Workplace Safety North

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Radon progeny in Ontario's non-uranium underground mines

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- Regulatory guide and protection actions
- Radon progeny sampling protocol
- Radon progeny concentration in Ontario's non-uranium underground mines, 2004-2017
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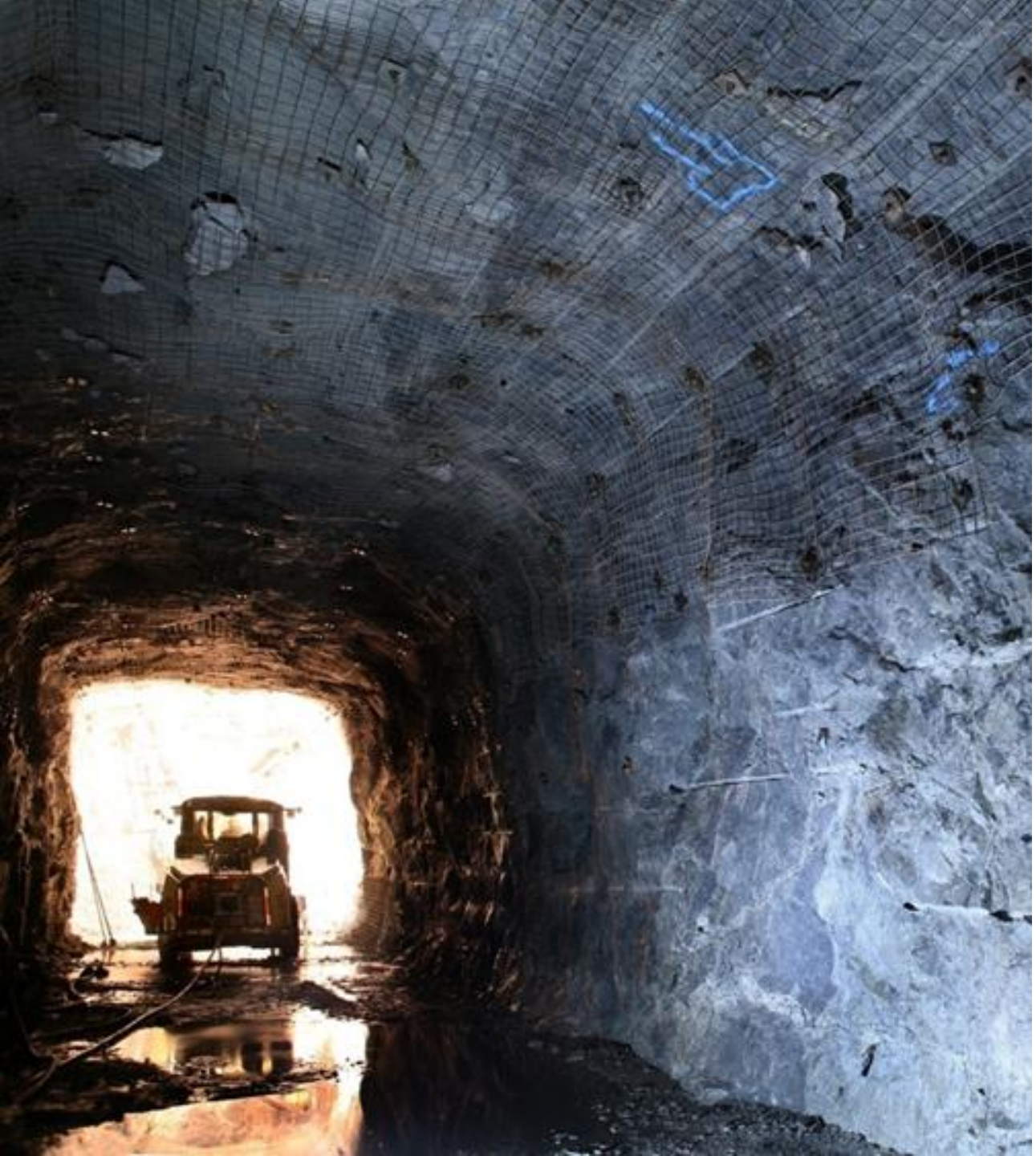
Introduction

What is radon?

- A natural radioactive gas - odourless, colourless and tasteless.
- A direct decay of radium 226.
- Radium 226 is one of the products of uranium decay found in all rocks, soil, concrete and bricks in varying amounts.

What is the health effects of radon?

- Long-term exposure to high levels of radon is directly linked to causing lung cancer.

