Section 61.1
NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM)

A. Purpose

1. The purpose of this procedure is to provide guidance to **JAGUAR ENERGY SERVICES, LLC** personnel on the potential hazards associated with Naturally Occurring Radioactive Materials (NORM), and to identify occupational settings where this material can be encountered.

2. **JAGUAR ENERGY SERVICES, LLC** has developed and implemented the following procedure to protect their employees from the possible occupational exposure to NORM.

3. Properly implemented it will:
   - (a) Establish **JAGUAR ENERGY SERVICES, LLC** expectations for employees who work at locations where NORM containing materials are or may be present.
   - (b) Aid in complying with federal, state, and local regulations such as:
     - (i) OSHA 29 CFR 1910.96(h) (2)
     - (ii) Louisiana Department of Environmental Quality Office of Air Quality Radiation Protection (LAC 33:XV Chapters 4, 5, 10
     - (iii) Texas Department of Health Radiation Control Part 46
   - (c) Help eliminate any potential threat to employee health due to NORM exposure.

B. Scope

1. This procedure applies to **JAGUAR ENERGY SERVICES, LLC** personnel who may perform maintenance work such as welding, cutting, or reaming of piping or equipment that has become contaminated with naturally occurring radioactive scale or precipitate at any **JAGUAR ENERGY SERVICES, LLC** or Client's premises.

2. The potential for Technology Enhanced Naturally Occurring Radioactive Materials (TENORM) exposure is present when the radioactive materials become airborne during welding, cutting or

reaming piping or equipment that contains radioactive scale or precipitate.

3. This procedure also applies to employees who may be exposed to the dust or fumes containing radioactive materials generated by someone working nearby.

C. Responsibilities

1. The Safety Coordinator or his/her designee responsible for ensuring that employees have completed the training required by this procedure.
   - (a) Additional responsibilities include:
     - (i) The implementation of this Policy.
     - (ii) Documentation of completion by each employee.
     - (iii) Take corrective actions on all violations or suspected violations of this procedure.
     - (iv) Ensuring that this procedure is followed in work done at a client's or **JAGUAR ENERGY SERVICES, LLC** location.
     - (v) Ensuring that proper records are maintained on all work performed where NORM is present.
     - (vi) For reviewing and revising the procedure as required.

2. The Safety Director is responsible for aiding in the implementation of this Procedure and has been named as the Program Administrator for any NORM projects.
   - (a) Additional responsibilities include:
     - (i) Keeping the Safety Coordinator informed of any incidents related to this Procedure.
     - (ii) Providing appropriate safety equipment to **JAGUAR ENERGY SERVICES, LLC** personnel.
     - (iii) Investigating all employee concerns regarding NORM on **JAGUAR ENERGY SERVICES, LLC** or client's premises.
     - (iv) Reviewing current technical information available on NORM.
     - (v) Maintaining medical surveillance records on personnel working with NORM.

(i) The Assistant Secretary of Labor, affected employees and designated employees' representatives shall have access to this program**.**

(vi) Investigating all employee concerns regarding NORM on **JAGUAR ENERGY SERVICES, LLC** or client premises.

(vii) Informing the Safety Coordinator of any suspected or newly identified sources of NORM at **JAGUAR ENERGY SERVICES, LLC** or client's premises.

(viii) In the event that **JAGUAR ENERGY SERVICES, LLC** did get involved with a NORM project the Safety Director would be assigned the responsibility to serve as the Program Administrator.

3. The Supervisor is responsible for providing assistance in the implementation of this policy.

(a) Additional responsibilities include:

(i) Informing the Safety Director of any incidents involving NORM.

(ii) Informing the Safety Director of any suspected or newly identified sources of NORM at **JAGUAR ENERGY SERVICES, LLC** or client's premises.

(iii) Ensuring that all employees are informed of any suspected or newly identified sources of NORM on **JAGUAR ENERGY SERVICES, LLC** or client's premises.

(iv) Making suggestions to management for ways to improve this Policy.

(v) Adhering to the rules and guidelines in this procedure.

4. **JAGUAR ENERGY SERVICES, LLC** personnel are responsible for recognizing and anticipating all job hazards that could involve the exposure of NORM to **JAGUAR ENERGY SERVICES, LLC** personnel, client personnel, the general public or impact the environment.

(a) Additional responsibilities include

(i) Completing the training required by this procedure.

(ii) Adhering to the rules and guidelines in this procedure.

(iii) Reporting to their supervisor any suspected or newly identified sources of caustic on **JAGUAR ENERGY SERVICES, LLC** or client's premises.

(iv) Take appropriate precautionary measures when working with NORM.

D. Introduction

Naturally Occurring Radioactive Materials, normally referred to as NORM, are a broad group of radioactive substances found naturally in our environment.

1. Radionuclides are leached from the clay minerals and are associated with the decay of uranium and thorium atoms.

2. Crude oil, natural gas, and other substances extracted from the ground were, in some cases, found to possess measurable levels of radioactivity.
   (a) These radioactive materials would then deposit themselves onto the pipes, compressors, and other production equipment and vessels used in the manufacturing and storage process.

3. They were first identified as a hazard in the oil and gas production industries in the early 1980's.
   (a) Since its discovery in the oil and gas industry, NORM has also been found in the petrochemical, fertilizer, mining and related industries.
   (b) The extent of the levels found in these industries thus far, seems to be well below that found in oil and gas production.

