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# NATURALLY OCCURING RADIOACTIVE MATERIALS (NORM)

## <u>SUBPART A - GENERAL</u>

It shall be noted that this standard is site-specific and all designated personnel participating in TENORM activities shall be orientated and trained according to their specific role within the scope of the project.

#### **SUBPART B - RESPONSIBILITY**

Pursuant to BBGCI's license number LA-7110-S01, Mr. Bo Sanner, NORM Superintendent, is the Radiation Safety Officer and as such is the program administrator.

#### SUBPART C - NATURALLY OCCURRING RADIOACTIVE MATERIAL (NORM)

NORM is a naturally occurring radioactive material that can be found as a byproduct of drilling and producing oil and gas wells. Naturally occurring radioactive materials include the elements uranium, thorium, radium, radon, and their daughter products. NORM can be associated with oil and gas production and is typically found in concentrations of corrosion, scale, or sediment rather than in the produced fluids themselves.

Much of the petroleum in the earth's crust was created at the site of ancient seas by the decay of sea life. As a result, petroleum deposits often occur in aquifers containing brine (salt water). Radionuclides, along with other minerals that are dissolved in the brine, precipitate (separate and settle) out forming various wastes at the surface:

- Mineral scales inside pipes.
- Sludges.
- Contaminated equipment or components.
- Produced waters.

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#### SUBPART D - TENORM (Technology Enhanced Naturally Occurring Radioactive Materials)

When resources (oil and gas) are extracted from the earth, the natural radioactive material (NORM) comes with those resources. In processing the desired resource, the radioactive material is removed and becomes a waste. The radioactive wastes from extraction and processing are called 'Technologically Enhanced Naturally Occurring Radioactive Material' (TENORM) because human activity has concentrated the radioactivity or increased the likelihood of exposure by making the radioactive material more accessible to human contact.

Examples of where TENORM has been found include but are not limited to:

- Down-hole tubing scale.
- Above ground processing equipment in natural gas liquid service.
- Salt water disposal/injection wells and associated equipment.
- Soils contaminated by well workovers, tank cleaning, salt water leaks, pipe cleaning, and other associated operations.

The primary objective is to control occupational illness and injuries caused by TENORM-associated hazards through the use of administrative means and personal protective equipment.

#### **SUBPART E - IDENTIFICATION**

#### Background

All three common types of radioactive decay (alpha, beta, and gamma) are associated with NORM. If body tissues or organs are exposed to excessive radiation, biological damage can occur. The radioactive decay from NORM behaves very much like light, except that the individual particles have much more energy. Consequently, the weaker the NORM source the less radiation it emits. The more material shielding the NORM the less radiation it emits. Also, the less time an individual is exposed to a source of radiation, the smaller the exposure. Therefore, it is important to follow proper precautions when handling NORM, in order to control any potential hazards the radioactive material might pose to employees, the public or the environment.

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High energy gamma radiation can easily pass through production equipment. Consequently, its presence is used to identify NORM deposits.

Alpha and beta emissions produced by NORM deposits have relatively low energy and are incapable of penetrating production equipment. Therefore, they are not of any concern during routine production operations. However, during certain maintenance and construction operations that may generate NORM dust, the potential for inhalation exposure shall determine what work practices and protective measures are used during certain tasks.

### SUBPART F - APPEARANCE OF NORM

NORM can vary in appearance depending on where it accumulates in the production stream.

**Exploration/Production -** NORM in primary separation equipment can range from a black oil viscous sludge to a "crusty" brown soft material.

**Processing Equipment -** NORM in equipment can appear as a hard gray/brown deposit, white dust, or sand. Separation vessels may have NORM - contaminated debris/grit in the bottom of the vessel.

**Gas Plants and other LPG facilities -** NORM typically plates-out as a thin film on equipment walls such as T-valves and elbows, with little or no loose accumulations. These films adhere to the metallic walls of the equipment and may not be readily visible. NORM may also incorporate itself into a readily removable material lining on the interior surface of the equipment, such as pipe rouge.

# **SUBPART G - ACTION LEVELS**

Equipment action levels are based on the maximum reading at any accessible point. The levels are as follows:

• Any equipment reading 50 microroentgens per hour (50 \_uR/hr) at any accessible point is considered NORM-contaminated and shall be handled in accordance with this policy.