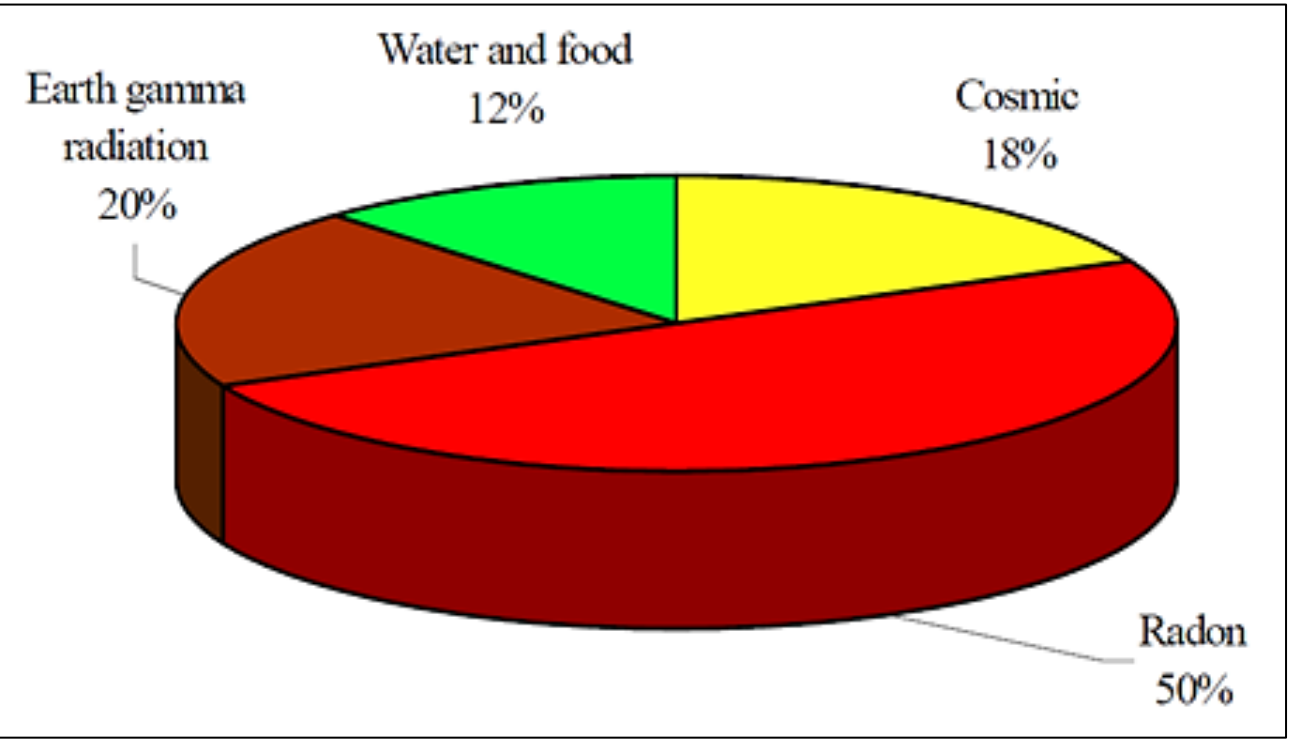


Introduction

Mode of entry to human body?

- Inhalation of the short-lived decay product (3.8 days half life) is responsible for most of the hazard.
- Radon progeny readily attach to dust particles (aerosol) in the air we breathe.
- Considered a significant contaminant affecting air quality in underground mines.
- It was known as early as the 1960's that some non-uranium mines in Ontario had elevated levels of radon progeny.
- Epidemiological studies show that miners exposed to elevated levels of radon have increased risk of developing lung cancer.

Introduction



(WHO Information Sheet 2004)

- Radon in confined air contributes up to 50% to the background radiation.
- The risk is very low when radon is diluted to extremely low concentrations in the open.
- The “Study of Mortality of Ontario Gold Miners 1955-1977, Part II” by Muller et al (1986) implicated radon progeny as well as arsenic in the significant increase of lung cancer among gold miners.

Introduction

- In 1982, the Mining Health and Safety Branch of the Ontario Ministry of Labour started a program to sample all non-uranium mines for radon progeny.
- In October 1988, Ontario's Mining Legislative Review Committee (MLRC) approved regulation to control the higher levels of radon progeny found in some of the non-uranium underground mines.

Ontario Regulatory Requirements - *Section 289* - Radon Progeny Sampling, Section 291 - Radon Progeny Concentration	
Concentration of radon progeny (WL)	**Protection Actions**
Less than 0.06 WL	A competent person to assess once a year whether to retest the air in the work area in the underground mine and in making the assessment shall consider previous test results and changes in the mine or its operations.
Greater than 0.06 - 0.10 WL	As a minimum, the air to which workers may be exposed in an underground mine shall be retested at least quarterly.
More than 0.10 WL	As a minimum, the air to which workers may be exposed in an underground mine shall be retested at least monthly.
More than 0.33 WL	(a) Immediately remove all workers from the affected area of the mine;
	(b) Give written notice of the occurrence to the joint health and safety committee or health and safety representative;
	(c) Implement the measures and procedures;
	(d) Provide the written instructions to all workers assigned to do remedial work; and
	e) Provide workers doing remedial work the require respiratory equipment appropriate to prevent or limit the workers' exposure to radon progeny.

Regulatory guide and protection actions

- Sections 287 to 293 of Regulation 854
- Regulatory guide titled "Measuring Airborne Radon Progeny at Uranium Mines and Mills" (G-4) published by the Canadian Nuclear Safety Commission in June 2003

Company : Ducky Sudbury Operations
Division: Donald Duck Mine
Date of Survey : 13-Feb-13
Surveyed by : Winnie the Pooh
Company Rep. Chicken Little, Industrial Hygiene Technician, and Tarzan, JHSC Worker Representative

