cornerstone
A TETRA TECH COMPANY

Building lifetime relationships with our clients and employees.

Comprehensive Compliance Plan

Blue Ridge Landfill

Activity ID: ENV20160001

March 17, 2016



Prepared for:
Blue Ridge Landfill
2700 Winchester Road
Irvine, KY 40336

2456 Fortune Drive, Suite 170
Lexington, KY 40509
(877) 663-5520

cornerstone
environmental

2456 Fortune Drive, Suite 170, Lexington, KY 40509
T 877.633.5520 | W www.cornerstoneeg.com

March 18, 2016

Mr. Richard Thomas
Environmental Control Supervisor
Department of Waste Management
200 Fair Oak Ln 3rd Floor, Frankfort KY 40601

Re: Notice of Violation
Response to Alleged Violation No. 2
Advanced Disposal Services Blue Ridge Landfill, LLC

Dear Mr. Thomas:

Because the March 9, 2016 Notice of Violation requires a seven-day turnaround on the response to Alleged Violation No. 2, Advanced Disposal Services Blue Ridge Landfill, LLC. (BRLF) is providing the following response to that alleged violation now. We plan to respond to the other alleged violations within ten days.

Response to Alleged Violation No. 2

Alleged Violation No. 2. Violation Description for Subject Item ACTV0000000007SW: Contained Landfill (Contained Landfill):

Any person possessing or controlling a hazardous substance, pollutant, or contaminant which is released to the environment, or any person who caused a release to the environment of a hazardous substance, pollutant, or contaminant, shall characterize the extent of the release as necessary to determine the effect of the release on the environment, and shall take actions necessary to correct the effect of the release on the environment. Any person required to take action under this subsection shall have the following options:

(a) Demonstrating that no action is necessary to protect human health, safety, and the environment;

(b) Managing the release in a manner that controls and minimizes the harmful effects of the release and protects human health, safety, and the environment, provided that the

management may include any existing or proposed engineering or institutional controls and the maintenance of those controls;
(c) Restoring the environment through the removal of the hazardous substance, pollutant, or contaminant; or
(d) Any combination of paragraphs (a) to (c) of this subsection. [KRS 224.1-400(18)]

Description of Non Compliance:
Blue Ridge Landfill failed to comply with provisions of KRS 224.1-400 (18) by failing to characterize a release/potential release of NORM/TENORM to the environment. The landfill shall not disturb the area except to characterize it pursuant to 401 KAR 100:030.

The required remedial measure(s), and date(s) to be completed by, are as follows:
Blue Ridge Landfill shall comply with all provisions of the attached Radiation Survey and Site Investigation guidance provided by the Cabinet for Family and Health Services. A comprehensive compliance plan shall be submitted to Jeff Cummins, Director, KY Department of Environmental Protection Enforcement Branch, within seven working days of the receipt of this Notice of Violation.

BLRF Response:

As of the date of this response, Advanced Disposal is in possession of no specific data, received from the transporter, generator, or the State of Kentucky, that TENORM waste was disposed of at the Blue Ridge Landfill. Advanced is awaiting responses to its open records request to the Cabinet of Health and Family Services and its information requests to Fairmont Brine and BES, Inc., for specific analytical information on the material allegedly disposed of at the Landfill.

Advanced Disposal is committed to fully cooperating with the Department in the investigation of this matter. Advanced Disposal has retained a State of Kentucky-approved radiological specialist, Chase Environmental, to develop a Radiation Survey and Site Investigation Plan. As the Department is aware, Chase has already performed the Gamma Surface Scan of the estimated area filled and the background areas. Chase has also collected surface samples. Nevertheless, it is premature to proceed with implementation of the remaining phases of the Radiation Survey and Site Investigation without detailed information of the material actually disposed of at the landfill. The absence of this crucial information currently prevents our technical team from developing the specific approach to identify this material within the waste mass. We emphasize that the waste in question was certified by the Generator as *"O&E Exploration and Production Waste Solids and Debris."* The Waste was generated from *"Oil and Gas Production and Exploration Soil and Filter Socks."* The Waste was certified as *"not containing Radioactive waste as defined by State of Federal regulations."* Clearly, not all Exploration and Production waste is radioactive.

As another pro-active measure, Advanced has retained Risk Assessment Corporation to prepare a Dose Assessment Plan that will be implemented once we all learn more about the characteristics of the material disposed of at the landfill. Both of these plans are in draft form and we expect them to be modified if and when it is confirmed that TENORM waste was disposed of at the landfill. We look forward to receiving your comments on the plans.

We look forward to discussing this matter with the Department on March 22, 2016.

Sincerely,
Cornerstone Environmental Group, LLC

James R. Wade, P.E.
Client Manager

Enclosures: RSSI Plan – Chase Environmental Group, Inc.
Dose Assessment – Risk Assessment Corporation

cc: David M. Rettell, P.E. – Advanced Disposal Services
Charles Laws – Advanced Disposal Services
Philip Comella – Seyfarth Shaw
Wallace C. Taylor – Estill County Judge Executive
Jeff Cummins, Director – Division of Enforcement

Blue Ridge Landfill
Radiation Survey and Site Investigation Plan

Advanced Disposal Services
Blue Ridge Landfill
2700 Winchester Road
Irvine, KY 40336

March 18, 2016

Prepared by:
Chase Environmental Group, Inc.
109 Flint Road
Oak Ridge, TN 37830

TABLE OF CONTENTS

1.0 INTRODUCTION 1
2.0 FACILITY DESCRIPTION 1
3.0 RADIATION DOSE CRITERIA 2
4.0 PROJECT MANAGEMENT AND ORGANIZATION 2
4.1 Chase's Corporate Radiation Safety Officer (CRSO) 2
4.2 Director, Radiological Services (DRS) 3
4.3 Field Services Manager (FSM) 3
4.4 Project Manager (PM) 3
4.5 Radiation Control Supervisor (RCS) 4
4.6 Radiation Control Technicians (RCTs) 4
4.7 Radiation Workers (RWs) 5
4.8 Chase Corporate Project Support 5
5.0 PROJECT TASK MANAGEMENT 5
5.1 Radiation Work Permits (RWP) 5
5.2 Survey Packages 6
6.0 PROJECT TRAINING REQUIREMENTS 7
6.1 Radiological Training 7
6.2 Project Specific Training 7
6.3 General Safety Briefings 7
6.4 Transportation Training 7
7.0 RADIATION PROTECTION PROGRAM 8
7.1 Exposure Control 8
7.1.1 Engineering Controls 8
7.1.2 Administrative Controls 8
7.1.3 Source Control 9
7.1.4 Personal Protective Equipment 9
7.2 Notifications 9
7.3 Dosimetry 9
7.4 Air Sampling Program 9
7.4.1 Breathing Zone Air Samples 10
7.4.2 General Area Air Samples 10
7.4.3 High Volume Air Samples 10
7.4.4 Effluent Monitoring Air Samples 10
8.0 OCCUPATIONAL HEALTH AND SAFETY PROGRAM 11
9.0 RADIOACTIVE WASTE MANAGEMENT PROGRAM 11
10.0 QUALITY ASSURANCE PROJECT PLAN 11
10.1 Quality Assurance Policy 11
10.2 Quality Assurance Goals 12
10.3 Chase Project Management Policy 12
10.4 Project Organization 12
10.5 Training Requirements 13
10.6 Quality Objectives and Criteria for Data Measurement 13
10.6.1 Radiological Criteria 13
10.6.2 Data Quality Objectives (DQO) 13
10.6.3 Sample Handling and Custody 13
10.6.4 Analytical Methods 14
10.6.5 Data Collection 14
10.7 Instrument/Equipment Testing, Inspection, and Maintenance Requirements 14
10.7.1 Instrument Functional Checks 14

10.7.2 Instrument Calibration and Frequency 15
10.7.3 Determination of Counting Times and Minimum Detectable Concentrations 15
10.8 Reports to Management 15
10.9 Document Control and Quality Assurance Records 15
10.10 Nonconformance Control and Corrective Action 16
10.11 Quality Assurance Audits 16
10.12 Data Quality Assessment (DQA) 16
10.13 Data Verification 17
10.14 External Laboratory Data Validation 17
10.15 Data Review 17
11.0 DATA COLLECTION GOALS 19
12.0 SURVEY ACTIVITIES 19
12.1 Gamma Scans 19
12.2 Exposure Rate Measurements ..... **Error! Bookmark not defined.**
12.3 Subsurface Soil Sampling ..... **Error! Bookmark not defined.**
12.4 Water Sampling ..... **Error! Bookmark not defined.**
12.5 Air Sampling ..... **Error! Bookmark not defined.**
12.6 Background Determination ..... **Error! Bookmark not defined.**
13.0 IN-PROCESS SURVEYS 20
14.0 SURVEY INSTRUMENTATION 20
14.1 Datalogging 21
14.2 Determination of Counting Times and Minimum Detectable Concentrations 21
14.2.1 Static Counting 22
14.2.2 Ratemeter Scanning 22
14.2.3 Smear Counting 23
15.0 DOSE ASSESSMENT 23
16.0 REPORT 23

TABLES

Table 14-1: Instrumentation 20

APPENDICES

APPENDIX A – Site Map
APPENDIX B – Chase Radioactive Materials License

ACRONYMS

ALARA	As Low As Reasonably Achievable
CFR	Code of Federal Regulations
COC	Chain of Custody
CRSO	Chase Corporate Radiation Safety Officer
DAC	Derived Air Concentration
DOT	US Department of Transportation
DRS	Director of Radiological Services
DQA	Data Quality Assessment
DQO	Data Quality Objective
FSM	Field Services Manager
GPS	Global Positioning System
HEPA	High Efficiency Particulate Air
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	Minimum Detectable Concentration
NORM	Naturally Occurring Radioactive Material
NRC	U.S. Nuclear Regulatory Commission
NIST	National Institute of Standards and Technology
PM	Project Manager
PPE	Personal Protective Equipment
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QM	Quality Manager
RCS	Radiation Control Supervisor
RCT	Radiation Control Technician
RPP	Radiation Protection Program
RSM	Radiation Safety Manual
RSO	Radiation Safety Officer
RSSI	Radiation Survey and Site Investigation
RW	Radiation Worker
RWP	Radiation Work Permit
TEDE	Total Effective Dose Equivalent
TENORM	Technically Enhanced Naturally Occurring Radioactive Material
TLD	Thermoluminescent Dosimeter

1.0 INTRODUCTION

Advanced Disposal Services (Advanced) is conducting a Radiation Survey and Site Investigation (RSSI) at their Blue Ridge Landfill located in Irvine, KY. The focus of the survey will be an area which coincides with where specific shipments of alleged Technically Enhanced Naturally Occurring Radioactive Material (TENORM) were buried in this municipal landfill. A map of the site is provided in Appendix A.

Advanced has procured Chase Environmental Group, Inc. (Chase) to develop and implement this RSSI. Project activities will be conducted under the Chase Commonwealth of Kentucky Radioactive Materials License 201-605-15 (see Appendix B) and in accordance with this Plan. On-site survey activities are expected to be conducted as an iterative process over several mobilizations.

The goals of the RSSI include determining the lateral and vertical extent of any TENORM materials that may have been placed on site, determine the nuclides of concern, and collect information necessary to conduct a comprehensive dose assessment. The dose assessment will be conducted by Risk Assessment Corporation.

After completion of this RSSI, Advanced will submit a report of project activities, the results of all radiological measurements, and the dose assessment.

2.0 FACILITY DESCRIPTION

The Blue Ridge Landfill, located in Irvine, KY at 2700 Winchester Road, is a Municipal Waste Landfill operated by Advanced Disposal Services.

The facility opened in 1984 and is permitted by the Kentucky Department of Environmental Protection and has no volume limit by permit. The facility currently accepts 550 tons of waste per day on average including Municipal Solid Waste, Construction and Demolition Debris, Municipal and Industrial Sewage Sludges, Special Wastes, Contaminated Soils, and residual wastes.

The facility is included in several Solid Waste Plans and has contracts with Municipal, Industrial, and Residual waste generators in KY and surrounding states. Blue Ridge is permitted to accept waste from all counties in Kentucky as well as Indiana, Illinois, Pennsylvania, Georgia, North Carolina, Virginia, West Virginia, Michigan, Ohio, Tennessee, South Carolina, and accepts waste from Advanced Disposal subsidiaries and third party companies.

3.0 RADIATION DOSE CRITERIA

Radiation dose criteria are contained in 902 KAR 100:022, Licensing requirements for land disposal of radioactive waste. Section 18, Protection of the General Population from Releases of Radioactivity, specifies dose criteria for members of the public from land disposal of radioactive wastes: *"A concentration of radioactive material that may be released to the general environment in groundwater, surface water, air, soil, plants, or animals shall not result in an annual dose exceeding an equivalent of twenty-five (25) millirems to the whole body, seventy-five (75) millirems to the thyroid, and twenty-five (25) millirems to any other organ of a member of the public. Reasonable effort shall be made to maintain releases of radioactivity in effluents to the general environment as low as it is reasonably achievable."*

4.0 PROJECT MANAGEMENT AND ORGANIZATION

4.1 Chase's Corporate Radiation Safety Officer (CRSO)

The CRSO is responsible for the management of the radiation protection program and for directing the program to limit occupational radiation exposures to levels that are ALARA. The CRSO is also responsible for the development and implementation of a program for monitoring project activities and conditions to determine their status of compliance with the radioactive materials license and relevant regulations. The CRSO reporting chain is separate from the project and site management reporting chain. In this independent role, the CRSO provides a mechanism by which any worker can report potentially unsafe conditions or safety concerns. The CRSO will promptly assess and resolve any reported concerns. The CRSO will have access to all levels of operational management as necessary for execution of the CRSO duties. The CRSO has the authority to immediately terminate any activity that is found to be an imminent threat to health, safety, or property, or that is likely to violate the license conditions or radiation safety program requirements, and this authority cannot be revoked. Specific duties of the CRSO include, but are not limited to, the following:

- Establishing company policy to comply with state and federal statutes, rules, regulations, and license conditions regarding occupational safety and health
- Providing selection criteria for equipment, supplies, and services for radiological work and personnel exposure monitoring
- Establishing standards for personnel protection to assure that exposures to ionizing radiation and radioactive contamination are ALARA
- Implementing the radiological control and safety audit program
- Ensuring the quality of protective equipment for personnel and prescribing usage standards

- Establishing procedures for radiological protection and monitoring, including the ALARA program

Chris Echterling is the CRSO and can be reached at 865-603-2618.

4.2 Director, Radiological Services (DRS)

The DRS reports to the Chase Board of Directors and is responsible for providing corporate and technical support to field projects including health physics, occupational safety, legal and/or administrative support. The DRS may choose to provide these support capabilities through permanent staffing or by subcontracting through outside organizations.

The DRS is also responsible to ensure projects are completed under the direction of Project Managers in full compliance with the requirements of all applicable licenses, permits, and regulations.

John O'Neil is the DRS and can be reached at 865-384-7555.

4.3 Field Services Manager (FSM)

The FSM directs all aspects of operations including radiological activities. The FSM establishes policies and procedures to assure regulatory compliance and oversees all aspects of health physics operations to ensure regulatory compliance and adherence to the ALARA principle. As the alternate Radiation Safety Officer, the FSM will act as RSO in the absence of the RSO named on the license.

The FSM is responsible for assigning PMs to individual projects and for providing technical support to projects. Technical support encompasses health physics, occupational safety, and /or administrative support. The FSM reports to the DRS.

Dave Culp is the FSM and can be reached at 865-207-3664.

4.4 Project Manager (PM)

The Project Manager is responsible for project operations from initiation through completion. The PM's duties include the following:

- Maintaining compliance with conditions of site operating licenses, permits, rules, and regulations
- Maintaining working conditions which assure health, safety, and protection for all employees and visitors
- Providing physical examinations for employees as required by company policy, local, state, and federal regulations

- Ensuring that employees are instructed regularly, or as required by law, on precautions, procedures, and practices to be followed to minimize exposure to radioactive materials and to conduct operations safely
- Notifying the CRSO, applicable State agency or the NRC, promptly, of any operation or condition which appears to present a radiological hazard to employees, the public, or the environment
- Furnishing proper personnel protective equipment, ensuring that employees are instructed in its proper use, and enforcing rules for the equipment's utilization
- Ensuring that sufficient staffing for the project is present and consists of individuals able to conduct daily operations in compliance with regulatory requirements and to maintain a safe working environment
- Maintaining project radiation exposures ALARA.

Dave Culp is the PM and can be reached at 865-207-3664.

4.5 Radiation Control Supervisor (RCS)

RCS reports directly to the PM and is responsible for the implementation of the Radiation Protection Program (RPP) at the project. Responsibilities may include but are not limited to the following:

- Monitoring site conditions to ensure compliance with the RPP and the Chase Radioactive Materials License
- Determining appropriate personal protective equipment (PPE)
- Ensuring that the CRSO is notified of conditions or situations that present a radiological hazard, concern, or exceed limitations set forth in the RSM or applicable procedures and work plans
- Issuing and maintaining RWPs
- Maintaining records related to the RPP in an auditable condition for the duration of the project.

4.6 Radiation Control Technicians (RCTs)

RCTs report to the RCS and act as the RCS's representatives in specifically implementing the RPP. Responsibilities may include but are not limited to the following:

- Performing and documenting radiological surveys
- Maintaining, inspecting, and performing operational checks of field instrumentation
- Identifying and controlling radiation protection hazards
- Performing job coverage duties, (i.e., surveys, contamination control, air sampling, sample analysis, environmental sampling, custody control, etc.).

4.7 Radiation Workers (RWs)

Radiation Workers are responsible for performing removal/remediation activities and removing, packaging and transporting waste to the appropriate waste stream. Specific aspects of RW duties include:

- Conducting work according to RCT instructions and in compliance with all project and site radiological controls, industrial safety, industrial hygiene and quality requirements
- Possessing a working knowledge of emergency procedures, location of evacuation routes, and ability to readily contact the appropriate emergency response personnel
- Reporting all deficiencies, non-conformances, or suspected procedure violations to the RCT, RCS, or PM
- Issuing stop work orders when work practices or conditions have or may lead to unsafe conditions.

4.8 Chase Corporate Project Support

The project will be supported by corporate personnel that will provide input and oversight to project activities to ensure that operations are conducted in strict accordance with all health physics, industrial safety and health, industrial hygiene, quality assurance, human resources, accounting, and administrative requirements.

5.0 PROJECT TASK MANAGEMENT

Project activities will be conducted under the provisions of the Chase radioactive materials license and in accordance with this Plan. Activities will be conducted in accordance with written and approved procedures, radiation work permits (RWP), and/or survey packages to ensure adequate worker protection and to comply with the radioactive materials license and this Plan.

5.1 Radiation Work Permits (RWP)

RWPs will be prepared, reviewed and authorized in accordance with the RWP procedure that addresses request, initiation, development, issuance, and termination of an RWP. The RWP contains the location and description of the task to be performed, expected contamination and radiation levels, radiological monitoring requirements, Personal Protective Equipment (PPE) requirements, and special work instructions necessary to complete the work in a safe and compliant manner.

RWP development will include specific identification of the radiological conditions and radiological protection requirements (e.g. clothing, respiratory protection, dosimetry, monitoring, training). Also, hold points and special

instruction may be described on the RWP. The RWP form contains items such as the job description, location, known radiological conditions, protective clothing requirements, respiratory protection, dosimetry, training, health physics monitoring requirements, and any other special instructions. RWP development also includes creating a sign-in/out sheet for use by the authorized users. After development, the RWP must be approved for issuance by the RCS. Issuance includes a review of the RWP with the authorized users, as required. A pre-job meeting may also be prerequisite to issuance of the RWP.

During use, a copy of the RWP will be maintained at the worksite, and authorized users will be required to sign-in/out when participating in the subject activity, indicating their understanding of the requirements of the RWP. RWPs will be terminated upon completion of the activity by signature on the RWP and completion of a form indicating the reason for termination and confirmation of final radiological survey of the activity or area. Upon termination of the RWP, the RWP package will be completed and filed. The package generally contains the completed RWP, sign-in sheets, applicable radiological surveys, and any other documents pertinent to the job. If radiological conditions or requirements change, appropriate changes to the RWP may be made by the RCS or designee. Alternatively, a new RWP may be issued.

5.2 Survey Packages

Characterization survey packages will be developed for each survey area that contain specific characterization survey instructions. Survey package preparation and completion will be approved by the RCS or designee to ensure all survey requirements and Data Quality Objectives (DQOs) are met. As applicable, each survey package will contain:

- Survey unit number
- Maps of the survey unit surfaces
- Overview maps detailing survey locations and placement methodology
- General survey requirements
- Instrument requirements with associated Minimum Detectable Concentrations (MDCs), count times and scan rates
- Survey Instruction Sheets
- Percentage of surface requiring scan surveys
- Number of measurements required
- Additional specific survey instructions
- Survey Data Sheets
- Sampling protocols
- Chain of Custody Forms
- Signature of Preparer, Surveyor and Reviewer

6.0 PROJECT TRAINING REQUIREMENTS

Advanced Disposal will provide personnel with site specific Contractor HSE/Site Orientation Training. Chase will provide all project personnel with radiation worker training required by the radioactive materials license, as well as training for project-specific programs, plans, and procedures.

6.1 Radiological Training

Radiological training will be completed and documented in accordance with the Section 7 of the Chase Radiation Safety Manual (RSM) and Chase license requirements. The PM will maintain a copy of each individual's certification on site in the project file.

6.2 Project Specific Training

Prior to project start-up, personnel will attend an initial project-specific training session conducted by the PM. The training session will include the following items:

- Review of the Plan
- Discussion regarding the scope of work and planned work activities
- Review of chemical, physical, and radiological hazards associated with the project
- Discussion of posting requirements
- Types and use of available personal protective equipment
- Project security control and operational work zones
- Emergency response and site evacuation procedures
- Project communications
- General safe work practices
- Data quality and chain of custody procedures
- Review of applicable regulatory standards as applied to project operations

6.3 General Safety Briefings

General safety meetings will be held by the PM at the beginning of each work shift. The purpose of these meetings will be to discuss project status, potential problem areas, general safety concerns, and to reiterate project requirements. Additional meetings will be held if conditions warrant.

6.4 Transportation Training

Persons who prepare hazardous materials for transportation or are otherwise responsible for safely transporting hazardous material will be trained in accordance with the requirements of 49 CFR 172, Subpart H.

7.0 RADIATION PROTECTION PROGRAM

The radiation protection program (RPP) will be implemented commensurate with the scope and extent of licensed activities at the site. This program and associated operating procedures are the primary means used to administratively establish safe radiation work practices and ensure compliance with regulatory requirements. The following sections provide a description of the primary elements that will be used to realize this commitment.

7.1 Exposure Control

Personnel exposure to radioactive material will be controlled by application of engineering, administrative, and personnel protection provisions in the order of priority listed below.

7.1.1 Engineering Controls

Engineering controls will be used, as practicable, to minimize or prevent the presence of uncontained radioactive material. Engineering controls will predominantly be comprised of containment, isolation, and ventilation.

All material removal and sampling activities will be conducted in a manner to control the spread of contamination and to maintain personnel exposures ALARA. Containments, HEPA-filtered negative air machines, HEPA-filtered vacuums and/or misting will be used as necessary to control airborne particulate radioactivity, and fugitive dusts during invasive activities.

7.1.2 Administrative Controls

Administrative controls will be used to control work conditions and work practices and are predominantly comprised of the following:

- *Access Control:* Routine access to work areas will be limited to personnel necessary to accomplish tasks or activities. Access will also be controlled with respect to training and use of specified personnel protection equipment.

- *Postings and Barriers:* Postings will be used to inform personnel of relevant hazards or conditions and associated access requirements. Barriers will be used to prevent unauthorized access.

- *Procedures:* Written procedures will be used to describe specific radiation protection requirements necessary for safe performance of tasks.

- *Radiation Work Permits:* RWPs will be used to describe specific or special worker protection requirements for specific activities involving radioactive material

7.1.3 Source Control

Action levels and limits for radiation surveys will be used to control the levels of radioactivity on equipment and in areas. These limits will be communicated via procedures, RWPs, and/or survey packages.

7.1.4 Personal Protective Equipment

Personal protective equipment will be used to control personnel exposure to radioactive material when administrative controls are not sufficient and engineering controls are not effective or practical. Personal protective equipment may include clothing, gloves, protective shoes or shoe covers, eye protection, and/or respiratory protection. Engineering controls are expected to be sufficient to control airborne radioactivity levels.

7.2 Notifications

Project personnel will notify the RSO of conditions or situations that present a radiological hazard, concern or exceed limitations set forth in this Plan or the radiation protection program. The RSO will then make notifications to the Cabinet as required.

7.3 Dosimetry

Radiation doses from internal and external sources are expected to be well below 10% of the occupational dose limits, so external and internal dosimetry procedures are not expected to be required. However, Radiation Workers will be monitored for external doses by thermoluminescent dosimeter (TLD) and internal doses by air sampling and/or bioassay. The RWP process includes an analysis of the requirements for dosimetry monitoring, air sampling, and respiratory protection.

Results of internal and external monitoring shall be used to calculate total organ dose equivalent and total effective dose equivalent to workers for which monitoring is required.

7.4 Air Sampling Program

Concentrations of radioactive material in air will be determined by sampling. Air samples will be collected under known physical conditions (e.g., sample time, flow rate). Air sampler flow meters will be calibrated at least annually and following repair and/or modification.

Airborne particulate sampling will be performed during invasive work to assess the potential for internal exposures.

Following air sample collection, the filter media will be counted for radioactivity and then stored for decay of short-lived radon progeny before recounting to achieve required sensitivity. If airborne radioactivity levels indicate that

assignment of internal dose may be required, the RSO will make the dose assessment based on actual nuclide distribution data. This may be performed using isotopic concentrations of solid samples obtained during characterization or by isotopic analysis of air sample filters from each area. Bioassays are not expected to be performed unless air sampling indicates a potential to exceed 10% of the internal dose limit.

The RSO shall apply professional judgment and experience to identify air sampling appropriate for the specific situation. Such judgment will be based on historical air sampling and characterization results, quantity of material being handled, potential for release of contaminants based on physical form and activity, type of confinement or containment, and other factors specific to the activity.

The air sampling program will consist of worker breathing zone air samples, general area samples, high volume air samples, and effluent monitoring air samples,.

7.4.1 Breathing Zone Air Samples

Breathing zone air samples (belt mounted pump with sample head affixed to worker's lapel) will be the primary method of monitoring the worker's intake of radioactive material.

7.4.2 General Area Air Samples

Air samples will be collected from general and localized areas when and/or where there is potential for generation of airborne radioactive material. These samples will be used to verify that engineering controls are effective, and provide warning of elevated concentrations for planning or response actions. In each case, the sampling point will be located in the airflow pathway near the known or suspected release point(s). As necessary, more than one air sample location may be used in order to provide a reasonable estimate of the general concentration of radioactive material in air.

7.4.3 High Volume Air Samples

High volume air sampling may be used to obtain sufficient detection sensitivities for nuclides with low DAC values during short duration activities or to estimate radon concentrations by measuring the concentrations of particulate progeny.

7.4.4 Effluent Monitoring Air Samples

General area air samples will be collected at effluent release locations and in the vicinity of outdoor activities as necessary to verify that any radioactive materials released to the environment meet the effluent concentration limits of 10 CFR 20, Appendix B, Table 2, Column 1.

8.0 OCCUPATIONAL HEALTH AND SAFETY PROGRAM

The project will be performed under the Chase Health and Safety Program, and in accordance with Advanced Disposal Safety Requirements. In addition, radiological work will be performed according to the Chase radioactive materials license and Radiation Safety Manual under the management and supervision of the RSO.

9.0 RADIOACTIVE WASTE MANAGEMENT PROGRAM

Radioactive waste generated during project activities, if any, will be packaged in DOT-compliant shipping containers for shipment to appropriately licensed and/or permitted facilities. All waste will be stored in approved storage areas at the facility until shipment off-site. Radioactive waste will be subdivided into categories based on types of material and processing/disposal methods. All radioactive waste will be transported via DOT-approved carriers and manifested by qualified waste shippers and/or brokers to appropriately licensed waste processors and/or disposal sites.

10.0 QUALITY ASSURANCE PROJECT PLAN

All project activities will be conducted in accordance with this Quality Assurance Project Plan (QAPP) and in a manner consistent with selectively applied elements of the Chase Quality Assurance Program.

The QA program is developed and organized with emphasis given to maximizing worker safety, eliminating off-site releases, collecting data that meets the DQOs, and minimizing overall project costs. QA criteria are applied in a graded manner to achieve a balance between the rigor of application of quality assurance measures and the scale, cost, and complexity of the work involved.

10.1 Quality Assurance Policy

Accountability for quality is the responsibility of every person assigned to the project, extending from the PM through established lines of authority to all project personnel, who are responsible for the requisite quality of their own work. Quality Assurance will be implemented by personnel conducting their activities to meet requirements and expectations according to established plans and procedures that reflect the way business is to be conducted on the project.

All project personnel are responsible for executing their work and ensuring that quality-affecting activities within their purview are performed in conformance with applicable plans and procedures. All personnel have the authority and responsibility to stop his/her own work and the responsibility to report such conditions when continuation will produce or conceal results that are not in accordance with prescribed requirements, and/or pose imminent radiological or

safety hazard to employees, the environment, or the general public. Project personnel have sufficient freedom, authority, access, and responsibility to:

- Identify quality problems, deficiencies, nonconformance's, and noncompliance with regulatory and performance objectives
- Initiate, recommend, or provide solutions through designated channels
- Verify implementation of the solutions
- Assure that deficient work is stopped or is proceeding under controlled conditions until proper disposition of the unsatisfactory condition is accomplished
- Identify and report opportunities for continuous improvement

10.2 Quality Assurance Goals

The following quality assurance goals have been established for the project:

- Safely perform the project on time and under budget with no quality defects.
- Perform all activities in full compliance with all applicable state, federal and local regulations.
- Ensure technically defensible data are generated to support a dose assessment to aid in determining whether or not the facility meets the dose criteria

10.3 Chase Project Management Policy

All Chase projects shall be managed in a manner consistent with the agreement between Chase and the Customer; Chase principles, values and organizational philosophy; and approved Chase standard operating procedures and plans. Our project management policy embodies the basic principles listed below:

- Chase's first priority is cultivating worker and workplace safety.
- Our project team is key to our success.
- Quality is defined as meeting all requirements, including environmental, safety and health regulations.
- Project Managers must have a clear understanding of their responsibility, accountability and limits of authority.
- Project Managers have the responsibility and authority to achieve quality, meet schedules, and budget.
- Project Managers have the responsibility and authority for the technical, contractual and financial aspects of the project.

10.4 Project Organization

The project organization is described in Section 4.0.

10.5 Training Requirements

Project personnel shall be indoctrinated and trained in accordance with the requirements of this plan.

- Indoctrination to the project scope of work shall be provided to all new hire project personnel.
- Project personnel shall be provided sufficient training prior to commencement of the individuals assigned task(s). The extent of training shall be determined by the Project Manager. The extent of training shall be based on the scope, complexity, and nature of the assigned task(s), education, experience, previous training, and proficiency of the individual.
- The training method employed may be one or all of the following:
  - Classroom instruction;
  - Reading assignments;
  - On-the-job; and
  - Practical demonstration
- Education and experience qualifications shall be documented by resume with relevant formal educational training certificates enclosed with the resume.

10.6 Quality Objectives and Criteria for Data Measurement

10.6.1 Radiological Criteria

The radiological criteria are specified in Section 3.0.

10.6.2 Data Quality Objectives (DQO)

The Data Quality Objective process as described in MARSSIM is used throughout the design and implementation of radiological surveys. The following is a list of the major DQOs:

- Measurements will be taken to achieve detection sensitivities below the associated limit or investigation level.
- Individual measurements will be made to a 95% confidence interval.
- A minimum of 5% duplication of samples will be performed for Quality Assurance.

10.6.3 Sample Handling and Custody

All samples are radiological in nature and do not need preservatives or special handling procedures except routine radiological controls sufficient to prevent cross-contamination.

The sample chain-of-custody (COC) maintains the integrity of the sample; that is, there is an accurate record of sample collection, transport, and analysis. This

ensures that samples are neither lost nor tampered with, and that the sample analyzed in the laboratory is actually and verifiably the sample taken from a specific location in the field. Samples sent off-site for analysis will use an approved Chain of Custody Procedure.

10.6.4 Analytical Methods

Solid and liquid samples will be analyzed at an external laboratory. Solid samples will be analyzed by gamma spectroscopy. Liquid samples will be analyzed for gross alpha and gross beta radioactivity and compared to drinking water standards.

10.6.5 Data Collection

The data collection process will be defined, controlled, verified, and documented. The general survey approach and methodology is outlined in this Plan. The following activities shall be addressed in the procedures:

- Scanning and direct measurements
- Field sampling methods
- Sample handling and custody
- Analytical operations for bench top laboratory equipment

Procedures shall be of a design which assures data are traceable to the survey and analytical procedures, performance standards, data collectors, analysts and measuring and test equipment.

10.7 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Radiological instrumentation shall be controlled in accordance with Chase procedures. Instruments shall be calibrated or adjusted in accordance with manufacturer's instructions or by subcontracted licensed calibration facilities. The selection of instruments shall be controlled to ensure that the items are of the proper type, range, accuracy and tolerance to accomplish conformance with specified requirements.

When an instrument is found to be out of calibration or not functioning as expected, evaluations shall be made to assess the validity of the data obtained since the last performance test. This evaluation shall be documented and, if required, processed as a nonconforming condition.

10.7.1 Instrument Functional Checks

Functional checks will be performed at least daily when in use. The background, source check, and field measurement count times for radiation detection instrumentation will be specified by procedure to ensure measurements are

statistically valid. Background readings will be taken as part of the daily instrument check and compared with the acceptance range for instrument and site conditions. If an instrument fails a functional check, all data obtained with the instrument since the last satisfactory check will be evaluated for usability by the PM.

10.7.2 Instrument Calibration and Frequency

Laboratory and portable field instruments will be calibrated at least annually with National Institute of Standards and Technology (NIST) traceable sources, where feasible, and to radiation emission types and energies that will provide detection capabilities similar to the nuclides of concern.

10.7.3 Determination of Counting Times and Minimum Detectable Concentrations

Minimum counting times for background determinations and measurement of radioactivity will be chosen to provide a minimum detectable concentration (MDC) that meets the criteria specified in the DQOs.

Instrumentation and MDC determination are described in Section 14.0.

10.8 Reports to Management

The Project Manager will prepare reports on a regular basis and submit to Chase management. Reports will include comparison-to-estimates for costs, schedule and productivity. Additionally, the Project Manager will provide reports to Chase management and customer representatives on any condition adverse to safety or quality, out of scope conditions or deviations from plans or procedures. Regulatory notification is required if emergent conditions arise that would cause the scope of work or schedule to significantly change or if deviations from this Plan are necessary.

10.9 Document Control and Quality Assurance Records

Project documents shall be reviewed for adequacy and approved by authorized personnel prior to issuance. The document control measures employed shall ensure that only the most current documents are in use during the performance of project activities.

Project documents that have been identified as Quality Assurance Records shall be maintained in accordance with Chase Quality Assurance procedures. Project-specific and supporting Quality Assurance procedures, work instructions, quality plans and other documents which specify quality requirements or prescribe activities affecting quality shall define the required documents or data to be maintained as Quality Assurance Records.

10.10 Nonconformance Control and Corrective Action

All project personnel shall be responsible for notifying their supervisor or the Project Manager of conditions or items that do not meet specified requirements. Project procedures address the following measures:

- Identification or segregation of the nonconformance;
- Documentation of the nonconformance;
- Evaluation of the nonconformance;
- Disposition and justification provisions;
- Notification to affected personnel or organizations, and;
- Verification of disposition

All project personnel are encouraged to identify any activity, process, or procedure that could lead to potential non-conformances or conditions adverse to quality. Corrective Action procedures provide the reporting and evaluation requirements for preventative actions resulting in the elimination of potential quality problems. All non-conformances, corrective actions, and preventative actions shall be documented and maintained in accordance with the appropriate procedures.

10.11 Quality Assurance Audits

The RSO is responsible for planned and periodic audits of project activities. These audits shall be scheduled in a manner that will provide sufficient coverage and coordination of activities throughout the duration of the project. These audits will verify compliance with the requirements specified in this plan, related procedures, plans, and regulatory requirements. These audit activities also provide a mechanism to identify opportunities for continuous improvement.

In addition to this audit activity, the RSO or designee will perform periodic surveillances to monitor and document compliance with this Plan and standard radiological and safety practices.

