Alberta Government

Management of Naturally Occurring Radioactive Materials (NORM) in Western Canada

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&

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Presentation Outline

- NORM basics
- Regulatory frameworks
- Worker protection
- NORM surveys and analysis
- NORM Management and Radiation Protection Programs
- NORM waste disposal

What is NORM?

- NORM - radioactive elements found in the environment
- Primordial - these elements have always been present in the earth's crust and within the tissues of all living beings
- The concentration of NORM in most natural substances is low, but higher concentrations may arise as the result of human activities - Technologically Enhanced NORM - TENORM
- Special precautions may be needed for handling, storing, transporting, and disposal

Sources of NORM

- **Oil and Gas Production**
  - **trace quantities of NORM may be found in hydrocarbon bearing geological formations**
- **Fertilizer Production**
  - **trace amounts of NORM may be released from the mineral bearing rock and concentrated in the phosphogypsum waste**
- **Mining and Ore Processing**
  - **NORM may be released or concentrated in a process stream during the processing of ore**

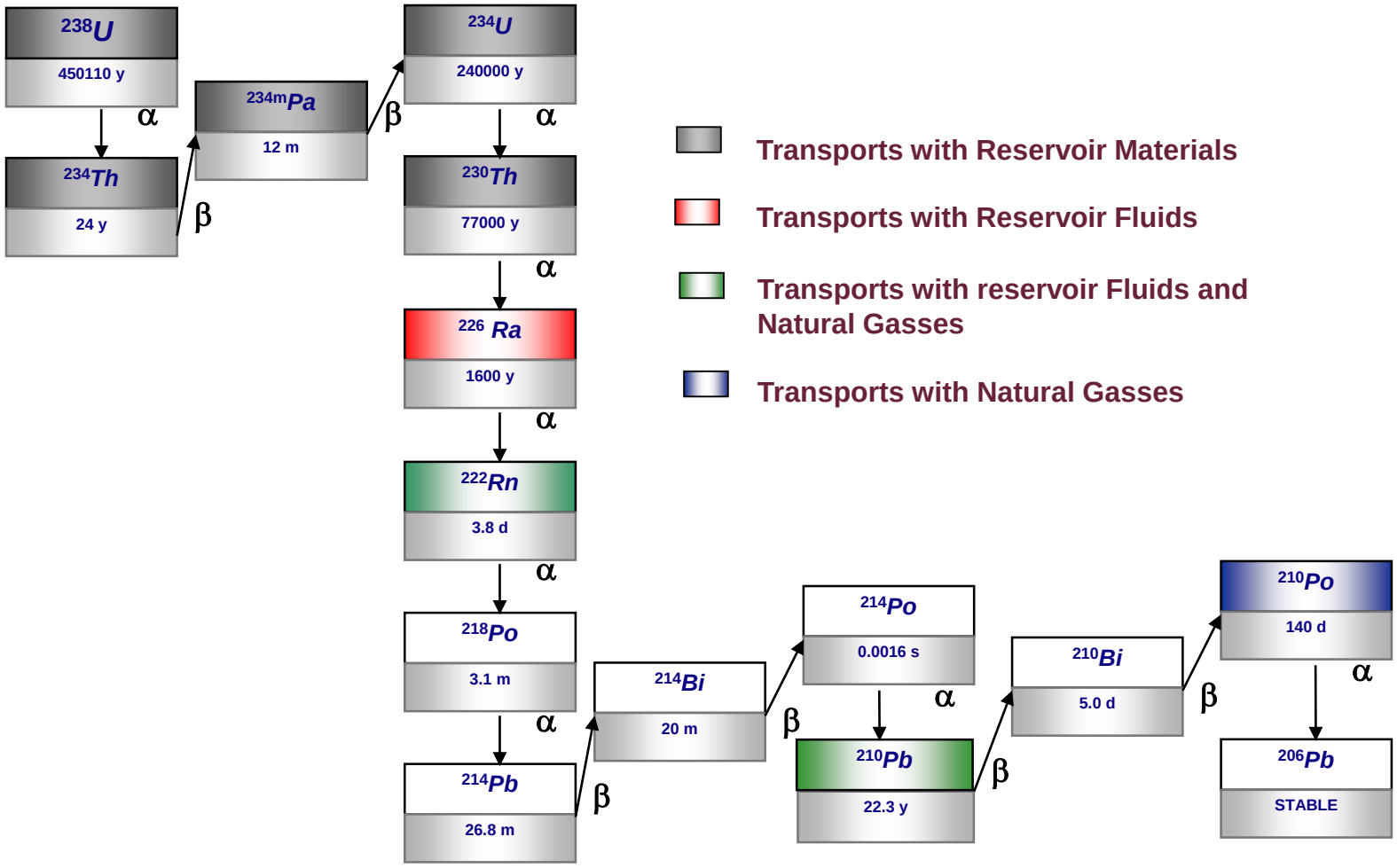
Sources of NORM

- **Metal Recycling**
  - **NORM-contaminated materials can be redistributed to new NORM-contaminated products**
- **Water Treatment Facilities**
  - **Buildup of NORM on sorptive media or ion-exchange resins used to remove minerals and other impurities from the water being treated**
- **Fish Hatcheries**
  - **Radon is released from water aeration**

