

Gulf of Mexico



Operations: HSE

Health and Industrial Hygiene

**Radiation Safety - Handling of Radioactive
Sources and Generally Licensed Devices
Safe Work Practice (SWP)**

AMENDMENT RECORD

Amendment Date	Revision Number	Amender Initials	Amendment
08/11/2016	3	VDMurray	Document reviewed with no changes.
08/05/2015	2	VDMurray	Updated document template and custodian/authority. Minor non-technical updates. Added definitions for radioactive material, radioactive tracer, and general license. Updated review frequency to annual to align with regulatory requirement in US NRC 10 CFR 20.
05/30/2012	1	Authority: HS Director Custodian: Health & IH Team Leader	Changed document title to reflect content of the document. Added references to active general license, NORM and Specifically Licensed Device policies. Updated definition of REM to include the SI unit (Sv) conversion. Added the definition of the SI unit (Sv). Amended the definition of radiation area to match the NRC's definition. Defined radiation symbol as "Radiation Trefoil", and provided a pictogram. Added the BP general requirements for working with or around radiation. Added the term radiation to General Radiation Awareness Training. Added Appendix 1: GoM – NRC Licensed Devices.
08/01/2008	0	Authority: HSSE Director Custodian: HSSE Programs Manager	Date of initial issue as a controlled document.

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1 Introduction

This Safe Work Practice (SWP) covers the occupational use of radioactive materials and devices permitted under a Nuclear Regulatory Commission (NRC) general license that may produce personnel exposures to ionizing radiation. The procedures, control methods, work practices, and monitoring described in this SWP aim to reduce the exposure from occupational sources of ionizing radiation to as low as reasonably achievable (ALARA) and maintain compliance with regulatory requirements.

Refer to Section 7 - Key Documents/Tools/Links for specific SWPs and requirements related to naturally occurring radioactive material (NORM) and handling requirements for specifically licensed radioactive devices between the NRC or local agreement state and BP GoM Region.

2 Scope

This SWP applies to BP GoM Region operations, wells, and projects.

3 Key Responsibilities

3.1 Offshore Installation Manager (OIM)/Facility Manager/ or designate

Verify that risk assessments are conducted to identify activities involving radioactive materials and devices that may be associated with potential radiation exposure.

3.2 Issuing Authority (IA)

- A. Ensure that the team understands the assessment process and that the aim is to recognize and reduce risks associated with the use of radioactive materials and devices for the task to be completed safely or, if risks cannot be controlled, to prevent the task from taking place.
- B. Ensure that the assessment team includes personnel with the necessary knowledge and competence for the task involved.
- C. Verify that this SWP has been communicated to third party/contract personnel and that they have procedures, resources, equipment, and training to complete the work activity.

3.3 Performing Authority (PA)

- A. Inspect the worksite, either alone or preferably with the Issuing Authority to identify the hazards associated with radioactive materials and devices and planned controls prior to completion of the risk assessment for the task being planned.

- B. Document the task hazards associated with radioactive materials and devices, risks and controls, jobsite and process safety hazards on the Work Control Certificate (WCC) Permit with input from the Issuing Authority.

3.4 Third Parties/Contractors

Provide work procedures, exposure monitoring methods and records, and exposure control measures to the Issuing Authority and Radiation Safety Officer that will be utilized when handling radioactive materials and devices when performing work activities at BP GoM facilities.

3.5 Health & Safety (H&S) Site Lead

- A. Assist management, supervisors, and workforce with requests regarding work practices and protective measures when working with radioactive materials and devices.
- B. Consult with Health & Industrial Hygiene Team on training, work practices, and protective measures for activities with potential for radiation exposure.
- C. Review third-party contract risk/hazard assessments when there is potential for radiation exposure, consult with Health & Industrial Hygiene Team as needed.

