

SUPREME COURT OF THE STATE OF NEW YORK  
COUNTY OF STEUBEN

In the Matter of the Application of

SIERRA CLUB, CONCERNED CITIZENS OF ALLEGANY  
COUNTY, PEOPLE FOR A HEALTHY ENVIRONMENT,  
INC., JOHN CULVER, AND BRIAN AND MARYALICE  
LITTLE

Petitioners,

For a Judgment Pursuant to Article 78 of the  
Civil Practice Law and Rules,

–against–

NEW YORK STATE DEPARTMENT OF  
ENVIRONMENTAL CONSERVATION, BASIL SEGGOS,  
COMMISSIONER, AND HAKES C&D DISPOSAL INC.,

Respondents.

State of New York,  
County of Rensselaer, ss.:

**DAVID O. CARPENTER, MD, being duly sworn, deposes and says:**

1. I am a public health physician who received his MD degree from Harvard Medical School in 1964. I chose a career of research and public health rather than the practice of medicine. I served as the Chair of the Neurobiology Department of the Armed Forces Radiobiology Research Institute, the research arm of the Defense Nuclear Agency, between 1973-1980 where I directed and performed research on the health effects of ionizing radiation. In great part because of that background and because of the concern of effects of ionizing radiation resulting from the Three Mile Island nuclear plant incident, in 1980 I was appointed as the Director of the Wadsworth Center for Laboratories and Research of the New York State Department of Health, where in addition to my other responsibilities I continued research on

AFFIDAVIT OF  
DAVID O. CARPENTER,  
MD, IN SUPPORT OF  
THE VERIFIED  
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health effects of ionizing radiation, funded in most part by the Defense Nuclear Agency. As a result of my expertise in these areas I have authored numerous scientific research articles, reviews and book chapters on various aspects of human health effects of ionizing radiation.

2. In 1985 I was appointed as Dean of the School of Public Health at the University at Albany, created as a partnership between the New York State Department of Health and the University at Albany. I stepped down from that position in 1998, but continued in my academic appointment as Professor of Environmental Health Sciences and also assumed my current position as Director of the Institute for Health and the Environment at the University at Albany. I continue my research on environmental causes of human disease from exposure to chemicals and various forms of radiation.

3. In 2014 my colleagues and I published a scientific report on air releases around fracking sites in five states, documenting episodic releases of carcinogenic chemicals at levels much above federal and state standards. When New York took action to prevent fracking the Commissioner of Health waved our publication as a basis for that decision. I have remained active in research and study of health effects associated with the oil and gas industry, including a recent report on air releases from natural gas compressor stations in New York but ones that are carrying Pennsylvania natural gas across the state. I have also testified and lectured on health concerns from fracking and also from compressor stations at local and state levels in New York and Pennsylvania.

4. All opinions expressed here are my own and do not necessarily reflect positions of my institution.

**Overview:**

5. I have been requested to provide an opinion as to whether the procedures regulated by the New York State Department of Environmental Conservation (NYSDEC) regarding drilling wastes from natural gas extraction activities in Pennsylvania are adequately protective to human health. In this regard I have reviewed the expert reports prepared by Dr. Raymond C. Vaughan and Mr. Dustin M May, and the memorandum to Regional Materials Management Engineers issued by the Acting director of the Division of Material Management of NYSDEC regarding drilling wastes from natural gas extraction activities in Pennsylvania coming the landfills in NYS. I have also examined some of the quarterly reports on radionuclide monitoring results of leachate from the Hakes C&D landfill. I have also been provided access to several documents related to the Hakes landfill including the Hakes Landfill Management Plan and the Hakes Environmental Monitoring Plan, although I have not reviewed these in great detail.