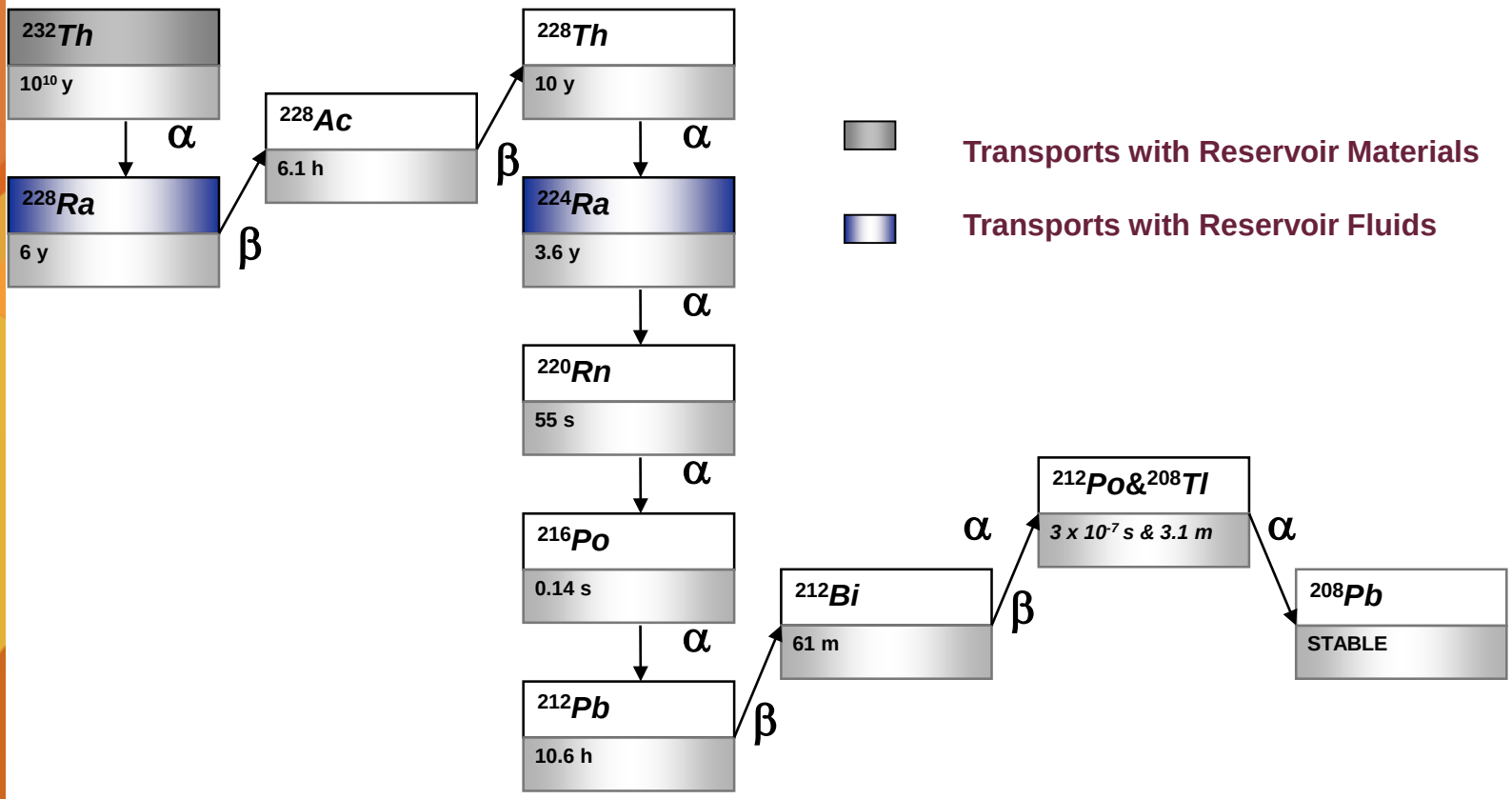
Sources of NORM

- **Forest Product Combustion and Thermal Electric Production**
  - **Mineral ashes left from combustion may concentrate small amounts of NORM naturally found in plant materials and in coal**
- **Tunneling and Underground Workings**
  - **Areas where small amounts of indigenous radioactive minerals or gases may be present**
- **Ceramics**
  - **Small amounts of indigenous radioactive minerals incorporated into the ceramic**

Uranium Decay Series



Thorium Decay Series



Differences between isotopes found in different industries

NORM prominently found in oil production

Radium-226 (Ra-226)	1600 yrs	Strong alpha, weak gamma
Radium-228 (Ra-228)	5.7 yrs	Strong beta
Thorium-228 (Th-228)	1.9 yrs	Strong alpha, weak gamma

NORM prominently found in gas production

Radon 222 (Rn-222)	3.8 days	Strong alpha, weak gamma
Lead 210 (Pb-210)	22.3 yrs	Med beta, weak gamma
Polonium 210 (Po-210)	183 days	Strong alpha

Sources of NORM

- **Oil Production**

  - Radium-226 dissolved in “produced water”

  - Concentrates as scale on inside of downhole process equipment e.g. tubulars, pumps and as sludge in surface storage tanks

  - Concentrations of NORM deposits can vary from 0.05 Bq/g to in excess of 1000 Bq/g

Sources of NORM

- Gas Production

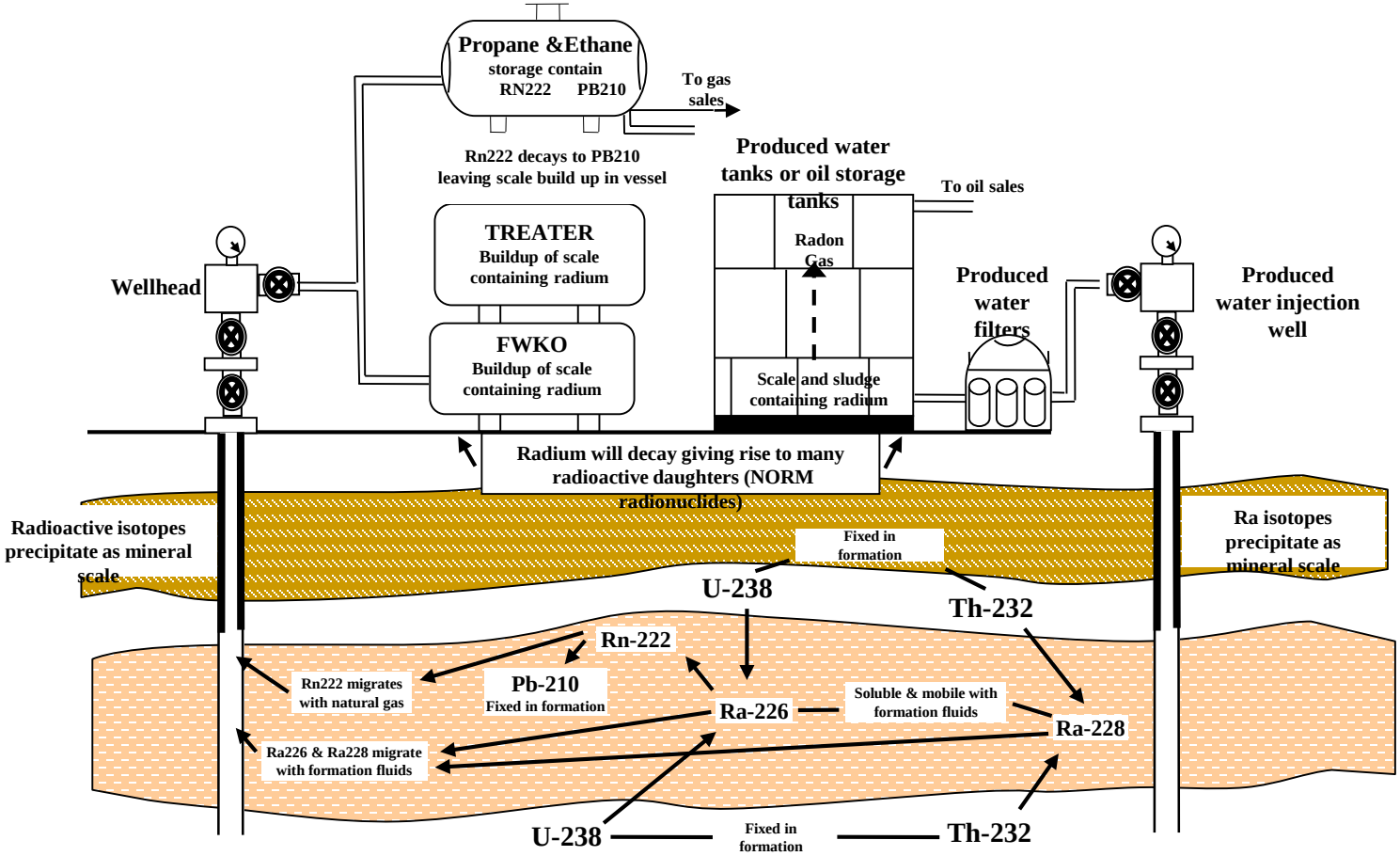
  - Radon-222 in natural gas - concentrates in the propane and ethane gas streams

  - Radon decays to Lead-210($T_{1/2}$= 22.3 years) – an exposure concern

  - Forms a thin film on inside of gas processing equipment, enclosed filtration systems or gas storage vessels