4. When these streams are pumped out of the ground, NORM can also plate out onto pipe scale or collect in precipitates.

5. Exposure can occur when the radioactive materials become airborne during welding, cutting, or reaming, piping or equipment that contains radioactive scale or precipitate.

6. Other operations, such as dismantling or refurbishing equipment or transportation may require precautionary procedures.

7. Radiation

Radiation is defined as "particles or electromagnetic waves released by an unstable atom in an effort to reach stability."

(a) There are three (3) types of radiation associated with NORM:
  (i) The alpha particle
  (ii) The beta particle
  (iii) The gamma ray

(b) Units of measurement of radiation include:
  (i) The roentgen, which is a unit of exposure.
  (ii) The rad, which is a unit of absorbed dose.
  (iii) The rem, which is a unit of biological damage.
    (i) Assorted doses (rad) can be equated to biological damage (rem) using a quality factor.

8. Another term that personnel should be familiar with is TENORM (Technologically Enhanced Naturally Occurring Radioactive Materials).
  (a) TENORM are radionuclides whose concentrations are increased by, or as a result of, past or present human practices.
  (b) TENORM does not include background radiation or the natural radioactivity of rocks or soils.

9. Radon is produced from the radioactive decay of the element Radium 226.
  (a) Radium is a decay product of uranium and thorium.
  (b) Radium has a half-life of 1,620 years.
  (c) Radon has a half-life of 3.8 days.
    (i) Radon decays into four daughter products which can attach to dust particles in the air and be inhaled into the lungs.
    (ii) When these dust particles are inhaled, they may be trapped inside the lungs and irradiate the lung tissue.
    (iii) Lung cancer is associated with radon gas.

10. The occurrence of environmentally high concentrations of radioactivity, specifically with radium isotopes in oil field production waters, is well documented.

11. The radium levels in certain coastal areas of the United States of America can significantly exceed the limits set by regulators for discharge waters at nuclear reactor sites.

12. The term "radiosensitivity" describes how easily a particular cell is affected by radiation.
    (a) Factors which affect the radiosensitivity of a cell are:
        (i) The rate of cell division.
        (ii) The stage of cell division.
        (iii) The degree of cell specialization.
        (iv) The amount of cell activity (metabolic rate).

13. NORM Health Hazards

The radiation exposure levels encountered by persons working around NORM have not been shown to be high enough to pose an external health risk.

(a) The primary hazard is not in the exposure to NORM itself, but when these materials are taken into the body.

(b) Radioactive scales and sludges deposited in pipes vessels and other equipment, when taken into the body can release alpha, beta and gamma radiation.

(c) NORM can be taken into the body by:
    (i) Breathing the material in through the nose or mouth which deposits NORM in the lungs.
    (ii) Eating (ingestion) which can deposit NORM in the digestive tract.
    (iii) Open cuts and wounds which can result in NORM being deposited in the blood stream.

(d) Biological damage to our bodies from radiation can be either a direct or indirect process.
    (i) The direct process involves the ionization of DNA molecules within the cell directly.
        (i) Ionization is defined as "the removal of an electron from an atom or molecule leaving that atom or molecule with some net electrical charge"
        (ii) Biological damage to our bodies from radiation occurs as a result of the ionization of our tissues.
    (ii) When DNA is damaged within a cell, there are four possible scenarios for the cell.
    (iii) They are as follows:
        (i) The cell may die.
        (ii) The cell may repair the damage and undergo normal ce

(iii) The cell may be unable to repair the damage, divide, and produce normal daughter cells.

(iv) The cell may be unable to repair the damage or divide; however, the daughter cells are incapable of sustaining life and die themselves.

(iv) The indirect process involves the formation of chemically active species from the ionization of a water molecule within the cell, which in turn chemically attaches to the DNA molecule.

14. Linear Dose Theory

(a) The amount of exposure that a cell receives is called Dose.

(b) The Linear Dose Theory states that there is a linear relationship between the amount of radiation exposure received and the effects of that exposure, i.e., large amounts of radiation will cause large amounts of biological damage, therefore, small amounts of radiation will cause small amounts of biological damage

15. The Threshold Dose Effect Theory

The Threshold Dose Effect Theory states that there is a certain amount of radiation exposure that must be received by an individual before any biological damage will take place.

16. Gardner Theory

The Gardner Theory postulates that the effects of exposure to alpha radiation to a parent may show up years later in the offspring of the parent.

17. Radiation Hormesis Theory

The Radiation Hormesis Theory states that low levels of ionizing radiation are beneficial to mankind.

(a) The theory states that low levels of ionizing radiation will result in increases in life span, growth, fertility, and a reduction in the cancer incident rate.

18. ALARA

All operations will be conducted to achieve ALARA.

(a) The term ALARA stands for "As Low As Reasonable Achievable." The concept of ALARA is both federal and state law.

19. Contamination

We know that radiation is emitted from radioactive material and are aware that there is radioactive material present in the oil and gas industry, in well equipment, pipes, tanks, etc.

(a) This radioactive material is located where we want it to be, and, as long as we keep it where it should be, we can make sure that it doesn't cause any significant damage.

(b) When radioactive material is someplace where we do not want it, we call it Contamination.

(c) Contamination is radioactive material where we do not want it.

(i) For example, if some radioactive material leaked from a valve or pipe onto the ground it would be called contamination.

(ii) We do not want radioactive material on the ground or floor where it could be tacked all over the site.

(iii) Similarly, we do not want radioactive dust in the air where we might breathe it into our lungs.

