MEMORANDUM OF UNDERSTANDING

BETWEEN THE UNITED STATES DEPARTMENT OF ENERGY, DEPARTMENT OF DEFENSE, DEPARTMENT OF HEALTH AND HUMAN SERVICES, ENVIRONMENTAL PROTECTION AGENCY, NUCLEAR REGULATORY COMMISSION, DEPARTMENT OF HOMELAND SECURITY, AND OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION REGARDING THE CENTER FOR RADIATION PROTECTION KNOWLEDGE

I. INTRODUCTION

A. Purpose. The extension of this Memorandum of Understanding (MOU) between the Department of Energy (DOE), Department of Defense (DoD), Department of Health and Human Services (HHS), Environmental Protection Agency (EPA), Nuclear Regulatory Commission (NRC), Department of Homeland Security (DHS), and Occupational Safety and Health Administration (OSHA) (participating agencies) provides for the reaffirmation of a Center for Radiation Protection Knowledge (Center) at the Department of Energy's Oak Ridge National Laboratory (ORNL), Environmental Sciences Division, Oak Ridge, Tennessee. Under the MOU, the Center would continue to serve as a common resource to assist the participating agencies in the development and application of radiation dosimetry and risk assessment methodologies that are based on the best available scientific information. The Center would be responsive to the participating agencies and would be administered by DOE.

This MOU is intended to help maintain and preserve U.S. expertise in radiation dosimetry and to ensure that Federal radiation programs are based on the best available information and applied in a consistent manner. A list of Center accomplishments since the latest extension of the MOU (2015) is included in Appendix A.

B. Background. For over sixty years, the Dosimetry Research Team at ORNL has developed and implemented biokinetic and dosimetric models for evaluation of doses to tissues of the body arising from external radiation fields or intake of radionuclides. The models and databases derived from these models have been widely used by the Federal agencies and by national and international scientific bodies such as the National Council on Radiation Protection and Measurements (NCRP), International Commission on Radiological Protection (ICRP) and the International Atomic Energy Agency. Currently, ORNL is one of only four organizations in the world involved in computation of dose coefficients and reference bioassay data published by the ICRP, and it is the only organization with extensive experience and capabilities in developing and implementing biokinetic and dosimetric models and their associated databases. Specific capabilities of the Center include:

- Computational dosimetry using both stylized and voxel anthropomorphic phantoms;
- Biokinetic modeling of the transport of different elements in the human body;
- Compilation and evaluation of radionuclide decay data and the construction of environmental source terms;
- Dose reconstruction and radiological assessment from a variety of source terms; and
- Radiation dosimetry using spectral and dose measuring instruments.

The participating agencies, acting through the Interagency Steering Committee on Radiation Standards (ISCORS)[1], recognize a mutual benefit from interagency coordination of ORNL work performed for individual Federal agencies in the areas of radiation dosimetry and risk assessment. Recognizing the importance of these activities to the primary Federal agencies with regulatory and/or operational authority in radiation protection, ISCORS recommends that such coordination of activities be facilitated under an MOU between these Federal agencies.

The purposes of the Center are to maintain U.S. expertise in radiation dosimetry and to use that

[1]The Interagency Steering Committee on Radiation Standards (ISCORS) is a voluntary interagency coordinating committee that operates under a Charter. ISCORS was established in 1995 at the urging of Senator John Glenn to, according to the Charter, "foster early resolution and coordination of regulatory issues associated with radiation standards and guidelines." ISCORS is a useful forum for Federal agencies involved in radiation protection to share information and attempt to reach consensus on radiation safety-related topics.

expertise to help ensure that Federal radiation protection and risk analysis programs are based on the best available scientific information. The Center would be supported by and responsive to DOE, DoD, HHS, EPA, NRC, DHS, and OSHA and would be administered by DOE. The Center would be maintained in the Environmental Sciences Division at ORNL.

C. Authority. This MOU is entered into under the authority of Reorganization Plan No. 3 of 1970 (EPA); the Atomic Energy Act of 1954 (AEA), as amended, (EPA, DOE, and NRC); the Occupational Safety and Health Act of 1970 (OSHA); the Energy Reorganization Act of 1974 (DOE and NRC); the Energy Policy Act of 2005 (DOE); the Public Health Service Act (HHS); the Food, Drug and Cosmetic Act of 2013 (HHS); Homeland Security Act of 2002 (DHS); and the Department of Energy Organization Act of 1977 (DOE).

Each participating agency asserts the following authority:

- DOE has authority under the AEA, the Energy Reorganization Act of 1974, and the Department of Energy Organization Act of 1977, to operate a system of laboratories and research centers concerned with the development of alternate sources of energy and studies on the biological and environmental impacts associated with energy sources and the assembly, disassembly and stockpiling of nuclear weapons. DOE has responsibility for assuring adequate protection of workers at its facilities, the public residing near these facilities, and protection of the environment at operating facilities and during cleanup of facilities and sites previously associated with its activities. DOE issues regulations and directives which it enforces at Departmental and DOE-contractor worksites to ensure this protection.
- DoD has a wide variety of activities related to the conduct and control of medical and military uses of radiation and radioactive materials, including cleanup and disposal of radioactive materials on military property. The DoD Components prepare manuals and procedures describing radiation protection activities applicable to their specific needs.
- HHS, through its Operational and Staff Divisions, has authority under the Public Health Service Act (42 USC) and the Federal Food, Drug and Cosmetic Act (21 USC) (as amended by the Pandemic and All-Hazards Preparedness Reauthorization Act of 2013) for the

conduct of health studies and the provision of guidance, assistance, and information on both health matters and health emergencies. This includes studies into the biological effects of ionizing radiation and response to radiological emergencies. HHS protects the public health and safety by preventing the adulteration of or controlling adulterated products such as foods, drugs, cosmetics, medical devices, animal feeds, and human biological products. It also protects the public from the dangers of electronic product radiation. HHS also has responsibility for assuring adequate protection of workers at its facilities who may use or be exposed to ionizing radiation, the public residing near these facilities, and protection of the environment at operating facilities.

- EPA is responsible under the AEA (42 U.S.C. 2021(h)) to advise the President with respect to radiation matters directly or indirectly affecting health and to recommend guidance to Federal agencies in the formulation of radiation protection standards. EPA is also responsible for setting generally applicable environmental radiation standards under the AEA and for regulating radionuclides under the Clean Air Act and the Safe Drinking Water Act. EPA also responds to radiological incidents and cleans up contaminated sites under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980. EPA issues guidance to Federal agencies and standards and regulations in pursuit of these activities.

- The NRC, created by the Energy Reorganization Act of 1974, exercises regulatory authority under the AEA. The NRC is responsible for regulating civilian applications of nuclear power and research reactors, isotope enrichment facilities, nuclear medicine, industrial and research applications of radioisotopes, and radioactive waste disposal. NRC conducts research and develops standards and regulations to support its regulatory activities.

- Under the Homeland Security Act of 2002 (Public Law 107-296, 2002) as amended by the Countering Weapons of Mass Destruction Act of 2018 (Public Law 115-387) (6 U.S.C. 592(a)), DHS is responsible for ensuring the safety and security of the United States from terrorism, and both man-made and natural disasters, including those involving chemical, biological, radiological and nuclear (CBRN) threats. It was created in the aftermath of the terrorist attacks of September 11, 2001. DHS has focused largely

on prevention and response to terrorism within the U.S. in conjunction with its related responsibilities for border security, customs, emergency management, and critical infrastructure protection.

- OSHA is responsible, under the Occupational Safety and Health Act of 1970 (OSH Act) (29 U.S.C. 651 *et seq.*), for assuring safe and healthful working conditions for workers. To carry out this responsibility, the OSH Act authorizes OSHA to promulgate and enforce occupational safety and health standards. Under section 6(b)(5) of the OSH Act for standards dealing with toxic materials or harmful physical agents, OSHA is required to promulgate a standard that reduces, to the extent that is technologically and economically feasible, significant risk of material impairment of employees' health (29 U.S.C. 655(b)(5)). OSHA adopted its existing ionizing radiation standard in 1971 (29 CFR 1910.1096). That standard applies to all working conditions in the private sector except those with respect to which other Federal agencies, such as DOE and NRC, and State agencies acting under section 274 of the AEA, as amended (42 U.S.C. 2021), have exercised statutory authority to "prescribe or enforce standards or regulations affecting occupational safety or health" (29 U.S.C. 653(b)(1)). Section 20(c) of the OSH Act specifically authorizes OSHA to enter into agreements with public agencies and private organizations to conduct studies relating to its responsibilities under the OSH Act (29 U.S.C. 669(c)).

II. PROGRAM AND MANAGEMENT GUIDELINES

A. <u>Objectives of the Center</u>. The primary objectives of the Center are to:

1. Develop and maintain state-of-the-art biokinetic and dosimetric methodologies for evaluation of exposures to radionuclides and radiation;
2. Make those methodologies available to Federal agencies and to the scientific community through such mechanisms as open literature publications, reports, participation in ICRP committees and task groups and other professional activities; distribution of computer software and maintenance of a Center website;

3. Provide technical assistance to Federal agencies in support of the application of dosimetric methodologies and the characterization of associated uncertainties in radiation protection and risk analysis programs, including assistance in preparation of interagency documents;

4. Under the direction of EPA and in coordination with other Federal agencies, provide technical analyses and documentation to support Federal Guidance Technical Reports establishing guidance on the assessment of dose and of risk, prospectively or retrospectively;

5. Prepare analyses and documentation on topics within the Center's expertise, as requested by any participating agency; and

6. Provide training material and conduct training courses for Federal agencies on specific computer models and modeling methods describing the fate of radionuclides in the human body and related technical topics.