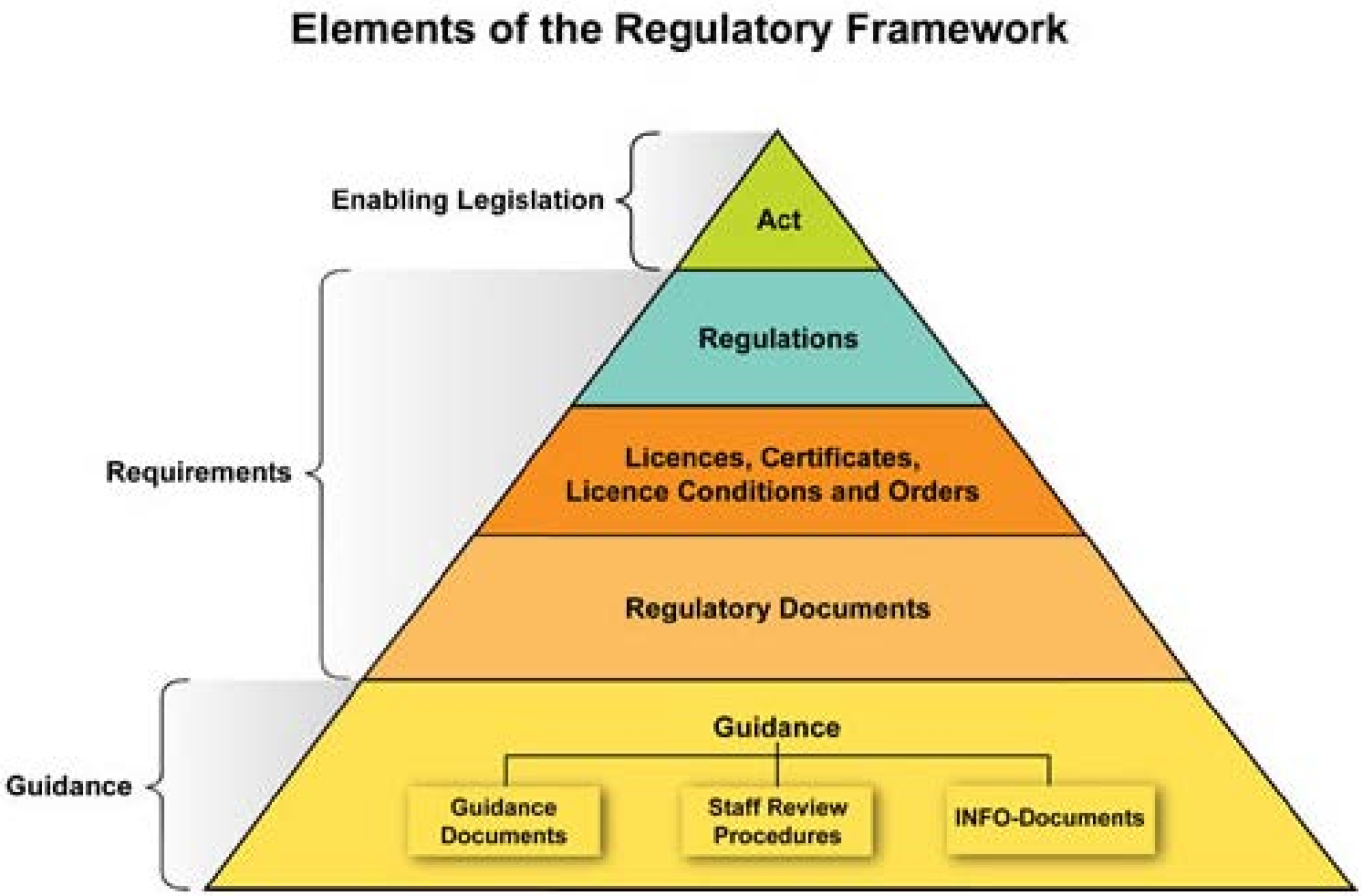
  - Radon-222 in natural gas - 0.37 to 4.0 Bq/g

NORM Formation in Oil & Gas Production



THE ORIGIN OF NORM

Regulatory Framework



Canadian NORM Guidelines

- ***Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM)*** **- Revised 2011**

  www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/norm-mrn/index-eng.php

- ***Guidelines for the Handling of Naturally Occurring Radioactive Materials (NORM) in Western Canada*** **- 1995**

  $35 + GST - (780) 427-2688

Canadian NORM Guidelines

Exposures:

- **Maximum exposure to members of the public or incidentally exposed workers is 1.0 mSv/a**
- **Implementation of Dose Constraint from single source or planned operation of 0.3 mSv/a**
- **Maximum exposure to occupationally exposed workers is 20 mSv/a**

Canadian NORM Guidelines

- Provides the basis for employers and regulators to develop more formal policies and procedures
- Provides NORM Management Program options based on assessed incremental dose:
  - NORM Management (< 1 mSv/a)
  - Dose Management (1 - 5 mSv/a)
  - Radiation Protection Management (>5 mSv/a)
- Provides Unconditional Derived Release Limits (UDRLs) for Diffuse NORM, Discrete NORM and NORM Surface Contaminated Objects that, in its final disposition, will not contribute a dose to an individual that is greater than 0.3 mSv/a

Regulatory Framework in Alberta

- **Radiation Protection Act**
  - **Radiation Protection Regulation**
    Alberta Regulation 182/2003

- **Occupational Health and Safety Act**
  - **Occupational Health and Safety Code (2009)**

http://work.alberta.ca/occupational-health-safety/12615.html

Alberta Labour

- **Radiation Protection Act**
  - **Inform workers of potential hazards of radiation and precautions to be taken**
  - **Use of “competent workers”**

- **Radiation Protection Regulation**
  - **ICRP 60 annual dose limits**
    - **Worker - 50 mSv - Maximum 100 mSv/ 5-year**
    - **Member of the public - 1 mSv**

Alberta Labour
Occupational Health and Safety Code

Part 2 - Hazard Assessment, Elimination & Control

(7) Hazard Assessment
- Written & dated report
- Repeated periodically

(8) Worker Participation
- Involve affected workers
- Inform affected workers of hazards & methods used to control or eliminate the hazards

(9) Hazard Elimination and Control
- Engineering controls
- Administrative controls
- PPE

Alberta Labour
Occupational Health and Safety Code

Part 20 - Radiation Exposure

If workers may be exposed to ionizing radiation at a work site, an employer must:

(a) develop and implement safe work practices and procedures

(b) involve the workers in (a), if practicable

(c) inform the workers of the potential hazards of ionizing radiation and the radiation source

BC Radiation Protection Regulations

- **Occupational Health and Safety (OHS) Regulations (WorkSafe BC) have jurisdiction of exposures to NORM for workers and members of the public**

  https://www.worksafebc.com/en/law-policy/occupational-health-safety/occupational-health-safety-regulation

- **Radioactive Waste falls under the jurisdiction of the Ministry of Environment through the BC Waste Discharge Regulations**

  http://www.bclaws.ca/civix/document/id/complete/statreg/320_2004

BC OHS Regulations for Controlling Radiation Exposure

5.53 Workplace Monitoring

- If a walk through survey reveals that a worker may be at risk of overexposure to an airborne contaminant, the employer must ensure that air sampling is conducted to assess the potential for overexposure

5.54 & 7.20 Exposure Control Plan

- If a worker exceeds or may exceed an ionizing radiation action level the employer must develop and implement an exposure control plan

