Naturally Occurring Radioactive Material

NORM Waste Management

Best Practices and Disposal Options for Western Canada

Tab Cuthill, P.Eng., RSO

General Manager NORM Services

SECURE Energy Services

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Agenda

- What is NORM?
- Impact of North American Shales Plays
- Best Practices
  - Regulatory Requirements
  - Trained personnel and equipment
  - Risk identification, assessment and control
  - Safe Work Procedures
- Disposal Options / Limitations

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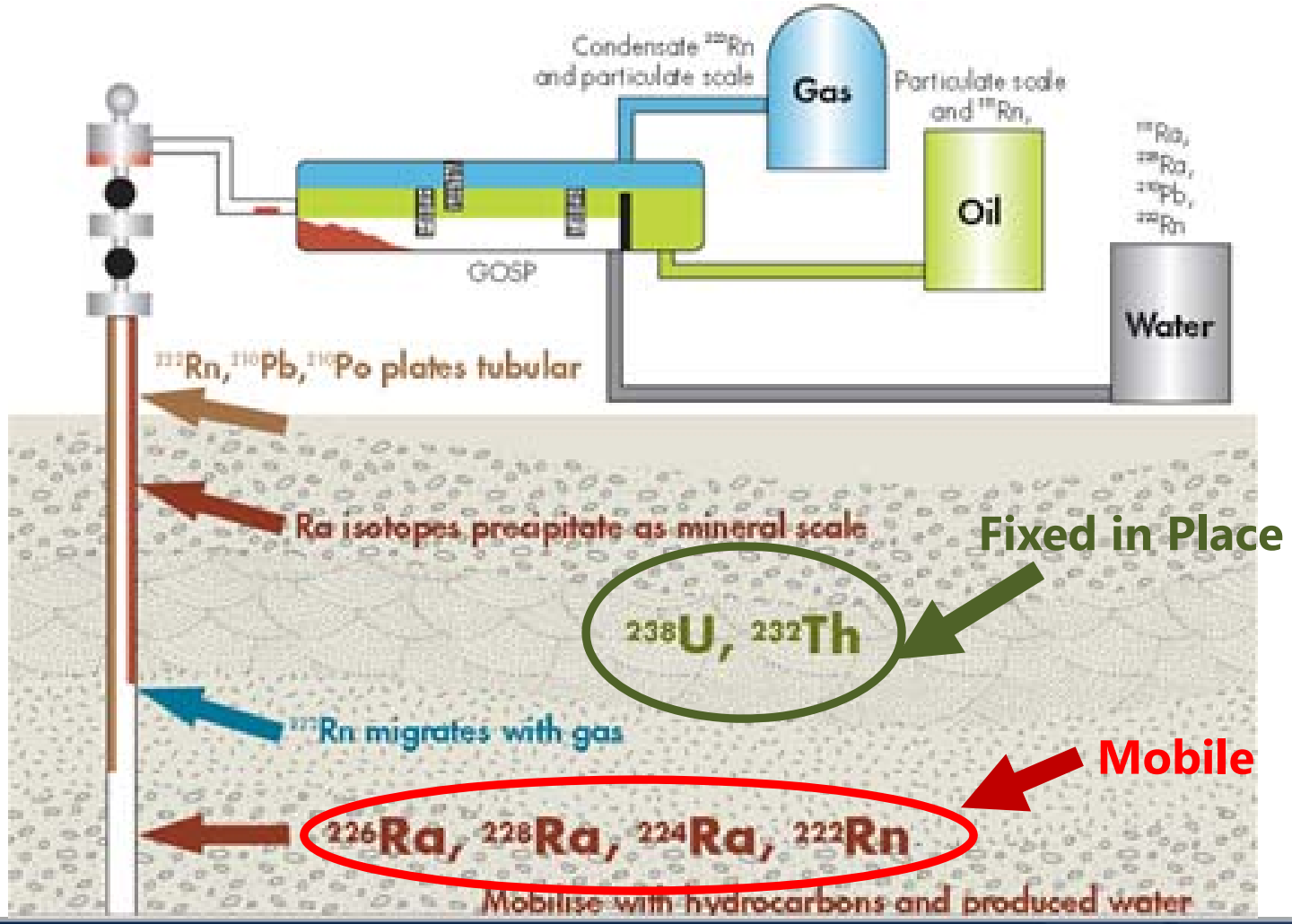
Where does NORM come from?



Examples of Technologically Enhanced NORM

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Reclamation of TENORM Impacted Sites

Naturally Occurring – What's the big deal?

NORM is Low Risk?

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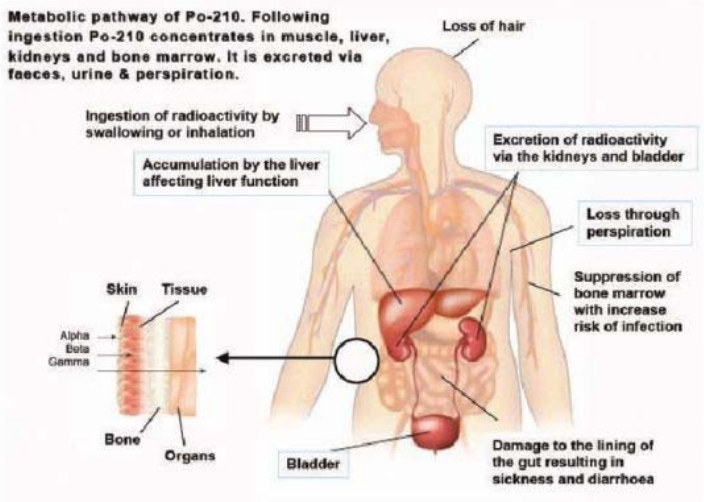
NORM is High Risk?

Po-210 & Alexander Litvinenko (Year 2006)



Reality: Long-Term Chronic Exposure

Asbestos

Asbestos Exposure and Cancer Risk

Key Points
▪ Asbestos is the name given to a group of minerals that occur naturally in the environment as bundles of fibers. ▪ Exposure to asbestos may increase the risk of asbestosis, other nonmalignant lung and pleural disorders, lung cancer, mesothelioma, and other cancers. ▪ Smokers who are also exposed to asbestos have a greatly increased risk of lung cancer. ▪ Individuals who have been exposed (or suspect they have been exposed) to asbestos on the job, through the environment, or at home through a family contact should inform their physician and report any symptoms. ▪ Government agencies can provide additional information on asbestos exposure.