Identified departures from specified requirements shall be treated as non-conformances and corrected. Management personnel shall take appropriate action to identify root causes, correct deficiencies, prevent recurrences, and determine impacts of audit findings in their area of responsibility. Follow-up actions will be performed as necessary to ensure that appropriate corrective actions have been implemented in a timely manner and are effective.

10.12 Data Quality Assessment (DQA)

All characterization data will undergo a data quality assessment to ensure usability for the intended purpose.

10.13 Data Verification

All radiological data shall be verified and validated. Verification personnel, whether in the line or organizationally independent, have sufficient freedom, authority, access, and responsibility to:

- Identify quality problems, deficiencies in hardware and documentation, and noncompliance with performance objectives.
- Initiate, recommend, or provide solutions through designated channels.
- Verify implementation of the solutions.
- Assure that deficient work is stopped or is proceeding under controlled conditions until proper disposition of the unsatisfactory condition is accomplished.

Field data will be reviewed and validated to ensure:

- Completeness of forms
- The correct type of survey has been assigned to the survey unit
- The MDCs for measurements meet the established data quality objectives; independent calculations will be performed for a representative sample of data sheets and survey areas.
- Instrument calibrations and daily functional checks have been performed accurately and at the required frequency.

10.14 External Laboratory Data Validation

External analytical laboratories, if used, will be required to provide their own data validation package for review. The RCS will review the sample data to ensure chain of custody has been preserved, all samples taken having corresponding sample results provided, and limits of detection are at or below criteria specified in this Plan.

10.15 Data Review

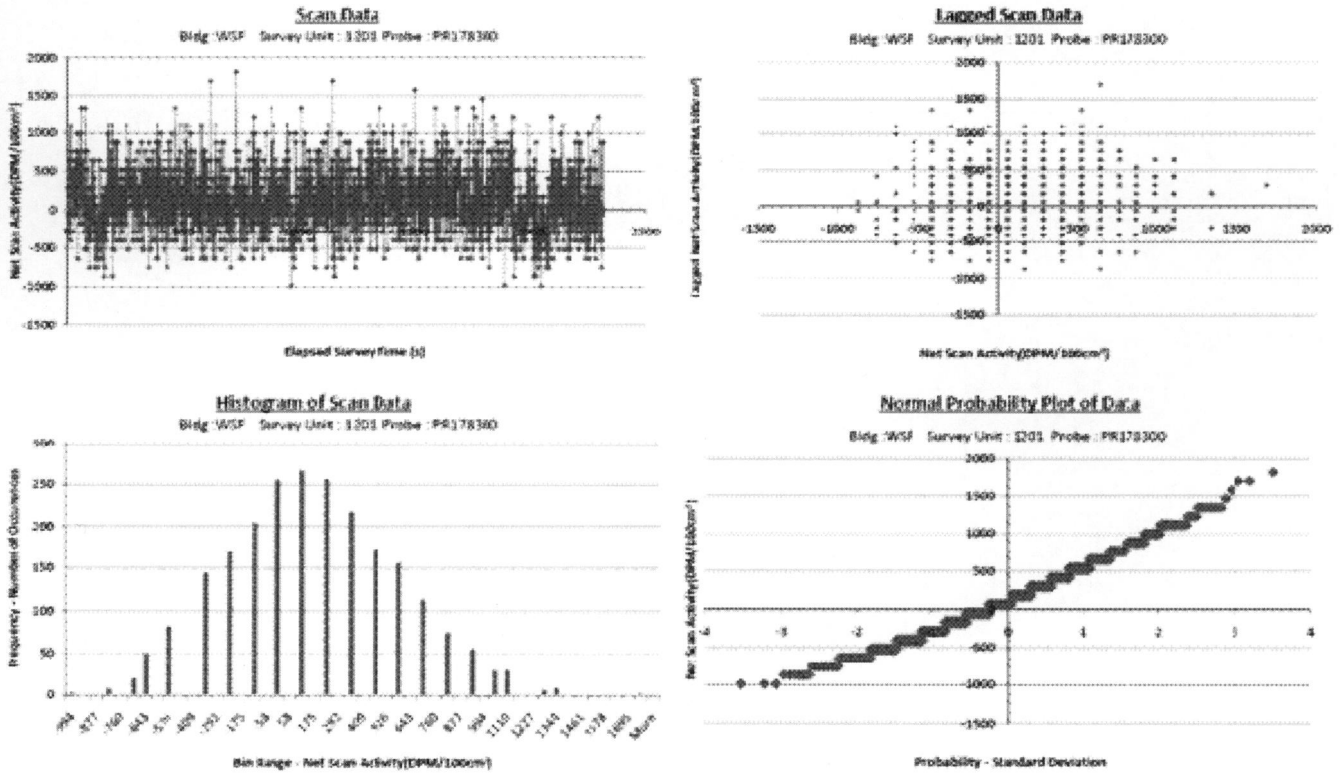
A preliminary data review will be performed for each survey area to identify any patterns, relationships or potential anomalies. The following preliminary data reviews will be performed for each survey unit:

- Calculations of the survey unit mean, median, maximum, minimum, and standard deviation for each type of reading.
- Comparison of the actual standard deviation to the assumed standard deviation used for calculating the number of measurements. If the actual standard deviation is greater than estimated, the minimum number of samples shall be calculated using the actual standard deviation to ensure a sufficient number of samples have been obtained.
- Comparison of survey data with applicable investigation levels.

For surface scans, the data management software will produce 4-plot graphical output of scan data to enhance data visualization. A 4-plot consists of the following:

- A **run sequence plot** presents logged data in chronological order, providing a time history of the survey data.
- A **lag plot** checks whether a data set or time series is random or not. Random data should not exhibit any identifiable structure in the lag plot.
- A **histogram plot** graphically summarizes the distribution of a univariate data set, showing center (i.e., the location) of the data, spread (i.e., the scale) of the data, skewness of the data, presence of outliers, and presence of multiple modes.
- A **probability plot** is a goodness-of-fit test used to verify the distributional model. The normal probability plot is a graphical technique for assessing whether or not a data set is approximately normally distributed. The data are plotted against a theoretical normal distribution in such a way that the points should form an approximate straight line. Departures from this straight line indicate departures from normality.

An example four-plot is provided below.



For surface soil scans, the GPS-correlated data will be presented in a color coded overlay onto a site map. The color coded overlay may be used to assist in selection of soil sample locations.

11.0 DATA COLLECTION GOALS

We will discuss with Advanced and the Cabinet and design radiological surveys with the following goals once we learn more about the nature and composition of the alleged TENORM materials.

- Determine background radioactivity levels and variability
- Determine the lateral and vertical extent of residual radioactivity
- Determine nuclides of concern
- Define the extent of radiological impact at the site, including surface and groundwater
- Collect all information necessary to develop a comprehensive dose assessment
- Determine if remediation is necessary
- If remediation is necessary, collect information necessary to determine disposal options and obtain waste profile approvals

12.0 SURVEY ACTIVITIES

12.1 Gamma Scans

Chase has performed performed a GPS position-correlated gamma scan surveys of the portion of the outside grounds that is expected to bound impacted soils as well as several on-site and off-site background reference areas. The surveyor scanned the ground surface to measure and record ambient gamma radiation levels. The survey was conducted using a 2" x 2" sodium iodide gamma scintillation detector linked to a Trimble GPS system or equivalent. The surveyor systematically walked over accessible areas of the property with the detector held at 10 cm from the ground surface with the meter's audio function active. In general, he walked at a rate of 0.5 meter/second or less along transect lines that are separated by no more than 0.5 meters. Radiation measurements and their associated spatial coordinates were recorded once each second by the GPS system. This data will be used to generate an electronic record of the gamma radiation levels encountered during the surface scan. Survey results will be color coded and superimposed on an aerial photo or map of the property.

Once we know more about the nature and composition of the alleged TENORM materials we coordinate with the Cabinet to design and perform radiological measurements as appropriate that could include Exposure Rate Measurements,

Subsurface Soil Sampling, Waste Sampling, Air Sampling, and how to factor in background radiation to accomplish the goals of this Plan.

13.0 IN-PROCESS SURVEYS

Project operations will be conducted to control the spread of contamination and keep personnel exposures ALARA. In-process surveys are conducted in support of project activities to monitor the effectiveness of contamination controls and engineering controls, and to ensure that surrounding areas are not cross-contaminated during removal activities.

Radiological surveys will be performed to describe the radiation types and levels in an area or during a task, to identify or quantify radioactive material, and to evaluate potential and known radiological hazards. In-process surveys will consist of dose rate surveys, airborne radioactivity monitoring, scan surveys, static measurements and removable contamination measurements. Additionally, personnel will be surveyed prior to leaving access-controlled areas.

14.0 SURVEY INSTRUMENTATION

The instrumentation used for facility characterization surveys is summarized in the tables below. Alternate or additional instrumentation with similar detection capabilities may be utilized as needed for survey requirements with RSO approval.

Table 14-1: Instrumentation

Detector Model	Detector Type	Meter Model	Use
Ludlum 44-10	Gamma Scintillation	Ludlum 2221	Gamma Surface Scans
Ludlum 19	Gamma Scintillation	N/A	Exposure Rate Measurements
Bicron MicroRem	Tissue Equivalent Organic Scintillation	N/A	Dose Rate Measurements
Ludlum 44-9	Pancake G-M	Ludlum 2241	Direct Surface Activity Measurements
Ludlum 43-10-1	Dual Alpha Beta	Ludlum 2929	Removable Surface Activity Measurements

14.1 Datalogging

Scans and static measurements will be performed using datalogging instrumentation. While scanning, in addition to the surveyor listening to the audible output, integrated counts will be recorded.

14.2 Determination of Counting Times and Minimum Detectable Concentrations

Minimum counting times for background determinations and measurement of total and removable contamination were chosen to provide a minimum detectable concentration (MDC) that met the DQOs. MARSSIM equations relative to building surfaces have been modified to convert to units of dpm/100 cm^2. Count times and scanning rates are determined using the following equations:

14.2.1 Static Counting

Static counting Minimum Detectable Concentration at a 95% confidence level is calculated using the following equation, which is an expansion of NUREG 1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions", Table 3.1 (Strom & Stansbury, 1992):

$$MDC_{static} = \frac{3 + 3.29\sqrt{B_r \cdot t_s \cdot (1 + \frac{t_s}{t_b})}}{t_s \cdot E_{tot} \cdot \frac{A}{100cm^2}}$$

Where:

MDC_{static} = minimum detectable concentration (dpm/100 cm^2)
B_r = background count rate (counts per minute)
t_b = background count time (minutes)
t_s = sample count time (minutes)
E_{tot} = total detector efficiency for radionuclide emission of interest (cpm/dpm)
A = detector probe area (cm^2)

14.2.2 Ratemeter Scanning

Scanning Minimum Detectable Concentration at a 95% confidence level is calculated using the following equation, which is a combination of MARSSIM equations 6-8, 6-9, and 6-10:

$$MDC_{scan} = \frac{d'\sqrt{b_i}\left(\frac{60}{i}\right)}{\sqrt{p} \cdot E_{tot} \cdot \frac{A}{100cm^2}}$$

Where:

MDC_{scan} = minimum detectable concentration level in dpm/100 cm^2
d' = desired performance variable (1.38)
b_i = background counts during the residence interval
i = residence interval
p = surveyor efficiency (0.5)
E_{tot} = total detector efficiency for radionuclide emission of interest (includes combination of instrument efficiency and surface efficiency)
A = detector probe area in cm^2

14.2.3 Smear Counting

Smear counting Minimum Detectable Concentration at a 95% confidence level is calculated using the following equation, which is NUREG 1507, Table 3.1 (Strom & Stansbury, 1992):

$$MDC_{smear} = \frac{3 + 3.29\sqrt{B_r \cdot t_s \cdot (1 + \frac{t_s}{t_b})}}{t_s \cdot E}$$

Where:

MDC_{smear} = minimum detectable concentration level (dpm/smear)
B_r = background count rate (counts per minute)
t_b = background count time (minutes)
t_s = sample count time (minutes)
E = instrument efficiency for radionuclide emission of interest (cpm/dpm)

15.0 DOSE ASSESSMENT

Because the dose criteria described in Section 3.0 cannot be measured directly, compliance is demonstrated by pathway analysis and dose modeling. Advanced will contract with Risk Assessment Corporation to conduct the dose assessment.

16.0 REPORT

At the completion of RSSI activities, Advanced will submit a report of project activities, including the results of all radiological measurements and the dose assessment.



Blue Ridge Landfill
2700 Winchester Road
Irvine, KY 40366

CHASE Environmental Group

Site Map	Appendix A

Appendix B

Chase Environmental Group

Radioactive Material License

CABINET FOR HEALTH SERVICES
COMMONWEALTH OF KENTUCKY
RADIOACTIVE MATERIAL LICENSE

1. LICENSEE AND 2. ADDRESS

CHASE ENVIRONMENTAL GROUP INC.
11450 WATTERSON COURT
LOUISVILLE, KY 40299-2389

ATTENTION: JOHN R. O'NEIL
TELEPHONE: 502-267-1455

PURSUANT TO KRS 211.842 ET SEQ., THE KENTUCKY CABINET FOR HUMAN RESOURCES REGULATIONS, 902 KAR 100, AND IN RELIANCE ON STATEMENTS AND REPRESENTATIONS HERETOFORE MADE BY THE LICENSEE, A LICENSE IS HEREBY ISSUED TO RECEIVE, ACQUIRE, OWN, POSSESS AND TRANSFER RADIOACTIVE MATERIAL LISTED BELOW; AND TO USE SUCH RADIOACTIVE MATERIAL FOR THE PURPOSE(S) AND AT THE PLACE(S) DESIGNATED BELOW. THIS LICENSE IS SUBJECT TO ALL APPLICABLE RULES, REGULATIONS, AND ORDERS OF THE CABINET FOR HEALTH SERVICES, NOW OR HEREINAFTER IN EFFECT AND TO ANY CONDITIONS SPECIFIED BELOW.

---

3. LICENSE NUMBER: 201-605-15
AMENDMENT NO. 33

4. EXPIRATION DATE: DECEMBER 31, 2016

5. REVIEWER: 41

---

6. LICENSED MATERIAL	7. FORM	8. POSSESSION LIMIT
A. ANY RADIOACTIVE MATERIAL WITH ATOMIC NUMBERS	A. ANY FORM	A. 100 CURIES (NOT TO EXCEED OR EQUAL INCREASED CONTROLS (IC) QUANTITIES OF CONCERN IN ACCORDANCE WITH IC TABLE 1)

	3-98 INCLUSIVE, EXCLUDING H-3, SOURCE MATERIAL AND SPECIAL NUCLEAR MATERIAL		
B.	HYDROGEN 3	B. SOLID, LIQUID OR GAS	B. 100 CURIES
C.	SOURCE MATERIAL	C. ANY FORM	C. 1,000 KILOGRAMS
D.	SPECIAL NUCLEAR MATERIAL	D. ANY FORM	D. 350 GRAMS URANIUM-235, 200 GRAMS URANIUM-233, OR 200 GRAMS PLUTONIUM OR ANY COMBINATION OF THESE PROVIDED THE SUM OF THE RATIOS OF THE QUANTITIES DOES NOT EXCEED UNITY
E.	URANIUM, DEPLETED	E. SOLID (NONDISPERSABLE)	E. 4,500 KILOGRAMS

9. AUTHORIZED USE

A.-D. 1. FOR DECONTAMINATION AND DECOMMISSIONING SERVICES, INCLUDING DEMOLITION, REMEDIATION, RADIOLOGICAL SURVEY, SAMPLING AND ACCELERATOR/CYCLOTRON DISASSEMBLY, REMOVAL, STORAGE AND RELOCATION.

2. FOR TRANSPORTATION SERVICES, INCLUDING PACKAGING, PROCESSING AND TRANSPORT FOR DISPOSAL OR TRANSFER TO FACILITIES AUTHORIZED TO STORE, POSSESS, OR DISPOSE OF RADIOACTIVE MATERIAL.

3. FOR STORAGE OF ACCELERATORS, CYCLOTRONS, ASSOCIATED COMPONENTS AND OTHER ACTIVATED OR CONTAMINATED ITEMS PENDING TRANSFER TO LICENSED FACILITIES OR DISPOSAL AND WASTE COLLECTION FOR LOAD CONSOLIDATION.

4. IMPLEMENTATION OF RADIATION SAFETY PROGRAMS AT TEMPORARY JOB SITES INCLUDING THOSE NOT DEFINED IN 1, 2 AND 3 ABOVE.

5. MATERIAL MAY BE USED AT TEMPORARY JOB SITES OF THE LICENSEE AT LOCATIONS THROUGHOUT KENTUCKY, THE UNITED STATES AND OTHER LOCATIONS AS NEEDED UPON RECEIPT OF RECIPROCITY.

1-5 ABOVE IS TO BE PERFORMED IN ACCORDANCE WITH THE TERMS AND CONDITIONS OF LICENSES ISSUED BY THE U.S. NUCLEAR REGULATORY COMMISSION OR AN AGREEMENT STATE.

E. FOR STORAGE ONLY.

CONDITIONS:

10. THE LICENSEE SHALL COMPLY WITH THE PROVISIONS OF THE KENTUCKY CABINET FOR HEALTH SERVICES ADMINISTRATIVE RADIATION REGULATIONS, 902 KAR 100.

11. RADIOACTIVE MATERIAL MAY BE STORED AT:
CHASE ENVIRONMENTAL GROUP
11450 WATTERSON COURT
LOUISVILLE, KY 40299-2389

RADIOACTIVE MATERIAL MAY BE USED AT TEMPORARY JOB SITES, IN AREAS NOT UNDER EXCLUSIVE FEDERAL JURISDICTION, ANYWHERE IN THE COMMONWEALTH OF KENTUCKY WHERE THE CABINET MAINTAINS JURISDICTION FOR REGULATING THE USE OF RADIOACTIVE MATERIAL. (THIS CONDITION DOES NOT PROHIBIT USE IN OTHER STATES UNDER RECIPROCITY PRIVILEGES WHICH MAY BE GRANTED BY THE REGULATORY AGENCY HAVING JURISDICTION.)

12. COPIES OF RECORDS REQUIRED PURSUANT TO 902 KAR 100 OR CONDITIONS OF THE LICENSE SHALL BE MAINTAINED FOR INSPECTION BY THE CABINET AT CHASE ENVIRONMENTAL GROUP, 11450 WATTERSON COURT, LOUISVILLE, KY 40222

13. RADIOACTIVE MATERIAL SHALL BE USED BY, OR UNDER THE SUPERVISION AND IN THE PHYSICAL PRESENCE OF JOHN R. O'NEIL, CHRISTOPHER E. ECHTERLING OR DAVE CULP.
ALTERNATIVELY, RADIOACTIVE MATERIAL MAY BE USED BY INDIVIDUALS WHO HAVE BEEN TRAINED AS SPECIFIED IN APPLICATION DATED NOVEMBER 9, 2009 AND HAVE BEEN APPROVED IN WRITING BY THE RADIATION SAFETY OFFICER. THE LICENSEE SHALL MAINTAIN RECORDS OF THE TRAINING RECEIVED BY INDIVIDUALS DESIGNATED AS USERS FOR INSPECTION BY THE CABINET FOR FIVE (5) YEARS FOLLOWING THE LAST USE OF RADIOACTIVE MATERIAL BY THE INDIVIDUAL. THIS TRAINING PROGRAM IS APPLICABLE ONLY TO INDIVIDUALS WHO SHALL USE

LICENSED MATERIAL UNDER THE AUTHORITY OF THIS LICENSE.

14. THE RADIATION SAFETY OFFICER FOR THE ACTIVITIES AUTHORIZED BY THIS LICENSE IS CHRISTOPHER E. ECHTERLING .

15. THE LICENSEE MAY TRANSPORT RADIOACTIVE MATERIAL, OR DELIVER RADIOACTIVE MATERIAL TO A CARRIER FOR TRANSPORT, IN ACCORDANCE WITH THE PROVISIONS OF 902 KAR 100:070, AND OTHER DEPARTMENTS OF THE COMMONWEALTH OF KENTUCKY HAVING JURISDICTION.

16. THIS LICENSE AND THE RIGHT TO POSSESS OR UTILIZE RADIOACTIVE MATERIAL GRANTED BY THIS LICENSE ISSUED UNDER 902 KAR CHAPTER 100 SHALL NOT BE TRANSFERRED, ASSIGNED, OR OTHERWISE DISPOSED OF, THROUGH TRANSFER OF CONTROL OF A LICENSE TO A PERSON UNLESS THE CABINET, AFTER SECURING FULL INFORMATION, FINDS THAT THE TRANSFER IS IN ACCORDANCE WITH THE REQUIREMENTS OF 902 KAR CHAPTER 100 AND GIVES ITS CONSENT IN WRITING IN ACCORDANCE WITH 902 KAR 100:040, SECTION 11.

17. IN ADDITION TO THE POSSESSION LIMITS SPECIFIED IN ITEM 8, THE LICENSEE SHALL FURTHER RESTRICT POSSESSION OF RADIOACTIVE MATERIAL TO QUANTITIES BELOW MINIMUM LIMIT SPECIFIED IN TABLE 1: RADIONUCLIDES OF CONCERN FROM THE U.S. NUCLEAR REGULATORY COMMISSION'S ORDER EA-05-090 IMPOSING INCREASED CONTROLS FOR LICENSEES THAT POSSESS SOURCES CONTAINING RADIOACTIVE MATERIAL QUANTITIES OF CONCERN.

18. THE LICENSEE SHALL SUBMIT A DECONTAMINATION, DECOMMISSIONING, AND REMEDIATION AND/OR OTHER PROJECT WORK PLAN FOR EACH PROJECT TO BE PERFORMED, UNDER THIS LICENSE. THIS PLAN WILL SPECIFY AN ESTIMATE OF THE TYPES, QUANTITIES, PHYSICAL/CHEMICAL FORMS OF RADIOACTIVE MATERIAL; SPECIFICATIONS OF SITE LOCATION INCLUDING FACILITIES AND EQUIPMENT, AND RADIATION DETECTION INSTRUMENTS TO BE USED; DESCRIPTION OF PROJECT ACTIVITIES INCLUDING WASTE MANAGEMENT AND DISPOSITION; ESTIMATED PROJECT START DATE AND DURATION; AND IDENTIFICATION OF, AND INFORMATION ON HOW TO CONTACT KEY PROJECT PERSONNEL. IN ADDITION, THE PLAN SHALL INCLUDE PERSONNEL QUALIFICATIONS INCLUDING THOSE OF THE RADIATION CONTROL SUPERVISOR, AND A DESCRIPTION OF PERSONNEL DOSIMETRY AND BIOASSAY PROCEDURES TO BE USED. OTHER INFORMATION SHALL BE SUBMITTED AS REQUIRED BY THE REFERENCES IN CONDITION 19 OF THIS LICENSE.

19. AT THE COMPLETION OF ACTIVITIES AT EACH JOB SITE LOCATION, THE LICENSE SHALL NOTIFY THE CABINET OF THE TEMPORARY JOB SITE STATUS AND THE DISPOSITION OF THE RADIOACTIVE MATERIAL.

20. THIS LICENSE DOES NOT AUTHORIZE THE POSSESSION AND USE OF LICENSED MATERIAL AT CUSTOMER FACILITIES OR CUSTOMER TEMPORARY JOB SITES FOR USES SPECIFICALLY AUTHORIZED BY THE CUSTOMERS LICENSE.

21. NOTWITHSTANDING THE POSSESSION LIMITS IN ITEM 8, THE LICENSEE SHALL FURTHER RESTRICT THE POSSESSION AND STORAGE OF RADIOACTIVE MATERIAL IN THE COMMONWEALTH OF KENTUCKY TO QUANTITIES BELOW THE MINIMUM LIMIT SPECIFIED IN 902 KAR 100:042, SECTION 11, FOR ESTABLISHING DECOMMISSIONING FINANCIAL ASSURANCE.

22. EXCEPT AS SPECIFICALLY PROVIDED OTHERWISE IN THIS LICENSE, THE LICENSEE SHALL CONDUCT ITS PROGRAM IN ACCORDANCE WITH THE STATEMENTS, REPRESENTATIONS, AND PROCEDURES CONTAINED IN THE DOCUMENTS, INCLUDING ANY ENCLOSURES, LISTED BELOW. THE CABINET FOR HEALTH SERVICES REGULATIONS, 902 KAR 100, SHALL GOVERN UNLESS STATEMENTS, REPRESENTATIONS, AND PROCEDURES IN THE LICENSEE'S APPLICATION AND CORRESPONDENCE ARE MORE RESTRICTIVE THAN THE REGULATION.

A. APPLICATION DATED NOVEMBER 9, 2009, SIGNED BY JOHN R. O'NEIL, DIRECTOR.

B. LETTERS DATED:

1. APRIL 16, 2010, SIGNED BY JOHN R. O'NEIL, DIRECTOR.
2. JUNE 7, 2010, SIGNED BY RICHARD SAUER, PRESIDENT.
3. JULY 6, 2010 (EMAIL), SIGNED BY RICHARD SAUER, PRESIDENT.
4. JANUARY 10, 2012, SIGNED BY RICHARD E. SAUER, PRESIDENT (CHANGING RSO).
5. MARCH 22, 2012, SIGNED BY RICHARD E. SAUER, PRESIDENT AND CHRISTOPHER E. ECHTERLING, CRSO (GRANTING SIGNATURE OF AUTHORITY).
6. MAY 17, 2012, EMAIL FROM RICHARD SAUER, PRESIDENT (RESTRICTING POSSESSION LIMIT).
7. JULY 27, 2012, SIGNED BY RICHARD SAUER, PRESIDENT (RESTRICTING H-3 POSSESSION LIMIT BELOW FINANCIAL ASSURANCE QUANTITIES).

8. SEPTEMBER 19, 2012, SIGNED BY CHRIS ECHTERLING, RADIATION SAFETY OFFICER (ADD DEPLETED URANIUM).
9. APRIL 16, 2013, SIGNED BY MARK T. RUST, PRESIDENT (DELETE/ADD CONTACT AND AUTHORIZED USER).
10. JANUARY 8, 2015, SIGNED BY CHRIS ECHTERLING, RSO (DELETE LETTER FROM ERIC LANING).
11. NOVEMBER 23, 2015, SIGNED BY CHRIS ECHTERLING, RADIATION SAFETY OFFICER (CHANGE DISCIPLINE CODE).

Mark McKinley

MANAGER
RADIATION HEALTH BRANCH

VICKIE YATES BROWN GLISSON

SECRETARY
CABINET FOR HEALTH AND FAMILY SERVICES

DATE ISSUED DECEMBER 17, 2015

Blue Ridge Landfill Radiation Dose Assessment Plan

Advanced Disposal Services
Blue Ridge Landfill
2700 Winchester Road
Irvine, KY 40336

March 16, 2016

Prepared by:
Risk Assessment Corporation
417 Till Road
Neeses, SC 29107
803-536-4883

TABLE OF CONTENTS

1.0 INTRODUCTION 5
2.0 FACILITY DESCRIPTION 6
3.0 RISK ASSESSMENT CORPORATION 6
3.1 Company History and Expertise 6
3.2 Helen A. Grogan, PhD., Cascade Scientific, Inc. 8
3.3 Tom Johnson, Ph.D., CHP 8
3.4 H. Justin Mohler, M.S., Bridger Scientific, Inc. 8
3.5 Arthur S. Rood, M.S., K-Spar, Inc. 9
3.6 Emily Caffrey, PhD., Independent Consultant 9
4.0 DOSE ASSESSMENT 9
4.1 Task 1: Collect and compile available environmental data in RACER 10
4.2 Task 2: Provide recommendations for additional monitoring data 10
4.3 Task 3: Develop inventories and source term 10
4.4 Task 4: Identify potential pathways of transport 13
4.5 Task 5: Provide dose estimates associated with different scenarios of exposure for present day and future 14
4.6 Task 6. Communication of radiation dose 15
5.0 QUALITY ASSURANCE PROJECT PLAN 16
6.0 REPORT 16
7.0 SCHEDULE 16

TABLES

Table 1: Relevant TENORM radionuclides and their half-lives 11
Table 2: Proposed schedule 16

FIGURES

Figure 1: Uranium-238 decay scheme showing the short-lived progeny that would be present if the parent is present. 12
Figure 2: Thorium-232 decay series showing the short-lived progeny that would be present if the parent is present. 13

1.0 INTRODUCTION

Advanced Disposal Services will conduct a Radiation Survey and Site Investigation (RSSI) at their Blue Ridge Landfill located in Irvine, KY if it is verified that TENORM was disposed of at the landfill. The focus of such a survey will be an area that coincides with where specific shipments of any such Technically Enhanced Naturally Occurring Radioactive Material (TENORM) was buried in this municipal landfill.

Advanced Disposal has retained Chase Environmental Group, Inc. (Chase) to develop and implement the RSSI. Project activities will be conducted under the Chase Commonwealth of Kentucky Radioactive Materials License 201-605-15. On-site survey activities are expected to be conducted as an iterative process over several mobilizations.

Advanced Disposal has also retained Risk Assessment Corporation (RAC). If it is verified that TENORM was disposed of at that landfill, RAC will conduct a dose assessment to determine doses to onsite and offsite receptors associated with specific shipments of alleged TENORM to the site.

The goals of the RSSI would include determining the lateral and vertical extent of any TENORM materials that may have been placed on site, identifying radionuclides of concern, and collecting information necessary to conduct a comprehensive dose assessment that includes both retrospective and prospective doses to on-site and off-site receptors. The dose assessment would include a characterization of the alleged TENORM materials, an analysis of feasible exposure pathways and consider the geology and hydrology of the area, background radiation, population distribution, meteorology, climatology, current and future land uses, and landfill construction.

The dose assessment and RSSI will provide the basis for identifying any necessary actions at the site.

2.0 FACILITY DESCRIPTION

The Blue Ridge Landfill is located in Irvine, KY at 2700 Winchester Road. It is a Municipal Waste Landfill operated by Advanced Disposal Services.

The facility opened in 1984 and is permitted by the Kentucky Department of Environmental Protection. The facility currently accepts 550 tons of waste per day on average including Municipal Solid Waste, Construction and Demolition Debris, Municipal and Industrial Sewage Sludges, Special Wastes, Contaminated Soils, and residual wastes.

The facility is included in several Solid Waste Plans and has contracts with Municipal, Industrial, and Residual waste generators in KY and surrounding states. Blue Ridge is permitted to accept waste from all counties in Kentucky as well as Indiana, Illinois, Pennsylvania, Georgia, North Carolina, Virginia, West Virginia, Michigan, Ohio, Tennessee, South Carolina, and accepts waste from Advanced Disposal subsidiaries and third party companies.

3.0 RISK ASSESSMENT CORPORATION

3.1 Company History and Expertise

Risk Assessment Corporation (RAC) was founded by Dr. John Till in 1977 (www.racteam.com). Dr. Till leads a team of independent scientists and has concentrated his 40-year career on radiological and chemical environmental risk assessment (see attached CV). This science is multidisciplinary, requiring individuals with a number of different skills to work together as an integrated team. RAC team members bring together technical skills and problem-solving experiences from a wide variety of disciplines, including dose and risk assessment, onsite and offsite monitoring, data evaluation, process engineering, environmental transport modeling, database development and use, geographic information systems integrated with databases and assessment models, radiation biology, and interactive public involvement. The RAC team combines the scientific knowledge, technical expertise, and open communication required to understand and complete tasks in a competitive manner.

Since RAC was formed in 1977, RAC team members have been integral members of and advisors to nationally and internationally recognized organizations including the National Academy of Sciences, the National Council on Radiation Protection and Measurements, the International Commission on Radiological Protection, the Atomic Energy Agency, the Environmental Protection Agency Science Advisory Board, and the United Nations Scientific Committee on the Effects of Atomic Radiation.

RAC has a great deal of experience in developing and applying methods to determine how people may be exposed to contaminants in the environment and in assessing the health effects associated with such exposures. Depending on the situation, this may involve piecing together evidence to evaluate past exposures for historical dose reconstruction, evaluating the present-day situation at a facility or location and, if appropriate, the likely future impacts, or assessing the potential impact of planned or unplanned releases.

Examples of RAC's work include reconstructing doses and risks to the public from radioactive materials released from the Fernald Feed Materials Production Center during its 38 years of operation near Fernald, Ohio; reconstructing historical public exposures from the former Rocky Flats Nuclear Weapons Plant near Denver, Colorado that operated from 1952 – 1989. Later, RAC also worked with the Radionuclide Soil Action Level Oversight Panel to develop recommendations for soil cleanup at the former Rocky Flats Site. The panel consisted of a mix of technical specialists and individuals with no technical experience drawn from public interest groups, local governments, and the general public.

In 1997, RAC was asked by the Department of Justice to perform a series of technical audits of Los Alamos National Laboratory for compliance with the Clean Air Act, 40 CFR 61, subpart H. The project was initiated by a lawsuit filed by Concerned Citizens for Nuclear Safety (CCNS) against the U.S. Department of Energy and the former director of Los Alamos National Laboratory. Settlement of the suit required that the audits be performed by an organization agreed to by all parties, and RAC was chosen as the independent auditor. The audit process was a success and led to significant improvements in the compliance program at LANL.

RAC is currently contracted by the U.S. Nuclear Regulatory Commission (NRC) to present up to five one-week training courses on risk assessment to NRC staff. RAC presented the first course to NRC staff in April 2015, and is scheduled to present a second course in May 2016. The contract runs through 2019.

RAC has developed the RACER© system over the last 10 years. RACER is an innovative method that converts environmental data directly to human health risk to facilitate and enhance decision making and communication about risks from chemicals and radionuclides in the environment. RAC developed RACER to facilitate easy access to and use of environmental measurement data for a variety of applications, ranging from basic data evaluation to more complex exposure analysis and risk calculations. RACER integrates scientific approaches with data management expertise, informed by years of experience in dose and risk assessment. The result is an approach geared toward turning data into knowledge that can be effectively communicated to a diverse audience, starting with clear objectives and using integrated processes and flexible design to make technically sound decisions. This is accomplished through the implementation of customer-

specific processes and tools with a focus on stakeholder interaction and sustainability.

RACER consists of three basic elements: managing information, converting information to knowledge, and communicating knowledge to decision makers and stakeholders. Data are maintained in a web-accessible database that accepts data as they are validated and uploaded. The user can select data for evaluation and convert them to knowledge using human health risk as a benchmark for ranking radionuclides, chemicals, pathways, or other criteria needed to make decisions. Knowledge about risk is communicated using graphic and tabular formats. The process is transparent, flexible, repeatable, and rapid, which enhances credibility and trust among decision makers and stakeholders. The fundamental principles used in RACER can be applied anywhere radionuclides or chemicals are present in the environment.

John Till can be reached at 803-536-4883.

3.2 Helen A. Grogan, PhD., Cascade Scientific, Inc.

Dr. Grogan has more than 25 years of experience in radioecology, dose reconstruction, and the assessment of radioactive and non-radioactive hazardous wastes (see attached CV). She is co-editor of Radiological Risk Assessment and Environmental Analysis (Oxford University Press, 2008). Dr. Grogan has been a member of the U.S. Delegation to the United Nations Scientific Committee on the Effects of Atomic Radiation, since 2014, and she is a member of the National Council for Radiation Protection and Measurements.

3.3 Tom Johnson, Ph.D., CHP

Dr. Thomas Johnson, CHP is an Associate Professor in the Department of Environmental and Radiological Health Sciences at Colorado State University (see attached CV). He holds a B.S. from Southern Illinois University, an MBA from the University of Illinois, an M.S. in Environmental Engineering from Northwestern University, and a Ph.D. in Health Physics from Purdue University. His research efforts are on decontamination, health effects of uranium mining, the effect of lasers on the skin and cornea and laser safety standards. Current research projects include determination of best methods to decontaminate livestock, and fate of in-situ recovery uranium mines. He is a member of the Governor's Radiation Advisory Committee for the State of Colorado, serves on the Colorado State University Radiation Safety Committee, and a member of the American National Standards Institute Z136 editorial working group. Dr. Johnson served on the Scientific Advisory Board/Radiation Advisory Committee Panel on Uranium In-Situ Recovery.

3.4 H. Justin Mohler, M.S., Bridger Scientific, Inc.

Mr. Mohler has more than 15 years of experience in various aspects of environmental health physics, including sampling and measurement, tabular and spatial data interpretation, transport modeling, exposure and risk assessment,

communication and presentation of technical information, and database design and management (see attached CV).

