APPENDIX O

ADDITIONAL EXPERT ANALYSIS (FRAZIER)

EIGHTEENTH JUDICIAL DISTRICT COURT
FOR THE PARISH OF IBERVILLE
STATE OF LOUISIANA

AUGUST J. LEVERT, JR., FAMILY, L.L.C., ET AL.	*	
	*	**DOCKET NO. 78953**
VERSUS	*	
	*	**DIVISION: "A"**
BP AMERICA PRODUCTION COMPANY	*	
	*	

EXPERT REPORT OF JOHN R. FRAZIER, Ph.D., CHP

I. INTRODUCTION

I have been retained by counsel for Defendant BP Production Company in the matter of *August J. Levert, Jr., Family, L.L.C., et al., v. BP America Production Company*, (18th Judicial District Court for the Parish of Iberville, State of Louisiana; Docket No. 78953; Division: "A") to assess the radiological conditions of certain property in the Grand River Field in Iberville Parish, Louisiana. Specifically, I have been asked to determine whether there is naturally occurring radioactive material (NORM) due to oil and gas operations on the Plaintiffs' property. I have been asked to review all available radiological data for the property.[1] I have also been asked to review the July 29, 2022 report by Gregory W. Miller, Wayne Prejean, and Jason S. Sills in this matter and provide opinions within my areas of expertise regarding that report.

II. OPINIONS

I have reached the following conclusion with a reasonable degree of scientific certainty:

1. There is no evidence of oilfield NORM-impacted soil on the subject property.

2. The ratios of concentrations of radium isotopes in the water from all monitoring wells are consistent with native soils and do not indicate the presence of NORM from oilfield operations. Groundwater samples were collected from five monitoring wells on the subject property. The ratios of concentrations of radium

[1] Soil and groundwater sampling data and radiological assessment of the western adjacent IPSB property was performed as part of a separate legacy lawsuit (*Iberville Parish School Board v. BP America Production Co., et.al* [18th JDC, Parish of Iberville, State of Louisiana, No. 72,605, Div. A]) and those data are considered here but, upon settlement of that litigation, those data and assessments are being evaluated under the direction of LDNR as part of the overall response to Conservation Order Nos. 018-024-001, 018-024-003, and 018-024-004.

isotopes in the water from all the wells on the subject property are consistent with natural ratios and the concentrations of radium isotopes in the solids are consistent with natural solids in Louisiana. The data do not indicate the presence NORM from oilfield operations.

3. Based on my review of the radiological characterization data for the subject property and potential exposure locations, potential exposure pathways, and potential exposure durations, I have concluded that no one on or near the subject property can reasonably be expected to receive a radiation dose greater than the range of radiation doses from natural background radiation in Louisiana.

III. QUALIFICATIONS

My qualifications are detailed in Attachment A. My area of expertise is health physics – the scientific discipline of measuring radiation and protecting people from the harmful effects caused by high doses of radiation. My academic degrees include a B.A. in physics, M.S. in physics, and Ph.D. in physics (with emphasis in health physics and radiation protection). I have over forty-five (45) years of professional experience in health physics, primarily in the areas of radiation detection and measurement, radiation dose assessments, external and internal radiation dosimetry, and radiation safety standards and practice. I have extensive experience performing radiological characterization surveys of property, assessing external and internal radiation doses from natural and man-made radiation sources, and reviewing/assessing operational data generated by facilities that are licensed to possess and use radioactive materials and other radiation sources. Over the past twenty-seven (27) years I have performed numerous radiological assessments of soil and groundwater on properties for oilfield NORM. I have also evaluated current and past radiation exposure conditions on properties impacted by oilfield NORM.

IV. BASIS OF OPINIONS

During preparation of my opinions presented in this report, I reviewed documents pertaining to the subject property and natural radiological conditions in the vicinity of the subject property and throughout the State of Louisiana. Specific documents that I reviewed in preparation of this report are listed in Attachment B. In forming my opinions, I am relying on the radiological characterization data acquired to date by BP's consultants Hydro-Environmental Technology, Inc. (HET) and Plaintiffs' consultants ICON Environmental Services, Inc. (ICON). The following is a description of basic terminology and concepts of radiation and radioactive materials in the natural environment and associated with oil production.

