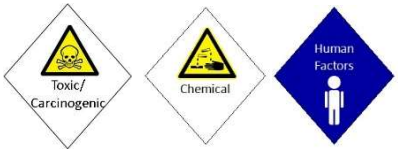


1. Introduction

1.1 Purpose

This Naturally Occurring Radioactive Material (NORM) COP is to identify the proper level of understanding, training, and protection to prevent over-exposure to NORMs for workers, visitors, and the public.

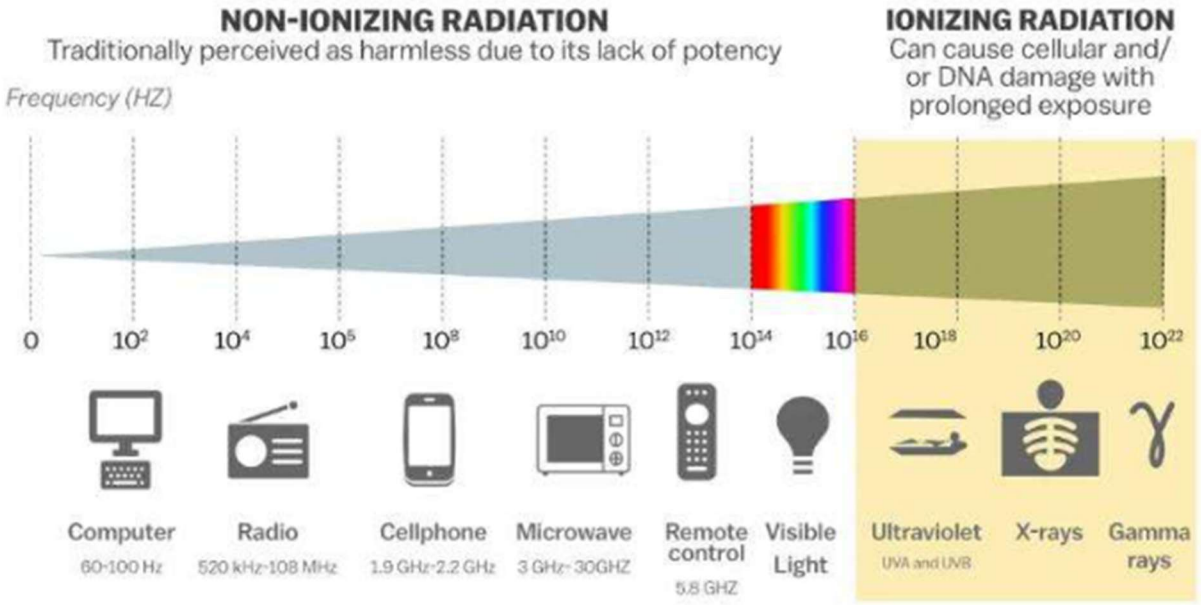
1.2 Application

This practice applies to all Strike workers and worksites where there is a potential for exposure to ionizing radiation above background levels. NORMs are everywhere but can pose a health hazard when their levels are concentrated and/or enhanced through technological process (Technologically Enhanced NORM – TENORM).

1.3 Physical Properties

Ionizing Radiation – A type of energy released by atoms in the form of electromagnetic waves or particles that has enough energy to remove tightly bound electrons from atoms, thus creating ions.

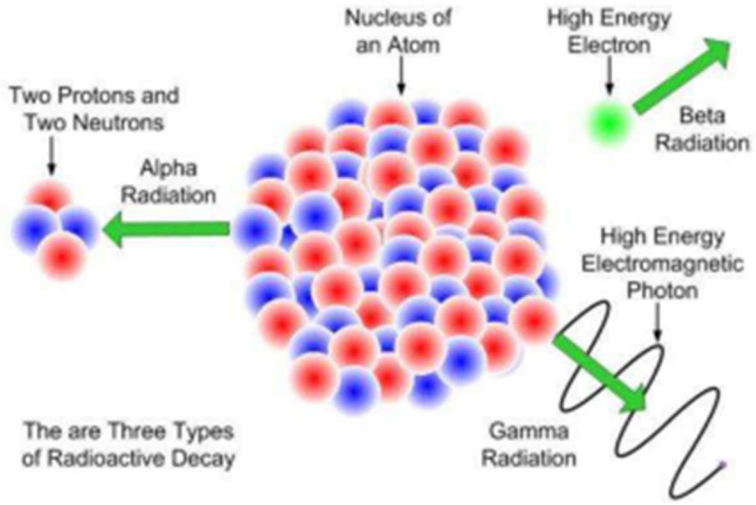
Non-Ionizing Radiation – A type of electromagnetic radiation that does not have enough energy to remove electrons from atoms or molecules. It includes visible light, infrared radiation, microwaves, and radio waves; non-ionizing radiation generally does not pose a significant health risk.