3.5 Arthur S. Rood, M.S., K-Spar, Inc.

Mr. Rood has more than 25 years of experience in multimedia assessment of contaminants in the environment (see attached CV). His broad range of experience includes data collection and analysis, instrumentation, multimedia contaminant transport modeling, and dose and risk assessment. Mr. Rood develops state-of-the-art models — whether atmospheric, groundwater, terrestrial, or aquatic — to address specific issues with an appropriate level of complexity. Mr. Rood recently gave an invited presentation on exposure pathways from Technically Enhanced Naturally Occurring Radioactive Material (TENORM) at an NCRP workshop on TENORM in unconventional oil and gas production and is a member of the HPS/ANSI standards committee on TENORM. Mr. Rood is also a member of ICRP Task Group 98, Application of the Commission's Recommendations to exposures resulting from contaminated sites from past industrial, military, and nuclear activities.

3.6 Emily Caffrey, PhD., Independent Consultant

Dr. Caffrey graduated in January 2016 with her Ph.D. in Radiation Health Physics (see attached CV). Her research includes environmental dose assessment and computational dosimetry methods, and her doctoral research was included in a technical program sponsored by the International Commission on Radiological Protection.

4.0 DOSE ASSESSMENT

Any Dose Assessment must necessarily await the verification of whether TENORM waste was disposed of at the landfill, including physical and chemical characteristics, volumes and locations. The following tasks will be undertaken if it is confirmed that TENORM was disposed of at the landfill and pending the receipt of the requisite data from the Radiation Survey and Site Investigation Plan.

As radiation dose criteria cannot be measured directly, regulatory compliance is demonstrated by pathway analysis and dose modeling. The environmental monitoring and radiological survey data that are collected by Chase as part of the RSSI will be used to conduct a comprehensive assessment of historical, current, and future doses to on-site and off-site receptors. The dose assessment will include an analysis of all feasible exposure pathways and consider the geology and hydrology of the area, background radiation levels, population distribution, meteorology, climatology, current and future land uses, and landfill construction. Doses will be reported as total effective dose equivalent as defined in 90 KAR 100:010 Section 1 (312). Records relating to the dose assessment will be retained per 902 KAR 100:019 Section 34, and will be provided as required by 902 KAR 100:165, Section 3. The dose assessment methods, data, calculations and

conclusions will be reviewed and approved by Dr. Thomas Johnson, a Certified Health Physicist (CHP).

The dose assessment has been divided into six tasks. Each task is described in the following subsections.

4.1 Task 1: Collect and compile available environmental data in RACER

The first task will be to compile the sampling and monitoring data that are collected by Chase as part of the RSSI. In addition, environmental measurement data that have been collected by any other agencies (e.g., State of Kentucky, county agencies, etc.) in the vicinity of the facility will be identified and compiled. The data would include isotope-specific concentrations primarily in air, soil, and water and also any external exposure or dose rate measurements. An important component of this effort will be to obtain location coordinates for all sampling locations. Once identified, these data will be organized, standardized, and compiled in the RACER system used by RAC to efficiently manage and use environmental monitoring data for the purpose of understanding potential doses and risks associated with exposure to affected environmental media.

4.2 Task 2: Provide recommendations for additional monitoring data

The available data compiled in Task 1 will be reviewed. RAC will provide recommendations to Chase for additional monitoring that may be needed to characterize either the disposed waste or environmental media concentrations to which people may have been exposed. This may include additional monitoring to help fill gaps in spatial coverage, analyses for potentially important isotopes that may not be included in currently available data, and/or collection of samples for media that may not have been sampled already.

4.3 Task 3: Develop inventories and source term

The inventory refers to the total activity, volume, and radionuclide composition of TENORM materials that was disposed in the landfill. The source term uses the inventory estimates and the geographical location of the TENORM, coupled with release mechanisms and models to estimate the quantity of TENORM materials that are released to the environment (i.e., air, soil, and water) per unit time. In this case, the inventory will be based on waste disposal manifests for the TENORM disposals, the time frame in which it was disposed in the landfill, estimated volume of TENORM disposed, and available waste characterization analyses.

Important TENORM radionuclides with half-lives greater than 5-years are presented in

Table 1. There are numerous short-lived radioactive progeny that would also be present if any of the parents are present in the source term. The uranium-238 and thorium-232 decay series are the two primary TENORM decay series (see Figure 1 and Figure 2). The uranium-235 decay series is also present in TENORM, but because of its low isotopic abundance it is generally not as important as the uranium-238 and thorium-232 decay series.

Table 1: Relevant TENORM radionuclides and their half-lives

Radionuclide	Half-life (years)
U-238	4.47×10^{9}
U-235	7.04×10^{8}
U-234	2.46×10^{5}
Th-230	7.538×10^{4}
Ra-226	1.6×10^{3}
Pb-210	22.5
Th-232	1.405×10^{10}
Ra-228	5.75
Pa-231	3.276×10^{4}

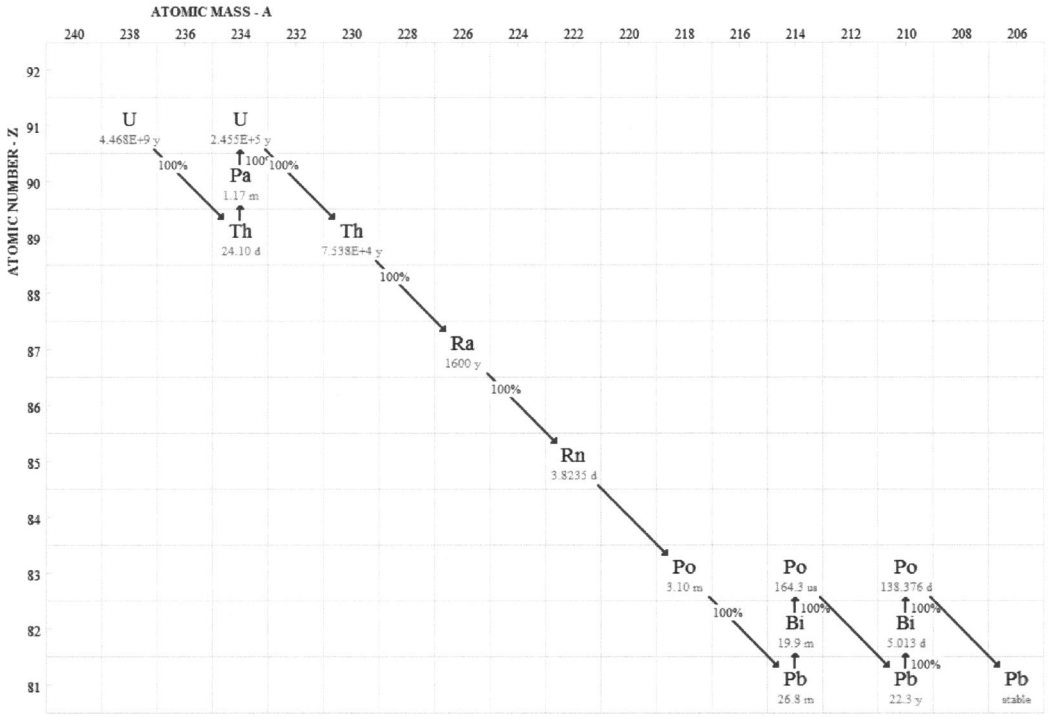


Figure 1: Uranium-238 decay scheme showing the short-lived progeny that would be present if the parent is present.

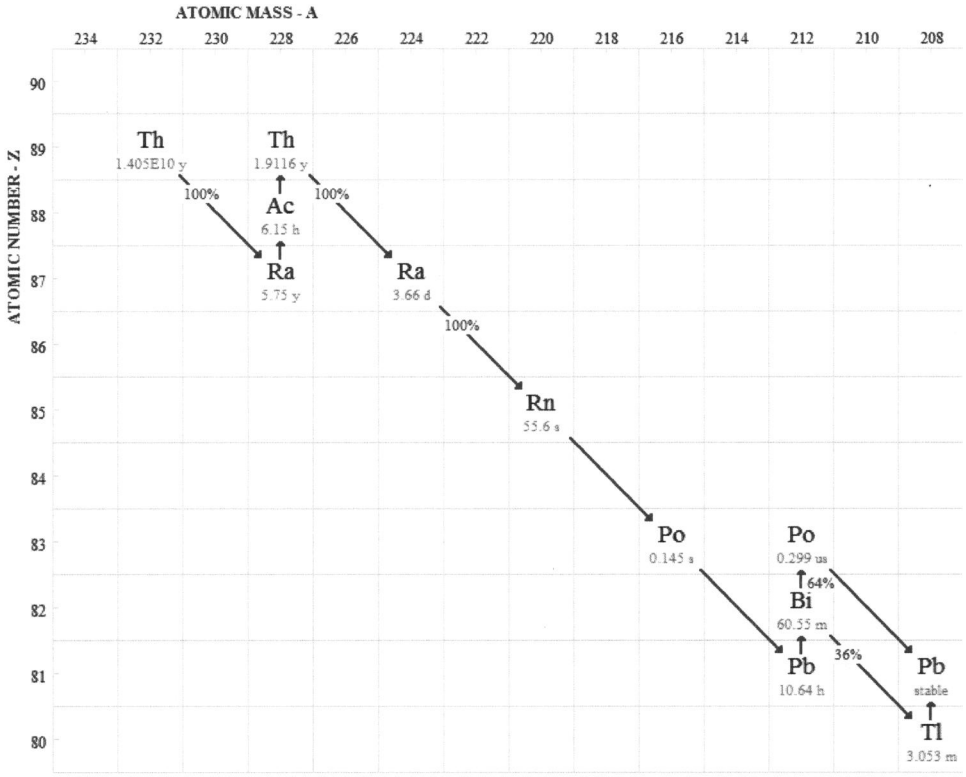


Figure 2: Thorium-232 decay series showing the short-lived progeny that would be present if the parent is present.

4.4 Task 4: Identify potential pathways of transport

TENORM radionuclides in a landfill may be subject to suspension into the ambient air, deposition from the air at both onsite and offsite locations, and leaching into the subsurface that may potentially migrate to underlying aquifers. Emission of Radon-222 to the ambient air derived from the decay of Ra-226 may also present an additional exposure pathway. For workers at the facility, gamma emissions from TENORM radionuclides may present an external exposure pathway.

This task will focus on identifying the potential transport pathways of the disposed TENORM waste, taking into consideration the volumes and activities of the TENORM waste, the placement within the facility, and mitigating factors such as earthen and synthetic covers and landfill liners that may inhibit movement of TENORM from the facility. A distinction will be made between potential offsite exposures and onsite exposures for the present day and in the future.

4.5 Task 5: Provide dose estimates associated with different scenarios of exposure for present day and future

Radiation dose criteria are contained in 902 KAR 100:022, Licensing requirements for land disposal of radioactive waste. Section 18, Protection of the General Population from Releases of Radioactivity, specifies dose criteria for members of the public from land disposal of radioactive wastes: *"A concentration of radioactive material that may be released to the general environment in groundwater, surface water, air, soil, plants, or animals shall not result in an annual dose exceeding an equivalent of twenty-five (25) millirems to the whole body, seventy-five (75) millirems to the thyroid, and twenty-five (25) millirems to any other organ of a member of the public. Reasonable effort shall be made to maintain releases of radioactivity in effluents to the general environment as low as it is reasonably achievable."*

To demonstrate compliance with this regulation, a dose assessment will be performed. Environmental monitoring data coupled with exposure scenario development and modeling will be used to estimate doses to workers and members of the public. The dose assessment will include present day doses to land fill workers and the general public, and future doses assuming the material remains within the landfill. Because the landfill is not a licensed radioactive waste disposal site, workers are not considered radiation workers, and are therefore subject to public radiation dose exposure limits. Pathways of exposure for the present day would include inhalation of particulate radionuclides and radon gas, inadvertent soil ingestion, skin dose from radionuclides deposited on skin and clothing, and external exposure. Because the facility is lined, the groundwater pathway is not expected to be a relevant pathway for the present time, but an assessment of doses from water collected in the leachate collection system will be performed. A prospective dose assessment will be performed assuming the TENORM material is to remain in the landfill. Pathways of exposure for the prospective assessment will include present day exposure pathways and groundwater, because the liner system is not expected to last indefinitely.

As part of Task 1, all environmental monitoring data and key exposure parameters will be organized and uploaded into the RACER system. Radionuclide concentrations in the waste material will be required for this step. These measurements should include isotopes of uranium (U-238, U-235, and U-234), thorium (Th-230, Th-232), and radium (Ra-226, Ra-228), along with Pb-210. Radon-222 measurements in ambient air and or radon flux measurements on the surface of the waste site will also be necessary. RACER forms the foundation of dosimetry for both workers and the public, and allows for the estimation of person-specific doses as outlined below.

Calculating radiation dose is a multi-step process. First, environmental monitoring data are used to define radionuclide concentrations in environmental media to which workers and the public may be exposed. Models may be used to estimate

environmental media concentrations that are lacking measurements. Second, scenarios in which receptors may be exposed to radionuclides in the environment are evaluated for their significance. Dose to any specific receptor will depend on their lifestyle, age, occupational and non-occupational activities, and a host of other individual parameters. In order to convert the amount of radiation taken into the body or delivered externally into a measure of dose, dose coefficients (DCs) are used. Dose coefficients have been developed by numerous national and international organizations, including the U.S. Environmental Protection Agency (U.S. EPA) and International Commission on Radiological Protection (ICRP), and are tabulated for specific age groups and radionuclides. For these calculations, dose coefficients published by the U.S. EPA in Federal Guidance Report 13 are recommended.

Present day dose estimates will be made with the RACER tool. Prospective dose estimates will require an assessment of the groundwater pathway, along with decay, ingrowth, and leaching calculations. These calculations will use a combination of the RACER tool and external fate and transport models. A simple, but conservative assessment of groundwater will be performed using the U.S. Department of Energy code RESRAD or another model with a similar level of complexity.

The dose estimates associated with the different exposure scenarios will be summarized and the need for any potential actions related to the TENORM identified.

All dose calculations will be reviewed and approved by Dr. Thomas Johnson, a Certified Health Physicist (see attached CV).

4.6 Task 6. Communication of radiation dose

The communication of dose is just as important as its estimation. This communication is important for understanding the options identified for potential corrective actions based on the RSSI and dose assessment. RAC will assist the client in communicating how dose and risk from radiation exposure are calculated and what the exposures mean in terms that both workers and the public can understand.

We will base this task on many years of experience we have had in the field of radiological risk assessment working with stakeholders who have an interest. We believe the best approach to take is to engage stakeholders in an open and transparent process to earn trust and credibility as the assessment process evolves. This approach can best be undertaken through public meetings and smaller working groups who can provide site specific input to the assessment process in the form of exposure scenario development, concerns about potential long term exposures, and possible comparison values that help put potential risk into

perspective. The precise steps that need to be taken to build credibility and trust with stakeholders will be identified and coordinated through the client.

5.0 QUALITY ASSURANCE PROJECT PLAN

Quality control checks are performed on the data as it is uploaded into RACER. Additionally, hand calculations are performed to verify the accuracy of the dose calculation module.

6.0 REPORT

At the completion of activities, RAC will submit a report of project activities and a comprehensive dose assessment.

7.0 SCHEDULE

A tentative schedule for the next 6 months for RAC and Chase is provided below.

Table 2: Proposed schedule

Target	Tasks	Lead Firm
April 15	Perform offsite surveys and sample collection with input from RAC	Chase
April 15	Perform subsurface sampling in fill area	Chase
April 15	Perform leachate sampling	Chase
April 29	Compile currently available data into RACER database. Develop a preliminary source term.	RAC
May 27	Compile April sampling data into RACER database and provide final source term. Identify all feasible transport pathways and exposure scenarios. Set up transport and dose calculations.	RAC
June 24	Calculate on-site and off-site present-day doses.	RAC
July 29	Calculate on-site and off-site prospective doses.	RAC
August 26	Review calculations and provide report and necessary dose assessment records.	RAC

Blue Ridge Landfill Radiation Dose Assessment Plan

Advanced Disposal Services
Blue Ridge Landfill
2700 Winchester Road
Irvine, KY 40336

Curriculum Vitae of Risk Assessment Corporation Staff

March 16, 2016

Prepared by:
Risk Assessment Corporation
417 Till Road
Neeses, SC 29107
803-536-4883

John E. Till, Ph.D.
President, Risk Assessment Corporation

Education

Ph.D., Nuclear Engineering, Georgia Institute of Technology, Atlanta, Georgia, 1976
M.S., Health Physics, Colorado State University, Fort Collins, Colorado, 1972
U.S. Naval Nuclear Propulsion Program, Submarine Force. Three schools consisting of Nuclear Power School, Mare Island, California; S5G Prototype NPTU, Idaho Falls, Idaho; Submarine School, Groton, Connecticut
B.S., Engineering (with distinction), U.S. Naval Academy, Annapolis, Maryland, 1967

Professional Experience

Risk Assessment Corporation (formerly ***Radiological Assessments Corporation***)
President/Owner, Neeses, South Carolina (1977–present)

Owner and president of *Risk Assessment Corporation, Inc.* (formerly *Radiological Assessments Corporation*), which focuses on the analysis of exposure and dose from radionuclides and chemicals released to the environment. Conducting research contracts for the Environmental Protection Agency, Vanderbilt University, Colorado State University, National Cancer Institute, Centers for Disease Control and Prevention, Chem-Nuclear Corporation, Oak Ridge National Laboratory, Battelle Pacific Northwest Laboratory, Du Pont Company, University of Utah, Colorado Department of Public Health and Environment, Department of Justice, Battelle Pacific Northwest Laboratories, the New Mexico Department of Environment, Pueblo de San Ildefonso, among others.

Embeford Farm
President/Owner (1000-acre family farm), Neeses, South Carolina (1977–present), producing corn and soybeans.

Oak Ridge National Laboratory
Research Associate, Oak Ridge Tennessee (1974–1977)

Conducted assessments of radiological impacts around nuclear facilities, performed studies to evaluate environmental impact of advanced fast reactor fuels, and developed and improved models to evaluate radionuclide releases to the environment.

Consultant, Allied-General Nuclear Services
Consultant, Barnwell, South Carolina (1973–1974)

Developed an in-plant health physics training program and wrote the *Safety and Environmental Control Department Policy Manual* for a nuclear fuel reprocessing plant being constructed by Allied-General Nuclear Services.

Georgia Institute of Technology
Research Assistant, Atlanta, Georgia (1973–1974)

Provided research and teaching support in the School of Nuclear Engineering.

Colorado State University
Research Assistant, Fort Collins, Colorado (1971–1972)

Developed and tested an instrument that rapidly measures working level exposure of radon daughters.

U.S. Navy, Nuclear Submarine Force (active duty)
Officer (1967–1971)

Became qualified to operate an S5W nuclear reactor and qualified in submarines. Other responsibilities included reactor control officer, electrical division officer, and operations officer.

Special Awards/Positions

37th Taylor lecture presented on March 11, 2013 at the annual meeting of the National Council on Radiation Protection and Measurements, Bethesda, MD.

Recipient of the E.O. Lawrence Award in the field of environmental science and technology. Award is presented to several outstanding scientists each year following nominations sought from over 2000 organizations, 1995

Recipient of Elda E. Anderson Award presented annually to a member of the Health Physics Society less than 40 years of age for excellence in contributions to the profession of health physics and the Society, 1983

Technical Advisor to Board of Directors, Exelon Corporation, (Current)

Member, International Commission on Radiological Protection (ICRP), Committee 4, 1997–2006

Chairman, Radiation Advisory Committee, Science Advisory Board, U.S. Environmental Protection Agency, member Executive Committee Science Advisory Board, U.S. Environmental Protection Agency, 1986–1987

Chairman, South Carolina Governor's Nuclear Advisory Council, 1987–1989

Advisor to Dean, University of Utah School of Medicine, "Assessment of Leukemia and Thyroid Disease in Relation to Fallout in Utah," 1986–1994

Adjunct Professor of Physics, Emory University, Atlanta, Georgia, 1985–1995

Chairman, Technical Steering Panel, Hanford Dose Reconstruction Project, 1988–1994

Professional Activities

National Council on Radiation Protection and Measurements (NCRP)
Distinguished Emeritus Member, NCRP, 2003–present

Member, National Council on Radiation Protection and Measurements (NCRP), 1984–2003.

Chairman NCRP Scientific Committee 6-8 Operation TOMODACHI Radiation Dose Assessment, 2012-2014

Member, NCRP Committee 6-9, Dosimetry on the One-mIllion Worker Study, 2012-current.

NCRP 2013 Annual Meeting Committee, 2012-2013

MemberAdvisor, NCRP Scientific Committee 6-22, "Design of Effective Radiological Effluent Monitoring and Environmental Surveillance Programs" NCRP Publication 169, 2009–2012

Chairman, NCRP Committee 64, Umbrella Committee on Environmental Issues, 1996–2003

Strategic Planning Committee, 1999-2000

President Selection Committee for successor to Dr. Warren Sinclair, 1992-1993

Member, NCRP Board of Directors, 1989–1994

Member, NCRP Nominating Committee, 1988–1993

Chairman, NCRP Program Committee for Year 2003 Annual Meeting of the NCRP, "Radiation Protection at the Beginning of the 21st Century–A Look Forward"

Member, Program Committee for Year 2000 Annual Meeting of the NCRP, "Past and Future Bases for Setting Radiation Protection Standards"

Member, National Council on Radiation Protection and Measurements Scientific Committee 64 on Environmental Radioactivity, 1985–2002

Chairman, NCRP Scientific Committee 64–19, "Dose Reconstruction," 1994–2000

Chairman, NCRP Program Committee for 1995 Annual Meeting, "Environmental Dose Reconstruction and Risk Implications," April 12–13, 1995, Crystal City, Virginia

Chairman, NCRP Task Group on Disposal of Low-Level Radioactive Waste in Oceans, National Council on Radiation Protection and Measurements, 1985–1990

Chairman, NCRP Committee 64–6, "Screening Models," NCRP Publication 123 1982-1994

Chairman, NCRP Committee 64–2 and 3, "Radiological Assessment," NCRP Publication 76, 1978–1982

Chairman, NCRP Committee for Comentary No. 3, "Screening Techniques for Determining Compliance with Environmental Standards," 1986 (Rev. 1989)

Member NCRP Task Group on "Guidelines for the Release of Waste Water from Nuclear Facilities with Special Reference to Public Health Significance of the Proposed Release of Tritiated Waters from Three Mile Island," NCRP Commentary No. 4, 1987

National Academy of Sciences

Chairman, National Academy of Sciences Committee, "A Review of the Dose Reconstruction Program of the Defense Threat Reduction Agency," 2001-2003

Member, National Academy of Sciences "Advisory Committee to Study the Mortality of Military Personnel Present at Atmospheric Tests of Nuclear Weapons," 1994-2000

Member, National Academy of Sciences Committee to Provide Interim Oversight of the Department of Energy Nuclear Weapons Complex, 1988–1989

Member, "Mortality of Military Personnel Present at Atmospheric Tests of Nuclear Weapons," National Academy of Sciences, 1993–1995

Chairman, Dosimetry Working Group, "Mortality of Military Personnel Present at Atmospheric Tests of Nuclear weapons," National Academy of Sciences, 1993–1995

International Commission on Radiological Protection (ICRP) and International Atomic Energy Agency (IAEA)

Member, Committee Four of the International Commission on Radiological Protection (ICRP) 1997-2005.

Chairman, ICRP Task Group on "Defining the Individual," 2002-2005.

Member, International Commission on Radiological Protection Committee on Prolonged Exposures, 1997–2000.

Member, International Commission on Radiological Protection Working Party on Controllable Doses, 1997-2000

Chairman, International Commission on Radiological Protection Working Party on Environmental Doses, 1997–2000.

Special Appointments

Appointment by the Secretary of Energy to the Department of Energy Commission on Fire Safety and Preparedness, November 2000–2001

Scientific Review Group, U.S. Department of Energy, Joint Coordinating Committee for Radiation Effects Research, 1995–1997.

Consultant to U.S. Nuclear Regulatory Commission, Advisory Committee on Reactor Safeguards, 1986–1990.

Chairman, Advisory Panel, "Managing Nuclear Materials from Warheads: Weapons Dismantlement and Its Aftermath," Office of Technology Assessment, Congress of the United States, June 1992–1993

Illinois Department of Nuclear Safety Technical Advisory Panel on Low-Level Waste Disposal Systems, 1986–1989.

Member, U.S. Department of Energy Committee on Research on the Validation of Predictive Models Resulting from the Chernobyl Nuclear Accident, 1986–1988

Member, Department of Energy "Joint Coordinating Committee on Radiation Effects Research," 1995–1997

Professional Society Memberships and Activities

Health Physics Society

Chairman, Education and Training Committee, Health Physics Society, 1975–1979.

Councilman, East Tennessee Chapter, Health Physics Society, 1975–1977.

Program Chairman, "Pathway Analysis and Risk Assessment," 1989 Health Physics Society Summer School, St. John's College, Santa Fe, New Mexico, June 18–23, 1989.

Program Chairman, "Assessment of Releases of Radioactivity to the Environment," 1980 Health Physics Society Summer School, University of Washington, Seattle, Washington, July 14–18, 1980.

Program Chairman, "A Seminar on Solid Radioactive Waste Storage in the United States," sponsored by the East Tennessee and Bluegrass Chapters of the Health Physics Society at Mammoth Cave, Kentucky, September 18, 1976.

Member, Committee on Scientific and Public Issues, Health Physics Society, 1979–1981.

Society for Risk Analysis

Society of Exposure Analysis

American Nuclear Society

American Association for the Advancement of Science

Journal Editorship

Editor, *International Radiation Protection Association* ***BULLETIN,*** 1988–1992.

Editor for Environmental Consequences Section of *Nuclear Safety,* 1975–1977.

Health Physics Advisory Board, 1988–1992.

Editor, "Radiation Protection at the Beginning of the 21st Century-A Look Forward," *Health Physics*.

Military

Rear Admiral, U.S. Naval Reserve, 1991–1999, retired

Mobilization Assistant to U.S. Strategic Command, 1998-1999

Deputy Commander, Submarine Operations, N87R, Washington, D.C., 1994–1997.

Deputy Commander, Submarine Force U.S. Atlantic Fleet, Norfolk, Virginia, 1991–1994

Commander Naval Reserve Readiness Command, Region Ten, New Orleans, Louisiana, 1992–1994.

Commanding Officer, Naval Weapons Station, HQ107, Charleston, South Carolina, 1988–1990.

Member, National Naval Reserve Policy Board, 1989–1992.

Commanding Officer, Naval Electronic Systems Engineering Command DET 407, 1985–1987.

Management Information Officer, Naval Reserve Readiness Command Region Seven, Charleston, South Carolina, 1983–1985.

Commanding Officer, AS–40 FRANK CABLE, DET 107, Charleston, South Carolina, 1981–1983.

Commanding Officer, Nuclear Weapon Training Group, DET 107, Charleston, South Carolina, 1979–1981.

Qualified in submarines.

Military Awards

National Defense Medal, 1999; Legion of Merit, 1994; Meritorious Service Medal, second award 1994; Meritorious Service Medal, 1990; Navy Commendation Medal, second award 1987; Navy Commendation Medal, 1984; Naval Reserve Service Medal, 1979; Navy Achievement Medal, 1971; National Defense Service Medal, 1964

Special Training and Certifications

Naval Nuclear Submarine Program including the following:

Six months (625 classroom hours) of instruction in the principles of science and engineering fundamental to design, construct, and operate a nuclear propulsion plant, July 1967–January 1968.

Six-month prototype training designed to provide on-the-job experience at starting up, operating, shutting down, and handling emergencies associated with nuclear propulsion plants, January 1968–August 1968.

Six months submarine school consisting of 675 hours of intensified instruction and 10 days of underway training aboard an operating submarine, August 1968–February 1969.

Certification to supervise the operation of a Naval Nuclear Reactor.

Training and certification to conduct experiments with highly toxic radioactive materials in a glove box, Oak Ridge National Laboratory, January 1968–April 1975.

Courses Taught and Offered

"Environmental Risk Assessment and Analysis," April 27—May 1, 2015, 15 Presented to staff of the US Nuclear Regulatory Commission, White Flint, MD, 15 attendees

"Radiological Risk Assessment for Decision-Making, Compliance, and Emergency Response," March 4-8, 2013, Washington, DC, 40 attendees

"Radiological Risk Assessment for Decision-Making, Compliance, and Emergency Response," March 5-9, 2012, Washington, DC, 40 attendees

"Environmental Risk Assessment Analysis," January 26-30, 2009, U.S. Nuclear Regulatory Commission, Washington, D.C. 25 attendees

"Three Short Courses for Regulators and Radiation Health Specialists: Emerging Topics in Radiation Protection and Risk Assessment," March 16 – 18, 2004, Kiawah Island, South Carolina, 25 attendees

"Calculating and Understanding Risk from Radionuclides Released to the Environment," November 15-19, 1999, Seattle, Washington, 40 attendees

"Calculating and Understanding Risk from Chemicals Released to the Environment," April 12-15, 1999, San Antonio, Texas, 30 attendees

"Chemical Risk Assessment—A Practical Approach for Making Risk-Based Decisions," April 27 – May 1, 1998, Santa Fe, New Mexico, 75 attendees

"Pathway Analysis and Risk Assessment for Environmental Compliance and Dose Reconstruction," November 6–10, 1995, Kiawah Island, South Carolina, 75 attendees

"Chemical Risk Assessment for Environmental Compliance and Dose Reconstruction," February 27–March 3, 1995, Kiawah Island, South Carolina, 85 attendees

"Pathway Analysis and Risk Assessment for Environmental Compliance and Dose Reconstruction," February 28–March 4, 1994, Kiawah Island, South Carolina, 150 attendees

"Risk Assessment and Public Communication," March 1–5, 1993, Kiawah Island, South Carolina, 85 attendees

"Pathway Analysis and Risk Assessment for Environmental Compliance and Dose Reconstruction," March 2–6, 1992, Kiawah Island, South Carolina, 150 attendees

"Pathway Analysis and Risk Assessment for Environmental Compliance and Dose Reconstruction," February 25–March 1, 1991, Kiawah Island, South Carolina, 90 attendees

"Calculating and Understanding Risk from Radionuclides Released to the Environment," April 28–May 2, 1997, Santa Fe, New Mexico, 150 attendees

"Chemical Risk Management–A Practical Approach for Implementing Risk-Based Corrective Action," April 27–May 1, 1998, Santa Fe, New Mexico, 75 attendees

"Calculating and Understanding Risk from Chemicals released to the Environment," April12-15, 1999, San Antonio, TX, 40 attendees

Peer Reviewed Publications and Technical Reports

Till, J.E. 1975. "A Comparison of the Potential Radiological Impact of Recycle ^{233}U Fuel and LMFBR Plutonium Fuel Released to the Environment." ORNL/TM-4768. January.

Parzyck, D.C., J.P. Witherspoon, and **J.E. Till**. 1976. "Validation of Environmental Transport Models in the CUEX Methodology." Chapter in *Radioecology and Energy Resources.* Edited by C.E. Cushing, Jr. New York: Dowden, Hutchinson & Ross, Inc.

Tennery, V.J., E.S. Bomar, W.D. Bond, S.V. Kaye, L.E. Morse, and **J.E. Till**. 1976. "Potential Generation and Radiological Impacts of Gaseous ^{14}C Released During Reprocessing of Advanced LMFBR Fuels." ORNL/TM-5538. June.

Tennery, V.J., E.S. Bomar, W.D. Bond, G.S. Hill, L.E. Morse, R.D. Seagren, L.B. Shappert, and **J.E. Till**. 1976. "Environmental Assessment of LMFBR Advanced Fuels—A Radiological Analysis of Fuel Reprocessing, Refabrication, and Transportation." ORNL-5230. November.

Till, J.E. 1976. "A Comparison of Environmentally Released Recycle ^{233}U Fuel and LMFBR Plutonium Fuel." Chapter in *Radioecology and Energy Resources.* Edited by C.E. Cushing, Jr. New York: Dowden, Hutchinson & Ross, Inc.

Till, J.E. 1976. "Assessment of the Radiological Impact of ^{232}U and Daughters in Recycled ^{233}U HTGR Fuel." ORNL/TM-5409. February.

Till, J.E. 1976. "The Toxicity of Uranium and Plutonium to the Developing Embryos of Fish." ORNL-5610. July.

Till, J.E. 1976. "Potential Radiation Doses from ^{14}C Produced in Advanced FBR Fuels." *Transcripts American Nuclear Society,* November 14–19.

Till, J.E. 1976. "Education and Training Opportunities in Health Physics." A brochure on education and training for the Health Physics Society. December.

Till, J.E. and Dennis C. Parzyck. 1976. "An Evaluation of Operational Exposures which could Result from Potential Environmental Releases of ^{232}U and Daughters." *Proceedings Ninth Midyear Topical Symposium on Operational Health Physics.* Denver, Colorado, February.

Emery, R.M., M.L. Warner, H.R. Meyer, C.A. Little, and **J.E. Till**. 1977. "Environmental Assessment Strategies in Support of the Nonproliferation Alternative Systems Assessment Program (NASAP)." PNL-2415. October.

Tennery, V.J., E.S. Bomar, **J.E. Till**, L.E. Morse, M. Pobereskin, and W.J. Madia. 1977. "Radiological Environmental Assessment of the Recycle of LMFBR Advanced Fuels" *Proceedings Advanced LMFBR Fuels.* Tucson, Arizona, October.

Till, J.E. 1977. "A Laboratory Technique for Obtaining Fathead Minnow Eggs for Use in Toxicity Experiments." *Prog. Fish. Cult.* **39**: pp. 24–27. April.

Till, J.E. 1977. "A Uniform Approach for On-Site Training and Qualification of Health Physics Technicians." *Health Physics* **32**: pp. 423–428. May.

Till, J.E. and M.L. Frank. 1977. "Bioaccumulation, Distribution, and Dose of ^{241}Am, ^{244}Cm, and ^{238}Pu in Developing Fish Embryos." *Proc. IVth International IRPA Congress.* Paris, France, April 24–30. pp. 645–648.

Till, J.E. and G.G. Killough. 1977. "Scenarios of ^{14}C Release from the World Nuclear Power Industry 1975–2020 and Estimated Radiological Insult to the Population." *Airborne Radioactivity.* Selected papers from 1977 ANS Winter Meeting. Edited by David Shaw. LaGrange, Illinois: American Nuclear Society Press.

Till, J.E., C.J. Barton, G.W. Parker. 1977. "Nuclear Energy: A Viable Alternative." *Aviation Medical Bulletin.* February.

Killough, G.G. and **J.E. Till**. 1978. "Scenarios of ^{14}C Release from the World Nuclear Power Industry 1975–2020 and Estimated Radiological Impact." *Nuclear Safety* **19** (5).

Tennery, V.J., E.S. Bomar, W.D. Bond, L.E. Morse, H.R. Meyer, **J.E. Till**, and M.G. Yalcintas. 1978. "Environmental Assessment of Alternate FBR Fuels: Radiological Assessment of Airborne Releases from Thorium Mining and Milling." ORNL/TM-6474. October.

Tennery, V.J., E.S. Boamr, W.D. Bond, H.R. Meyer, L.E. Morse, and **J.E. Till**. 1978. "Environmental Assessment of Alternate FBR Fuels: Radiological Assessment of Reprocessing and Refabrication of Thorium/Uranium Carbide Fuel." ORNL/TM-6493. August.

Meyer, H.R., **J.E. Till** et al. 1978. "Nonproliferation Alternative Systems Assessment Program (NASAP)—Preliminary Environmental Assessment of Thorium/Uranium Fuel Cycle Systems." ORNL/TM-6069. June.

Meyer, H.R. and **J.E. Till**. 1978. "Radiological Hazards of Denatured Fuel Isotopes," Section 3.3 in *Interim Assessment of the Denatured Uranium Fuel Cycle.* Edited by L.S. Abbott, D.E. Bartine, and T.J. Burns. ORNL-5388. December.

Till, J.E. 1978. "The Effect of Chronic Exposure to $^{238}Pu(IV)$ Citrate on the Embryonic Development of Carp and Fathead Minnow Eggs." *Health Physics* **34** (4).

Till, J.E., E.S. Bomar, L.E. Morse, and V.J. Tennery. 1978. "A Radiological Assessment of Reprocessing Advanced Liquid-Metal Fast Breeder Reactor Fuels." *Nuclear Technology* **37** (3). March.

Till, J.E., F.O. Hoffman, and D.E. Dunning. 1978. "Assessment of Technetium-99 Releases to the Atmosphere—A Plea for Applied Research." ORNL/TM-6260. June.

Etnier, E.L. and **J.E. Till**. 1979. "Significance of Incorporating Age-Dependent Data into Population Dose Estimates." *Health Physics* **37** (6).

Kocher, D.C. and **J.E. Till**. 1979. "Iodine-129 Dose to the World Population from the Nuclear Power Industry." *Trans. Am. Nuc. Soc.*, November 12–16.