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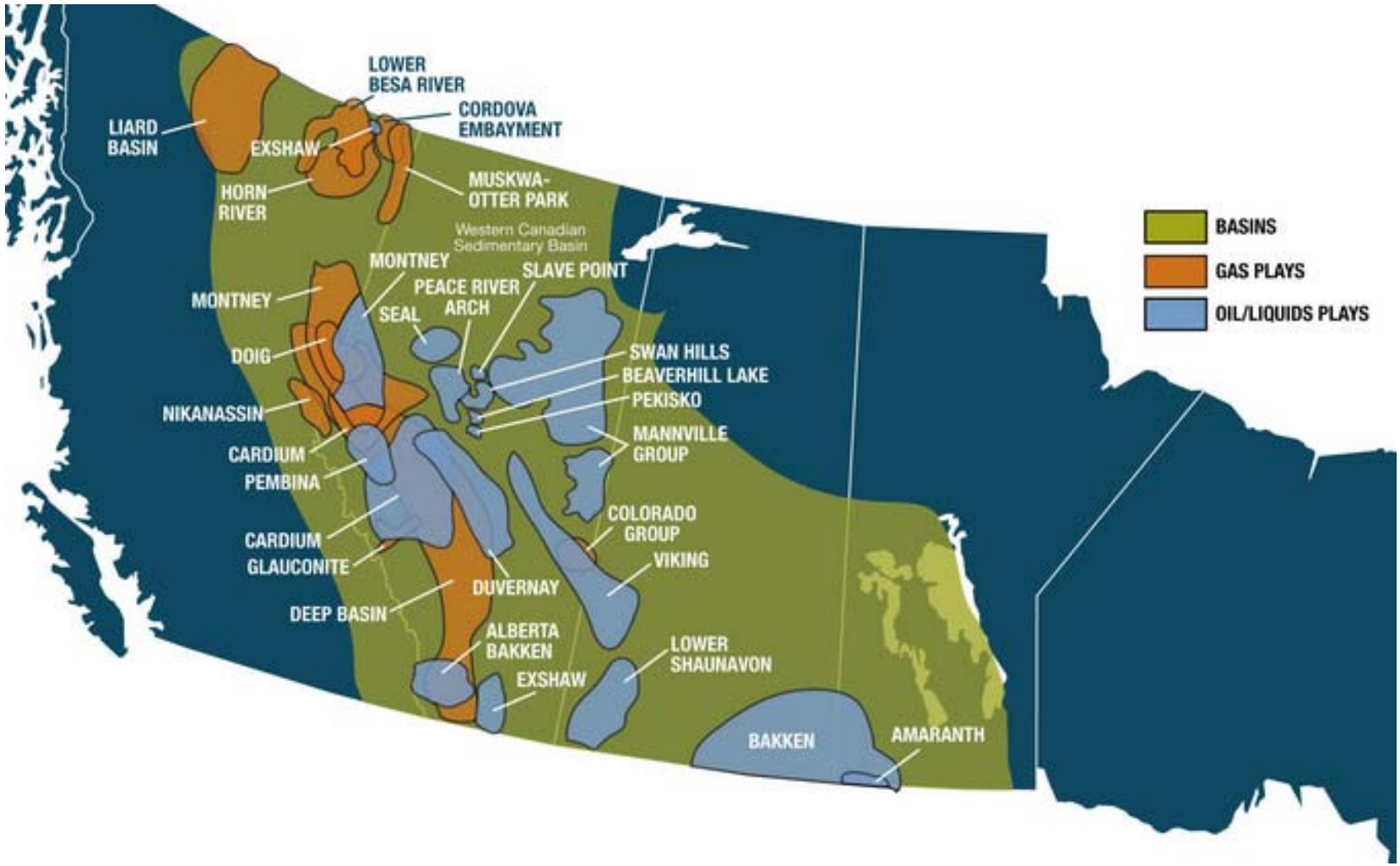
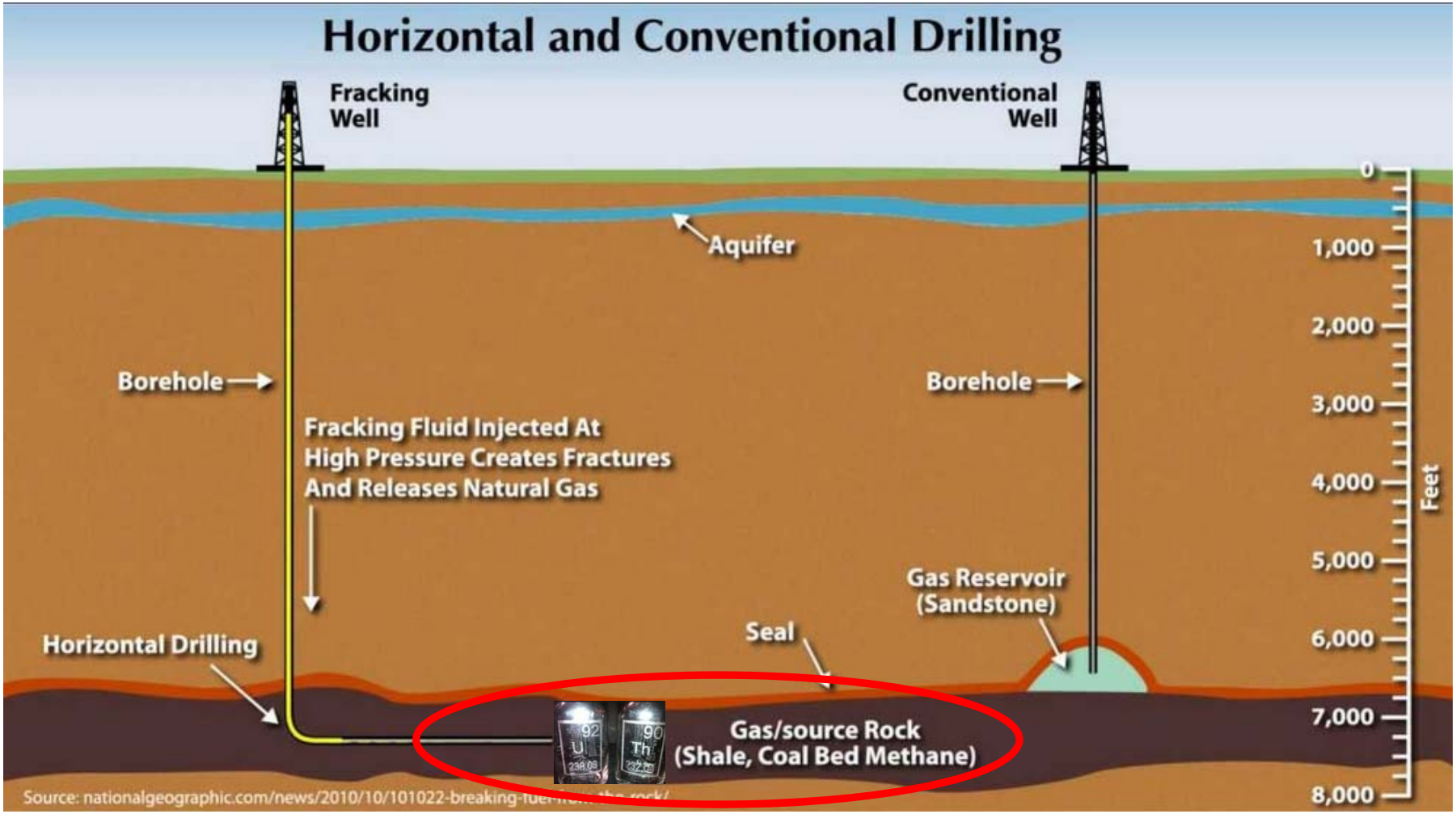
Canadian Unconventional Shale Plays & NORM?