B. Management and Review. The ISCORS principals serve as the coordination function to carry out essential functions related to the Center which include, but are not limited to, the following:

1. Act as a facilitating liaison between the Center and the participating agencies;

2. Coordinate Federal agencies' proposals for ORNL technical support activities to avoid overlap and duplication of effort and assist in determining priorities. ISCORS may also propose projects based on the agency's common needs;

3. Promote consistent and long-term support of the Center;

4. Coordinate interagency review of comments on the draft reports and papers prepared by the Center staff; and

5. Facilitate and coordinate the use of external reviewers for pertinent scientific documents prepared by the Center technical staff.

C. Funding. The details of the levels of support to be furnished by each participating agency are expected to be developed in specific interagency agreements, or other agreements, subject

to the availability of appropriated funds and within existing statutory authorities. This MOU shall not be used to obligate or commit funds of any participating agency or as the basis for the transfer of funds. The participating agencies plan to provide one another with mutual support in budget justification to OMB and hearings before the Congress with respect to programs on which the agencies collaborate.

D. Management Arrangements. This MOU envisions direct communication between the ISCORS principals involved in managing the work the Center performs. The participating agencies expect to implement interagency agreements or project plans for setting forth specific funding arrangements and taskings for program implementation, and such agreements or plans may also set forth necessary cooperative arrangements and procedures for handling decisions required by Government officials.

E. Landlord Responsibilities. DOE currently owns, leases, and administers the facilities and activities of ORNL and provides for its management and operation by private contractors. Under this MOU, DOE intends to continue its landlord role and responsibilities. The Center will be subject to laws, regulations, orders, and directives applicable to DOE facilities and activities and to DOE contractors.

III. PATENTS AND PROCEDURAL MATTERS

A. Patents and Technical Data. Appropriate patent and other intellectual property provisions shall be included in specific interagency agreements and any other agreements or contracts entered into by the participating agencies in order to implement this MOU. DOE patent and intellectual property policies shall apply to work performed by a DOE contractor, (e.g. ORNL and the Center). Rights to inventions made by United States Government employees shall be determined in accordance with Title 37, Part 501, of the *Code of Federal Regulations* (37 CFR Part 501), "Uniform Patent Policy for Rights in Inventions Made by Government Employees."

B. Public Information Coordination. Subject to the Freedom of Information Act (5 U.S.C. 552), the participating agencies expect to make decisions on disclosure of

information to the public regarding projects and programs referenced in this MOU in consultation with all of the participating agencies.

C. Organizational Conflict of Interest. The participating agencies are mindful of the conflict of interest requirements and obligations of the respective agencies. With respect to contracts or subcontracts which may be issued by ORNL to implement the objectives of this MOU, the participating agencies plan to consult together regarding the best means to resolve any conflict of interest issues that may arise.

D. No Private Right of Action. This MOU does not create any right or benefit, substantive or procedural, enforceable by law or equity, by persons or entities who are not party to this MOU, against DOE, DoD, HHS, EPA, NRC, DHS or OSHA, their officers or employees, or any other person. This MOU does not apply to any person outside of DOE, DoD, HHS, EPA, NRC, DHS or OSHA.

E. Commencement/Duration/Modification/Termination. This MOU is to take effect upon the last date of the last signature of the participating agencies and remain in effect for a period of five (5) years. This MOU may be extended or modified at any time per the mutual written consent of all the participating agencies. A participating agency may terminate its participation in this MOU at any time by providing written notice to the other participating agencies thirty (30) days prior to its withdrawal. The withdrawal of a participating agency does not result in the termination of this MOU for the remaining participating agencies. Additionally, this MOU may be terminated by the mutual written agreement of a majority of the participating agencies.

For the U.S. Nuclear Regulatory Commission

Date: Raymond V. Furstenau Digitally signed by Raymond V. Furstenau Date: 2021.09.27 16:18:39 -04'00'

Name, Raymond V. Furstenau
Title Director, Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission

For the U.S. Environmental Protection Agency

Date: June 11, 2021

JONATHAN EDWARDS

Digitally signed by JONATHAN EDWARDS
Date: 2021.06.11 09:33:39 -04'00'

Name, Jonathan D. Edwards
Title Director, Office of Radiation and Indoor Air
Office of Air and Radiation
U.S. Environmental Protection Agency

For the U.S. Department of Energy

Date: 7/8/2021

MICHAEL J. SILVERMAN
DIRECTOR
OFFICE OF ENVIRONMENTAL PROTECTION AND
ES&H REPORTING
OFFICE OF ENVIRONMENT, HEALTH, SAFETY AND SECURITY

For the U.S. Department of Defense

Date: ___August 25, 2021___

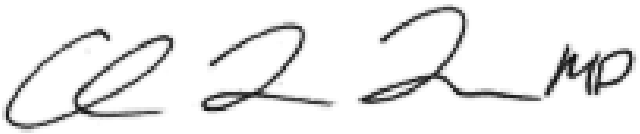
MACALUSO.LAURA.A.1293588887

Digitally signed by MACALUSO.LAURA.A.1293588887
Date: 2021.08.25 17:14:09 -04'00'

Laura A. Macaluso
Director, Force Safety and Occupational Health
Office of the Assistant Secretary of Defense

For the U.S. Department of Health and Human Services

Date: 7/9/2021



HHS, Assistant Secretary for Health

Name,
Title

For the U.S. Department of Labor (OSHA)

Date: _____

ANDREW LEVINSON

Digitally signed by ANDREW LEVINSON
Date: 2021.08.03 12:03:01 -04'00'

Andrew Levinson
Acting Director
Directorate of Standards and Guidance

For the U.S. Department of Homeland Security

Date: _____

GARY C RASICOT

Digitally signed by GARY C RASICOT
Date: 2021.08.11 10:51:25 -04'00'

_____

Name,
Title

APPENDIX A. CRPK CAPABILITIES AND RECENT ACCOMPLISHMENTS

Purpose of this appendix

The Center for Radiation Protection Knowledge (CRPK) was created to help maintain and preserve U.S. expertise in radiation dosimetry and ensure that Federal radiation programs are based on sound scientific data and models and applied in a consistent manner across agencies. Over the past decade the CRPK has assisted the participating agencies in the development and application of a variety of radiation dose and risk methodologies built on best available scientific information. This appendix summarizes the current capabilities of the CRPK and its accomplishments since the latest extension of the MOU (2015), for the purpose of demonstrating that CRPK served its intended role under the 2015 MOU while maintaining international leadership in radiation dose and risk modeling and assessment.

This appendix is divided into six sections, each consisting of bulleted or outlined lists of capabilities or accomplishments:

- CRPK capabilities
- Selected projects for U.S. Federal agencies, 2015-present
- International radiation protection activities, 2015-present
- Recognition and awards, 2015-present
- Publications, 2015-present
- Presentations, 2015-present

CRPK capabilities

Many of the capabilities of the Center for Radiation Protection Knowledge are listed below. The list includes capabilities that are available or can be generated by calling upon ORNL resources including the Center's association with other scientists:

- Computational Dosimetry using both stylized and voxel anthropomorphic phantoms including:
    - Use of Monte Carlo and other radiation transport methods to compute dose coefficients for external exposure as well as internal irradiation of the human body.
    - Construction of anthropomorphic phantoms for dosimetry studies.
    - Development of phantoms for dosimetry and biokinetic modeling relevant to animals, particularly in emergency response situations.
    - Integration of the above capabilities into a variety of facility analyses, e.g. the computation of dose to individuals due to activation products in materials or radionuclide contamination in the decommissioning of a facility.
    - Benchmarking of Monte Carlo methods against direct measurement in the zero-scatter dosimetry calibration laboratory at ORNL (RADCAL/RASCAL). Capabilities for neutron, gamma-ray and beta irradiation measurements are available.
- Biokinetic modeling of elements and compounds in the human body. CRPK personnel can generate both basic physiological system models and element-specific models.
    - Supports the organ dose calculations for internal dosimetry needs.
    - Supports dose reconstruction as the biokinetic models are designed for interpretation of radionuclide bioassay.
    - This capability can also be directed at intakes for other purposes, such as the intake of chemical toxins.
- Compilation and evaluation of radionuclide decay data and construction of environmental source terms.
- Dose reconstruction and radiological assessment directed at accidental exposures and exposures from a variety of sources terms, including transport through the biosphere and atmosphere.
- Radiation dosimetry using both spectral and dose measuring instruments as well as simulations to support the interpretation of instrument readings.
    - Supports development of improved dosimetry instruments through collaborations within ORNL.
    - Examples:
        - Neutron dose measurements in facilities and reactors to generate field adjustment corrections to personnel dosimeter readings.

        - Simulation of instrument response to contamination in or on a person for use in an emergency response screening situation.