Meyer, H.R. and **J.E. Till**. 1979. "Anticipated Radiological Impacts from the Mining and Milling of Thorium for the Nonproliferative Fuels." Invited paper, *Proceedings of the Symposium—Radioactivity and Environment.* Norderney, Federal Republic of Germany, October 2–6, 1978, IRPA.

Meyer, H.R., **J.E. Till**, E.S. Bomar, W.D. Bond, L.E. Morse, V.J. Tennery, and M.G. Yalcintas. 1979. "Radiological Impact of Thorium Mining and Milling." *Nuclear Safety* 20 (3).

Meyer, H.R., C.A. Little, J.P. Witherspoon, and **J.E. Till**. 1979. "A Comparison of Potential Radiological Impacts of ^{233}U and ^{239}Pu Fuel Cycles." *Trans. Am. Nuc. Soc.*, November 12–16.

Till, J.E. and G.G. Killough. 1979. "Scenarios for ^{14}C Release to the Atmosphere by the World Nuclear Industry and Estimated Radiological Impacts." Invited paper *Proceedings of the Symposium—Radioactivity and Environment,* Norderney, Federal Republic of Germany, October 2–6, 1978, IRPA.

Till, J.E., F.O. Hoffman, and D.E. Dunning. 1979. "A New Look at ^{99}Tc Releases to the Atmosphere." *Health Physics* **36** (1).

Tennery, V.J., E.S. Bomar, W.D. Bond, H.R. Meyer, L.E. Morse, **J.E. Till**, and M.G. Yalcintas. 1980. "Summary of Radiological Assessment of the Fuel Cycle for a Thorium/Uranium Carbide Fueled Fast Breeder Reactor." ORNL/TM-6953. May.

Till, J.E., H.R. Meyer, V.J. Tennery, E.S. Bomar, M.G. Yalcintas, L.E. Morse, and W.D. Bond. 1980. "Reprocessing Nuclear Fuels of the Future: A Radiological Assessment of Advanced (Th, U)C Fuels." *Nuclear Technology* **48** (1).

Till, J.E. , H.R. Meyer, E.L. Etnier, E.S. Bomar, R.D. Gentry, G.G. Killough, P.S. Rohwer, V.J. Tennery, and C.C. Travis. 1980. "Tritium—An Analysis of Key Environmental and Dosimetric Questions." ORNL/TM-6990. May.

Till, J.E., E.L. Etnier, and H.R. Meyer. 1980. "Updating the Tritium Quality Factor—The Argument for Conservatism." *Proc. Tritium Technology in Fission, Fusion, and Isotopic Applications.* American Nuclear Society National Topical Meeting, U.S. Department of Energy Document No. CONF-800427.

Till, J.E., 1981. "Radiological Assessment for Submerged Demineralizer System for Three Mile Island." *RAC* Report 1/81. *Radiological Assessments Corporation*, Neeses, South Carolina.

Till, J.E., E.L. Etnier, and H.R. Meyer. 1981. "A Review of Methodologies for Calculating Dose from Environmental Releases of Tritium." *Nuclear Safety* **22** (2).

Till, J.E. 1983. "Special Case Radionuclides." Chapter 9 in *Radiological Assessment,* U.S. Nuclear Regulatory Commission. NUREG/CR-3332.

Till, J.E. 1983. "Long-Lived Radionuclides," *Proc. 19th Annual Meeting of National Council on Radiation Protection and Measurements.* NCRP, Washington, D.C.

Till, J.E. 1983. "Tritium—An Executive Summary of Environmental and Dosimetric Properties." Report for Chem-Nuclear Corporation. RAC/R/1. *Radiological Assessments Corporation*, Neeses, South Carolina. March.

Till, J.E. 1983. "Long-Lived Global Cycling Radionuclides." *Proc. 1983 American Nuclear Society Annual Meeting.* **41**. June.

Till, J.E. and H.R. Meyer, eds. 1983. *Radiological Assessment: A Textbook on Environmental Dose Analysis.* NUREG/CR-3332, ORNL-5968. U.S. Nuclear Regulatory Commission.

Killough, G.G., **J.E. Till**, E.L. Etnier, B.D. Murphy, and R.J. Raridon. 1984. "Dose Equivalent due to Atmospheric Releases of Carbon-14." Chapter 11 in *Models and Parameters for Environmental Radiological Assessments*. Edited by C.W. Miller. DOE/TIC-11468, U.S. Department of Energy, Washington, D.C.

Till, J.E. and W.L. Templeton (technical editors and task group leaders). 1984. *Radiological Assessment: Predicting the Transport, Bioaccumulation, and Intake by Man of Radionuclides Released to the Environment.* NCRP Report No. 76.

Till, J.E. 1985. "A Critique of the Environmental Monitoring Program at the Savannah River Plant. Report on Task 1, Review of Facilities, Equipment, and Personnel." *Radiological Assessments Corporation* Report No. 1/85. January 30.

Till, J.E. 1985. "Changes in Risk Resulting from Removal of Class 'C' from a Low-Level Waste Disposal Facility," Testimony submitted to House Committee on Interior and Insular Affairs, July 19.

Till, J.E. 1985. "A Critique of the Environmental Monitoring Program at the Savannah River Plant. Report on Task 2, Review of Sample Locations, Frequency, and Radionuclides Monitored." *Radiological Assessments Corporation* Report No. 8/85. September 10.

Till, J.E. and H.R. Moore. 1985. "A Pathway Analysis Approach for Determining Acceptable Levels of Contamination from Cobalt-60 in Soil at the International Nutronics Irradiation Facility." *Radiological Assessments Corporation* Report No. 7/85, August 28.

Till, J.E., R.L. Toole, and G. Shinopolus. 1985. "Report on the Proposed New Facility for Conversion of UF_6 to UF_4." *Radiological Assessments Corporation* Report RAC-10. January.

Till, J.E., R.W. Shor, and F.O. Hoffman. 1985. "Environmental Effects of the Uranium Fuel Cycle—A Review of Data for Technetium." ORNL/TM-9150, NUREG/CR-3738. February.

Schiager, K.J., W.J. Bair, M.W. Carter, A.P. Hull, and **J.E. Till**. 1986. *"De Minimis* Environmental Radiation Levels: Concepts and Consequences." *Health Physics* **50** (5).

Till, J.E. 1986. "Source Terms for Technetium-99 from Nuclear Fuel Cycle Facilities," in *Technetium in the Environment.* Edited by G. DeSmet and C. Myttenaere. London: Elsevier Applied Science Publishers.

Till, J.E. and R.E. Moore. 1986. *DECOM: A Pathway Analysis Approach for Determining Acceptable Levels of Contamination of Radionuclides in Soil. RAC* Report No. 2/86. *Radiological Assessments Corporation*. February 28.

Till, J.E. and K.R. Meyer. 1986. *A Review of the Basis of Risk Calculations for Exposure to Chemicals and Radionuclides and Recommendations Regarding the Acceptability of Combining Risk Estimates. RAC* Report No. 5/86. *Radiological Assessments Corporation*. July 18.

Till, J.E., W.L. Templeton, D.A. Baker, B.G. Blaylock, R.B. Codell, F.O. Hoffman, Y.C. Ng, Y.O. Onishi, and C.W. Miller. 1986. "Screening Techniques for Determining Compliance with Environmental Standards." NCRP Commentary No. 3. National Council on Radiation Protection. Bethesda, Maryland.

Till, J.E., M.S. Whitaker, and R.E. Moore. 1986. "A Simplified Pathway Approach for Establishing Limits for Soil Contamination," in *Health Physics Considerations in Decontamination and Decommissioning,* Proceedings of the 19th Midyear Topical Symposium of the Health Physics Society. CONF–860203.

Zeigler, C.C., I.B. Lawrimore, E.M. Heath, and **J.E. Till**. 1986. "Savannah River Plant Environmental Report—Annual Report for 1985." DPSPU-86-30-1.

King, C.M., W.L. Marter, B.B. Looney, J.B. Picket, **J.E. Till**, K.R. Meyer, G.C. Merrel, V.C. Rogers, G.A. Holton, and D.F. Montague. 1987. "Performance Assessment Methods for Mixed Waste Sites at the Savannah River Plant." in *Proceedings Ninth Annual DOE Low-Level Radioactive Waste Management Conference*. Denver, Colorado, August 25–27.

Meinhold, C.B., L. Emma, D.G. Jacobs, W.L. Templeton, and **J.E. Till**. 1987. "Guidelines for the Release of Waste Water from Nuclear Facilities with Special Reference to the Public Health Significance of the Proposed Release of Treated Waste Waters at Three Mile Island." NCRP Commentary No. 4. National Council on Radiation Protection, Bethesda, Maryland.

Till, J.E. 1987. *Application for a Radioactive Materials License State of South Carolina*. Report prepared for NuPac Services, Inc. *RAC* Report No. 1/87. *Radiological Assessments Corporation*.

Till, J.E. 1987. "Mathematical Models as the Basis for Monitoring Program Design." Appendix C in *Light Water Reactors Monitoring and Management In-Plant and Environmental for Three Mile Island*. Philadelphia: Pennsylvania: Academy of Natural Sciences.

Till, J.E. 1987. "Environmental Monitoring Programs for Nuclear Facilities: U.S. and International Regulations." Appendix D in *Light Water Reactors Monitoring and Management In-Plant and Environmental for Three Mile Island*. Philadelphia, Pennsylvania: Academy of Natural Sciences.

Till, J.E. and K.R. Meyer. 1987. "A Comparison Between the Soviet Source Term and Predicted Values for the Chernobyl Nuclear Accident." *Trans. Am. Nuc. Soc.*, Volume **55**, TTANSAO55 1-760, Los Angeles, California, November.

Till, J.E., W.R. Schell, and D.J. Strom. 1987. "Assessing Risk from Long-Lived Radionuclides: The Need for New Perspective." Invited paper in Proc. Symposium on *Cycling of Long-Lived Radionuclides in the Biosphere: Observations and Models*. Madrid, Spain, September 15–19, 1986. Brussels, Belgium: Commission of the European Communities.

Zeigler, C.C., E.M. Heath, L.B. Taus, J.L. Todd, and **J.E. Till**. 1987. "Savannah River Plant Environmental Report for 1986." DPSPU-87-30-1.

Kahn, B., **J.E. Till**, and D. Hendricks. 1988. *Review of Pacific Northwest Environmental Radiation Monitoring Programs around Hanford*. Environmental Radiation Quality Assurance Task Force of the Pacific Northwest, Department of Social and Health Services, State of Washington, Olympia, Washington.

Reith, C.H., R. Richey, M. Mathews, H.R. Meyer, C. Daily, F. Petelka, W. Glover, D. Lechel, and **J.E. Till**. 1988. "Characterization and Remedial Planning for Non-Radiological Toxicants at UMTRA Project Sites," in *Waste Management 88.* Proceedings of the Tenth Annual DOE Low-Level Waste Management Conference, Denver, Colorado. August 30–September 1. Edited by R.G. Post and M.E. Wacks: Tucson, Arizona: University of Arizona Press.

Richmond, C.R., F.O. Hoffman, B.G. Blaylock, K.F. Eckerman, P.A. Leslie, C.W. Miller, Y.C. Ng, and **J.E. Till**. 1988. "The Potential Use of Chernobyl Fallout Data to Test and Evaluate the Predictions of Environmental Radiological Assessment Models." Report to the U.S. Department of Energy Office of Health and Environmental Research from the Interlaboratory Task Group on Health and Environmental Aspects of the Soviet Nuclear Accident. ORNL-6466.

Till, J.E. 1988. "Modeling the Outdoor Environment—New Perspectives and Challenges." Invited paper in Proceedings of the Twenty-Fifth Hanford Life Sciences Symposium, October 21–23, 1986. *Health Physics* **55** (2).

Till, J.E. and K.R. Meyer. 1988. *Living Without Landfills: A Critical Review. RAC* Report 8/88. Prepared for the Illinois Department of Nuclear Safety. *Radiological Assessments Corporation*, Neeses, SC, 29107.

Till, J.E. and K.R. Meyer. 1988. "The Use of Chemical and Radionuclide Risk Estimates in Site Performance Evaluation of Mixed Waste Sites," in *Waste Management 88.* Proceedings of the Tenth Annual DOE Low-Level Waste Management Conference, Denver, Colorado. August 30–September 1. Edited by R.G. Post and M.E. Wacks: Tucson, Arizona: University of Arizona Press. pp. 148–161.

Till, J.E. and K.R. Meyer. 1988. "Living Without Landfills: Confronting the Low-Level Radioactive Waste Crisis." Book Review, *Health Physics* **57** (1)

Till, J.E. and R.E. Moore. 1988. "A Pathway Analysis Approach for Determining Acceptable Levels of Contamination of Radionuclides in Soil." *Health Physics* **55** (3).

Till, J.E., J. Charles Jennett, R.I. Newman, P.O. Kusek, and J.D. Spencer. 1988. "Implications for South Carolina Resulting from the National Academy of Sciences Report–Safety Issues at the Defense Production Reactors." A Report to the Governor and the South Carolina General Assembly and the Joint Legislative Committee on Energy.

Till, J.E., R.E. Moore, and G.G. Killough. 1988. *DECHEM™: A Pathway Analysis Approach for Determining Acceptable Levels of Chemicals in Soil. Radiological Assessments Corporation*, Neeses, SC, 29107.

Reith, C.H., H.R. Meyer, **J.E. Till**, and M.L. Mathews. 1989. "DECHEM: A Program for Characterization and Mitigating Chemical Contaminants at UMTRA Project Sites," in *Waste*

Management 89, Proceedings of the Annual DOE Low-Level Waste Management Conference, Denver, Colorado.

Reith, C.C., **J.E. Till**, and H.R. Meyer. 1989. "DECHEM™: A Program for Characterization and Mitigation," in Proceedings of the American Institute of Chemical Engineers 1989 Summer Meeting, August 20-23, 1989, Philadelphia, Pennsylvania.

Till, J.E. and K.R. Meyer. 1989. "A Review of Protective Actions Taken During the Chernobyl Accident-Implications for the U.S. and the State of Illinois." *Chernobyl: Implications for Illinois.* Proceedings of conference held in Chicago Illinois, October 22–23, 1987, Illinois Department of Nuclear Safety, Springfield, Illinois..

Till, J.E., R.E. Moore, and G.G. Killough. 1989. *DECHEM™: An All-Pathway Assessment Procedure for Determining Acceptable Concentrations of Chemicals in Soil of Waste Sites. Radiological Assessments Corporation*, Neeses, SC, 29107.

Till, J.E., R.E. Moore, and G.G. Killough. 1989. *DECOM™: An All-Pathway Approach for Determining Acceptable Levels of Radionuclides in Soil. Radiological Assessments Corporation* Report, Neeses, SC, 29107.

Till, J..E., R.E. Moore, G.G. Killough, K.R. Meyer, and D.W. Schmidt. 1989. "MICROAIRDOS™: A Version of the AIRDOS-EPA Radionuclide Dispersion and Dose Assessment Code Specifically Developed for Microcomputers." *Radiological Assessments Corporation*, Neeses, South Carolina.

Lloyd, R.D., S.L. Simon, **J.E. Till**, H.A. Hawthorne, D.C. Gren, M.L. Rallison, and W. Stevens. 1990. "Development of A Method to Estimate Dose from Fallout Radioiodine in A Thyroid Cohort Study." *Health Physics* **59** (5).

Lloyd, R.D., D.C. Gren, S.L. Simon, M.E. Wrenn, H.A. Hawthorne, W. Stevens, **J.E. Till**, and T.M. Lotz. 1990. "Individual External Exposures from Nevada Test Site Fallout for Leukemia Cases and Controls." *Health Physics* **59** (5).

Reith, C.C. and **J.E. Till**. 1990. "DECHEM: A Remedial Planning Tool for Chemical Contaminants in Soil," *Proceedings of Envirotec 90*. IAEA, Vienna, Austria.

Stevens, W., **J.E. Till**, J.L. Lyon, D.C. Thomas, R.A. Kerber, S. Preston-Martin, R.D. Lloyd, and S.L. Simon. 1990. *Final Report A Case-Control Study of Leukemia Deaths in Utah (1952-81) and Exposure to Radioactive Fallout from the Nevada Test Site (1952-58)* The University of Utah, Salt Lake City, Utah.

Stevens, W., D.C. Thomas, J.L. Lyon, **J.E. Till**, R.A. Kerber, S.L. Simon, R.D. Lloyd, N.A. Elghany, and S. Preston-Martin. 1990. "Leukemia in Utah and Radioactive Fallout from the Nevada Test Site: A Case-Control Study." *JAMA* **264** (5).

Stevens, W., **J.E. Till**, D.C. Thomas, J.L. Lyon, and R.A. Kerber. 1990. "A Historical Dose Reconstruction and Epidemiologic Study of Leukemia in Utah Residents Exposed to Fallout." *Proceedings Health Physics Society Topical Symposium on Environmental Radiation and Public Policy.* Las Vegas, Nevada, October 23–25. Health Physics Society, McLean, Virginia.

Till, J.E. 1990. "Reconstructing Historical Exposures to the Public from Environmental Sources." *Radiation Protection Today-The NCRP at 60 Years.* Proceedings of the 25th Annual Meeting of the NCRP. National Council on Radiation Protection and Measurements, Bethesda, Maryland. April 1.

Till, J.E. 1990. "The Hanford Environmental Dose Reconstruction Project." *Proceedings Health Physics Society Topical Symposium on Environmental Radiation and Public Policy.* Las Vegas, Nevada, October 23–25. Health Physics Society, McLean, Virginia.

Till, J.E. and K.R. Meyer. 1990. "The Additivity of Radionuclide and Chemical Risk Estimates in Performance Evaluation of Mixed-Waste Sites." *Environmental Monitoring, Restoration and Assessment: What Have We Learned.* Twenty-eighth Hanford Symposium on Health and the Environment. Edited by R.H. Gray. Pacific Northwest Laboratory, Richland, Washington. pp. 207–218.

Till, J.E., F.A. Gifford, B.W. Graham, J.R. Horan, J.M. Leitch, J. Ruttenber, P.G. Voillequé, M. Von Braun, and F.W. Whicker. 1990. "Findings and Recommendations of the Review Panel for the Draft INEL Historical Dose Evaluation." Special report of the review committee to the Department of Energy, Idaho Operations Office, Idaho Falls, Idaho.

Till, J.E., R.E. Moore, and D.W. Schmidt. 1991. "Preliminary Radiological Assessment for the Martinsville Alternative Site." *RAC* Report No. CNSI-91-1. *Radiological Assessments Corporation*, Neeses, South Carolina.

Stevens, W., **J.E. Till**, D.C. Thomas, J.L. Lyon, R.A. Kerber, S. Preston-Martin, S.L. Simon, M.L. Rallison, and R.D. Lloyd. 1992. "Assessment of Leukemia and Thyroid Disease in Relation to Fallout in Utah, Report of A Cohort Study of Thyroid Disease and Radioactive Fallout from the Nevada Test Site." The University of Utah, Salt Lake City, Utah.

Till, J.E., K.R. Meyer, D.W. Schmidt, and R.E. Moore. 1992. "The Fernald Dosimetry Reconstruction Project, Task 1: Identification of Release Points." *RAC* Report No. CDC-1. *Radiological Assessments Corporation*, Neeses, South Carolina, 29107.

Voillequé, P.G., K.R. Meyer, D.W. Schmidt, G.G. Killough, R.E. Moore, V.I. Ichimura, S.K. Rope, B.S. Shleien, and **J.E. Till**. 1992. "The Fernald Dosimetry Reconstruction Project, Tasks 2 and 3, Radionuclide Source Terms and Uncertainties—1960-1962." *RAC* Report No. CDC-2. *Radiological Assessments Corporation*, Neeses, South Carolina, 29107.

[&]Grogan, H.A., K.R. Meyer, P.G. Voillequé, S.K. Rope, Marilyn J. Case, H.R. Meyer, R.E. Moore, T. Winsor, and **J.E. Till**. 1993. "Verification of Phase I Source Term and Uncertainty Estimates. The Rocky Flats Nuclear Weapons Plant Dose Reconstruction Project — Phase II: Toxicity Assessment and Risk Characterization." *RAC* Report No. CDH-1. *Radiological Assessments Corporation*, Neeses, South Carolina, 29107.

Kerber, R.A., **J.E. Till**, S.L. Simon, J.L. Lyon, D.C. Thomas, S. Preston-Martin, M.L. Rallison, R.D. Lloyd, and W. Stevens. 1993. "A Cohort Study of Thyroid Disease in Relation to Fallout from Nuclear Weapons Testing." *JAMA* **270**(17).

Killough, G.G., M.J. Case, K.R. Meyer, R.E. Moore, J.F. Rogers, S.K. Rope, D.W. Schmidt, B. Shleien, **J.E. Till**, and P.G. Voillequé. 1993. "The Fernald Dosimetry Reconstruction Project, Task 4, Environmental Pathways—Models and Validation." *RAC* Report No. CDC-3. *Radiological Assessments Corporation*, Neeses, South Carolina, 29107.

Shleien, B., S.K. Rope, M.J. Case, G.G. Killough, K.R. Meyer, R.E. Moore, D.W. Schmidt, **J.E. Till**, and P.G. Voillequé. 1993. "The Fernald Dosimetry Reconstruction Project, Task 5, Review of Historic Data and Assessments for the FMPC." *RAC* Report No. CDC-4. *Radiological Assessments Corporation*, Neeses, South Carolina, 29107.

Till, J.E. 1993. "Implications of the Dose Reconstruction Studies on the Future of Environmental Health Physics." Keynote address in the Proceedings of the 26th Midyear Topical Meeting of the Health Physics Society, Coeur d'Alene, Idaho, January 24–28. Edited by R.D. Kathrine,

---

[&] Independent peer review and oversight provided by the Health Advisory Panel, Historical Public Exposures Studies on Rocky Flats, Colorado Department of Public Health and Environment, Denver, CO.

D.H. Denham, and K. Salmon. Columbia Chapter of the Health Physics Society, Richland, Washington.

[&]Grogan, H.A., K.R. Meyer, P.G. Voillequé, S.K. Rope, M.J. Case, H.R. Meyer, R.E. Moore, T. Winsor, and **J.E. Till**. 1994. "Verification of Phase I Source Term & Uncertainty Estimates." Final Task 2 report prepared for the Colorado Department of Public Health and Environment. *Radiological Assessments Corporation*, Neeses, South Carolina, 29107.

Grogan, H.A., M.O. Langan, H.R. Meyer, E.A. Stetar, and **J.E. Till.** 1995. "Identification and Cataloging of Information Sources. Savannah River Site Dose Reconstruction Project." *RAC* Report No. 3 CDC-SRS-95-Final. *Radiological Assessments Corporation*, Neeses, South Carolina, 29107.

Meyer, K.R., P.D. McGavran, P.G. Voillequé, H.A. Grogan, L.W. Bell, H.R. Meyer, S.K. Rope, and **J.E. Till**. 1995. "Savannah River Site Dose Reconstruction Projection, Phase I Data Retrieval and Assessment, Evaluation of Materials Released from the Savannah River Site." *RAC* Report No. 6 CDC-SRS-95-Final. *Radiological Assessments Corporation*, *Radiological Assessments Corporation*, 29107.

Simon, S.L., **J.E. Till**, R.D. Lloyd, R. Kerber, D.C. Thomas, S. Preston-Martin, and W. Stevens. 1995. "The Utah Leukemia Case-Control Study: Dosimetry Methodology and Results." *Health Physics* **68** (4).

Stetar, E.A., M.J. Case, L.W. Bell, H.A. Grogan, K.R. Meyer, H.R. Meyer, S.K. Rope, D.W. Schmidt, T.F. Winsor, and **J.E. Till**. 1995. "Identifying Sources of Environmental Monitoring and Research Data. Savannah River Site Dose Reconstruction Project." *RAC* Report No. 2 CDC-SRS-95-Final. *Radiological Assessments Corporation*, Neeses, SC, 29107.

Templeton, W.L., **J.E. Till** (Co-Chairmen), D.A. Baker, B.G. Blaylock, R.B. Codell, F.O. Hoffman, C.W. Miller, and Y. Onishi. 1995. *Screening Models for Releases of Radionuclides to Air, Surface Water, and Ground Water*. NCRP Report No. 123 (Vols. I and II). National Council on Radiation Protection and Measurements, Bethesda, Maryland.

Till, J.E.. 1995. "Building Credibility in Public Studies." *American Scientist* **83** (5).

Till, J.E., S.L. Simon, R. Kerber, R.D. Lloyd, W. Stevens, D.C. Thomas, J.L. Lyon, and S. Preston-Martin. 1995. "The Utah Thyroid Cohort Study: Analysis of the Dosimetry Results." *Health Physics* **68** (4).

Till, J.E., F.O. Hoffman, Keith J. Schiager, and J. Taschner. 1995. "Letter Report of the Dose Assessment Working Group, Committee to study the Mortality of Military Personnel Present at Atmospheric Tests of Nuclear Weapons." National Academy of Sciences, Washington, D.C.

[*]Voillequé, P.G., K.R. Meyer, D.W. Schmidt, S.K. Rope, G.G. Killough, R.E. Moore, M.C. Case, B. Shleien and **J.E. Till**. 1995. "The Fernald Dosimetry Reconstruction Project, Tasks 2 and 3, Radionuclide Source Terms and Uncertainties (Final Report)." *RAC* Report No. CDC-5. *Radiological Assessments Corporation*, Neeses, South Carolina, Neeses, SC, 29107.

[&] Independent peer review and oversight provided by the Health Advisory Panel, Historical Public Exposures Studies on Rocky Flats, Colorado Department of Public Health and Environment, Denver, CO.

[*] Independent peer review provided by National Academy of Sciences Committee on an Assessment of Centers for Disease Control and Prevention Radiation Stuedies from Department of Energy Contractor Sites.

Meyer , K.R., P.G. Voillequé, D.W. Schmidt, S.K. Rope, G.G. Killough, B. Shleien, R.E. Moore, M.J. Case, and **J.E. Till**. 1996. "Overview of the Fernald Dosimetry Reconstruction Project and Source Term Estimates for 1951–1988." *Health Physics* **71** (4): 425–437.

[&]Meyer, H.R., S.K. Rope, T.F. Winsor, P.G. Voillequé, K.M. Meyer, L.A. Stetar, **J.E. Till**, and J.M. Weber. 1996. "Task 2: The Rocky Flats Plant 903 Area Characterization." *RAC* Report No. 2-CDPHE-RFP-1996-FINAL. *Radiological Assessments Corporation*, Neeses, South Carolina.

[&]Meyer, K.R. and **J.E. Till**. 1996. "Task 2c: Characterization of Surface Water Releases from the Rocky Flats Plant." *RAC* Report #7-CDPHE-RFP-1996. Phase II, Rocky Flats Historical Public Exposure Studies. *Radiological Assessments Corporation*, Neeses, South Carolina, Neeses, SC, 29107.

[&]Rope, S.K., K.R. Meyer, M.J. Case, D. W. Schmidt, M. Dreicer, T. Winsor, L. W. Bell, E.S. Stetar, and **J.E. Till**. 1996. "Task 4, Evaluation Of Historical Environmental Data." Draft report for public comment. *RAC* Report #1 CDPHE-RFP-1996-Draft. Phase II, Rocky Flats Historical Public Exposures Studies. *Radiological Assessments Corporation*, Neeses, South Carolina, Neeses, SC, 29107.

Grogan, H.A. and **J.E. Till** (Principal Investigator). 1996. "Calculating and Interpreting Radiological Doses and Risks for Individuals Exposed to Radionuclides Due to Historical Releases from the Hanford Nuclear Reservation," Workshop Report. *RAC* Report No. 5-CDC-Task Order 2-1996-FINAL. *RAC*, 417 Till Rd. Neeses, SC 29107.

Till, J.E. 1996. "Methodology of Environmental Dose Assessment." Proceedings of the 1996 International Congress on Radiation Protection, IRPA 9, Vienna, Austria, April 14–19.

[&]Rope, S.K., K.R. Meyer, M.J. Case, D. W. Schmidt, T. Winsor, M. Dreicer, and **J.E. Till**. 1997. *Task 4, Evaluation Of Historical Environmental Data. RAC* Report #1 CDPHE-RFP-1997-Final. Phase II, Rocky Flats Historical Public Exposures Studies. *Radiological Assessments Corporation*, Neeses, South Carolina, Neeses, SC, 29107.

Till, J.E. 1997. "A 1993 Report on Reconstruction of Environmental Exposures and Uncertainties in Support of Epidemiological Studies Related to Low-Dose Radiation." In *Radiation Injury and the Chernobyl Catastrophe.* Stem Cells 1997, **15**(suppl 2). pp.87–94.

Till, J.E. 1997. "Environmental Dose Reconstruction." *Radiological Protection Bulletin.* No. **185**, January. National Radiological Protection Board, Harwell, United Kingdom.

Till, J.E. 1997. "Environmental Dose Reconstruction." *Proceedings Thirty First Annual Meeting of the National Council on Radiation Protection and Measurements (NCRP).* Washington, D.C., April 12–13, 1995. National Council on Radiation Protection, Bethesda, Maryland.

Till, J.E. (editor). 1997. *Proceedings Thirty First Annual Meeting of the National Council on Radiation Protection and Measurements (NCRP).* Washington, D.C., April 12–13, 1995. National Council on Radiation Protection, Bethesda, Maryland.

Till, J.E. 1998. Keynote Address. *Proceedings of the First Annual University of Washington Conference on the Ecological, Community and Occupational Health Issues at Hanford, December 3, 1997.* University of Washington Press, Seattle, WA.

[&] Independent peer review and oversight provided by the Health Advisory Panel, Historical Public Exposures Studies on Rocky Flats, Colorado Department of Public Health and Environment, Denver, CO.

*Killough, G. G., M.J. Case, K.R. Meyer, R.E. Moore, S.K. Rope, D W. Schmidt, B. Shleien, W.K. Sinclair, P.G. Voillequé, and **J.E. Till**. 1998. "Radiation Doses and Risk to residents from FMPC Operations from 1951-1988, Vols. I and II," Task 6 Final Report, The Fernald Dosimetry Reconstruction Project, *RAC* Report No. 1-CDC-Fernald-1998-FINAL. *RAC*, 417 Till Rd. Neeses, SC 29107.

Grogan, H.A. and **J.E. Till** (Principal Investigator). 1998. "Issues related to estimating Doses Due to I^{131} Releases to the Atmosphere from the Hanford Site," Workshop Report. *RAC* Report No. 2-CDC-Task Order 4-1998-FINAL. *RAC*, 417 Till Rd. Neeses, SC 29107.

&Grogan, H.A., W.K. Sinclair, P.G. Voillequé, and **J.E. Till** (Principal Investigator). 1999. "Assessing Risks of Exposure to Plutonium," Rocky Flats Dose Reconstruction Project. *RAC* Report No. 5-CDPHE-RFP-1998-FINAL. *RAC*, 417 Till Rd. Neeses, SC 29107.

±Weber, J.M. and **J.E. Till** (Principal Investigator). 1999 "Cleanup Levels at Other Sites," Task 1 of the Rocky Flats Soil Action Levels Project. *RAC* Report No. 6-RSALOP-1999-FINAL. *RAC*, 417 Till Rd. Neeses, SC 29107.

McGavran, P.D., A.S. Rood., and **J.E. Till**. 1999. "Chronic Beryllium Disease and Cancer Risk Estimates with Uncertainty for Beryllium Released to the Air from the Rocky Flats Plant." *Environmental Health Perspectives*. **107** (9): 731-744.

&Meyer, K.R. and **J.E. Till**. 1999. *Characterization of Releases to Surface Water From the Rocky Flats Plant. RAC* Report No.7-CDPHE-1996-FINAL(Rev. 1). *Radiological Assessments Corporation*, Neeses, South Carolina, Neeses, SC, 29107.

&Meyer, K.R., H.G. Grogan, and **J.E. Till**. 1999. "Responses to Public Questions and Concerns." *RAC* Report No.12-CDPHE-1999-FINAL. *Radiological Assessments Corporation*, Neeses, South Carolina, Neeses, SC, 29107.

&Rope S.K., K.R. Meyer, M.J. Case, H.A. Grogan, D.W. Schmidt, M. Dreicer, T.F. Winsor, and **J.E. Till**. 1999. "Evaluation of Environmental Data for Historical Public Exposures Studies on Rocky Flats." *RAC* Report No. 1-CDPHE-RFP-1997-FINAL(Rev.1). *Radiological Assessments Corporation.* Neeses, South Carolina, Neeses, SC, 29107.

&Weber, J.M., A.S. Rood, H.R. Meyer, and **J.E. Till**, 1999. "Development of the Rocky Flats Plant 903 Area Plutonium Source Term." *RAC* Report No. 8-CDPHE-RFP-1998-FINAL(Rev.1). *Radiological Assessments Corporation*, Neeses, South Carolina, Neeses, SC, 29107.

Rood, A.S., G.G. Killough, and **J.E. Till**. 1999. "Evaluation of Atmospheric Transport Models for Use in Phase II of the Historical Public Exposures Studies at the Rocky Flats Plant." Risk Analysis, **19** (4): 559-576, Neeses, SC, 29107.

Aanenson, J.W., S.J. Maheras, H.J. Mohler, P.G. Voillequé, and **J.E. Till**. 1999. "Independent Audit of Los Alamos National Laboratory for Compliance with the Clean Air Act, 40 CFR 61, Subpart H." *RAC* Report No. 3-DOJ-LANL Audit-1998-FINAL. *Risk Assessment Corporation,* Neeses, South Carolina.

---

* Independent peer review provided by National Academy of Sciences Committee on an Assessment of Centers for Disease Control and Prevention Radiation Stuedies from Department of Energy Contractor Sites.

& Independent peer review and oversight provided by the Health Advisory Panel, Historical Public Exposures Studies on Rocky Flats, Colorado Department of Public Health and Environment, Denver, CO.

± Independent peer review provided by technical experts on the Rocky Flats Soil Action Level Panel, Rocky Flats Citizens Advisory Board, Boulder, Colorado.

Till, J.E., G.G. Killough, K.R. Meyer, W.S. Sinclair, P.G. Voillequé, S.K. Rope, and M.J. Case. 2000. "The Fernald Dosimetry Reconstruction Project." *Technology*, **7** pp270-295.

Till, J.E., G.G. Killough, K.R. Meyer, J.W. Aanenson, and A.S. Rood. 2000. "Calculating Soil Action Levels and Uncertainties for Decision-Making during Cleanup of Contaminated Sites." In *Proc. 10th International Congress of the International Radiation Protection Association*. May 14-19, 2000, Hiroshima, Japan.

Till, J.E. and S.L. Sharp. "Public Participation in Decision-Making for Contaminated Sites." In *Proc. 10th International Congress of the International radiation Protection Association*. May 14-19, 2000, Hiroshima, Japan.

*Meyer, K.R., H.J. Mohler, J.W. Aanenson, **J.E. Till** (Principal Investigator), "Identification and Prioritization of Radionuclide Releases from the Idaho National Engineering and Environmental Laboratory," *RAC **Report No. 3-CDC-Task Order 5-2000,*** September 30, 2000, *Risk Assessment Corporation,* Neeses, SC 29107.

Aanenson, J.W., S.J. Maheras, H.J. Mohler, P.G. Voillequé, and **J.E. Till**. 2000. "Independent Audit of Los Alamos National Laboratory for Compliance with the Clean Air Act, 40 CFR 61, Subpart H for 1999." *RAC* Report No. 4-DOJ-LANL Audit-2000-FINAL. *Risk Assessment Corporation,* Neeses, South Carolina.

Till, J.E. and K.R. Meyer. 2001. "Public Involvement in Science and Decision-Making." *Health Physics*, **80** (4) pp 370-379.

Rood, A.S., P.D. McGavran, J.W. Aanenson, and **J.E. Till**. 2001. "Stochastic Estimates of Exposure and Cancer Risk from Carbon Tetrachloride Released to the Air from the Rocky Flats Plant." *Risk Analysis*, **21** (4) pp 675-695.

*Till, J.E., J.W. Aanenson, P.J. Boelter, M.J. Case, M. Dreicer, H.A. Grogan, M.O. Langan, P.D. McGavran, K.R. Meyer, H.R. Meyer, H.J. Mohler, A.S. Rood, R.C. Rope, S.K. Rope, L.A. Stetar, P.G. Voillequé, T.F. Winson, W. Yang. 2001. "SRS Environmental Dose Reconstruction Project Phase II," *RAC* report No. 1-CDC-SRS-1999-FINAL, *Risk Assessment Corporation*, Neeses, SC 29107.

Rood, A.S., H.A. Grogan, and **J.E. Till**. 2002. "A Model for A Comprehensive Assessment of Exposure and Lifetime Cancer Incidence Risk from Plutonium released from the Rocky Flats Plant, 1953-1989." *Health Physics*, **82** (2) pp 182-212.

