Brunel Energy, Inc.

NATURALLY OCCURRING RADIOACTIVE MATERIAL (NORM)

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1. Purpose

1.1. Brunel Energy, Inc., herein, "the Company," has established a program compliant with OSHA Ionizing Radiation Standard (29 CFR 1910.1096) to protect employees from exposure to ionizing radiation sources that are not regulated by other federal agencies. This policy describes NORM characteristics, testing, disposal, and safety procedures. The NORM Policy is administered by the HSE Manager of the Company.

2. Applicability

2.1. This policy applies to employees, subcontractors and/or visitor(s) of the Company. For the purposes of this policy, an employee shall be considered on the job whenever he/she is:

2.1.1. On or in, any company or client property, including parking areas; or

2.1.2. On company time even if off company premises (including paid lunch, rest periods and periods of being on call). f

2.2. As a condition of employment, Company employees are required to abide by additional governmental or customer policies and requirements that may be imposed at a worksite in addition to the requirements of these policies and procedures. Nothing set forth in this policy constitutes, construes, or interprets in any way as a contract of employment.

3. Definitions

3.1. **NORM** is a low-level, naturally occurring radioactive material. In the oilfield, NORM forms when radium is dissolved and carried to the surface in produced water. The amount of radium varies among produced waters from different geologic formations. Where NORM occurs it typically accumulates as sludge and scale. It may be present in operations involving water tanks, gun barrels and flow lines.

3.2. **Radionuclides** of natural origin are contained in or released from process materials and may pose a risk to workers, the public or the environment. These radioactive elements in minerals and ores originally found in the environment are commonly known as NORM - Naturally occurring radioactive material. Some NORM materials require radiation and control.

3.3. **Radon** is a naturally occurring radioactive gas, is found in soils, rock, and water throughout the US. Radon bars can accumulate in below-ground areas (e.g., basements, tunnels) as well as in above ground areas inside buildings, trenches, and excavations. The primary source of radon is uranium found in the earth.

3.4. **Radium (Ra-226 and Ra-228)** may occur in water drawn from deep aquifers (groundwater sources).

3.5. **Uranium (U)** is in the ground before being mined and processed.

3.6. **Carbon-14 (C-14)** is taken up by all plants and animals and can be measured by scientists to determine the age of organic materials through "carbon dating."

3.7. **Potassium-40 (k-40)** occurs naturally and can be found in several foods, especially bananas.

3.8. **Cosmic rays** come from high energy particles originating both within and outside our solar system, are associated with several different types of radiation (e.g., alpha, gamma, neutron, and x-ray) and contribute to the radiation does airline crew members services.

4. Responsibilities

4.1. The HSE Manager is responsible for overseeing the NORM safety program.

4.2. Managers/Supervisors shall:

4.2.1. Responsible for understanding the NORM policy and enforcing the policy.

4.2.2. Ensure that all employees assigned to at risk areas for NORM receive training.

4.2.3. Ensure that all employees are aware of the proper work procedures for NORM.

4.2.4. Ensure that initial training is conducted for all new employees and that retraining is conducted when employee behaviors suggest that retraining is warranted.

4.2.5. Identify and evaluate NORM hazards and potential exposures during planning and performing work.

4.2.6. Review and approve the task-specific safety analysis.

4.2.7. As necessary, quantitatively determines the presence of NORM in materials, substrates, and other media. This may involve the collection of samples for analysis by a qualified laboratory or field testing using acceptable test methods.

4.2.8. Provide results of any NORM survey to management/supervision, along with information regarding hazard potential and control measures. as appropriate, makes recommendations to management/supervision to maintain, modify, upgrade, or downgrade controls accordingly.

4.2.9. Take prompt corrective measures (or supports any competent person in this role) to eliminate hazards, such as recommending to management/supervision to implement or modify engineering, administrative, work practice, and personal protection (including respiratory protection) controls.

4.2.10. Conducts periodic exposure assessments.

4.2.11. As appropriate, assist management/supervision in ensuring that workers have the necessary training and medical surveillance based upon the activity and hazard.