A. Naturally Occurring Radionuclides in Native Louisiana Soil

Naturally occurring radioactivity is present in essentially everything on, beneath, or above the earth's surface. These radioactive materials are present as primordial radioactivity (as they have been present since the earth was formed) or as naturally produced radioactivity (e.g., cosmogenic radioactivity) that continues to be formed from interactions of cosmic rays with the earth. The most abundant radionuclides on the earth are the primordial radionuclides in three natural decay series (thorium, uranium, and actinium) and the non-series primordial radionuclide, potassium-40. The concentrations and amounts of these natural radioactive materials that comprise the natural background radioactivity in substances on or in the earth have been described in detail in various reports. The NCRP, a council of 100 eminent independent scientists chartered by Congress, has published Report No. 160, "Ionizing Radiation Exposure of the Population of the United States" (NCR P 2009), that includes information on the sources and amounts of natural background radiation exposure being received by the U.S. public. NCRP Report No. 160 notes that concentrations of each of the primordial radionuclides vary with substance (rock, soil, sediment, etc.), location, and other factors. For surficial soil in the United States, each radionuclide in the uranium series and each radionuclide in the thorium series is present at a typical average concentration of one (1) picocurie per gram (pCi/g). The typical average concentration of potassium-40 in soil is in the range of approximately 10-25 pCi/g. However, the range of concentrations of these radionuclides in native soil varies with location, depending on the components of the soil (Myrick 1981; NCRP 2009).

Natural background concentrations of selected radionuclides, including radium-226 (Ra-226) and Ra-228, in soil, rock, and other natural materials in Louisiana are given in several publications (DeLaune 1986; Meriwether 1988; Meriwether 1991; Meriwether 1992). The range of concentrations of Ra-226 in native Louisiana soil is approximately 0.2 pCi/g to approximately 3 pCi/g, with an average concentration of approximately 1 pCi/g. The average and range of concentrations of Ra-228 in native Louisiana soil are approximately the same as the respective concentrations of Ra-226. In native soil, both Ra-226 and Ra-228 are continually being produced in the natural radioactive decay series uranium and thorium, respectively. The environmental behavior of radium is described in various publications, such as Technical Reports of the International Atomic Energy Agency (IAEA) (IAEA 1990; IAEA 2014).

B. Natural Background Radioactive Material in Louisiana Groundwater

Natural waters contain solids from contact with soils, rocks, and other natural materials. Some solids are suspended in the groundwater and some solids are dissolved (not removed by filtration) in the groundwater. The United States Geological Survey (USGS) has summarized the following points regarding dissolved solids in water:

> The dissolved solids concentration in water is the sum of all the substances, organic and inorganic, dissolved in water. This also is referred to as "total dissolved solids", or TDS. Calcium, magnesium, sodium, potassium, bicarbonate, sulfate, chloride, nitrate, and silica typically make up most of the dissolved solids in water. Combinations of these ions—sodium and chloride, for example—form salts, and salinity is another term commonly used to describe the dissolved solids content of water (USGS 2020).

Concentrations of dissolved solids in water can be so high that the water is unsuitable for drinking, irrigation, or other uses. Groundwater that contains natural solids (i.e., TDS) contains naturally occurring radioactive materials (NCRP 2009). Radium is a trace metal in groundwater that is usually present in the TDS as radium chloride (IAEA 1990). In general, greater concentrations of TDS and chlorides in groundwater correspond to greater concentrations of radium in that same water (Kraemer 1984; IAEA 1990; IAEA 2014). Elevated concentrations of chlorides in groundwater in contact with native soil, rock, and other natural materials can cause natural radium to pass from the soil, rock, and other natural materials into the groundwater as radium chloride (IAEA 1990; IAEA 2014). In Louisiana, groundwater sampling has shown that concentrations of Ra-228 are slightly greater than, or approximately equal to, the concentrations of Ra-226 in the groundwater (USGS 1988). This is a consequence of the approximate equal concentration of natural background uranium and thorium in the soil, rock, and other natural materials that is in contact with groundwater (IAEA 1990; IAEA 2014).

C. Natural Background External Radiation Levels in Louisiana

Every person is exposed to external radiation from natural background radiation sources every day of their lives. Natural background sources of external radiation include cosmic rays (and the external radiation from the interactions of cosmic rays with the atmosphere) and naturally occurring radioactive materials in the earth (soil, rocks, building materials, etc.). External radiation produces an external exposure rate that is often expressed in units of microroentgen per hour (μR/hr). The external exposure rate from natural background radiation sources varies with altitude, latitude, and the natural radionuclide content of soil, rocks, building materials, etc. In the United States, the external exposure rate from natural background radiation varies from less than approximately 3 μR/hr to well over 20 μR/hr (Myrick 1981). In Louisiana, the nominal external exposure rate from natural background radiation sources has a range from less than 5 μR/hr to over 14 μR/hr (Beck 1986).