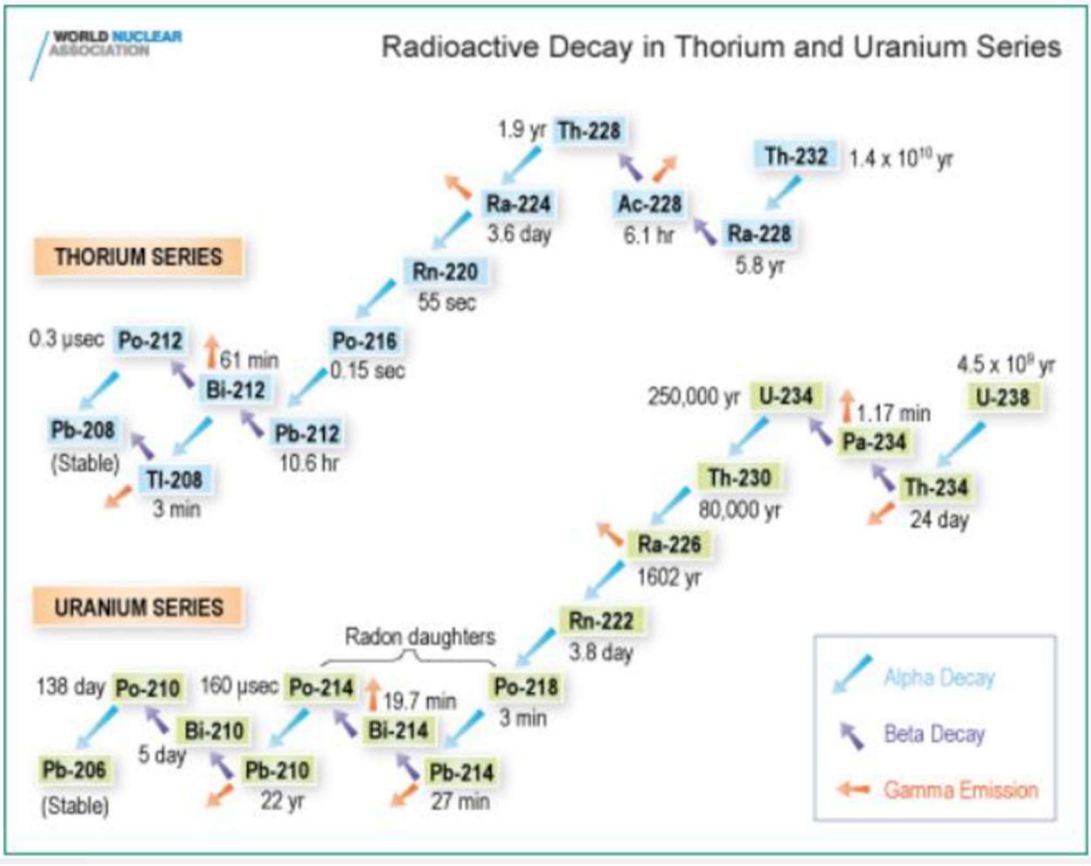


Every person on earth is exposed to NORMs at various levels (e.g., sunlight, elements/isotopes within the earth's crust, humans, food, etc.). NORMs are Ionizing Radiation; therefore, result from decay of isotopes, with the two most common decay chains originating as Uranium-238 and Thorium-232. Each isotope in the decay process may emit different forms of NORM and must be detected with the proper detection method (more information on this can be found in the "5.0 Testing / Exposure Limits").

Half-Life is the time required for a radioactive substance to lose 50% of its activity by radioactive decay. After one half-life, 50% of the original amount of radioactivity remains; after two half-lives, 25% remain, etc.

New isotopes within the decay chains are formed when an isotope expels enough electrons to effectively create a new isotope. Knowing an isotope's half-life is useful for knowing if storage is a viable option and how long it would have to be stored for.

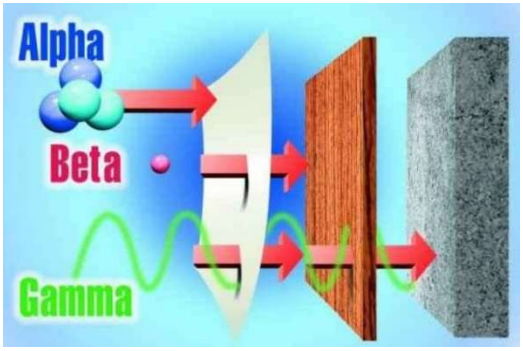




NORMs present themselves in 3 identifiable forms – rays, particles, and gas, with the two most common occupational exposures in the oil & gas construction industry captured within ray and particle forms.

Gamma radiation *(rays)* is high-energy electromagnetic radiation, emitted from unstable nuclei purging itself of excess energy. This form of radiation can penetrate tough barriers such as steel and can travel over hundreds of meters; however, they are so small and of such high energy that they are less likely to acutely affect the cells within our bodies as they pass through without much effect. High concentrations, or higher than normal levels over a prolonged period, pose a hazard to cell alteration.

Beta radiation *(particles, occasionally referred to as rays due to higher energy)* is made up of beta particles that are high energy, negatively charged sub-particles. They have a higher penetration ability over alpha particles, but when passing through clothing, equipment, or living tissue, the particles lose most of their original energy. Beta particles pose a smaller internal hazard to humans than alpha particles, but due to an increase in speed and travelling distance, these particles remain hazardous to internal organs.



Alpha radiation *(particles)* is made up of positively charged alpha particles that travel a very short distance and have little penetrating power. Even a piece of paper or the dead outer layer of human skin is sufficient to stop alpha particles. Ingestion or inhalation of these particles can cause internal tissue damage.

Radon gas *(gas)* is a colourless, odourless radioactive gas originating within soil and rock. Radon gas is not usually a health concern provided the enclosed areas are well ventilated.

NORMs are not soluble in water and are commonly found in higher concentrations within products/processes where water content is present. NORMs are often found in rocks or sand, oil and gas production residue such as mineral scale in pipes, sludge and contaminated equipment, coal ash, and on filter media such as the desiccant and gas filters. NORM's can also be present in consumer products, including common building products such as brick and cement blocks, granite countertops, glazed tiles, phosphate fertilizers, and tobacco products. High hazard locations include:

Liquid Petroleum Gases (LPG's)

- Radon and lead-210 are concentrated within refrigeration equipment and bullets, propane filters

Sludge

- Common where liquids and solids are mixed such as, separators, tanks, filter pots, produced water, glycol, amine, etc.