4.2.12. Implement site controls isolating employees from NORM hazards when NORM is discovered or suspected on a jobsite.

4.3. Employee(s)

4.3.1. Shall follow all requirements regarding the safe work procedures for NORM.

4.3.2. Stop work if NORM is discovered on a jobsite.

4.3.3. Protect themselves and others from unnecessary NORM exposure by wearing appropriate PPE.

4.3.4. Following safety rules and guidelines regarding NORM hazard protection.

4.3.5. Immediately report to a supervisor any changes, deficiency or breaches in site controls established to isolate employees from NORM hazards on a jobsite.

4.3.6. Participate in JSA and hazard recognition activities and make an effort to identify NORM hazards during daily JSA's.

5. General Requirements

5.1. List of Locations where NORM can be found.

5.1.1. NORM, or naturally occurring radioactive material, is found almost everywhere. It is found in the air and in soil, and even in radioactive potassium in our own bodies. It is found in public water supplies and foods such as Brazil nuts, cereal, and peanut butter.

5.1.2. Health risks from exposure to low levels of NORM are low. However, activities involving the extraction, mining, beneficiating, processing, use, transfer, transport, storage, disposal, and/or recycling of NORM-containing or NORM-contaminated materials may increase exposure levels to workers and other individuals to levels of concern. Human activities such as petroleum refining, natural gas extraction, water treatment, and mining can alter the natural background radiation.

1000 rem as a short-term and whole-body dose would cause immediate illness, such as nausea and decreased white blood cell count and subsequent death within a few weeks. Between 200 and 1000 rem in a short-term dose would cause severe radiation sickness with increasing likelihood that this would be fatal.
100 rem in a short-term dose is about the threshold for causing immediate radiation sickness in a person of average physical attributes, but would be unlikely to cause death. Above 100 rem, severity of illness increases with dose. If doses greater than 100 rem occur over a long period, they are less likely to have early health effects, but they create a definite risk that cancer will develop many years later.
Above about **10 rem**, the probability of cancer (rather than the severity of illness) increases with dose. The estimated risk of fatal cancer is 5 of every 100 persons exposed to a dose of 100 rem (ie. if the normal incidence of fatal cancer were 25%, this dose would increase it to 30%).
5 rem is, conservatively, the lowest dose at which there is any evidence of cancer being caused in adults. It is also the highest dose that is allowed by regulation in any one year of occupational exposure. Dose rates greater than 5 rem/yr arise from natural background levels in several parts of the world but do not cause any discernible harm to local populations.

5.2. NORM Characteristics

5.2.1. NORM is a low-level, naturally occurring radioactive material. In the oilfield, NORM forms when radium is dissolved and carried to the surface in produced water. The amount of radium varies among produced waters from different geologic formations. Thus, some areas are more likely to have NORM than others. Where NORM occurs it typically accumulates as sludges and scale in water tanks, gun barrels, and flow lines.

5.2.2. Radionuclides found in NORM are Ra-226 and Ra-228. Measurements in the field and lab measure the activity of Ra-226 and Ra-228.

5.3. Testing for NORM

5.3.1. NORM is tested for 2 properties: (1) Exposure level to an individual and (2) Radioactivity in a sample.

5.3.2. Exposure level is determined by using a radiation survey instrument calibrated for Ra-226 and Ra-228. The survey instrument typically displays a reading in UR/hr (micro-Roentgens per hour). When NORM is suspected field testing for exposure must be accomplished with a survey instrument that complies with State Health Department regulations. The survey instrument shall have appropriate detector sensitivity and shall be properly calibrated for Ra-226 and Ra-228.

5.3.3. Radioactivity in a sample is measured in the lab using EPA procedures. Lab results for NORM samples are typically reported to be a pCi/gm (pico Curies per gram).