D. Radiation Doses from Natural Background Sources

Radiation doses to persons from natural background radiation have been studied extensively for many decades. The term "dose" is used to represent the amount of radiation energy deposited in tissue per unit mass of tissue of a person exposed to ionizing radiation. External radiation doses are produced by penetrating radiation (e.g., gamma rays or x-rays) from radiation sources outside the human body. Internal radiation doses are produced by radioactive material within the body following inhalation or ingestion of that radioactive material. Natural radiation and radioactivity in the environment provide the major source of external and internal radiation doses to humans. NCRP Report No. 160 describes the radiation doses received from natural background radiation sources in the U.S. (NCRP 2009).

The NCRP notes in Report No. 160 that the average radiation dose in the United States from cosmic radiation at ground level is 0.033 rem per year (NCRP 2009). [33 millirem; 1 rem equals 1,000 millirem.] The average external radiation doses from terrestrial radionuclides in the United States is 0.021 rem (21 millirem) per year. As with soil and other terrestrial matter, the human body also contains naturally occurring radionuclides, the most abundant of which is the primordial radionuclide potassium-40. The average internal dose from radionuclides (excluding radon and radon progeny) in the body is 0.029 rem (29 millirem) per year. Therefore, the NCRP concludes that the total natural background radiation dose (excluding radon and radon progeny) in the United States is approximately 0.083 rem (83 millirem) per year (NCRP 2009). In addition, the NCRP has determined that the average radiation dose from inhaled radon and radon progeny in the United States is approximately 0.228 rem (228 millirem) per year. Therefore, the total average annual radiation dose from natural background radiation sources in the United States is approximately 0.311 rem (311 millirem) per year (NCRP 2009). The total average annual radiation dose from natural background radiation sources in Louisiana is somewhat less than the average for the United States (NCRP 2009).

E. Oilfield NORM

During production of oil from underground geological formations, water that is co-mingled with the oil is transported to the ground surface. This water is generally referred to as “produced water”. There are concentrations of NORM in some oil-bearing geologic formations that exceed the natural background concentrations of the same radionuclides in native soil. The chemical compounds that are present in produced water include trace amounts of the natural element radium. Because radium is radioactive, produced water that contains radium compounds contains NORM. The principal radionuclides in affected produced water are Ra-226 and Ra-228 (NRC 1999). During oil production, some radium compounds in the produced water convert to sulfates or carbonates and are precipitated, or are otherwise deposited, onto surfaces as scale and sludge in tubulars, pipe, and other production equipment. The scale is primarily barium sulfate with trace amounts (by mass) of radium in the same mineral matrix (Smith 1996; NRC 1999). The chemical forms of scale that have been shown to contain oilfield NORM are highly insoluble and NORM radionuclides (i.e., Ra-226 and Ra-228) in the scale are not readily leached or transported from impacted pipe, other production equipment, or soil by surface water or groundwater (IAEA 1990).

The presence (or absence) of oilfield NORM at the ground surface (in soil, pipe, or other production equipment) is determined by measurement of external radiation levels near the ground surface or production equipment (as NORM radionuclides emit measurable gamma radiation) and by analysis of soil samples and/or samples of the contents of production equipment (e.g., scale). The presence (or absence) of oilfield NORM in groundwater is determined by collection of representative samples of groundwater from suspect locations and analysis of the water samples for the concentrations of Ra-226, Ra-228, and TDS in the water.

F. Description of the Subject Property

The property that is the subject of this radiological assessment is property owned by Plaintiffs in the Grand River Field in Iberville Parish, Louisiana (Levert 2019). Descriptions of the location of the subject property are given in the Petition for Damages (Levert 2019) and in the July 29, 2022 report by Gregory W. Miller, Wayne Prejean, and Jason S. Sills of ICON (Miller 2022).