6. Based on the information provided to me and my knowledge of the human health effects arising from exposure to ionizing radiation, I have concluded that: (a) there are substantial and significant risks to human health posed by the current procedures used at the Hakes Landfill and approved by NYSDEC, (b) while the greatest threat to human health comes from inhalation of radon-222, other naturally occurring radioactive material (NORM) and the progeny of these elements pose significant threats to human health, and (c) inhalation is the route of exposure of greatest concern but other routes (ingestion, dermal absorption) are also possible.

**Background:**

7. All forms of ionizing radiation pose threats to human health, and there is no level of exposure that does not increase risk. Radiation is a proven human carcinogen according to all international and national organizations, including the International Agency for Research on Cancer (IARC) of the World Health Organization, the US Environmental Protection Agency and the National Toxicology Program of the National Institutes of Health. Ionizing radiation has sufficient energy to damage DNA, leading to increased risk of cancer and mutations. This results in an increased risk of birth defects and well as mutations that will alter succeeding generations. Ionizing radiation also will damage other cellular components either by direct ionization or through generation of reactive oxygen species (free radicals) that react with DNA and other cellular components to cause damage. It is the policy of the US government that for any mutagenic carcinogen, such as ionizing radiation, there is a linear dose-response relationship between exposure and cancer, which is to say that there is no exposure that does not increase risk of cancer.

8. Ionizing radiation comes in several forms, each with different energies. The most dangerous are alpha particles, which are helium nuclei. These have a positive charge and consist of two protons and two neutrons, so they have a much higher mass than other radioactive emissions, and have high momentum. While they do not penetrate deeply into tissue they are particularly dangerous if inhaled or ingested. Neutrons and protons have only one quarter of the weight of alpha particles, and neutrons have no charge while protons are positively charged. Because of having less weight they penetrate deeper into the skin or body, and neutrons penetrate further than protons because they lack charge. Beta particles are electrons, with a very small mass but a negative charge. Because of their small mass they can penetrate further but their

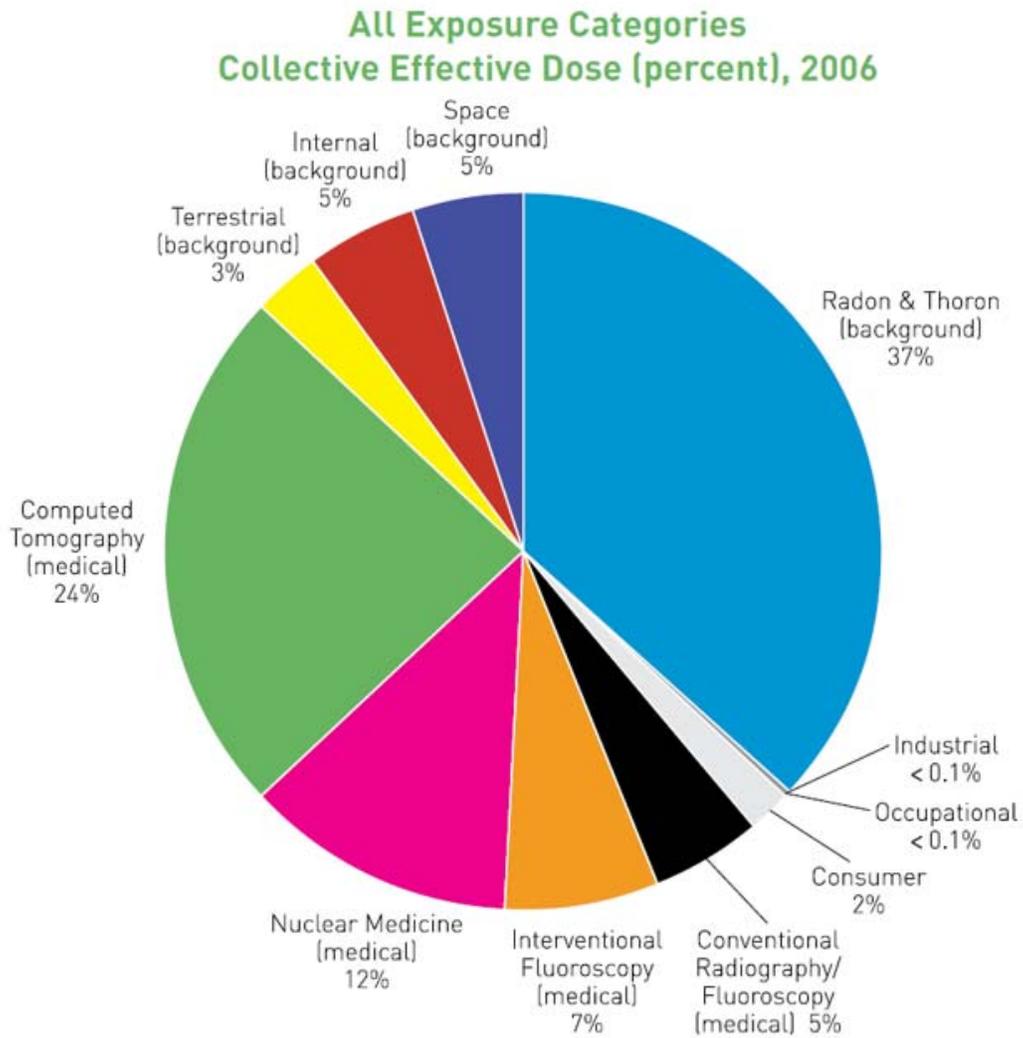
pathway through the body is irregular because of their charge. Gamma rays, x-rays and cosmic rays are electromagnetic forms of energy that do not have any mass. They easily pass through the body but are much less likely to cause harm by colliding with cellular constituents. Depending upon route of exposure the human health hazard coming from ionizing radiation is greatest for alpha particles, followed by neutrons and protons, and much less for electromagnetic radiation.