5.3.3.1. When utilizing a 0-1 µR/hr meter face, the following limits are associated with the range selector switch:

5.3.3.2. When in the ×1 position, the maximum measurable value is 1 µR/hr (0.01 µSv/h).

5.3.3.3. When in the ×10 position, the maximum measurable value is 10 µR/hr (0.1 µSv/h).

5.3.3.4. When in the ×100 position, the maximum measurable value is 100 µR/hr (1µ Sv/h).

5.3.3.5. When in the ×1000 position, the maximum measurable value is 1000 µR/hr (10 µSv/h).

5.3.3.6. The value of 1000 µR/hr is equal to 1 mR/hr (0.01 mSv/h), and represents the largest exposure rate that can be measured by the instrument. Consequently, this equates to half the established 2mR/hr limit set by the CFR.

5.3.4. To determine the actual radiation measurement, multiply the meter reading by the set position of the range selector (multiplier) switch.

5.3.5. As previously stated, the CFR limits the general public to radiation exposure of 100 mrem/year, with no more than 2 mrem of exposure in any one hour. For gamma radiation only, this limit corresponds to about 100 mR/year (1 mSv/year), with no more than 2 mR (0.02 mSv) in any one hour.

5.4. Exemptions from NORM Regulations

5.4.1. NORM wastes are exempt if the exposure level and sample concentration is less than State specified levels. For comparison, the State of Texas considers a substance exempt if the exposure level is <50-uR/hr (measured in the field with a survey instrument) and the sample concentration is < 30-pCi/gm (measured in the lab).

5.5. Comparative Radiation Exposure Levels

5.5.1. In industries with radiation hazards, OSHA requires employers to post caution signs where radiation doses exceed 5000-uR/hr, or 100,000-uR/hr in any 5 consecutive days. For comparison, exposure to the sun is about10-uR/hr. An exceptionally low dose for a dental x-ray is 3,000-uR and a typical chest x-ray is about 5,000-uR.

5.6. Worker Safety

5.6.1. To minimize radiation exposure, there are three factors to remember:

5.6.1.1. Reduce the amount of TIME Exposure

5.6.1.2. Maintain a DISTANCE from the source.

5.6.1.3. Have a sufficient SHIELD from the source.

5.6.2. Where NORM is present, safety practices may include but not be limited to the following:

5.6.2.1. Flush production equipment before cleaning.

5.6.2.2. Use dust respirators and goggles when performing small scale cleaning to minimize dust.

5.6.2.3. When working inside the vessel, use appropriate breath equipment and goggles.

5.6.2.4. Use wet process methods to minimize dust when applicable.

5.6.2.5. Use protective clothing.

5.6.2.6. Make sure all wounds or cuts (including scratches and scabs are protected from potential radiation contamination

5.6.2.7. Be careful not to rub eyes, scratch exposed areas of skin, or touch hair.

5.6.2.8. Do not eat, drink, smoke or when around NORM containing equipment.

5.7. Disposal of NORM Waste

5.7.1. NORM waste disposal must comply with State regulations. Disposal options will depend upon the amount of radioactivity and if the NORM is in liquid or solid form. As a general rule, liquids can be pumped into a permitted disposal well, but solids must be disposed in a permitted NORM disposal facility.

6. Training

6.1. Training shall be conducted in accordance with 29 CFR 1910.1096 (or comparable state regulations). Training shall be provided Time of initial assignment and annually. This training will include:

6.1.1. Hazard communication training for potentially exposed employees.

6.1.2. NORM standard

6.1.3. Stop Work Authority
6.1.4. Personal Protective Equipment (PPE)
6.1.5. Definition of NORM
6.1.6. Background radiation
6.1.7. Man-made radiation
6.1.8. Measurement of radiation
6.1.9. Radiation in oil and gas operations
6.1.10. Precautions to reduce exposure
6.1.11. Health hazards and
6.1.12. any use/handling requirements of NORM

6.2. The Company will ensure employee participation and maintain a written record of the training contents.

7. Recordkeeping

7.1. A record shall be kept describing NORM disposal that includes: (a) the lease where the NORM was generated, (b) the facility where the NORM was disposed, and (c) the radioactivity of Ra-226 and Ra-228.

8. Reference

8.1. OSHA (CFR 1910.1096)

8.2. LUDLUM MODEL 193-6 SURVEY METER Manual

8.3.