G. Collection and Analysis of Groundwater Samples

Four groundwater samples were collected by ICON personnel from three wells on the subject property in September 2019. The locations of those wells are described in the July 29, 2022 report by ICON (Miller 2022). Each sample was sealed in a sample container, marked with a unique sample identification code, and shipped under chain of custody to an offsite, commercial laboratory (Pace Analytical Services, LLC [Pace] in Greensburg, Pennsylvania). The samples were analyzed by Pace to determine concentrations of Ra-226 and Ra-228 in each sample. Results of analysis of those samples are given in one report of analysis (Pace 2019) and are summarized in Table 1.

Splits of groundwater samples (excluding the "Blind Duplicate") from each the three wells were collected by HET, sealed in a sample container, marked with a unique sample identification code and shipped under chain of custody to Eberline Analytical Services (Eberline) in Oak Ridge, Tennessee, for analysis of concentrations of Ra-226, Ra-228, and total dissolved solids (TDS). Results of the analyses by Eberline of the split samples (except for sample LT-1 which had "elemental interference"[2]) are given in one report of analysis (Eberline 2019). Results of the analyses of groundwater samples by Eberline are also summarized in Table 1.

Two groundwater samples were collected by ICON personnel from two wells on the subject property and two groundwater samples were collected by ICON personnel from two wells located on additional property owned by Plaintiffs more than a mile north of the subject property in June 2022. The locations of those wells are described in the July 29, 2022 report by ICON (Miller 2022). Each sample was sealed in a sample container, marked with a unique sample identification code, and shipped under chain of custody to Pace. The samples were analyzed by Pace to determine concentrations of Ra-226 and Ra-228 in each sample. Results of analysis of those samples are given in one report of analysis (Pace 2022) and are summarized in Table 1.

Splits of all groundwater samples collected by ICON in June 2022 were also collected by HET, sealed in a sample container, marked with a unique sample identification code and shipped under chain of custody to Eberline for analysis of concentrations of Ra-226, Ra-228, and TDS. Results of the analyses by Eberline of the split samples are given in two reports of analysis (Eberline 2022). Results of the analyses of groundwater samples by Eberline are also summarized in Table 1.

Table 1. Summary of Laboratory Measurements of Groundwater Samples

	Eberline Lab					Pace Lab				
	Ra-226		Ra-228			Ra-226		Ra-228		
Sample ID	Result (pCi/L)	CSU* (pCi/L)	Result (pCi/L)	CSU (pCi/L)	TDS** (mg/L)	Result (pCi/L)	CSU (pCi/L)	Result (pCi/L)	CSU (pCi/L)	TDS*** (mg/L)
LT-1	NA	-	NA	-	NA	2.65	1.00	3.63	0.954	18,800
LT-2	2.43	0.783	2.07	0.653	6,320	3.20	1.03	1.57	0.602	7,380
Lab. Dup.	2.62	0.870	2.88	0.834	6,320	-	-	-	-	-
Blind Dup.	-	-	-	-	-	3.26	1.10	1.58	0.660	8,350
LT-3	0.769	0.280	1.51	0.631	3,340	1.06	0.613	1.07	0.634	3,260
LT-4	0.528	0.342	1.46	0.627	647	0.0498	0.352	0.563	0.510	875
Lab. Dup.	0.810	0.417	0.887	0.569	647	-	-	-	-	-
LT-5	0.852	0.460	1.16	0.539	885	0.310	0.407	0.662	0.505	925
LT-8	0.522	0.354	1.20	0.575	1,300	0.825	0.574	0.591	0.476	920
Lab. Dop	1.29	0.594	0.913	0.523	1,300	-	-	-	-	-
LT-9	0.833	0.494	0.829	1.02	1,060	0.810	0.476	0.458	0.498	965

NA – Not Analyzed (Elemental Interference)
*CSU = Calculated Standard Uncertainty (2 sigma)
**TDS = Total Dissolved Solids
***TDS values for ICON samples taken from Table 4 of the July 29, 2022 ICON report (Miller 2022)

[2] "Elemental interference" is a term assigned by Eberline to indicate the presence of non-radiological element(s) that prevented performance of the specified analysis. This is of no consequence here as there was analysis of the split sample at Pace laboratory.

H. Discussion of Results for Groundwater Samples

The ratios of concentrations of radium isotopes in the water from all monitoring wells are consistent with native soils and do not indicate the presence of NORM from oilfield operations.