BC OHS Regulations Controlling Radiation Exposure

7.19 Exposure Limits

- A worker's exposure to ionizing radiation must not exceed an annual effective dose of 20 mSv
- The employer must ensure that the exposure of workers to ionizing radiation is kept as low as reasonably achievable below the exposure limits

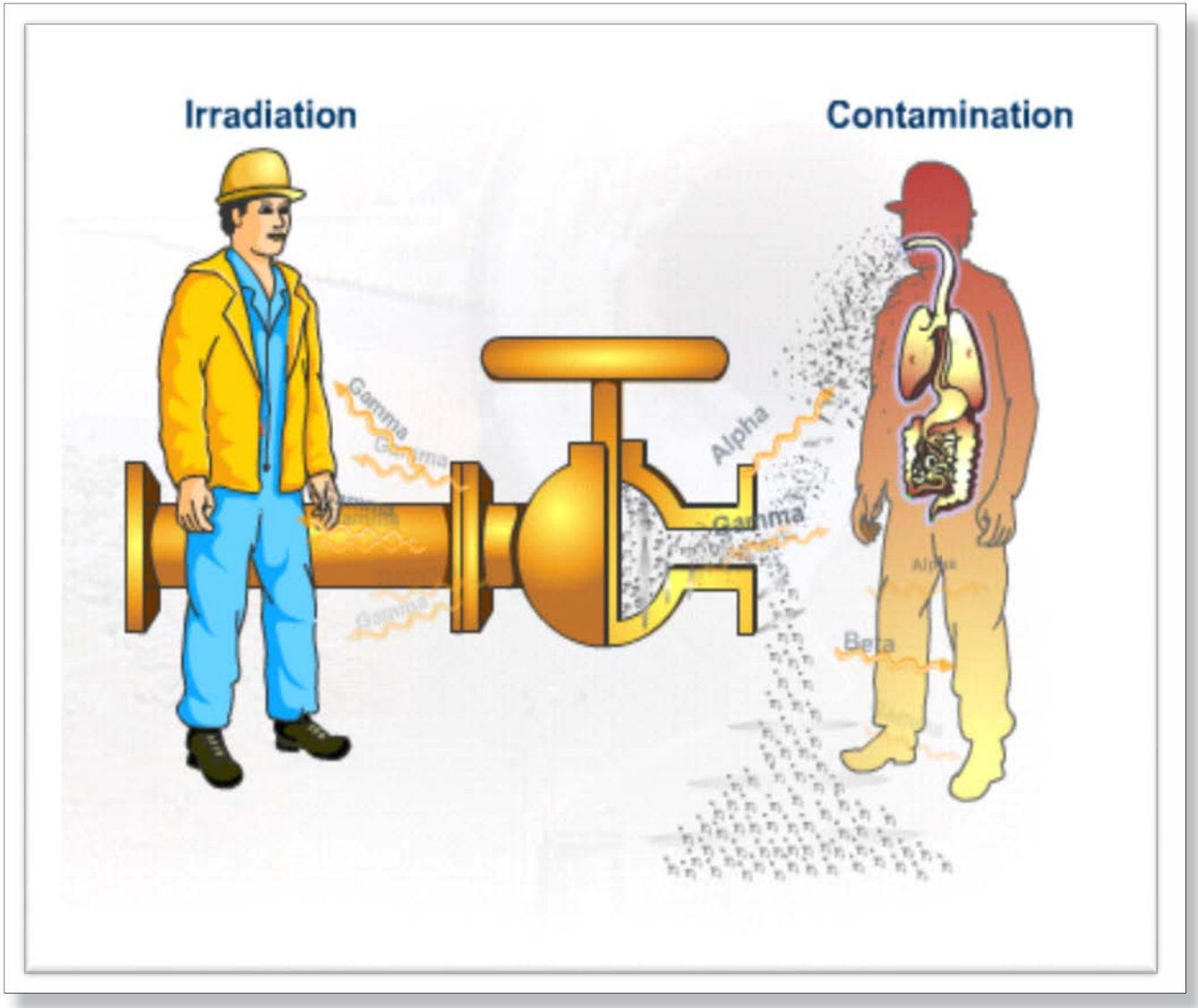
7.25 Record Keeping

- Maintain records of radiation surveys, exposure monitoring and personal dosimetry data for a period of 10 years

Worker Protection
Three Key Facts

- Exposures to NORM are low level
- Control the conventional hazards and NORM hazards are controlled in most situations
- NORM is a larger internal hazard than external hazard

Exposure Pathways



Worker Protection - Internal Exposure

Eliminating the pathway eliminates the risk

NORM Handling & Occupational Safety Requirements

- Employ proper personal hygiene practices:

- Do not eat, drink, or smoke in NORM-contaminated work areas

- Designate a “NORM hygiene area” for washing before eating and drinking, and

- Remove NORM-contaminated clothing before leaving NORM-contaminated work areas

NORM Handling & Occupational Safety Requirements

- Use appropriate personal protective equipment (PPE):

- Hooded disposable coveralls or nonporous rain suits

- Rubber or other nonporous protective footwear

- Disposable or nonporous gloves

- Respirators with appropriate NIOSH approved cartridge filters (such as P-100 HEPA)

- Protective eyewear (e.g. goggles in high dust areas)

NORM Handling & Occupational Safety Requirements

- **Institute safe work and handling procedures:**

- **Minimize operations such as cutting, grinding, and polishing to reduce airborne dusts**

- **Keep contaminated materials damp (if materials are too wet, the result is an increased volume of low-activity contaminated water)**

- **Monitor personnel and equipment for contamination before leaving the controlled area**

NORM Handling & Occupational Safety Requirements

- **Institute safe work and handling procedures:**

- **Minimize the amount of time spent in NORM-contaminated work areas and NORM storage areas**

- **Undertake radiation surveys of NORM-contaminated work areas and NORM storage areas to evaluate radiation doses to personnel**

- **Develop procedures to monitor the worksite and limit worker exposure to NORM**

NORM Handling & Occupational Safety Requirements

- **Practice good housekeeping to minimize NORM contamination:**

- **Do not use compressed air or dry sweeping to clean up NORM-contaminated areas - use wet sweeping, wash down, or HEPA filter vacuuming**

- **Use temporary heavy-duty tarpaulin covers where NORM contaminated material may be deposited on the ground, or work on curbed concrete or pavement.**

NORM Handling & Occupational Safety Requirements

- Use appropriate signage to restrict access for incidentally exposed workers to limit exposures to less than 1 mSv/a
- Institute a radiation dose estimate program if worker exposure is expected to be between 1 and 5 mSv/a.
- Institute external monitoring for workers expected to receive more than 5 mSv/a effective dose (workers directly involved with NORM landfill operations, preparation and disposal of tubulars or preparation of waste slurry).

Worker Training

- Key to controlling worker exposures to NORM
- Training Providers:

- Enform: www.enform.ca
  - NORM awareness e-learning course (on-line)
  - One-day worker level NORM safety course

- www.carswell.com (search for “radioactive”)
  - Series of four (4) training manuals for the oil & gas industry

- Radiation Safety Consultants:
  - e.g. ALARA Consultants - One-day NORM training - monthly basis

Radiation Protection Programs

- Radiation protection programs are key top ensuring worker protection
- OH&S regulations require employers whom subject workers to a hazardous substance to develop safe work practices (Radiation Protection Programs).
- The CNSC requires shippers have a radiation safety program in place and requires they ensure transporters and receivers also have a radiation safety program in place.
- Canadian NORM Guidelines provides NORM management classifications based of derived working limits.