(d) Contamination in the work site is a major concern to us because of the possibility that it might get inside our bodies.

(e) Internal contamination, or contamination inside the body, is a problem for two reasons:

(i) It increases the possibility of damage to the vital organs.

(ii) It may be retained by the body for long periods of time.

(f) If contamination enters the body, it is that much closer to the vital organs.

(g) The ingested contamination continues to emit radiation and, because the radiation is being emitted inside the body, the vital organs are not shielded by the skin or muscles.

(h) Contamination that has gotten inside the body may be very difficult to remove.

(i) This means that radiation could be emitted inside the body for an extended period of time.

(ii) The body does not take special steps to rid itself of contamination, because it does not

know the difference between radioactive nuclides and non-radioactive nuclides.

(i) For example, when iodine is taken into the body, some of it is sent to the thyroid.

(ii) If the iodine happens to be radioactive iodine-131, the body still sends it to the thyroid.

(iii) In the thyroid, the radioactive iodine would continue to emit radiation, which, as we know, can damage cells.

(i) The most obvious way for contamination to enter the body is through the mouth.

(i) That is why it is necessary not to eat, drink, or smoke in contaminated areas.

(j) Your nose may be another entrance into the body for contamination.

(i) Contamination in the air may be breathed in through the nose to the lungs.

(k) A cut in your skin is another way that contamination can enter the body.

(l) As we have said, once contamination gets inside the body, it continues to emit radiation.

(i) But this process does not last forever, radionuclides decay and, as each atom decays, it changes into another nuclide.

(ii) Eventually, the decay process will cause the radioactive material to disappear.

(iii) The radiological half-life (TR), is the time required for half of the radioactive atoms present in a sample to decay.

(m) The body also rids itself of contaminated material through normal body functions.

(n) We can get an idea of how long this would take by looking at the biological half-life of the radionuclide involved.

(i) The biological half-life (TB) is defined as the time required for the body to eliminate half of the atoms rough normal bodily functions.

(ii) Every nuclide has a radiological half-life and a biological half-life.

(iii) The biological half-life of radium is 45 years.

(iv) Because the processes of radioactive decay and biological elimination are going on at the

same time, neither the radiological half-life nor the biological half-life will be a true measure of the actual half-life of a radionuclide inside the body.

(v) The actual half-life would be a combination of the radiological half-life and the biological half-life.

(vi) This combined half-life is called the effective half-life.

(i) The effective half-life (TEFF) is defined as the time required for half of the radioactive atoms to be removed from the body by a combination of decay and body elimination.

20. Time, Distance, Shielding

When time, distance, and shielding are used effectively, adequate protection can always be provided to workers and members of the general public.

(a) Time is the first of the "big three" exposure-reducing tools available to the worker in the field dealing with radiation sources.

(i) The radiation worker should be aware that radiation doses are directly proportional to the time spent in a given radiation field.

(i) If the worker’s time in a given radiation field is doubled, the worker’s dose will be doubled.

(ii) Likewise, if the worker's time in the radiation field is cut in half,his/her dose will also be reduced by half.

(iii) To maintain ALARA, the time spent in a radiation field must always be limited to the maximum extent possible.

(iv) Although this concept is simple, IT WORKS.

(v) Workers should be made aware of the exact location of radiation sources in a work area.

(vi) They should be familiar with the area and know which locations are "hotter" and which locations are "colder."

(vii) Time in the hotter locations should be minimized.

(viii) They should be familiar and well briefed with their job tasks to minimize their time spent in any given radiation field.

(b) Distance is the second of the "big three." Again, the concept is a simple one.

(i) Radiation fields become less intense the further a worker moves away from the source.

(ii) The worker should spend as much time away from the source as possible.

(iii) If a problem arises on the job, the worker should back away from the source rather than standing next to it to discuss a solution with his/her coworker or supervisor.

(c) Shielding is the last of the "big three" tools.

(i) In some cases a worker will need to spend extended periods of time in close proximity to a radiation source.

(ii) When shielding such as lead, steel, or iron are placed around a source the intensity of the radiation field is reduced.

(i) For example, a worker needs to work on a pump that is close to a valve giving a dose in the work area of 1500 microroentgens per hour.

(iii) The work is estimated to take a total of 30 man-hours to complete. Simple math will tell us that the total radiation dose to complete the job will be 45 millirem.

(i) However, when shielding is placed around the valve, the radiation dose in the work area is reduced to 500 microroentgens per hour.

(ii) Thus, the same 30 man-hour job will now have a total exposure associated with it of only 15 millirem.

E. Procedure

1. Contamination Control

(a) The primary concern regarding contamination is always to protect persons from inhalation and ingestion of

radioactive materials for the purpose of preventing internal exposure.

(b) A secondary concern is to prevent the spread of contamination throughout the work site by tracking it where other workers may unknowingly come in contact with it.

(i) Constant vigilance to prevent or minimize contamination or to contain its spread must be maintained by every worker, since the escape of even an insignificant physical amount of material may be a considerable health problem.

(ii) Areas containing loose surface contamination need to be identified and marked to make the worker aware of the hazard so that proper preventive measures can be taken.

(iii) The worker should also be made aware of work evolutions which may cause loose surface contamination.

(i) For example, descaling a tubular, opening a pump for maintenance, changing out filters, or entering tanks and separators for cleaning.

(iv) There may not be any loose surface contamination on the exterior of these items; however, the interior may be highly contaminated.

(v) A simple radiation survey on the exterior surface of these items may be used to determine if a contamination problem exists on the interior item.