Impact of Shale Plays



Google naturally occurring radioactive material news

TEXAS' FIRST COMPREHENSIVE M
MIDSTREAM TEXAS
OCT. 25
San Antonio,

The BAKKEN MAGAZINE

EXPLORATION & PRODUCTION | LOGISTICS | INFRASTRUCTURE & CONSTRUCTION | PRODUCTS & TEC

More

ND DOH: TENORM disposal rules improve accountability, safety

By Patrick C. Miller | September 09, 2015

There's more to new North Dakota rules for the disposal of technologically enhanced naturally occurring radioactive material (TENORM) than increasing the radiation level from 5 to 50 picocuries.

"That's what everybody focuses on, but there's a lot more in the rules besides that limit," said Scott Radig, director of waste management in the Environmental Health Section of North Dakota Department of Health.

After months of public comments and public hearings, the rules approved last month by the state health council are currently being reviewed by the North Dakota Attorney General's Office. If approved, they'll go on the December agenda of the North Dakota Legislative Council Administrative Rules Committee.

If the committee approves the rules, they'll go into effect Jan. 1, 2016, according to Radig. But in addition to increasing the allowable radiation in TENORM to increase to 50 picocuries, Radig said the ru accountability and safety into the disposal process.

A TENORM and environmental exp for levels of TENO

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Storing anything radioactive in St. John's a 'concern', says Danny Breen

CBC News Posted: Jul 10, 2015 11:51 AM NT | Last Updated: Jul 10, 2015 11:51 AM NT

Danny Breen said the City of St. John's will review the application to store the radioactive material, even if the province approves it. (CBC)

28 shares

Facebook Twitter Reddit Google

A St. John's councillor says the provincial government should think long and hard about allowing radioactive material to be stored at an industrial site in the city's northeast end.

Crosbie Industrial Services wants to temporarily store Naturally Occurring Radioactive Materials (NORM) generated by offshore oil drilling at a site off Logy Bay near a couple of residential neighbourhoods.

near Logy Bay Road too risky.

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- Teen passenger seriously injured after stolen car crashes in St. John's

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REGULATION | ECONOMY | INFLUENCE | IMPACT

Environmentalists threaten to sue EPA over oil & gas waste-disposal law

AUGUST 26, 2015 | 4:44 PM
BY JON HURDLE

1 Comment | Email | Tweet 15 | Recommend 190

MARIE CUSICK/ STATEIMPACT PENNSYLVANIA
Drilling waste at a site in Tioga County.

Seven environmental groups on Wednesday threatened to sue the U.S. Environmental Protection Agency for allegedly failing to update a law on the disposal of oil and gas waste to reflect the fracking boom of recent years.

The organizations, which include Pennsylvania's **Responsible Drilling Alliance**, said they sent an Intent to Sue notice to the EPA and will file it in 60 days' time if the agency does not review and revise regulations under the **Resource Conservation and Recovery Act**, a 1976 law that requires the agency to review the regulations every three years but which, the environmental groups say, it has failed to do.

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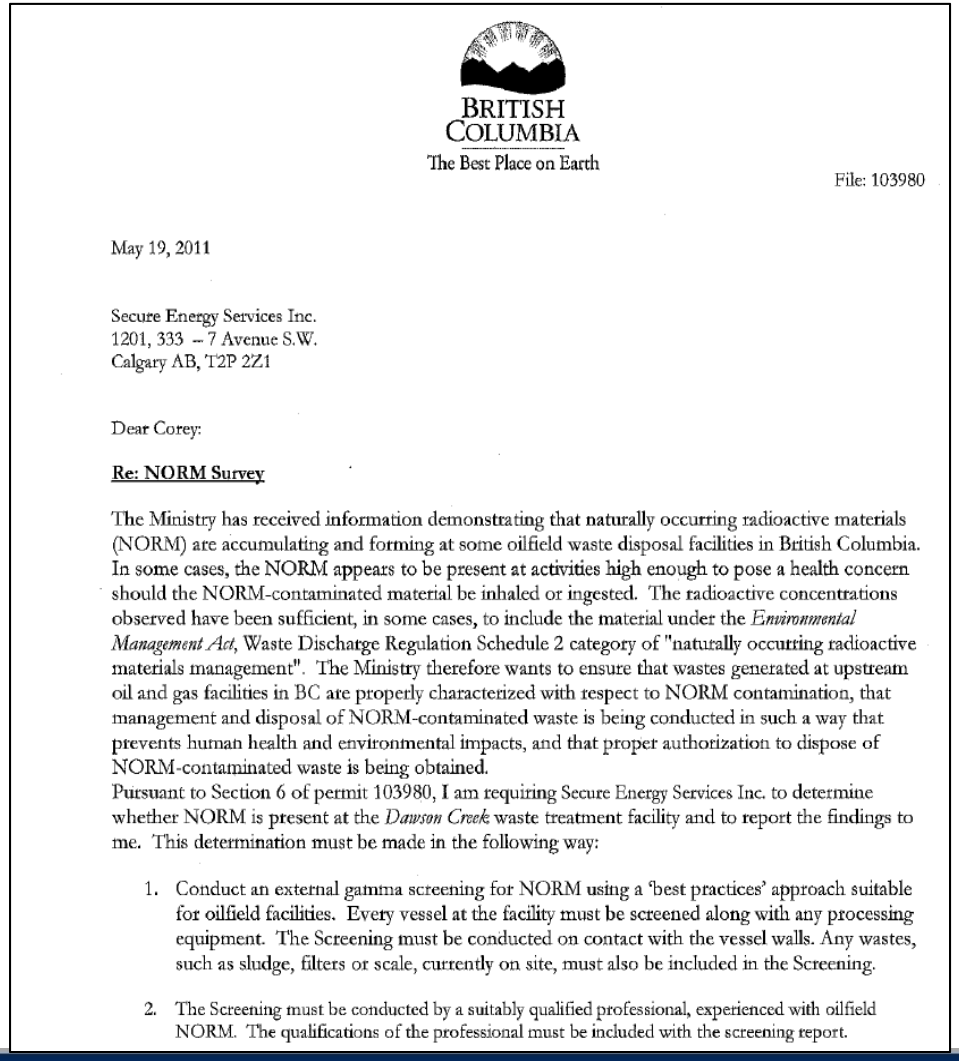
Impact of Shale Plays