Scale

- Typically encountered where there is turbulence such as in valves, meters etc.

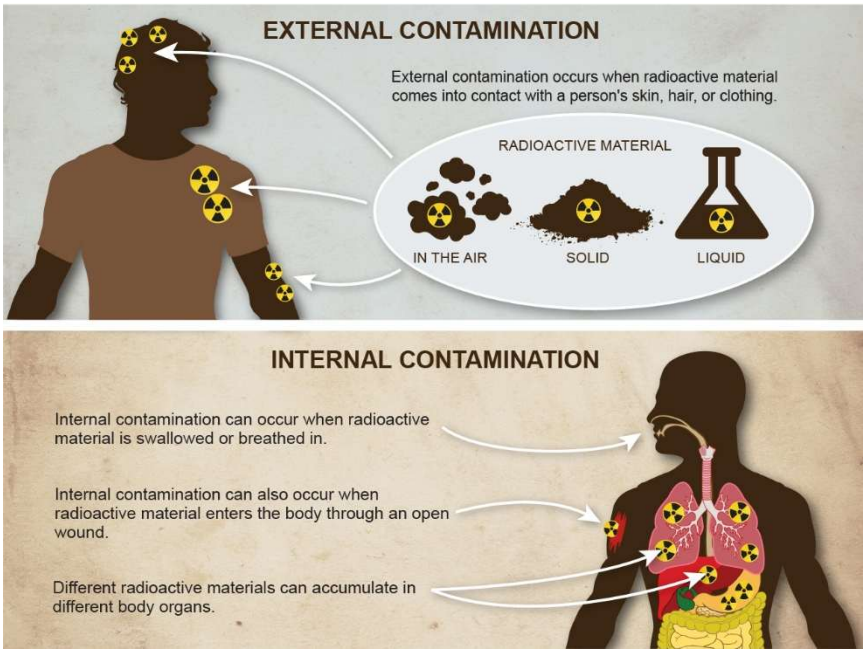
Scale containing NORM on service line

1.4 Health Effects

Gamma rays can penetrate body tissues. It is not usually a concern because of lower activity, low quantities, and low exposure time.

Radon (gaseous form) are not usually an inhalation concern if confined spaces are adequately ventilated.

Beta and Alpha particles can represent an inhalation/ingestion concern. When taken into the body, they are absorbed by the body in the same way that Calcium and Potassium are absorbed and can be stored in our bones and organs. Once these particles are stored within our bodies, they continue to emit radiation, heightening the chances of developing alteration to our cells (e.g., cancer, mutations/tumors, reproductive/hereditary issues, etc.).



Since NORMs are everywhere, people naturally absorb a certain amount of radiation from NORMs whether they are exposed in an occupational setting or not; however, we spend most of our life working and continual exposure accumulates. It is important to keep overall exposures **A**s **L**ow **A**s **R**easonably **A**chievable (**ALARA**); therefore, the exposure limit to measurable ionizing radiation in an occupational setting for a non-nuclear worker, or Incidentally Exposed Workers, is 1 milli-Sievert per year (mSv/a). Beyond occupational exposure to 1 mSv/a, personal dose monitoring for workers is required; Strike workers are considered non-nuclear workers and must not exceed 1 mSv/a. Occasional exposure throughout the course of our work at Strike is unlikely to expose our workers to 1 mSv/a. However, if you are required to work with NORMs impacted equipment/material semi-regularly, test for NORMs, and transport NORMs regular testing for exposures is wise to ensure we do not over-expose any single worker. If exposure to 1 mSv/a through occupationally related tasks is, or may be a concern, see the "5.0 Testing / Exposure Limits" for more information.

How Big is 1mSv	
Example	mSv / year
Dental x-ray 4 bitewings	0.005
Cross Canada flight	0.02
Living in a concrete/stone/brick home vs wood	0.07
Chest x-ray (single view)	0.1
Occupational Dose Limit – Incidental Worker	**1**
Natural background radiation	3.0
Occupational Dose Limit – Radiation Worker	**20**
1 Pack of Cigarettes per Day	80-90
Observable Biological Damage (48 hrs)	100
Highest dose received by worker Fukushima	670
Acute Radiation Sickness	1,000
Fatality	10,000

Radiation Source	Description	Avg Annual Dose mSv
Cosmic	From sun, solar particles, varies with elevation	0.3
Terrestrial	From radioactive elements in the Earth's crust…food we eat…building products	0.3
Internal	In our bodies and tissue	1.0
Radon Gas	Decays from uranium in the soil and accumulates in buildings, confined spaces, outside air. Doses vary greatly with geological composition in environment. Vancouver 0.2 – Winnipeg 2.2 mSv	1.4
	Total Annual Avg	3.0

2.0 Responsibilities

Strike holds all managers, supervisors, and employees accountable to work safely, follow this COP, and comply with all relevant legislation. All workers are expected to stop work if unsure of the hazards or the control measures.

Management

Strike Management is accountable for providing authority, resources, and oversight to ensure initiation, planning, design, execution, monitoring, controlling, and closure of the project by hiring and/or assigning qualified personnel to plan and execute the work.

