NATURALLY OCCURRING RADIOACTIVE MATERIAL (NORM) SURVEYS

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 REVISED NOV. 12, 2012

BACKGROUND:

INTRODUCTION TO NORM

NATURALLY OCCURRING RADIOACTIVE MATERIAL (NORM) CONSISTS OF MATERIALS, USUALLY INDUSTRIAL WASTES OR BYPRODUCTS, ENRICHED WITH RADIOACTIVE ELEMENTS FOUND IN THE ENVIRONMENT. EXAMPLES OF NORM INCLUDE URANIUM, THORIUM, AND POTASSIUM AND ANY OF THEIR DECAY PRODUCTS, SUCH AS RADIUM AND RADON. THESE NATURAL RADIOACTIVE ELEMENTS ARE PRESENT IN VERY LOW CONCENTRATIONS IN EARTH'S CRUST AND ARE BROUGHT TO THE SURFACE THROUGH MAN-MADE ACTIVITIES, SUCH AS OIL AND GAS EXPLORATION OR MINING, AND THROUGH NATURAL PROCESSES LIKE LEAKAGE OF RADON GAS TO THE ATMOSPHERE OR THROUGH DISSOLUTION IN GROUNDWATER.

The average person in the U.S. is exposed to approximately 360 accumulated millirems of radiation from natural sources each year. Over 80% of this exposure level comes from background radiation sources.

UNITS OF MEASUREMENT FOR RADIOACTIVITY	
Microroentgens per hour (μR/hr)	A measure of exposure from X-ray and gamma ray mR/hr radiation in air. Measurement of the intensity of radiation in air. *Microroentgen = one millionth of a roentgen*
Picocuries per gram (pCi/g)	A measure of the radioactivity of one gram of radionuclide that decays at a rate of 3.7E-2 disintegration per sec.
MilliREM (mREM/yr)	An acronym for roentgens equivalent man. Relates to the adsorption of radiation on parts of the body over time. *REM ~ One roentgen*

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INTRODUCTION TO NORM

Health risks from exposure to low levels of NORM are minimal; 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 exploration, development, production, and refining; natural gas extraction, water treatment; and mining can alter the natural background radiation.

OUR SERVICES AND APPROACH:

CONDUCTING NORM SURVEYS FOR THE OIL & GAS INDUSTRY

Sage performs NORM surveys and develops documentation for both the oil and gas upstream and downstream sectors.

NORM ENCOUNTERED IN OIL & GAS ACTVITIES

NORM encountered in oil and gas exploration, development, and production operations originates in subsurface formations may contain radioactive materials such as uranium and thorium and their products, radium 226 and radium 228. These materials are brought to the surface in the formation water that is produced in the extraction of oil and gas. NORM in these produced waters typically consists of the radionuclides, radium 226 and 228. Radon gas may also be found in produced natural gas.

Radium 226 and radium 228, found in produced waters, may co-precipitate with the barium sulfate scale present in the wells and surface equipment, due to temperature and pressure changes that occur during oil and gas production operations. Concentrations of radium 226 and 228 may also occur in the sludge that accumulates in oilfield pits and tanks. These solids become sources of oil and gas NORM waste. In gas processing activities, NORM generally occurs as radon gas in the natural gas stream. Radon decays to Lead-210, then to Bismuth-210, Polonium-210, and finally to stable Lead-206. Radon decay elements occur as a film on the inner surface of inlet lines, treating units, pumps, and valves principally associated with propylene, ethane, and propane processing streams.

Workers employed in the area of cutting and reaming oilfield pipe, removing solids from tanks and pits, and refurbishing gas processing equipment may be exposed to particles containing levels of alpha-emitting radionuclides that could pose health risks if inhaled or ingested. Sage performs NORM surveys for all aspects of the oil and gas industry.

NORM REGULATIONS

NORM is not federally regulated in the United States. The Nuclear Regulatory Commission (NRC) has jurisdiction over a relatively narrow spectrum of radiation; the Environmental Protection Agency (EPA) has jurisdiction over NORM but has not

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developed NORM regulations. Therefore, this responsibility is delegated to the states. Since no federal government entity has implemented NORM regulations, the states may determine the stringency level of the regulations.

State regulations establish radiation protection standards for the possession, use, transfer, transport, and/or storage of NORM or the recycling of NORM-contaminated materials. Regulations may identify exemption levels for NORM contained in or that has contaminated soils, materials in the recycling process, and equipment. Additional exemptions may be identified for the possession, storage, use, transportation, and commercial distribution of natural gas and natural gas products, crude oil and crude oil products containing NORM, and possession of produced water containing NORM.

NORM waste with radioactivity levels above the established exemption levels must be managed in accordance with current disposal regulations. Additionally, NORM-contaminated equipment that is being discarded must be decontaminated before it is disposed or recycled. Operators are obligated to determine whether they possess NORM above exemption levels.

Standards for cleanup of radium-contaminated soils that typically appear in enacted or proposed NORM regulations call for an average concentration of less than 5 pCi/g in the upper 15 cm (centimeters) of soil and an average of less than 15 pCi/g in deeper increments of 15 cm. Some states allow an average of as much as 30 pCi/g of radium in the upper 15 cm of soil. Sage's knowledge of and experience with the NORM regulations ensures completion and acceptance of surveys at all regulatory levels of review.

NORM SURVEYS

NORM surveys detect radiation and locate and identify the radiation source. Levels of detected radiation are measured and identified concentrations may be used to determine the regulated procedures associated with the possession, use, transfer, storage, cleanup, and disposal.

Baseline surveys may be conducted to locate NORM accumulation and levels in facilities. This information is essential in determining which category of workers requires what level of protection and the type of contamination control procedures to be instituted. Additionally, pre-shutdown surveys take place to determine the locations of accumulation in facilities where NORM contamination is suspected to identify proper closure procedures.