Derived Working Limits

NORM CLASSIFICATION	THRESHOLD DOSE mSv/a	DERIVED WORKING LIMIT - (above background)	THRESHOLD REQUIREMENTS
Investigation Threshold	**< 0.3 mSv/a**	**<150 nSv/hr**	**- Public and worker access unrestricted**
NORM Management Threshold and Classification	**> 0.3 mSv/a to 1.0 mSv/a**	**>150 nSv/hr**	**- Public access restricted and incidentally exposed worker access unrestricted**
Dose Management Threshold and Classification	**> 1.0 mSv/a to 5.0 mSv/a**	**>500 nSv/hr**	**- Incidentally exposed worker access restricted - Introduce formal dose management program. -Reporting of worker doses to national Dose Registry recommended.**
Radiation Protection Threshold and Classification	**>5.0 mSv/a to 20 mSv/a**	**N/A**	**- Worker dosage measurement required through national Dose Registry. - Maximum allowable dose is 20mSv/a**

Key Elements of a Radiation Protection Program

- Management control over work practices including supervisory requirements to ensure radiation protection plans are developed and implemented.
- Worker qualifications and training.
- Control of occupational and public exposure to radiation.
- External gamma radiation monitoring and protection requirements.
- Air contamination monitoring requirements.
- Radon Gas testing and monitoring requirements.
- Contamination monitoring and control.
- Environmental monitoring and controls.
- Waste management controls.
- Record keeping.

NORM Management

The first step of NORM management is conducting monitoring of the workplace as required by OHS Regulations. Employers in NORM industries should ensure that:

- **a walkthrough survey is conducted to assess the potential for overexposure taking into account all routes of exposure, including inhalation and ingestion, and**
- **re-assessment is conducted when there is a change in work conditions which may increase the exposure, such as a change in production rate, process or equipment.**

Monitoring Workplaces

Monitoring workplaces for NORM include:

- Gamma radiation Screening Survey
- Radiation Dose Rate Assessments
- Contamination Surveys
- Radon Gas Monitoring
- Low Level Radioactive Dust Monitoring (LLRD)
- Radiochemical Analysis

Gamma Radiation Screening Surveys

- Gamma Screening Surveys – Used to verify if NORM has been concentrated in the workplace.
- Action level is a definitive reading above background. This indicates the waste in process equipment exceeds the CNG unrestricted derived release limits.
- Issues – Some NORM radionuclides do not have a detectable Gamma signature (Pb210) and waste volumes must be sufficient for detection otherwise false negative result obtained.

Radiation Dose Rate Surveys

- Dose rate Surveys are used verify worker exposure to gamma radiation. Readings greater than 0.15 µSv/hr indicate the potential to exceed the dose constraint limit of 0.3 mSv/a (0.15 µSv/hr X 2000 hrs = 0.3 mSv/a
- Gamma Dose rates have been identified as high as 450 µSv/hr. Dose rates of 20 µSv/hr are not uncommon.
- In most cases workers typically do not spend enough time around the equipment with these dose rates and exposures do not exceed 1 mSv/a.

Contamination Surveys

- **Contamination surveys are regularly completed by NORM industries. Industries such as Oil and Gas concentrate Pb210 in process equipment and contamination surveys are the only reliable method of determining if equipment is contamination.**

Radon Gas Monitoring

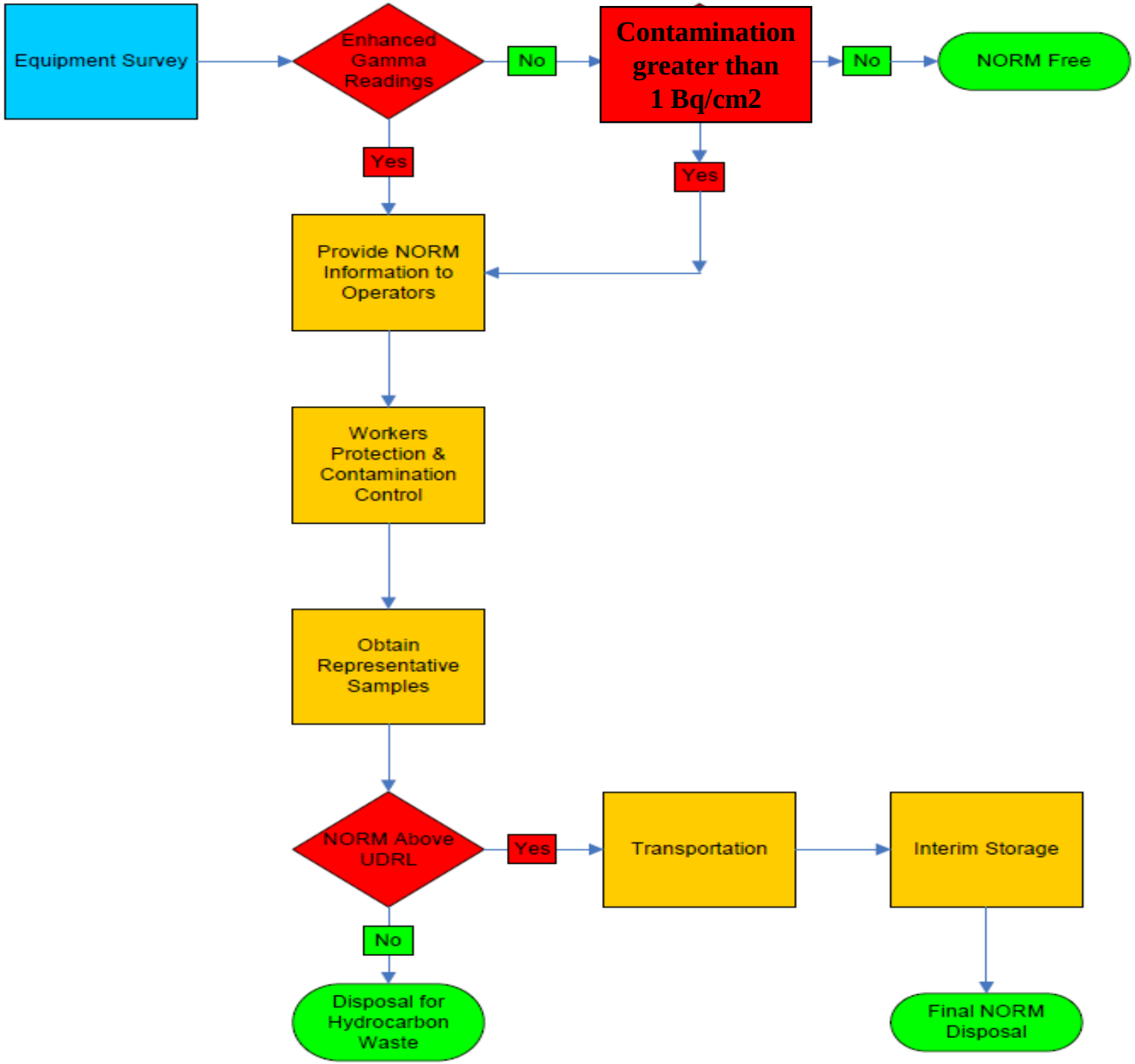
- Radon Gas monitoring needs to be conducted by NORM industries that concentrate Radium Scales or sludge's or handle natural gas.
- Higher levels of radon gas have been found within buildings and in ponds where open radium scales and sludge's or natural gas handling equipment is contained.
- Typically levels do not exceed Health Canada's recommended limits.