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File: 103980

May 19, 2011

Secure Energy Services Inc.
1201, 333 – 7 Avenue S.W.
Calgary AB, T2P 2Z1

Dear Corey:

Re: NORM Survey

The Ministry has received information demonstrating that naturally occurring radioactive materials (NORM) are accumulating and forming at some oilfield waste disposal facilities in British Columbia. In some cases, the NORM appears to be present at activities high enough to pose a health concern should the NORM-contaminated material be inhaled or ingested. The radioactive concentrations observed have been sufficient, in some cases, to include the material under the *Environmental Management Act*, Waste Discharge Regulation Schedule 2 category of "naturally occurring radioactive materials management". The Ministry therefore wants to ensure that wastes generated at upstream oil and gas facilities in BC are properly characterized with respect to NORM contamination, that management and disposal of NORM-contaminated waste is being conducted in such a way that prevents human health and environmental impacts, and that proper authorization to dispose of NORM-contaminated waste is being obtained.
Pursuant to Section 6 of permit 103980, I am requiring Secure Energy Services Inc. to determine whether NORM is present at the *Dawson Creek* waste treatment facility and to report the findings to me. This determination must be made in the following way:

1. Conduct an external gamma screening for NORM using a 'best practices' approach suitable for oilfield facilities. Every vessel at the facility must be screened along with any processing equipment. The Screening must be conducted on contact with the vessel walls. Any wastes, such as sludge, filters or scale, currently on site, must also be included in the Screening.

2. The Screening must be conducted by a suitably qualified professional, experienced with oilfield NORM. The qualifications of the professional must be included with the screening report.

- 5-10 Times Increase in NORM Levels Since 2011
- All Oil and Gas Waste Management Facilities Handling Produced Water From Shale Have NORM Impacts

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Impact of Shale Plays – Dawson Creek FST

SASKATCHEWAN RESEARCH COUNCIL

Environmental Analytical Laboratories
102 - 422 Downey Road, Saskatoon, SK Canada S7N 4N1

T: 306-933-6932 F: 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca

www.src.sk.ca/analytical

SRC Group # 2015-7353
Jul 22, 2015

Analyte Name	Units	Results	Unconditional Release Limit	
Thorium-232 (calc)	Bq/g	0.005	10	
Uranium-238 (calc)	Bq/g	0.006	10	
Radium-228	Bq/g	13	0.3	+
Thorium-228	Bq/g	5.6	0.3	+
Thorium-230	Bq/g	5	10	
Radium-226	Bq/g	81	0.3	+
Lead-210	Bq/g	0.9	0.3	+
Potassium-40	Bq/g	1	17	

NORM MGMT PLAN

1

CANADA

CONSOLIDATION

CODIFICATION

Packaging and Transport of Nuclear Substances Regulations

Règlement sur l'emballage et le transport des substances nucléaires

[Repealed, SOR/2015-145, s. 51]

[Abrogé, DORS/2015-145, art. 51]

Current to August 30, 2015

Last amended on June 12, 2015

2

3

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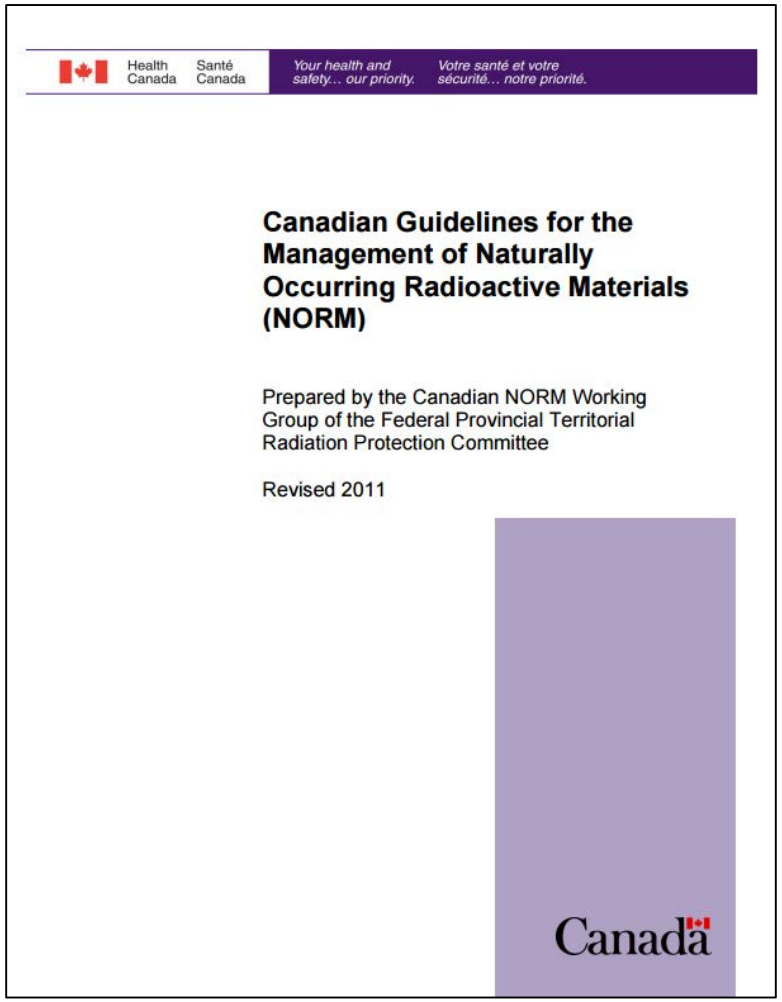
Health Canada NORM Guidelines