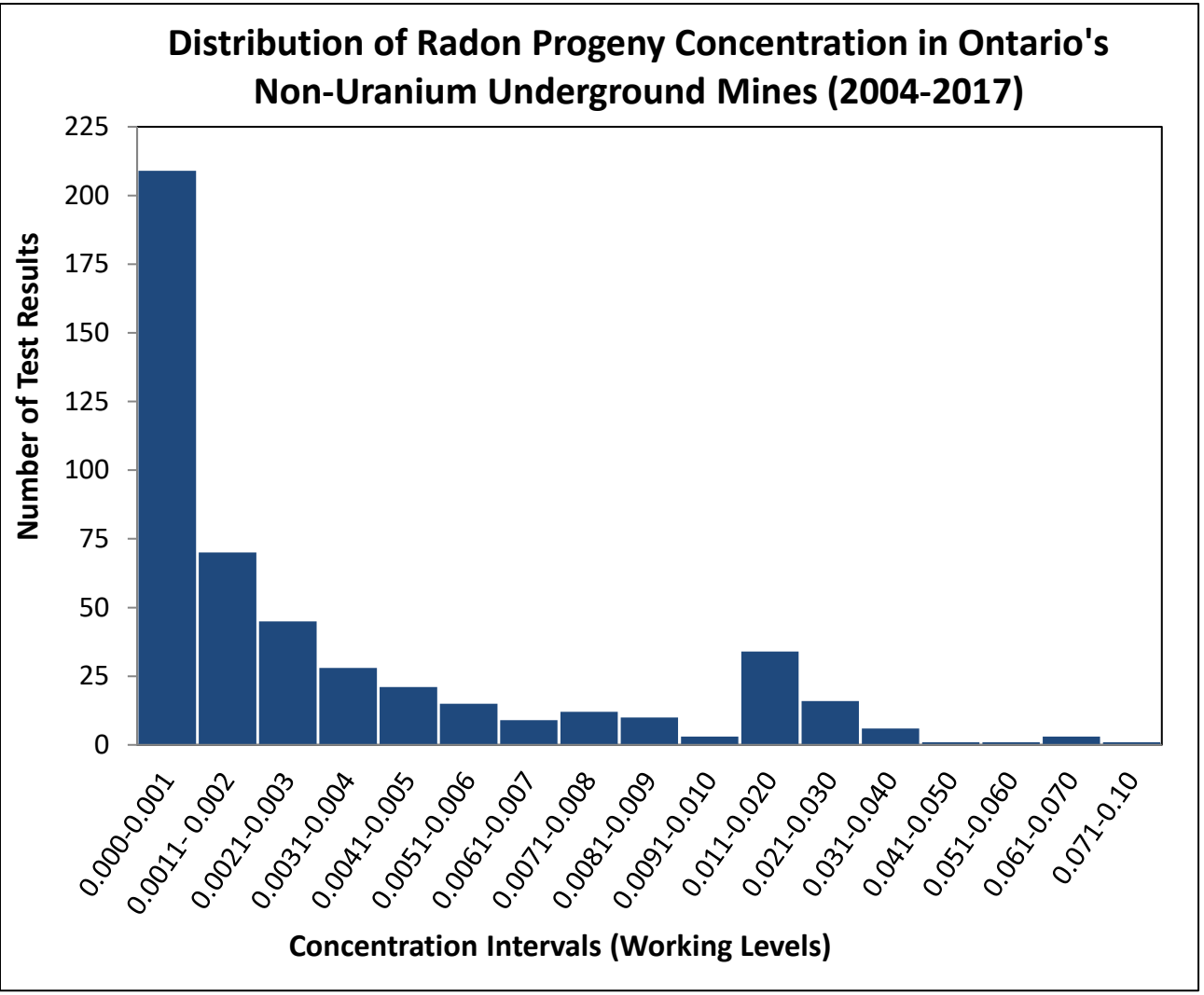
RESULTS OF SAMPLING FOR RADON PROGENY

No.	Sampling location	Air Sample Volume (V), Litres (flowrate x time)	Flow Rate, l/min	Sampling start time	Sampling End Time	Sample time, min	Start time counting	Mid point time counting	Elapsed time to mid point counting	Kuanetz Factor (K)	Count Rate (CPM)	Counter Efficiency, % (C)	Radon Progeny Concentration, WL= (CPM)/(V*C*K)
DDM-A	Blank filter after survey										0	44.30%	No background reading
DDM-1	1255-58 Bottom Sub Drawpoint #1 (unventilated during the time of sampling)	24.5	3.5	8:39	8:46	7	9:50	9:52	66	98.0	13	44.30%	0.012
DDM-2	1100 Level Shaft Station (main exhaust)	24.5	3.5	9:18	9:25	7	10:27	10:29	63	104.0	13	44.30%	0.012
DDM-3	26 Level South Drawpoint #1	24.5	3.5	10:16	10:23	7	11:23	11:25	62	106.0	16	44.30%	0.014
DDM-4	37 Level Conical Sump #1 (unventilated)	24.5	3.5	11:07	11:14	7	12:14	12:16	62	106.0	30	44.30%	0.026
DDM-B	Blank filter after survey										0	44.30%	No background reading

Radon sampling protocol

- Considerations for sampling:
  - Changes in geology or new mining areas
  - New inflow or sources of water
  - Re-opening of old workings (if applicable)
  - Previous results of sampling including the degree of fluctuation of results
  - Major changes to ventilation system

Radon progeny concentration in Ontario's non-uranium underground mines , 2004-2017



- 483 locations were sampled from 28 Ontario's non-uranium underground mines
- Measured concentrations range between 0.000 to 0.093 WL