Low Level Radioactive Dust Monitoring

- Numerous activities within NORM industries can create low level radioactive dust to enter the air.
- Monitoring allows for determination of exposures to workers in the event of PPE malfunction and verifies if activities cause airborne contamination.

Radiochemical Analysis

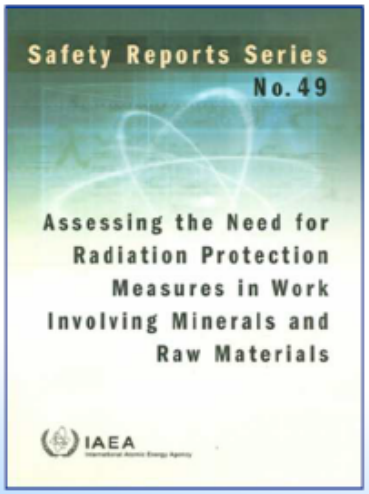
- A radiochemical analysis is required prior to disposal of NORM.
- Several analytical methods are used for determining the activity of different isotopes.
- Gamma Spectroscopy is typically used for Radium 226, Radium 228, Thorium 228 and Lead 210.
- Mass Spectroscopy (ICP-MS) is typically used for Uranium 238 and Thorium 232


Equipment Survey
Enhanced Gamma Readings
No
Contamination greater than 1 Bq/cm2
No
NORM Free
Yes
Yes
Provide NORM Information to Operators
Workers Protection & Contamination Control
Obtain Representative Samples
NORM Above UDRL
Yes
Transportation
Interim Storage
No
Disposal for Hydrocarbon Waste
Final NORM Disposal

WORK of the IAEA

Typical industries

- Uranium mining and processing
- Rare earths extraction
- Thorium extraction & use
- Niobium extraction
- Non-U mining – incl. radon
- Oil and gas
- Production and use of TiO2
- Phosphate Industry
- Zircon & zirconia
- Metals production (Sn, Cu, Al, Fe, Zn, Pb)
- Burning of coal etc.
- Water treatment



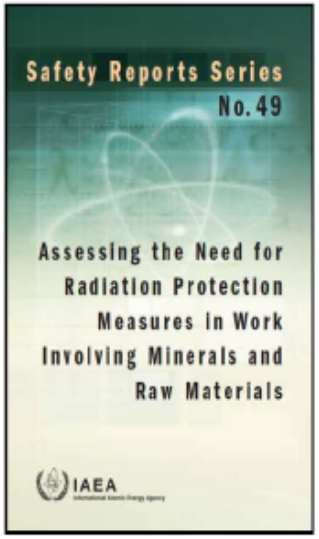
IAEA guidance

- Oil and gas industry – Safety Report No.34, 2003
- Zircon and zirconia industries – No.51, 2006
- Rare earths industry – No. 68, 2011
- Titanium Dioxide and Related Industries - No. 76, 2012
- Phosphate industry – No.78, 2013
- Uranium mining & processing, Coal and Coal Ash industry and RP and NORM Residue Management in the Industrial Uses of Thorium – advanced stage of preparation.

- NORM IV, NORM V, NORM VI and NORM VII Symposia – IAEA Proceedings series
- Publications on Exposure to Radiation from Natural Sources (**https://www-ns.iaea.org/publications/norm-publications.asp**)
- Training course series No.40 – Oil and gas industries.

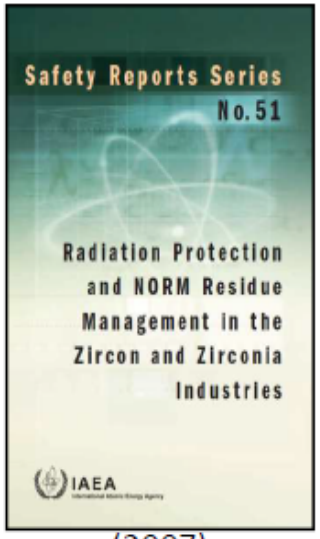
WORK of the IAEA

Safety Reports Series 49 addresses the question under what circumstances does it become necessary to regulate?



(2006)

The characteristics of NORM and the implications for their management are specific to the industrial process.



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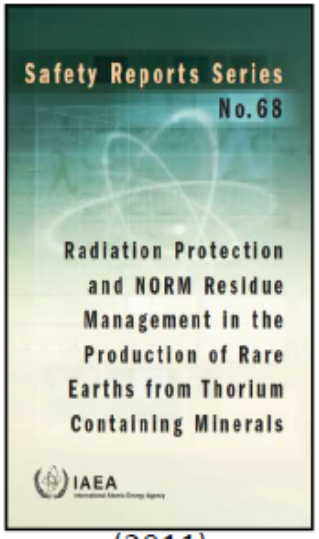

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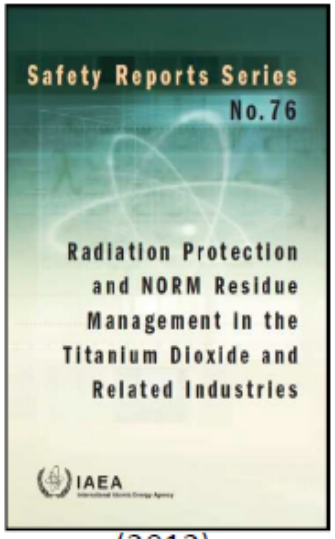

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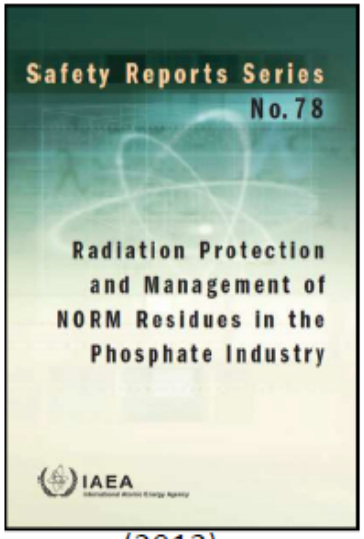

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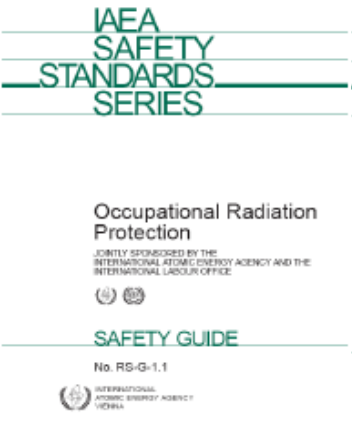
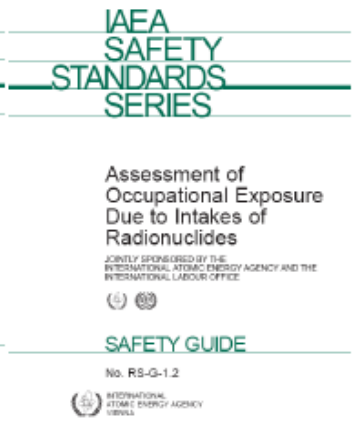
WORK of the IAEA - ORP