- Sludge/Scale shall be considered NORM-contaminated if the concentrations of radium-226 and/or radium- 228 are greater than or equal to 30 picocuries per gram (pCi/gm).
- Soil shall be considered NORM-contaminated if the concentrations of radium-226 and/or radium 228, averaged over any 100 square meters, are greater than background levels.

**NOTE:** Some local regulations may have a lower limit specified, in which case the more stringent of the limits shall apply.

#### SUBPART H - RADIATION SURVEY INSTRUMENTS AND MEASUREMENTS

Radiation emitted from NORM cannot be detected by human senses. Instrumentation is required to detect and quantify the radiation emissions from NORM. The measurement of radiation dose rates and/or surface activity levels is necessary both to determine whether NORM is present and to select appropriate precautionary measures.

The type of survey equipment used is based on the form of the radiation (alpha, beta and/or gamma) being measured. There is no universal radiation field instrument that can be used to measure all forms of radiation. Consequently, several different instruments or probes are used in assessing NORM contamination.

A radiation meter that can support the three measurement probes listed below or separate meters as appropriate.

- Gamma scintillation probe (screening survey) or a pressurized ion chamber meter.
- Energy-compensated GM tube (dose rates).
- Thin window or pancake probe (surface contamination).

# **SUBPART I - NORM SURVEYS**



NORM surveys shall be conducted with the appropriate survey meter to determine NORM levels. Two types of surveys may be conducted, external surveys and internal surveys. The type of survey performed depends on the NORM materials you are trying to detect.

The following survey requirements apply to all operations that are not already documented as being free of any NORM contamination.

Production facility, plant, and wells shall be surveyed prior to release for unrestricted use.

The Radiation Safety Officer or his/her designee will be responsible for conducting the initial testing of equipment for the presence of NORM.

A NORM survey shall be performed before any transfer of equipment. This includes:

- Transfer for unrestricted or restricted use.
- Purchase of used equipment.
- Sale of surplus or scrap equipment.

#### SUBPART J - INSTRUMENT CARE

- To avoid breaking internal wires, do not kink the connecting cables.
- Keep battery contacts clean and free of corrosion residue.
- Remove the batteries between uses when the instruments are used infrequently or when they are stored in a humid environment.
- Keep survey instruments clean and free of NORM residue.
- Conduct operational checks of the instruments prior to each use, or after the detector has been dropped or jarred.
- Check the battery reading.
- Check the instrument reading against a known standard, such as a check source.
- Have a radiation service laboratory calibrate each survey instrument every 12 months (unless state regulations require more frequent servicing) and/or after each instrument servicing.



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- Maintain records of calibration tests for a period of three years unless local regulations require longer retention.
- The laboratory shall ensure that the instrument is accurate within plus or minus 20 percent of the true radiation level measured on each scale.

# **SUBPART K - PERSONAL PROTECTIVE EQUIPMENT (PPE)**

The preferred type of protection against radiation is time, distance and shielding. In addition, PPE shall be selected and worn according to the severity of the hazard to be encountered. It shall include both respiratory protection and chemical protective clothing.

#### **Respiratory Protection**

The guidelines in the host employer's policy and procedures shall be followed whenever respiratory protection is used to protect personnel from the potential effects of radionuclide dusts and other respiratory hazards that may be encountered on the work site.

The minimum approved level of respiratory protection shall consist of a half-facepiece respirator with high efficiency particulate air (HEPA) cartridges approved for radionuclide dust. These cartridges have a magenta or hot pink color code. Fullface-piece respirators with HEPA cartridges or SCBA or airline respirators may also be used.

During vessel entry for inspection or cleaning, one of the following positive pressure (pressure demand) devices shall be used:

- Self-contained breathing apparatus (SCBA).
- Airline respirator with air cylinder cascades or another approved air supply.

#### **Chemical Protective Clothing (CPC)**

CPC shall include, but not be limited to:

- Gloves of latex rubber or neoprene.
- Rubber work boots with steel toe and shank.



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• Coveralls: Nomex® is sufficient in most cases where decontamination is possible. Disposable suits such as Tyvek® or Kleenguard® may also be used and is preferable if available.

#### SUBPART L - DECONTAMINATION OF PERSONAL PROTECTIVE EQUIPMENT (HYGIENE)

Clean all contaminated PPE in a designated area. Decontaminate gloves, coveralls, boots, cleaning rags, and tools by rinsing with soapy water. Contain, dilute, and disposing of the rinse water in a Class II disposal well. Clean respirators according to the provisions of the facility's *Respiratory Protection Program*.