Supervisors

Supervisors are responsible for the work and workers on their worksites:

- Ensure that an Exposure Control Plan (ECP) is implemented when working with NORMs
- Ensure personnel assigned to tasks regarding the management of NORMs are properly trained, as per this COP
- Coach/mentor all workers on their worksite on applicable guidance/requirements (e.g., Strike's practices/procedures, SDSs, ECP, etc.)
- Ensure appropriate PPE as specified in this COP is readily available for workers
- Ensure that workers properly utilize the appropriate Personal Protective Equipment (PPE) specified in this COP in accordance with the training and instruction provided
- Ensure compliance with this COP, ECP, or Site-Specific Safety Plans
- Ensure that any identified hazards/risks that may prevent workers from safely and efficiently completing tasks associated with NORMs are addressed prior to work continuing
- Ensure any events where a worker may have been exposed to NORMs are fully reported, recorded, and investigated
- Ensure tasks completed that expose workers to higher concentrations on Gamma radiation are reported to their manager, including the dose of exposure and the amount of time the worker was exposed

Worker (Employee / ISP / Subcontractor)

- Participate in activities that help educate on and manage risks (site-specific orientations, safety meetings, daily HIACs/reassessments, etc.)
- Participate and utilize required training for safely managing NORMs
- Properly utilize the appropriate PPE as required in accordance with the training and instruction received
- Follow all hygiene precautions required within the site's ECP and this COP to minimize/eliminate over-exposure to NORMs
- Report to Supervisor when moving between crews, and/or completing several projects in a row around NORMs
- If you feel as though you have worked around NORMs a lot in the past year, or if you have, or are about to work around higher concentrations of NORMs, ensure this is communicated to your Supervisor
- Stop Work if unclear on the hazard and control methods in place

HSE Department

- Aid with assessment of hazards, aligning training, and creating or reviewing the ECP
- Where required or requested, provide onsite coaching/mentoring on proper management of NORMs
- When warranted, complete or facilitate assessments on worker exposure and provide advice to Managers and Supervisors on how to proceed with minimal exposure

3.0 Training

All levels of NORMs affected workers need to be able to access this COP for reference prior to beginning work with NORMs Contaminated materials. The level of "certified" training required will be based on Strike's intended work activities for NORMs management.

Onsite Handling Limited to onsite handling of NORMs Contaminated Equipment and/or waste under the Supervision and direction of the owner of the equipment (client) (no responsibility for transportation, storage, testing, or disposal)	NORMs Awareness training, completed in-house through Strike's Learning Management System (LMS) or presented in a group setting, or by a third party
Testing Testing of equipment and/or waste to determine if material is NORMs Contaminated	Third Party (external) training that meets the Level 3 (Advanced) NORMs training through ALARA Consultants Inc. Includes methods of detecting different types of NORMs (e.g., Gamma Rays vs. Alpha Particles), PPE requirements, and transportation requirements Familiarization with the manufacturer's instructions of the NORMs meter of choice
Transportation *(Carrier)*	Valid TDG certificate through Strike's LMS. If limits exceed Provincial jurisdiction, as described in section 6 of this COP, a third-party transport company must be utilized.
Waste	Strike does not generate or assume ownership of NORMs Waste. Once an entity (e.g., Strike Group) "generates" a certain amount of waste by weight, they must apply for a waste generator license; therefore, training requirements for generation, transportation, and/or disposal of NORMs Waste is not in our purview.

4.0 Hazard Identification, Assessment, and Control (HIAC)

Where NORMs are present or suspected at a worksite, Strike will take all reasonably practicable steps to eliminate the potential exposure to Alpha/Beta particles and/or over-exposure to Gamma rays.

ALARA is the goal!

Strike's preference is that the owner of the NORMs (Client) maintains ownership and management of NORMs, including the creation and implementation of the ECP, sourcing of PPE, storage, and transportation of NORMs contaminated equipment/material. If the agreement between Strike/Client is for Strike to assume greater responsibility in managing NORMs, this COP must be adhered to fully. If deviation is desired, prior approval from the relevant VP of Operations is required.

NORMs Contaminated Equipment is material or equipment that contains NORMs contamination, higher than background levels, that can be of further use (e.g., a vessel, piping, valves, pipe coupon (even if for research purposes), etc.).

NORMs Waste is the process of removing the NORMs contamination from the NORMs Contaminated Equipment, becoming a product that is only intended for disposal (e.g., steaming/cleaning sludge/scale/etc., PPE contaminated with NORMs that exceed acceptable disposal limits at the intended place of disposal, etc.).

Strike does not assume ownership of or generate, transport, and/or dispose of NORMs Waste; however, within certain limits, we can safely manage NORMs Contaminated Equipment.

Below is an outline of the hierarchy of controls as it pertains to hazard management.

Engineering Controls

- Ventilation (includes consideration of flow rate (in cfm) formula)
- Air filtration
- Shielding
- Sealing ends of equipment/piping with appropriate barriers/caps

Flow rate in Cfm (cubic feet per minute) formula

Q = V x A	Q = Flow rate in cubic feet per minute (cfm)
	V = Velocity of air
	A = Area where the ventilated air flows through

Example: Air velocity produced by air mover is 40 feet per minute and exhaust opening is 2 feet x 3 feet.

$$Q = 40 \times (2 \times 3) = 40 \times 6 = 240 \text{ cfm}$$

Administrative Controls

- Identification and labelling of NORMs contaminated equipment/materials
- Training on NORMs specific to worker's level of managing the NORMs
- Exclusion zones, including signage and area barriers/barricades. Ensure edge of exclusion zone is <150 nSv/hr
- Time and Distance (inverse square law – explained in "5.0 Testing / Exposure Limits")
- Wetting to avoid dust generation