RS-G-1.1



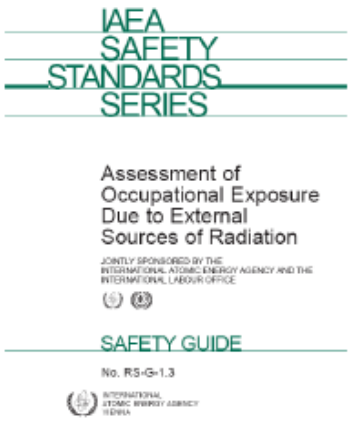
1999

RS-G-1.2



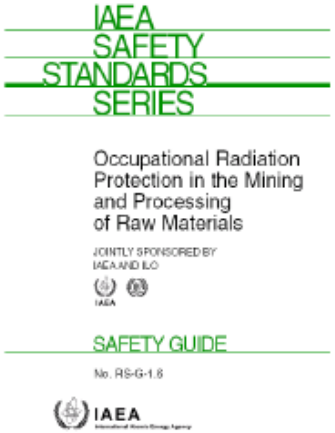
1999

RS-G-1.3



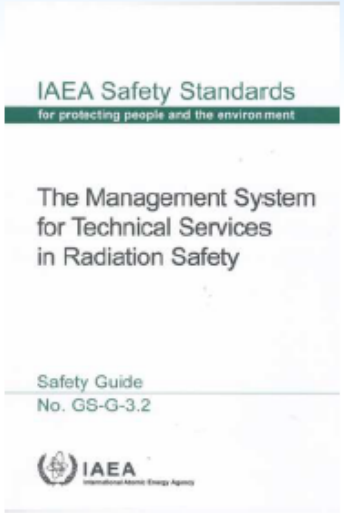
1999

RS-G-1.6



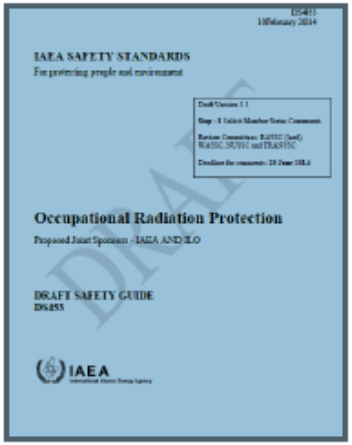
2004

GS-G-3.2



2008

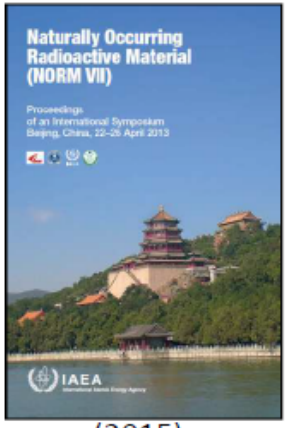
- Co-sponsored by IAEA and ILO
- Specific to NORM industries
- Guidance on:
  - Regulatory approach
  - Dose calculations
  - Radiation protection programme



DS 453-Combine, revise and supersede five safety guides

Work of the IAEA

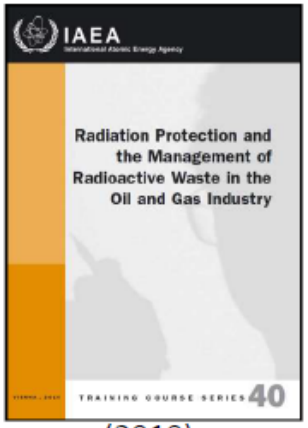
The NORM VIII symposia – Rio de Janeiro, Brazil, 18-21 Oct 2016.



(2015)

(2011)

The Agency also develops many topical reports on aspects of NORM Management



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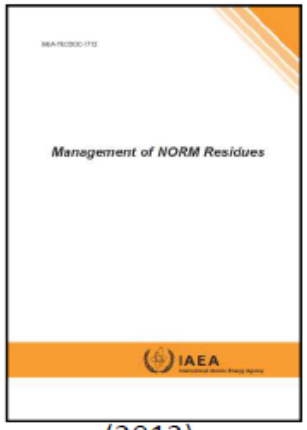

(2013)

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NORM Waste Management

The international Atomic Energy Agency (IAEA) recommends management of radioactive waste occur at the point of generation by:

- **Separating long lived radionuclides (+30 year half life) from short lived radionuclides if possible.**
- **Separating high concentrations of short lived and long lived radionuclides.**
- **Separating waste based on physical form (Liquids vs. Solids) as disposal options are different.**

NORM Waste Classification

The international Atomic Energy Agency (IAEA) has 6 classifications of radioactive waste. Three of which pertain to NORM:

- **Very Low Level Waste (VLLW)**
- **Low Level Waste (LLW)**
- **Intermediate Level Waste (ILW)**

Very Low Level Waste

- Very Low level waste is waste above the unrestricted release limits but contains low levels of radioactive materials which are suitable for landfill disposal. Includes items such as soil and rubble.
- VLLW contains very limited amounts of long lived radionuclides (half-life greater than 30 years).
- Saskatchewan allows disposal of VLLW up to 1 Bq/g in its landfills.

Low Level Waste

- Low level waste are also waste above the unrestricted release limits but require longer periods of containment and are suitable for disposal in engineered industrial or hazardous waste landfills.
- LLW contains higher concentrations of short lived radionuclides(less than 30 years), however, long lived radionuclides concentrations are generally limited (Less than 5 to10 Bq/g).
- Alberta and BC have approved hazardous waste landfills for NORM.

Low Level Waste

- Radioactive waste management is typically based off regulations and best practices.
- A best practice is that which member countries of the IAEA deem appropriate and typically follow. During the NORM VI symposium it was outlined what the member countries considered low activity waste and how they looked at disposal of NORM.

A reasonably clear picture emerged from the symposium regarding the most commonly used (and accepted) options for disposal of NORM waste, which can be summarized as follows:

(a) For large volumes of relatively low activity waste, such as mine tailings, the only two practicable options available were for it to be isolated in above ground, custom built containments such as tailings dams or to be diluted with non-radioactive soil or sand and returned into the remediated land form. The latter option is accepted practice for mineral sand tailings.

(b) Low and intermediate volumes of relatively high activity NORM waste such as pipe scale from the oil and gas industry and process residue from the extraction of rare earths and thorium were usually disposed of in one of three ways:

  (i) By emplacement in underground radioactive waste repositories such as that described in a presentation from Norway;

  (ii) By emplacement in shallow ground, engineered (usually concrete) structures such as those described in a paper from India.

  (iii) In the case of pipe scale from the oil and gas industry, by reinjection into the formation using a process known as 'slurry fracture injection'.

(c) Moderate volumes of NORM waste with low activity concentrations (but above the applicable exemption or clearance level) were increasingly being authorized for disposal in conventional disposal facilities for industrial or hazardous waste, such as landfill sites, sometimes with some additional, relatively simple protection measures being applied to cater for the radionuclide content. In all cases reported, the upper bound on the radionuclide activity concentration was being set at 10 times the exemption or clearance level (the actual or proposed value of which varied between countries — 1 Bq/g in Sweden and the Netherlands and 0.5 Bq/g in Norway). Thus the actual or proposed upper bound on activity concentration for this form of disposal was either 5 or 10 Bq/g.