Results of laboratory analysis by Pace of groundwater samples from the subject property show only one well (LT-1) with total radium (Ra-226 + Ra-228) concentration slightly greater than 5 pCi/L[3], but the ratios of concentrations of radium isotopes in that well are also consistent with native soils and do not indicate the presence of NORM from oilfield operations.

Five monitoring wells (LT-1 through LT-5) are located on the subject property. Two monitoring wells (LT-8 and LT-9) are located on a different property, about 1.5 miles north, owned by the Plaintiffs but not subject to this litigation. Monitoring wells LT-4, LT-8, and LT-9 were selected by ICON as representative background groundwater wells (Miller 2022). The "background" wells are consistent with the other wells on the subject property in that all of them demonstrate an absence of oilfield NORM.

The secondary standard for TDS in drinking water is 500 milligrams per liter (mg/L) (USEPA 1991). Groundwater samples from all of the monitoring wells, including wells located on the subject property and background wells selected by ICON located more than a mile north of the subject property, have TDS concentrations greater than 500 mg/L. Based on the high TDS concentration, the water from those wells is not considered to be potable.

V. CLOSING REMARKS

The observations, conclusions, and opinions noted in this report are based on my personal knowledge and experience and are consistent with accepted practice in the field of health physics. I reserve the right to amend this report should additional data or other information become available to me in the future.

VI. RATE OF COMPENSATION

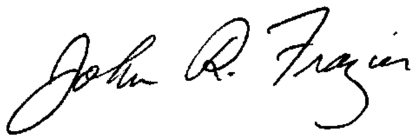
I am being compensated at a rate of $250 per hour for my time to work on this project, including sworn testimony at deposition and trial.

[3] Listed for comparison, 5 pCi/L is the maximum contaminant level (MCL) issued by the U.S. Environmental Protection Agency for Ra-226 + Ra-228 in community water systems at the tap (USEPA 2000b). The MCL is not applicable to groundwater. Additionally, Louisiana NORM regulations do not apply to groundwater (LADEQ 2015).

VII. PRIOR TESTIMONY

A list of cases in which I have given sworn testimony at deposition or at trial during the past four years is included in Attachment C.

Prepared and submitted by:



John R. Frazier, Ph.D., CHP

Date: October 14, 2022

ATTACHMENT A

CURRICULUM VITAE OF JOHN R. FRAZIER, PH.D.

JOHN R. FRAZIER, Ph.D., CHP

Professional Qualifications

Dr. Frazier has over 45 years of health physics experience in external and internal dosimetry, environmental dose assessment, radiation risk assessment, radiation spectroscopy, health physics training, bioassay, radiation detection and measurement, and radiological site characterization. Numerous federal agencies including the Nuclear Regulatory Commission (NRC), Environmental Protection Agency (EPA), U.S. Department of Agriculture (USDA), U.S. Department of Defense (DOD), and U.S. Department of Justice (DOJ) have sought his advice on a wide range of health physics and radiation protection topics from operational health physics program design to environmental radiation dose and risk assessments. He has also served as a consultant to private companies and individuals on numerous health physics issues. He is a Distinguished Emeritus member of the National Council on Radiation Protection and Measurements (NCRP). Dr. Frazier has made presentations on introductory and advanced health physics and radiation protection topics for professional society meetings, student groups, and public interest forums. His publications are in the areas of fundamental interactions of radiation with matter, radiation detection instrumentation, radiological site assessments, and external and internal radiation dosimetry.

Education

Ph.D., Physics, University of Tennessee, Knoxville, Tennessee; 1978.

M.S., Physics, University of Tennessee, Knoxville, Tennessee; 1973.

B.A., Physics, Berea College, Berea, Kentucky; 1970.

Registrations/Certifications

Certification by the American Board of Health Physics since 1981; recertified through 2025.

Experience and Background

2004 - *Present* *Independent Health Physics Consultant*

Dr. Frazier provides consultation services to individuals, private companies, and government agencies on a wide range of radiation protection topics. His principal areas of expertise are internal and external radiation exposure assessments, environmental radiation dose and radiological risk assessments from occupational and environmental exposures, and evaluations and assessments of all aspects of operational health physics programs.

1993 - 2004 ***Senior Radiological Scientist, Auxier & Associates, Inc., Knoxville, Tennessee.***

Dr. Frazier served as senior consultant on radiation protection issues for private companies and government agencies. He performed assessments of internal and external radiation exposures, environmental radiation doses and radiological risks from occupational and environmental exposures. He also performed evaluations and assessments of all aspects of operational health physics programs. Dr. Frazier served as technical advisor to organizations that performed environmental radiological assessments and risk assessments and that provided occupational radiation protection services in government and industry.