3.6 Health & Industrial Hygiene Team

- A. Review and update this SWP and training materials per the document management control system review process and cycle.
- B. Provide technical support on training, work practices, and protective measures when handling radioactive materials and devices.
- C. Conduct and/or support surveys/sampling, as requested. Assess the results of assessments and audits to identify trends, emerging risks, and opportunities to improve risk reduction measures.
- D. Provide guidance and technical support regarding medical surveillance and biological monitoring requirements for potential radiation exposures, as appropriate.

3.7 Environmental Advisor

- A. Provide technical support on radioactive material and device waste characterization and disposal, as appropriate.
- B. Conduct and/or support surveys/sampling, as requested.

3.8 Authorized Users

Personnel who conduct radiation work in accordance with BP's general license and under the direction of the Radiation Safety Officer.

3.9 Radiation Safety Officer (RSO)

- A. Responsible for oversight of the radiation safety program for the GoM Region.
- B. Provide technical support on training, work practices, and protective measures when handling radioactive materials and devices.
- C. Act as the point of contact for radiation questions and concerns as well as radiation emergencies.
- D. Maintain records, receipts, exposure monitoring data, and radiation source inventories.
- E. Shall be notified prior to the purchase and installation of radiation sources or devices to assist with the appropriate licensing requirements.

4 General Requirements

- A. Work involving the use of ionizing radioactive materials at BP facilities is generally conducted by third party/contract personnel. The responsibility for the radioactive material; implementing testing and exposure control measures; disposal; and decontamination of any associated equipment or the site is the responsibility of third party/contract personnel and shall be managed in accordance with the regulatory requirements.
- B. The following health and safety regulatory standards apply for controlling and managing potential ionizing radiation exposures that may occur at BP GoM Region facilities:
 - 1. 10 CFR 20 US NRC Standards for Protection Against Radiation
 - 2. OSHA 29 CFR 1910.1096 Ionizing Radiation
- C. Due to potential health effects resulting from exposure to radiation, exposure levels should be kept ALARA.
- D. The standard personal protective equipment requirements apply when handling radioactive materials, this includes a hardhat, safety glasses, gloves, hearing protection, and fire retardant clothing. Survey meters and personal dosimeters / film badges may also be required when handling radioactive materials depending on source activity level and potential for personnel exposure.
- E. The BP general license requires annual calibration of survey meters and leak tests and function tests of safety devices every six months unless a longer interval has been approved by the NRC.

- F. Sources shall be shielded to minimize exposure and prevent release of radioactive materials.
- G. Radioactive materials and devices shall be secured while in use and/or in storage.

5 Process

5.1 Uses of radioactive materials and devices

- A. Natural, man-made, and enhanced radioisotopes are used by the oil and gas industry to:
 1. Explore for oil and natural gas;
 2. Determine density and level of products in pipelines or vessels;
 3. Test pipes and welds, including structural cracks and stresses in equipment;
 4. Test the thickness of metal products such as steel; and
 5. Trace or monitor the movement of materials and equipment (e.g., radioactive tracers).

5.2 Health Effects

- A. Stochastic Health Effects
 1. Stochastic effects are associated with long-term, low-level (chronic) exposure to radiation. "Stochastic" refers to the likelihood that something will happen.
 2. Increased levels of exposure make these health effects more likely to occur, but they do not influence the type or severity of the effect.
 3. Cancer is considered to be the primary health effect from radiation exposure. Radiation can also cause mutation changes in DNA that are teratogenic or genetic. Teratogenic mutations are caused by exposure of the fetus in the uterus and affect only the individual who was exposed. Genetic mutations are passed on to offspring.
- B. Non-Stochastic Health Effects
 1. Non-stochastic effects appear in cases of exposure to high levels of radiation, and they become more severe as the exposure increases. Short-term, high-level exposure is referred to as acute exposure.
 2. Many non-cancerous health effects of radiation are non-stochastic. Unlike cancer, health effects from acute exposure to radiation usually appear quickly.
 3. Acute health effects include burns and radiation sickness. Radiation sickness is also called radiation poisoning. It can cause premature aging or even death. If the dose is fatal, death usually occurs within two months. The symptoms of

radiation sickness include nausea, weakness, hair loss, skin burns or diminished organ function.