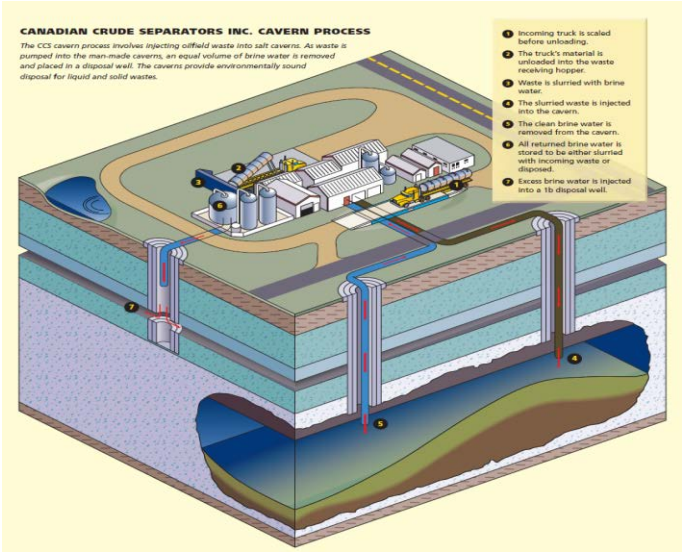
Intermediate Level Waste

- Intermediate level waste, because of its content, particularly of long lived waste requires greater isolation and containment than can be provided by hazardous waste landfills.
- Long lived radionuclides will not decay to an acceptable level of concentration for which institutional controls can be relied upon and required disposal at greater depths for isolation.
- Only Saskatchewan has two each have an approved geological disposal facilities (Salt Caverns).

Geological Disposal Facilities For NORM in Canada

Geological disposal into salt caverns is the preferred option for disposal of NORM impacted waste. Only 2 facilities are licensed to accept these materials.

- **Plains Environmental Melville Saskatchewan facility limits – 300 Bq/g per isotope**
- **Tervita Corporation Unity Saskatchewan facility limits 70 Ba/g total specific activity.**



Commercial Landfill Disposal of NORM in Canada

Two landfills have been licensed in Canada however they have not followed the recommendations of the IAEA and as such should generators review their disposal policies to these facilities or limit long lived radionuclides to 5-10 Bq/g?

- **Fort St. John Facility allows 70 Bq/g with the exception of Ra226 restricted to 5 Bq/g. Does not restrict long lived uranium and thorium isotopes.**

- **Pembina Area Landfill accepts up to 70 Bq/g but only restricts radium 226 to 55 Bq/g. It does restrict natural Uranium to 2 Bq/g and natural Thorium to 6 Bq/g but does not put any restrictions on Th230. Cannot accept TDG NORM.**

Waste Control Regulations

Canada Wide Accord on Environmental Harmonization

- On January 29, 1998, the Canadian Council of Ministers of the Environment (CCME) - with the exception of Quebec - signed the Canada-wide Accord on Environmental Harmonization, designed to lead to improved cooperation and better environmental protection across Canada.

- The Canada-wide Accord on Environmental Harmonization envisions governments working in partnership to achieve the highest level of environmental quality for all Canadians. Under the accord, each government will retain its existing authorities but will use them in a coordinated manner to achieve enhanced environmental results. Each government will undertake clearly defined responsibility for environmental performance and will report publicly on its results.

Waste Control Regulations

- Even though the Western Canadian NORM Guidelines were published in 1995 followed by the Canadian NORM Guidelines in October 2000 no Province or Territory has developed waste control regulations for NORM.
- Wastes are classified as Hazardous, Non-hazardous or radioactive.
- Ontario has included NORM as a hazardous waste even thought the definition of hazardous waste does not include radioactive, BC has not included NORM within its hazardous waste regulations but indicate it is a hazardous substance. Alberta Environment has defined NORM under 70 Bq/g as non-hazardous, however Alberta Energy Regulator has defined NORM over 0.3 Bq/g as a Dangerous Oilfield Waste. The World Health Organization has identified NORM as the second leading cause of cancer (Radon Gas).

Liquid NORM Disposal

- All Produced waters that come from oil and gas wells contain some degree of NORM.
- As a result regulators have authorized liquid disposal of NORM into Class 1 B disposal wells that put the materials back into the formation where the oil and gas originated.
- Frac ponds can contain large quantities of water.

NORM Storage

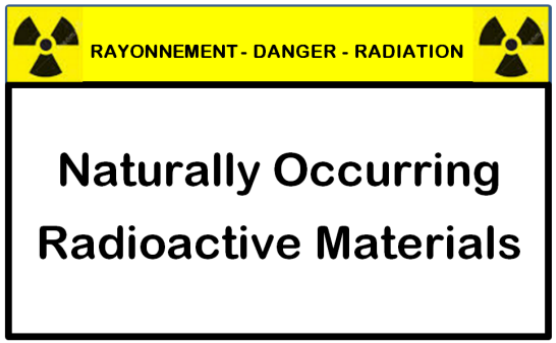
Temporary storage of impacted equipment or waste will be required prior to disposal. Considerations for storage should include the following:

- **Appropriate containers**
- **Stored in sectioned off areas**
- **Limit access to authorized personnel**
- **Accurate and current inventory records**
- **All openings sealed to prevent spread of contamination**

NORM Storage

- Signs and barricades restrict access to unauthorized workers and members of the public

- Warning sign specifications should include the following:
  - Be prominently displayed
  - Optional use of the radiation warning symbol (black trefoil on yellow background)
  - Contain the words “Caution – Naturally Occurring Radioactive Material – Authorized Personnel Only

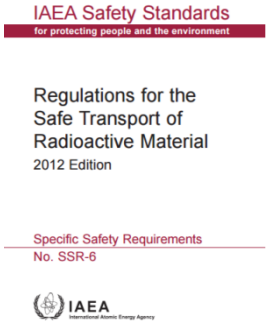


NORM Transport

- Transport of NORM falls under provincial jurisdiction if activities do not exceed 70 Bq/g for all NORM isotopes except Uranium or Thorium isotopes which is 10 Bq/g and Radium scales and sludge mixtures is 41 Bq/g.
- All loads are required to be packaged so as to prevent the spread of contamination during routine conditions of transport and must have a manifest with the descriptor “Naturally Occurring Radioactive Materials”.
- Loads in excess of the provincial limits should have transport documents completed by a person experienced in transport of radioactive materials governed under the packaging and transport of nuclear substances regulations.

Federal Transport Regulations

- Responsibility for transport of Class 7 materials is split between CNSC and Transport Canada
- CNSC – Packaging and Transport of Nuclear Substances Regulations (PTNSR)
- The PTNSR reference the IAEA Regulations of the Safe Transport of Radioactive Materials (SSR-6)
- Transport Canada – Transport of Dangerous Goods Regulations
- Packaging requirements are stipulated by the CNSC
- Transportation requirements for carriers are administered by Transport Canada



Packaging and Transport of Nuclear Substances Regulations

NORM shipments are typically shipped as one of the following:

- **UN2908 Excepted Package/Empty Package**
- **UN2910 Excepted Package – Limited Quantity of Material**
- **UN2912 Low Specific Activity (LSA-I) non-fissile or fissile excepted**
- **UN2913 Surface Contaminated Objects (SCO-I & SCO-II) non-fissile or fissile excepted**
- **UN2915 Type A Package, no-special form, non-fissile or fissile excepted**

Questions?