- Conduct radiation protection dosimetry-based measurements at nearby facilities, such as the Oak Ridge Associated Universities (ORAU), Oak Ridge Institute for Science and Education (ORISE), the Radiation Emergency Assistance Center/Training Site (REAC/TS), and the Nuclear Power Reactors of the Tennessee Valley Area, in collaboration with those entities. Examples include:
    - Skyshine evaluation from Independent Spent Fuel Storage Installations
    - Pulsed, 14-MeV neutron and Cf-252 irradiation facilities
    - 6-MV pulsed LINAC
    - Spallation Neutron Source
- Serves as a research hub that could be used to integrate the capabilities of universities and laboratories into a coordinated radiation protection research program and serves as a means to convey advanced radiation protection knowledge to young professionals.
- Serves as a center for investigation of radiation protection in nuclear medicine procedures and radiotherapy.

Selected projects for U.S. Federal agencies, 2015-present

Accomplishments of the Center for Radiation Protection Knowledge (CRPK) since the extension of the MOU in 2015 are listed below. Participation in national and international radiation protection activities are listed, in addition to products delivered to specific U.S. federal agencies. Current activities in both categories are also listed.

Department of Energy

- Revised DOE Standard 1196-2011, including an update of the age-specific internal dose coefficients and replacement of external dose coefficients based on a reference adult with age-specific values. Updated Derived Concentration Standards (DCS values) were also derived and tabulated. The DCS values are guidelines for radionuclide concentrations in environmental media based on current radiation protection practices for controlling exposure to members of the public. The DCS values reflect the age- and sex-specific composition of the population, usage of environmental media, and radiation dosimetry. Age-specific biokinetic models were applied.

Environmental Protection Agency

- Issued final version of Federal Guidance Report 15 *External Exposure to Radionuclides in Soil, Air, and Water: External Dose Coefficients for General Application*.
- Issued Federal Guidance Report No. 16 *Preliminary Version: Cancer Risk Coefficients for Environmental Exposure to Radionuclides -- Radionuclide-Specific Lifetime Radiogenic Cancer Risk Coefficients for the U.S. Population, Based on Age and Gender Specific Intake Rates, Dosimetry, and Risk Model*

U.S. Nuclear Regulatory Commission

- The book Advanced Radiation Protection Dosimetry was published by CRC Press (Francis and Taylor) with a copyright date of 2019. CRPK staff served as the general editors of the book written for the NRC. Chapters were prepared by a collection of ORNL and non-ORNL authors. The topics include advanced external and internal radiation dosimetry concepts and regulatory applications. The book is intended to provide a reasonably comprehensive treatise of the state-of-the-art in radiation protection with the overarching goal of providing useful knowledge management references for the NRC staff and others involved in radiation protection.
- Provided the technical basis for NRC efforts on I-131 Patient Release doses to the public, e.g. Estimated Doses to Members of the Public from Exposure to Patients with ^{131}I Thyroid Treatment, ORNL/TM-2017/442, August 18, 2017.
- Updated Regulatory Guide 8.36, Radiation Dose to the Embryo/Fetus and expanded the set of radionuclides by ~50%. The rationale for the updated dose coefficients was strengthened over the approach used in the original Regulatory Guide.
- Maintained PIMAL software and delivered courses on its use through the NRC's Radiation Protection Code Analysis and Maintenance Program.

Centers for Disease Control and Prevention

- Performed dose reconstruction for plutonium workers as part of the Million Worker Study.
- Developed age-specific biokinetic models for selected radionuclides.
- Developed biokinetic models and computer software for estimating doses to the nursing infant from intake of radionuclides by the mother.

International radiation protection activities, 2015-present

- Drs. Leggett and Jokisch served as members of ICRP Committee 2 (Doses from Radiation Exposure). Dr. Eckerman served as a member emeritus.
- Dr. Martinez served as a member of ICRP Committee 4 (Application of the Commission's Recommendations).

- ICRP Task Group Memberships
    - Drs. Hertel and Eckerman served on Task Group 90 *Age-Dependent Dose Conversion Coefficients for External Exposures to Environmental Sources.* Dr. Bellamy also served on this task group while at ORNL.
    - Dr. Leggett served on Task Group 95 *Internal Dose Coefficients* and as one of the authors of ICRP publications listed below under "Co-Authorship of ICRP Publications".
    - Drs. Jokisch and Eckerman served on Task Group *96, Computational Phantoms and Radiation Transport.*
    - Dr. Eckerman served on Task Group 103, *Mesh-type Reference Computational Phantoms (MRCP).*
    - Dr Martinez co-chaired Task Group 110, *Radiological Protection in Veterinary Practice.*
    - Dr. Martinez served on Task Group 114, *Reasonableness and Tolerability in the System of Radiological Protection.*
- Co-Authorship of ICRP Publications
    - W. E. Bolch, C. Lee, M. Zankl, **D.W. Jokisch**, N. Petoussi-Henss, C.H. Kim, J.G.S. Hunt, T. Sato, **K. Eckerman**, K.P. Kim, J. Li, and Y.S. Yeom. ICRP Publication 143. *Paediatric reference computational phantoms*. Ann. ICRP 49(1); 2020 (in press).
    - W.E. Bolch, D. **Jokisch**, M. Zankl, K.F. Eckerman, T. Fell, **R. Manger**, A. Endo, J. Hunt, K.P. Kim, N. Petoussi-Henss. ICRP Publication 133. *The ICRP Computational Framework for Internal Dose Assessment for Reference Adults: Specific Absorbed Fractions* (2016). Ann. ICRP 45(2).
    - F. Paquet, G. Etherington, M.R. Bailey, **R.W. Leggett**, J. Lipsztein, W. Bolch, **K.F. Eckerman**, J.D. Harrison. ICRP Publication 130. *Occupational Intakes of Radionuclides: Part 1* (2015). Ann. ICRP 44(2).
    - F. Pacquet, M. Bailey, **R. Leggett** , J. Lipsztein, T. Fell, T. Smith, D. Nosske, **K. Eckerman**, V. Berkovski, E. Ansoborlo, A. Giussani, W. Bolch, J. Harrison. ICRP Publication 134. *Occupational Intakes of Radionuclides, Part 2* (2016). Ann. ICRP 45(3/4).
    - F. Paquet, M.R. Bailey, **R.W. Leggett**, J. Lipsztein, J. Marsh, T.P. Fell, T. Smith, D. Nosske, **K.F. Eckerman**, V. Berkovski, E. Blanchardon, D. Gregoratto, J.D.

Harrison. ICRP Publication 137. *Occupational Intakes of Radionuclides: Part 3* (2017). Ann. ICRP 46(3/4).

- F. Paquet, M.R. Bailey, **R.W. Leggett**, G. Etherington, E. Blanchardon, T. Smith, G. Ratia, D. Melo, T.P. Fell, V. Berkovski, J.D. Harrison. ICRP Publication 141. *Occupational intakes of radionuclides: Part 4 (2019)*. Ann. ICRP 48(2/3).
- K-W. Cho, M-C. Cantone, C. Kurihara-Saio, B. Le Guen, N. Martinez, D. Oughton, T. Schneider, R. Toohey, F. Zölzer. ICRP Publication 138. *Ethical Foundations of the System of Radiological Protection* (2018). Ann. ICRP 47(1).

- Dr. Hertel is co-chairing International Commission on Radiation Units and Measurements Report Group 26, *Operational Radiation Protection Quantities for External Radiation*, to be issued in 2020.

Recognition and Awards

- Dr. Leggett was awarded the Health Physics Society Robley Evans Medal in 2019. This is the highest honor bestowed by the HPS and is awarded infrequently.
- Dr. Martinez was awarded the first Bo Lindell Medal by the ICRP in 2017.[2]
- Dr. Martinez was the recipient of the HPS's Elda Anderson Award in 2019.[3]
- Dr. Dewji was the recipient of the HPS Elda Anderson Award in 2018 while at the CRPK.
- Dr. Hertel was awarded the HPS Distinguished Scientific Achievement Award in 2016 and the American Nuclear Society Radiation Protection and Shielding Division's Rockwell Lifetime Achievement Award in 2018.
- Dr. Eckerman delivered the Lauriston S. Taylor Lecture No. 39: Dosimetry of Internal Emitters: Contributions of Radiation Protection Bodies and Radiological Events, National Council on Radiation Protection in 2015.

[2] The Bo Lindell Medal is to be awarded to an early to mid-career professional making a significant contribution to the promotion of radiological protection.

[3] This distinction is awarded to a member of the Health Physics Society under 40 years of age who exemplifies excellence in research or development, discovery or invention, devotion to health physics, and/or significant contributions to the profession of health physics.

Publications, 2015-present

2020

Leggett, R., Samuels, C. (2020). Biokinetic models for Group IVB elements. Accepted for publication in J. Radiol. Prot.

Hiller, M., R. Leggett. (2020). A biokinetic model for trivalent or hexavalent chromium in adult humans. J. Radiol. Prot. 40:19-39.

Martinez, N.E., Van Bladel, L. (2020) Radiation protection challenges in applications of ionizing radiation on animals in veterinary practice. Annals of the ICRP (under review)

Martinez, N.E. (2020) The 2018 Bo Lindell Laureate lecture: Finding common ground between science, ethics, and experience. Annals of the ICRP (under review)

Veinot, K.G., N E Hertel, M M Hiller, K F Eckerman. (2020). Neutron dose coefficients for local skin. J. Radiol. Prot. 40: 554-582

Bolch, W. E., C Lee, M Zankl, **DW Jokisch**, N Petoussi-Henss, CH Kim, JGS Hunt, T Sato, **K Eckerman**, KP Kim, J Li, YS Yeom. ICRP Publication 143 – Paediatric reference computational phantoms. Ann. ICRP 49(1); 2020 (in press).