4.1 Personal Protective Equipment

- Disposable gloves, Tyvek suits (FR where required), respiratory protection, Strike minimum PPE
- Goggles and/or boot coverings may be required
- Respiratory protection requires a minimum of ½ mask and P-100 filters; combo filters/cartridges may be required if other hazards are present (e.g., OV & P-100 combo)
- All respiratory protection must conform to requirements within COP 02 – Respiratory Protective Equipment

Step #1	Step #2	Step #3	Step #4	Risk & Controls		
NORM disturbance Occurs dry?	Tools used to disturb NORM?	Adequate Ventilation?	Confined Space?	Airborne risk level	Respirator type	Additional controls / comments
No disturbance	No disturbance	Yes	No	Low	None	Disposable gloves are recommended for all internal NORMs assessments
No disturbance	No disturbance	Yes	Yes	Low	None	Mechanical ventilation at 100 cfm per worker
No disturbance	No disturbance	No	Yes	Medium	Supplied Air	Radon gas hazard
No	No	Yes	No	Low	None	Provided there is no visible dust, mist, or fume from NORM materials
No	No	Yes	Yes	Medium	½ Mask	Mechanical ventilation at 100 cfm per worker
No	No	No	No	Medium	½ Mask	
No	No	No	Yes	Medium	Supplied Air	Additional radon gas hazard

No	Yes	Yes	No	Medium	½ Mask	Additional eye and face protection may be required / Disposable or washable gloves, Tyvek suit, and boots or boot coverings
No	Yes	Yes	Yes	Medium	½ Mask	Mechanical ventilation at 100 cfm per worker / Eye and face protection required / Disposable or washable gloves, Tyvek suit, and boots or boot coverings
No	Yes	No	Yes	Medium	Supplied Air	Additional radon gas hazard / Disposable or washable gloves, Tyvek suit, and boots or boot coverings
No	Yes	No	No	Medium	½ Mask	Additional eye and face protection may be required / Disposable or washable gloves, Tyvek suit, and boots or boot coverings
Yes	No	Yes	No	Medium	½ Mask	Disposable or washable gloves, Tyvek suit, and boots or boot coverings
Yes	No	Yes	Yes	Medium	½ Mask	Mechanical ventilation at 100 cfm per worker / Disposable or washable gloves, Tyvek suit, and boots or boot coverings
Yes	No	No	Yes	Medium	Supplied Air	Additional radon gas hazard / Disposable or washable gloves, Tyvek suit, and boots or boot coverings
Yes	No	No	No	Medium	½ Mask	Disposable or washable gloves, Tyvek suit, and boots or boot coverings
Yes	Yes	Yes	Yes	High	Full-face Mask	Mechanical ventilation at ≥150 cfm per worker / Disposable or washable gloves, Tyvek suit, and boots or boot coverings
Yes	Yes	Yes	No	High	Full-face Mask	Disposable or washable gloves, Tyvek suit, and boots or boot coverings
Yes	Yes	No	No	High	Full-face Mask	Disposable or washable gloves, Tyvek suit, and boots or boot coverings / Prevent adjacent contamination
Yes	Yes	No	Yes	Extreme	Supplied Air	Additional radon gas hazard / shower required / Disposable or washable gloves, Tyvek suit, and boots or boot coverings

4.2 Exposure Control Plan (ECP)

When NORMs are present or expected to be present within our scope of work, Strike must work under the guidance of an ECP. The minimum requirements for this plan should outline:

- Work scope
- Type and levels of NORMs present/suspected at the worksite

- Level of training for all personnel through Strike working with the NORM
- PPE required to complete tasks safely
- Area securement (e.g., signage, barriers, permitting, etc.)
- Procedure to manage NORMs contaminated equipment
- Onsite storage area
- Decontamination procedure
- Identification of Consignor/ Carrier/ Consignee

ECP creation can be assisted by use of SDS Binders (Chemscape). Reach out to your HSE Advisor to aid in the creation of an ECP through this platform. Below is an example "Table of Controls" from within a previously generated ECP:

Work Activity	Work Positions	Current Engineering Controls	Administrative Controls	PPE is Product Dependent (in addition to Standard PPE)
Maintenance work on equipment containing NORM (e.g., values, pipe, vessels, filters)	Supervisor Worker Welders Pipefitter	NORM testing during dismantling	Site orientation, internal NORM training, supervisor training, pre-job meeting, SWP 73, suspicious or reported material treated as NORM.	[P100] [Nitrile] [Tyvek]
Working around NORM-contaminated equipment, no other interaction.	Field Supervisor Worker Welders Pipefitter Electrician		Site orientation, internal NORM awareness training, SWP 73	

5.0 Testing / Exposure Limits

If Strike is to complete testing for NORMs, the tester must be trained and comfortable with testing for NORMs. For guidance on testing, refer to Appendix A.

Gamma rays can be detected through steel, therefore can be detected without opening the equipment. Gamma rays must be tested with a Scintillating device, usually measured in nano-Sieverts per hour (nSv/hr). This is important as rays are the direct comparative to the allowable exposure limit for non-nuclear workers of 1 milli-Sievert per year (mSv).

Workers that test or continually work with NORMs must be cognizant of the amount of exposure to Gamma Rays throughout the year. If the potential for a worker within Strike to exceed the 1 mSv/year exists, an assessment must be completed and actioned on to ensure the worker does not exceed 1 mSv/a (see "9.0 Monitoring").

1,000,000 nSv = 1000 µSv (micro-sievert) = 1 mSv

Alpha and Beta particles are detected with a Geiger-Mueller device (pancake attachment). These two particles cannot penetrate steel, therefore they must be tested once the internals of the equipment are exposed. The owners of the process equipment have a requirement to complete periodic hygiene assessments and may have some background information as to the potential for NORMs in their equipment. Particles are measured in Counts per Minute (CPM) or Counts per Second (CPS).