(c) Any radiation reading on the exterior surface of the item is significant of a large alpha contamination problem inside that item.

(i) This is due to the fact that most NORM radionuclides, including radium-226, emit both a gamma and alpha particle when they decay.

(ii) The gamma ray will penetrate the steel or iron that the item is made of allowing for an external radiation measurement, however, the alpha particle will not.

(d) When working in areas of loose surface contamination, some form of anti-contamination clothing should be worn.

(i) Anti-contamination clothing is simply clothing, including gloves and head caps, which are worn to prevent contamination from coming in contact with the workers' clothes or skin.

(ii) Often a simple set of disposable coveralls along with gloves and a skull cap are worn to prevent personnel contamination.

(iii) During wet maintenance evolutions, a plastic set of coveralls is also worn.

(e) When the maintenance evolution is completed, the workers will carefully remove their outer set of protective clothing minimizing contact of the exterior surface of the clothing with their undergarments and skin.

(f) The contaminated protective clothing is then placed in a properly staged container for disposal.

(i) After exiting the controlled contamination areas, the workers should monitor themselves with a pancake type probe to ensure that they are not contaminated.

(ii) The probe should be held within one-half inch of the body and moved at a rate of two to three inches per second.

(iii) Probe contact with the body should be minimized to prevent possible probe contamination.

(iv) Monitoring the whole body for contamination usually takes three to five minutes on the average.

(v) Special attention should be paid to the hands, feet, and head of the worker.

(vi) Generally speaking, a reading of 100 cpm above background using a pancake type probe indicates personnel contamination.

(g) If a worker is found to be contaminated during monitoring, he must be decontaminated.

(i) The simplest way to decontaminate a worker is to use soap and water.

(ii) A mild soap giving a good lather and tepid water should be used.

(iii) Strong alkaline soaps or abrasives are to be avoided.

(iv) Once the worker has washed the affected area, he should monitor again to ensure that the contamination has been removed.

(v) It must be remembered that contamination is never destroyed, but only transferred from one medium to another.

(i) Thus, if contamination is present in sufficient quantities, the agents used in decontamination must be treated as radioactive waste.

2. Airborne Contamination Control

Many maintenance evolutions such as grinding, welding, scraping, and sandblasting on contaminated items cause loose surface contamination to become airborne.

(a) If radioactive material is present in the air above 25% of the Federal regulations contained in 10 CFR 20, the area must be posted as an Airborne Radioactive Material Area.

(b) The limits used in the federal and state regulations use the designation MPC.

(i) MPC stands for Maximum Permissible Concentration.

(c) The maximum permissible concentration is that amount of radioactive material that an individual may inhale for 40 hours per week, 50 weeks per year, for his/her working lifetime and not exceed the federal and state radiation exposure limits.

(i) If the air activity is at MPC levels, a person could remain in the area for 40 hours per week.

(ii) If the activity level is only half of the MPC value, the person could remain in the area twice as long.

(iii) If the activity is twice the MPC value, the opposite is true, and the person could remain in the area only 20 hours.

(d) MPC values are used for two things.

(i) First they are an indicator.

(i) When a person sees an Airborne Radioactivity Warning sign, he knows that the airborne concentrations in that area are at least 25% of the federal and state limits.

(ii) Secondly, MPC values are often used as a threshold point for determining when personnel

should be placed in respiratory protective equipment.

(i) Generally speaking, any posted airborne radioactivity area should require some form of respiratory protection.

(e) To determine if an airborne radioactivity situation exists, air samples must be taken and counted.

(i) Normally, several different isotopes will be found on the air sampling patch.

(ii) To determine which isotopes are present in the air, and thus which MPC value to use, requires laboratory analysis.

(iii) All radionuclides have different MPC values due to the fact that different radionuclides cause different amounts of biological damage when breathed into the body.

(iv) For untrained radiation workers and members of the general public, the MPC value for unknown mixtures of alphaernitters is 2 x 10' uCi/ml.

(f) State and federal law requires the tracking of the MPCs accumulated by an individual whenever that individual may exceed 40 MPC-hours in any given week.

(i) Therefore, we normally track MPCs accumulated for an individual whenever he is exposed to airborne concentrations greater than 25% of the MPC value.

(ii) That way, data is available should the individual exceed 40 MPC-hours in any given week.

(iii) By federal and state law, no individual is allowed to accumulate more than 520 MPGs in any given quarter.

(g) To reduce the amount of radioactive material a person breathes, and to reduce his/her total MPC accumulation, respiratory devices are worn.

(h) Different respiratory devices have different protection factors assigned to them.

(i) A protection factor is a measurement that can be used to determine the efficiency of a respirator to filter radioactive material out of the air.

(ii) A half-faced respirator normally is assigned a protection factor of 10, and a full faced respirator is assigned a protection factor of 50.

(i) Thus, if an individual was exposed to an airborne concentration of 10 MPCs for one hour, his/her total MPC accumulated exposure would be 10 MPC-hours.

(ii) However, if the individual was wearing a half-faced respirator with a protection factor of 10, instead of breathing 10 MPGs he would only be breathing 1 MPC.

(iii) Thus, his/her MPC exposure for the same one hour period would only be 1 MPC per hour

3. NORM Workers Protection Plan

The intent and purpose of this Worker Protection Plan is to provide guidelines for the safety and welfare of **JAGUAR ENERGY SERVICES, LLC** personnel working in and around areas where NORM contamination is prevalent.

