


# **EXHIBIT R**

**NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION**

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**MEMORANDUM**

**TO:** Regional Materials Management Engineers

**FROM:** Robert J. Phaneuf, P.E., Acting Director, Division of Materials Management 

**SUBJECT:** Program Policy Memorandum: Recommended Permit Modifications and Operating Procedures for Landfills relating to Wastes from Drilling in the Marcellus Shale Formation

**DATE:** SEP 18 2015

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Issue

Drilling wastes from natural gas extraction activities are being directed to landfills regulated under 6 NYCRR Part 360 (Solid Waste Management Facilities) (Part 360) in increasing volumes due to high-volume hydraulic fracturing (HVHF) activities in Pennsylvania. Data available to date indicate that drilling wastes such as drill cuttings do not display elevated radioactivity above naturally occurring background levels and are appropriate for disposal in landfills regulated under Part 360. However, there is a need to clarify the requirements of Part 360, including limitations on such disposal to ensure the protection of the public from potential elevated radioactivity. This Program Policy Memorandum<sup>1</sup> describes operating and monitoring procedures that should be included in permits for landfills regulated under Part 360 if the operators of those landfills elect to accept drilling wastes from HVHF-related drilling in the Marcellus Shale formation for disposal or use as alternative daily cover.

Discussion

Natural gas well drilling, completion and production generate several distinctly regulated waste streams. The Division has determined that under Part 360, certain Marcellus drilling wastes may be disposed of in landfills regulated under that Part within limits described below and as further described in this memorandum. Specifically, the wastes that may be disposed of include drill cuttings and dewatered drilling mud (for purposes of this memorandum, drill cuttings and dewatered drilling mud will be termed Marcellus Drilling Waste). However, to ensure the protection of the public from potentially elevated radioactivity, permits for landfills which receive Marcellus Drilling Waste from

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<sup>1</sup> A Program Policy Memorandum is designed to provide guidance and clarify program issues for Division staff to ensure compliance with statutory and regulatory requirements. It provides assistance to staff in interpreting and applying regulations and statutes to assure that program uniformity is attained throughout the State. Nothing set forth in a Program Policy Memorandum prevents DEC staff from varying from that guidance as statutes or regulations require or authorize. As this guidance is not a fixed rule, it does not create any enforceable right by any party using the Program Policy Memorandum.



the horizontal leg of HVHF-related wells should include special conditions which require the installation and operation of radiation detectors. For these landfills the operation and maintenance manuals should include alarm setpoint, calibration, training, investigation, and response protocols as discussed below, and include leachate analysis for certain radiological parameters in the landfill's environmental monitoring plan.

Uncontaminated drill cuttings and drilling muds from drilling processes which utilize only air, water, or water-based drilling fluids are considered to be construction and demolition debris under Part 360 and can be disposed of at either construction and demolition (C&D) debris landfills or at municipal solid waste (MSW) landfills. Drill cuttings from drilling processes which utilize any oil-based mud or polymer-based mud containing mineral oil lubricant are considered to be contaminated and can only be disposed of at MSW landfills. Similarly, dewatered drilling muds including any oil-based mud or polymer-based mud containing mineral oil lubricant can only be disposed of at MSW landfills.

The Department has determined that drill cuttings from the Marcellus Shale contain naturally occurring radioactive material (NORM), though the radioactivity is similar to background concentrations. The drilling process utilized (e.g., air-based, oil-based mud, etc.) has no impact on the radioactive characteristics of resultant drill cuttings. NORM-containing wastes are not regulated radioactive wastes (see 6 NYCRR 380-1.2(e)) and are not categorically prohibited from disposal in landfills regulated under Part 360; however, due to the large volume of Marcellus Drilling Wastes entering the State and concerns relating to potential radioactivity associated with Marcellus Wastes, language should be included in either special permit conditions or permit documents which establishes a maximum concentration of 25 pCi/g for any load of Marcellus Drilling Wastes accepted by the landfill.