Radon progeny concentration by sampling location, 2004-2017

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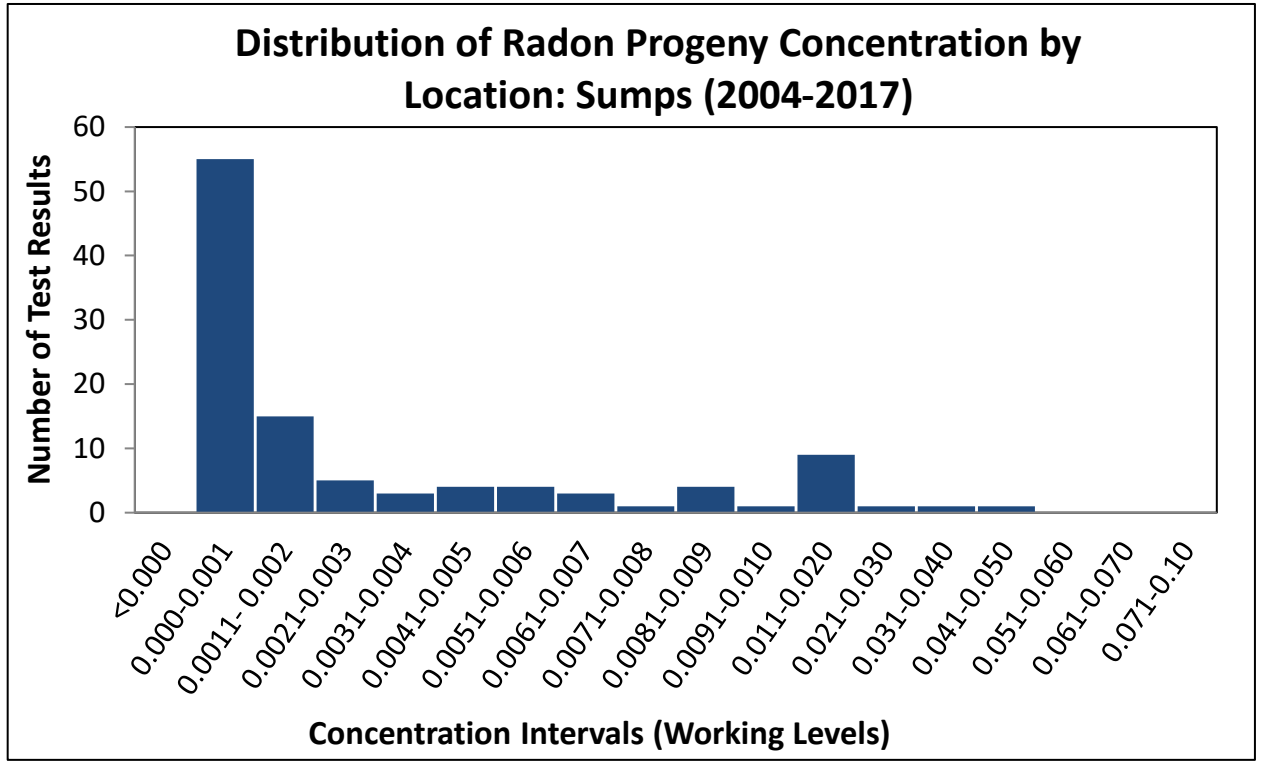