(a) **JAGUAR ENERGY SERVICES, LLC** is providing this Plan for workers' protection, to aid in the identification of a possible NORM contaminated area or piece of equipment, and to aid in minimizing the spread of NORM contaminants.

(b) This Plan has been prepared in accordance with all applicable federal, state, and local regulations.

(c) Each state or country will probably have its own rules and laws regulating NORM.

(i) In this program, there may be references to the State of Louisiana.

(ii) This is so because Louisiana was the first state to regulate NORM operations and probably has the most stringent regulations.

(iii) Be sure to check with the Safety Director for specific regulations.

(iv) Remember NORM is subject to be found at any work location.

(d) The concepts of As Low As Reasonably Achievable (ALARA) and Time, Distance and Shielding shall be strictly adhered to in terms of personnel exposure to NORM.

(i) These Concepts shall be associated with any and every activity involving radioactive material, and will be incorporated into regularly scheduled safety meetings and prior to the

commencement of any activity to be done in NORM contaminated atmospheres or with NORM contaminated equipment.

4. In the event that **JAGUAR ENERGY SERVICES, LLC** did get involved with a NORM project the Safety Director would be assigned the responsibility to serve as the Program Administrator.
   (a) Their responsibilities include:
      (i) Ensuring that employees have completed the training required by this procedure.
      (ii) Sending all training records to the Safety Coordinator.
      (iii) The implementing and enforcing **JAGUAR ENERGY SERVICES, LLC**'s NORM Workers Protection Plan.
      (iv) Investigating all employee concerns regarding NORM on **JAGUAR ENERGY SERVICES, LLC** or Client premises.
      (v) Informing the Safety Coordinator of any employee concerns or potential exposure incidents involving NORM.
      (vi) Informing the supervisors and **JAGUAR ENERGY SERVICES, LLC** management of any suspected or newly identified sources of NORM on **JAGUAR ENERGY SERVICES, LLC** or Client premises.

5. Source of Hazards

The source of hazards associated with the **JAGUAR ENERGY SERVICES, LLC**'s operation would be:

(a) Fumes
(b) Scale
(c) Sludge
(d) Solids
(e) Hydrocarbons
(f) Waste water

6. Locations of Source Hazards

In **JAGUAR ENERGY SERVICES, LLC**'s work activities NORM hazards could be found in:

(a) Piping
(b) Tanks
(c) Pumps
(d) Process equipment

7. Activities and Processes of Exposure

During repair or maintenance, personnel could be exposed to hazards of NORM while:

(a) Breaking, cleaning, repairing, and installing interconnecting piping, tanks and equipment.

8. Standard Work Procedures

The following procedures shall be followed when working with NORM contaminated equipment or materials:

(a) Determine if the equipment on which they are working has been in service that could expose the equipment components to NORM.

(b) If working on contaminated equipment, minimize the exposure potential by completing work activities when a minimum number of personnel are in the work area.

(c) Notification to employees and contractors shall be furnished where- ever the presence of NORM contamination is known.

(i) This will be accomplished through safety meetings, signs and notices.

(d) There will be no eating, drinking, smoking, or chewing tobacco allowed in the immediate work area where NORM contaminated fluids, solids, equipment and/or soil are being handled.

(e) Direct skin contact with scale, sludges, and solids should be avoided.

(f) Precautions will be taken to minimize further NORM contamination.

(g) For work operations that have the potential to produce NORM contaminated dusts the following will occur:

(i) Contaminated area will be dampened with water, prior to work activities, to minimize enhancement of airborne particulates.

(i) Personnel shall wear appropriate personal protective equipment as specified below.

(ii) Safety glasses will be worn for eye protection.

(iii) Respirators appropriate for radioactive particulates will be worn during any operation.

(iv) The appropriate respirators include:

(i) Half-face High Efficiency Particulate Air (HEPA) respirators.

(ii) Full-face Self-Contained Breathing Apparatus (SCBA) respirators.

(iii) Full-face supplied-air respirators.

(v) Work operations will be conducted in well ventilated areas.

(vi) These areas will be restricted to a minimum of only those trained personnel necessary to accomplish work operations.

(vii) Openings on contaminated equipment and pipe should be sealed by wrapping them in plastic.

(viii) Minimize the amount of cutting, grinding, sandblasting, welding, drilling, or polishing of contaminated equipment.

(ix) Plastic ground covers should be used whenever possible to contain any NORM contamination and to facilitate cleanup when work is performed on NORM contaminated equipment.

(i) This may cause a release of contaminated particulates from the equipment, such as during cutting, grinding, hammering, or drilling.

(x) Ground covers should also be implemented during the temporary storage of NORM contaminated materials and equipment.

(xi) Hands and face must be washed after working with potentially contaminated equipment.

(xii) Personnel monitoring, as defined in this program, will be conducted before leaving the NORM restricted area.

9. Personal Protective Equipment

JAGUAR ENERGY SERVICES, LLC personnel should utilize appropriate protective equipment, when loose contamination is suspected or work tasks require any action that might produce dust or contact with contaminated equipment.

(a) The following procedure should be followed:

(i) Utilize a respirator approved for radioactive particulates.

(ii) Wear suitable coveralls, such as disposable tyvek, and gloves.

(iii) Where possible, conduct work activities in well-ventilated areas.

(iv) Utilize, to the extent possible, plastic ground covers to contain contaminants and facilitate cleanup.

(v) Decontaminate gloves, respirators, coveralls, and rags, or place them in double bags and seal for proper disposal.