1986 - 1993 ***Senior Radiological Scientist, Nuclear Sciences, IT Corporation, Knoxville, Tennessee.***

Dr. Frazier served as senior radiological scientist and technical manager of the health physics consulting group within IT. He was responsible for health physics professional services provided by IT for federal, state, and local agencies, contractors, and private companies. These services included development of all aspects of the health physics programs for nuclear facilities, technical assessments and evaluations of existing health physics programs, and environmental and occupational radiation dose assessments. He served as technical advisor and task manager for radiological aspects of remedial investigations and feasibility studies (RI/FSs). He also served as manager and technical director for specific projects in areas that included design and implementation of environmental monitoring and sampling programs, assessment of operational health physics programs, and radiation dose and risk assessments for occupational exposures and environmental releases. Previous responsibilities included serving as senior technical consultant for upgrading Environmental Health and Safety Programs at the Department of Energy Rocky Flats Plant, Oak Ridge National Laboratory, and the Oak Ridge Y-12 Plant.

1980 - 1986 ***Health Physicist, Oak Ridge Associated Universities, Oak Ridge, Tennessee.***

Dr. Frazier developed and coordinated Oak Ridge Associated Universities (ORAU) health physics training programs. He taught health physics and radiation protection courses for several hundred students each year at ORAU Professional Training Programs. He developed new lectures, laboratory exercises, and training materials for health physics training for the Nuclear Regulatory Commission, Department of Energy, and corporate clients. In addition to his training responsibilities, Dr. Frazier served as division health physicist for the Manpower Education, Research, and Training Division of ORAU. He served as technical consultant to federal and state agencies, other training institutions, and ORAU clientele on environmental, health and safety issues. He evaluated radiation measurement and radiation protection instrumentation equipment.

1978 - 1980 ***Chief Radiation Physics Section, Bureau of Radiological Health, Rockville, Maryland.***

Dr. Frazier supervised research and support activities of a staff of seven health physics professionals and technicians. He planned and implemented radiation research projects pertaining to ionizing radiation detection/ measurement. He scheduled personnel requirements in accordance with the scope of such projects. He coordinated support for external radiation dosimetry by the Radiation Physics Section for all other branches in the Division of Electronic Products. He supervised and performed multi-point calibrations of radiation detection/ measurement instruments per month. Dr. Frazier also assisted in planning radiation dosimetric surveys of large numbers and types of ionizing radiation sources to reduce population exposure. He coordinated environmental radiation dosimetry for extended geographical areas using external radiation dosimeters.

1977- 1980 ***Research Physicist, Bureau of Radiological Health, Rockville, Maryland.***

Dr. Frazier calibrated X-ray detection/measurement instruments. He maintained radiation calibration secondary standards traceable to the National Bureau of Standards. He evaluated new X-Ray detection/measurement instruments with radio-frequency fields under controlled environmental conditions and a wide range of ionizing radiation fields. He also developed external radiation dosimetry techniques with both active and passive dosimeters.

Awards/Activities

Joyce P. Davis Memorial Award, American Academy of Health Physics, 2016
Fellow, Health Physics Society, 2000
Elda E. Anderson Award, Health Physics Society, 1988
John C. Villforth Lecture, Conference of Radiation Control Program Directors, 2007
Distinguished Technical Associate, IT Corporation, 1990
National Council on Radiation Protection and Measurements (NCRP)
  Distinguished Emeritus Member, 2014-2022
  Council Member, 2002-2014
  Scientific Committee 46, 1999-2006
  Scientific Committee 2-1, 2004-2006
  PAC-2 Committee 2006-2015

Professional Affiliations

Health Physics Society
  (Plenary Membership since 1981; President, 2002-3; President-Elect, 2001-2; Board of Directors, 1992-5; Treasurer-Elect, 1997-8; Treasurer, 1998-2000)
American Academy of Health Physics (Past-president, 2013; President, 2012; President-elect, 2011; Secretary, 1996-1997; Director, 1998)
East Tennessee Chapter of the Health Physics Society (Past President)
International Radiation Protection Association (Plenary Membership since 1981)

Publications

Dr. Frazier has prepared or contributed to over 100 reports and publications in the fields of health physics and environmental science.