Strike considers equipment/materials to be "NORMs Contaminated" and pose a potential hazard to health once Gamma radiation levels exceed background levels by ≥150 nSv/hr, and/or Alpha/Beta particles register ≥200 CPM.

Dose / Dose Rate →		20 uSv 0.02 mSv	100 uSv 0.1 mSv	500 uSv 0.5 mSv	1,000 uSv 1 mSv
0.25 uSv/h	250 nSv/h	80 hrs	400 hrs	2000 hrs	4000 hrs
0.5 uSv/h	500 nSv/h	40 hrs	200 hrs	1000 hrs	2000 hrs
1.0 uSv/h	1000 nSv/h	20 hrs	100 hrs	500 hrs	1000 hrs
5.0 uSv/h	5000 nSv/h	4 hrs	20 hrs	100 hrs	8.3 days
100 uSv/h	100000 nSv/h	2 hrs	10 hrs	50 hrs	100 hrs
0.5 mSv		Recommended turn back dose (non-emergency)			
1 mSv		General Public & NON Occupationally Exposed Worker Annual dose limit			
20 mSv		Average annual dose limit (Occupationally Exposed Worker)			

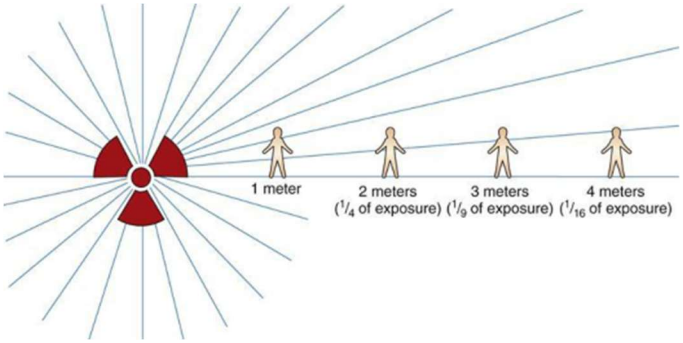
If any worker is or may be exposed to NORMs continually throughout the year, or in high concentrations, ensure an assessment is completed to calculate their potential exposures. As per the table above, exposure is calculated in Dose (nSv/hr) x Exposure (hours).

Total Exposure = (Dose1 x Exposure1)+(Dose2 x Exposure2)+…..

Example: (184 nSv/hr x 2.3 hrs)+(264 nSv/hr x 0.5 hrs) = 555 nSv

Considering that 555 nSv = 0.000555 mSv, and the allowable exposure limit for a non-nuclear worker is 1 mSv/yr, exposure like the example above could occur several times per year without reaching the annual occupational exposure limit. If workers are exposed to higher levels of radiation (e.g., 90,000 nSv/hr for 5 hours), the allowable time spent around NORMs throughout the year would be significantly decreased.

Time and Distance are important factors to consider when assessing exposure to radiation. Limiting time and increasing distance from the radiation are beneficial to keeping exposure ALARA. Radiation follows the inverse square law, where the intensity of exposure decreases inversely proportional to the square of the distance (i.e., double the distance and you quarter the dose of radiation).



6.0 Transportation of NORMs Contaminated Equipment

If Strike is to transport NORMs Contaminated Equipment, ensure that exposure of workers, transportation personnel, and the public is considered. Several pieces of NORMs Contaminated Equipment with lower levels compiled into one area can create a synergistic effect where the radiation emitted from the group of equipment gives off an exponentially larger level of radiation than any one of the pieces (e.g., 1+1=3).

Whenever this is possible, ensure the placement of the NORMs Contaminated Equipment is far enough away from the driver.

Ensure that the equipment is enclosed (e.g., plastic wrapped, in an enclosed transport bin, blinds and/or plugs installed, etc.) and cannot release NORM contamination to the environment or expose the public.

Ensure a Transport Manifest is issued to the driver from the Consignor, prior to transportation.

Ensure the classification of the NORMs Contaminated Equipment is known by the owner/client (e.g., Ra-226 @ 1.2 becquerels per gram (Bq/g) & Pb-210 @ 3.2 Bq/g). The value of Bq/g is the determining factor for the regulations the material falls under.

Below is a sample chart from the Canadian Guidelines for the Management of NORMs – Vol. 3 Transportation (2021):

NORM RADIONUCLIDE	I. Unrestricted Derived Release Limit (UDRL)		II. Provincially Regulated NORM		III. Federally Regulated NORM Follow PTNSR[4] and TDGR[3]	
	Specific Activity Limits[2]	Exempt Package Activity Limits[5]	Specific Activity Limits[2,4,5]	Exempt Package Activity Limits[5]	Specific Activity Limits[4,5]	Exempt Package Activity Limits[5]
Uranium-238 Natural (All progeny in equilibrium)	< 0.3 Bq/g	< 1,000 Bq	0.3 Bq/g to 10 Bq/g	< 1,000 Bq	> 10 Bq/g	< 1,000 Bq
Thorium-230	< 10 Bq/g	< 10,000 Bq	N/A	N/A	> 10 Bq/g	< 10,000 Bq
Radium-226 (All progeny in equilibrium)	< 0.3 Bq/g	< 10,000 Bq	0.3 Bq/g to 70 Bq/g	< 10,000 Bq	> 70 Bq/g	< 10,000 Bq
Lead-210 (In equilibrium with Bi-210 and Po-210)	< 0.3 Bq/g	< 10,000 Bq	0.3 Bq/g to 70 Bq/g	< 10,000 Bq	> 70 Bq/g	< 10,000 Bq
Thorium-232 Natural (All progeny in equilibrium)	< 0.3 Bq/g	< 1,000 Bq	0.3 Bq/g to 10 Bq/g	< 1,000 Bq	> 10 Bq/g	< 1,000 Bq
Thorium-232	< 10 Bq/g	< 10,000 Bq	10 Bq/g to 70 Bq/g	< 10,000 Bq	> 70 Bq/g	< 10,000 Bq
Radium-228 (In equilibrium with Ac-228)	< 0.3 Bq/g	< 100,000 Bq	0.3 Bq/g to 70 Bq/g	< 100,000 Bq	> 70 Bq/g	< 100,000 Bq
Thorium-228 (All progeny in equilibrium)	< 0.3 Bq/g	< 10,000 Bq	0.3 Bq/g to 10 Bq/g	< 10,000 Bq	> 10 Bq/g	< 10,000 Bq