Modeling performed by Argonne National Laboratory (ANL)<sup>2</sup> shows that an average concentration of 50 pCi/g of radium-226 is protective of public health and the environment for non-intrusive future uses of properly designed, operated, and closed landfills. Setting a limit at half the ANL-modeled value for Marcellus Drilling Waste loads received at landfills regulated under Part 360 provides a conservative limit, and will address any reasonable uncertainties associated with detection of NORM in incoming loads.

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<sup>2</sup> "An Assessment of the Disposal of Petroleum Industry NORM in Nonhazardous Landfills," Karen P. Smith, et al., Argonne National Laboratory, Environmental Assessment Division, September 1999. Further research has corroborated these conclusions. Recently, North Dakota requested that Argonne National Lab reassess their original landfill disposal modeling in support of planned regulatory development by the state. Based on Argonne's affirmation of their original study results, North Dakota is adopting a 50 pCi/g radium limit for oil and gas wastes disposed in their commercial solid waste landfills.

Flowback water and production brines may be generated by gas well completion and production activities. Liquid wastes are prohibited in landfills regulated under Part 360 as per 6 NYCRR Part 360-2.17(k). In addition, wastes from the treatment of flowback water or production brine, such as filter cake, sludge and concentrate, are likely to contain processed and concentrated NORM-containing wastes, i.e., technologically enhanced NORM (TENORM)-containing wastes. TENORM can also build up within piping and process equipment at well sites, creating TENORM-containing waste in the form of piping and other equipment. TENORM-containing wastes are regulated radioactive wastes and as per 6 NYCRR Part 360-1.5(b) may not be disposed of in landfills regulated under Part 360.

#### 1. *Regulatory Clarifications*

##### (a) Unauthorized materials.

The following are unauthorized materials and are therefore prohibited from disposal at any landfill regulated under Part 360. Inadvertent or purposeful disposal of the following listed unauthorized materials must be reported by the landfill to the Department's Regional Materials Management Supervisor and the New York State Department of Health (DOH) Bureau of Environmental Radiation Protection:

(i) Bulk liquids of any kind, unless accepted at a facility permitted by the Department to perform solidification;

(ii) Processed and concentrated, or technologically enhanced, naturally-occurring radioactive materials (TENORM), including but not limited to:

a) piping or equipment with pipe scale, and

b) waste residuals (sludge, filters, resins, etc.) generated from the treatment or processing of flowback water, production brine, or other wastes generated by Marcellus Formation gas development operations;

(iii) Medical use radionuclides such as iodine-131, iodine-125, technetium-99m, thallium-204, and other short half-life nuclides that are contained in vials, syringes, etc. and have been improperly disposed of by a radiopharmacy or hospital directly into the waste stream; and

(iv) Industrial, military or commercial use radionuclides. Examples include luminous dials or markers (radium), static eliminators or thickness gauges (strontium-90, krypton-85, etc.), non-destructive testing or medical sources (cesium-137, cobalt-60, iridium-192, etc.), depleted uranium counterweights, self-luminous exit signs that contain tritium, non-residential smoke detectors designed for commercial or industrial uses, thoriated aircraft engines and parts, welding rods, etc.

**(b) Authorized materials.**

The following applies to wastes associated with wells drilled horizontally in the Marcellus Shale. Acceptance of waste streams other than those described below requires prior written approval from the Department.

(i) The following materials are acceptable for disposal at an MSW landfill without prior Department approval subject to the limitations set forth below:

a) Marcellus Drilling Wastes, which include:

- drill cuttings generated from operations using air, water, polymer-based, and/or oil-based drilling fluids, and
- dewatered drilling muds.

b) non-hazardous soil from a Marcellus Shale gas well site contaminated with, and resulting from the cleanup of a spill of petroleum-based fuel, hydraulic or lubricating oil from construction equipment and/or other vehicles, or drilling fluids.

c) paper, food, packaging and other MSW from offices, living quarters, and maintenance facilities.

d) scrap well pad synthetic geomembrane liner material.