9. Route of exposure to ionizing radiation is important. Alpha particles do not travel far into the body but because of their mass, they are very dangerous if inhaled or ingested. This is because the lung and the gastrointestinal track are both very sensitive to ionizing radiation, and if an alpha emitter is in either the lung or the gut it can cause significant ionization to the alveoli and bronchioles of the lung or the cells lining of the gastrointestinal track. Neutrons and protons do not have a major role in the concerns over fracking wastes. Gamma rays, because of their low quality factors (a measure of degree of biological damage), are of lesser concern in this case although they are released from the radionuclides found in fracking wastes.

We are all exposed to ionizing radiation. Figure 1 shows the average current sources of exposure. About half comes from medical procedures but the other half comes from radioactive substances found on the earth or coming from cosmic rays. Radon is the single largest source, and the route of exposure is primarily by inhalation. However there are natural radioactive compounds in drinking water and food, including uranium, thorium and radium. These are listed under “consumer products” in Figure 1. There is natural potassium 40 in our bodies, a part of the potassium ion that is the major cation in every cell of the body, identified as “internal background”. There is also some exposure to radioactivity from soil, rocks and other sources under the category of “terrestrial background”. Finally cosmic rays, which are electromagnetic,

are listed as “space backgrounds”. Thus it is impossible for any person to totally avoid exposure to ionizing radiation. However because any amount of radiation exposure is harmful it is critical that exposure be reduced to the greatest degree possible.

**Figure1:**



Total collective effective dose [1,870,000 person-sieverts (Sv)] and total effective dose per individual in the U.S. population [6.2 millisieverts (mSv)]  
Percent values rounded to the nearest 1%, except for those <1%.