(b) The following personal protective equipment will be worn by all employees at all times while working in NORM contaminated areas:

(i) Hardhats
(ii) Rubber steel-toed boots
(iii) Safety glasses with face shields
(iv) Disposable anti-contamination suits
(v) Respiratory protection as described above
(vi) T.L.D. badges

(c) T.L.D. Badges

(i) T.L.D. badges shall be worn at all times, and exclusively at the NORM work-site.
(ii) Each employee shall be assigned a T.L.D. with a specific badge number.
(iii) T. L. D. badges are not to be worn by different individuals during the period of issuance.
(iv) This will ensure proper documentation of each individual's exposure level.
(v) T.L.D. badges will be handled with extreme care.
(vi) They shall be kept clean, dry, be worn between the neck and waist, and be exchanged on a quarterly basis.
(vii) Female employees may request exchanges on a monthly basis.
(viii) Records of individual exposures shall be kept and maintained indefinitely and provided upon request.
(ix) All T.L.D.'s, to include spare, unassigned, and control badges, shall be kept in a non-contaminated area when not being used.
(x) Lost or damaged T.L.D.'s shall be reported to the individual's supervisor immediately and a replacement provided.

10. Security and Posting

(a) Storage areas for equipment and any other contaminated areas shall be properly marked with radioactive warning signs according to the following:

CAUTION RADIOACTIVE MATERIALS

(b) The following signs will be required for areas with radiation.

CAUTION RADIATION AREA

(c) The following signs will be required for areas with radiation of such levels that a major portion of the body could receive:
- (i) In any one hour, a dose of 5 millirems.
- (ii) In any five consecutive days, a dose in excess of 100 millirems.

(d) Any and all contaminated areas shall be deemed **RESTRICTED** areas and shall be cordoned off with yellow tape or signs with the words **"CAUTION RADIOACTIVE MATERIAL"** in red or magenta.

(e) Yellow tape with the words **"CAUTION RADIATION AREA"** in gold or magenta shall be used in any contaminated area in which an individual could receive doses greater than five millirems in any one hour, or 100 millirems in any 5 consecutive days.
- (i) These areas shall be restricted areas in which only trained and authorized personnel will be allowed.

11. Testing and Instrumentation

JAGUAR ENERGY SERVICES, LLC does not and will not employ qualified personnel to test for NORM.

(a) This activity will be performed by the client or a contract Radiation Safety Officer.

(b) Survey meter specifications to be used by **JAGUAR ENERGY SERVICES, LLC** are as outlined below.
- (i) Survey Meter with Geiger-Meuller Pancake Probe
  - (i) A survey meter with a GM Pancake probe will detect Alpha, Beta, and Gamma radiation.
  - (ii) Readings shall be recorded in counts per minute (CPM).
  - (iii) The pancake probe is generally used for external surface or personnel contamination surveys.
  - (iv) It is also the generally preferred instrument for use in wipe-testing.
- (ii) Survey Meter with Gamma Scintillator

(i) Scintillation detectors will detect exposure levels of Gamma radiation.
(ii) Readings shall be recorded in microroentgens per hour (uR/hr).
(iii) Scintillators shall demonstrate on accuracy to within 20% of actual radiation level on each scale.
(iv) Scintillation detectors are generally used for area and equipment surveys.

12. General Operating Procedures For Survey Meters

The following general operating procedures will be used for survey meters:

(a) Inspect meter, probe, and cables for damage.
(b) Test battery level.
  (i) Most meters have battery check capabilities.
(c) Check background level in a non-contaminated area.
  (i) Background levels in Louisiana generally fall between 4 and 10 ur/hr.
(d) Check meter response and calibration with a radiation check source.
  (i) If response is not within the expected range, do not use.
  (ii) Return meter for recalibration.
(e) Check audible in both on and off positions to ensure proper functioning.
(f) Verify proper functioning of Slow and Fast settings.
(g) Document results of meter function checks.
(h) Keep meter and probe clean to prevent contamination.

13. Calibration Requirements

Meters shall be calibrated by an authorized facility every 6 months and after any maintenance beyond battery changes.

(a) Authorized facilities for calibration are:
  (i) Ludlum Measurements, Inc., Sweetwater, TX (915)235-5494
  (ii) Amersham Corp., Baton Rouge, LA (504)751-5893
  (iii) Suntrac Services, Houston, TX (713)326-2346

14. Air Samplers

(a) Air samplers should be used:
  (i) At the beginning of each new operation or site.

(ii) At times when new contaminants are introduced to the work site.

(iii) When there is the potential for radon levels to exceed allowable limits.

(b) Air samplers shall be used by qualified personnel only.

(i) Sample filter disks shall be checked with a pancake probe only after a minimum of 60 cubic feet of air sample has been collected.

(ii) The sample filter disk will be sealed and sent to a radiochemistry laboratory meeting EPA standards and criteria for analysis for gross Alpha/Beta.

(c) Results shall be recorded in picocuries per liter (pCi/L) or equivalent.

(d) Documentation and records shall be maintained for not less than 5 years.

(e) Should "hot spots" be detected, soil samples shall be analyzed for Radium 226 and Radium 228 content by a radiochemistry lab meeting EPA criteria.

(i) Soil sample results shall be reported in Pci/gm or equivalent units

15. Water Contamination

All water contaminated during processing, spill containment, and decontamination operations shall also be sampled and analyzed before being released to the environment.

(a) Water sample results shall be reported in uCi/ml or equivalent units.