List of Publications

Frazier, J. R., "Negative Ion Resonances in the Fluorobenzenes and Biphenyl" Ph.D. Dissertation, University of Tennessee, Knoxville, Tennessee, 1978.

Frazier, J. R., "Low-Energy Electron Interactions with Organic Molecules: Negative Ion States of Fluorobenzenes," Journal of Chemical Physics, Vol. 69, No. 3807, 1978.

Frazier, J. R., "Performances of X-ray Measurement Instruments in RF Fields," HEW Publication (FDA) 78-8065 Rockville, Maryland, 1978.

Frazier, J. R., "A Dosimetry System for Evaluating Chest X-Ray Exposures," HEW Publication (FDA) 79-I 107, 1979.

Film Badge Dosimetry in Atmospheric Nuclear Tests, National Academy Press, Washington, D.C., 1989.

Key Elements of Preparing Emergency Responders for Nuclear and Radiological Terrorism, NCRP Commentary No. 19, Bethesda, MD, December 31, 2005.

Radiation Protection in Educational Institutions, NCRP Report No. 157, National Council on Radiation Protection and Measurements, Bethesda, MD, June 25, 2007.

Self Assessment of Radiation-Safety Programs, NCRP Report No. 162, National Council on Radiation Protection and Measurements, Bethesda, MD, June 3, 2009.

Radiological Health Protection Issues Associated with Use of Active Detection Technology Systems for Detection of Radioactive Threat Materials, NCRP Commentary No. 22, National Council on Radiation Protection and Measurements, Bethesda, MD, 2011.

Investigation of Radiological Incidents, NCRP Report No. 173, National Council on Radiation Protection and Measurements, Bethesda, MD, September 14, 2012.

Radiation Safety of Sealed Radioactive Sources, NCRP Report No. 182, National Council on Radiation Protection and Measurements, Bethesda, Maryland, April 5, 2019.

Naturally Occurring Radioactive Material (NORM) and Technologically Enhanced NORM (TENORM) from the Oil and Gas Industry, NCRP Commentary No. 29, National Council on Radiation Protection and Measurements, Bethesda, Maryland, April 22, 2020.

ATTACHMENT B

LIST OF DOCUMENTS REVIEWED

ATTACHMENT B

Beck 1986 Beck, J.N., et al., "Environmental Radiation Exposure Rate in Louisiana," Journal of Environmental Quality, Vol. 15, 1986.

Carter 1988 Carter, M.W., et al., "Radionuclides in the Food Chain", Springer-Verlag, New York, NY, 1988.

DeLaune 1986 Delaune, R.D., et al., "Radionuclide Concentrations in Louisiana Soils and Sediments", Health Physics, Vol. 51, August 1986.

Eberline 2019 Eberline Analytical Corporation, "Standard Level IV Report of Analysis," Work Order #19-10011-OR, Oak Ridge, Tennessee, July 1, 2015.

Eberline 2022a Eberline Analytical Corporation, "Standard Level IV Report of Analysis," Work Order #22-06118-OR, Oak Ridge, Tennessee, August 11, 2022.

Eberline 2022b Eberline Analytical Corporation, "Standard Level IV Report of Analysis," Work Order #22-07019-OR, Oak Ridge, Tennessee, August 11, 2022.

Frazier 2016 Frazier, John R., "Expert Report of John R. Frazier, Ph.D., CHP, in State of Louisiana and the Iberville Parish School Board vs. BP America Production Company, et al., 18th Judicial District Court, Parish of Iberville, State of Louisiana; Docket No. 72,605; Division A," Knoxville, Tennessee, March 31, 2016.

IAEA 1990 International Atomic Energy Agency (IAEA), "The Environmental Behaviour of Radium, Volumes 1 & 2," Technical Reports Series No. 310, Vienna, Austria, 1990.

IAEA 2003 International Atomic Energy Agency (IAEA), "Extent of Environmental Contamination by Naturally Occurring Radioactive Material (NORM) and Technological Options for Mitigation," Technical Reports Series No. 419, Vienna, Austria, 2003.

IAEA 2014 International Atomic Energy Agency (IAEA), "The Environmental Behaviour of Radium: Revised Edition," Technical Reports Series No. 476, Vienna, Austria, 2014.

ICRP 1978 International Commission on Radiological Protection (ICRP), "Radionuclide Release into the Environment: Assessment of Doses to Man," ICRP Publication 29, New York, New York, 1978.