Till, J.E., A.S. Rood, P.G. Voillequé, P.D. Mcgavran, K.R. Meyer, H.G. Grogan, W.K. Sinclair, J.W. Aanenson, H.R. Meyer, S.K. Rope, and M.J. Case. 2002. "Risk to the Public from Historical Releases of Radionuclides and Chemicals at the Rocky Flats Nuclear Weapons Plant." *J of Exposure. Analysis and Epidemiology*, **12** (5) pp355-372.

+**Till, J.E.** (Principal Investigator), A. S. Rood, J. W. Aanenson, S. S. Mohler, P. D. McGavran, H. J. Mohler, and H. A. Grogan. 2002. "Analysis of Exposure and Risks to the Public from Radionuclides and Chemicals Released by the Cerro Grande Fire at Los Alamos, Estimated Risks from Releases to Air." *RAC Report No. 3-NMED-2002-FINAL*, June 3, 2002 *Risk Assessment Corporation,* Neeses, SC 29107.

---

* Independent peer review provided by National Academy of Sciences Committee on an Assessment of Centers for Disease Control and Prevention Radiation Stuedies from Department of Energy Contractor Sites.

+ Independent peer review provided by expert team lead by Dr. F. Ward Whicker, Professor Emeritus, Colorado State University, Ft. Collins, Colorado.

[+]**Till, J.E.** (Principal Investigator), J.R. Rocco, K.R. Meyer, H. J. Mohler, J. W. Aanenson, L.H. Wilson, A. S. Rood, P. D. McGavran. 2002. "Analysis of Exposure and Risks to the Public from Radionuclides and Chemicals Released by the Cerro Grande Fire at Los Alamos, Estimated Risks from Releases to Surface Water." *RAC Report No. 4-NMED-2002-FINAL*, June 3, 2002 *Risk Assessment Corporation,* Neeses, SC 29107.

[+]**Till, J.**E. (Principal Investigator), H. J. Mohler,K.R. Meyer, J. W. Aanenson, H.A. Grogan, and J.R. Rocco. 2002. "Analysis of Exposure and Risks to the Public from Radionuclides and Chemicals Released by the Cerro Grande Fire at Los Alamos, Calculating and Communicating Risks: Observations and Recommendations." *RAC* ***Report No. 5-NMED-2002-FINAL***, June 3, 2002 *Risk Assessment Corporation,* Neeses, SC 29107.

*Voillequé, P.G., G.G. Killough, S.K. Rope, and **J.E. Till**. 2002. "Methods for Estimating Radiation Doses from Short-Lived Gaseous Radionuclides and Radioactive Particles Released to the Atmosphere during Early Hanford Operations." *RAC* Report No. 2-CDC-Task Order 3-2002-FINAL. *Risk Assessment Corporation*, Neeses, SC 29107.

Till, J.E.. 2002. "Stakeholder Involvement in Developing Environmental Radiation Protection Policy and Recommendations," in *Proc. Radiological Protection of the Environment, The Path forward to a New Policy*," NEA Forum in Collaboration with the International Commission on Radiological Protection, Taormina, Sicily, Italy, 12-14 February, 2002.

*Meyer, K.R., H.J. Mohler, J.W. Aanenson, and **J.E. Till**. 2002. "Identification and Prioritization of Radionuclide Releases from the Idaho National Engineering and Environmental Laboratory." *RAC* Report No. 3-CDC Task Order 5-2000-FINAL. *Risk Assessment Corporation*, Neeses, SC 29107.

Aanenson, J.W., H.A. Grogan, S.J. Maheras, H.J. Mohler, A.S. Rood, P.G. Voillequé, and **J.E. Till**. 2002. "Independent Audit of Los Alamos National Laboratory for Compliance with the Clean Air Act, 40 CFR 61, Subpart H for 2001." *RAC* Report No. 6-DOJ-LANL Audit-2000-FINAL. *Risk Assessment Corporation,* Neeses, South Carolina.

*Grogan, H.A., A.S. Rood, J.W. Aanenson, E.B. Liebow, **J.E. Till**. 2002. "A Risk-Based Screening Analysis for Radionuclides Released to the Columbia River from Past Activities at the U.S. Department of Energy Nuclear Weapons Site in Hanford, Washington." *RAC* Report No. 3-CDC- Task Order 7-2000-FINAL. *Risk Assessment Corporation*, Neeses, SC 29107.

Till, J.E. 2003. "Dose to Individuals: Who and How," in *Proc. The Future Policy for Radiological Protection*," NEA Forum in Collaboration with the International Commission on Radiological Protection, Lanzarote, Spain, 2-4 April, 2003.

Till, J.E., H.L. Beck, W.J. Brady. T.F. Gesell, D.G. Hoel, E.E. Kearsley, D.C. Kocher, J.D. Moreno, C.R. Weinberg, E.B. Douple, I. Al-Nabulsi. 2003. *A Review of the Dose Reconstruction Program of the Defense Threat Reduction Agency*. National Academy Press, National Academy of Sciences, Washington, DC 20001.

Mohler, H.J., K.R. Meyer, H.A. Grogan, J.W. Aanenson, and **J.E. Till**. 2004. "Application of NCRP Air Screening Factors for Evaluating Both Routine and Episodic Radionuclide releases to the Atmosphere." *Health Physics*, **86** (2).

---

* Independent peer review provided by National Academy of Sciences Committee on an Assessment of Centers for Disease Control and Prevention Radiation Stuedies from Department of Energy Contractor Sites.

Helen Grogan, **John Till**, Kathleen Meyer, and Justin Mohler. 2004. "Involving Stakeholders and Tailoring Environmental Databases for Shared Analysis of a Contaminated Site." *Proc. EnviroInfo 2004*. 18th International Conference Informatics for Environmental Protection. October 21-23, 2004. Sh@ring. CERN, Geneva, Switzerland.

J. E. Till, G. G. Killough, K. R. Meyer, J. W. Aanenson, and A.S. Rood. 2004. "Technical Basis and Public Process for Deriving Cleanup Levels at Rocky Flats. *Proc. Workshop on Solutions to Security Concerns about Radioactive Legacy of the Cold War that Remain in Urban Environments*. International Institute for Applied System Analysis at Vanderbilt University. Nashville, TN. November 14-16, 2004.

J.E. Till. "ICRP's New Report on the Individual: Assessing Dose of the Representative Individual for the Purpose of Radiation Protection of the Public." Proc. Of the 37th Annual National Conference on Radiation Control Program Directors, Inc., Kansas City, Mo., April 25-28, 2005.

H. Justin Mohler, Jill Weber Aanenson, Helen A. Grogan, and **John E. Till**. "Creating Spatially-Linked Data and Risk Evaluation Tools to Support Community Participation and Decision Making for a Contaminated Site." *Proc. Informatics for Environmental Protection, Networking Environmental Information.* Masaryk University in Brno, Center for Biostatistics and Analyses, Faculty of Medicine Masaryk University in Brno, Czech Republic, September 7-9, 2005.

Till, J.E. and D. McBaugh. 2005. "Practical and Scientifically Based Approaches for Cleanup and Site Restoration." *Health Physics*, **89** (5).

Till, J.E., D. Cancio, M. Clark, D. Cool, J.Cooper, T. Kosako, A. McEwan, K. Ulbak, and C. Zuur. 2006. "New Developments in the Critical Group Concept." In *Proc. Second European International Radiation Protection Association (IRPA) Congress*, IRPA c/o CEPN, 28 rue de la Redoute, 92260 Fontenay-aux-Roses France.

Till, J.E. and H.A. Grogan. 2006. "Applied Modeling and Computations in Nuclear Science: the Foundation for Risk Assessment and Decision Making." In *Applied Modeling and Computations in Nuclear Science*, Oxford University Press.

Helen A. Grogan, Jill W. Aanenson, Patricia D. McGavran, Kathleen R. Meyer, S. Shawn Mohler, H. Justin Mohler, James R. Rocco, and Lesley H. Wilson, and **John E. Till**. 2006. "Applied Modeling of the Cerro Grande Fire at Los Alamos: An Independent Analysis of Exposure, Health Risk, and Communication with the Public." In *Applied Modeling and Computations in Nuclear Science*, Oxford University Press, November.

Till, J.E. 2007. "Reconstruction of Historical Doses from Radionuclides Released to the Environment by the Uravan Mining and Milling Site." In re: June et al. v. Union Carbide Corporation et al., No.1: 04-CV-00123-MSK-MJW, January 15, 2007.

[∞]Stetar, E.A., L. H. Wilson, J. R. Rocco, S. Mohler, H. A. Grogan, and **John E. Till.** 2007. "Focus Group Data Evaluation." Risk Analysis, Communication, Evaluation and Reduction at LANL. RAC Report No. 19-RACER LANL-2007-Final. July 20, 2007.

[∞]Wilson, L.H., J.R. Rocco, S. Mohler, E.A. Stetar, H. A. Grogan, H.J. Mohler, J. Wilson, B. Jacobs, P.G. Voillequé, and **John E. Till.** 2007. "Decision Support Methodology." Risk Analysis,

---

[∞] Independent peer review provided by expert team lead by Dr. F. Ward Whicker, Professor Emeritus, Colorado State University, Fort Collins.

Communication, Evaluation and Reduction at LANL. RAC Report No. 18-RACER LANL-2007-Final. July 20, 2007.

J.E. Till and H.A. Grogan (editors). 2008. *Radiological Risk Assessment and Environmental Analysis.* Oxford University Press, New York. (June 2008.)

J.E. Till. 2008. "The Radiological Assessment Process." Chapter 1 in *Radiological Risk Assessment and Environmental Analysis.* Oxford University Press, New York. (June 2008.)

A.S. Rood, P.S. B. Jacobs, P. Shanahan, J.R. Rocco, L.H. Wilson, H.A. Grogan, **J.E. Till**, H.J. Mohler, and J.W. Aanenson. 2009. "Overview of Environmental Transport Models Contained in the Risk Analysis, Communication, Evaluation and Reduction (RACER) Software at Los Alamos National Laboratory." In *Proc.Waste Management for the Nuclear Renaissance*, March 1-5, 2009, Phoenix, Arizona. Waste Management 2009. www.wmsym.org.

J.E. Till and H.A Grogan. 2009. "It's the Dose — Strategies for Environmental Dose Reconstruction and Risk Assessment." Proceedings of Toxic Torts and Environmental Law Seminar, March 19-20, 2009, Phoenix Arizona. Defense Research Institute, Chicago, IL 60678-7252.

[∞]J.W. Aanenson, H.A. Grogan, B. Jacobs, G.G. Killough, K.R. Meyer, H.J. Mohler, S. Mohler, J.R. Rocco, A.S. Rood, E.A. Stetar, L.H. Wilson, and **J.E. Till**. 2009. "Ranking Tool Methodology." Risk Analysis, Communication, Evaluation, and Reduction at LANL. RAC Report No. 35-RACER LANL-2008-FINAL. April 2009.

J.E. Till. 2011. "Building Trust, Credibility, and Respect in Environmental Risk Assessment." *Health Physics News*, **39** (5). January.

Mohler, H.J., H.A. Grogan, J.R. Rocco, R.F. Kiefer, and **J.E. Till**. 2012. RACER: Dynamic Use of Environmental Measurement Data for Decision Making and Communication. *Operational Radiation Safety*, Vol. **102**, Suppl 1. February.

J.E. Till, H.A. Grogan, H.J. Mohler, J.R. Rocco, S.S. Mohler. 2012. "An Integrated Approach to Data Management, Risk Assessment, and Decision Making." *Health Physics*, **102** (4), April.

J.E. Till. 2014. "When Does Risk Assessment Get Fuzzy?" 37th Taylor Lecture presented at the annual Meeting of the National Council on Radiation Protection and Measurements, March 11, 2013. *Health Physics*, **106** (2). February.

J.E. Till, H.L. Beck, J.W. Aanenson, H.A. Grogan, J.J. Mohler, S. S. Mohler, and P.G. Voillequé. 2014. "Military Participants at U.S. Atmospheric Nuclear Weapons Testing—Methodology for Estimating Dose and Uncertainty. *Radiation Research*, **181**, 471-484.

J.E. Till, A.S. Rood, C.D. Garzon, and R.H. Lagdon. 2014. "Comparison of the MACCS2 Atmospheric Transport Model with Lagrangian Puff Models as Applied to Deterministic and Probabilistic Safety Analysis." *Health Physics*, **107**, 213-230.

A. Bouville, R. E. Toohey, J.D. Boice, H.L. Beck, L.T. Dauer, K.F. Eckerman, D. Hagemeyer, R.W. Leggett, D.L. Miller, B. Napier, K.H. Pryor, M. Rosenstein, D.A. Schauer, S. Sherbini, D.O. Stram, J. L. Thompson, **J.E. Till**, C. Yoder, C. Zeitlin. "Dose Reconstruction for the Million-WorkerMillion Worker Epidemiologic Study: Status and Guidelines." *Health Physics*, **108**, 206-220.

G. G. Caldwell, MD; M. M. Zack, MD; M.T. Mumma, MS; H. Falk, MD, MPH; C. W. Heath, Jr., MD; **J. E. Till, PhD**; H. Chen, PhD; J. D. Boice, Jr., ScD. "Mortality of Military Nuclear Test Participants at SMOKY and PLUMBBOB, 1957–2010." Submitted for publication, *JAMA*.

Helen A. Grogan, Ph.D.

Cascade Scientific, Inc.
1678 NW Albany Ave., Bend, Oregon 97703, USA
Tel: +1 541 317 9825
Email: groganha@gmail.com

Profile

Trained as a radioecologist, with 3 decades of experience evaluating exposure and health risk to the public from radionuclides and chemicals in the environment. Served on committees for the International Atomic Energy Agency, United Nations, National Academy of Sciences, the Environmental Protection Agency and the National Council on Radiation Protection. Presently works closely with Risk Assessment Corporation (**www.racteam.com**) assuming responsibilities for the technical aspects of projects and undertakes independent projects as time permits. Career highlights include:

- Contribution to reconstruction of public exposures and risks from historical releases of radionuclides and chemicals from nuclear weapon production facilities in the USA including Rocky Flats in Colorado, the Savannah River Site in South Carolina, and the Hanford Nuclear Facility in Washington, and from former uranium processing facilities at Uravan, Colorado and Apollo, Pennsylvannia.
- Quantifying organ-specific cancer incidence risk and its uncertainty following exposure to plutonium from inhalation and ingestion
- Development of data management applications that facilitate access to and use of environmental measurement data for a variety of applications, ranging from basic data evaluation to more complex analyses including dose/risk assessment and decision making.
- Development of scientific methods and decision support tools to guide efforts to reduce public exposures and environmental impacts from existing exposures.
- Participation in BIOMOVS, the first international cooperative effort to test computer models developed to predict the fate and transport of radionuclides in the environment, and chairing one of the test scenarios.
- Assisting in developing an International Features, Events and Processes (FEP) Database for the Nuclear Energy Agency, Organization for Economic Cooperation and Development, France used in the performance assessment of radioactive waste disposal systems.
- Co-editor of Radiological Risk Assessment and Environmental Analysis (Oxford University Press, 2008) and author/co-author of more than 70 open technical publications (papers, reports, articles and book chapters - appended).

Experience

2002 – date: **Risk Assessment Corporation**, Neeses, South Carolina, USA

Technical Coordinator

1999 – date: **Cascade Scientific**, Bend, Oregon, USA

President

Senior Consultant: Consultant in all areas of environmental risk assessment with emphasis on public exposures to radionuclides and chemicals released to the environment. Work has been carried out for EPRI, US EPA, NCRP, NAS/NRC, Waste Control Specialists, Colorado Department of Public Health and Environment, Centers for Disease Control and Prevention, State of New Jersey Department of Environmental Protection, New Mexico Environment Department, Department of Justice, and State of Washington Office of Attorney General. Many projects have been performed in collaboration with Risk Assessment Corporation.

- Dose reconstruction of public exposures and risks from historical releases of radionuclides and chemicals from Rocky Flats in Colorado, the Savannah River Site in South Carolina and the Hanford Nuclear Facility in Washington.
- Audits of Los Alamos National Laboratory for compliance with the Clean Air Act, and Oak Ridge National Laboratory Rad NESHAPs Program and Dose Assessment Methodologies Required for DOE Order 5400.5
- Review and Development of Soil Action Levels for Clean Up of Rocky Flats
- Exposure and Risks from the Cerro Grande Fire at Los Alamos
- Development of scientific methods and tools to guide long term recovery decisions with stakeholder involvement following a radiological emergency.
- RACER - Development of web-based data management application that facilitates access to and use of environmental measurement data for a variety of applications, ranging from basic data evaluation to more complex analyses.

Teaching:

- Environmental Risk Assessment Training Course H-420. Source Term Evaluation; Terrestrial Transport and Pathway Analysis; Exposure Scenarios, Dose and Risk Coefficients; Screening Approach Case Studies; Validation and Confirmatory Analysis; Case Study – The Fernald Historical Dose Reconstruction Project. Training Course H-420 prepared and presented by Risk Assessment Corporation for the U.S. Nuclear Regulatory Commission at the NRC Professional Development Center, Three White Flint North, Maryland. April 27–May 1, 2015. 9 Attendees
- Radiological Risk Assessment for Decision Making, Compliance, and Emergency Response. Exposure Scenarios; Model Validation and Testing. Crystal City Marriott, Arlington, VA. Risk Assessment Corporation. March 4-8, 2013. 52 Attendees.
- Radiological Risk Assessment for Decision Making, Compliance, and Emergency Response. Scenarios of Exposure, Defining the Representative Individual; Model Validation and Testing. Crystal City Marriott, Arlington, VA. Risk Assessment Corporation. March 5-9, 2012. 37 Attendees.
- Radiological Risk Assessment and Environmental Analysis Course. Uncertainty in Assessment Models and Validation; Case Studies: Pulling it all Together; RACER: A Process and Tools for an Integrated Approach to Risk Assessment. ITC School of Underground Waste Storage and Disposal. University of Bristol Risk Centre, Bristol, United Kingdom. June 22–26, 2009. 17 Attendees.
- Environmental Risk Assessment Analysis Training Course H-401. Source Term

Evaluation; Exposure, Dose and Risk Assessment; Practical Application of Models to Risk Assessment; Validation and Confirmatory Analysis; Continuing the Environmental Risk Assessment Process. Training Course H-401 prepared and presented by Risk Assessment Corporation for the U.S. Nuclear Regulatory Commission at the NRC's Professional Development Center, Bethesda, Maryland. January 26–30, 2009. 23 Attendees.

- Risk Assessment for Radioactively Contaminated Sites: Los Alamos Case Study. Geologic Disposal of High-Level Waste. ITC School of Underground Waste Storage and Disposal. September 2–5, 2008. Las Vagas, Nevada. 25 Attendees.
- Risk Assessment for Radioactively Contaminated Sites: Los Alamos Case Study. Geologic Disposal of High-Level Waste. ITC School of Underground Waste Storage and Disposal. June 25–28, 2007. Las Vagas, Nevada. 24 Attendees.
- Conversion to Dose and Risk. Part of Three Short Courses for Regulators and Radiation Health Specialists: Emerging Topics in Radiation Protection and Risk Assessment. March 16–18, 2004. Kiawah Island, South Carolina. 25 Attendees.
- Model Testing and Uncertainty. Part of Three Short Courses for Regulators and Radiation Health Specialists: Emerging Topics in Radiation Protection and Risk Assessment. March 16–18, 2004. Kiawah Island, South Carolina. 25 Attendees.
- Testing Models Used for Risk Assessment. Part of a five-day course developed and presented by Risk Assessment Corporation. Calculating and Understanding Risks from Radionuclides Released to the Environment. November 15–19, 1999. Seattle, Washington. 40 Attendees.
- Testing Models Used for Risk Assessment. Part of a five-day course developed and presented by Radiological Assessment Corporation. Calculating and Understanding Risks from Radionuclides Released to the Environment. April 28–May 2, 1997. Santa Fe, New Mexico. 150 Attendees.

1989 – 1992: **Intera Information Technologies**

Environmental Systems Assessment Group

Senior Consultant

Involved in a wide range of projects concerned with the assessment of radioactive and nonradioactive hazardous wastes. Provided technical assistance to Nagra to coordinate and execute the Kristallin I and Wellenberg '92 safety assessments for high-level waste and low-/intermediate-level waste disposal. Responsible for technical coordination of Intera contracts with Nagra. Key projects included the following:

- Technical secretariat to BIOMOVS (BIospheric MOdel Validation Study) – an international cooperative effort to test models designed to quantify the transfer and accumulation of radionuclides and other trace substances in the environment.
- Developed an outline methodology for the comparative assessment of environmental impacts from landfilled wastes generated by prescribed processes for Her Majesty's Inspectorate of Pollution, Department of the Environment.
- Conducted a project for the Commission of the European Communities (CEC) in collaboration with IMA (Spain) to compare the approaches used to justify land based disposal of toxic wastes and solid radioactive wastes, to identify where technical improvements to these approaches could be made, and to develop methods for their implementation.

- Conducted scenario analyses for the Nagra Kristallin I and Wellenberg projects and developed the supporting databases to provide a structured and consistent framework for identifying important phenomena (features, events, and processes)
- that need to be accounted for in repository performance assessment.
- Investigated the post-disposal implications of gas generated from a low- /intermediate-level waste repository for Nagra.

1984 –1989: **Eidg. Institut für Reaktorforschung (EIR)**
EIR (now the Paul Scherrer Institute (PSI)) was the Swiss Federal Institute for Reactor Research).

Repository Performance Assessment Group

Research Scientist

- Responsible for the biosphere modelling aspects of the performance assessment of high-level waste and low-/intermediate-level waste repositories.
- Contributed to Projekt Gewähr 1985 (demonstration of radwaste disposal feasibility in Switzerland)
- Spent summer of 1987, working with Robert Gardner, Ph.D and F. Owen Hoffman at Oak Ridge National Laboratory to gain experience in probabilistic modelling techniques.
- Development of quantitative geomicrobiological models. Appointed technical coordinator of the new Nagra microbiology program, in April 1988, which was designed to quantitatively consider microbial effects in a radioactive waste repository for use in subsequent performance assessments. This effort involved coordinating research groups within Switzerland and other European countries.
- January 1988, appointed sub-program leader for the geosphere and biosphere transport modelling. This work encompassed performance assessment in general, including scenario evaluation and consequence analysis.
- Actively participated in BIOMOVS. As chairperson for test scenario B2 (Irrigation with Contaminated Groundwater), was responsible for producing and editing the technical report presenting the study results.

Committee Memberships

- Member, U.S. Delegation, 62st Session of United Nations Scientific Committee on the Effects of Atomic Radiation. Vienna, Austria. 1 – 5 June, 2015.
- Member, U.S. Delegation, 61st Session of United Nations Scientific Committee on the Effects of Atomic Radiation. Vienna, Austria. 21 – 25 July, 2014.
- Member, National Council on Radiation Protection and Measurements Scientific Committee 3-1 "Guidance for Emergency Responder Dosimetry," 2014 – present.
- Chair, IAEA consultancy to develop guidance on management of large amounts of radioactive waste after an emergency situation, 2013 – present.
- Member, Institute of Medicine of the National Academies "Research Directions in Human Biological Effects of Low Level Ionizing Radiation," 2013 – 2014.
- Advisor, National Council on Radiation Protection and Measurements Scientific Committee 5-1 "Decision Making for Late-Phase Recovery from Nuclear or Radiological Incidents," 2011–2013.

- Member, National Council on Radiation Protection and Measurements Scientific Committee 1-19 "Health Protection Issues Associated with Use of Active Detection Technology Security Systems for Detection of Radioactive Threat Materials," 2009–2011.

- Member, National Academy of Sciences Committee to Review the "Worker and Public Health Activities Program Administered by the Department of Energy and the Department of Health and Human Services," 2005–2006.
- Member, Merit Panel, "Review of the Preliminary Performance Assessment for Waste Management Area C at the Hanford Site, Washington." Convened by CH2M-Hill Hanford Group Inc. with concurrence of the Department of Energy and the State of Washington Department of Ecology, 2004.
- Member, Radiation Advisory Committee, Science Advisory Board, U.S. Environmental Protection Agency, 2001–2007.
- Consultant, Environmental Models Subcommittee, Executive Committee, U.S. Environmental Protection Agency, 1999–2000.
- Member, Scientific Committee on Dose Reconstruction, National Council on Radiation Protection and Measurements, 1994–2000.

Professional Society Memberships

American Association for the Advancement of Science
Member, National Council on Radiation Protection and Measurements (NCRP), 2014
Health Physics Society

Education / Professional Qualifications

Ph.D. in Radioecology, Imperial College of Science and Technology, University of London, 1984
"Pathways of Radionuclides from Soils into Crops Under British Field Conditions."

B.Sc 2(1) in Botany, Imperial College of Science and Technology, University of London, 1980

Diploma of Imperial College, University of London, 1980

Associate of the Royal College of Science, University of London, 1980

Nationality: **American / British**

Languages: **English, German, intermediate French**

List of **Open Publications: January 2015**

Book Publications

Institute of Medicine and National Research Council of the National Academies. 2014. *Research on Health Effects of Low-Level Ionizing Radiation Exposure – Opportunities for the Armed Forces Radiobiology Research Institute.* Review Committee Members– Hricak, H. (Chair), D.J. Brenner, L.T. Dauer, G.X. Ding, F. Dominici, **H.A. Grogan**, D. Hoel, E.F. Maher, W.F. Morgan, G. Pion, D. Richardson, R. Wilkins. The National Academies Press, Washington, DC.

Till, J.E. and **H.A. Grogan** (editors). 2008. *Radiological Risk Assessment and Environmental Analysis.* Oxford University Press, New York.

National Research Council of the National Academies. 2006. *Review of the Worker and Public Health Activities Program Administered by the Department of Energy and the Department of Health and Human Services.* Review Committee Members–Przybylowicz, E.P (Chair), E.H. Clark II, I. Feller, P. Fenner-Crisp, R.W. Field, S.M. Friedman, **H.A. Grogan**, J. Mandel, G. Paulson, R.K. Sokas, D.O. Stram, T. Zheng. The National Academies Press, Washington, DC.

Referred Publications / Book Chapters

Till, J.E., H.L. Beck, J.W. Aanenson, **H.A. Grogan**, H.J. Mohler, S.S. Mohler, P.G. Voillequé. 2014. Military Participants at U.S. Atmospheric Nuclear Weapons Testing-Methodology for Estimating Dose and Uncertainty. *Radiat Res.* 181, 471 – 484.

J.E. Till, **H.A. Grogan**, H.J. Mohler, J.R. Rocco, S.S. Mohler. 2012. "An Integrated Approach to Data Management, Risk Assessment, and Decision Making." *Health Physics*, 102 (4), April.

Mohler, H.J., **H.A. Grogan**, J.R. Rocco, R.F. Kiefer, and J.E. Till. 2012. RACER: Dynamic Use of Environmental Measurement Data for Decision Making and Communication. *Operational Radiation Safety*, Vol. 102, Suppl 1. February.

McKinley, I.G., **H.A. Grogan** and L.E. McKinley. 2011. Fukushima: Overview of Relevant International Experience. *Journal of Nuclear Fuel Cycle and Environment* 18 (2): 89–100.

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

Grogan, H.A. 2008. "Model Validation." Chapter 14 in *Radiological Risk Assessment and Environmental Analysis.* Oxford University Press, New York. pp. 589-612.

Rood, A.S., P.G. Voillequé, S.K. Rope, **H.A. Grogan**, and J.E. Till. 2008. Reconstruction of atmospheric concentrations and deposition of uranium and decay products released from the former uranium mill at Uravan, Colorado. *J. Env. Radioactivity* 99:1258–1278.

Mohler, H.J., K.R. Meyer, **H.A. Grogan**, J.W. Aanenson, and J.E. Till. 2004. Application of NCRP Air Screening Factors for Evaluating Both Routine and Episodic Radionuclide Releases to the Atmosphere. *Health Physics* 86(2): 135–144.

Till, J.E., A.S. Rood, P.G. Voillequé, P.D. McGavran, K.R. Meyer, **H.A. Grogan**, W.K. Sinclair, J.W. Aanenson, H.R. Meyer, H.J. Mohler, S.K. Rope, and M.J. Case. 2002. Risks to the Pubic

from Historical Releases of Radionuclides and Chemicals at the Rocky Flats Nuclear Weapons Plant. *J. Exp. Analysis and Env. Epidemiology* 12: 355–372.

Grogan, H.A., W.K. Sinclair, and P.G. Voillequé. 2001. Risks of Fatal Cancer From Inhalation of Plutonium-239,240 By Humans: A Combined Four Method Approach With Uncertainty Evaluation. *Health Physics* 80(5): 447–461.

Rood, A.S., **H.A. Grogan** and J.E. Till. 2001. A Model for a Comprehensive Assessment of Exposure and Lifetime Cancer Incidence Risk from Plutonium Released from the Rocky Flats Plant, 1953-1989. *Health Physics* 82(2): 182–212.

Little, R.H., **H.A. Grogan,** G.M. Smith, and C. Torres. 1993. "Land Disposal Practices in Europe and North America." *J. Inst. Water and Environmental Management* 7 (4): 354–363.

Nair, S., **H.A. Grogan,** M.J. Minski, and J.N.B. Bell. 1983. "Models for the Prediction of Doses from the Ingestion of Terrestrial Foods." In *Ecological Aspects of Radionuclide Releases.* Edited by P.J. Coughtrey, J.N.B. Bell, and T.M. Roberts. Oxford: Blackwell Scientific. 141–159.

McKinley, I.G. and **H.A. Grogan.** 1991. "Radionuclide Sorption Databases for Swiss Repository Safety Assessments." *Radiochimica Acta* 52/53: 415–420.

McKinley, I.G. and **H.A. Grogan.** 1991. "Consideration of Microbiology in Modeling the Near-Field of a L/ILW Repository." *Experientia* 47: 573–577.

West, J.M., **H.A. Grogan,** and I.G. McKinley. 1991. "The Role of Microbiology in the Geological Containment of Radioactive Wastes." In *Diversity of Environmental Biogeochemistry.* Developments in Geochemistry: 6. Edited by J. Berthelin. Elsevier Science Publishers B V. 205–215.

Van Dorp, F., **H.A. Grogan,** and C. McCombie. 1989. "Disposal of Radioactive Waste." International Journal of Radiation Applications and Instrumentation Part C. *Radiat. Phys. Chem.* 34 (2): 337–347

Grogan, H.A. and F. van Dorp. 1988. "The Reliability of Environmental Transfer Models Applied to Waste Disposal." In *Reliability of Radioactive Transfer Models.* Edited by G. Deems. Elsevier Applied Science. EUR 11367. 276–284.

Grogan, H.A., N.G. Mitchell, M.J. Minski, and J.N.B. Bell. 1988. "Pathways of Radionuclides from Soils to Wheat." In *Pollutant Transport and Fate in Ecosystems.* Edited by P.J. Coughtrey, M.H. Martin, and M.H. Unsworth. Oxford: Blackwell Scientific Publications. 353–370.

Bell, J.N.B., M.J. Minski, and **H.A. Grogan.** 1988. "Plant Uptake of Radionuclides." *Soil Use and Management* 4 (3): 76–84.

Conference Proceedings

Till, J.E., and **H.A. Grogan**. 2009. It's the Dose! – Strategies for Environmental Dose Reconstruction and Risk Assessment. Environmental Dose Reconstruction and Risk Assessment for Litigation and Planning Purposes. Phoenix, AZ.

Rood, A.S., B. Jacobs, P. Shanahan, H.J. Mohler, J.W. Aanenson, J.R. Rocco, L. Hay Wilson, **H.A. Grogan,** and J.E. Till. 2009. "Overview of Environmental Transport Models Contained in the Risk Analysis, Communication, Evaluation, and Reduction (RACER) Software Tools at Los Alamos National Laboratory." In *Proc. Waste Management for the Nuclear Renaissance*, March 1-5, 2009, Phoenix, Arizona. Waste Management 2009. www.wmsym.org.

J.E. Till and **H.A. Grogan**. 2006. "Applied Modeling and Computations in Nuclear Science: the Foundation for Risk Assessment and Decision Making." In *Applied Modeling and Computations in Nuclear Science*. ACS Symposium Series 945. Edited by T.M. Semkow, S. Pommé, S.M. Jerome, and D.J. Strome. American Chemical Society, Washington, DC.

H.A. Grogan, J.W. Aanenson, P.D. McGavran, K.R. Meyer, S.S. Mohler, H. J. Mohler, J.R. Rocco, A.S. Rood, J.E. Till and L.H. Wilson. 2006 "Applied Modeling of the Cerro Grande Fire at Los Alamos: An Independent Analysis of Exposure, Health Risk, and Communication with the Public." In *Applied Modeling and Computations in Nuclear Science*. ACS Symposium Series 945. Edited by T.M. Semkow, S. Pommé, S.M. Jerome, and D.J. Strome. American Chemical Society, Washington, DC.

Mohler, H.J., J.W. Aanenson, **H.A. Grogan**, and J.E. Till. 2005. "Creating Spatially-Linked Data and Risk Evaluation Tools to Support Community Participation and Decision Making for a Contaminated Site." *Proc. EnviroInfo 2005*. 19th International Conference Informatics for Environmental Protection. September, 7 – 9. Networking Environmental Information. Brno, Czech Republic.

Grogan, H.A., J.E. Till, K.R. Meyer, and H.J. Mohler. 2004. "Involving Stakeholders and Tailoring Environmental Databases for Shared Analysis of a Contaminated Site." Proceedings of the 18th International Conference Informatics for Environmental Protection, Sh@ring, CERN, Geneva, Switzerland, October 21-23.

Sumerling, T.J., **H.A. Grogan,** P. Zuidema, and F. van Dorp. 1993. "Scenario Development for Safety Demonstration for Deep Geological Disposal in Switzerland." *Proceedings of the 4th Annual International Conference on High-Level Radioactive Waste Management.* Las Vegas, Nevada, April 26–30, 1993. American Society of Civil Engineers and the American Nuclear Society.

Smith, G.M. and **H.A. Grogan.** 1992. "Taking Account of the Biosphere in HLW Assessment." *Proceedings of the Third International Conference on High Level Radioactive Waste Management.* Las Vegas, Nevada, April 12–16, 1992. American Society of Civil Engineers and the American Nuclear Society.

Grogan, H.A. and K.J. Worgan. 1991. "Testing Near-Field Models for Deep Disposal." In *Proceedings of the Technical Workshop on Near-Field Performance Assessment for High-Level Waste.* Madrid, Spain, October 15–17, 1990. Edited by P. Sellin, M. Apted, and J. Gago. SKB Technical Report 91–59. Swedish Nuclear Fuel and Waste Management Co. Available from Box 5864, S–10248, Stockholm, Sweden.

Zuidema, P., F. van Dorp, **H.A. Grogan,** and M. Hugi. 1991. "Radioactive Waste Disposal In Switzerland: The Impact of Safety Criteria on Repository Design and Hydrogeological Requirements." In Proceedings *Water Resources in Mountainous Regions.* Edited by A. Parmaux. *Memories of the 22nd Congress of IAH*, Vol. XXII Part, GEOLEP–EPFL. CH-1015 Lausanne.

Grogan, H.A. 1991. "BIOMOVS Contribution to Long Term Radioactive Waste Assessment." *Proceedings of the Symposium on the Validity of Environmental Transfer Models.* Stockholm, Sweden., October 1990. Swedish Radiation Protection Institute.

Schenker-Wicki, A., F. van Dorp, and **H.A. Grogan.** 1988. "The Use of Multi-Criteria Analysis (MCA) for Evaluating Feasible Countermeasures After an Accidental Release of Radioactivity." IV Symposium Internationale de Radioécologie Impact des Accidents d'Origine Nucléaire sur l'Environment, March 14–19, Cadarache, France.

Grogan, H.A. and F. van Dorp. 1986. "Modelling the Behaviour of Radionuclides in the Biosphere for the Safety Assessment of a High-Level Waste Repository, First Estimates of Uncertainties." In *CEC Seminar on The Cycling of Long-lived Radionuclides in the Biosphere: Observations and Models. Madrid, Spain, 1986.*

Grogan, H.A. and F. van Dorp. 1986. "The Importance of Models for Predicting the Behaviour and Impact of Radionuclides Released to the Environment." Paper presented at the Symposium Radioaktivitätsmessungen in der Schweiz nach Tschernobyl und ihre wissenschaftliche Interpretation, October 20–24, Bern, Switzerland.