5.3 Occupational Exposure Limits

Operations, Wells, and Projects shall limit doses of ionizing radiation from occupational sources of ionizing radiation to ALARA and shall not exceed the following limits:

- A. **5 rem/year** for workers (total dose equivalent)
- B. **100 mrem/year** for non-workers (members of the public)

5.4 Risk Management

A. Detecting and Measuring Ionizing Radiation in the Workplace

1. Facilities or operations utilizing ionizing radioactive sources or equipment continuously shall conduct and document surveys at least annually to verify that dose limits for ionizing radiation from occupational sources are not exceeded. Survey equipment shall be appropriately calibrated and capable of measuring the types of ionizing radiation present. Third party/contract personnel utilizing ionizing radioactive sources or equipment shall provide documentation that such surveys are conducted.
2. Personnel utilizing equipment or allowed access to areas with dose rates greater than or equal to 2 mrem in any hour or who have the potential to receive 500 mrem (0.5 rem) per year shall be issued a personal dosimeter that is capable of measuring the types of radiation to which they are exposed.
3. An investigation and action plan to reduce further doses are required whenever a worker's dose equals or exceeds the exposure limits.

B. Testing of Sources

Licensed third party/contract personnel may utilize radioactive sources for well logging sources, Table 1 defines leak testing requirements for these and other radioactive sources.

Table 1. Sources and Leak Testing Frequency Requirements

Type of Source	Routine Period
Well Logging Source	12 months
Energy Stabilization Sources for Well Logging Detectors	36 months
Sources contained within Surface Meters (level indicators, density gauges, flow meters)	6 months Unless otherwise specified
Alpha Emitters	3 Months

Minitrons (Neutron Generators)	Exempt
<ol style="list-style-type: none"> 1. Sources containing activities less than or equal to 3.7 MBq are exempt. 2. Any sealed source test result greater than or equal to 18.5 Bq shall be temporarily removed from service and tested again. If a second test result is greater than or equal to 18.5 Bq, the source shall be permanently removed from service. 3. Radiation producing machines purchased directly from manufacturers shall be tested per the schedule set out by the manufacturer or at least annually to determine the radiation levels produced by the machines in areas accessible to personnel. 	

5.5 Controlling Ionizing Radiation Exposures

A. Radioactive Sources

1. Control measures appropriate to the ionizing radiation equipment used and potential exposure levels present shall be in place and implemented.
2. Prior to obtaining any radioactive materials, the RSO shall be notified.
3. Radioactive materials shall be obtained from approved suppliers and shall be legally authorized as materials.
4. Sealed sources and radiation producing machines, other than those used as a component of designed equipment, shall be purchased directly from approved, legally authorized manufacturers. Accelerators, cabinet and flash X-ray units, X-ray fluorescence devices and scanning electron microscopes are examples of radiation producing machines.

B. Inventory and Storage of Material

1. Sources and devices shall meet applicable regulatory standards and licensing requirements.
2. Radioactive materials shall be physically inventoried and documented at least annually unless otherwise specified by a device registry or license, except for special form materials with activities less than 50 kBq.
3. Licensed third party/contract personnel may utilize and store radioactive sources to prevent unauthorized removal while onsite, Table 2 defines requirements with regards to defining controlled and restricted areas for barricading.

