

	<p align="center"><b>ILLINOIS DEPARTMENT OF NATURAL RESOURCES</b></p> <p align="center">Office of Oil and Gas Resource Management One Natural Resources Way Springfield, Illinois 62702-1271</p>	
<p align="center"><b>HIGH VOLUME HORIZONTAL HYDRAULIC FRACTURING PERMIT APPLICATION HVHFF-10</b></p>		

References to "1-xx" or "§1-xx" are to the Hydraulic Fracturing Regulatory Act., 225 ILCS 732/1-1 et seq. References to "240.xxx" and "245.xxx" are to 62 Ill. Admin. Code 240 and 245, respectively.

**Attachment: RadioactiveMaterialsManagement**

Please save attachment and use the file name above.

**Radioactive Materials Management §1-35)b)(20); 245.210(b)(7).**

Attach a plan explaining how you will test for and identify, manage, transport, and dispose of radioactive materials used or generated during your operations. The strategy at minimum must:

(a) Confirm that the initial site sampling will determine concentrations of the following:

	Total Dissolved Solids	Gross Alpha	Gross Beta	Radium-226	Radium-228	Potassium-40
Soil						
Private wells						
Surface water						

(b) Describe what you plan for radiation testing of drill cuttings from the black shale

(c) Describe what you plan for radiation testing of flowback

(d) Describe what you plan for radiation testing of the well site during site restoration, including reserve pits and any surface waters within 1500 feet of the well site.

(e) Describe the frequency and components of surveys of equipment and waste streams prior to disposal, maintenance or recycling.

## **Radioactive Materials Management**

This Radioactive Materials Management Program provides the procedures that will be followed to test for, identify, manage, transport, and dispose of any radioactive materials utilized or generated during the course of High Volume Horizontal Hydraulic Fracturing (HVHFF) operations. This document should be employed in conjunction with the Well Site Safety Plan also provided for the Site. Radioactive material management is also regulated by the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Transportation (DOT).

### **(a) Baseline Site Sampling**

Initial site conditions will be assessed through the collection and analysis of five soil samples from the drill pad location. The sample locations latitudes and longitudes shall be recorded so that the baseline samples can be compared to subsequent site restoration samples described below. Since there are no existing private wells in the vicinity of the proposed oil well, nor any surface water bodies, there are, as yet, no water sources to sample under this permit requirement. (Water bodies and sources are covered in the Water Source Management Plan and the Water Quality Management Plan for non-radioactive constituents.) The water supply wells constructed for purposes of oil well drilling and hydraulic fracturing are to be located in the vicinity of the proposed oil well, and shall be sampled and analyzed after completion of their construction, but before hydraulic fracturing takes place. The analysis for radioactive particles and isotopes will be conducted by an Illinois EPA approved laboratory in accordance with the analytical methods described in the attached table. Sample collection methods are described in the Well Site Safety Plan in Section 3.2.10.3.

### **(b) Radiation Testing of Drill Cuttings from Black Shale**

In addition to baseline sampling at the Site prior to drilling, samples of the target black shale drill cuttings will be collected and submitted for analysis for Naturally Occurring Radioactive Materials (NORM) as Identified in the table below. The number of samples to be collected for analysis will be consistent with one sample per 1,000 feet of horizontal drilling in the black shale. The analysis for radioactive particles and isotopes will be conducted by an Illinois EPA approved laboratory in accordance with the analytical methods described in the attached table. Sampling methods and equipment are described in the Well Site Safety Plan in Section 3.2.10.3.

**(c) Testing for Radiation in Flowback Water and Solids**

Flowback fluids will be returned to the surface from each stage of the hydraulic fracturing procedure. That fluid will contain some of the injected hydraulic fracturing fluids and solids as well as water, oil, and solids from the shale formation. The solids and liquids will be separated in a settling tank, and samples from the solid and liquid fractions will be collected and analyzed for radioactive particles and isotopes by the same methods used for other materials potentially containing NORM. Sampling methods and equipment are described in the Well Site Safety Plan in Section 3.2.10.3.

**Table of Radionuclide Sampling and Analysis**

Media	Schedule	TDS	Gross Alpha	Gross Beta	Radium-226	Radium-228	Potassium-40
Baseline Soils	Prior to Well Pad Construction	Not Applicable	EPA 900	EPA 900	SM 7500 Ra B M	EPA 904	EPA 6010B
Drill Cuttings from black Shale	During drilling of black shale	Not Applicable	EPA 900	EPA 900	SM 7500 Ra B M	EPA 904	EPA 6010B
Private wells	After Water Well Drilling	EPA 160.1	EPA 900	EPA 900	SM 7500 Ra B M	EPA 904	EPA 6010B
Surface water	No surface water bodies near the well						
Flowback Water	One sample per 1000 feet of horizontal well in black shale	EPA 160.1	EPA 900	EPA 900	SM 7500 Ra B M	EPA 904	EPA 6010B
Flowback Solids	One sample per 1000 feet of horizontal well in black shale	Not Applicable	EPA 900	EPA 900	SM 7500 Ra B M	EPA 904	EPA 6010B

**(d) Well Site Testing During Site Restoration**

Site restoration is intended to return the Site to near the original Site conditions. In that regard, the original five baseline sample locations shall be re-sampled after Site restoration activities

and analyzed for the same analytes. In addition, any area where discharge of suspect NORM material has occurred during drilling or hydraulic fracturing activities shall be sampled and compared to the baseline data for the overall Site.

### **(e) Equipment and Waste Stream Disposal, Maintenance, or Recycling**

The level of NORM accumulation can vary substantially from one petroleum or gas production facility to another, depending on geological formation and operational conditions, and will also change over the lifetime of a single well.<sup>i</sup> Since there is little data available regarding NORM potential at the Site to determine whether or not the subject facility is accumulating NORM, a NORM survey with sampling and analysis will be conducted to provide sufficient information to assess the risk. As more fully described in the Well Site Safety Plan, workers at risk of exposure to NORM include those handling pipes and equipment that might have been contaminated by well materials. Sludge, drilling mud, and pipe scales can contain elevated levels of NORM, and the radioactive materials might be removed from the site as wastes or within equipment as the equipment is moved from one site to another. To prevent excess exposure to workers, Section 3.2.10 of the Well Site Safety Plan describes field testing procedures that will be employed and the equipment to be used prior to maintenance activities on equipment that may be suspected of accumulating NORM at the Site during drilling and hydraulic fracturing work. Suspect equipment would include piping, valves and tanks where scale may accumulate on the inside of the equipment .

Prior to disposal or recycling, materials that are suspected of containing NORM materials will be subjected to field testing and/or laboratory analysis to assess the possible requirement to be managed as radioactive wastes. If warranted, the appropriate NRC and DOT requirements shall be followed.

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<sup>i</sup> *Managing Naturally Occurring Radioactive Material (NORM) in the oil and gas industry*, International Association of Oil & Gas Producers, Report 412, March, 2016.