9 Bq/g, the material will still be exempt, as none of two values is above 10).

Suggested Solutions

1. Industry should be encouraged to share the relevant data and undertake more research into actual exposures of workers in the process of NORM transport. Good examples are zirconium and tantalum/niobium associations that have developed specific ‘NORM transport’ guidance and template SDS documents and it will be good if other industries will follow.
2. Regulators should pay more attention to attending not the radiation conferences, but the industry ones. An excellent example is the lecture from the IAEA Occupational Radiation Protection Section at the zirconium industry conference in 2018.

Additional Suggestion for the Industry

Make sure that radiation safety personnel is fully qualified and management is completely aware of NORM-related issues, otherwise the following is a frequent result:

Additional Suggestion for the Regulators

Set the limits/thresholds for the minerals industry and leave it to the industry itself to develop technical systems to meet these standards in specific circumstances.

<u>BUT</u>:

Always check if the establish systems are appropriate and are in compliance with relevant legislative documents, without over-regulation of the same activity by numerous departments (which very often do not communicate with each other)…

Thank you for your attention!

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35 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 80 IAEA meetings, missions and assignments).

A Member of the Radiological Council of Western Australia 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, Senegal, Singapore, South Africa, Spain, Sri Lanka, Syria, Tajikistan, Tanzania, UAE, Ukraine, USA, Zambia.

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