EUREKA RESOURCES
THE FIRST STEP TO CLEANER WATERS

Hydraulic Fracturing – Naturally Occurring Radioactive Materials (NORM)

Hydraulic Fracturing

Hydraulic fracturing is the propagation of fractures in a rock layer by a pressurized fluid. Some fractures form naturally, creating conduits along which gas and petroleum from source rocks may migrate to reservoir rocks. Induced hydraulic fracturing or hydrofracturing, commonly known as fracing, or fracking, is a technique used to artificially create conduits for release of petroleum and natural gas (including shale gas, tight gas, and coal seam gas). This type of fracturing creates fractures from a wellbore drilled into reservoir rock formations. Water-based hydraulic fracturing, commonly referred to as slick water fracing, is the typical process used by Oil and Gas Developers in most shale gas & oil basins throughout the continental United States.

Hydraulic fracturing results in the generation of development and produced wastewaters which can contain low levels of naturally occurring radioactive materials (NORM). Radioactivity is attributed to radionuclides which are known to be associated with organic materials in nature; therefore, oil, gas, and oil field wastewaters frequently contain NORM. Naturally occurring radioactive elements include uranium, radium, and radon which are typically dissolved in very low concentrations during normal reactions between water and rock or soil. Groundwater that coexists with deposits of oil and/or gas can have high concentrations of dissolved constituents (total dissolved solids or TDS) that build up during prolonged periods of water/rock contact.

NORM Management at EUREKA

The Marcellus Shale Play related development and produced wastewaters received at Eureka's facilities do contain low levels of NORM. Eureka developed and implemented an action plan for detection and handling of NORM at all of our facilities. The plans include a customized complex decision matrix for determining whether a load of wastewater should be accepted at the facilities based on predicted NORM concentration impacts on treatment processes and resulting residuals generation.

Eureka Resources, LLC. Treatment Facility
419 Second Street, Williamsport, Pennsylvania 17701

Action Plan for Detection & Handling of Radioactive Materials

September 2010
Revised February 2013

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FACT SHEET

ABILITY • RESPONSIBILITY • STEWARDSHIP

FREQUENTLY ASKED QUESTIONS:

Q *What is NORM?*

A NORM consists primarily of material containing potassium-40 and isotopes belonging to the primordial radionuclides which are isotopes of heavy elements belonging to the radioactive series headed by the three long-lived isotopes uranium-238 (uranium series), uranium-235 (actinium series), and thorium-232 (thorium series). When resources (oil and gas) are extracted from the earth, natural radioactive material comes with those resources typically as constituents in development and produced wastewaters. When treating/processing the wastewaters, NORM is typically removed.

Q *Where does NORM come from?*

A NORM is everywhere and we are exposed to it every day. Natural radiation has been around forever. NORM is wide spread in the natural environment and is found in our food, our homes, and in products we use. Almost everything in nature has some small amount of natural radioactivity. We are also bathed in natural radiation coming from the sun. The occurrence of NORM varies throughout the world, and may be more or less likely in oil and gas wastewaters depending on the types of rocks and minerals in a given geographic area. NORM contributes a part of the natural "background" exposure from radiation. Living systems have adapted to these levels of radiation and radioactivity.

Q *What is TENORM?*

A TENORM is an acronym for Technologically Enhanced Naturally Occurring Radioactive Material. The term TENORM is used to identify NORM which may have been technologically enhanced in some way. The enhancement occurs when NORM has its composition, concentration, availability, or proximity to people altered by human activity. The term is usually applied when the NORM is present in sufficient quantities or concentrations to require control for purposes of radiological protection of the public or the environment.

Q *Are there ongoing studies on the impacts of NORM and TENORM related to oil and gas wastewater?*

A **Yes.** Both the USEPA and PADEP are conducting studies on the impacts of NORM/TENORM related to treatment/processing of development and produced wastewaters.

Q *Are Marcellus Shale Play development and produced wastewaters radioactive*?

A Eureka Resources has been treating Marcellus Shale Play related development and produced wastewaters at our Williamsport facility since 2008. Eureka routinely monitors radiation levels throughout the Williamsport facility in accordance with a plan required by the Pennsylvania Department of Environmental Protection (PADEP). While the influent wastewaters do contain low levels of Naturally Occurring Radioactive Material (NORM), routine monitoring and implementation of our action plan has determined that the NORM levels stay below action levels and the wastewater is not radioactive.

Q *Where does the NORM that is present in development and produced wastewaters processed by Eureka end up?*

A The NORM constituents end up in the sludge generated in the pretreatment process or in the concentrated brine generated in the distillation and/or crystallization processes. Our operating history and routine monitoring have indicated NORM levels stay below applicable regulatory action levels which allow us to dispose of our sludge in sanitary landfills and our concentrated brine (when it can't be recycled) in Ohio underground injection wells.

Q *Will NORM levels in water, sludge or air impact me?*

A **No.** The historic NORM levels have been low and no one has been exposed to radioactivity or radiation from the treatment processes. Eureka will continue to use our Radiation Monitoring Plan to evaluate NORM levels and verify that levels will not adversely impact the public or the environment.

REFERENCES:

- USGS Science For a Changing World - U.S. Geological Survey Fact Sheet 0142-99 - Naturally Occurring Radioactive Materials (NORM) in Produced Water and Oil-Field Equipment—An Issue for the Energy Industry – January 2013
- Web Site: Health Physics Society: NORM Fact Sheet - hps1.org/glossary/norm.htm
- Web Site: http://www.epa.gov/rpdweb00/tenorm/about.html

Visit us on our Website:
www.eureka-resources.com

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GAS WELL WASTEWATER TREATMENT

TYPE OF FACILITIES/WASTEWATERS: Oil & Gas Wastewater Treatment & Storage Facilities that accept/treat/manage development (top hole waters, pit waters, drilling muds, flowback) & produced (formation waters & compressor station condensate waters).

LOCATIONS OF FACILITIES:

- 419 Second Street, Williamsport, PA 17701
- Off Route 6 near Towanda, Standing Stone Township, Bradford County, PA
- Reach Road, Williamsport, PA 17701

ADDRESS: Eureka Resources, LLC, 454 Pine Street, Williamsport, PA, 17701
Please Contact Us at **570-651-9972** for More Information.
Visit us on our Website: **www.eureka-resources.com**