McKinley, I.G., **H.A. Grogan,** and J.M. West. 1985. "Quantitative Modelling of the Effects of Microorganisms on Radionuclide Transport from a HLW Repository." *Proceedings of the NEA Workshop on the Effects of Natural Organic Compounds and of Microorganisms on Radionuclide Transport*. 50–66.

West, J.M., I.G. McKinley, **H.A. Grogan,** and S.C. Arme. 1985. "Laboratory and Modeling Studies of Microbial Activity in the Near Field of a HLW Repository." *Proceedings of the Stockholm MRS Meeting, Scientific Basis for Radioactive Waste Management, IX.*, Edited by L.O. Werne. 533–538.

Published Technical Reports
(excludes technical notes, internal reports and commercial reports)

New Mexico Community Foundation. 2011. Contributing Authors; H.J. Mohler, J.E. Till, **H.A. Grogan**, S. Wolters, E. Archuleta, P. Medvick, S. Price, D. Cuthbertson, R. Rivera. *Audit Report: Evaluation of the Completeness and Accuracy of the Environmental Monitoring Data Provided by Los Alamos National Laboratory and the New Mexico Environment Department Oversight Bureau to the RACER Database.* Report Prepared by Risk Assessment Corporation for New Mexico Community Foundation. February.

Risk Assessment Corporation (RAC). 2009. Contributing Authors; J.W. Aanenson, **H.A. Grogan**, B. Jacobs, G.G. Killough, K.R. Meyer, H.J. Mohler, S. Mohler, J.R. Rocco, A.S. Rood, P. Shanahan, E.A. Stetar, L. Hay Wilson, J.E. Till. *Risk Analysis, Communication, Evaluation, and Reduction at LANL. Ranking Tool Methodology.* RAC Report No. 35-RACER LANL-2008-FINAL. Risk Assessment Corporation. Neeses, South Carolina. April.

Aanenson, J.W., D. Gonzales, **H.A. Grogan,** S.S. Mohler, J.R. Rocco, E.A. Stetar, L. Hay Wilson, and J E. Till. 2007. *Risk Analysis, Communication, Evaluation, and Reduction at LANL. Stakeholder Involvement Summary*. RAC Report No. 21-RACER LANL-2007-FINAL. Risk Assessment Corporation. Neeses, South Carolina. September.

Wilson, L.H, J.R. Rocco, S. Mohler, E.A. Stetar, **H.A. Grogan**, H.J. Mohler, J. Wilson, B. Jacobs, P. G. Voillequé and J E. Till. 2007. *Risk Analysis, Communication, Evaluation, and Reduction at LANL. Decision Support Tool Methodology*. RAC Report No. 18-RACER LANL-2007-FINAL. Risk Assessment Corporation. Neeses, South Carolina. July.

Stetar, E.A, L.H. Wilson, J.R. Rocco, S. Mohler, **H.A. Grogan** and J E. Till. 2007. *Risk Analysis, Communication, Evaluation, and Reduction at LANL. Focus Group Data Evaluation*. RAC Report No. 19-RACER LANL-2007-FINAL. Risk Assessment Corporation. Neeses, South Carolina. July.

Kosson, D., **H. Grogan**, K. Higley, R. Maddalena, and C. Whipple. 2004. Merit Panel Review of the C-Tank Farm Closure Performance Assessment. Final Report. Submitted to CH2M-Hill Hanford Group, Inc. April 20.

Grogan, H.A., K.R. Meyer, S.S. Mohler, A.S. Rood, P.G. Voillequé, and J.E. Till. 2004. *Assessment of Thyroid Doses Received by Specified Individuals from Releases of Iodine-131 from Hanford.* In re: Hanford Nuclear Reservation Litigation. Master File No. CY-91-3015-WFN. RAC Report No.14-Hanford Litigation. RAC Expert Report. August 13.

Aanenson, J.W., J. Goldberg, **H.A. Grogan**, L.H. Wilson, G.G. Killough, K.R. Meyer, H.J. Mohler, S. Mohler, J.R. Rocco, A.S. Rood, P. Shanahan, W.K. Sinclair, C. Slack, E.A. Stetar, J. Wilson, J E. Till. 2004. *Risk Analysis, Communication, Evaluation, and Reduction at LANL-Contemporary Risk Assessment: Demonstration of an Integrated Methodology*. RAC Report No. 11-RACER LANL-2004-FINAL. Risk Assessment Corporation. Neeses, South Carolina. December.

Mohler, H.J., K.R. Meyer, J.W. Aanenson, and **H.A. Grogan**. 2002. Analysis of Exposure and Risks to the Public from Radionuclides and Chemicals Released by the Cerro Grande Fire at Los Alamos. Task 3: Calculating and Communicating Risks: Observations and Recommendations. RAC Report No.15-NMED-2001-FINAL(Rev.1). Prepared by Risk Assessment Corporation, Neeses, South Carolina for New Mexico Environment Department, Santa Fe. June 12.

Rood, A.S., J.W. Aanenson, S.S. Mohler, P.D. McGavran, H.J. Mohler, and **H.A. Grogan**. 2002. Analysis of Exposure and Risks to the Public from Radionuclides and Chemicals Released by the Cerro Grande Fire at Los Alamos. Task 1.7: Final Report on Estimated Risks from Releases to Air. RAC Report No. 3-NMED-2002-FINAL(Rev.1). Prepared by Risk Assessment Corporation, Neeses, South Carolina for New Mexico Environment Department, Santa Fe. June 12.

Mohler, S.S., J.W. Aanenson, **H.A. Grogan**, L. Hay Wilson, P.D. McGavran, K.R. Meyer, Ph.D., H.J. Mohler, J.R. Rocco, and A.S. Rood. 2002. *Analysis of Exposure and Risks to the Public from Radionuclides and Chemicals Released by the Cerro Grande Fire at Los Alamos. Summary Report. RAC* Report No. 5-NMED-2002-FINAL. Prepared by Risk Assessment Corporation, Neeses, South Carolina for New Mexico Environment Department, Santa Fe. June 12.

Grogan, H.A., A.S. Rood, J.W. Aanenson, and E.B. Liebow. 2002. FINAL REPORT A Risk-based Screening Analysis for Radionuclides Released to the Columbia River from Past Activities at the U.S. Department of Energy Nuclear Weapons Site in Hanford, Washington. RAC Report No. 3-CDC-Task Order 7-2000-FINAL. Prepared by Risk Assessment Corporation, Neeses, South Carolina for the Centers for Disease Control and Prevention, Atlanta. November.

Till, J.E., Aanenson, J.W., Boelter, P.J., M.C. Case, M. Dreicer, **H.A. Grogan**, M.O. Langan, P.D. McGavran, K.R. Meyer, R. Meyer, H.J. Mohler, A.S. Rood, R.C. Rope, S.K. Rope, L.A. Stetar, P.G. Voillequé, T.F. Winsor, W. Yang. 2001. *Evaluation of Materials Released from the Savannah River Site. Savannah River Site Environmental Dose Reconstruction Project.* Phase II: Source Term Calculation and Ingestion Pathway Data Retrieval. RAC Report No.1-CDC-SRS-1999-Final. Final Report. Prepared by *Radiological Assessments Corporation,* Neeses, South Carolina for Centers for Disease Control and Prevention. April.

Grogan, H.A., W.K. Sinclair, and P.G. Voillequé, 2000. *Assessing Risks of Exposure to Plutonium.* RAC Report No. 5-CDPHE-RFP-1998-FINAL(Rev.2). Prepared by *Radiological*

Assessments Corporation, Neeses, South Carolina for Colorado Department of Public Health and Environment. February.

Killough, G. G., A.S. Rood, J.W. Aanenson, K.R. Meyer, **H.A. Grogan**, W.K. Sinclair, and J.E. Till. 2000. *Task 5: Independent Calculation*. Radionuclide Soil Action Level Oversight Panel. *RAC* Report No. 16-RSALOP-RSAL-1999-FINAL. *Risk Assessment Corporation.* February.

Sumerling, T.J., **H.A. Grogan** and P.A. Smith. 1999. *Scenario Development for Kristallin-1*. Nagra Technical Report Series NTB 93–13. CH–5430 Wettingen, Switzerland.

Grogan, H.A., P.D. McGavran, H.R. Meyer, K.R. Meyer, H.J. Mohler, A.S. Rood, W.K. Sinclair, P.G. Voillequé and J.M. Weber. 1999. *Technical Summary Report for the Historical Public Exposures Studies for Rocky Flats Phase II.* RAC Report No. 14-CDPHE-RFP-1999-FINAL. Prepared by *Radiological Assessments Corporation*. Neeses, South Carolina for Colorado Department of Public Health and Environment. September.

Meyer, K. R., **H.A. Grogan**, and J.E. Till. 1999. *RAC Responses to Public Questions and Concerns.* RAC Report No.12-CDPHE-1999-FINAL. Prepared by *Radiological Assessments Corporation*, Neeses, South Carolina for Colorado Department of Public Health and Environment. August.

Rood, A.S. and **H.A. Grogan**. 1999. *Estimated Exposure and Lifetime Cancer Incidence Risk from 903 Area Plutonium Releases at the Rocky Flats Plant.* RAC Report No. 1-CDPHE-RFP-1999-FINAL. Prepared by *Radiological Assessments Corporation.* Neeses, South Carolina for Colorado Department of Public Health and Environment. August.

Rood, A.S. and **H.A. Grogan**. 1999. *Estimated Exposure and Lifetime Cancer Incidence Risk from Plutonium Released from the 1957 Fire at the Rocky Flats Plant.* RAC Report No. 2-CDPHE-RFP-1999-FINAL. Prepared by *Radiological Assessments Corporation.* Neeses, South Carolina for Colorado Department of Public Health and Environment. August.

Rood, A.S. and **H.A. Grogan**. 1999. *Estimated Exposure and Lifetime Cancer Incidence Risk from Plutonium Released from the 1969 Fire at the Rocky Flats Plant.* RAC Report No. 7-CDPHE-RFP-1999-FINAL. Prepared by *Radiological Assessments Corporation.* Neeses, South Carolina for Colorado Department of Public Health and Environment. August.

Rood, A.S. and **H.A. Grogan**. 1999. *Comprehensive Assessment of Exposure and Lifetime Cancer Incidence Risk from Plutonium Released from the Rocky Flats Plant, 1953–1989.* RAC Report No. 13-CDPHE-RFP-1999-FINAL. Prepared by *Radiological Assessments Corporation*, Neeses, South Carolina for Colorado Department of Public Health and Environment. September.

Rope S.K., K.R. Meyer, M.J. Case, **H.A. Grogan**, D.W. Schmidt, M. Dreicer, T.F. Winsor, and J.E. Till. 1999. *Evaluation of Environmental Data for Historical Public Exposures Studies on Rocky Flats.* RAC Report No. 1-CDPHE-RFP-1997-FINAL(Rev.1). Prepared by *Radiological Assessments Corporation,* Neeses, South Carolina for Colorado Department of Public Health and Environment. August.

Centers for Disease Control and Prevention. 1998. *Issues Related to Estimating Doses Due to I-131 Releases to the Atmosphere from the Hanford Site*. Technical Workshop Report. Prepared by **H.A. Grogan**. RAC Report No. 2-CDC-Task Order 4-1998-FINAL. *Radiological Assessments Corporation.*

Centers for Disease Control and Prevention. 1996. *Calculating and Interpreting Radiological Doses and Risks for Individuals Exposed to Radionuclides Due to Historical Releases from the Hanford Nuclear Reservation*. Technical Workshop Report. Prepared by **H.A. Grogan**. RAC Report No. 5-CDC-Task Order 2-1996-FINAL. *Radiological Assessments Corporation.*

Stetar, E.A., M.J. Case, L.W. Bell, **H.A. Grogan**, K.R. Meyer, H.R. Meyer, S.K. Rope, D.W. Schmidt, T.F. Winsor, and J.E. Till. 1995. *Identifying Sources of Environmental Monitoring and Research Data. Savannah River Site Dose Reconstruction Project*. RAC Report No. 2 CDC-SRS-95-Final. *Radiological Assessments Corporation*.

Meyer, K.R., P.D. McGavran, P.G. Voillequé, **H.A. Grogan**, L.W. Bell, H.R. Meyer, S.K. Rope, and J.E. Till. 1995. Phase I Data Retrieval and Assessment. *Evaluation of Materials Released from the Savannah River Site*. RAC Report No. 6 CDC-SRS-95-Final. *Radiological Assessments Corporation*.

Grogan, H.A., M.O. Langan, H.R. Meyer, E.A. Stetar, and J.E. Till. 1995. *Identification and Cataloging of Information Sources. Savannah River Site Dose Reconstruction Project*. RAC Report No. 3 CDC-SRS-95-Final. *Radiological Assessments Corporation*.

Watkins, B.M. and **H.A. Grogan**. 1994. *Overview of Information Concerning Microbial Effects on Radioactive Waste Repositories*. Nagra Technical Report Series NTB 93–40. CH–5430 Wettingen, Switzerland.

Grogan, H.A., K.R. Meyer, P.G. Voillequé, S.K. Rope, M.J. Case, H.R. Meyer, R.E. Moore, T. Winsor, and J.E. Till. 1994. *Verification of Phase I Source Term & Uncertainty Estimates*.Final Task 2 Report prepared by *Radiological Assessments Corporation* for the Colorado Department of Public Health and Environment.

Little, R.H., C. Torres, D. Charles, **H.A. Grogan**, I. Simon, G.M. Smith, T.J. Sumerling, and B.M. Watkins. 1993. Post-Disposal Safety Assessment of Toxic and Radioactive Waste: Waste Types, Disposal Practices, Disposal Criteria, Assessment Methods and Post-Disposal Impacts. EUR 14627 EN. Commission of the European Communities. ISBN 92-826-5610-1, Luxembourg.

Grogan, H.A., K.J. Worgan, G.M. Smith, and D.P. Hodgkinson. 1992. *Post–Disposal Implications of Gas Generated from Low and Intermediate Level Wastes*. Nagra Technical Report Series NTB 92–07. CH–5430 Wettingen, Switzerland.

Grogan, H.A., D. Charles, and G.M. Smith. 1991. *An Outline Methodology for Comparative Assessment of Environmental Impacts from Landfilled Wastes*. DoE Report No. DOE/HMIP/RR/91/058. Available from Romney House, 43 Marsham Street, London SW1P 3PY, United Kingdom.

Baeyens, B., **H.A. Grogan**, and F. van Dorp. 1991. *Biosphere Modelling for a Deep Radioactive Repository: Treatment of the Groundwater–Soil Pathway*. PSI Technical Report PSI Bericht Nr. 98. CH–5232 Villigen PSI, Switzerland.

Grogan, H.A., B. Baeyens, H. Müller, and F. van Dorp. 1991. *Biosphere Modelling for a Deep Radioactive Repository: Site–Specific Consideration of the Groundwater–Soil Pathway*. PSI Technical Report PSI Bericht Nr. 99. CH–5232 Villigen PSI, Switzerland.

Stenhouse, M.J. and **H.A. Grogan**. 1991. *Review of Reactions of Hydrogen and Methane in the Geosphere and Biosphere*. Nirex Safety Series Report, NSS/R262. Available from UK Nirex Ltd, Curie Ave, Harwell, Oxon, OX11 0RH, United Kingdom.

Grindrod, P., M.J. Williams, **H.A. Grogan**, and M.D. Impey. 1990. *STRENG: A Source Term Model for Vitrified High Level Waste*. Nagra Technical Report Series NTB 90–48. CH–5430 Wettingen, Switzerland.

Grogan, H.A., ed. 1989. *BIOMOVS Technical Report 6 – Scenario B2: Irrigation with Contaminated Groundwater.* National Institute of Radiation Protection, Box 60204, S-10401 Stockholm, Sweden.

Grogan, H.A. and I.G. McKinley. 1989. *An Approach to Microbiological Modelling Application to the Near–Field of a Swiss Low/Intermediate Level Waste Repository*. Nagra Technical Report Series NTB 86–09. CH–5430 Wettingen, Switzerland

Grogan, H.A. and F. van Dorp. 1986. *BIOMOVS Test Scenario Model Comparison Using BIOPATH. EIR Bericht Nr. 599, CH–5232 Villigen PSI, Switzerland.* Nagra Technical Report Series NTB 86–23. CH–5430 Wettingen, Switzerland.

Grogan, H.A. 1985. "Biosphere Modeling." EIR Bulletin Nr. 56 23. CH–5232 Villigen PSI, Switzerland.

Grogan, H.A. 1985. *Concentration Ratios for BIOPATH: Selection of the Soil-to-Plant Concentration Ratio Database. EIR Bericht Nr. 575, CH–5232 Villigen PSI, Switzerland.* Nagra Technical Report Series NTB 85–16. CH–5430 Wettingen, Switzerland.

Grogan, H.A. 1985. *Biosphere Modelling of a HLW Repository – Scenario and Parameter Variations. EIR Bericht Nr. 561, CH–5232 Villigen PSI, Switzerland.* Nagra Technical Report Series NTB 85–48. CH–5430 Wettingen, Switzerland.

McKinley, I.G., J.M. West, and **H.A. Grogan**. 1985. *An Analytical Overview of the Consequences of Microbial Activity in a Swiss HLW Repository. EIR Bericht Nr. 562, CH–5232 Villigen PSI, Switzerland.* Nagra Technical Report Series NTB 85–43. CH–5430 Wettingen, Switzerland.

Grogan, H.A., J.N.B. Bell, M.J. Minski, and S. Nair. 1984. An Experimental Study of the Time Dependence of Uptake from Soil of Cs–137, Ru–106, Ce–144, and Tc–99 into Green Vegetables, Wheat and Potatoes. CEGB Report TPRD/B/0416/N84. Berkeley Nuclear Laboratories, Berkeley, Glos, GL13 9PB, United Kingdom.

Thomas E. Johnson

Department of Environmental and Radiological Health Sciences
Colorado State University
1618 Campus Delivery
Fort Collins CO 80523

EDUCATION

1997	PhD, Health Physics, Purdue University.
1993	MS, Environmental Engineering, Northwestern University.
1991	MBA, University of Illinois at Chicago
1989	BS, Industrial Technology, Southern Illinois University

Professional Certification

2002	Certified Laser Safety Officer
1998	Comprehensive Certification, American Board of Health Physics
1998	National Registry of Radiation Protection Technologists
1996	Fellow, American College of Forensic Examiners

ACADEMIC POSITIONS

(2012-2015) Elected Head, Radiation Protection & Measurements Section, Department of Environmental and Radiological Health Sciences, Colorado State University, Fort Collins, CO

(2011 - present) Associate Professor, Health Physics, Department of Environmental and Radiological Health Sciences, Colorado State University, Fort Collins, CO

(2005 - 2011) Assistant Professor, Health Physics, Department of Environmental and Radiological Health Sciences, Colorado State University, Fort Collins, CO

(1998-2005) Assistant Professor, Health Physics, Department of Preventive Medicine and Biometrics, Uniformed Services University of the Health Sciences, Bethesda, MD

(1994 - 1997) Teaching Assistant, Department of Health Sciences, Industrial Hygiene and Health Physics, Purdue University, West Lafayette, IN

(1993 - 1994) Teaching Assistant, Department of Environmental Engineering, Industrial Hygiene and Health Physics, Northwestern University, Evanston, IL

OTHER POSITIONS

(2011-2012) Appointed to the US EPA Radiation Advisory Committee augmented In- Situ Recovery Panel

2015 Chair, State of Colorado Radiation Advisory Committee

(2010 – 2018) Appointed by Governors Ritter(2010) and Hickenlooper (2013, 2016) to represent higher education on the Colorado Radiation Advisory Committee

(1997 - 1999) Consulting Health Physicist, CSI - Radiation Safety Training and Consulting, Kensington, MD

(1995) Health Physicist, Commonwealth Edison, Braidwood, IL

(1994) Health Physicist, Commonwealth Edison, Braidwood, IL

(1993) Industrial Hygienist and Health Physicist, The Dow Chemical Company, Midland, MI

(1992 - 1993) Safety and Quality Control Engineer, Northern Indiana Public Service Co., Merrillville, IN

(1990 - 1992) Pressure Vessel Inspector and Risk Assessment Analyst, The Chubb Group, Chicago, IL

Military

(2005- 2009) Senior Health Physicist, (reservist) Air Force Radiation Assistant Team, Brooks Air Force Base, TX (AFRAT).

(2000- 2005) Program Reviewer, (reservist) Air Force Office of Scientific Research (NE), Ballston, VA

(1997 –2000) Technical Advisor, (reservist),USAF Surgeon General's Radioisotope Committee, Air Force Medical Operations Agency, SGOR Bolling AFB, DC

(1994 - 1997) Medical Physicist, (reservist), Radiation Safety Office, Air Force Reserves, Wright Patterson Medical Center, SGORP WPAFB, OH

(1986 - 1990) Engineering Laboratory Technician, USS Cavalla (SSN 684), F.P.O. San Francisco, CA

HONORS AND AWARDS

(2014) Fellow, Health Physics Society
(2012) CVMBS Graduate Advisor Award, Colorado State University
(2010) N. Preston Davis Award, Colorado State University
(2010) CVMBS Innovative Instructional Methodology Award in Graduate Education, Colorado State University
(2007) CVMBS Innovative Teaching Award, Colorado State University
(2007) Honorable Mention Award, Great Plains University Continuing Education Association
(2005) Meritorious Service Medal, USAF Reserve
(2003) Air Force Commendation Medal, USAF Reserve
(2001) Air Force Organizational Excellence Award, USAF Reserve
(2000) Air Force Achievement Medal, USAF Reserve
(1997) Air Force Longevity Service Award, USAF Reserve
(1996) Air Force Outstanding Unit Award, USAF Reserve
(1995) Air Force Training Ribbon, USAF Reserve
(1996) Health Physics Society Scholarship Recipient
(1995) Rho Chi Honor Society for Health Sciences, Purdue University
(1994) National Defense Service Medal, USAF Reserve
(1994, 1995) Health Physics Society Summer School Scholarship Recipient
(1988, 1989) Dean's List, Southern Illinois University
(1988) Navy Good Conduct Medal, USN
(1987) Qualified Submarines, USN

PUBLISHED WORKS

Student papers indicated by * Corresponding author indicated by #

Books:

T.E. Johnson, B. Birky, Radiological Health Handbook, 4th Edition, Wolters Kluwer, NY, December 2011, 1281 pages.

T.E. Johnson, 2005, ElectroMed 2005 Symposium Record Abstracts, Bartleby Press, MD, May, 178 pages

T.E. Johnson, 2003, Editor, ElectroMed 2003 Symposium Record Abstracts, Veridian Co, San Antonio TX, 140 pages

W.P Roach, T.E. Johnson, 2003, Ultrashort Laser Pulse Bioeffects, Milestones in Science Series, International Society for Optical Engineering Press, Bellingham, WA (ISBN 0-8194-4747-1), 678 pages

T.E. Johnson, 2001, ElectroMed 2001 Symposium Record Abstracts, Eastern Virginia Medical School, VA, 136 pages

Refereed Journal Articles:

Elizabeth Ruedig, PhD; Colleen Duncan; Bobette Dickerson; Michael Williams; Thomas Gelatt; Justin Bell; Thomas Johnson (2016) Fukushima derived radiocesium in subsistence-consumed northern fur seal and wild celery, Journal of Environmental Radioactivity, pp. 1-7 DOI information: 10.1016/j.jenvrad.2015.10.024

Ruedig, E. Johnson T.E., (2015) An evaluation of health risk to the public as a consequence of in situ uranium mining in Wyoming, USA Journal of Environmental Radioactivity, accepted for publication, Volume 150, December 2015, Pages 170–178

Luke D. Hetrick, Susan L. Kraft, Dayton McMillan Thomas E. Johnson (2015) Occupational Exposure to Veterinary Workers from the Positron Emission Tomography Imaging Agent ^{64}Cu-ATSM. Health Physics Journal, Vol. 109, No. 5, Suppl. 3, S219-S223, November, 2015.

Schilz, J. R., Reddy, K. J., Nair, S., Johnson, T. E., Tjalkens, R. B., Krueger, K. P. (2015) Removal of Trace Elements by Cupric Oxide Nanoparticles from Uranium In Situ Recovery Bleed Water and Its Effect on Cell Viability. J. Vis. Exp. (100), e52715, doi:10.3791/52715 (2015)

Martinez, N.E., Johnson, T.E., Kuhne, W, Stafford, C. Duff, M.(submitted 2014) "The Feasibility of Reflectance spectroscopy as a technique to assess symptoms of cesium toxicity in Arabadopsis thaliana" International Journal of Remote Sensing (in revision)*

Martinez, N.E., Pinder, J.E., Johnson, T.E., (2014) Development and comparison of computational models for estimation of absorbed organ radiation dose in rainbow trout (Oncorhynchus mykiss) from uptake of iodine-131 Journal of Environmental Radioactivity, 138; 50-59 *#

Martinez, N.E., J.E. Pinder III, T.E. Johnson (2014), "The Influence of Lake Trophic Structure on 131-I Accumulation and Subsequent Cumulative Radiation Dose to Trout Thyroids," Journal of Environmental Radioactivity. 131; 62-71 *#

Georg Steinhauser, Alexander Brandl, Thomas E. Johnson (2014); Comparison of the Chernobyl and Fukushima nuclear accidents: A review of the environmental impacts. Science of the Total Environment. Science of the Total Environment 470–471 (2014) 800–817

Martinez, N.E., S.L. Kraft, and T.E. Johnson (2014), "A Proposed Simple Model for Occupational Radiation Dose to Staff From Veterinary 18F-FDG PET Procedures," Health Phys. 2014 May;106(5):583-91. *#

Xianan Liu, John E. Doerges, John Volckens, Thomas E. Johnson (2014) "Aerosol Size Distribution in the Schwartzwalder Uranium Mine" Health Physics Journal, Feb;106,S20-24. *#

T. Borch, N. Roche, T.E. Johnson, 2012,"Determination of Contaminant Levels and Remediation Efficacy In Groundwater at a Former In-Situ Recovery Uranium Mine", Journal of Environmental Monitoring, May, 2012 DOI: 10.1039/C2EM30077J*#

Martinez Nicole E, Kraft Susan L, Gibbons Debra S, Arceneaux Billie K, Stewart Jeffrey A, Mama Khursheed R, Johnson Thomas E, 2012 "Occupational Per-Patient Radiation Dose From a Conservative Protocol for Veterinary ^{18}F Fluorodeoxyglucose Positron Emission Tomography" Veterinary Radiology & Ultrasound, Accepted May, 2012. *#

D. McMillan, T.E. Johnson, Y. Guo, A. Brandl, 2011 "A Plan for the Handling of Externally Contaminated Livestock" Health Physics, 101 (supplement 3), S164-169, November, 2011. *#

D. Schaaf, and T. E. Johnson, 2010 "Relationships of skin depths and temperatures when varying pulse repetition frequencies from 2.0 μm laser light incident on pigs skin" Journal of Biomedical Optics, 15(4) *#

D. Schaaf, T. Eurell, and T. E. Johnson, 2010 "Cultured Human Keratinocytes for Optical Transmission Measurement" Journal of Biophotonics, 3:161-168 *#

MD Rosenbaum, S VandeWoude, J Volckens, TE Johnson, 2009 "Macroenvironmental and Microenvironmental Disparities in Ammonia, Temperature, Humidity and Airborne Particulate Matter in Individually Ventilated Caging Housing Mice" Journal of the American Association for Laboratory Animal Science, 49: 177-183 *#

MD Rosenbaum, S VandeWoude, TE Johnson, 2009 "The Effect of Cage Change Frequency and Bedding Volume on the Mouse and its Microenvironment" Journal of the American Association for Laboratory Animal Science, 48:763-773 *#

N.A. McPherson, T.A. Neal, T.E. Johnson, 2008 "The Potential Hidden Hazards of a Laser Pumped Tunable OPO System" Health Physics Journal, 95: S194-S196 *#

R.D. Glickman, T.E. Johnson, G.D. Noojin, D.J. Stolarski, M.L. Denton, N. Kumar, B.A. Rockwell, 2008 "Laser Bioeffects Associated With Ultrafast Lasers: Role Of Multiphoton Absorption" Journal of Laser Applications, 20: 89-97.

N.A. McPherson, T.E. Eurell, T. E. Johnson, 2007 "Comparison of 1540 nm laser induced injuries in ex-vivo and in-vitro rabbit corneal models" Journal of Biomedical Optics. 12:064033 *#

G.L. Langham GL, R.F. Hoyt RF, T.E. Johnson, 2006 "Comparison of Particulate Matter in Laboratory Animal Rooms Housing Mice in Microisolators" Journal of the American Association for Laboratory Animal Science, 45: 22-26 *#

C.A. Ege, N.C. Parra, T.E. Johnson, 2006 "Noninfectious Complications of Vascular Access Ports (VAP) use in the Yucatan Mini-Pig (Sus scrofa domestica)" Journal of the American Association for Laboratory Animal Science, 45:54-61 *#

T.E. Johnson, M.J. Roy, 2006 "Cutaneous sensation threshold for 3.8 um radiation from a short duration pulsed laser on the calves of human subjects: A pilot study" Journal of Laser Applications, 18:334-339 #

K.R. Clark, T.A. Neal, T.E. Johnson, 2006 "Creation of an Innovative Laser Incident Reporting Form for Improved Trend Analysis using the Delphi Technique" Military Medicine, 171: 894-899*#

A.C. Bostick, D.E. Stoffregen, T.E. Johnson, 2006 "Response of Lightly and Highly Pigmented Porcine Skin (Sus scrofa domestica) to Single 3.8 micron Laser Radiation Pulses" Journal of the American Association for Laboratory Animal Science, 45:33-7 *#

J.J. Tomon, T.E. Johnson, K.N. Swenson, D.A. Schauer, 2006, "Applicability of ACR breast dosimetry methodology to a digital mammography system" Medical Physics, 33:799-807 *#

J.G. Fyffe, T.A. Neal, W.P. Butler, T.E. Johnson, 2005 "The Ex-Vivo Pig Eye As A Replacement Model For Laser Safety Testing" Comparative Medicine, 55:502-508 *#

B. Ketzenberger, T. E. Johnson, Y.A. Van Gessel, S. P. Wild, W. P. Roach, 2002 "A Study of Corneal Lesions in the Dutch Belted Rabbit (Oryctolagus cuniculus) Induced by 1318 nm Laser Radiation Pulses." Comparative Medicine, 52: 513-517 *#

T.F. Clarke, T.E. Johnson, B. Ketzenberger, W.P. Roach, 2002 "Corneal Injury Threshold And Public Health Implications Of The 1540 nm Laser (Infrared Laser Eye Injury)" Aviation, Space, and Environmental Medicine, 73:787-790 *#

P.J. Rico, W.P. Roach, M.A. Mitchell, T.E. Johnson, 2000 "ED50 Determination and Histological Characterization of Porcine (Sus scrofa domestica) Dermal Lesions Produced by 1540 nm Laser Radiation Pulses" Comparative Medicine, 50:633-638 *#

T.A. Eggleston, W.P. Roach, M. Mitchell, K. Smith, D. Oler, T.E. Johnson, 2000 "Comparison of In Vivo Skin Models for Near Infrared Laser Exposure" Comparative Medicine, 50: 391-397 *#

W.P. Roach, T.E. Johnson, B.A. Rockwell, 1999 "Maximum Permissible Exposure Limits for Ultrashort Laser Pulses" Health Physics, 76: 349-354 #

T.E. Johnson, 1996 "Operational Decision Levels for Skin Contamination" Radiation Protection Management., 13:58-64

Textbooks:

H. Cember, T.E. Johnson, 2009 The Health Physics Solutions Manual, 2nd Edition, P.S. & E. Press, Silver Spring, MD (ISBN 0-9625963-8-8), 518 pages.
Completely responsible for all revisions after passing of Herman Cember in March 2009.

H. Cember, T.E. Johnson, 2008, Introduction to Health Physics, 4th Edition, McGraw-Hill, NY, (ISBN 0071423087) 806 pages
Responsible for editing/updates of all chapters and complete revision of Chapter 14. Sales as of August 2010, Domestic: 2117, International: 735.

H. Cember, T.E. Johnson, 1999, The Health Physics Solutions Manual, P.S. & E. Press, Silver Spring, MD (ISBN 0-9625963-6-1), 442 pages
Performed majority of work in preparing manuscript.

Refereed Chapters in Books:

H. Cember, T.E. Johnson, 2010, Physical Agents, Ionizing Radiation, Volume 4, Chapter 29, In: Patty's Toxicology 6th edition, edited by Vernon Rose, John Wiley & Sons.
Completely revised and updated chapter upon Herman Cember's passing in March 2009.

J.A. Johnson, T.E. Johnson, S. Brown, 2009, Uranium Recovery Operations, Chapter 4 In: NORM/TENORM Health Physics Society Professional Development School Textbook, Edited by P. Andrew Karam and Brian J. Vetter, (ISBN 978-1-930524-47-7) Medical Physics Publishing, Madison WI. pp. 50-109
Prepared all numerical examples and sections on dose, approximately 33% of the text.

Refereed Proceedings/Transactions:

Long term stability of sensation thresholds from 10 ms pulses of 2.01μm laser light Ernest L. Scott, Thomas E. Johnson* SPIE, Photonics West, January, 2013

E. Kelly, T.E. Johnson, 2011 "Temperature increase of ex-vivo corneas from multiple 2.01-micron incident laser pulses" In: Optical Interactions with Tissue and Cells XXII, E. Duco Jansen.; Robert J. Thomas; William P. Roach, Vol. 7897.