Montgomery, D.A., **N.E. Martinez**. (2020) Dosimetric modeling of ^{99}Tc, ^{137}Cs, ^{237}Np, and ^{238}U in the grass species Andropogon Virginicus: Development and comparison of stylized, voxel, and hybrid phantom geometry. Journal of Environmental Radioactivity 211: 106075. doi: 10.1016/j.jenvrad.2019.106075.

Root, C., R.R. Sinclair, T.A. DeVol, **N.E. Martinez** (2020) A mixed methods approach to improving radiation safety culture in a university setting. Health Physics doi: 10.1097/HP.0000000000001147

Dewji S, Bales K, Asano E, **Veinot K, Eckerman K**, Hart S, Finklea L, Ansari A. (2020). Estimation of External Contamination and Exposure Rates Due to Fission Product Release. Health Physics. 1. 10.1097/HP.0000000000001168.

2019

Leggett, R., E. Blanchardon. (2019) Updated biokinetic model for systemic americium. J. Radiol. Prot. 39:579-597.

Hertel, N. E., D. W. Jokisch. (2019) Chapter 8 – Dose Coefficients, in Advanced Radiation Protection Dosimetry. 60 pages, CRC Press (SA Dewji and NE Hertel, eds).

Leggett, R. (2019) Chapter 6 – Biokinetic Models. Advanced Radiation Protection Dosimetry. 92 pages, CRC Press (SA Dewji and NE Hertel, eds.).

Leggett, R., S. Tolmachev, J. Boice. Potential improvements in brain dose estimates for internal emitters. January 2019 (published online ahead of print). Int. J. Radiat. Biol., 13 pages.

Leggett, R., S. Tolmachev, J. Boice. (2019). Case studies in brain dosimetry for internal emitters: Is more detail needed for epidemiology. Proceedings of HEIR 2018. BIO Web of Conferences 14, 03008, 2 pages, doi.org/10.1051/bioconf/20191403008.

Leggett, R. W., S. Y. Tolmachev, J. D. Boice. Case studies in brain dosimetry for internal emitters: Is more detail needed for epidemiology? BIO Web Conf., 14 (2019) 03008 DOI: https://doi.org/10.1051/bioconf/20191403008.

Ellis, E. D.; **R. W. Leggett,** A. P. Golden, J. D. Boice. Comprehensive dosimetry for seven exposure sources at the earliest US uranium processing facility. BIO Web Conf., 14 (2019) 03005 DOI: https://doi.org/10.1051/bioconf/20191403005.

Golden, A., **R. Leggett**, et al. Updated mortality analysis of the Mallinckrodt uranium processing workers, 1942-2012. February 2019 (published online ahead of print). Int. J. Radiat. Biol., 22 pages.

Ethan, Fredrick Dolislager, Karessa Manning, Debra Stewart, Katie Noto, Hayden Ringer, **Caleigh Samuels**, Leslie Galloway, Anthony Armstrong, **Michael Bellamy**. (2019) Air Exchange Rate Impact on Actinon, Thoron, and Radon Activity Equilibrium Factor and Inhalation Fractional Equilibrium Factor Determination in Vapor Intrusion Risk and Dose Models. ORNL/TM-2019/1269, 50 pages.

Bellamy, M., S. Dewji, R. Leggett, et al. (2019) External exposure to radionuclides in air, water and soil. Federal Guidance Report 15. EPA 402-R-19-002, August 2019.

Davis, Jason, **Shaheen Dewji**, Eric Abelquist, and **Nolan Hertel.** (2019) Synopsis of the Oak Ridge Radiation Protection Needs Workshop, Health Physics 116, 69-80.

Griffin, Keith, Colin Paulbeck, Wesley Bolch, Harry Cullings, Stephen Egbert, Sachiyo Funamoto, Tatsuhiko Sato, Akira Endo, **Nolan Hertel**, Choonsik Lee. (2019) Dosimetric Impact Of A New Computational Voxel Phantom Series For The Japanese Atomic Bomb Survivors: Children And Adult. Radiation Research, 191, 369–379.

Funamoto, Tatsuhiko Sato, Akira Endo, **Nolan Hertel**, Wesley E. Bolch. (2019) Dosimetric Impact of a New Computational Voxel Phantom Series for the Japanese Atomic Bomb Survivors: Pregnant Females. Radiation Research, 192, 538-561.

Eckerman, K.F., K.G. Veinot. (2019) Transitional Epithelium of Urinary Bladder: Dosimetric Data for Cells at Risk in Nuclear Medicine. IEEE Transactions on Radiation and Plasma Medical Sciences, Volume 3, Issue 1, pp. 61-64.

Willey, A.H., T.A. DeVol, **N.E. Martinez** (2019). Thermal neutron flux characterization and dose modeling of a PuBe source. Health Physics 117(6):669-679.

M. Anderson, K. F. Eckerman, D. Pawel, A. Almen. (2019) Improved radiation risk models applied to different patient groups in Sweden. Rad Hygiene 12(2).

2018

Paquet, F., M. Bailey**, R. Leggett**, et al. (2018) Occupational Intakes of Radionuclides, Part 3, Annals of the International Commission on Radiological Protection, ICRP Publication 137.

Leggett, R. W., C. O'Connell. (2018) Biokinetic models for Group VB elements. J. Radiol. Prot. 38: 564-586.

Leggett, R. W., R. Meck. (2018) Action levels for airborne uranium in the workplace: Chemical and radiological assessments. J. Radiol. Prot. 38: 632-649.

Wayson, M. B., **R. W. Leggett, D. Jokisch**, et al. (2018) Suggested reference values for regional blood volumes in children and adolescents. Phys. Med. Biol. 63:1-20.

Meck, R., **R. Leggett**. (2018) Action levels for airborne natural uranium in the workplace: chemical and radiological assessments. Pp. 272-274 in: URAM2018 - Material for the Nuclear Fuel Cycle: Exploration, Mining, Production, Supply and Demand, Economics and Environmental Issues. 25-29 June 2018, Vienna, Austria.

Ellis, E., **R. Leggett,** A. Golden, J. Boice. (2018) Comprehensive dosimetry for seven sources of exposure at the earliest uranium processing facility in the United States. Proceedings of HEIR 2018, BIO Web of Conferences 14: 03005, 2 pages, doi.org/10.1051/bioconf/20191403005.

Metzger, R. L., G. P. Lasche, **K. F. Eckerman, R. W. Leggett**. (2018) Long-lived contaminants in cyclotron-produced radiopharmaceuticals: Measurements and dosimetry. J. Radioanal. Nucl. Chem., published online 28 June 2018.

Metzger, R. L., K. A. van Riper, **K. F. Eckerman, R. W. Legge**tt. (2018) Detection of long-lived contaminants in cyclotron-produced radiopharmaceuticals by large area plastic scintillators. J. Radioanal. Nucl. Chem, published online 29 June 2018.

Wayson, M. B., **RW Leggett, DW Jokisch**, C Lee, BC Schwarz, WJ Godwin, WE Bolch. (2018) Suggested reference values for regional blood volumes in children and adolescents. Physics in Medicine and Biology 63(15): 155022.

Dauer, L., **R. Leggett**, et al. (2018) Dosimetry and uncertainty approaches for the Million Person Study of low dose radiation health effects: overview of the recommendations in NCRP Report No. 178. November 2018 (published online ahead of print) Int. J. Radiat. Biol., 31 pages.

Boice, John D. Jr.; Elizabeth D. Ellis, Ashley P. Golden, David J. Girardi, Sarah S. Cohen, Heidi Chen, Michael T. Mumma; Roy E. Shore, **Richard W**. **Leggett.** (2018) The past informs the future: An overview of the Million Worker Study and the Mallinckrodt Chemical Works Cohort. Health Phys. 114:381-385.

Boice, J. D., **R. W. Leggett** et al. (2018) Response to Mortazavi et al. on detecting bone-seeking radionuclides in bone tissue. Health Phys. 115:389-390.

Elizabeth D. Ellis, John D. Boice, Jr., Ashley P. Golden, David J. Girardi, Sarah S. Cohen, Michael T. Mumma, Roy E. Shore, **Richard W. Leggett**, Georg D. Kerr. (2018) Less Dosimetry is key to good epidemiology: Workers at Mallinckrodt Chemical Works had seven different source exposures. Health Phys. 114:386-397.

Leggett, R., K. Eckerman, M. Bellamy. (2018) MPS dose reconstruction for internal emitters: Some site-specific issues and approaches. December 2018 (published online ahead of print). Int. J. Radiat. Biol, 13 pages.

Mille, M. M., **N. E. Hertel**, P. M. Bergstrom, C. Lee. (2018) Piecewise Polynomial Approximations to The ICRP 116 Effective Dose Coefficients: Photons And Neutrons, Radiation Protection Dosimetry 178: 310-312.

Otto, T., **N. E. Hertel**, D. T. Bartlett, R. Behrens, J.-M. Bordy, G. Dietze, A. Endo, G. Gualdrini, M. Pelliccioni. (2018) The ICRU Proposal For New Operational Quantities For External Radiation, Radiation Protection Dosimetry 180: 10-16.

M. Anderson, D. Pawel, **K.F. Eckerman**, A. Almen. (2018)Age and gender specific radiation risk models as an alternative to effective dose, Phys Medica 53977.