Health Canada Santé Canada

Your health and safety… our priority. *Votre santé et votre sécurité… notre priorité.*

Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM)

Prepared by the Canadian NORM Working Group of the Federal Provincial Territorial Radiation Protection Committee

Revised 2011

Canada

Table 2.1
Radiation Dose Limits

Affected Group	Annual Effective Dose Limit (mSv)[a]	Five Year Cumulative Dose Limit (mSv)
Occupationally Exposed Workers[b]	20[c]	100
Incidentally Exposed Workers and Members of the Public	1	5

Table 5.1
Unconditional Derived Release Limits- Diffuse NORM Sources

NORM Radionuclide	Derived Release Limit[a] Aqueous[b] (Bq/L)	Solid (Bq/kg)	Air (Bq/m^3)
Uranium-238 Series (all progeny)	1	300	0.003
Uranium-238 (U-238, Th-234, Pa-234m, U-234)	10	10,000	0.05
Thorium-230	5	10,000	0.01
Radium-226 (in equilibrium with its progeny)	5	300	0.05
Lead-210 (in equilibrium with bismuth-210 and polonium-210)	1	300	0.05
Thorium-232 Series (all progeny)	1	300	0.002
Thorium-232	1	10,000	0.006
Radium-228 (in equilibrium with Ac-228)	5	300	0.005
Thorium-228 (in equilibrium with all its progeny)	1	300	0.003
Potassium-40	n/a[d]	17,000[c]	n/a

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Provincial Regulations / OH&S

Environmental Management Act

WASTE DISCHARGE REGULATION

Note: Check the Cumulative Regulation Bulletin 2014 and 2015 for any non-consolidated amendments to this regulation that may be in effect.

[includes amendments up to B.C. Reg. 87/2012, April 20, 2012]

"naturally occurring radioactive materials management" means activities and operations associated with controlling or discharging naturally occurring radioactive materials that exceed the limits specified in Tables 5.1, 5.2 or 5.3 of the Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORMs),

(a) prepared by the Canadian NORM Working Group of the Federal Provincial Territorial Radiation Protection Committee,

(b) published by authority of the Ministry of Health (Canada), and

(c) as amended from time to time,

but does not include managing radon in buildings;

Directive 058

ERCB

Oilfield Waste Management Requirements for the Upstream Petroleum Industry

November 1996, incorporating change of February 1, 2006

Appendix 8.1 and 8.2 replaced by Section 4 of *Directive 030*

Waste Management Table (cont'd)

EUB Waste Name [Waste Code]	Oilfield Class	Common Transport Class	Common Criteria	Common/Acceptable Practices	Comments
Naturally Occurring Radioactive Materials - NORMs [NORM]	Dangerous Oilfield Waste	- Class 7	toxicity	- General disposal guidelines as given in the Alberta Labour Guidelines *Guidelines for the Handling of Naturally Occurring Radioactive Materials (NORM) in Western Canada*	- See Part F, Section 31.0 for specific disposal procedures - General guidelines for the handling and disposal of NORM waste have been developed by the Western Canada NORM Committee. *Guidelines for the Handling of Naturally Occurring Radioactive Materials (NORM) in Western Canada* are available from Alberta Labour

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Alberta Tier 1 Soil Cleanup Standards

Soil Type	Fine					Coarse					Notes
Land Use	Natural Area	Agricultural	Residential/ Parkland	Commercial	Industrial	Natural Area	Agricultural	Residential/ Parkland	Commercial	Industrial	
Unit	(Bq/g)	(Bq/g)	(Bq/g)	(Bq/g)	(Bq/g)	(Bq/g)	(Bq/g)	(Bq/g)	(Bq/g)	(Bq/g)	
Radionuclides											
Uranium-238 Series (all progeny)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	10
Uranium-238 (^{238}U, ^{234}Th, ^{234}mPa, ^{234}U)	10	10	10	10	10	10	10	10	10	10	10
Thorium-230	10	10	10	10	10	10	10	10	10	10	10
Radium-226 (in equilibrium with its progeny)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	10
Lead-210 (in equilibrium with ^{210}Bi and ^{210}Po)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	10
Thorium-232 Series (all progeny)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	10

NORM – Activity Levels in WCSB

NORM Unrestricted Release @ 0.3 Bq/g:

1) **Treater Waste: Ra226 > 600 Bq/g**
2) **LPG Waste: Pb210 > 17,000 Bq/g**

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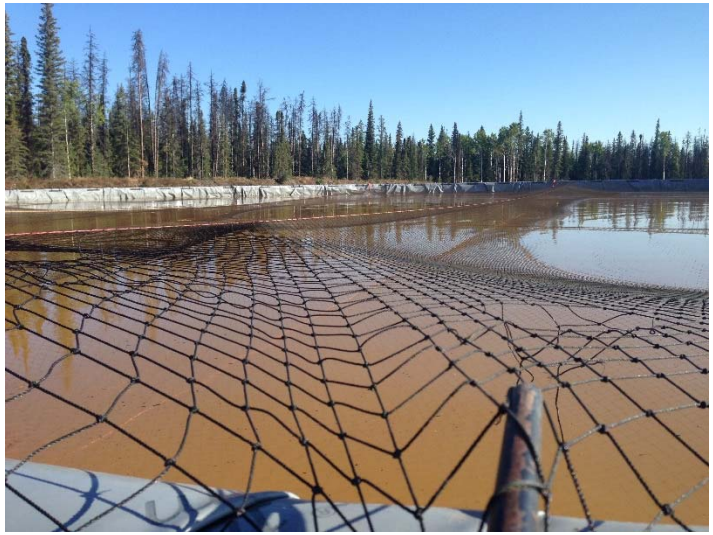
NORM Management – Best Practices