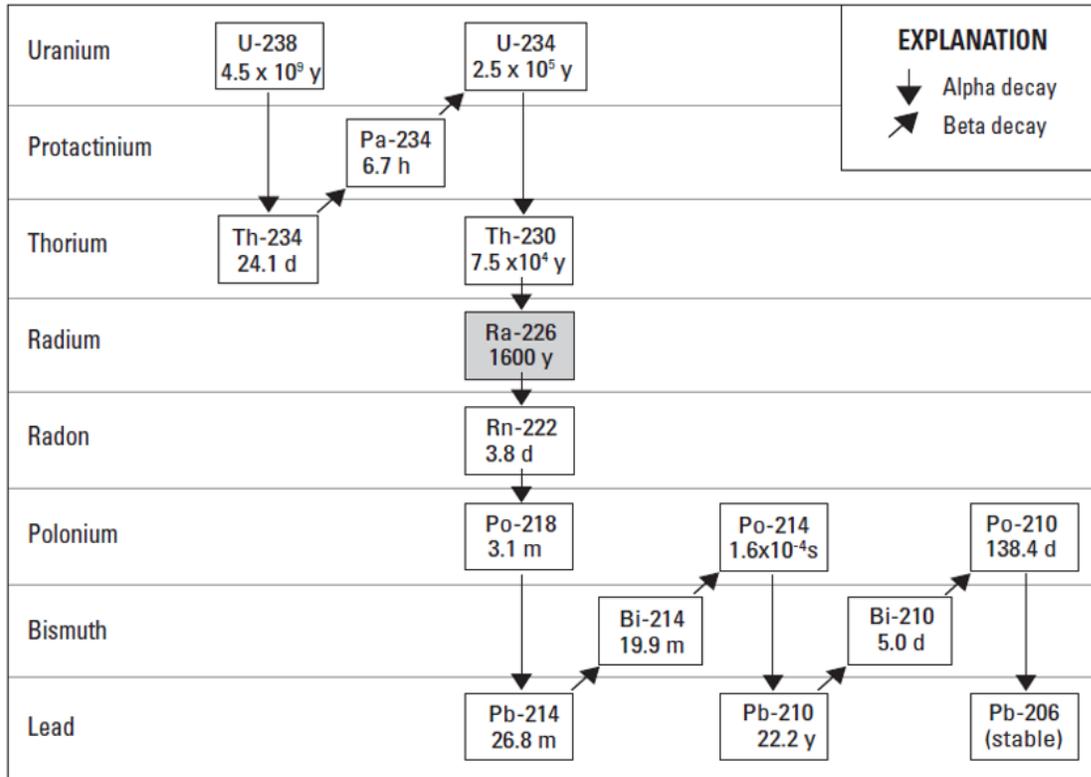
Source: National Council on Radiation Protection and Measurement. Ionizing Radiation Exposure of the Population of the United States. Report No. 160, Figure 1-1. Bethesda, MD: NCRP, 2009.

10. The greatest danger to human health comes from alpha particles. This is because of their energy and because the most common routes of exposure are inhalation or ingestion, where the powerful alpha particles have intimate contact with lung or gastrointestinal tissues, leading to

lung or gastrointestinal cancers. Figure 2 shows the decay process of uranium 238. Note that alpha decay is indicated by downward arrows, but beta decay is indicated by upward arrows. Again the greatest risk comes from alpha decay, and most of the progeny of uranium 238 are alpha emitters. Radon-222 is the form of greatest concern because it is a gas. While it has a relatively short half-life of 3.8 days, its decay by alpha emission and its decay products are not gases are also alpha emitters with short half-lives. When radon is inhaled and decays in the lung, its progeny deposit in the lung and undergo further decay, causing damage.

**Figure2:**

**A. Uranium-238**



11. Radon-222 is also frequently ingested, most often in drinking water. While uranium and thorium are not very water soluble, radium is quite water soluble, so drinking water can be a source of both radon and radium. Other natural radioactivity substances are also commonly

found in food at low concentrations. When these radioactive elements decay within the gastrointestinal track they damage the cells lining the gut. These cells are particularly sensitive to ionizing radiation because they divide frequently (about every two days), and it is during the process of cell division that ionizing radiation causes the greatest harm. If these radioactive heavy elements are absorbed they tend to deposit in bone, where they increase the risk of leukemia and bone cancer. Thus anything that increases the risk of elevations of radioactive alpha emitters in either water or food poses significant risk to human health. Furthermore lower exposures to ionizing radiation that do not cause specific diseases are known to decrease life span in animals and humans. This is almost certainly due to the generation of the reactive oxygen species mentioned above, as these are known to be the basic cause of the aging process.