Note: Although the following materials have the potential to trigger a radiation detector, they are not regulated radioactive waste, do not pose a significant risk to landfill workers or the environment, and may be accepted for disposal at an MSW landfill: medical use radionuclides such as iodine-131, iodine-125, technetium-99m, thallium-204, and other short half-life nuclides if they were excreted from a medical patient (such as into a diaper, on tissues or bed linens, etc.).

(ii) The Division has determined that the following materials are acceptable for disposal at a C&D debris landfill without prior department approval subject to the limitations set forth above:

a) drill cuttings and drilling muds generated from operations using air, water or water-based drilling fluids.

b) scrap well pad synthetic geomembrane liner material.

2. *Special permit conditions:* Prior to accepting any Marcellus Drilling Waste the landfills' existing permit should be modified using either a Department initiated modification or during time of renewal or at the time of other permit modification. The provisions of the permit should be similar to the following and are recommended to be included in the landfill's Part 360 solid waste management permit:

(a) Radiation detectors shall be installed, operated, and maintained in accordance with the procedures described in the landfill's operation and maintenance manual for as long as the facility accepts Marcellus Drilling Waste.

(b) The landfill's operation and maintenance manual shall address operation of the radiation detectors and the procedures landfill staff will use to assess a load causing a detector reading in excess of the investigation alarm setpoint, which is recommended to be two times site background radioactivity but under no circumstances should be set at greater than five times site background radioactivity. Specific items that must be addressed include:

- (i) Investigation procedures and waste rejection criteria and procedures for specific waste types;
- (ii) Radiation investigation alarm set points, calibration and field checks frequency, and the procedure used to correlate detector reading to load concentrations; and
- (iii) Staff training on detector operations and associated procedures.

3. *Environmental Monitoring Plan: Radionuclide Sampling*

The Division recommends that the following radionuclide sampling and analysis requirements be included in the facility's permit or environmental monitoring plan.

(a) In order to assess existing leachate radiological conditions prior to the acceptance of Marcellus Drilling Waste, samples of leachate and leachate sediment for each cell that will receive Marcellus Drilling Waste must be collected in accordance with normal collection procedures and analyzed for radioactivity to establish a baseline prior to acceptance of Marcellus Drilling Waste. Once Marcellus Drilling Wastes are accepted, sampling should be conducted on a semi-annual basis and submitted to the Department. After a minimum of three years, the sampling frequency may be reduced to an annual basis or eliminated upon Department approval.

(b) For a normal round of sampling, radionuclide analytes should include:

- Radium-226 per EPA 903.1
- Radium-228 per EPA 904.0
- Total Uranium per EPA 908.0
- Gamma Spectrum per EPA 901.1

If special investigation is necessary (e.g., if significantly elevated NORM levels are observed), isotopic thorium and/or isotopic uranium may be specified. Reasonable proposals to the Department for the use of alternate analytical methods will be considered.

(c) Two sets of samples should be collected: one filtered and one unfiltered. Filtered samples should be filtered using a 0.45 micron filter via standard techniques. (Note: The presence of sediment or suspended solids in a sample can greatly affect the apparent radionuclide concentration and thus care should be used to ensure filtering is effective.)

4. *Operation & Maintenance Manual:*

(a) The Division recommends that the following radiation acceptance criteria be included as requirements in the facility's permit or operation and maintenance manual.

(i) The investigation alarm setpoint is recommended to be set at two times background radiation levels, but under no circumstance may be set at greater than five times background radiation levels.

(ii) No load of Marcellus Drilling Waste may be accepted if the concentration of radium-226 is greater than 25 pCi/g.