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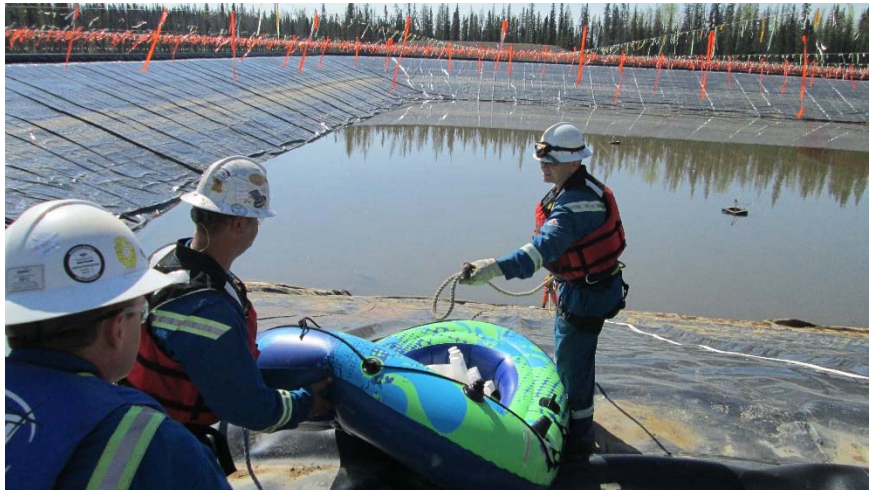
Risk Identification, Assessment and Control



Analyte Name	Units	Results	Unconditional Release Limit	
Thorium-232 (calc)	Bq/g	0.002	10	
Uranium-238 (calc)	Bq/g	0.004	10	
Radium-228	Bq/g	2.4	0.3	+
Thorium-228	Bq/g	6.2	0.3	+
Thorium-230	Bq/g	8	10	
Radium-226	Bq/g	13	0.3	+
Lead-210	Bq/g	2.2	0.3	+
Potassium-40	Bq/g	0.3	17	

Photograph 2 **Date:** May 11, 2015

Background confirmation, 109 nSv/hr and 46 counts per minute (cpm).

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Potential Concerns: Radium Impacted Waste?

1) External Exposure
   - Gamma Radiation
2) Internal Exposure
   - Inhalation Low Level Radioactive Dust (LLRD)
   - Radon gas build up at bottom of pit
3) Spread and Tracking of Radium Sludge (clothing, pickups, equipment)
4) NORM Impacted Equipment (pumps, excavators, hoses, other)
5) Training and Regulatory Requirements
6) Transport and Licensed Disposal of NORM Waste

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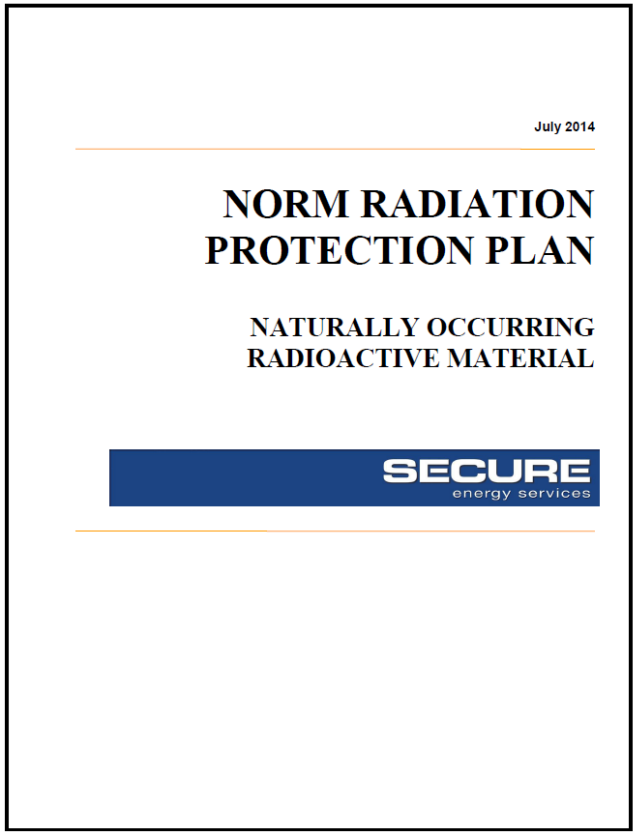
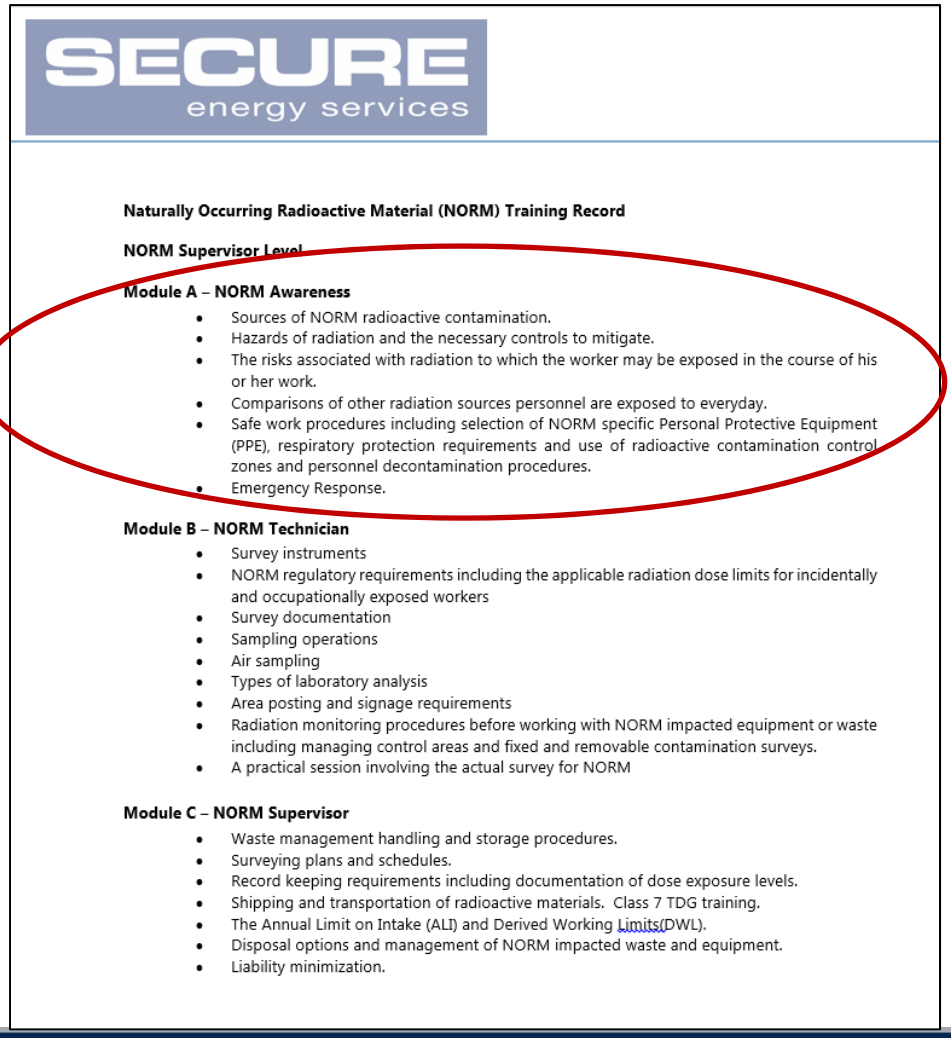
Step 1 – NORM Management Program