Kim C H, Y Yeom, N Tat Thang, M Han, C Choi, H Lee, H Han, B Shin, J-K Lee, H S Kim, M Zankl, N Petoussi-Henss, W E Bolch, C Lee, B Chung, R Qiu, **K Eckerman.** (2018). New mesh-type phantoms and their dosimetric applications, including emergencies. Annals of the ICRP. 47. 014664531875623. 10.1177/0146645318756231.

2017

Leggett, R. W. (2017) An age-specific biokinetic model for iodine. J. Radiol. Prot. 37:864-882.

Leggett, R. W. (2017) Biokinetics of yttrium and comparison with its geochemical twin holmium. J. Radiol. Prot. 37:434-449.

Leggett, R. W. (2017) Basis for the ICRP's updated biokinetic model for carbon inhaled as CO_2. J. Radiol. Prot. 37:340-353.

Leggett, R. W., M. Bellamy. (2017) Radon Cancer Risk Coefficients and Age-Specific Effective Dose Coefficients. ORNL-TM.

Melo D, **R. Leggett**. (2017) A biokinetic model for systemic nickel. Health Physics 112:18-27.

Hertel, N. E. (2017) Developing a Radiation Protection Hub, Health Physics 112: 172-175.

Bellamy, M. B., K. G. Veinot, M.M. Hiller, S. A. Dewji, K.F. Eckerman, C.E. Easterly, N. E. Hertel, R. W. Leggett, R. Manger. (2017) Effective Dose Rate Coefficients for Immersions in Radioactive Air and Water. Radiation Protection Dosimetry 174: 275-286.

Hiller, M.M., K.G. Veinot, C.E. Easterly, N.E. Hertel, K.F. Eckerman, M.B. Bellamy. (2017) Reducing Statistical Uncertainties in Simulated Organ Doses of Phantoms Immersed in Water: Radiation Protection Dosimetry 174: 439-448.

Dewji, Shaheen, Nolan Hertel, Michael Bellamy, Richard Leggett, Keith Eckerman. (2017) Estimated Doses to Members of the Public from Exposure to Patients with ^{131}I Thyroid Treatment. ORNL/TM-2017/442, 152 pages.

Dewji, Shaheen, **Mauritius Hiller**, **Michael Bellamy**, Hattice Akkurt, Dorothea Wiarda, Guruprasad Kora, **Keith Eckerman, Keith Griffin,** Tanya Oxenberg, Sami Sherbini, Mohammad Saba. (2017) PIMAL: Phantom wIth Moving Arms and Legs Version 4.1.0. ORNL/TM-2017/336, 93 pages.

Veinot, K.G., S.A. Dewji, M.M. Hiller, K.F. Eckerman, C. E. Easterly. (2017) Organ and Effective Dose Coefficients For Room Immersions In Occupational Settings: Radiation and Environmental Biophysics 56:453-462.

Veinot, K.G., K.F. Eckerman, M.B. Bellamy, M.M. Hiller, S.A. Dewji, C.E. Easterly, N.E. Hertel, R. Manger. (2017) Effective Dose Rate Coefficients for Exposure to Contaminated Soil: Radiation and Environmental Biophysics 56: 255-267.

Veinot, K.G., K.F. Eckerman, N.E. Hertel, M.M. Hiller. (2017) Organ and Effective Dose Coefficients for Cranial and Caudal Irradiation Geometries: Neutrons: Radiation Protection Dosimetry Vol. 175: 26-30.

2016

Harrison J., **Leggett R.** (2016) Appropriate selection of dose coefficients in radiological assessments: C 14 and Cl 36: Response to the letter of G Smith and M Thorne, J. Radiol. Prot. 35:737–40.

F. Pacquet, M. Bailey, **R. Leggett** , J. Lipsztein, T. Fell, T. Smith, D. Nosske, **K. Eckerman**, V. Berkovski, E. Ansoborlo, A. Giussani, W. Bolch, J. Harrison. (2016) ICRP Publication 134. *Occupational Intakes of Radionuclides, Part 2*. Ann. ICRP 45(3/4).

Schwahn, S.O. (2016) U.S. Department of Energy. Clearance and Release of Personal Property From Accelerator Facilities. https://www.energy.gov/sites/prod/files/2016/09/f33/OE-3_2016-07.pdf, March 2016.

Veinot, K. G., K. F. Eckerman, N. E. Hertel. (2016) Organ and Effective Dose Coefficients for Cranial and Caudal Irradiation Geometries: Photons, Radiation Protection Dosimetry 168:167-174.

Bellamy, M. B., M. M. Hiller, S. A. Dewji, K. G. Veinot, R. W. Leggett, K. F. Eckerman, C. E. Easterly, N. E. Hertel. (2016) Comparison Of Monoenergetic Photon Organ Dose Rate Coefficients For Stylized And Voxel Phantoms Submerged In Air, Radiation Protection Dosimetry 172: 367-374.

Bellamy, M.; K. Goodman. (2016) A review of observed intake, distribution, retention, and excretion of tin in humans and animals. ORNL/LTR-2016. 2016.

Bolch W.E., D. **Jokisch**, M. Zankl, K.F. Eckerman, T. Fell, **R. Manger**, A. Endo, J. Hunt, K.P. Kim, N. Petoussi-Henss. (2016) ICRP Publication 133. *The ICRP Computational Framework for Internal Dose Assessment for Reference Adults: Specific Absorbed Fractions*. Ann. ICRP 45(2).

Manning, Karessa, Fredrick Dolislager, **Michael Bellamy**. (2016) Biota Modeling in EPA's Preliminary Remediation Goal and Dose Compliance Concentration Calculators for Use in EPA Superfund Risk Assessment: Explanation of Intake Rate Derivation, Transfer Factor Compilation, and Mass Loading Factor Sources. ORNL/TM-2016/328, 11 pages.

2015

Ansoborlo, E., **R. W. Leggett**. (2015) In your element: Quantum caesium. Nature Chemistry 7:360.

F. Paquet, G. Etherington, M.R. Bailey, **R.W. Leggett**, J. Lipsztein, W. Bolch, **K.F. Eckerman**, J.D. Harrison. (2015) ICRP Publication 130. *Occupational Intakes of Radionuclides: Part 1*. Ann. ICRP 44(2).

Leggett, R., W. A. Giussani. (2015) A biokinetic model for systemic technetium in adult humans. J. Radiol. Prot. 35:297-315.

Li, W.B., W. Klein, E. Blanchardon, M. Puncher, **R.W. Leggett**, U. Oeh, B. Breustedt, D. Noßke, M.A. Lopez. (2015) Parameter uncertainty analysis of a biokinetic model of caesium. Radiat. Prot. Dosim. 163:37-57.

Hertel, N. E., K. F. Eckerman, M. B. Bellamy, C. E. Easterly, R. W. Leggett, J. C. Ryman, D. J. Stewart, M. Boyd. (2015) Federal Guidance Report 15: External Exposure to Radionuclides in Soil, Air, and Water, Trans. Am. Nucl. Soc. 113: 999-1001.

Hertel, Nolan E., Keith F. Eckerman, Casper Sun. (2015) "Radiological Toolbox 3.0.0, Trans. Am. Nucl. Soc. 113: 977-980.

Bellamy M, W. Bolch, **S Dewji, K Eckerman, C Easterly,** W Godwin, **N Hertel, M Hiller, D Jokish, R Leggett, S Schwahn, B Schwarz, P Scofield, K Veinot**, R Ward. (2015) Technical basis for derivation of dose coefficients for use in radiation protection. ORNL/TM-2015/597.

Bellamy, M., J. Puskin**, N. Hertel, K. Eckerman.** (2015) Empirical Method For Deriving RBE Values Associated With Electrons, Photons And Radionuclides, Radiation Protection 167: 664-670.

Dewji, S., M. Bellamy, N. Hertel, R. Leggett, K. Eckerman, S. Sherbini, M. Saba. (2015) Assessment of point source method for estimating dose rates to members of the public from exposure to patients with ^{131}I thyroid treatment. Health Phys. 109:233–241.

Dewji, S., M. Bellamy, N. Hertel, R. Leggett, K. Eckerman, S. Sherbini, M. Saba. (2015) Estimated dose rates to members of the public from external exposure to patients with ^{131}I thyroid treatment. Med. Phys. 42:1851-1859.

Dewji, S., M. Bellamy, N. Hertel, R. Leggett, S. Sherbini, M. Saba, K. Eckerman. (2015) Assessment Of Point Source Method For Estimating Dose Rates To Members Of The Public From Exposure To Patients With ^{131}I Thyroid Treatment. Health Physics, 109, 233-241.

Dewji, Shaheen, Sarah Poe, Mark Carringer. (2015) Human Capital Roadmap in Safeguards and Nonproliferation Education, Training, and Knowledge Retention – FY 2015 Snapshot on Metrics Development. ORNL/TM-2015/553, 147 pages.

Dewji, Shaheen, Jason Davis, Eric Abelquist, **Nolan Hertel**. (2015) Radiation Protection Research Needs Workshop: Summary Report. ORNL/TM-2017/460, 15 pages.

Gaudet, Rachel, **Shaheen Dewji**, Sarah Poe, Mark Carringer. (2015) Human Capital Roadmap in Safeguards and Nonproliferation Education, Training, and Knowledge Retention: Subject Matter Expert – Core Capabilities Database. ORNL/TM-2015/552, 88 pages.