Norms contaminated equipment/material that exceed 1 Bq/g but remain under 70 Bq/g fall under provincial jurisdiction. Most NORM contaminated equipment in our industry will fall under the provincially regulated jurisdiction; however, it is necessary to know the classification from the owner of the equipment/material prior to accepting the material for transport. Bq/g is typically determined through a lab administered Radiochemical Analysis test. Being that most NORM classifications fall within this jurisdiction and, therefore, pose little risk to the public if handled properly, it is not necessary for the owner to have a radiochemical analysis test completed on every shipment if they have historical data that can show what the typical classification would be.

Shipments of provincially regulated NORM must ensure that:

- A manifest is issued to the carrier, by the consignor, prior to transport
- The manifest is kept within reach of the vehicle operator
- The manifest contains the descriptor "Naturally Occurring Radioactive Material – NORM"
- The materials are securely packaged in a manner that effectively prevents the release of any NORM contamination during transport

- Shipment has taken into account any other hazardous materials in accordance with the applicable hazardous waste regulations
- The shipper (consignor) has in place a Radiation Protection Program (RPP) and emergency response plan to ensure safe handling, packaging, and transport of the NORM-impacted materials

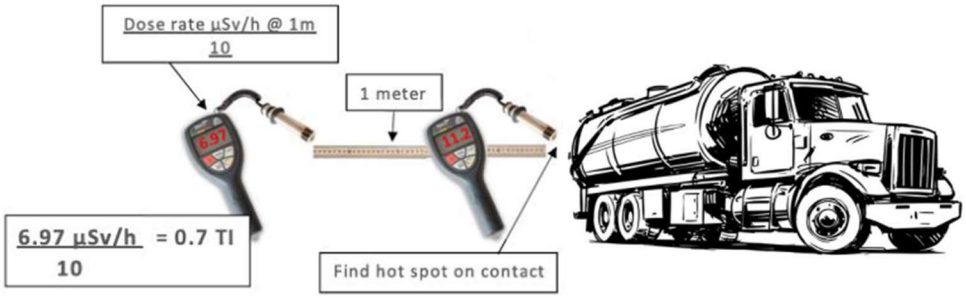
No placards or labels should be affixed to a conveyance transported under provincial jurisdiction

Receivers are likely to have a limit of NORMs contamination they are willing to accept. Ensure the receiver's accepted limit of NORMs is understood and met prior to transport. For example, some facilities have a limit of 150 or 200 nSv/hr, where some facilities will not accept anything over background limit. This includes materials like disposable PPE; once PPE is doffed and stored in a segregated area, it should be tested prior to disposal. If the readings of the PPE exceed 150 nSv/hr or 200 CPM, they should not be disposed of in a standard facility, rather treated as NORMs waste.

6.1 Transport Index

Prior to transport, it is important to know whether the cumulative gamma levels of a load are within an acceptable range. Loads that contain NORMs over 70 Bq/g or land within the Transport Index fall within Federal Jurisdiction and require carriers to be trained in TDG Class 7 and begin using placards on loads. Strike does not train workers in TDG Class 7; if loads reach this criterion, transportation of the NORMs Contaminated Equipment must be third partied.

To determine if the load has reached the Transport Index criteria for TDG Class 7, a Gamma Radiation measurement must be made for the entire load prior to transport. This is completed by taking a measurement (nSv/hr) on the surface of the load to find any "hot spots", then stepping back and recording the reading at 1 meter from that point. If no reading on the load exceeds 5000 nSv/hr, then the load remains under Provincial Jurisdiction and can be transported as such.



Conditions		
Transportation Index	**Maximum Radiation Level at Any Point on External Surface**	**Category**
0[a]	Not more than 5 µSv/hr	I-WHITE
More than 0 but not more than 1[a]	More than 5 µSv/hr but not more than 500 µSv/hr	II-YELLOW
More than 1 but not more than 10	More than 500 µSv/hr but not more than 2 mSv/hr	III-YELLOW
More than 10	More than 2 mSv/hr but not more than 10 mSv/hr	III-YELLOW[b]

(a) If the measured TI is not greater than 0.05 then the value shall be zero.
(b) Shall be transported only under exclusive use.

7.0 Storage of NORMs Contaminated Equipment

When storing NORMs Contaminated Equipment, there is still a risk of exposure to surrounding personnel. Distance and barriers provide great help with controlling exposure in this case. Long-term storage can potentially result in environmental contamination, which could incur extra costs when attempting to disperse assets; aim to keep storage of NORMs Contaminated Equipment on Strike property to a minimum. When storing, regardless of duration, ensure the following precautions are in place.