D. N. Schaaf, Jr., T. E. Johnson, 2009 "Comparison of commercial temperature measurement instruments" In: Optical Interactions with Tissue and Cells XX, Steven L. Jacques; E. Duco Jansen; William P. Roach, Vol. 7175, pp. 71750O *#

D. C. Dugan, T. E. Johnson, 2009 "Determination of sensation threshold from 2.01μm laser light" In: Optical Interactions with Tissue and Cells XX, Steven L. Jacques; E. Duco Jansen; William P. Roach, Vol. 7175, pp. 71750P *#

K.J. Walter, T.E. Eurell, T.E. Johnson, 2008 "Optimizing the Use of Laser Alignment Thermal Sensitive Paper for a 1.54 micron Er: Glass Laser" In: Optical Interactions with Tissue and Cells XIX, Steven L. Jacques; William P. Roach; Robert J. Thomas, Vol. 6854, pp. 685419 *#

E. Rickers, K.J. Walter, T.E. Johnson, 2008 "Characterization of neutral density filters for use in near infrared lasers" In: Optical Interactions with Tissue and Cells XIX, Steven L. Jacques; William P. Roach; Robert J. Thomas, Vol. 6854, pp. 68541H *#

A.C. Bostick, T.E. Johnson, D.Q. Randolph, G.C. Winston, 2005 "Response of pigmented porcine skin (Sus scrofa domestica) to single 3.8-micron laser radiation pulses" In: Photonic Therapeutics and Diagnostics, Kenneth E. Bartels; Lawrence S. Bass; Werner T. W. de Riese; Kenton W. Gregory; Henry Hirschberg; Abraham Katzir; Nikiforos Kollias; Steen J. Madsen; Reza S. Malek M.D.; Karen M. McNally-Heintzelman; Lloyd P. Tate, Jr.; Eugene A. Trowers M.D.; Brian Jet-Fei Wong, Vol. 5686, pp. 668-673, *#

T.E. Johnson, D.C. Fitzhugh, N. McPherson, G.C. Winston, T.D. Winston, D.Q. Randolph, 2005 "Evaluating the potential for internal injuries from a pulsed 3.8-micron laser" In: Photonic Therapeutics and Diagnostics, Kenneth E. Bartels; Lawrence S. Bass; Werner T. W. de Riese; Kenton W. Gregory; Henry Hirschberg; Abraham Katzir; Nikiforos Kollias; Steen J. Madsen; Reza S. Malek M.D.; Karen M. McNally-Heintzelman; Lloyd P. Tate, Jr.; Eugene A. Trowers M.D.; Brian Jet-Fei Wong, Vol. 5686, pp. 654-659 *#

J.G. Fyffe, D.Q. Randolph, G.C. Winston, T.E. Johnson, 2005 "Corneal injury to ex vivo eyes exposed to a 3.8-micron laser" In: Photonic Therapeutics and Diagnostics, Kenneth E. Bartels; Lawrence S. Bass; Werner T. W. de Riese; Kenton W. Gregory; Henry Hirschberg; Abraham Katzir; Nikiforos Kollias; Steen J. Madsen; Reza S. Malek M.D.; Karen M. McNally-Heintzelman; Lloyd P. Tate, Jr.; Eugene A. Trowers M.D.; Brian Jet-Fei Wong, Vol. 5686, pp. 660-667 *#

R.D. Glickman, T.E. Johnson, 2004 "Multiphoton absorption is probably not the primary threshold damage mechanism for femtosecond laser pulse exposures in the retinal pigment epithelium" In: Laser Interaction with Tissue and Cells XV, Steven L. Jacques; William P. Roach, Vol. 5319, pp.162-172

L.L. Saunders, T.E. Johnson, T.A. Neal, 2004 "A Review of Infrared Laser Energy Absorption and Subsequent Healing in the Cornea" In: Laser Interaction with Tissue and Cells XV, Steven L. Jacques; William P. Roach, Vol. 5319, pp.349-354 #

G.C. Winston, D.Q. Randolph, T.E. Johnson, 2004 "Evaluating Acute Physiological Responses of Porcine Epidermis exposed to a Pulsed 3.8 Mircron Laser" In: Laser Interaction with Tissue and Cells XV, Steven L. Jacques; William P. Roach, Vol. 5319, pp. 344-348 #

K.R. Clark, T.E. Johnson, T.A. Neal, 2004 "Delphi Technique Used In Laser Incident Surveillance" In:: Laser Interaction with Tissue and Cells XV, Steven L. Jacques; William P. Roach, Vol. 5319, pp.238-244 *#

P.C.M. Williams, G.C.H. Winston, D.Q. Randolph, T.A. Neal, T.E. Eurell, T.E. Johnson, 2004 "Comparison of experimental models for predicting laser tissue interaction from 3.8 micron lasers" In: Lasers in Surgery: Advanced Characterization, Therapeutics, and Systems XIV, Kenneth E. Bartels D.V.M.; Lawrence S. Bass M.D.; Werner T. W. de Riese; Kenton W. Gregory M.D.; Henry Hirschberg; Abraham Katzir; Nikiforos Kollias; Steen J. Madsen; Reza S. Malek M.D.; Karen M. McNally-Heintzelman; Keith D. Paulsen; David S. Robinson M.D.; Lloyd P. Tate, Jr.; Eugene A. Trowers M.D.; Brian J. Wong M.D., Vol. 5312, pp. 334-340 *#

T. E. Eurell, T. E. Johnson, W. P. Roach, 2004 "Proteomic analyses of the acute tissue response for explant rabbit corneas and engineered corneal tissue models following in vitro exposure to 1540-nm laser light" In: Laser Interaction with Tissue and Cells XV, Steven L. Jacques; William P. Roach, Vol. 5319, pp.341-343

T.E. Johnson, N. Keeler, J.E. Dennis, C.L. Figueroa, H.A. Press, R. J. Rockwell Jr., B.E. Stuck, W.P. Roach, A.L. Wartick, 2003 "Investigation of Laser Injuries" In: Laser and Noncoherent Light Ocular Effects: Epidemiology, Prevention, and Treatment III, Bruce E. Stuck; Michael Belkin M.D., Vol. 4953, pp.61-69 *#

T. E. Johnson, G.C.H. Winston, W.L. Greene, 2003 "A Comparison of Yucatan mini-pig and Yorkshire pig skin response to 1318 nm laser pulses," In: Laser-Tissue Interaction XIV, Steven L. Jacques; Donald D. Duncan; Sean J. Kirkpatrick; Andres Kriete, Vol. 4961, pp.75-80 *#

T.E. Johnson, N. Keeler, A. Wartick, 2003 "Laser Eye Injuries Among US Military Personnel," In: Laser and Noncoherent Light Ocular Effects: Epidemiology, Prevention, and Treatment III, Bruce E. Stuck; Michael Belkin M.D., Vol. 4953, pp.51-60 *#

T. E. Eurell, T. E. Johnson, W. P. Roach, 2003 "Histomorphometric and proteomic analysis of the acute corneal tissue response following in vitro exposure to 1540 nm laser light" In: Vol. 4953: Laser and Noncoherent Light Ocular Effects: Epidemiology, Prevention, and Treatment III, Bruce E. Stuck; Michael Belkin M.D., Vol. 4953, pp.113-116 #

T.E. Johnson, G.C.H. Winston, M. Burton, W.L. Greene, 2003 "Porcine Dermal Lesions Produced by 1.3 micron Laser Pulses" In: Laser-Tissue Interaction XIV, Steven L. Jacques; Donald D. Duncan; Sean J. Kirkpatrick; Andres Kriete, Vol. 4961, pp.86-89 *#

G.C.H. Winston, W.L. Greene, T.E. Johnson, 2003 "Utilizing Yucatan Mini-pigs for 1318 nm Skin Exposure ED50 Determination" In: Laser-Tissue Interaction XIV, Steven L. Jacques; Donald D. Duncan; Sean J. Kirkpatrick; Andres Kriete, Vol. 4961, pp.81-85 *#

T.E. Eurell, T.E. Johnson, W.P. Roach, 2002 "Morphometric Comparison of the Acute Rabbit Corneal Response to 1540 nm Laser Light Following In Vitro Exposure to Millisecond or Nanosecond Pulse Widths" In: Laser Tissue Interaction XIII: Photochemical, Photothermal, and Photomechanical, Steven L. Jacques; Donald D. Duncan; Sean J. Kirkpatrick; Andres Kriete, Vol. 4617, pp.26-29

T.E. Johnson, J.C. Dunn, W.P. Roach, 2002 "Survey of Laser Injury" In: Laser Tissue Interaction XIII: Photochemical, Photothermal, and Photomechanical, Steven L. Jacques; Donald D. Duncan; Sean J. Kirkpatrick; Andres Kriete, Vol. 4617, pp. 125-133, *#

W.P. Roach, B. K. Ketzenberger, T.E. Johnson, 2002 "Corneal Injury from 1318-nm Single Laser Pulses" In: Laser Tissue Interaction XIII: Photochemical, Photothermal, and Photomechanical, Steven L. Jacques; Donald D. Duncan; Sean J. Kirkpatrick; Andres Kriete, Vol. 4617, pp. 30-39 *#

T.E. Eurell, T.E. Johnson, W.P. Roach, 2001 "A morphometric comparison of the acute rabbit and pig corneal response to 1540 nm laser light following ex vivo exposure" In: Laser and Noncoherent Light Ocular Effects: Epidemiology, Prevention, and Treatment, Bruce E. Stuck; Michael Belkin M.D., Vol 4246; pp. 180-184

W.P. Roach, T.E. Johnson, 2001 "Porcine Dermal Lesions Produced by 1540 nm Laser Radiation Pulses" In: Laser-Tissue Interaction XII: Photochemical, Photothermal, and Photomechanical, Donald D. Duncan; Steven L. Jacques; Peter C. Johnson, Editors, Vol. 4257, pp. 363-368 #

T.E. Johnson, B. K. Ketzenberger, K.B. Pletcher, W.P. Roach, 2001 "Skin Exposures from 1318 nm Laser Pulses" In: Laser-Tissue Interaction XII: Photochemical, Photothermal, and Photomechanical, Donald D. Duncan; Steven L. Jacques; Peter C. Johnson, Vol. 4257, pp. 355-362 *#

W. P. Roach, T.E. Eurell, T.E. Johnson, 2001 "A morphometric comparison of the acute rabbit and pig corneal response to 1540 nm laser light following ex vivo exposure," In:

Vol. 4246: Laser and Noncoherent Light Ocular Effects: Epidemiology, Prevention, and Treatment, Bruce E. Stuck; Michael Belkin M.D., Vol. 4246, pp. 89-96,

B. Ketzenberger, T.E. Johnson, Stephen P. Wild, Kenneth B. Pletcher, and W. P. Roach, 2001 "ED50 Determination and Histological Characterization of Epithelial Layers in Animal Models: Lesions Produced by 1318 nm Laser Radiation Pulses" In: Lasers in Surgery: Advanced Characterization, Therapeutics, and Systems XI, R. Rox Anderson M.D.; Kenneth E. Bartels D.V.M.; Lawrence S. Bass M.D.; C. Gaelyn Garrett M.D.; Kenton W. Gregory M.D.; Abraham Katzir; Nikiforos Kollias; Michael D. Lucroy D.V.M.; Reza S. Malek M.D.; J. Stuart Nelson M.D.; George M. Peavy D.V.M.; Hans-Dieter Reidenbach; Lou Reinisch; David S. Robinson M.D.; Lloyd P. Tate V.D.M.; Eugene A. Trowers M.D.; Timothy A. Woodward M.D. Vol. 4244, pp. 544-551 *#

T.E. Johnson, M.A. Mitchell, P.J. Rico, D. J. Fletcher, T.E. Eurell, W.P. Roach, 2000 "Corneal and Skin Laser Exposures from 1540 nm Laser Pulses" In: Laser-Tissue Interaction XI: Photochemical, Photothermal, and Photomechanical, Donald D. Duncan; Jeffrey O. Hollinger D.D.S.; Steven L. Jacques, Vol. 3914, pp. 222-229 *#

D.J. Fletcher, T.E. Johnson, M.A. Mitchell, T.E. Eurell, P.J. Rico, W. P. Roach, 2000 "Corneal Equivalents: a Replacement Model for In-vivo 1540 nm Laser Exposure Studies" In: Lasers in Surgery: Advanced Characterization, Therapeutics, and Systems X, R. Rox Anderson M.D.; Kenneth E. Bartels D.V.M.; Lawrence S. Bass M.D.; C. Gaelyn Garrett M.D.; Kenton W. Gregory M.D.; Nikiforos Kollias; Harvey Lui M.D.; Reza S. Malek M.D.; George M. Peavy D.V.M.; Hans-Dieter Reidenbach; Lou Reinisch; David S. Robinson M.D.; Lloyd P. Tate V.D.M.; Eugene A. Trowers M.D.; Timothy A. Woodward M.D. Vol. 3907, p. 468-475 *#

P.J. Rico, M.A. Mitchell, T.E. Johnson, W. P. Roach, 2000 "ED50 determination and histologic characterization of porcine dermal lesions produced by 1540 nm laser radiation pulses" In: Lasers in Surgery: Advanced Characterization, Therapeutics, and Systems X, R. Rox Anderson M.D.; Kenneth E. Bartels D.V.M.; Lawrence S. Bass M.D.; C. Gaelyn Garrett M.D.; Kenton W. Gregory M.D.; Nikiforos Kollias; Harvey Lui M.D.; Reza S. Malek M.D.; George M. Peavy D.V.M.; Hans-Dieter Reidenbach; Lou Reinisch; David S. Robinson M.D.; Lloyd P. Tate V.D.M.; Eugene A. Trowers M.D.; Timothy A. Woodward M.D., Vol. 3907, p. 476-483 *#

T. E. Johnson, T. A. Eggleston, D. Fletcher, K. Lopez, P.J. Rico, M.A. Mitchell, W.P. Roach, 1999 "Determination of Single-Pulse Exposure Threshold (ED50) for 1400 – 2000 nm Lasers" In: Laser-Tissue Interaction X: Photochemical, Photothermal, and Photomechanical, Steven L. Jacques; Gerhard J. Mueller; Andre Roggan; David H. Sliney, Vol. 3601, pp.55-58 *#

T.A. Eggleston, M. Mitchell, T.E. Johnson, W.P. Roach, 1999 "Comparison of In Vivo Skin Models for Near Infrared Laser Exposure" In: Lasers in Surgery: Advanced Characterization, Therapeutics, and Systems IX, R. Rox Anderson M.D.; Kenneth E. Bartels D.V.M.; Lawrence S. Bass M.D.; Darryl J. Bornhop; C. Gaelyn Garrett M.D.;

Kenton W. Gregory M.D.; Nikiforos Kollias; Harvey Lui M.D.; Reza S. Malek M.D.; Aaron P. Perlmutter M.D.; Hans-Dieter Reidenbach; Lou Reinisch; David S. Robinson M.D.; Lloyd P. Tate V.D.M.; Eugene A. Trowers M.D, Vol. 3590, pp. 356-360 *#

Non-Refereed Journal Articles/Chapters/Proceedings/Transactions:

T.E.Johnson, 2013, Central Rocky Mountain Chapter Update, in: Health Physics Society Newsletter, Vol. XLI p.11

T.E.Johnson, 2012, Getting to know the HPS, in: Health Physics Society Newsletter, Vol. XL p.29

T.E.Johnson and A. Brandl, 2011, Central Rocky Mountain Chapter Update, in: Health Physics Society Newsletter, Vol. XXXIX p.11

T.E. Johnson, 2010, Colorado State University Student Branch Activities, In: Health Physics Society Newsletter, Vol. 38, No. 7, pp. 9

T.E. Johnson, 2010, ANSI Z136 Annual Meeting Updates, In: Laser Institute of America Newsletter, No. 2 pp. 20

T.E. Johnson, 2009, Central Rocky Mountain Chapter of the Health Physics Society sponsors two CSU students, In: Health Physics Society Newsletter, Vol. 37, No. 12, pp. 8

J. Sorcic, T.E. Johnson, 2009, Colorado State University Student Branch Activities, In: Health Physics Society Newsletter, Vol. 37, No. 8, pp. 7

T.E. Johnson, 2009, CRMCHPS Annual Technical Meeting at CSU, In: Health Physics Society Newsletter, Vol. 37, No. 6, pp. 18-19

A.E. Draine, J. Sorcic, T.E. Johnson, 2009, Colorado State University Student Branch Activities, In: Health Physics Society Newsletter, Vol. 37, No. 1, pp. 8

T.E. Johnson, 2008, ANSI Z136 Annual Meeting Updates, In: Laser Institute of America Newsletter, pp.10

T.E. Johnson, 2008, Annual ANSI Z136 Laser Safety Meeting, In: Health Physics Society Newsletter, Vol. 36, No. 4, p. 14

T.E. Johnson, 2007, "American National Standards institute Standards for Nonionizing Radiation," In: Health Physics Society Newsletter, Vol. 35, No. 12, p. 16-17

T.E. Johnson, 2006, "Annual Meeting Focuses on Updates," In: Vol. 14, No. 3, p. 1 and 8.

T.E. Johnson, 2006 "Annual ANSI Z136 Laser Safety Meeting," In: Health Physics Society Newsletter, Vol. 34, No. 5, p. 23-24

T.E. Johnson, W.P. Roach, 2002 "Solution to question 9 from the American Board of Health Physics Exam," In: Health Physics Society Newsletter, p. 10

T.E. Johnson, 1997, "The Problem With Tritium in Beer," In: Baltimore-Washington Chapter of the Health Physics Society Chapter Newsletter, pp.3-4

PERFORMANCES, EXHIBITS, PRODUCTIONS (Visual/Performing Arts):

Clinics/Adjudications/Workshops:

2008, "Uranium Technical Symposium" Colorado State University (worldwide distribution)
Videotaping, editing and producing a four DVD set of the for distribution to the public. Almost eight hours of video were produced. Approximately 50 copies were produced and distributed.

Non-Juried Activities

2009, "Seminar Series in Health Physics" Colorado State University (worldwide distribution)
Videotaping, editing and producing seminars in health physics for the MAP ERC website for continuing education. Five videos have been posted to date.

2006, 2007, 2008, 2009, "Health Physics Exam Review" Colorado State University (worldwide distribution)
Videotaping, editing and producing and annual updating of EDLL 2005. Approximately 50 hours of video were produced for both streaming and use on an iPod. Over 100 copies of the entire production distributed.

2009, "Radioecology" Colorado State University (worldwide distribution)
Videotaping, editing and producing of ERHS 570. Approximately 30 hours of video are in the process of being produced for both streaming and use on an iPod. This video is capturing Dr Ward Whicker, as he is retiring, and will make his lecture material available for future classes for reference.

PAPERS PRESENTED/SYMPOSIA/INVITED LECTURES/PROFESSIONAL MEETINGS/WORKSHOPS

Invited Lectures and Presentations

2013 "Laser User's Perspective on Laser Safety" with Benjamin Rockwell, ILSC, Orlando, FL

2012 "Livestock Decomtamination Considerations" Webinar, CSU Extension.

2012 "Livestock Decontamination" Dr Herman Cember memorial presentation, AIHA annual meeting, Indianapolis, IN

2011 "Decontamination of Livestock" EFCOG SOMD, at NREL, Golden, CO

2011 "Uranium Mining, Milling and Enrichment" University of Ontario Institute of Technology, Ontario, Canada

2010 "In Situ Uranium Mining" Fort Collins Rotary Club, presenter, Fort Collins CO

2009 "In-situ Uranium Mining" Weld County Commissioners, presenter, Greeley, CO

2009 , "Uranium Fuel Cycle Impacts" Global Uranium Symposium, U2009, presenter, Keystone, CO

2009, "Advanced Health Physics Problem Solving" Navy and Marine Corps Occupational Health and Preventive Medicine Conference, presenter, Portsmouth, Virginia

2006 "Workshop on Solving Advanced Health Physics Problems," US Army Center for Health Promotion and Preventive Medicine, presenter, Aberdeen Proving Ground, MD

2006 , "Power Lines, Politics and Pulses," University of Michigan, presenter, Ann Arbor, MI

2003 "Trends in Laser Injury Reporting," Keynote speaker, Joint International Laser Conference, prepared materials for student to present (K. Clark), Edinburgh, Scotland

2001 "Airborne Radioactive Materials Transport," Baltimore-Washington Chapter of the Health Physics Society, presenter, Bethesda, MD

2000, August 2000 "Radiation Bioeffects," presenter, USAF School of Aerospace Medicine, Brooks AFB, TX

2000 "Radioactive Decay," presenter, Baltimore-Washington Chapter of the Health Physics Society Review Class, White Flint, MD

1999 "C.H.P. Certification Review Class," instructor and coordinator, Air Force Office of Scientific Research, Bethesda, MD

1998 "Statistics Review for Health Physicists," presenter, Baltimore-Washington Chapter of the Health Physics Society, White Flint, MD

Professional Meetings

2014 Shatila, O., Johnson, T., "A Review of Radiation Doses at Oil Extraction Sites" 59th Annual HPS meeting, Baltimore, MD, July, 2014

2014 Ruedig, E., Borch, T., Bhattacharyya, A., Johnson, T. "Model-Model Intercomparison of Risk Assessment at an In Situ Recovery Uranium Mine Located in Wyoming, USA", 59th Annual HPS meeting, Baltimore, MD, July, 2014

2014 Johnson, T., Daxon, E., Ruedig, E. "A Brief History of Emergency Responder Dose Recommendations" 59th Annual HPS meeting, Baltimore, MD, July, 2014

2014 Daxon, E., Johnson, T., Ruedig, E. "An Argument for Using Health Risk in Place of Dose Guidance in Operational Decision Making in Radiological Emergencies" 59th Annual HPS meeting, Baltimore, MD, July, 2014

2014 Martinez, N.E., T.E. Johnson, E. Ruedig, J.E. Pinder III, "Comparison of rainbow trout phantoms for estimation of whole body and organ radiation dose rates from uptake of iodine-131 in freshwater systems," International Conference on Radioecology and Environmental Radioactivity, 2014

2013 Transitioning from Radiation Safety to Health Risk for Emergency Response: Complete the Separation
Daxon, E., Johnson, T. 58th Annual HPS Meeting, Madison, Wisconsin, July 11, 2013.

2013 The Development of a Livestock Decontamination Protocol. Sprenger, P., Brandl, A., Johnson, T. 58th Annual HPS Meeting, Madison, Wisconsin, July 11, 2013.

2013 Areal Radiological Surveys - A Comparison of Radiation Detection Technologies. Bailey, D., Cardarelli, J., Johnson, T. 58th Annual HPS Meeting, Madison, Wisconsin, July 11, 2013.

2013 Perceptions of Product Irradiation in a College Population Condon, C., Johnson, T., Peel, J. 58th Annual HPS Meeting, Madison, Wisconsin, July 11, 2013.

2013 Aerosol Size Distribution in the Schwartzwalder Uranium Mine Liu, X., Doerges, J., Volckens, J., Johnson, T. 58th Annual HPS Meeting, Madison, Wisconsin, July 11, 2013.

2013 A Health Physics Student's Experience at the AECL ZED-2 Reactor Physics Winter School

Edquist, B., Parson, J., Johnson, T. 58th Annual HPS Meeting, Madison, Wisconsin, July 11, 2013.

2013 Martinez, N.E. and T.E. Johnson, "Community involvement of the Colorado State University Health Physics Program: Ideas for boosting interest in and understanding of radiation and radiation protection," 58th Annual HPS Meeting, Madison, Wisconsin, July 11, 2013.

2013 Martinez, N.E., J.E. Pinder III, T.E. Johnson, "The Influence of Lake Trophic Structure on 131-I Accumulation and Subsequent Cumulative Radiation Dose to Trout Thyroids," 12th International Conference of the Biogeochemistry of Trace Elements. Athens, Georgia, June 17, 2013. (Invited)

2013 Martinez, N.E., S.L. Kraft, and T.E. Johnson, "A Proposed Simple Model for Occupational Radiation Dose to Staff From Veterinary 18F-FDG PET Procedures," 5th Annual NIOSH Mountain & Plains Education and Research Center Research Day, Denver, Colorado, April 4, 2013

2013 J.R. Schilz, K.J. Reddy, S. Nair, T.E. Johnson, R.B. Tjalkens, K.P. Krueger, S. Clark, Adsorption of Arsenic by Cupric Oxide Nanoparticles* from Uranium In Situ Recovery Bleed Water and Effects on Cell Viability, 12th International Conference on the Biogeochemistry of Trace Elements - ICOBTE 2013, Athens, GA

2012 Martinez, N.E., T.E. Johnson, T.G. Hinton, F.W. Whicker, J.E. Pinder, "The Transfer of Cesium Through Aquatic Trophic Levels Following Releases into Experimental Ponds," Poster presentation, Workshop on Radioecology in the 21st Century hosted by the National Center for Radioecology, Aiken, South Carolina, August 15, 2012.

2012 Dayton McMilian, A. Brandl, T.E. Johnson, Livestock Decontamination. Washington DC, IND forum.

2012 Martinez, NE; Kraft, SL; Ryan, SD; Johnson, TE, Occupational External Radiation Dose to Personnel Involved inVeterinary Positron Emission Tomography Procedures, IRPA 13, Glascow, Scotland

2011 Empirical Comparison of Neutron Activation Sample Analysis Methods - Gillenwalters, E., Johnson, T., Pinder, J., Kearney, P. HPS meeting, Palm Beach Florida.

2011 A Comparison of MCNP Modeling against Empirical Data for the Measurement of the Effectiveness of Lead Apron Shielding - Adams, D., Lee, M., George, G., Brandl, A., Johnson, T. HPS meeting, Palm Beach Florida.

2011 Laser Damage Thresholds of Ex-Vivo Pig and Rabbit Corneas at 2500 and 2700 nm with 8 ns Laser Pulse Duration - Guo, Y., Johnson, T. HPS meeting, Palm Beach Florida.

2011 Occupational Radiation Exposure to Personnel in Veterinary Positron Emission Tomography - Martinez, N.E., Kraft, S.L., Ryan, S.D., Johnson, T.E HPS meeting, Palm Beach Florida.

2011 Efficacy of Coffee Makers at Removing Contaminants - Nguyen, V., Johnson, T., Brattin, B., Dooley, G., Ramsdell, H. HPS meeting, Palm Beach Florida.

2011 The Transfer of Cs Trhough Aquatic Trophic Levels Following Releases into Experimental Ponds - Martinez, N., Johnson, T., Hinton, T., Whicker, W., Pinder, J. HPS meeting, Palm Beach Florida.

2011, Involvement of Different Mechanisms in Heavy Ion and Gamma Ray Induced Hepatocellular Carcinoma of Mice - Liu, X., Bedford, J., Ray, F., Genik, P., Fallgren, C., Battaglia, C., Ullrich, R., Johnson, T., Weil, M. HPS meeting, Palm Beach Florida.

2011, "Temperature increase of ex-vivo Corneas from multiple 2.01 micron incident laser pulses", E. Kelly, T.E. Johnson. Thirteenth Annual Directed Energy Symposium, 15-19 November 2010, Bethesda, Maryland Abstract ID 10-Symp-124

2010 , "A Comparison of the Stated Performance of Various Radon Measurement Instruments and Techniques" A. Riccardi, T.E. Johnson, presenter, Annual Meeting of the Health Physics Society, Salt Lake City, UT

2010 "Characterizing Biomass Accumulation Dynamics in Uranium Bioremediation by Principal Component Analysis" H. Dong, T.E. Johnson, presenter, Annual Meeting of the Health Physics Society, Salt Lake City, UT

2010, "Trends in Groundwater Chemistry Pre- and Post-Remediation at Irigaray and Grover In-Situ Uranium Mines" N. Roche, T.E. Johnson, student presented, Annual Meeting of the Health Physics Society, Salt Lake City, UT

2010 "Dosimetry and Partial Body Irradiation of Mice" C. Pedersen, F.R. Ray, T.E. Johnson, student presented, Annual Meeting of the Health Physics Society, Salt Lake City, UT

2010 "Determining Canine Organ Radiation Doses from PET-CT Procedures" N. Martinez, T.E. Johnson, S. Kraft, J.F. Harmon, D. Gibbons, student presented, Annual Meeting of the Health Physics Society, Salt Lake City, UT

2010 " Determining the Activity in a Shipping Container Using a High Purity Germanium Detector" E.D. Gillenwalters, T.M. Debey, T.E. Johnson, student presented, Annual Meeting of the Health Physics Society, Salt Lake City, UT

2010 "Characterizing Canine Organ Radiation Doses from CT Procedures" C. Hall, J.F. Harmon, E. Randall, T.E. Johnson, student presented, Annual Meeting of the Health Physics Society, Salt Lake City, UT

2010 "Intentional Poisonings with Radioactive Materials" J. Sorcic, T.J. Johnson, student presented, Annual Meeting of the Health Physics Society, Salt Lake City, UT

2010 "The contribution of U-238 and Th-232 to Radiation Dose and Risk from Fly Ash Effluent of Coal Fired Power Plants" F.Beckfield, T.E. Johnson, student presented, Annual Meeting of the Health Physics Society, Salt Lake City, UT

2010 "Characterization of Canine Organ Radiation Doses from PET & CT Procedures" S.L. Kraft, N. E. Martinez, C. Hall, T.E. Johnson, D.S. Gibbons, E. Randall, J. F. Harmon, student presented, World Molecular Imaging, Montreal, Canada

2009 "Monte Carlo Spectral Simulations as Microcalorimeter Gamma-Spectrometer Design Tool" E.Sassi, T.E. Johnson, M.Rabin, J. Ullom, student presented, Annual Meeting of the Health Physics Society, Minneapolis, MN

2009 "The Medical X-ray Technologist: A potential Source of Health Physicists or Radiation Safety Officers?" F. Beckfield, T.E.Johnson, student presented, Annual Meeting of the Health Physics Society, Minneapolis, Minnesota

2009 "Radiofrequency Field Strength Fluctuation Due to Digital Conversion of Television Signals: a Pilot Study" P.B. Lane, T.E. Johnson, student presented, Annual Meeting of the Health Physics Society, Minneapolis, MN

2009 "Radioactive and Non-radioactive Contaminants in Aquifers Post In-situ Recovery Uranium Mining" A. Coler, T.E.Johnson, student presented, Annual Meeting of the Health Physics Society, Minneapolis, MN

2009 "Decommissioning a Major Medical Research Institution" A. Morton, T.E. Johnson, D. Elder, R. Safadi, T.E. Johnson, student presented, Annual Meeting of the Health Physics Society, Minneapolis, MN

2009 "Public Reaction to Uranium In-situ Recovery in Northern Colorado" T.E. Johnson, A.E. Draine, student presented, Annual Meeting of the Health Physics Society, Minneapolis, MN

2008 "Groundwater Chemistry of the Grover Uranium In-Situ Recovery Pilot Test Site, Weld County" Hall, Susan M, Johnson, T.E., prepared part of presentation, Geological Society of America 2008 Joint Annual Meeting, Houston, TX

2008 "Decontamination of Medical Radioisotopes from Hard Surfaces Using Peelable Polymer Based Decontamination Agents: Update" A.E. Draine, K.J. Walter, M.P. O'Neil, G.J. Edgington, T.E.Johnson, student presented, Annual Meeting of the Health Physics Society, Pittsburgh, PA

2008 "The Long Path of Tc-99m Production in North America" M. Cervera, E. Waller, T.E. Johnson, student presented, Annual Meeting of the Health Physics Society, Pittsburgh, PA

2008 "Adventures in Public Information: A Uranium Case Study" J.A. Johnson, S.H. Brown, T.E. Johnson, prepared part of presentation, Annual Meeting of the Health Physics Society, Pittsburgh, PA

2008 ,"Decontamination of Medical Radioisotopes from Hard Surfaces using Peelable Polymer-Based Decontamination Agents," A. E. Draine, K. J. Walter, M. P. O'Neill, T.E. Johnson, student presented, Health Physics Society Mid-Year Meeting, Oakland, CA

2007 "Uranium Mining and Uranium Toxicity," T.E. Johnson, presenter, Rocky Mountain Chapter, American Society of Safety Engineers, Denver, CO

2007 "NIOSH Training Programs in Health Physics" T. B. Borak, T.E. Johnson, presenter, Annual Meeting of the Health Physics Society, Portland, OR

2007 "Variation in Gamma Emitter Concentration in Urine in a High Background Region R. Zhang, E. Crawford, T.E. Johnson," student presented, Annual Meeting of the Health Physics Society, Portland, OR

2007 "Developing a Rapid Screening Method for ^{90}Sr Contamination in Urine" E. Crawford, J. LaRosa, T.E. Johnson, student presented, Annual Meeting of the Health Physics Society, Portland, OR

2007 "Distance Continuing Education On-line: Experiences of the Colorado State University Student Chapter of Health Physics Society" D. Elder, T.E. Johnson, student presented, Annual Meeting of the Health Physics Society, Portland, OR

2007 "Decontamination of a Fume Hood Contaminated with Tritiated Thymidine" K.J. Walter, T.E. Johnson, student presented, Annual Meeting of the Health Physics Society, Portland, OR

2007 "Decontamination of Nuclear Medicine Isotopes from Hard Surfaces using a Peelable Polymer-based Hydrogel" G.J. Edgington, M.P. O'Neill, T.E. Johnson, W.C. Gaul, M.S. Davidson, K.M. Lee, prepared part of presentation, Annual Meeting of the Health Physics Society, Portland, OR

2007 "A method of measuring cutaneous laser injury thickness" C. Walker, T. Eurell, T. Johnson, student poster, Annual Meeting of the Health Physics Society, Portland, OR

2006 "Gross Skin Response to 3.8 Micron Laser Pulses" T.E. Johnson, A. Wood, presenter, Annual Meeting of the Health Physics Society, Providence, RI

2006 "Comparision of ESR Dosimetry in Human vs. Sus Scrofa Domestica Tooth Enamel" C. Heiserman, T. Johnson and J. Zimbrick, student poster, Annual Meeting of the Health Physics Society, Providence, RI

2006 "Characterization of a Low Dose Rate Facility Using Radiochromic Film" T. Sirisalee Magers, R. Ullrich, T.E. Johnson, student presented, Annual Meeting of the Health Physics Society, Providence, RI

2006 "Re-vitalizing a Radiation Dosimetry Laboratory Class" T.E. Johnson, J.D. Zimbrick, presenter, Health Physics Society Mid-Year meeting, Phoenix, Arizona

2003 "Prediction of Bioeffects of Human Exposure to 3.8 micron Lasers" P. Williams, T.E. Johnson, student presented, The Non-lethal Technology and Academic Research Symposium V, Baltimore, MD

2003 "Correlating In-vivo and In-vitro Models to Predict the Bioeffects of Human Exposure to 3.8 micron Lasers," P. Williams, T.E. Johnson, student presented, Directed Energy Weapons Symposium, Albuquerque NM

2002 "Trends in Laser Injury Reporting," T.E. Johnson, Health Physics Society Annual Meeting, Tampa, FL

2001 "Trends in Laser Injury" J. C. Dunn, T.E. Johnson, W.P. Roach, student presented, Baltimore Washington Chapter of the Health Physics Society Annual Meeting, Gaithersburg, MD

2000 "Hazards Associated with 1540 nm Lasers" T.E. Johnson, W.P. Roach, presenter, Health Physics Society Annual Meeting, Denver, CO

2000 "Effects of 1540 nm Laser Pulses on the Skin and Cornea" T.E. Johnson, W.P. Roach, presenter, Baltimore Washington Chapter of the Health Physics Society Annual Meeting, Gaithersburg, MD

2000 "Misconceptions and Portable Radiation Detection Instrument Training" T.E. Johnson, Health Physics Society Midyear Meeting, Virginia Beach, VA

1999 "Probability of Biological Effects from High Energy Infrared Lasers" T.E. Johnson, W.P. Roach, presenter, First High Energy Laser Probabilistic Risk Assessment Conference, San Antonio, TX

1998 "Recent Experiences in Radiation Safety Officer Training" T.E. Johnson, presenter, Health Physics Society Mid-Year Meeting, Mobile, AL

1997 "External Radiation Dosimetry" T.E. Johnson, USAF School of Aerospace Medicine, Health Physics Symposium, Brooks Air Force Base, TX

1995 "Current Implications of the Chelyabinsk Nuclear Incident," T.E. Johnson, Purdue University Department of Health Sciences, West Lafayette, IN

1994 "Evaluation of the Concentrations of 14C and 3H in Stack Gas, Water, and Ash Effluents Following Incineration of Radioactive Wastes Containing 14C and 3H," E.A. Crim, T.E. Johnson, prepared materials, Health Physics Society Annual Meeting, San Francisco, CA

Workshops

2012 "CHP Review class" T.E. Johnson, presenter, Rio Grande Chapter Health Physics Society Annual Meeting, Santa Fe, NM.

2010 "Cloud Chamber Theory and Construction" T.E. Johnson, presenter, Professional Enrichment Program, Health Physics Society Annual Meeting, Salt Lake City, UT

2009 "Uranium Mining and Milling" T.E. Johnson, presenter, Professional Enrichment Program, Health Physics Society Annual Meeting, Minneapolis, MN

2008 "Uranium Mining and Milling" T.E. Johnson, presenter, Professional Enrichment Program, Health Physics Society Annual Meeting, Pittsburgh, PA

2008 "Solving Complex Health Physics Problems Workshop" T.E. Johnson, presenter and organizer, US Army Center for Health Promotion and Preventive Medicine, Aberdeen Proving Grounds, MD

2008 "Overview of Part One of the CHP Exam" T.E. Johnson, presenter, Navy Occupational Health and Preventive Medicine Conference, Portsmouth, Virginia

2008 "Overview of the Uranium Fuel Cycle" T.E. Johnson, presenter and organizer, Uranium Technical Symposium, Fort Collins, CO

2007 "Non-ionizing radiation: An Overview of Incoherent Non-ionizing Radiation Hazards" T.E. Johnson, presenter, Professional Enrichment Program, Health Physics Society Annual Meeting, Portland, OR

2007 "Identification and Control of Electromagnetic Fields (0-300 GHz)" B. Edwards, T.E. Johnson, presenter, Professional Enrichment Program, Health Physics Society Annual Meeting, Portland, OR

2007 "Non-ionizing Radiation: An Overview of Incoherent Non-ionizing Radiation Hazards" T.E. Johnson, presenter, Professional Enrichment Program, Annual Meeting of the Health Physics Society, Portland, OR

2006 "Power Lines and Politics" T.E. Johnson, presenter, Professional Enrichment Program, Health Physics Society Annual Meeting, Providence, RI

2005 "Laser Safety Audits" T.E. Johnson, presenter, Professional Enrichment Program, Annual Meeting of the Health Physics Society, Spokane, WA

2004 "Radiological Detection Equipment" T.E. Johnson, presenter, AIHce Professional Development Course, Atlanta, GA

2002 "Laser Safety Calculations Using the 2000 ANSI Z136.1 Standard" T.E. Johnson, presenter, Professional Enrichment Program, Health Physics Society Annual Meeting, Tampa, FL

2001 "Laser Safety Calculations Using the 2000 ANSI Z136.1 Standard" T.E. Johnson, presenter, Professional Enrichment Program, Health Physics Society Annual Meeting, Cleveland, OH

2000 Laser Safety Calculations," T.E. Johnson and W.P. Roach, "presenter, Professional Enrichment Program, Health Physics Society Annual Meeting, Denver, CO

1997 "Problem Solving for Health Physicists" T.E. Johnson, presenter, Professional Enrichment Program, Health Physics Society Annual Meeting, San Antonio, TX

Other Evidence

Nicole Martinez awarded F. Ward Whicker Scholarship by HPS (2012).

Nikolas Roche (Robert Gardner Fellowship) and Nicole Martinez (Burton J. Moyer Fellowship) awarded Health Physics Society Fellowships in Summer 2010.

Elizabeth Gillenwalters awarded a Health Physics Society Fellowship in Summer 2009.

Amanda Drain was awarded best poster at the MAP ERC First Annual Research Day held in conjunction with the Rocky Mountain Academy of Occupational and Environmental Medicine on January 16th, 2009.