16. Air Contamination

Air samples shall be taken during all NORM operations.

(a) If the sample data indicates air contamination above acceptable levels, the operations being conducted will be stopped and reevaluated.

(i) Air samples shall be analyzed by a radiochemistry lab meeting EPA criteria.

17. Comparison Levels

(a) Background

(i) All areas by nature contain some level of background radiation.

(ii) In testing for radiation levels of equipment or product the background level must be

subtracted from the reading on the equipment or product.

(b) All operations will be conducted to achieve ALARA.

18. Emergency Procedures

Emergency Procedures for Spills.

(a) In event of an accidental spill or release, the personnel involved shall contact **JAGUAR ENERGY SERVICES, LLC** personnel as defined by this procedure.

(b) Emergency medical attention shall be given to any injured personnel until medical help arrive.

(c) The site shall be evacuated and secured to prevent unauthorized personnel from entering the area.

(d) All personnel present shall be detained and checked for contamination.

(e) Persons found to be contaminated will immediately proceed to the decontamination area and follow the established DECON procedures.

(f) Signs shall be posted in the NORM contaminated area as follows:

(i) < 5 millirems per hour - **"Caution Radioactive Material"**

(ii) 6 - 100 millirems per hour - **"Caution Radiation Area"**

(iii) Above 100 millirems per hour - **"Caution High Radiation Area"**

(g) Efforts to contain the spill shall be implemented to prevent further contamination or discharge of NORM contamination into streams, waterways, or sewer systems.

(h) Proper personal protective equipment shall be worn at all times during cleanup operations.

(i) All NORM contaminated material shall be placed in D.O.T. 17-H drums, or other D.O.T. approved containers and properly labeled.

19. Notification Procedures

(a) In the event of an emergency, immediate notification shall be made to:

(i) Your District Manager

(ii) **JAGUAR ENERGY SERVICES, LLC** safety department

(iii) Depending on the severity of the event, the following persons shall be contacted.

PRIMARY JAGUAR ENERGY SERVICES, LLC CONTACT

DISTRICT MANAGER'S NAME

_____

JAGUAR ENERGY SERVICES, LLC

_____

TITLE

_____

WORK PHONE

_____

HOME PHONE

_____

SECONDARY JAGUAR ENERGY SERVICES, LLC CONTACT

NAME

_____

JAGUAR ENERGY SERVICES, LLC

_____

TITLE

_____

WORK PHONE

_____

HOME PHONE

_____

PRIMARY CLIENT CONTACT

NAME

_____

COMPANY

_____

TITLE

_____

WORK PHONE

_____

HOME PHONE

_____

SECONDARY CLIENT CONTACT

NAME

_____

COMPANY

_____

TITLE

_____

WORK PHONE

_____

HOME PHONE

_____

CLIENT OR DISTRICT MANAGER WILL CONTACT:

DEPARTMENT OF ENVIRONMENTAL QUALITY

_____

PROTECTION DIVISION

_____

P. 0. BOX 82135

BATON ROUGE, LA 70884-2135

Phone (504) 765-0160

FOR POLICE, AMBULANCE OR FIRE, DIAL 911.

20. Transportation

The Department of Transportation defines radioactive materials as any material having a specific activity greater than 2,000 picocuries per gram (pCi/gm).

(a) The majority of oilfield NORM wastes and materials do not have specific activities greater than 2,000 Ci/gm and are exempt from DOT radioactive material regulations.

(b) However, if the container contains NORM materials with a specific activity greater than 30 pCi/gm or surface radiation levels are greater than 25 microroentgens per hour (uR/hr) above background levels, it must be packaged, marked and/or labeled in accordance with Louisiana Radiation Regulations, Chapters 14 and 15, and must be manifested.

21. Shipment of NORM

Each shipment of NORM waste to a facility specifically licensed for storage or disposal and that contains Ra-226 or Ra-228 in concentrations greater than 30 pCi/gm or greater that 25 microroentgens per hour, excluding background, shall be accompanied by a shipment manifest.

(a) A manifest form must be obtained from the LDEQ Radiation Protection Division and must consist of, at a minimum, the number of copies that will provide the generator, each transporter, and the operator of the designated facility with one copy each for their records with the remaining copies to be returned to the generator and the other appropriate parties.

22. General Requirements

A generator who transports, or offers for transportation, NORM waste for off-site treatment, storage, or disposal must prepare and sign sufficient copies of a manifest before transporting the waste off-site.

(a) A generator must designate on the manifest one facility which is permitted to handle the waste described on the manifest.

(i) If the transporter is unable to deliver the NORM to the designated facility, the generator must either designate another facility or instruct the transporter to return the waste.

(b) Generators must provide a statement concerning the nature of the material and general guidelines for an

emergency situation involving this waste to accompany the manifest on shipments and loads.

(c) If the NORM is to be transported out-of-state, the generator will be responsible for receiving the completed, signed manifest from the out-of-state storage or disposal facility.

(d) Generators must get written confirmation of acceptability of the NORM from the operator of the storage of disposal facility before shipping the NORM.

(i) The confirmation must be maintained as part of the facility manifest records.

(ii) Generators are required to report to the division any irregularities between the NORM actually received and the waste described on the manifest, or any other irregularities, within fifteen days.

23. Required Information

The manifest must contain all of the following information prior to leaving the generator site:

(a) A state manifest document which shall be obtained from the LDEQ Radiation Protection Division if the destination point is in Louisiana.