1) A statement of purpose and responsibilities
2) Risk identification, assessment and control
3) Education and training
4) Written work procedures
5) Hygiene facilities and decontamination procedures
6) Health monitoring - internal and external
7) Waste Management
8) Documentation



Education and Training



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Naturally Occurring Radioactive Material (NORM) Training Record

NORM Supervisor Level

Module A – NORM Awareness

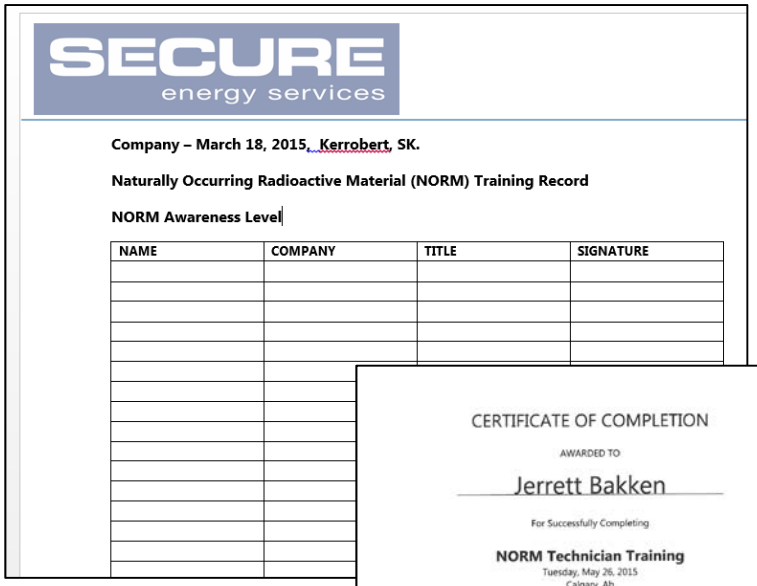
- Sources of NORM radioactive contamination.
- Hazards of radiation and the necessary controls to mitigate.
- The risks associated with radiation to which the worker may be exposed in the course of his or her work.
- Comparisons of other radiation sources personnel are exposed to everyday.
- Safe work procedures including selection of NORM specific Personal Protective Equipment (PPE), respiratory protection requirements and use of radioactive contamination control zones and personnel decontamination procedures.
- Emergency Response.

Module B – NORM Technician

- Survey instruments
- NORM regulatory requirements including the applicable radiation dose limits for incidentally and occupationally exposed workers
- Survey documentation
- Sampling operations
- Air sampling
- Types of laboratory analysis
- Area posting and signage requirements
- Radiation monitoring procedures before working with NORM impacted equipment or waste including managing control areas and fixed and removable contamination surveys.
- A practical session involving the actual survey for NORM

Module C – NORM Supervisor

- Waste management handling and storage procedures.
- Surveying plans and schedules.
- Record keeping requirements including documentation of dose exposure levels.
- Shipping and transportation of radioactive materials. Class 7 TDG training.
- The Annual Limit on Intake (ALI) and Derived Working Limits(DWL).
- Disposal options and management of NORM impacted waste and equipment.
- Liability minimization.



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Company – March 18, 2015, Kerrobert, SK.

Naturally Occurring Radioactive Material (NORM) Training Record

NORM Awareness Level

NAME	COMPANY	TITLE	SIGNATURE

CERTIFICATE OF COMPLETION

AWARDED TO

Jerrett Bakken

For Successfully Completing

NORM Technician Training

Tuesday, May 26, 2015

Calgary, Ab

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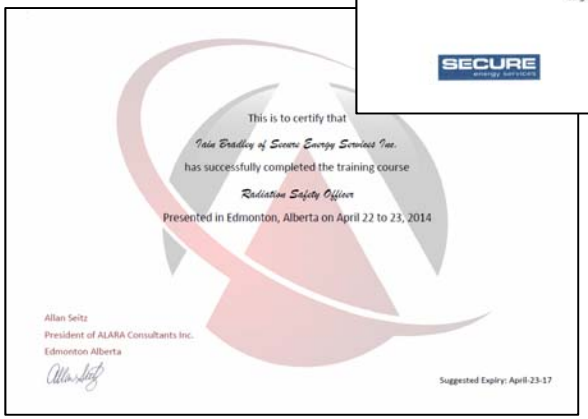

This is to certify that

Tala Bradley of Secure Energy Services Inc.

has successfully completed the training course

Radiation Safety Officer

Presented in Edmonton, Alberta on April 22 to 23, 2014

Allan Seitz

President of ALARA Consultants Inc.