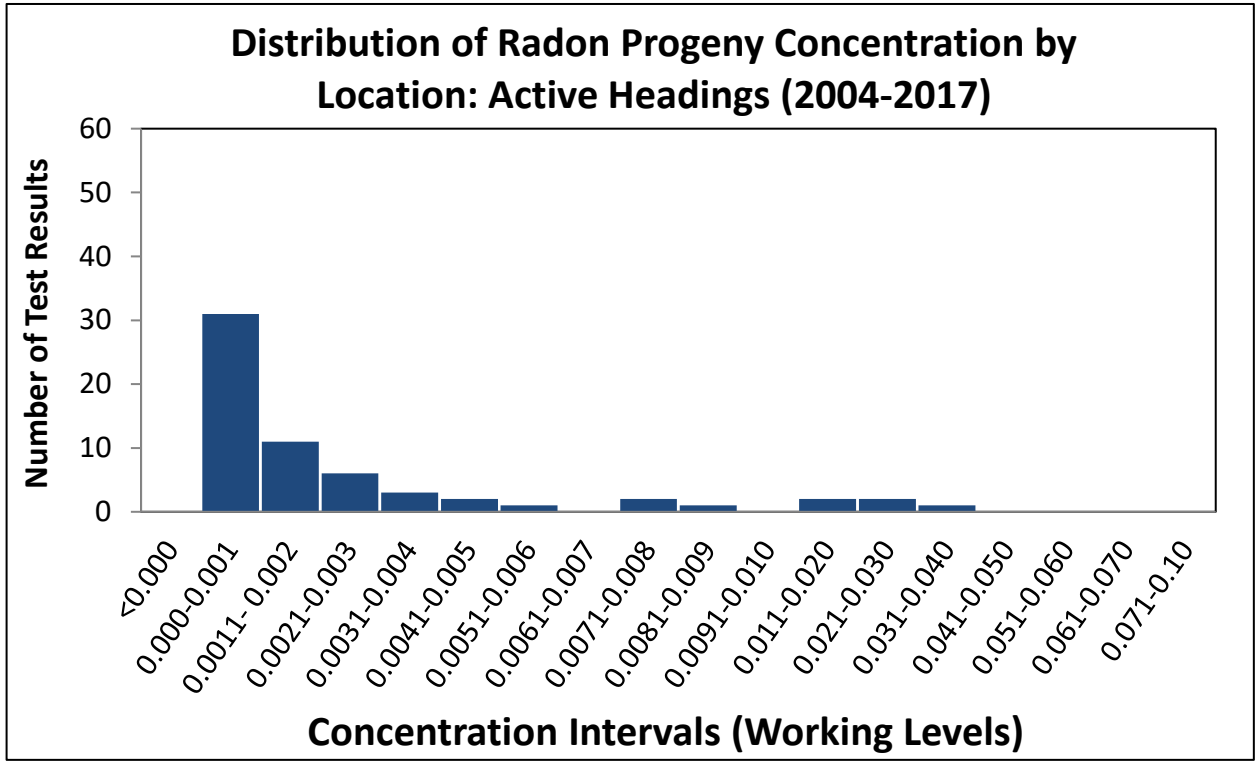

Radon progeny concentration by sampling location, 2004-2017

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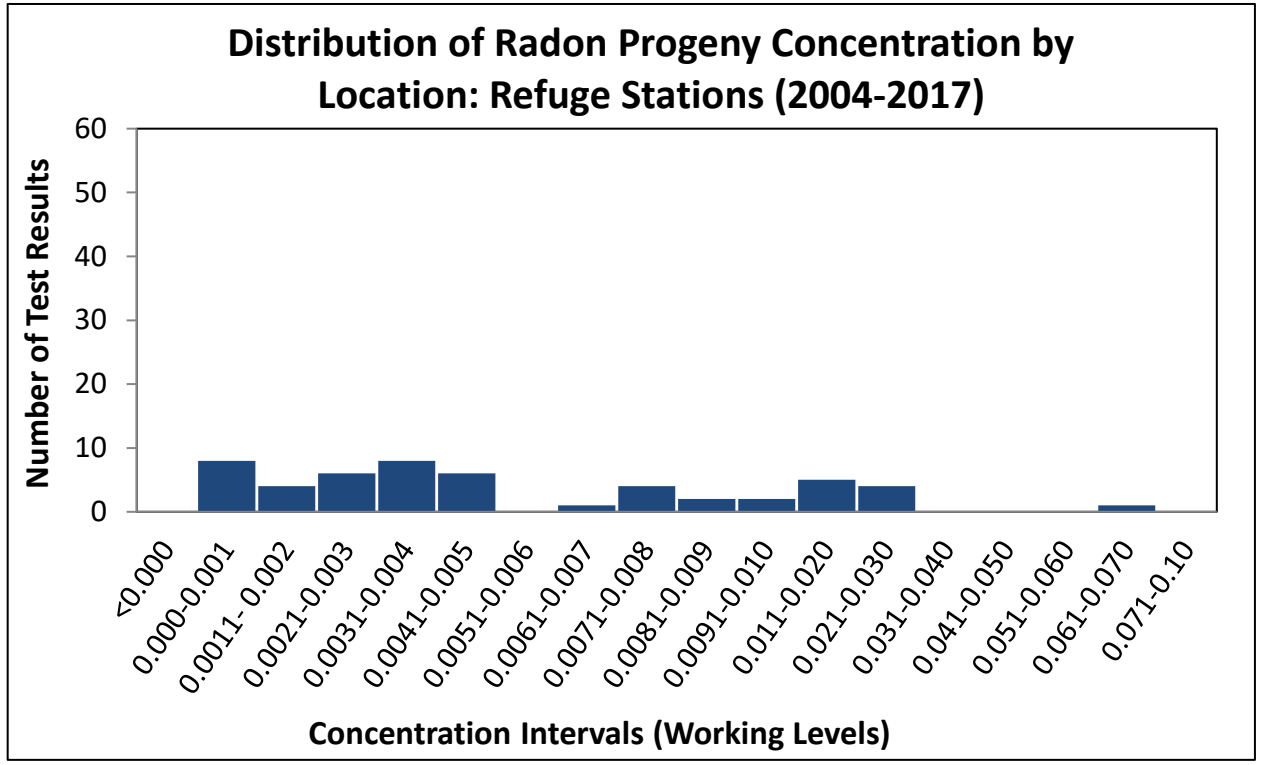