Paquet F, M Bailey, **R Leggett,** J Harrison. (2015) Assessment and interpretation of internal doses: uncertainty and variability. Proceedings of the Third International Symposium on the System of Radiological Protection. Annals of the ICRP, Volume 45, Oct 2015, pp. 202-208.

Schwahn, S.O. (2015) Absorbed dose rates in tissue from prompt gamma emissions from near-thermal neutron absorption. Health Physics: The Radiation Safety Journal 109: 319-322 (Oct 2015). doi:10.1097/HP.0000000000000288

Eckerman K. (2015). 39th Lauriston S. Taylor Lecture: Dosimetry of Internal Emitters: Contribution of Radiation Protection Bodies and Radiological Events. Health Physics 110: 192-200.

Kerr G, S Egbert, I Al-Nabulsi, I Bailiff, H Beck, I Belukha, J Cockayne, H Cullings**, K Eckerman**, E Granovskaya, E Grant, M Hoshi, D Kaul, V Kryuchkov, D Mannis, M Ohtaki, K Otani, S Shinkarev, S Simon, R Young. (2015). Workshop Report on Atomic Bomb Dosimetry-Review of Dose Related Factors for the Evaluation of Exposures to Residual Radiation at Hiroshima and Nagasaki. Health Physics. 109: 582-600.

Ljungberg M, A Celler, M Konijnenberg, **K Eckerman**, Y Dewaraja, G Sjogree, (2015). MIRD pamphlet no. 26: Joint EANM/MIRD guidelines for quantitative 177Lu SPECT applied for dosimetry of radiopharmaceutical therapy. Journal of nuclear medicine: Society of Nuclear Medicine. 57. 10.2967/jnumed.115.159012.

Dickson E, D Hamby, **K Eckerman** (2015). Contaminant deposition building shielding factors for US residential structures. Journal of radiological protection: Society for Radiological Protection 35: 317-341.

Presentations, 2015-present

2020

Martinez, N. E. "Uptake and dosimetric modeling of select radionuclides in a native perennial bunchgrass." George W. Woodruff School of Mechanical Engineering Seminar, Georgia Institute of Technology, Atlanta, GA, February 27, 2020. (invited)

Martinez, N. E. "Uptake of select radionuclides in a native South Carolina grass for application in radioactive waste management." Nuclear Engineering Colloquium, University of Tennessee, Knoxville, TN, January 29, 2020. (invited)

2019

Jokisch, D. W. "A review of computational dosimetry for intakes of strontium-90." Health Physics Society Annual Meeting, Orlando, FL. July 2019.

Fulmer, P. C. and **D. W. Jokisch**. "Revision of an undergraduate health physics program for a new generation." Health Physics Society Annual Meeting, Orlando, FL. July 2019.

Jokisch, D. W. and N. E. Martinez. "Summary of age-dependent specific absorbed fraction quality assurance/control." International Commission on Radiological Protection Committee 2 Meeting, Adelaide, Australia. November 2019.

Jokisch, D. W. "Details in age-dependent dose coefficient computation." International Commission on Radiological Protection Committee 2 Meeting, Adelaide, Australia. November 2019.

Martinez, N. E. Acceptance of the Alda E. Anderson Award, Health Physics Society Annual Meeting, Orlando, FL, July 7-11, 2019.

Leggett, R. W. "Acceptance of the Robley Evans Award." Health Physics Society Annual Meeting, Orlando, FL, July 7-11, 2019.

Manglass, L., C. Vogel, P. Zuo, C. Eiman, and **N. Martinez**. "Impact of 17-α ethinylestradiol and phosphorus-32 on Arabidopsis thaliana seed development." Poster presentation, SETAC North America 40th Annual Meeting, Toronto, Canada, November 3-7, 2019.

Manglass, L., M. Wintenberg, M. Blenner, and **N. Martinez**. "Impact of iron-55 and stable iron chlorides on uptake and sorption of plutonium-239 in liquid cultures of common environmental microorganisms." SETAC North America 40th Annual Meeting, Toronto, Canada, November 7, 2019.

Martinez, N. E. and L. Van Bladel. "TG 110: Radiological Protection in Veterinary Practice." Poster presentation, 5th International Symposium on the System of Radiological Protection, Adelaide, Australia, November 17-21, 2019.

Martinez, N. E., T. Schneider, et al. "TG 114: Reasonableness and Tolerability in the System of Radiological Protection." Poster presentation, 5th International Symposium on the System of Radiological Protection, Adelaide, Australia, November 17-21, 2019.

Martinez, N. E. and L. Van Bladel. "Radiation Protection Challenges in Applications of Ionising Radiation on Animals in Veterinary Practice." 5th International Symposium on the System of Radiological Protection, Adelaide, Australia, November 20, 2019. (invited)

Sneve, M., P. Strand, N. Shandala, **N. Martinez**, K. Smith, K. Baines, and H. Monken-Fernandes. "Use of Case Studies in Progressing Guidance on the Application of Recommendations on Radiological Protection in the Existing Exposure Situations." 5th International Symposium on the System of Radiological Protection, Adelaide, Australia, November 18, 2019.

Wintenberg, M., L. Manglass, **N. Martinez**, and M. Blenner. "Transcriptional biosensors that discriminate between radiation sources." 2019 American Institute of Chemical Engineers (AIChE) Annual Meeting, Orlando, FL, November 11, 2019.

2018

Hertel, Nolan E. "Doses to Members of the Public from I-131 Patient Release." Plenary Presentation, 2018 Academic Annual Meeting of the China Radiation Protection Society Guangzhou, China.

Hertel, Nolan E. "Radiation Protection: What we know, don't know and need to know?" (HPS President-Elect Chapter tour) Hoosier Chapter of the Health Physics Society, Indianapolis, IN, January 25, 2018.

Hertel, Nolan E. "Radiation Protection: What we know, don't know and need to know?" (HPS President-Elect Chapter tour) Atlanta Chapter of the Health Physics Society, Atlanta, GA, February 1, 2018.

Hertel, Nolan E. "Doses to Members of the Public from I-131 Patient Release." (HPS President-Elect Chapter tour) Savannah River Chapter of the Health Physics Society, Aiken, SC, February 15, 2018.

Hertel, Nolan E. "Radiation Protection: What we know, don't know and need to know?" (HPS President-Elect Chapter tour) Arkansas Chapter of the Health Physics Society, Little Rock, AK, February 22, 2018.

Hertel, Nolan E. *"*Doses to Members of the Public from I-131 Patient Release." (HPS President-Elect Chapter tour) Deep South Chapter of the Health Physics Society, Baton Rouge, LA, February 23, 2018.

Hertel, Nolan E. "Radiation Protection: What we know, don't know and need to know?" North Carolina State University Student Section of the American Nuclear Society, Raleigh, NC, March 1, 2018.

Hertel, Nolan E. "Radiation Protection: What we know, don't know and need to know?" (HPS President-Elect Chapter tour) Midwest Chapter of the Health Physics Society, Westmont, IL, March 6, 2018.

Hertel, Nolan E. "Doses to Members of the Public from I-131 Patient Release." (HPS President-Elect Chapter tour) Northern California Chapter of the Health Physics Society, Oakland, CA, March 15, 2018.

Hertel, Nolan E. "Doses to Members of the Public from I-131 Patient Release." (HPS President-Elect Chapter tour) Western New York Chapter of the Health Physics Society, Rochester, NY, March 22, 2018.

Hertel, Nolan E. "Doses to Members of the Public from I-131 Patient Release." (HPS President-Elect Chapter tour) Northeast New York Chapter of the Health Physics Society, Albany, NY, March 23, 2018.

Hertel, Nolan E. "Doses to Members of the Public from I-131 Patient Release." (HPS President-Elect Chapter tour) Alabama Chapter of the Health Physics Society, Huntsville, AL, March 31, 2018.

Hertel, Nolan E. "Radiation Protection: What we know, don't know and need to know?" (HPS President-Elect Chapter tour) 50th Anniversary of the Florida Chapter of the Health Physics Society, Tallahassee, FL, April 6, 2018.

Hertel, Nolan E. "Radiation Protection: What we know, don't know and need to know?" (HPS President-Elect Chapter tour) Central Rocky Mountain Chapter of the Health Physics Society, Boulder, CO, April 19, 2018.

Schwahn, S.O. "Planning and Execution of Radiological Work for Spallation Neutron Source Inner Reflector Plug Changeout." East Tennessee Chapter Health Physics Society, April 2018; Health Physics Society 63rd Annual Meeting, Cleveland, 2018.

Hertel, Nolan E. "Radiation Protection: What we know, don't know and need to know?" (HPS President-Elect Chapter tour) Joint Meeting of the Eastern Idaho Chapter and the Salt Lake City Chapter of the Health Physics Society, Pocatello, ID, April 21, 2018.

Hertel, Nolan E. "Doses to Members of the Public from I-131 Patient Release." (HPS President-Elect Chapter tour) Virginia Chapter of the Health Physics Society, Charlottesville, VA, April 27, 2018.

Hertel, Nolan E. "Radiation Protection: What we know, don't know and need to know?" (HPS President-Elect Chapter tour) Cascade Chapter of the Health Physics Society E Dale Trout Symposium, Portland, OR, May 4, 2018.

Hertel, Nolan E. "Doses to Members of the Public from I-131 Patient Release." (HPS President-Elect Chapter tour) Delaware Valley Chapter of the Health Physics Society, Morgantown, PA, May 18, 2018.