Edmonton Alberta

Suggested Expiry: April-23-17

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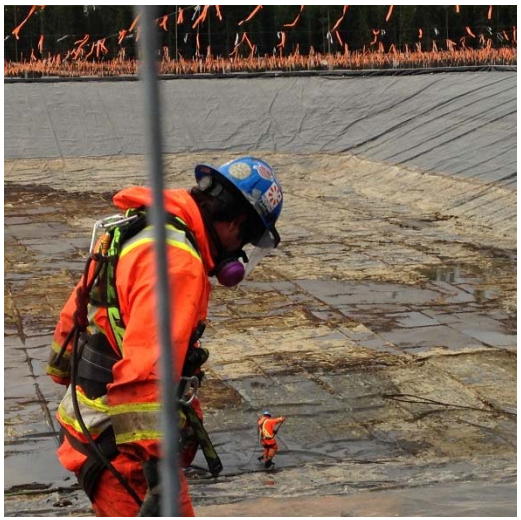
Environmental Monitoring and Control Areas



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NORM Disposal Options

British Columbia:

- **1 NORM Landfill**
  - ✓ **Fort St. John, BC < 5 Bq/g Ra226**

  Solids ONLY ***(Filter Socks, PPE, Debris, Soil)***

Alberta:

✓ **No NORM Disposal Options in Alberta**

Saskatchewan:

- **2 NORM Salt Caverns**
  - ✓ **Unity, Sk. < 70 Bq/g**
  - ✓ **Melville, Sk. < 300 Bq/g**

  Liquid / Sludge ONLY

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Waste Management – Transport and Disposal

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Journey Management

Appendix A – Journey Management Plan Form

Journey Management Form

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	Trip Description:	Names of Passengers (for light vehicles / pickups only)	Alternate driver?
Is the trip necessary? Why?			
Can it be combined with another trip? Why not?			
Is there a need for night driving? Why?			
Name of nominated contact person			

Departure date	Departure time	Vehicle ID

Route Destination and Rest Area

No alcohol or drugs while working or driving

Do not use your phone or exceed speed limits while driving

May 2015

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NORM HOLDING POND CLEANOUT AND INSPECTION – EMERGENCY RESPONSE PLAN

MAY 2015

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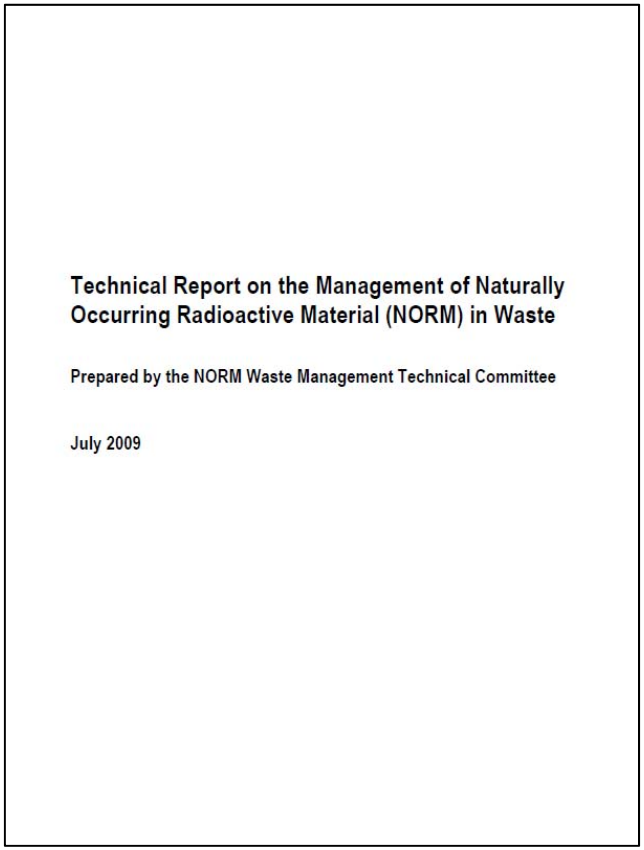
What can we do better? Disposal!



Technical Report on the Management of Naturally Occurring Radioactive Material (NORM) in Waste

Prepared by the NORM Waste Management Technical Committee

July 2009

1 PREFACE

The NORM Waste Management Technical Committee (NORM committee), comprising government and industry representatives, was established to identify and recommend technical requirements for management of waste in Alberta with naturally occurring radioactive material (NORM).

Conclusions

The committee concludes the following:

1) Although NORM waste currently exists at upstream petroleum sites, an industry survey would provide an understanding of the extent, quantity, and types of NORM wastes. This would support the development of a NORM waste management policy that provides appropriate public safety and environmental protection and reflects industry's waste disposal needs.

2) The radiological protection criteria set out in the *Canadian NORM Guidelines* are technically appropriate standards for the safe handling, storage, and disposal of NORM.

3) The *Canadian NORM Guidelines* provide sufficient information regarding NORM public health and worker safety, but they do not provide guidance on NORM waste disposal options.

4) Waste minimization techniques should be applied, where appropriate, to NORM wastes. The recovery of recyclable components such as crude oil or metal equipment should be encouraged.

5) Four options are technically appropriate for the disposal of NORM, although specific regulatory requirements for the options need to be developed:
   - canister disposal during well abandonment,
   - deep well injection,
   - salt cavern injection, and
   - landfill disposal.

6) Based on available risk assessment studies, radioactive concentration limits
   - are recommended for disposal of NORM into landfills, but
   - are not recommended for disposal of NORM into canister disposal during well abandonment, deep well injection, and salt cavern injection.

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2 New Disposal Options – In Regulatory Process

BC: Kotcho - Deep Well Disposal

- NORM Sludge / Liquids
- Existing licensed disposal well
- Non-fracture slurry injection

AB: Pembina- Class I Landfill Disposal

- Solid NORM Waste
- Existing licensed Hazardous Waste Landfill
- (non-TDG / non- CNSC regulated)

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A Better Way to Manage Waste

Cleanup underway in Noonan

12 HOURS AGO • BY LAUREN DONOVAN | BISMARCK TRIBUNE

NOONAN — A radiation team cleaning up an illegal oil field waste dump site in Noonan found an underground cache of the material and labels that are possible evidence of companies that contributed to the mess.

The cleanup was expected to take all day Wednesday, with a crew of six workers in oil-streaked suits and respirators pulling tons of low-level radioactive filter socks from an abandoned gas station in this tiny town near the Canadian border.

The dump was discovered in late February and state and local officials started looking for the culprit and making plans to get the material safely disposed.

The property owner is a criminal fugitive in Wyoming and the state is using its own clean up funds instead of forcing the owner to deal with the situation.

Robert Krumberger, manager for Secure Energy Services, said his workers soon uncovered an underground sump area in the old garage, which also was full of the filter socks. He said he called for additional lined containers and estimated the building contained 60 cubic yards of filter sock waste, instead of the 40 originally estimated.

QUESTIONS?