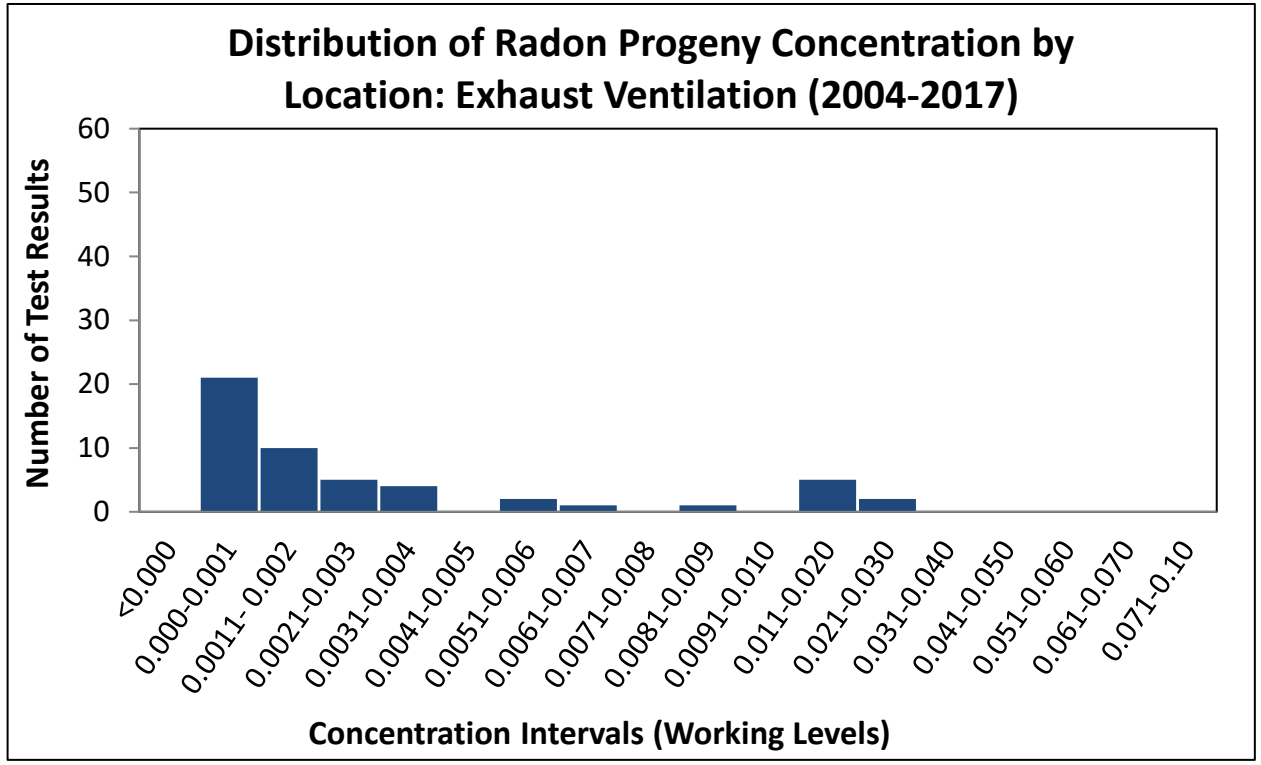

Radon progeny concentration by sampling location, 2004-2017

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