Dewji, Shaheen, Kathryn Bales, Keith Griffin, Choonsik Lee, **Mauritius Hiller.** "Comparison of Monoenergetic Photon Organ Dose Rate Coefficients for Male and Female Pediatric Stylized and Voxel Phantoms Submerged in Air." 63rd Annual Meeting of the Health Physics Society, Cleveland, OH, July 2018.

Smith, Jonas, **D. W. Jokisch**, **R. W. Leggett**, and **M. Bellamy**. "Designing tools to display and edit large specific absorbed fraction files." ORNL Student Symposium, Oak Ridge, TN. August 9, 2018.

Hertel, N. "Radiation Protection: What We Know, What We Don't Know and What We Need to Know." American Nuclear Society, 20th Topical Meeting of the Radiation Protection and Shielding Division Topical Meeting, Plenary Session, August 2018.

Hertel, N., P. Bergstrom, M. M. Mille, and E. Dickson. "Recent Updates of ANS/ANSI 6.1.1: Neutron and Gamma-Ray Flux-to-Dose-Rate Factors." Special Session: ANS Standards Related to RPSD Applications: What are they and How DO They Impact You?, American Nuclear Society, 20th Topical Meeting of the Radiation Protection and Shielding Division Topical Meeting, Santa Fe, NM, August 2018. (invited)

Smith, Jonas, **D. W. Jokisch, R. W. Leggett**, and **M. Bellamy**. "Designing tools to display and edit large specific absorbed fraction files." North Carolina Chapter of Health Physics Society, Greensboro, NC., October 5, 2018.

Jokisch, D. W. "Recent work in developing ICRP dose coefficients for intake of radionuclides." North Carolina Chapter of Health Physics Society, Greensboro, NC., October 5, 2018.

Hertel, Nolan E. "Doses to Members of the Public from I-131 Patient Release." Chinese Institute for Radiation Protection, Taiyuan, China, November 19, 2018.

2017

Dewji, S., M. Hiller, N. Hertel. "Comparison of Neutron Organ Doses for PIMAL Stylized Phantom in Upright and Bent Positions for Standard Irradiation Geometries." Neutron and Ion Dosimetry Symposium NEUDOS-13, Krakow, Poland, May 13-17, 2017.

Dewji, Shaheen, Kenneth Veinot, Mauritius Hiller, Keith Eckerman, Clay Easterly. "Enhanced Monte Carlo Simulation of the Voxel Phantom Lattice Submersed in a Contaminated Air Environment." 2017 ANS Annual Meeting, San Francisco, CA, June 2017.

Dewji, Shaheen, Mullin Green, Eli Sanchez. "Organ and Effective Photon Dose Coefficients for Reference Phantoms in Articulated Positions in Cranial and Caudal Irradiation Geometries." Health Physics Society 62nd Annual Meeting, Raleigh, NC, July 2017.

Dewji, Shaheen, Kristina Reed, **Mauritius Hiller**. "Computation of Photon Effective Dose Coefficients for PIMAL Stylized Phantoms in Upright and Bent Positions in Standard Irradiation Geometries." Health Physics Society 62nd Annual Meeting, Raleigh, NC, July 2017.

Dewji, Shaheen, Kathryn Bales, **Mauritius Hiller**. "Computation of Neutron Dose Coefficients for PIMAL Stylized Phantoms in Upright and Bent Positions in Standard Irradiation Geometries." Health Physics Society 62nd Annual Meeting, Raleigh, NC, July 2017.

Dewji, Shaheen, Eli Sanchez. "Correlation of TLD Placement and Organ Dose for Adult Reference Phantoms in Articulated Positions." Health Physics Society 62nd Annual Meeting, Raleigh, NC, July 2017.

Dewji, Shaheen, Eli Sanchez, Kristina Reed, Kathryn Bales, Mullin Green, Tanya Oxenberg, Vered Shaffer. "Validation of PIMAL 3.0 – Phantom with Moving Arms and Legs." 6th International Workshop on Computational Human Phantoms, Annapolis, MD, August 2017.

Dewji, Shaheen, Michael Bellamy, K. Veinot, Mauritius Hiller, Keith Eckerman, Clay Easterly, Nolan Hertel. "External Dose Coefficients for Age-Dependent Exposures to Radionuclides in Soil, Air, and Water." 2nd European Radiological Protection Week, Paris, France, October 2017.

Dewji, Shaheen, Eli Sanchez, Kathryn Bales, Kristina Reed, Mullin Green. "Computation of Organ and Effective Dose Coefficients for Adult Reference Phantoms in Articulated Positions." 2nd European Radiological Protection Week, Paris, France, October 2017.

Dewji, Shaheen, Nolan Hertel. "Radiation Protection Strategic Research Needs in the United States." 2nd European Radiological Protection Week, Paris, France, October 2017.

Griffin, Keith, **Michael Bellamy, Shaheen Dewji**. "Validation of PIMAL 3.0 - Phantom with Moving Arms and Legs." 6th International Workshop on Computational Human Phantoms, Annapolis, MD, August 2017.

Hertel, Nolan E., Kenneth G. Veinot, and Keith Eckerman. "Neutron Dosimeters and the Angular Dependence of Effective Dose." Neutron and Ion Dosimetry Symposium NEUDOS-13, Krakow, Poland, May 13-17, 2017.

Hertel, N. E., E. Abelquist, **S. Dewji,** and J. Davis. "Review of a Radiation Protection Needs Workshop." Opening Plenary Session, Health Physics Society Annual Meeting, July 2017.

Hertel, N.E., K. F. Eckerman, S. Dewji, and M. Hiller. "Radiological Toolbox 3.0.0." Health Physics Society Midyear Symposium, 2017.

Hertel, Nolan E. "Radiation Protection: What we know, don't know and need to know?" (HPS President-Elect Chapter tour) Rio Grande Chapter of the Health Physics Society, Albuquerque, NM, September 12, 2017.

Hertel, Nolan E. "Iodine-131 Patient Dose to Members of the Public," University of New Mexico, Albuquerque, NM, September 13, 2017.

Hertel, Nolan E. "Radiation Protection: What we know, don't know and need to know?" (HPS President-Elect Chapter tour) New England Chapter of the Health Physics Society, Sturbridge, MA, September 26, 2017.

Hertel, Nolan E. "Doses to Members of the Public from I-131 Patient Release." (HPS President-Elect Chapter tour), Joint meeting of the New Jersey and Greater New York Chapters of the Health Physics Society, New York, NY, October 10, 2017.

Hertel, Nolan E. "Radiation Protection: What we know, don't know and need to know?" (HPS President-Elect Chapter tour) Northeast Ohio Chapter of the Health Physics Society, Cleveland, OH, October 18, 2017.

Hertel, Nolan E. "Radiation Protection: What we know, don't know and need to know?" (HPS President-Elect Chapter tour) Columbia Chapter of the Health Physics Society, Kennewick, WA, October 19, 2017.

Hertel, Nolan E. "Doses to Members of the Public from I-131 Patient Release." (HPS President-Elect Chapter tour) North Central Chapter of the Health Physics Society, ST. Paul. MN, October 20, 2017.

Hertel, Nolan E. "Radiation Protection: What we know, don't know and need to know?" (HPS President-Elect Chapter tour) East Tennessee Chapter of the Health Physics Society, Oak Ridge, TN, November 2, 2017.

Hertel, Nolan E. "Radiation Protection: What we know, don't know and need to know?" (HPS President-Elect Chapter tour), Cincinnati Radiation Society, Cincinnati, OH, November 8, 2017.

Hertel, Nolan E. "Radiation Protection: What we know, don't know and need to know?" (HPS President-Elect Chapter tour) Baltimore-Washington Chapter of the Health Physics Society, Bethesda, MD, November 14, 2017.

Jokisch, D. W. "Recommendations on skeletal dosimetry – March 2017." Urals Research Center for Radiation Medicine, Chelyabinsk, Russia. March 2017.

Jokisch, D. W. and W. E. Bolch. "Recent ICRP recommendations on internal dosimetry." Spring 2017 meeting of the North Carolina Chapter of the Health Physics Society, Carolina Beach, NC, March 2, 2017.

Jokisch, D. W. "Techa river population skeletal dosimetry." US Scientific Review Group Meeting for US DOE Russian Health Studies program, Herndon, VA. May 25, 2017.

Jokisch, D. W. "Update on age-dependent specific absorbed fraction (and masses) development." International Commission on Radiological Protection, Committee 2 Meeting, Paris, France. October 2017.

Jokisch, D. W. "Update on age-dependent specific absorbed fraction (and masses) development." International Commission on Radiological Protection, Task Group 96 Meeting, Hiroshima, Japan. November 2017.

Samuels, C. E., N. E. Hertel, and A. J. Ansari, "Screening Criteria for External Contamination in a Radiation Emergency," Health Physics Society Annual Meeting, 2017.

2016

Bellamy, Michael, Shaheen Dewji, Guruprasad Kora**, Mauritius Hiller, Nolan Hertel, Keith Eckerman**, Sami Sherbini, and Mohammad Saba. "Enhancements to the Phantom with Moving Arms and Legs Software (PIMAL 4.0)." Midyear Meeting of the Health Physics Society, Austin, Texas, January 31-February 3, 2016.

Bellamy, M. B., M. M. Hiller, S. A. Dewji, K. G. Veinot, R. W. Leggett, K. F. Eckerman, C. E. Easterly, N. E. Hertel. "Comparison Of Monoenergetic Photon Organ Dose Rate Coefficients For Stylized And Voxel Phantoms Submerged In Air." Midyear Meeting of the Health Physics Society, Austin, Texas, January 31-February 3, 2016.