Kocher 1981 Kocher, David C., "Radioactive Decay Data Tables," DOE/TIC-11026, U.S. Department of Energy, Washington, DC, 1981.

Kraemer 1984 Kraemer, Thomas F., and David F. Reid, "The Occurrence and Behavior of Radium in Saline Formation Water of the U.S. Gulf Coast Region," Isotope Geoscience, Vol. 2, pp. 153-174, Elsevier Science Publishers, Netherlands, 1984.

LADEQ 2015 State of Louisiana Department of Environmental Quality, LAC Title 33, Environmental Quality, Part XV. Radiation Protection, Chapter 14. Regulations and Licensing of Naturally Occurring Radioactive Material (NORM), July 2015.

LDEQ 2021 Louisiana Department of Environmental Quality, Office of Environmental Compliance, Letter to Matthew Rogenes (Stag Liuzza), Re; Romaine v. Freeport-McMoran Oil & Gas et al., Baton Rouge, Louisiana, August 18, 2021.

LDNR 2020 State of Louisiana Department of Natural Resources, "Ground Water Resources Program Glossary of Terms," accessed 2020. (http://www.dnr.louisiana.gov/index.cfm?md=pagebuilder&tmp=home&pid=477)

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ATTACHMENT C

LITIGATION IN WHICH DR. JOHN R. FRAZIER HAS PROVIDED SWORN TESTIMONY SINCE OCTOBER 13, 2018

LITIGATION IN WHICH DR. JOHN R. FRAZIER HAS PROVIDED SWORN TESTIMONY SINCE OCTOBER 14, 2018

FIRM	CASE	CLIENT	DATE
Kean Miller	New 90, LLC and Louisiana Wetlands, LLC v. Grigsby Petroleum, Inc. and Chevron U.S.A., Inc.	Grigsby Petroleum, Inc. and Chevron U.S.A., Inc.	October 29, 2018
Jose	Estate of Jeffrey H. Ware v. Hospital of the University of Pennsylvania, et al.	Hospital of the University of Pennsylvania, et al.	December 18, 2018
Liskow & Lewis	Jack Anthony Devillier, et al. v. Chevron U.S.A. Inc., et al.	Chevron U.S.A. Inc., et al.	July 8, 2020
Kean Miller	Hero Lands Company, L.L.C. v. Chevron U.S.A. Inc., et al.	Chevron U.S.A. Inc., et al.	July 10, 2020
Shook Hardy & Bacon	Scott D. McClurg, et al. v. Mallinckrodt LLC, et al.	Mallinckrodt LLC, et al.	August 17, 2020
Kean Miller	Litel Explorations, LLC v. Aegis Development Company, L.L.C., et al.	Aegis Development Company, L.L.C., et al.	November 16, 2020
Kean Miller	Hero Lands Company, L.L.C. v. Chevron U.S.A. Inc., et al.	Chevron U.S.A., Inc., et al.	December 21, 2020

Kean Miller	Louisiana Wetlands, LLC and New 90, LLC v. Energen Resources Corporation, et al.	Energen Resources Corporation, et al.	February 19, 2021
Kean Miller	Louisiana Wetlands, LLC and New 90, LLC v. Energen Resources Corporation, et al.	Energen Resources Corporation, et al.	February 25-26, 2021
Kean Miller	James J. Martin Family, L.L.C. Consolidated with Robert Patricia Fleming, L.L.C. v. B.P. America Production Company, et al..	BP America Production Company, et al.	March 4, 2021
Holland & Knight	John J Jerue and Michael J. Feist, On behalf of themselves and all others similarly situated, v. The Drummond Company, Inc.	The Drummond Company, Inc.	March 23, 2021
Barrasso Usdin Kupperman Freeman & Sarver	Dolores H. Lewis, in Her Capacity as Co-trustee of the Rutherford Estate Trust, et al., v. Quintana Petroleum Corporation, et al.	Quintana Petroleum Corporation, et al.	May 19, 2021
Gunster	Richard Cotromano, et al., all on behalf of themselves and all other s similarly situated, v. Raytheon Technologies Corporation	Raytheon Technologies Corporation	July 20, 2022
Kean Miller	Henning Management LLC v. Chevron U.S.A. Inc., et al.	Chevron U.S.A., et al.	August 25, 2022