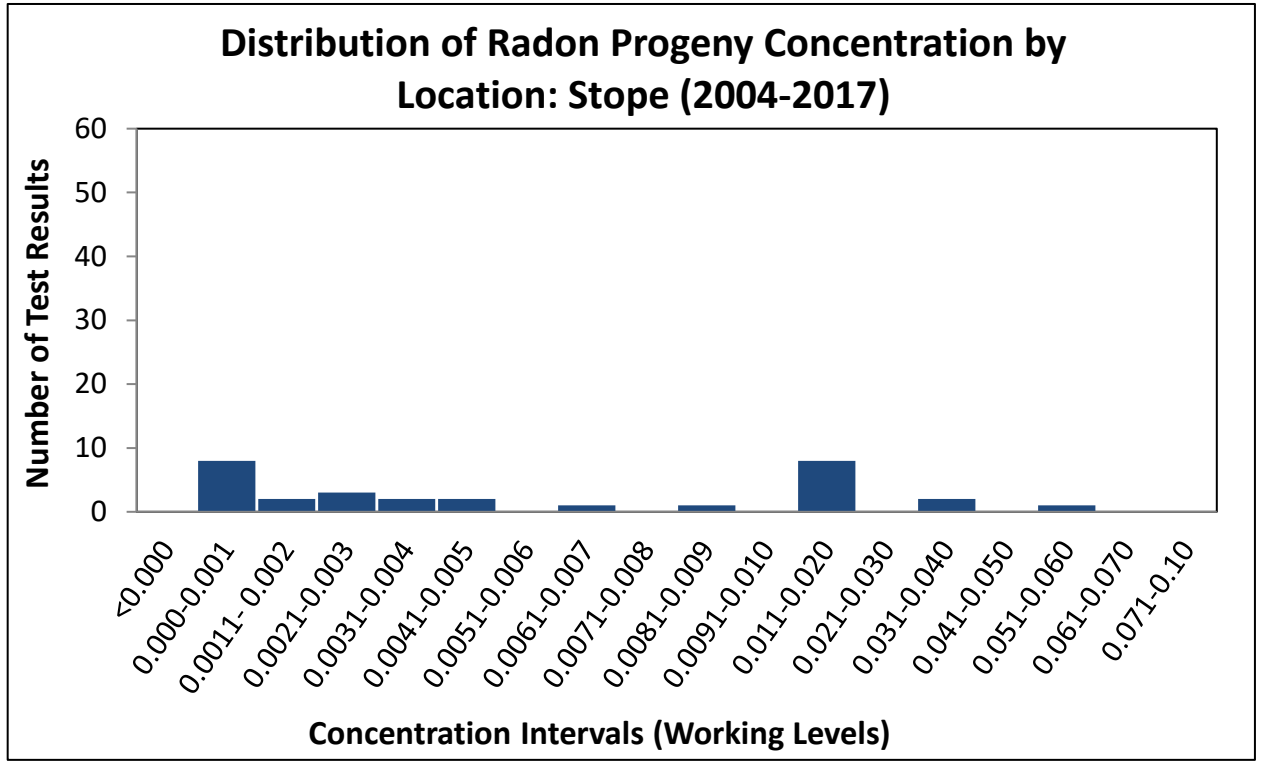
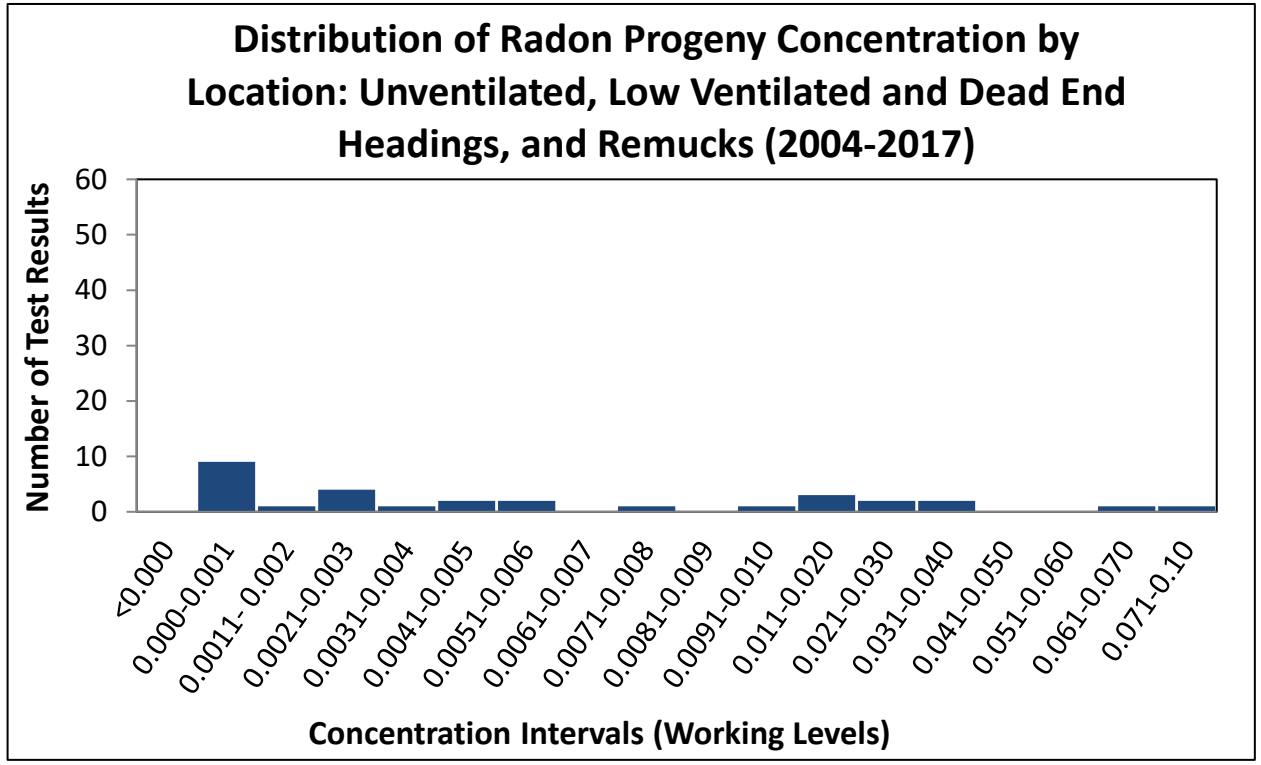
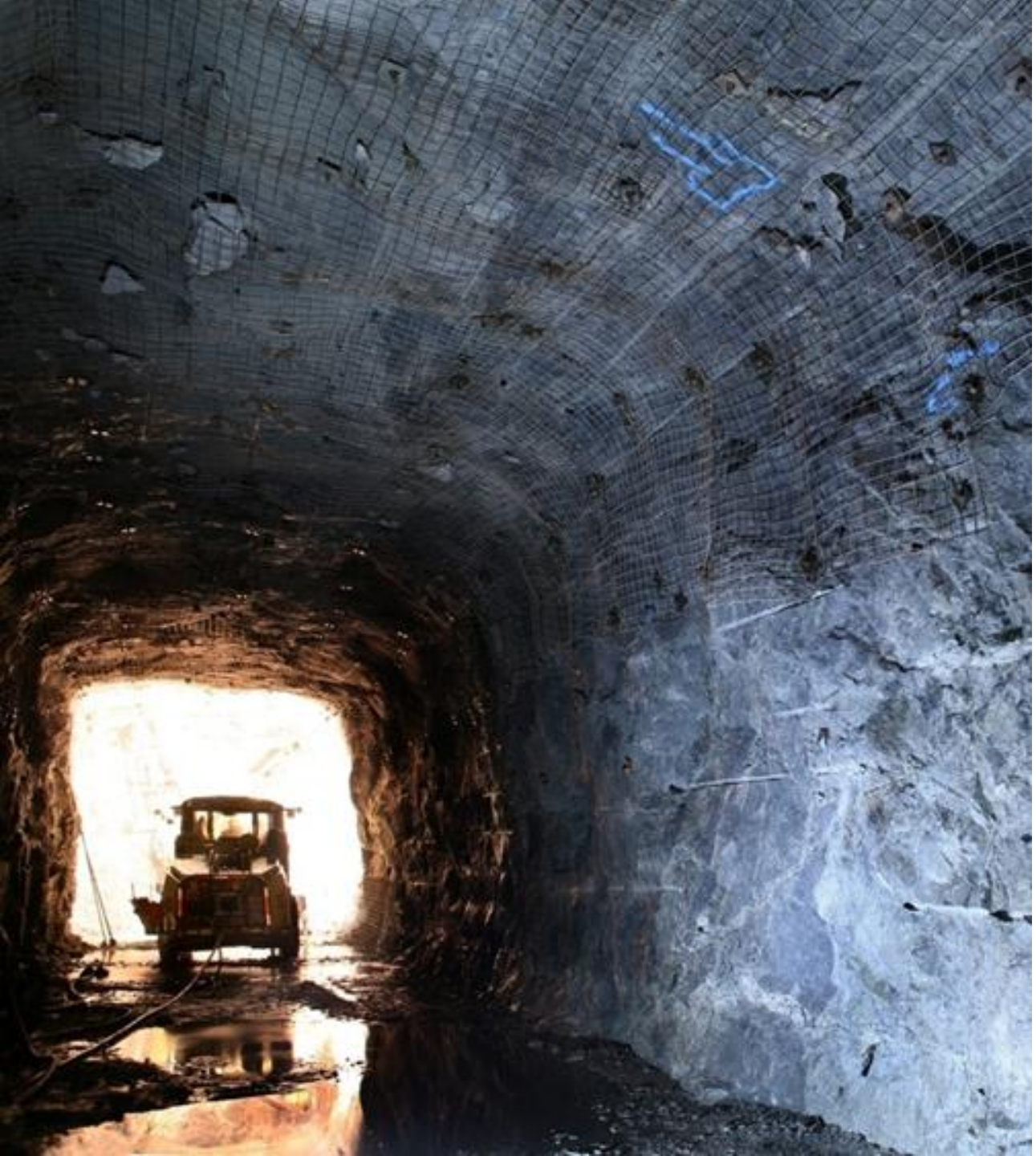