When decontamination is not possible, the materials shall be placed in double bags, sealed, and held for proper disposal with other NORM waste. No contaminated material shall leave the site unless properly sealed for storage or disposal.

Decontaminated clothing should be checked with an appropriate survey meter. If the surface radiation level is greater than 50 CPM, (using a pancake probe) the clothing should be cleaned again.

# **SUBPART M - MEDICAL SURVEILLANCE**

Employees required to use respiratory protection shall be in a facility respiratory protection plan and shall be medically qualified and trained for the type of respirator they are required to use. Refer to Berry Bros.' *Respiratory Protection Program*.

# **SUBPART N - NORMAL WORK PROCEDURES**

Normally, no significant external radiation hazard is associated with the routine operation of TENORM contaminated equipment in production and gas processing facilities. Consequently, no changes to normal work procedures are required. As always, following good personal hygiene practices minimizes any potential exposure to NORM.

# SUBPART O - AREAS OF POTENTIAL NORM EXPOSURE



Direct contact by employees with NORM-contaminated sand, scale, and sludge may occur during certain specific jobs, including but not limited to the following:

- Well work-over.
- Equipment maintenance.
- Decommissioning equipment and handling and/or repair.
- Vessel entry.
- Surface remediation.

# **SUBPART P - GUIDELINES FOR WORKING WITH/AROUND NORM**

When working with NORM-contaminated materials, the following shall be done to minimize any potential internal exposure hazards:

- If practical, establishing and marking off, using yellow tape or similar method, perimeters around the NORM work area. Inside the perimeter, NORM work practices would be required.
- Advising employees and contractors of the presence of NORM and of the procedures used to minimize exposure.
- Capping, sealing, or wrapping in plastic all openings on NORM-contaminated equipment to minimize the generation of any dust or the displacement of scale or sludge that may contaminate the surrounding soil.
- Wearing approved protective boots and gloves when moving, handling, or transporting tubulars or other open equipment that has been identified as NORM-contaminated. Every effort shall be made to eliminate or contain scale and dust.
- Employees will also wear a dosimeter to measure the amount of radiation they are exposed too.
- Keeping NORM scale and sludge materials wet during handling to minimize dust generation.



- Wearing gloves, boots, coveralls, and an approved radionuclide respirator when doing work that creates dust on NORM-contaminated equipment.
- Using temporary plastic ground covers and/or approved storage containers to contain any displaced NORM contamination.

**NOTE:** For more specific rules and guidelines please refer to Berry Bros.' state license for NORM Remediation.

# **SUBPART Q - WARNING SIGNS AND LABELS**

NORM storage areas shall be identified by a sign bearing the three-bladed radiation symbol (magenta blades on yellow background) and stating:

NORM Storage Area Sign



#### STORAGE AREA SIGN

Yellow Background Black Printing Magenta Trifoil

If radiation levels at any accessible point within the storage area exceed 5 mrem/yr, the sign shall contain the words "CAUTION - RADIATION AREA," as required in the OSHA regulations 29 CFR 1910.96, *Ionizing Radiation*.



Each storage drum of NORM-contaminated equipment shall bear a label that clearly states the following:

NORM Storage Drum Label



DRUM LABEL

Yellow Background Black Printing Magenta Trifoil

NOTE: Under DOT requirements, the shipment of such drums may require additional labeling.

NORM storage area documentation records shall be maintained according to the host employer's requirements of Record Keeping.

Each piece of in-service or stored NORM-contaminated equipment, such as heater- treaters and separators, shall bear a label that clearly states the following:

NORM-Contaminated Equipment Sign



#### **EQUIPMENT LABEL**

Yellow Background Black Printing Magenta Trifoil



#### SUBPART R - GENERAL TRANSPORTATION PROVISIONS

DOT Specification 7A packaging shall be used for transporting NORM. Packaging that meets these requirements include DOT 17H drums or equivalent, or sealed equipment such as heater treaters and separators.

Small NORM-contaminated materials (bulk scale, sludge, soil, and any decontamination materials such as Tyvek® suits) shall be packaged in strong, tight packages, such as DOT-approved 17H drums or the equivalent, to prevent leakage of radioactive material.

