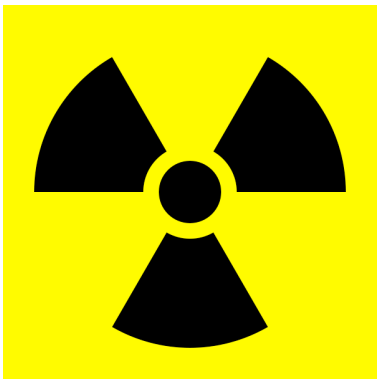

Consideration of Radiation in Hazardous Waste Produced from Horizontal Hydrofracking

Report of E. Ivan White
Staff Scientist for the
National Council on Radiation Protection

GRASSROOTS
Environmental
Education

Consideration of Radiation in Hazardous Waste Produced from Horizontal Hydrofracking

Report of E. Ivan White
Staff Scientist for the
National Council on Radiation Protection

Radioactivity in the environment, especially the presence of the known carcinogen radium, poses a potentially significant threat to human health. Therefore, any activity that has the potential to increase that exposure must be carefully analyzed prior to its commencement so that the risks can be fully understood. Horizontal hydrofracking for natural gas in the Marcellus Shale region of New York State has the potential to result in the production of large amounts of waste materials containing Radium-226 and Radium-228 in both solid and liquid mediums.

A complete and thorough analysis of the potential environmental pathways for exposure of people to these radioactive materials is a prerequisite to any regulatory approval of activities involving their extraction, handling, transportation and storage.

> The guiding principle for this work is that ***radioactivity should never be released into the environment in an uncontrolled manner*** because of the potential for exposure from the many potential pathways that exist.

Over the past fifty years, the Atomic Energy Commission (AEC) and the Nuclear Regulatory Commission (NRC) have spent millions of dollars on research that has resulted in computer models of the transport of radioactivity through the environment to humans. These environmental transport and human uptake models, known as "RESidual RADiation," or "RESRAD," are designed to be incorporated into governmental regulatory guidelines to ensure that people are not exposed to levels of radiation and radioactivity that would result in negative health impacts.

In April of 1999, the New York State Department of Environmental Conservation's Division of Solid and Hazardous Materials, assisted by representatives from sixteen oil and gas companies, conducted an internal investigation entitled *An Investigation of Naturally Occurring Radioactive Materials (NORM) in Oil and Gas Wells in New York State.* The report concluded that drill cuttings and wastewater from oil and gas drilling operations "do not constitute a health risk for the State's residents nor present a potential degradation of the State's environment."

A similarly cavalier attitude towards human exposure to radioactive material pervades the NYS DEC's 2011 Draft Revised Supplemental Generic Environmental Impact Statement (rSGEIS). The document's superficial characterization of radiation risks has prompted warnings from radiation experts, including those at the EPA whose public comments on the rSGEIS reflect deep concerns about the DEC's understanding and appreciation of the actual risks posed by radiation.

The National Council on Radiation Protection (NCRP) is a Congressionally-chartered agency charged with the authority and responsibilty to coordinate public information on radiation protection and radiation measurements. In its 2010 NCRP Report #169, *Design of Effective Radiological Effluent Monitoring and Environmental Surveillance Programs*, we describe the required radiation detection equipment and state-of-the-art modeling approaches for determining radionuclide transport pathways in the atmosphere, surface water, groundwater, and soil. Methods are presented for estimating potential radiation dose to the public and natural ecosystems resulting from releases of radionuclides into the environment.

Based on my experience in assessing potential transport pathways for radiation and a review of the DEC's internal report, I find two serious flaws that must be addressed and corrected prior to any final determination related to hydrofracking in New York State. The first is that the report examined a very different type of drilling than that which is being proposed. The second is that the authors used RESRAD in a limited way, resulting in faulty conclusions.

The 1999 DEC report examines vertically-drilled oil and gas wells in New York State that have been hydrofracked. This is very different from the ***horizontal*** hydrofracking currently being proposed for New York State. Vertical wells of the type measured by the NYSDEC are typically 1500-3000 feet deep with minimal penetration into the Marcellus shale formation. Horizontal slickwater hydrofracking wells, on the other hand, reach depths of 6,000 feet before turning horizontally for an additional mile or so. These deeper, longer wells have a much greater overall exposure to the Marcellus Shale formation and the radioactive materials contained within it, and thus an increased likelihood of bringing that radioactivity to the surface. (See Figure 1)