12. Drill cuttings and de-watered mud will contain NORM and most of the radioactive elements present are alpha emitters. The multiple leachate radiological analytical results document the presence of uranium 235 and 238, thorium 232 and 234, radium-226 and 228, and lead 212 and 214. For all of these radionuclides there is a distribution between particulate-bound and dissolved concentrations, as expected.

13. When drill cuttings and de-watered mud containing uranium, thorium and radium are placed in the landfill they will continue to emit radiation for a very long time because they have long half-lives. The standard practice in contemporary landfills is to cover them sufficiently to prevent rain water from penetrating and causing greater amounts of leachate. However these covers often erode with time, leading to the strong possibility that 100-plus years from now an increased amount of highly radioactive leachate will be coming from the landfill.

14. As clearly shown in the expert reports of Dr. Vaughan and Mr. May, DEC has grossly underestimated the amount of radium in the landfill because the method used for radium analysis

was not adequate in leachate containing high concentrations of dissolved solids, leading them to conclude that the levels of radium in the leachate were low, and because they ignored the presence of high concentrations of radon. One cannot get high concentrations of radon without having high concentrations of radium. This indicates that there are high concentrations of radium in the landfill that will continue to generate radon and that both will continue to be found in the leachate for centuries, given the half-life of radium being 1600 years.

15. Accepting radioactive fracking waste in the landfills in New York will lead to human exposure to ionizing radiation by various routes. The greatest concern is inhalation of radon. The levels of radon in air above the leachate may potentially be as high as 1.05 million pCi/L, as documented in the report of Dr. Vaughan. This poses a clear hazard to anyone in the vicinity of leachate. Radon will also be released into the air over the landfill. The leachate will migrate into ground water, where radon will be transported and will appear in the drinking water of people on wells and be ingested. A major hazard will come from hot water showers, where the radon is released from the water by the heat and will fill the shower stall and be inhaled. The radon will also migrate up from the ground water in basements of homes, where it will be inhaled by occupants.

16. When ground water is used as drinking water for those persons with wells they will be ingesting radon, radium and lower concentrations of the other less soluble radionuclides that are dissolved in the water as well particulates containing bound radionuclides coming from the fracking drill cuttings and de-watered mud.

17. There is always dust that comes from landfills, and the dust particulates will contain radionuclides that are derived from the progeny of uranium. This dust will get into homes, will be deposited in garden soils and this will be another, albeit less important, route of exposure.

**Conclusions:**

18. As made clear by the reports of Dr. Vaughan and Mr. May and the leachate analyses, there is a significant amount of radioactivity contained in and coming from the Hakes C&D Disposal Site as the result of the deposits of drill cuttings and de-watered mud coming from fracking sites in Pennsylvania.

19. The net effect of New York accepting drill cuttings and de-watered mud from Pennsylvania fracking sites will be the New Yorkers will have an increased risk of cancer, especially lung and gastrointestinal cancers, an increased risk of birth defects coming from DNA damage and increased risk of a shortened life span.

20. There is reason to believe the DEC is underestimating the amount of radioactivity deposited in and being released from the landfill. The statement made in the Memorandum of 18 September 2015 that "drilling wastes such as drill cuttings do not display elevated radioactivity above naturally occurring background levels" is simply untrue.

21. The peer-reviewed scientific evidence available to anyone indicates that the carcinogenic material found in fracking waste poses a real hazard to human health. Any increase in exposure to ionizing radiation beyond that which is unavoidable should not be tolerated.



Sworn to before me this <sup>17th</sup> day of January 2018.



Notary Public