Table 2. Source Type and Storage Requirements

Type of Source	Activity	Stored Within
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Special form sources not contained within surface meters of logging tools	Any	Restricted Area
Natural Thorium	Any	Restricted Area
Minitrons not installed within equipment	Any	Restricted Area
Minitrons installed within equipment	Any	Controlled Area
Special form sources contained within logging tools	≤ 3.7 MBq	Controlled Area
Special form sources contained within surface meters	< 10 GBq	Restricted Area or Permanently Mounted to Operating
All other authorized materials	Any	Restricted Area

C. Safe Handling of Ionizing Radioactive Materials/Sources

1. Personnel handling ionizing radiation material/sources shall be aware of the type of material/source and be trained on the hazards and proper control procedures.
2. Exposure to ionizing radiation shall be minimized to ALARA.
3. No eating, drinking or smoking may take place in any area in which there are ionizing radioactive sources.
4. Wear gloves and/or other protective clothing when there is a possibility of contamination of the hands or body.
5. Personnel shall wear the appropriate radiation dose monitoring equipment, if applicable, when working with or around materials/sources.
6. Radioactive materials/sources shall be clearly labeled, using the standard radiation symbol.
7. Commercially prepared materials/sources shall not be tampered with or physically modified.
8. Discarded ionizing radioactive waste shall be properly disposed of and documented according to approved methods and never deposited into trash cans.
9. Check the hands and body for accidental contamination after the use of sources with the potential for contamination.

D. Incident and Emergency Reporting

1. The following incidents shall be immediately reported to the BP Person in Charge and the RSO:

- a. Leaking or ruptured source;
 - b. Spill of radioactive material;
 - c. Lost, missing or stolen radioactive material;
 - d. Vehicle accident when the cargo includes radioactive material;
 - e. Any dose of ionizing radiation exceeding the limits defined in this document; and
 - f. A shutter on a surface meter is stuck in the open position.
2. Whenever a source is stuck in a well, it shall be immediately reported to the BP Person in Charge and the RSO for any of the following:
 - a. The first attempt to recover the source has failed;
 - b. The abandonment of the source is imminent; or
 - c. When fishing operations could damage or rupture the source.
 3. Any accident, injury, or loss of control of a radiation source that could cause an excessive or uncontrolled radiation exposure to any individual shall be considered a radiation emergency.
 - a. The first action to take in any such emergency is to provide first aid to injured persons and/or prevent further injury.
 - b. Persons should immediately leave the affected area until the extent of the radiological hazard can be determined, but they should remain in the vicinity until they have been personally scanned for contamination.
 - c. The RSO shall be immediately notified for guidance before additional actions are taken.
- E. Disposal
1. Disposal transportation and final disposal, if applicable, shall be in accordance with the NRC, Department of Transportation (DOT) and Environmental Protection Agency (EPA) regulations.
 2. Contact the RSO and/or Environmental Team.
 3. Most special form materials should be returned to the manufacturer/origin for disposal.

5.6 Training

- A. Workers whose tasks may expose them to ionizing radiation shall receive General Radiation Awareness training.
- B. Those who may be exposed to levels above 100 mrem per year, operate ionizing radiation devices, handle ionizing radiation sources, or work within restricted areas shall receive General Radiation Awareness training and additional Task and Exposure Control training. These individuals will also be identified as Authorized Users.

1. General Radiation Awareness Training should include, at a minimum:
 - a. Radiation safety principles;
 - b. Background radiation sources and levels;
 - c. Health risk from radiation; and
 - d. Applicable regulations and applicable document procedures.

2. Task and Exposure Control Training should include, at a minimum:
 - a. Time, distance and shielding;
 - b. Health risks from radiation;
 - c. Dosimeters and survey meters;
 - d. Survey meter operation and applicable surveys;
 - e. Applicable procedures materials handled;
 - f. Applicable leak test procedures;
 - g. Applicable survey meter calibration procedures;
 - h. Procedures for all other applicable unsealed materials; and
 - i. Specific emergency and operating procedures.


5.7 Recordkeeping

- A. Audits of the radiation safety program shall be maintained for three years unless defined by a license.
- B. Current up-to-date licenses shall be maintained until the NRC or agreement state authorizes disposal.
- C. Disposal records shall be maintained until the NRC or agreement state authorizes disposal and a transfer letter is received.
- D. Annual Inventory records shall be maintained for three years unless defined by a license.
- E. Survey and calibration records shall be maintained for a minimum of three years.
- F. Personal monitoring records should be maintained for a minimum of 30 years plus facility lifetime.
- G. Source leak tests are required by the NRC and Agreement states to be maintained for three years.
- H. Gauge receipt records shall be maintained for three years following disposal.
- I. Shutter safety mechanism test records shall be maintained for three years.
- J. Training records shall be maintained for three years.
- K. Transfer records shall be maintained for three years following transfer.