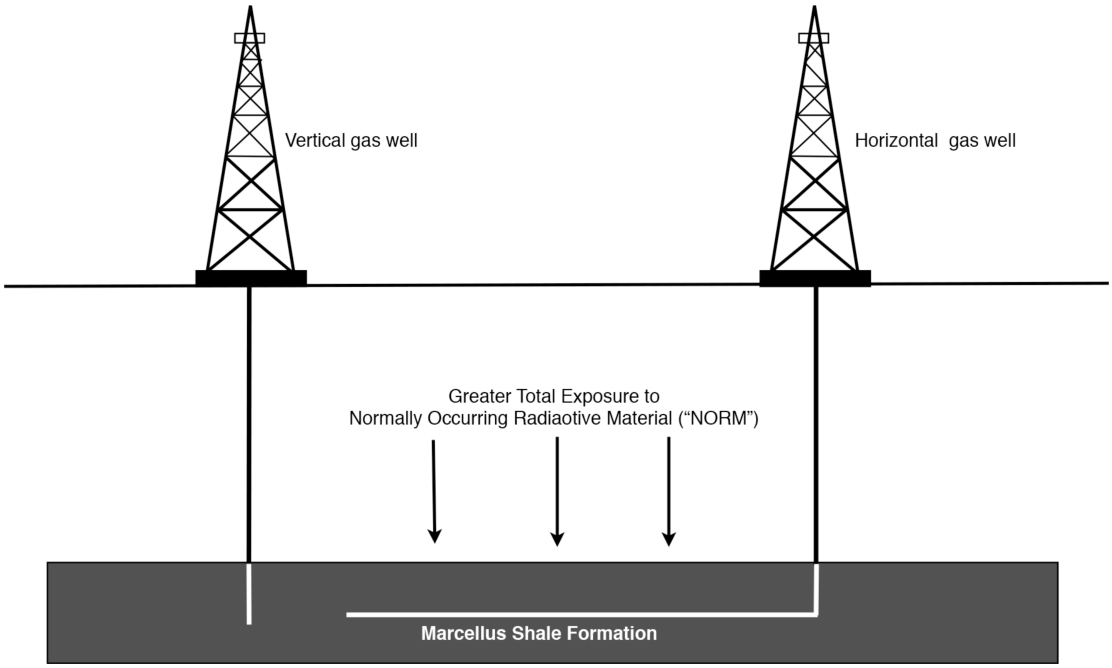

Figure 1: Comparison of Exposure to NORM in Marcellus Shale for Vertical Wells and Horizontal Wells

The second flaw is that RESRAD was not properly used to determine **all** of the potential pathways of the radiation. The following diagrams illustrate the potential pathways for radionuclides released into the environment in an uncontrolled manner, in air or in water.