(b) The following training, record keeping, and quality assurance/quality control documents and procedures are recommended to be included as requirements in the facility's permit or operating and maintenance manual:

(i) A log of daily background readings should be maintained at the landfill;

(ii) The radiation detection system should be calibrated at least annually, and documentation describing the calibration should be maintained at the facility;

(iii) Field checks utilizing a known radiation source should be performed and recorded at least weekly;

(iv) Records identifying the particular types and associated tonnage of Marcellus Drilling Waste accepted for disposal should be maintained and reported on the facility's Solid Waste Management Facility Annual Report each year;

(v) In order to demonstrate a correlation between radiation detector readings (in kcps) and analytical results (in pCi/g), the landfill should obtain a sample from six loads of Marcellus Drilling Waste entering the landfill. Three samples should represent loads that have no elevated radiation levels. The remaining samples should come from separate loads of waste that have triggered the radiation detector. Radiation monitoring information should be obtained for each sample at the time of sampling. The samples should then be sent for radiological analysis by a DOH Environmental Laboratory Approval Program (ELAP)-certified laboratory. The sample results should be compared to the data collected on-site to further calibrate the detectors; and

(vi) Landfill staff should receive annual training related to the radiation monitoring system operating procedures, radiation investigation alarm response procedures, and drilling waste acceptance and handling procedures. Radiation monitoring system training should also include manufacturer-provided training or equivalent on the operation and trouble shooting of the detector system.

(c) The following Marcellus Drilling Waste handling procedures are recommended to be included as requirements in the facility's permit or operating and maintenance manual:

(i) Marcellus Drilling Wastes may not be placed within six feet of the leachate collection and removal system in order to minimize potential for sediments to enter the leachate collection and removal system.

(ii) Marcellus Drilling Waste may not be placed within ten feet of the exterior of any final cover.

(iii) Marcellus Drilling Waste, which when compacted may create a low-permeability lens, should be placed so that leachate flows in the cell are not inhibited.

(d) The following radiation monitoring and response protocol is recommended to be included as minimum requirements in the facility's permit or operating and maintenance manual:

(i) Each inbound load entering the landfill should be screened for radioactivity using a radiation detector located at the scale/weigh station. In the event that the alarm sounds, the attendant should immediately direct the vehicle to a designated parking area away from the detectors. The driver should be directed to walk near one of the detectors. If the alarm sounds due to the driver, a detector reading of the vehicle alone should be performed. If the vehicle alone does not cause an alarm, the load may be accepted for disposal without further evaluation.

(ii) If it is determined that the alarm was triggered by the load, the vehicle should be driven slowly through the detectors to determine and mark the location of the elevated detector readings, or stopped so that the detectors are centered on the load in order to obtain a stabilized reading. If the stabilized reading is less than the investigation alarm set point, the load can be accepted for disposal. If the stabilized reading exceeds the investigation alarm set point, a trained staff member should determine the type of radioactivity in the load using hand-held radiation identifier readings, visual observation, gamma spectrometer readings, and/or discussion with the generator. If these steps establish that the waste is not a regulated



radioactive waste, the waste may then be accepted for disposal so long as it meets a radiation acceptance criterion such as the one described in Section 4.a.ii of this memorandum. Immediately after the investigation, the facility should notify the Department's Regional Materials Management Supervisor and Facility Section Supervisor in the Central Office, at a minimum, via telephone or e-mail.

(iii) If, after consultation with Department staff, a load containing regulated radioactive materials is to be released for return to the generator or for transport to a different facility, the transporter should obtain a DOT authorization form from the Department unless necessary analytical results are provided to show compliance with DOT radioactive materials shipping requirements. A load shown to contain a medical isotope that had passed through a patient does not need a DOT authorization form as this material is not a regulated radioactive material and may be accepted for disposal.

(iv) If the drive-through radiation detectors become inoperable, the facility should discontinue acceptance of Marcellus Drilling Wastes until the radiation detectors are operable, or should use hand-held radiation detectors to perform the initial scan of the inbound vehicles carrying Marcellus Drilling Wastes.

(v) If a driver leaves the facility after an alarm is triggered and before the load has been investigated, facility staff should immediately call, at a minimum, the Department's Regional Materials Management Supervisor, the Central Office Facility Section Supervisor and the New York State Police.

If you have any questions or concerns related to the issues discussed in this memorandum, please contact Richard Clarkson, of my staff, at [richard.clarkson@dec.ny.gov](mailto:richard.clarkson@dec.ny.gov) or at (518) 402-8678.

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