Bellamy, M. B., K. Veinot, K. F. Eckerman, S. A. Dewji, M. Hiller, C. E. Easterly, N. E. Hertel, R. W. Leggett. "Comparison of Federal Guidance Reports 12 and 15: External Exposure to Radionuclides in Soil, Air, and Water." IRPA14: 14th International Congress of the International Radiation Protection Association, Capetown, South Africa, May 9-13, 2016.

Dewji, Shaheen, Mauritius Hiller, Nolan Hertel, Sami Sherbini, and Mohammad Saba. "PIMAL: A GUI-Driven Software Package To Conduct Radiation Dose Assessments Using Realistic Phantom Postures." IRPA14: 14th International Congress of the International Radiation Protection Association, Capetown, South Africa, May 9-13, 2016.

Dewji, Shaheen, Kristina Reed, **Mauritius Hiller.** "Comparison of Organ Doses for PIMAL Stylized Phantoms in Upright and Bent Positions for Standard Irradiation Geometries." Radiation Protection Week 2016, Oxford, England, September 2016.

Gaudet, Rachel, **Shaheen Dewji**, Sarah Poe, Melissa Scholz, Kathryn Glynn, Wayne Mei. "Next Generation Safeguards Initiative Human Capital Development Roadmap: Assessing Temporal Trends in Nuclear Safeguards Core Capabilities." 57th Annual Institute of Nuclear Materials Management, Atlanta, GA, July 2016.

Hertel, N. E. and D. Bartlett. "Revisions to ICRU Operational Quantities, ICRP Symposium on Radiological Protection Dosimetry: Historical Review and Current Activities." The University of Tokyo, Japan, February 18, 2016.

Hertel, Nolan E. "Developing a Radiation Protection Hub." 2016 National Council on Radiation Protection and Measurements Annual Meeting: Meeting the Needs of the Nation for Radiation Protection, Bethesda, MD, April 11-12, 2016.

Hertel, Nolan E. "The Role of the Scientific Review Group in the Russian Health Studies Programs: Key Contributions and Influence and Impact on Radiation Protection." IRPA14: 14th International Congress of the International Radiation Protection Association, Capetown, South Africa, May 9-13, 2016.

Hertel, Nolan E. "Center for Radiation Protection Knowledge: Mission and Ongoing Activities." Pacific Northwest National Laboratory, July 22, 2016.

Hiller, M., K. G. Veinot, K. F. Eckerman, and N.E. Hertel. "Cranial and Caudal Dose Coefficients for Photons and Neutrons Up to 10 GeV." Radiation Protection Week, Oxford, England, September 19-23, 2016.

Hiller, M., M. Bellamy, K. Eckerman, T. Miller, and N. Hertel. "Reduced Variance using ADVANTAG in Monte Carlo Calculations of Dose Coefficients to Stylized- and Voxel Phantoms." 13th International Conference on Radiation Shielding, Paris, France, October 3-6, 2016.

Jokisch, D. W. "Methods of dose assessment to the skeletal tissues." ICRP Symposium on Radiological Protection Dosimetry, University of Tokyo, Japan, February 18, 2016.

Jokisch, D. W. "Future challenges for undergraduate health physics programs." Annual Meeting of the Health Physics Society, Spokane, WA. July 19, 2016.

Jokisch, D. W. "A summary review of skeletal dosimetry." Fall 2016 meeting of the U.S. Scientific Review Group, Department of Energy Russian Health Studies Program, Seattle, WA, November 10, 2016.

Leggett, Rich. "Basis for the ICRP's Reference Values for the Blood Content of Tissues." 2016 meeting of Committee 2 of the ICRP, Oxford, England, September 22-25, 2016.

Petoussi-Henss, N., **M. Bellamy**, W. Bolch, **K. Eckerman**, A. Endo, **N. Hertel**, J. Hunt, J. Jansen, C. H. Kim, C. Lee, D. Satoh, K. Saito, H. Schlattl, Y. S. Yeom, S. J. Yoo, and J. Harrison. "ICRP activities on Dose Coefficients for Members of the Public from External Exposures to Environmental Sources." Radiation Protection Week, Oxford, England, September 19-23, 2016.

Veinot, Ken, Shaheen Dewji, Michael Bellamy, Keith Eckerman, Nolan Hertel, and Mauritius Hiller. "Room Submersion Calculations of Noble Gas Dose Rate Coefficients." IRPA14: 14th International Congress of the International Radiation Protection Association, Capetown, South Africa, May 9-13, 2016.

Veinot, K. G., K. F. Eckerman, M. Hiller, T. Miller and N. E. Hertel. "Organ and Effective Dose Coefficients for Cranial and Caudal Irradiation Geometries: Neutrons." 13th International Conference on Radiation Shielding, Paris, France, October 3-6, 2016.

Schwahn, S.O. "Advance determination of respiratory protection needs when performing destructive work on structural materials." 14th International Congress of the International Radiation Protection Association (IRPA), Capetown, 2016.

2015

Bellamy, M., K. Eckerman, C. Easterly, R. Leggett, D. Steward, and N. Hertel. "Dose Rate Coefficients for Exposure to Ground Contamination." Health Physics Society 48th Midyear Meeting, Norfolk, VA, February 1-4, 2015.

Bellamy, M., K. Eckerman, C. Easterly, R. Leggett, D. Steward, and N. Hertel. "Updated External Dose Coefficients for Air Submersion and Water Immersion." Health Physics Society 48th Midyear Meeting, Norfolk, VA, February 1-4, 2015.

Dewji, S. and N. Hertel. "Critical Issues in Knowledge Management in Domestic Radiation Protection Research Capabilities." 60th Annual Meeting of the Health Physics Society, Indianapolis, Indiana, 12-16 July 2015, Health Physics 109S, S131-132 (2015).

Eckerman, K. F., M. B. Bellamy, R. P. Manger, C. E. Easterly, R. W. Leggett, J. C. Ryman, D. J. Stewart, N. E. Hertel. "FGR15 External Exposure To Radionuclides in Soil, Air, and Water: Methods and Status." Baltimore-Washington Chapter of the Health Physics Society Annual Workshop, Rockville, MD, May 8, 2015.

Finklea, L., **N. Hertel**, F. Dolislager, and **M. Bellamy**. "Room Dose Ratios in Comparison to FGR12 Dose Coefficients." 60th Annual Meeting of the Health Physics Society, Indianapolis, Indiana, 12-16 July 2015, Health Physics 109S, S4 (2015).

Hertel, N. E., D. T. Bartlett, G. Dietze, J-M. Bordy, A. Endo, G. Gualdrini, M. Pelliccioni, P. Ambrosi, B.R.L Siebert, **K. Veinot**, P. Ferrari, T. Otto, R. Behrens, Jean-Francois Bottollier. "ICRU Committee Proposal on Operational Quantities for External Radiation Exposure." IM2015: International Conference on Individual Monitoring of Ionising Radiation, Bruges, Belgium, April 20-24, 2015.

Hertel, Nolan E. "Is the Time Right for a Radiation Protection Research and Educational Hub?" 60th Annual Meeting of the Health Physics Society, Indianapolis, Indiana, 12-16 July 2015, Health Physics 109S, S117-118 (2015).

Hertel, Nolan E. "How Many Phantom Do We Need for Radiation Protection?" 60th Annual Meeting of the Health Physics Society, Indianapolis, Indiana, 12-16 July 2015, Health Physics 109S, S56 (2015).

Hertel, Nolan E. "Estimated External Doses to Members of the Public from Patients with ^{131}I Treatment." Georgia Tech NRE Seminar, March 26, 2015.

Hertel, Nolan E. "Oak Ridge Update: Center for Radiation Protection Knowledge Activities." Interagency Steering Committee on Radiation Standards, May 27, 2015.

Hertel, Nolan E. "Center for Radiation Protection Knowledge: Mission and Ongoing Activities." Oak Ridge National Laboratory, Reactor and Nuclear Systems Division Seminar, October 28, 2015.

Jokisch, D. W., and R. W. Leggett. "A comparison of two methods for handling the biological distribution of radionuclides in decay chains." Annual Meeting of the Health Physics Society, Indianapolis, IN, July 14, 2015.

Leggett, R. W., "Progress on Environmental Exposure to Radionuclides." 2015 meeting of Committee 2 of the ICRP, Seoul, Korea, October 19-25, 2015.

Leggett, Rich. "Biokinetics of systemic lanthanides and actinides." 2015 meeting of Committee 2 of the ICRP, Seoul, Korea, October 19-25, 2015.

Veinot, K. G., K. F. Eckerman, and N. E. Hertel. "Photon and Neutron Organ and Effective Dose Coefficients for Cranial and Caudal Irradiation Geometries." 60th Annual Meeting of the Health Physics Society, Indianapolis, Indiana, 12-16 July 2015, Health Physics 109S, S89 (2015).

Walford, Graham, **Shaheen Dewji**, Franklin Dubose, Dave Roberts, Andrew Nicholson, Stephen Croft, Sean Branney, Gregory Peacock, Jeffrey Chapman. "Quality Improvements in Calibration and Use of Portable Holdup Detectors for Uranium and Plutonium Fissile Deposits." INMM 56th Annual Meeting, Indian Wells, CA, July 2015.