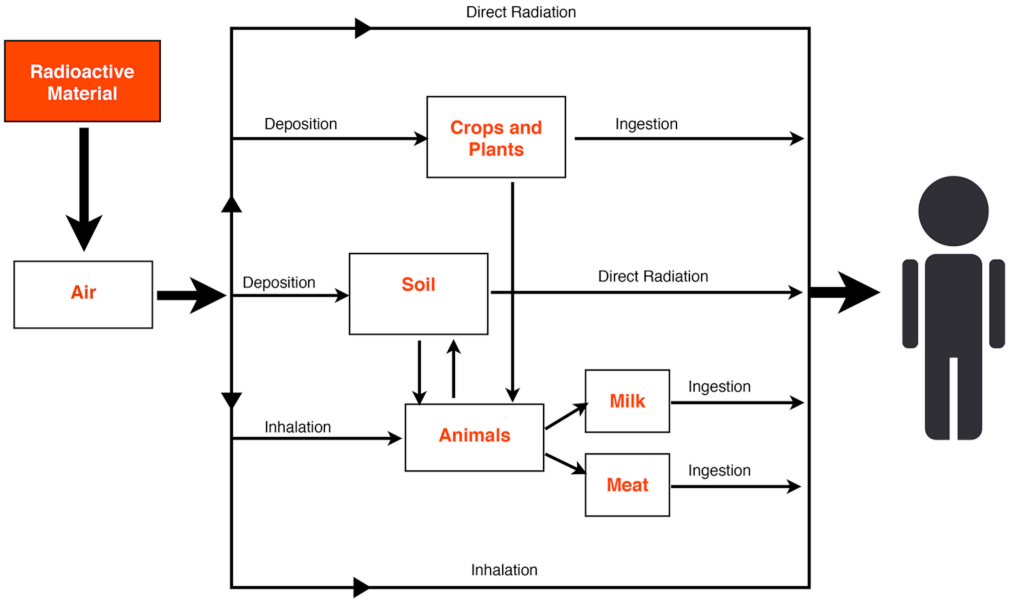

Figure 2: Pathways for Radiation Migration Through Air

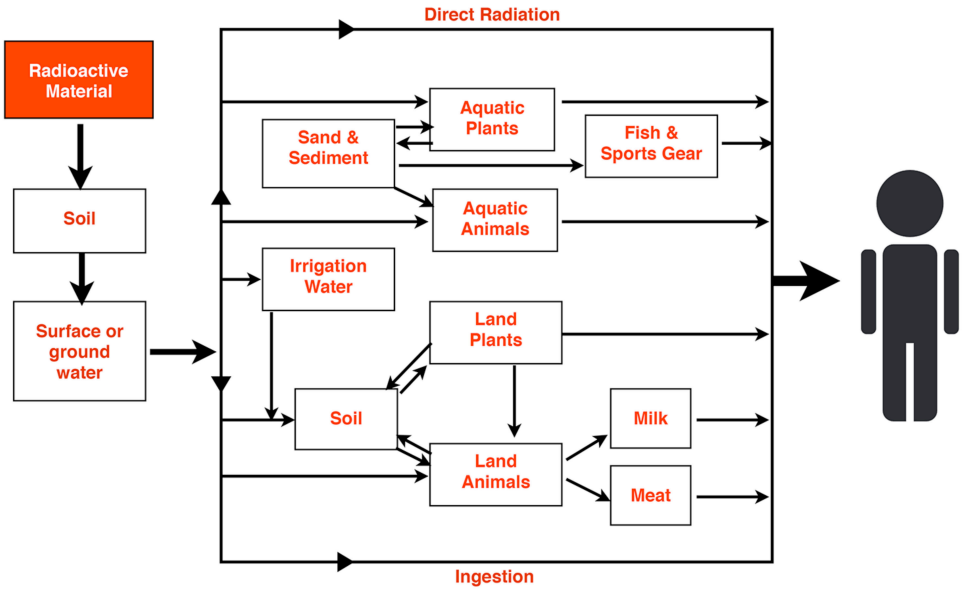

Figure 3: Pathways for Radiation Migration Through Soil and Water

For example, if radioactive wastewater from hydrofracking is spread on a road, there are two possible scenarios involving different pathways.

In one, the radioactive waste is spread on a paved road with a crown. Some of the waste will inevitably run off the road and find its way into a waterway or onto grazing fields or crops with the resulting pathways. The radioactivity in the waste remaining on the road will be resuspended by the traffic into the air with the resulting direct exposure to humans or biota.

In the second scenario, the waste spread on the dirt road is adsorbed by the dirt. When the dirt road dries out, the radioactive waste is resuspended in the dust from the road. The dust particle size and concentration is determined by the weight of a vehicle, the number of tires, and its speed. The dust is inhaled by humans and animals and deposited on the local vegetation, with the resulting pathways as illustrated above.

In both cases the cumulative impact of the radioactive waste will be determined by the amount of radiation contained in the waste, the number of vehicles and humans travelling on the road over years, proximity to residential or commercial areas, the amount of radiation migrating off road into streams or lakes or blowing onto agricultural land, and finally, the total potential dose to affected humans over time.

The radiation dose from a single truck travelling 40 miles per hour on a dirt road in rural New York State may appear to be insignificant, but the cumulative dose from 30 to 40 years of trucks could very easily be significant and needs to be rigorously calculated. Although there is considerable concern for the general population, exposed populations also include those most vulnerable; the old, the young and the ill.

Importantly, the type of radioactive material found in the Marcellus Shale and brought to the surface by horizontal hydrofracking is the type that is particularly long-lived, and could easily bio-accumulate over time and deliver a dangerous radiation dose to potentially millions of people long after the drilling is over.

Under the linear-no threshold hypothesis used in radiation protection, the goal is to limit the total radiation dose to large populations because of the increased probability of health effects. In the current case, the uncontrolled release of hazardous waste could result in the exposure of millions of people over decades.

Moreover, this scenario does not include any analysis of exposures to other hazardous chemicals used in the fracking process, which could have an unknown synergistic effect on the population.

SUMMARY CONCLUSIONS

1. Radioactive materials and chemical wastes do not just go away when they are released into the environment. They remain active and potentially lethal, and can show up years later in unexpected places. They bio-accumulate in the food chain, eventually reaching humans. Under the proposal for horizontal hydrofracking in New York State, there are insufficient precautions for monitoring potential pathways or to even know what is being released into the environment.

2. The NYS DEC has not proposed sufficient regulations for tracking radioactive waste from horizontal hydrofracking. By way of comparison, the nuclear industry has to rigorously account for all releases of radioactivity. No radioactive material leaves a nuclear facility without being carefully tracked to its safe final destination. Neither New York State nor the Nuclear Regulatory Commission would permit a nuclear power plant to handle radioactive material in this manner. (It is important to note that tracking of radioactive materials cannot be accomplished retrospectively; accurate accounting *must* be incorporated from the very beginning to ensure public safety.)

3. RESRAD was made precisely for situations like this, but it must be used properly to produce valid conclusions. Picking and choosing isolated scenarios and ignoring downstream exposures, as was done in the Report, is not a proper use of RESRAD and renders the conclusions invalid. All of the potential pathways over a span of decades as the hazardous material accumulates and the public's body burden build up must be considered to produce a valid RESRAD conclusion. This applies to both radioactive and chemical waste.

4. While this statement deals only with the radioactivity of waste produced by horizontal hydrofracking, the same principles of exposure pathways must be taken into account for all of the toxic chemicals used in the process. The EPA Pavillion Report demonstrates that there are hazardous chemicals in fracking fluid, and a recent review of the EPA report confirmed that it was valid.

E. Ivan White
October, 2012

This report was edited for public release by Grassroots Environmental Education, a non-profit organization.