- Store in a segregated area, preferably away from work areas
- Flagging and signage to identify area and keep personnel out
- Ensure the edge of the segregated area is reading less than 150 nSv/hr above background or is a minimum of 1m from the edge of the NORMs Contaminated Equipment
- If adequate segregation from work activities is not possible, ensure that barriers are in place to reduce gamma ray effect (e.g., Lead can stop gamma rays (think of x-rays in a hospital), thick concrete blocks will significantly slow the rays down)
- Ensure the equipment cannot release alpha/beta particles (e.g., enclose the ends of pipe with plastic, tape, or blinds)
- Ensure the equipment cannot take on water or external elements

8.0 Decontamination, Cleaning, and Disposal Requirements

- Before removing disposable PPE, test for NORMs contamination. If levels are above background, ensure PPE is doffed in a segregated area and stored in a separate disposal container from non-contaminated trash and/or materials
- Ensure segregated disposal container is labelled as "NORMs Contaminated"
- Ensure tools/materials contaminated with NORMs are segregated and labelled
- All coveralls and gloves should have the outer layers down or inside out, helping to contain any dispersible particles within itself
- Wash reusable PPE and any hand tools with soap and water – let air dry in a clean location
- Wash your hands and face with soap and water
- Prior to disposal of the water used for washing, test to ensure it is below the safe limits (150 nSv/hr/200 CPM)

9.0 Monitoring

It is important that we do not expose any single worker to more than 1 mSv/a of occupationally related radiation. If your group or area has worker(s) that may be exposed to 1 mSv/a or more, ensure that an assessment is completed that provides insight into a sample of exposures. If any single worker must work near a high energy source (e.g., 90,000 nSv/hr for 5 hours), ensure that the worker's dose exposure is documented and kept with that worker's file. If that worker must be exposed to NORMs again within the year, that assessment must be updated to ensure that exposure is being tracked to not exceed exposure to ≥1 mSv/a.

Where workers have been incidentally exposed to NORMs at hazardous levels:

- Event must be reported and investigated
- Strike will be responsible for the costs incurred for health assessments regarding radiation exposure

APPENDIX A – TESTING PROCEDURES

Prior to commencing testing for NORM ensure you have the correct NORMs meter for the type of radiation you are intending to test for (Gamma and/or Alpha/Beta). Being that Strike does not own process equipment, and we will not allow our workers to exceed 1 mSv/a of occupational exposure, we are not required by regulations to keep testing data beyond assurance of due diligence in exposure monitoring. Testing by Strike workers is for exposure control and transportation purposes only; therefore, Strike does not require use of a certain brand/model of NORMs meter, as long as it properly functions within the parameters listed below.

All NORMs meters must be function tested prior to use and calibrated at least every 12 months.

Record the readings in nSv/hr and CPM for function tests, background levels, and tests on equipment/materials. Recordings can be kept on anything referenceable to the job (e.g., HIAC, formalized bump log, client forms, etc.) provided it is kept with the job package for future reference.

Most meters are not intrinsically safe; ensure continuous gas monitoring and a Hot Work Permit is issued prior to NORMs testing in areas where flash fire is possible.

Ensure proper PPE is donned prior to testing for Alpha/Beta particles. No additional PPE is required when completing a Gamma measurement on a closed system. Refer to "4.1 Personal Protective Equipment".

Function Test

- Ensure battery is of sufficient charge. If it is not, replace battery as per manufacturer's instructions.
- Position the pancake and/or scintillator device within 1cm of the check source. Ensure the reading is at least the concentration labelled on the check source; it can be slightly higher than the check source, but not lower. If it cannot achieve an acceptable reading, flag the meter Out of Service and have it calibrated. Record type of check source and readings achieved during function test.
- Test background measurements away from sources of radiation/NORM and/or potential spill areas.

Gamma Radiation Measurement

Preferred method of testing for Gamma Radiation is when the process is still in service. When gas is stagnant for days it may be depleted of radon and there is a chance that gamma radiation may not read accurately.

- Ensure monitor is set to measure nSv/hr
- Use the scintillating device (internal or external attachments are available)

External Testing

Test the outside of the equipment (e.g, pipe, valves, pig traps, etc.) as close as possible to the surface, and at ~50 cm (arm's length) on all sides of the equipment; record results.

Internal Testing

Even if external testing for Gamma radiation was completed, completing a test internally after process has been exposed is a wise idea. Test internals as close to surface as possible, as well as ~50 cm away from opening. Record results ensuring they are labelled as an internal test.

If readings are ≥150 nSv/hr over background, equipment is considered NORMs contaminated. Ensure worker's exposure (time and distance), storage, and transportation requirements are managed properly.

Alpha/Beta Radiation Measurement

Alpha/Beta Radiation do not penetrate steel and therefore must be tested internally.

- Ensure monitor is set to measure CPM
- Use the Gieger-Mueller device (pancake attachment)
- Hold device close to the surface where contamination may exist (2-3 cm) but do not touch the surface

If readings are ≥200 CPM, equipment is considered NORMs contaminated. Ensure the ECP designates proper PPE and that contamination is isolated/contained prior to transportation and storage.

REFERENCES/ADDITIONAL INFORMATION

- Directive 58 (part of the Oil and Gas Conservation regulations)
- Guidelines for the handling of Naturally Occurring Radioactive materials (NORM) in Western Canada, Western Canadian NORM Committee, August 1995
- Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM) – (2011)
- Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM) – Volume 3 Transportation (November 2021)
- CAPP Guide – Naturally Occurring Radioactive Material (NORM) June 2005
- IAEA - Regulations for the Safe Transport of Radioactive Material (2025)

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SWP 73 – NORM Retired and Revised in COP 11 - NORM

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