6 Definitions/Acronyms

Terms	Description
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Background Sources of Radiation	Cosmic radiation or naturally occurring radioactive material (NORM) such as Thorium and Uranium.
Becquerel (Bq)	Unit of radioactive decay equal to 1 disintegration per second. 37 billion Becquerel's are equal to 1 curie (Ci).
Controlled Area	An area, outside a restricted area but inside the site boundary, to which access can be limited by the licensee for any reason.
Terms	Description
Dosimeter	Small air filled ionization chamber that measures radiation dose by responding to ionization in the air.
General License	Allows certain persons to receive and use a device containing byproduct material if the device has been manufactured and distributed in accordance with a specific license issued by the NRC or by an Agreement State.
Ionizing Radiation	Charged particles (alphas, betas, positrons and protons), neutrons, gamma rays and x-rays capable of creating damage to human cells through the ionization of chemicals within the cell.
Leak test	Check for the escape of radioactive material from a source housing.
Nuclear Regulatory Commission (NRC)	The federal regulating body with jurisdiction over radiation activities for the Gulf of Mexico Deep Water.
Occupational Sources of Ionizing Radiation	Includes radiation-producing machines and radioactive source materials either present or used at BP locations or for BP operations (background sources of radiation are not occupational sources of ionizing radiation).
Radiation Area	An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates or 100 mrem in any 5 consecutive days.
Radiation Emergency	An emergency in which there is, or is perceived to be, a hazard due to radiation exposure from a source. Examples include a leaking source, spill of radioactive material, or an exposure that exceeds the occupational exposure limits.

Radiation Producing Machine	Any device with the specific purpose of creating ionizing radiation (e.g., X-ray units, X-ray fluorescence devices, radiation flow detection device, level detection devices, etc.). Note: Electronic devices creating ionizing radiation as an indirect consequence of their operations are not classified as radiation producing machines.
Radiation Safety Officer (RSO)	The individual accountable for the radiation safety program.
Terms	Description
Radioactive Materials	Materials and substances that spontaneously emit energy in the form of alpha, beta, gamma radiation or x-rays.
Radioactive Tracers	Examples include use of tracers to determine the injection profile and locate fractures created by hydraulic fracturing or investigate and trace the movement of materials and equipment by utilizing radiation detection equipment.
Radiation Symbol	The standardized radiation presence symbol. Also known as the Trefoil. 
rem	A measure of the dose to the human body tissues in terms of its estimated biological effect (1 millirem (mrem) = 0.001 rem and 1 mrem = 0.01 mSv).
Restricted Area	An area, access to which is limited by the licensee or registrant for the purpose of protecting individuals against undue risks from exposure to sources of radiation.
Sealed Source	Radioactive material sealed in a capsule designed to prevent leakage or escape of the material.
Sievert (Sv)	The SI measure of the dose to the human body tissues in terms of its estimated biological effect. (1 mSv = 100 mrem).
Special Form Radioactive Material	Radioactive material that is either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule and the piece or capsule has at least one dimension not less than 5 mm (0.2 in)

7 Key Documents/Tools/References

A. US NRC 10 CFR 20, Standards for Protection Against Radiation

- B. OSHA 29 CFR 1910.1096, Ionizing Radiation
- C. OSHA 29 CFR 1910.1200, Hazard Communication Standard
- D. OSHA 29 CFR 1910.1020, Access to Employee Exposure and Medical Records
- E. GoM Region Naturally Occurring Radioactive Material (NORM) Manual
- F. GoM Region Radiation Safety – Specifically Licensed Devices Safe Work Practice

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