(b) The generator's name, mailing address, telephone number, and NORM general license number.

(c) The name, Interstate Commerce Commission number (ICC), and telephone number of each transporter.

(d) The name, address, telephone number, and NORM specific license number of the designated facility, if applicable.

(e) The description of the waste(s) (e.g., scale, soil, sludge) or contaminated equipment (heater treater, tubulars).

(f) The total quantity of all NORM by units of weight in tons, cubic yards, pounds, or gallons (liquid only).

(g) The type and number of containers (metal drums, barrels, kegs, fiberboard or plastic drums, cargo tanks, tank trucks, dump trucks, metal boxes, cartons, cases, burlap bags, paper bags, plastic bags, wooden drums, tanks portable, cylinder, wooden boxes, and fiber or plastic boxes) as loaded into or onto the transport vehicle.

(h) If the weight is known, the volume and estimated weight should be provided.

24. Use of Manifest

The generator must:

(a) Sign and date the manifest certification by hand when the initial transporter accepts the shipment.
(b) Obtain the handwritten signature of the initial transporter and date of acceptance of the manifest.
(c) Retain one copy.
(d) Give the transporter the remaining copies of the manifest.
(e) Receive the fully signed copy of the manifest from the designated storage or disposal facility within 45 days from the delivery to the initial transporter.
(f) In the event the generator does not receive the signed manifest timely, it shall:
    (i) Notify the division in writing within seven days.
    (ii) Conduct an investigation into the reasons why it did not receive the manifest.
    (iii) Report the results of the investigation to the division.

25. Transporters

A transporter may not accept NORM for transportation unless the NORM is accompanied by sufficient copies of a manifest, properly prepared and each copy signed and dated by the generator and each previous transporter in accordance with these regulations.

(a) Before transporting the NORM, the transporter must sign and date each copy of the manifest acknowledging acceptance of the NORM from the generator or previous transporter.
(b) The transporter must return a signed copy to the generator or previous transporter before leaving the property with the NORM.
(c) A transporter who delivers NORM to another transporter or to the designated storage or disposal facility shall:
    (i) Obtain the date and signature of the accepting transporter or designated storage or disposal facility.
    (ii) Retain one copy of the manifest signed and dated by the generator, all previous transporters, and the next transporter or designated facility.
    (iii) Give the remaining copies of the manifest to the accepting transporter or designated facility.

26. Designated Facility

The designated facility should fill out their portion, retain a copy for their files, submit the original to the division, and send any

remaining copies to the generator no later than 15 days after delivery of the NORM waste.

F. Training Requirements

No personnel shall be allowed into a NORM restricted area unless the individual has been properly trained in NORM by a DEQ recognized instructor.

1. The NORM training course shall include, as a minimum, the following areas:
   - (a) Radiation Safety Fundamentals
   - (b) Worker Protection and Operating Procedures
   - (c) Radiation Detection Instrumentation
   - (d) Hazard locations
   - (e) Methods to identify the hazards
   - (f) Methods to protect themselves
   - (g) Potential Exposures of Routine and Emergency Situations
   - (h) Respiratory Protection
     - (i) Respirators and Their Limitations
     - (ii) Filter Selection
     - (iii) Use and Care of Filters
     - (iv) HEPA Filters

2. In addition to the above, the supervisor shall complete 8 additional hours of training in the following areas:
   - (a) Regulatory and Licensing Procedures
   - (b) Advanced Operating and Emergency Procedures
   - (c) Environmental Monitoring
   - (d) Record keeping and Documentation Procedures
   - (e) Transportation and Disposal of NORM contaminated materials

G. Training Frequency

1. **JAGUAR ENERGY SERVICES, LLC** personnel trained as Workers or RSO will be trained according to the following schedule:
   - (a) Before exposures could occur.
   - (b) Refresher every year.

2. **JAGUAR ENERGY SERVICES, LLC** personnel will be trained according to the following schedule for NORM Awareness:

(a) Initially upon hire.
(b) Refresher every year.

H. Definitions

1. **Alpha Particle** is a small, positively charged particle made up of two neutrons and two protons and of very high velocity, thrown off by many radioactive materials including uranium and radium.

2. **Beta Particle** is a small electrically charged particle thrown off by many radioactive materials; identical to an electron. Beta particles emerge from radioactive materials at high speeds.

3. **Decay** is the disintegration of a radioactive atom; what remains is a different element.
(a) An atom of polonium decays to form lead, ejecting an alpha particle.

4. **Daughter** is the product nucleus or atom resulting from the decay of the precursor or parent.

5. **Gamma-rays (gamma radiation)** is the most penetrating of all radiation. Gamma-rays are very high-energy x-rays.

6. **Half-life** (For a single radioactive decay process) is the time required for the activity to decrease to half its value by that process.

7. **Natural radioactivity** is the radioactive background, or more properly, the radioactivity that is associated with the heavy naturally occurring elements.

8. **Nuclide** is a type of atom characterized by its mass number, atomic number, and energy state of the nucleus, provided that the mean life in that state is long enough to be observable.

9. **Radioactive** is the property of an isotope or element that is characterized by spontaneous decay to emit radiation.

10. **Radioactivity** is the emission of energy in the form of alpha, beta, or gamma radiation from the nucleus of an atom.

(a) This always involves change of one kind of atom into a different kind.

(b) A few elements, such as radium, are naturally radioactive.

11. **Radionuclide** is a radioactive nuclide; one that has the capability to spontaneously emitting radiation.