Summary

- Ninety-nine percent (99%) of the measured radon concentration or 480 out of 484 samples were below the allowed 0.060 WL limit.
- Four (4) samples were above the 0.06 WL limit requiring retesting quarterly.
- Samples with test results more than the allowed limit were noted to be taken from refuge stations and in low ventilated or unventilated workings such as stopes and dead-end headings.



Summary (continued…)

- Ensuring good ventilation flow will contribute to the generally low radon concentration levels.

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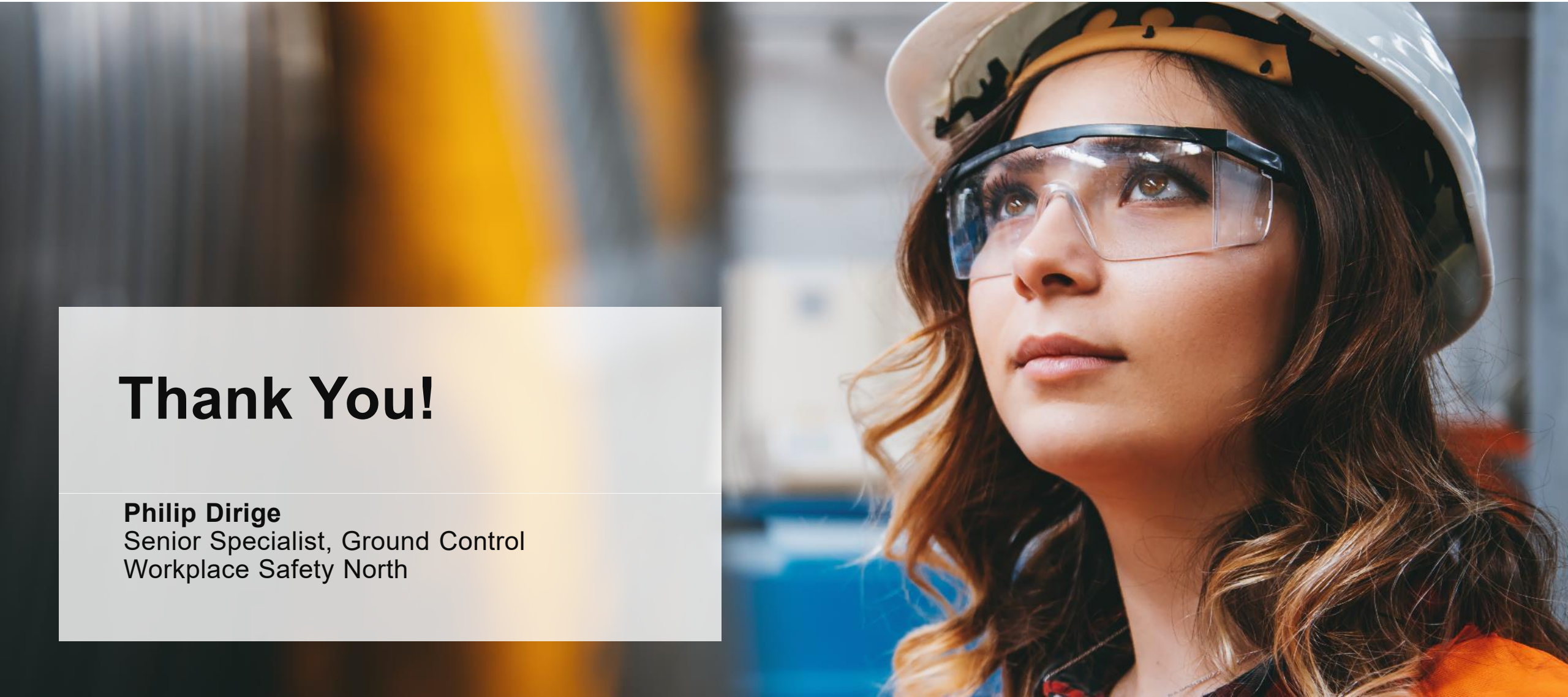

Thank You!

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TF: 1-888-730-7821 (Ontario)
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