All the openings on NORM-contaminated equipment shall be sealed to prevent possible leakage of radioactive material. Production tubing shall be capped and chained tightly together. Openings of heater treaters and separators shall be covered with blanks or suitable plastic and tape. The coverings shall be watertight.

The truck shall not contain any loose radioactive material such as scale or sludge.

Equipment shall be braced to prevent shifting.

Trained Company or contractor personnel shall be used to load and unload NORM waste shipments.

#### **SUBPART S - SHIPPING PAPERS**

A shipping order, bill of lading, manifest, or other document shall accompany the NORM shipment. The paper shall contain at least the following information:

- Designation of the item or material as contaminated with naturally occurring radioactive material.
- The container identification code.
- The quantity of NORM being transported.
- The person or firm to whom the material is consigned.
- Emergency response information.

The shipping paper description should read as follows:

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RQ, Radioactive Material, Low Specific Activity (LSA), N.O.S., UN 2912, [Number of drums or total weight] [drums or pounds], RA 226, solid, [Number of microcuries], [Radioactive White I or Radioactive Yellow II], [transport number if the material is Radioactive Yellow II].

The following additional documents shall be included with the shipping papers:

- Written instructions, either stamped or attached to the bill of lading, that inform the carrier not to unload or receive additional loads en route to the designated delivery site; for example: "The carrier is forbidden to unload or receive additional loads in route to the designated delivery site;"
- A Material Safety Data Sheet (MSDS) or equivalent document with a 24-hour emergency telephone number;
- A completed Vehicle Survey Form. Refer to APPENDIX 10, Vehicle Survey Data Sheet, for an example of this form. The form shall be completed once the vehicle has been loaded. It shall include survey readings taken at 1 meter (3-foot) intervals along the exterior sides of the cargo compartment and from within the driver's compartment.

**Note:** This survey shall be performed with the Ludlum 3, 44-2 or 44-9 probe.

#### SUBPART T - EMERGENCY PROCEDURES

#### Spill or Leak Procedures

If NORM material is spilled or released, steps should be taken to contain or prevent discharges to streams, waterways, or sewer systems; and to control or stop release of NORM material into the air as dust.

Refer to the Environmental Management Policy and Procedures.

#### <u>SUBPART U - TRAINING</u>

#### General

All employees working or having contact with NORM-contaminated materials shall be trained in the wearing and use of approved radionuclide respirators, gloves, boots, and coveralls.



BBGCI will train employees in the hazards, location, methods to identify the hazards and methods used to protect themselves (HEPA filters on respirators & limitations).

The training will take place at least annually and before exposures occur and will include normal & emergency situations.

All employees responsible for performing surveys, monitoring and sampling NORM contamination shall be trained according to the requirements of this policy and any applicable local regulatory requirements. In addition, NORM survey technicians shall be trained in the following subjects prior to conducting survey work:

- Characteristics of Radiation
  - o NORM occurrence
- Units of Measurements
- Radiation dose
  - o Quantity of radioactivity
- Health Effects
- Radiation Control
- Time, distance and shielding
  - Personal protective equipment
- Radiation Instrumentation
- Principles of operation
  - o Calibration
  - o Limitations
- Survey Techniques
- Measurement protocol for NORM
  - o Survey procedures

#### Hazard Communication

Employees and contractors entering NORM storage areas shall be informed about:

- The presence of radioactive materials.
- Safety problems associated with exposure to radioactive materials.



• The methods of minimizing exposure to radiation.

# SUBPART V - RECORD KEEPING

All training and medical surveillance records will be kept in accordance with local, state, and federal regulations.

The recorded data shall include:

A unique identification code corresponding to each of the stored containers or pieces of equipment, use the standard equipment types as described on the back of the form, with additional description as necessary;

**NOTE:** Tubular goods may be referenced to a unique identification code.

- The storage location of the material.
- The type of radioactive material, for example, scale or sludge.
- The date the material or equipment entered storage.
- The original location and the type of service of the material or equipment.
- The level of radioactivity (\_uR/hr, etc.) of each container and piece of equipment.
- Results of semi-annual radiation level surveys.
- Radiation exposure data of those individuals required by OSHA regulations to wear employee monitoring equipment.

ATTACHEMNT: BBGCI's Radioactive Material License

Revision Date: \_\_\_\_11-17-14\_\_\_\_\_



Approved By: \_Joe Berry & Safety Committee