Margaret Cervera was selected to receive the Richard J. Burke Jr. award from the Health Physics Society ($5000 cash award) based on her scholarship.

Jeffery Hibbert (Lone Star high School) was selected for best science fair project in his region in Colorado for 2008, and was judged number 2 at the state science fair. He won a $250 cash award from the Health Physics Society for his poster presentation. In 2009 he won the medallion award from both the Army and Air Force at the Colorado State Regional Science Fair, chosen to present at the International Science Fair, and will be competing at the State Science Fair in April 2009.

The following students received scholarships for travel to the Annual Health Physics Society meetings during their time at CSU based on their presentations at that meeting:

Ken Walter, Rui Zhang, Amanda Draine, Angela Coler, Clint Walker, Chris Heiserman, Margaret Cervera, Felicity Cunningham-Beckfield (two awards), Haitao Dong, Cheri Hall, Nicole Martinez, Alan Morton, Chris Pedersen, Nikolas Roche.

ADVISING:

GRADUATE STUDENTS:

Current Graduate Advisees:

Omar Shatila Master of Science in Health Physics, Chair (2015)

Peter Sprenger Doctorate in Health Physics, Committee Member (2014)

Albert Riccardi Master of Science in Health Physics, Chair (2012)

Jonathan Elden, Doctorate in Electrical Engineering, Committee Member (2014)

Graduate Degrees Completed Under Your Supervision (past 5 years):

Jonathan Elden, Master of Science in Electrical Engineering, Committee Member (2014)

John Klumpp, PhD, Committee member, 2014

Lisa Scallan, committee member, 2014

Sarah Sublett, committee member, 2014

Britt Mueller Master of Science in Health Physics, Chair (2014)

Lucas Hetrick Master of Science in Health Physics, Chair (2014)

Derek Bailey Master of Science in Health Physics, committee member (2014)

Nicole Martinez Doctorate in Health Physics, Chair (2014)

Ernie Scott Master of Science in Health Physics, Chair (2013)

Daniel Mannis Master of Science in Health Physics, committee member (2013)

David Dolan Master of Science in Health Physics, Chair (2013)

Ahamad Hussin Doctorate in Education, committee member (2013)

Alan Morton Master of Science in Health Physics, Chair (2012)

David Adams Master of Science in Health Physics, committee member (2012)

Aaron Miaullis Master of Science in Health Physics, Chair (2012)

Xianan Liu, Master of Science in Health Physics, Chair (2012)

Chris Pederson Master of Science in Health Physics, Chair (2012)

Yuanqing Guo Master of Science in Health Physics, Chair (2011)

Elizabeth Gillenwalters Master of Science in Health Physics, Chair (2011)

Cheri Hall Master of Science in Health Physics, committee member (2011)

Edward Kelly Master of Science in Health Physics, Chair (2011)

Nicole Martinez Master of Science in Health Physics, Chair (2011)

Nikolas Roche Master of Science in Health Physics, Chair (2011)

Jessica Nieset Doctorate in Health Physics, committee member (2010)

Felicity Cunningham Master of Science in Health Physics, Chair (2010)

Haitao Dong Master of Science in Health Physics, Chair (2010)

P. Brian Lane Master of Science in Health Physics, Chair (2010)

Joseph Sorcic Master of Science in Health Physics, Chair (2010)

D.N. Schaaf Doctorate in Health Physics, Chair (2010)

Margaret Cervera Master of Science in Health Physics, Chair (2009)

Amanda Draine Master of Science in Health Physics, Chair (2009)

Dan Dugan Master of Science in Health Physics, Chair (2009)

Matt Rosenbaum D.V.M. Master of Science in Microbiology Immunology Pathology, Chair (2009)
First and only Laboratory Animal Medicine Resident to successfully defend a thesis, complete all requirements and graduate as scheduled.

Eric Sassi Master of Science in Health Physics, Chair (2009)

Deirdre Elder Master of Science in Health Physics, Committee member (2008)

Ken Walters Master of Science in Health Physics, Chair (2008)

Nichole McPherson Doctorate in Public Health, Uniformed Services University of the Health Sciences, Chair (2007)

Jim Fyffe Master of Science in Public Health, Uniformed Services University of the Health Sciences, Chair (2005)

POSTDOCTORAL STUDENTS/RESEARCH ASSOCIATES:

Elizabeth Ruedig, PhD, CHP, August 2013 – February 2015

Past 5 years: Valarie Adams PhD 2007-2008

Descriptions of Mentoring Activities

Jeffery Hibbert, High School Student at Lone Star High School: Mentored Jeff for two years. His first year (2007-2008) Jeff was awarded regional and state prizes for his poster, and presented his poster at the Annual Health Physics Society meeting in Pittsburg PA, and was awarded $250 for his efforts.

Undergraduate Mentoring
Jessica Gills (2010-2013)
Dayton McMillian (2010-2013)
Vi Nguyen (2010-2011) Presented at the Annual Health Physics Society meeting.
Jennifer Hartman (2008-2009)
Angela Coler (2007-2009) Presented a poster at the Annual Health Physics Society meeting.
Clint Walker (2007-2008) Presented a poster at the Annual Health Physics Society meeting.
Chris Heiserman (2006-2007) Presented a poster at the Annual Health Physics Society meeting.
Sarah Yoder (2006-2007)
Luci Nelson (2005-2006)

Research Advisor for Laboratory Animal Residents
Matthew Rosenbaum (2009)
Christine Ege (2007)
Anthony Bostick (2006)
Gregory Langham (2005)

Two HP students, Haitao Dong and Daniel Dugan, have been funded, at least partially, in their education using funds generated from Continuing Education classes. Both students might have otherwise been forced to drop out to be able to afford completing their education.

Six HP graduate students were funded (from EDLL 2005 funds) to travel to Keystone Colorado in August 2008 to attend the NEI Health Physics conference. This resulted in multiple contacts for both the students and the HP program, increasing the status of the program, since no other graduate students from any other programs in the country attended.

Annually since 2006 presentations on basics of radiation and health physics have been made at the University of Northern Colorado in the Physics Department. This has resulted in two outstanding students (Ken Walter, graduated May 2008) and Nicholas Roche (Fall 2009) attending CSU. We are also negotiating a potential track III collaboration with UNC.

As faculty advisor for the CSU Branch of the Health Physics Society, we have established a strong local presence and collaboration with the local Chapter of the Health Physics Society. We have also been using the student branch of the HPS to work with alumni. In 2007 we prepared polo shirts with the CSU logo, in 2008 we had both vests and water bottles with the CSU logo that were offered to alumni and friends of the program. This has resulted in a great increase in goodwill from our alumni, and several donations to the student branch. These donations have allowed us to entertain prospective students, taking them to lunch and dinner, and assisting with our recruiting activities. This has engaged the alumni with the current students, resulting in increased opportunities for our students.

COMMITTEES

CRC College Committee, 2013-present

EPA Science Advisory Board ISR Uranium mining advisory Committee, 2011 to 2012

State of Colorado Radiation Advisory Committee, 2010 to 2016

American Board of Health Physics Professional Development Committee, 2009-2012

University Radiation Safety Committee, 2007 to present

Department Health Physics ABET Accreditation Committee Chair, 2005 to present

CSU achieved accreditation 18 months after starting at CSU. The Health Physics program not only was accredited in the shortest amount of time possible. The program was accredited for seven years, and the maximum that is typically allowed for any program is 6 years. This was in recognition of the outstanding health physics program and the accreditation cycle of the IH program. The Health Physics section had proposed pursuing accreditation in 2003, but no action. Under my leadership, a 200 page accreditation document, complete with the associated monitoring programs, were created and implemented. There are only five accredited master's programs in health physics in the USA. It should be noted that I also spearheaded the accreditation process of one of the other four ABET programs.

Responsible for re-accreditation in 2013, only 2 concerns found.

PROFESSIONAL AFFILIATIONS AND ACTIVITIES

Chair, ANSI Z136 Editorial Working Group, 2010
JAALAS Reviewer, 2010
Member, ANSI Z136 Editorial Working Group, (2008-present)
Health Physics Society, Continuing Education Committee, (2008-present)
American Academy of Health Physics, Professional Development Committee (2008-present)
NCRP Reviewer, 2007
Editorial Reviewer: Toxicology for the Industrial Hygienist, Chapter 19 (2007)
Vice Chair, ANSI Z136.1 revision (2007-present)
Member, Editorial Working Group, ANSI Z136 Committee (2007-present)
Reviewer, Health Physics Society Journal (2006-present)
Reviewer, IEEE Transactions on Plasma Science (2005-present)
Chair, Baltimore Washington Chapter of the Health Physics Society CHP review class, (2003-2004)
Executive Committee, Baltimore-Washington Chapter, Health Physics Society (2001-2004)
President, Baltimore-Washington Chapter of the Health Physics Society (2000 - 2001)
Certification Review Course Instructor, Potomac Chapter AIHA (2000- 2002)
Chair, Science Teacher's Workshop, Baltimore-Washington Chapter of the Health Physics Society (1998 – 2000)
Teacher's Workshop Committee Baltimore Washington Chapter (1997)
Health Physics Society History Committee Secretariat (1999-2004)
BWC Health Physics Society CHP review committee and class instructor (1998-2004)
ANSI Z136.1 Health Physics Society Representative (1999-present)
Laser Institute of America (1998-present)
International Society for Optical Engineering (1999-2005)
American Academy of Health Physics, Member (1996 - present)
Fellow, American College of Forensic Examiners (1996- present)
Radiation Research Society (1995-present)
Health Physics Society (1994-present)
American Nuclear Society (1988-present)
Graduate Representative, Grade Appeals Committee, Purdue University (1996)
Lindgren Science and Engineering Residence Advisor, Northwestern University (1993-1994)
Licensed by the National Board of Boiler and Pressure Vessel Inspectors (1990)

OTHER ACTIVITIES/ACCOMPLISHMENTS – SERVICE/OUTREACH

Selected to be an ABET program evaluator 2013.

Virginia Uranium Mining Symposium, November, 2011. Public information forum on uranium and uranium mining. Over 100 attendees from across the USA.

Lone Star High School – Invited to lecture to entire school on basics of radiation. October, 2010

Uranium Technical Symposium, February 2008 – Public information forum on uranium and uranium mining. Over 270 attendees from across the USA.

Poudre High School Chemistry Class - Invited lecture on radiation basics. Taught to 2 chemistry classes at the high school. 2009.

Invited lecture for four 6th grade classes at Mountain School in Los Alamos NM. Supervised students during the annual practicum teaching these classes, May, 2009, May 2010.

Fossil Ridge High School Chemistry Class – Invited lecture on radiation basics. Taught to every chemistry class (six) at the high school. November 16, 2007.

Central Rocky Mountain Chapter of the Health Physics Society – Responsible for organizing annual technical meeting for 2007, 2008, 2009, 2010, 2011, including speakers and all other arrangements.

Mentor for Jeff Hibbert, High School Student at Lone Star High School, Colorado. Winner of local and state science fair awards in 2008 and 2009.

ARTHUR S. ROOD

4835 West Foxtrail Lane, Idaho Falls ID 83402 (208) 528-0670, asr@kspar.com

EDUCATION

M.S. - Health Physics, Radioecology, Colorado State University, 1987
B.S. - Geology, Mesa State College, 1982
AA - Mathematics, Santa Monica College, 1978

SUMMARY

Twenty-seven years experience in multimedia contaminant fate and transport modeling, dose and risk assessment. Developed and implemented mathematical models for contaminant fate and transport in environment systems, conducted numerical uncertainty analysis, and designed and implemented environmental sampling and monitoring programs.

EMPLOYMENT HISTORY

Private Consultant (7/1994 - Present)

K-Spar Inc. Idaho Falls, Idaho

Develop and implement mathematical and computer models for assessment of multimedia transport of contaminants (radionuclides and other) in the environment. Quantify uncertainty and sensitivity of model predictions using Monte Carlo sampling techniques. Validate models using environmental monitoring data and compute health risk associated with predicted environmental media concentrations. Specific projects include evaluation of environmental air monitoring network at the Idaho National Laboratory, atmospheric transport of radionuclide and chemicals from the former Rocky Flats Plant for the Historical Public Exposures Studies at Rocky Flats, establishment of plutonium clean up levels at the former Rocky Flats Plant, fluvial transport of radionuclides at the Hanford Reservation, performance assessment of the U.S. Ecology low-level waste site in Richland Washington, analysis of air quality impacts from the Cerro Grande Fire in Los Alamos, New Mexico, reconstruction of atmospheric concentrations and doses from the former Uravan uranium mill, development contaminant transport models for contaminated soils at Los Alamos National Laboratory, and development of radionuclide limits in waste water and sediments for Waste Control Specialists low-level waste site.

Instructor for Risk Assessments Corporation courses on radiological risk assessment held in Washington DC (2009, 2012, 2013), Bristol UK (2009), and Nuclear Regulatory Commission (2015). Member of Task Group 98 of the International Commission on Radiation Protection.

Advisory Scientist (Retired), 5/1994 – 1/2013

Modeling and Measurements Group, Idaho National Laboratory, Idaho Falls, Idaho

Research, develop, and apply state-of-the-art techniques for assessment of environmental transport and impacts associated with release of radioactive material and hazardous chemicals. Specific modeling expertise includes chronic and accident air dispersion, food-chain transport, groundwater flow and transport, dose and risk assessment, thermodynamic chemical vapor models, shielding and external exposure calculations, and first order kinetic models. Major efforts were directed toward low-level waste performance assessment at the three Idaho National Laboratory low-level waste disposal sites and long-range atmospheric dispersion calculations for evaluation of toxic pollutants emitted to the air from INL facilities using the CALPUFF dispersion model.

Provide lead technical guidance for INL and Department of Energy-wide programs requiring complex environmental assessments and safety analyses. Provide technical guidance for an international study on uncertainty estimates in reactor consequence code evaluation. Assist the National Low-Level Waste program in providing technical assistance to waste compact states and foreign countries. Instructor for the University of Idaho graduate-level course, **Environmental Modeling** (INTER 504) from 1991 to 1999.

Principal Investigator for a national survey of naturally occurring radioactive material (NORM) in oil and gas production equipment. Member of the Health Physics Society/ANSI working group on NORM.

SENIOR SCIENTIST, 5/1990 - 5/1994

Integrated Earth Science/Geotechnologies, Idaho National Laboratory

Provide lead technical guidance and funding management for Idaho National Engineering Laboratory (INEL) and DOE-wide programs requiring complex environmental assessments and safety analyses. Developed groundwater transport models and computer codes (GWSCREEN) for assessment of CERCLA sites and performance assessment of low-level waste disposal facilities at the INEL. Performed the groundwater modeling and dose assessment section for the Radioactive Waste Management Complex Performance Assessment at the Idaho National Engineering Laboratory. Co-author of the food-chain model (COMIDA) for the MAACS reactor consequence code, an internationally-recognized reactor accident assessment code. Participated in four "AIRDOS/CAP-88" radiological assessment courses for another DOE laboratory, INEL contractor, and state personnel. Conducted Performance Assessment Workshops and provided technical assistance to the low level waste compact states for the National Low-Level Waste Management Program.

STAFF SCIENTIST, 8/1989 - 4/1990

UNC Geotech, Grand Junction, Colorado

Radon Laboratory - Performed indoor radon assessments and developed instrumentation for measurement of radon progeny using alpha and beta spectroscopy. Conducted quality control experiments of radon measuring devices and wrote software for data acquisition systems and computer controlled instrumentation.

ENVIRONMENTAL SCIENTIST, 9/1987 - 7/1989

Environmental Sciences and Engineering Unit, Idaho National Laboratory, Idaho Falls, Idaho

Environmental Sciences and Engineering - Research, develop, and apply state-of-the-art techniques assessing the environmental transport and impacts associated with release of radioactive material and hazardous chemicals. Specific modeling experience includes chronic and accident air dispersion, food-chain transport, groundwater contaminant transport, and dose and risk assessment.

SENIOR HEALTH PHYSICS TECHNICIAN, 11/1984 - 9/1986

Oak Ridge National Laboratory, Grand Junction, Colorado
Coordinated gamma spectroscopy laboratory for gamma spectral analysis of soil samples contaminated with uranium mill tailings. Wrote and implemented spectral analysis algorithms, multichannel analyzer control programs and data base software. Designed, constructed, and calibrated an activated charcoal radon measurement device. Developed and implemented laboratory quality control procedures.

ASSOCIATE MINE GEOLOGIST, 8/1982 - 12/1983
Plateau Resources LTD, Grand Junction, Colorado
Supervised uranium mine longhole drilling program for ore body fringe development and preparation for full scale production. Evaluated drilling results for ore trend production and ore reserve calculations.

GEOSCIENTIST I, 1/1981 - 7/1982
Bendix Field Engineering, Grand Junction, Colorado
Assisted in researching uranium ore body development and exploration indicators and writing results published in Department of Energy reports. Tasks included interpretation of electric drill hole logs and generation of isopleth maps and cross sections from the data.

PHYSICAL SCIENCE AIDE, 5/1980 - 9/1980
U.S. Department of Energy, Grand Junction, Colorado
Assisted staff geologist in reviewing resource maps and assessment data for the 1980 National Uranium Resource Evaluation Report.

AFFILIATIONS

Member of the Health Physics Society Working Group on Naturally Occurring Radioactive Material
Member of the Health Physics Society
Member of the International Commission on Radiation Protection (ICRP) Task Group 98.

HONORS & AWARDS & LEADERSHIP POSITIONS

- Licensed Invention, GWSCREEN Software System, Lockheed Martin 1996
- President and Executive Board Member, Desert Eagles Model Airplane Club, 2008–2010

COURSES TAUGHT

Environmental Risk Assessment for the Nuclear Regulatory Commission, Bethesda Maryland, April 2015.

Radiological Risk Assessment and Environmental Assessment. Crystal City Marriott, Arlington, VA. Risk Assessment Corporation. March 4-8, 2013. 51 Attendees.

Radiological Risk Assessment for Decision Making, Compliance, and Emergency Response. Crystal City Marriott, Arlington, VA. Risk Assessment Corporation. March 5-9, 2012. 37 Attendees.

Radiological Risk Assessment and Environmental Analysis Course. ITC School of Underground Waste Storage and Disposal. University of Bristol Risk Centre, Bristol, United Kingdom. June 22–26, 2009. 17 Attendees.

Environmental Risk Assessment Analysis Training Course H-401. Training Course H-401 prepared and presented by Risk Assessment Corporation for the U.S. Nuclear Regulatory Commission at the NRC's Professional Development Center, Bethesda, Maryland. January 26–30, 2009. 23 Attendees.

EXPERT TESTIMOY

"Reconstruction of Historical Doses from Radionuclides Released to the Environment by the Uravan Mining and Milling Site." In re: June et al. v. Union Carbide Corporation et al., No.1: 04-CV-00123-MSK-MJW. January 15, 2007.

"Assessment of Thyroid Doses Received by Specified Individuals from Releases of Iodine-131 from Hanford." In re: Hanford Nuclear Reservation Litigation Master File No. CY-91-3015-WFN. August 13, 2004.

"Historical Public Exposures Studies on Rocky Flats." August 6, 2004, In re: Cook et al. v. Rockwell et al., U.S. District Court for the District of Colorado, No. 90-K-181. August 6, 2004.

SELECTED PUBLICATIONS AND REPORTS

TEXT BOOK CHAPTERS

Whicker, F.W. and **A.S. Rood**, 2008. "Terrestrial Food Chain Pathways: Concepts and Models" In: *Radiological Risk Assessment and Environmental Analysis*", J.E. Till and H.A. Grogan Editors. CRC Press, Boca Raton FL.

Grogan, H.A., J.W. Aanenson,, P.D. McGavran, K.R. Meyer, H.J. Mohler, S.S. Mohler, J.R. Rocco, **A.S. Rood**, J.E. Till, and L.H. Wilson, 2006. "Modeling of the Cerro Grande Fire at Los Alamos: An Independent Analysis of Exposure, Heath Risk, and Communication with the Public" In: *Applied Modeling and Computations in Nuclear Science*. ACS Symposium Series 945. American Chemical Society, Washington DC.

PEER-REVIEWED PUBLICATIONS

Rood, A.S., A.J. Sondrup, and P.D. Ritter, 2016. "Quantitative Evaluation of an Air Monitoring Network using Atmospheric Dispersion Modeling and Frequency of Detection Methods" Health Physics 110(4).

Till, J.E., **A.S. Rood**, C.D. Garzon, and R.H. Lagdon, 2014. "Comparison of the MACCS2 Atmospheric Transport Model with Lagrangian Puff Models as Applied to Deterministic and Probabilistic Safety Analysis." *Health Physics,* 107(2): 213-230.

Rood, A.S., 2014. "Performance Evaluation of AERMOD, CALPUFF, and Legacy Air Dispersion Models using the Winter Validation Tracer Study Dataset." *Atmospheric Environment,* 89: 707-720.

Till, J.E., H.A. Grogan, J.H. Mohler, J.R. Rocco, **A.S. Rood**, and S.S. Mohler, 2011. "An Integrated Approach to Data Management, Risk Assessment, and Decision Making." *Health Physics,* 102(4): 367-377.

Rood, A.S., P.G. Voillequé, S.K. Rope, H.A. Grogan, and J.E. Till, 2008. "Reconstruction of Atmospheric Concentrations and Deposition of Uranium and Decay Products Released from the Former Uranium Mill at Uravan Colorado USA." *Journal of Environmental Radioactivity*, 99: 1258–1278.

Rood, A.S., 2004. "A Mixing-Cell Model for Assessment of Contaminant Transport in the Unsaturated Zone Under Steady-State and Transient Flow Conditions." *Environmental Engineering Science*, 21(6): 661–677.

Abbott, M.L., D.D. Susong, D.P. Krabbenhoft, **A.S. Rood**, 2002. "Mercury Deposition in Snow near an Industrial Emission Source in Southeastern Idaho and the Teton Range, Wyoming," *Water, Air, and Soil Pollution*, 139: 95–114.

Rood, A.S., H.A. Grogan, J.E. Till, 2002. "A Model for a Comprehensive Evaluation of Plutonium Released to the Air from the Rocky Flats Plant, 1953–1989." *Health Physics,* 82(2).

Till, J.E., **A.S. Rood**, P.G. Voilleque, P.D. McGavran, K.R. Meyer, H.A. Grogan, W.K. Sinclair, J.W. Aanenson, H.R. Meyer, H.J. Mohler, S.K. Rope, and M.J. Case, 2002. "Risks to the Public from Historical Releases of Radionuclides and Chemicals at the Rocky Flats Environmental Technology Site." *Journal of Exposure Analysis and Environmental Epidemiology,* 12 (5): 355-372

White, G.J., and **A.S. Rood**, 2001. "Radon Emanation from NORM-Contaminated Pipe Scale and Soil at Petroleum Industry Sites." *Journal of Environmental Radioactivity,* 54: 401–413.

Rood, A.S., P.D. McGavran, J. Aanennson, 2000. "Stochastic Estimates of Carcinogenic Risk with Uncertainty from Carbon Tetrachloride Released from the Rocky Flats Plant." *Risk Analysis*, 21(4): 675-696.

Rood, A. S., G. G. Killough, J. E. Till, 1999 "Evaluation of Atmospheric Transport Models for use in Phase II of the Historical Public Exposure Studies at the Rocky Flats Plant." *Risk Analysis*, 19(4): 559-576.

McGavran, P. D., **A. S. Rood**, J. E. Till, 1999. "Chronic Beryllium Disease and Cancer Risk Estimates with Uncertainty for Beryllium Released to the Air from the Rocky Flats Plant." *Environmental Health Perspectives,* 107(8): 731-744.

Rood, A. S., G. J. White, and D. T. Kendrick, 1998. "Measurement of ^{222}Rn Flux, ^{222}Rn Emanation, and ^{226}Ra Concentration from Injection Well Pipe Scale" *Health Physics,* 75(2): 187-192.

Rood, A. S., 1994, "GWSCREEN: A Model for Assessment of the Groundwater Pathway from Surface or Buried Contamination", *The Environmental Professional*, 16(3):196-210.

Nguyen, H. D., S. Paik, **A. S. Rood**, 1994, "Effects of Thermally Generated Convection on the Migration of Radionuclides in Saturated Geologic Formations" *International Journal Engineering Science*, 32(10): 1605-1614.

Abbott, M. L. and **A. S. Rood**, 1994 "COMIDA: A Radionuclide Food-Chain Model for Acute Fallout Deposition", *Health Physics*, 66(1):17-29.

Martz, D. E., **A. S. Rood**, J. L. George, M. D. Pearson, G. H. Langner, 1991, "Year-to-Year Variations in Annual Average Indoor ^{222}Rn Concentrations". *Health Physics*, 61(3): 409-413.

Walton, J. C., **A. S. Rood**, R. G. Baca and M. D. Otis, 1989, "Model for Estimation of Chlorinated Solvent Releases from Waste Disposal Sites", *Journal of Hazardous Materials*, 21, 15-34.

COMPANY TECHNICAL PUBLICATIONS

Rood, A.S., and A.J. Sondrup, 2014. *Development and Demonstration of a Methodology to Quantitatively Assess the INL Site Ambient Air Monitoring Network*. INL/EXT-14-33194. Idaho National Laboratory, Idaho Falls, Idaho.

Rood, A.S., H.J. Mohler, H.A. Grogan, and J.E. Till, 2014. *Methodology and Example Calculations for Effluent Discharge Limits and Sediment Concentration Limits for the LLRW Federal Waste Facility Discharge Evaporation Pond*. 1-WCS-TO2-2014. Risk Assessment Corporation, Neeses, SC.

Electric Power Research Institute, 2014. *EPRI Recommendations for the National Academies' Pilot Study of Cancer Risks in Populations around Nuclear Facilities*. Technical Report 3002003163. Electric Power Research Institute, Palo Alto, CA.

U.S. Department of Energy, 2012. *Performance Assessment for the Idaho National Laboratory Remote-Handled Low-Level Waste Disposal Facility*. DOE/ID-11421. Idaho National Laboratory, Idaho Falls, ID.

U.S. Department of Energy, 2011. *Performance Assessment for the Idaho CERCLA Disposal Facility Landfill*. DOE/ID-10978. Idaho National Laboratory, Idaho Falls, ID.

Grogan, H.A., B. Jacobs, and **A.S. Rood**, 2010. *Source Term and Transport Modeling for Single-Shell Tanks at the Hanford Site*. RAC Report No. 1-WA-2009-FINAL. *Risk Assessments Corporation,* Neeses, South Carolina.

Rood, A.S., and B.L. Jacobs, 2008. *Response Surface Model User Documentation*. 32-RACER LANL 2008 FINAL. Risk Assessment Corporation, Neeses, South Carolina.

U.S. Department of Energy, 2008. *Composite Analysis for the RWMC Active Low-Level Waste Disposal Facility at the Idaho National Laboratory Site*. DOE/NE-ID-11244. Idaho National Laboratory, Idaho Falls, ID.

U.S. Department of Energy, 2007. *Performance Assessment for the RWMC Active Low-Level Waste Disposal Facility at the Idaho National Laboratory Site*. DOE/NE-ID-11243. Idaho National Laboratory, Idaho Falls, ID.

Rood, A.S. 2005. *Mixing Cell Model: A One-Dimensional Numerical Model for Assessment of Water Flow and Contaminant Transport in the Unsaturated Zone*. ICP/EXT-05-00748, Idaho National Laboratory, Idaho Falls, ID. March .

Grogan, H.A., **A.S. Rood**, J.W. Aanenson, and E.B. Liebow, 2002. *A Risk-based Screening Analysis for Radionuclides Released to the Columbia River from Past Activities at the U.S. Department of Energy Nuclear Weapons Site in Hanford, Washington*. RAC Report No. 3-CDC Task Order 7-2000 FINAL. *Risk Assessments Corporation,* Neeses, South Carolina.

Case, M.J., **A.S. Rood**, J.M. McCarthy, S.O. Magnuson, B.H. Becker, T.K. Honeycutt, 2000. *Technical Revision of the Radioactive Waste Management Complex Low-Level Waste Radiological Performance Assessment for Calendar Year 2000*. INEEL/EXT-2000-01089. Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho.

White, G.J. and **A.S. Rood**, 1999. *Radon Emanation from NORM-Contaminated Pipe Scale, Soil, and Sediment at Petroleum Industry Sites*. DOE/ID/13223-2. National Petroleum Technology Office, U.S. Department of Energy, Tulsa Oklahoma.

Rood, A. S., H. A. Grogan, 1999. *Estimated Exposure and Lifetime Cancer Incidence Risk from Plutonium Released from the 1969 Fire at the Rocky Flats Plant*. 07-CDPHE-RFP-1999, *Radiological Assessments Corporation,* Neeses, South Carolina. August.

Rood, A. S., H. A. Grogan, 1999. *Comprehensive Assessment of Exposure and Lifetime Cancer Incidence Risk from Plutonium Released from the Rocky Flats Plant*. 13-CDPHE-RFP-1999, *Radiological Assessments Corporation,* Neeses, South Carolina. September.

Rood, A. S., H. A. Grogan, 1999. *Estimated Exposure and Lifetime Cancer Incidence Risk from Plutonium Released from the 1957 Fire at the Rocky Flats Plant*. 02-CDPHE-RFP-1999, *Radiological Assessments Corporation, Neeses*, South Carolina. August.

Rood, A. S., H. A. Grogan, 1999. *Estimated Exposure and Lifetime Cancer Incidence Risk from 903 Area Plutonium Releases at the Rocky Flats Plant*. 01-CDPHE-RFP-1999, *Radiological Assessments Corporation,* Neeses, South Carolina. August.

Rood, A. S., 1999. *Performance Evaluation of Atmospheric Transport Models*. 3-CDPHE-RFP-1996 (Rev. 1), *Radiological Assessments Corporation*, Neeses, South Carolina. August.

Rood, A. S., 1999. *Estimated Exposure and Lifetime Cancer Incidence Risk from Routine Plutonium Releases at the Rocky Flats Plant*. 08-CDPHE-RFP-1997 (Rev. 1), *Radiological Assessments Corporation*, Neeses, South Carolina. August.

Grogan, H. A., P. D. McGavran, K. R. Meyer, H. R. Meyer, J. Moler, **A. S. Rood**, W. K. Sinclair, P. G. Voillequé, J. M. Weber, 1999. *Technical Summary Report of the Historical Public Exposures Studies for Rocky Flats Phase II*. 14-CDPHE-RFP-1999-DRAFT, *Radiological Assessments Corporation*, Neeses, South Carolina. August.

McGavran, P. D., **A. S. Rood**, 1999. *Estimated Exposure and Cancer Risk from Beryllium Released to the Air from the Rocky Flats Plant*. 02-CDPHE-RFP-1997 (Rev. 1), *Radiological Assessments Corporation*, Neeses, South Carolina. August.

McGavran, P. D., **A. S. Rood**, 1999. *Estimated Exposure and Cancer Risk from Carbon Tetrachloride Released to the Air from the Rocky Flats Plant*. 04-CDPHE-RFP-1997 (Rev. 1), *Radiological Assessments Corporation*, Neeses, South Carolina. August.

Weber, J.M., **A. S. Rood**, H. R. Meyer, 1999. Development of the Rocky Flats Plant 903 Area Plutonium Source Term. 08-CDPHE-RFP-1998 (Rev. 1), *Radiological Assessments Corporation*, Neeses, South Carolina. August.

White, G.J. and **A.S. Rood**, 199*8.Characterization of the National Petroleum Reserve NO. 3 (NPR-3) Site for Naturally Occurring Radioactive Material (NORM).* DOE/5AC304. National Petroleum Technology Office, U.S. Department of Energy, Tulsa Oklahoma.

Brown, J., M. L. H. J. Goossens, B. C. P. Kraan, R. M. Cooke, J. A. Jones, F. T. Harper, F. E. Haskin, M. L. Abbott, M. L. Young, S. C. Hora, **A. S. Rood**, 1997. Probabilistic Accident Consequence Uncertainty Analysis: Food Chain Uncertainty Assessment. NUREG/CR-6523 U.S. Nuclear Regulatory Commission, Washington D.C.

Abbott, M. L. and **A. S. Rood**, 1996. *Source Group Optimization Program (SGOP): A Program the Groups Emission Sources for Input into Air Dispersion Models* INEL-96/0376 Idaho National Engineering Laboratory, Idaho Falls, Idaho.

Maheras, S.J. **A. S. Rood**, S. O. Magnuson, M. E. Sussman, R. N. Bhatt, 1994. *Radioactive Waste Management Complex Low-Level Waste Radiological Performance Assessment*. EGG-WM-8773, Idaho National Engineering Laboratory, May.

Rood, A.S., 1994. *GWSCREEN: A Semi-Analytical Model for Assessment of the Groundwater Pathway from Surface or Buried Contamination: Theory and Users Manual Version 2.0*, EGG-GEO-10797, Revision 2, Idaho National Engineering Laboratory, June.

Abbott M. L. and **A. S. Rood**, 1993. *COMIDA: A Radionuclide Food-Chain Model for Acute Fallout Deposition*, EGG-GEO-10367, Idaho National Engineering Laboratory, November.

Abbott, M. L. S. L. Harms, **A. S. Rood**, 1993. *Dose Calculations for Accidental Airborne Releases of ITER Activation Products*, EGG-EEL-10994, Idaho National Engineering Laboratory, December.

Rood, A. S. and M. L. Abbott, 1991. *Comparison of Dose and Dose-rate Conversion Factors from the Soviet Union, United Kingdom, U.S. Department of Energy and the Idaho National Engineering Laboratory Fusion Safety Program*, EGG-FSP-9865, Idaho National Engineering Laboratory, December.

Seitz, R. R. **A. S. Rood**, G. A. Harris, S. J. Maheras, M. Kotecki, 1991. *Sample Application of Sensitivity/Uncertainty Analysis Techniques to a Groundwater Problem,* DOE/LLW-108, U. S. Department of Energy, National Low Level Waste Program, June.

Rood, A. S. *Assessment of Impacts at the Advanced Test Reactor as a Result of Chemical Releases at the Idaho Chemical Processing Plant*, EGG-EST-9523, Idaho National Engineering Laboratory, February, 1991.

Abbott, M. L. and **A. S. Rood**, 1990. *Concentration Factors for Fusion-Related Radionuclides Calculated Using the Food-Chain Model FUSEMOD*, EGG-EST-9223, Idaho National Engineering Laboratory, September.

Rood, A. S., J. L. George, G. H. Langner, 1990. *Variation in the Annual Average Radon Concentration Measured in Homes in Mesa County, Colorado,* DOE/ID/12584-57 UNC/GJ-50(TMC), U. S. Department of Energy, Grand Junction, Colorado, April.

Rood, A. S., R. C. Arnett, J. Barraclough, 1989. *Contaminant Transport in the Snake River Plain Aquifer: Phase 1, Part 1: Simple Analytical Model of Individual Plumes,* EGG-ER-8623, Idaho National Engineering Laboratory, May.

Rood, A. S., 1988. *Environmental Transport Concentration Factors for the FUSECRAC Fusion Reactor Safety Code,* EGG-ESE-8033, Idaho National Engineering Laboratory, May.

PRESENTATIONS AND SYMPOSIUM PROCEEDING

Rood, A.S., A.J. Sondrup, and A.L. Schafer, 2011. "An Evaluation of Long-Term Performance of Liner Systems for Low-Level Waste Disposal Facilities." Waste Management 2011, Phoenix, AZ February 28 – March 4, 2011.

Rood, A.S, B.L. Jacobs, P. Shanahan, H.J. Mohler, J.W. Aannenson, J.R. Rocco, L.Hay-Wilson, H.A. Grogan, and J.E. Till, 2009. "Overview of Environmental Transport Models Contained in the Risk Analysis Communication, Evaluation, and Reduction (RACER) Software Tools at Los Alamos National Laboratory", Waste Management 2009, Phoenix Arizona, March, 1–5, 2009.

Rood, A.S, "Sensitivity and Uncertainty Analysis for Low-Level Waste Performance Assessment" Probabilistic Workshop on Performance Assessment, Augusta Georgia, March 10–11, 2008.

Rood, A.S, "Distilling Complex Models into Simpler Models for Assessment of Performance of Waste Facilities" Waste Management 2007, Tucson, Arizona, February 2007.

Rood, A.S, "Response Surface Modeling Activities to Simulate Transport in the Snake River Plain Aquifer at the Idaho National Laboratory" Great Rift Symposium, Idaho State University, Pocatello, Idaho, October 6, 2005.

Rood, A.S, "A Mixing-Cell Model for Assessment of Water Flow and Solute Transport in the Unsaturated Zone" INRA 2003 Subsurface Science Symposium, Salt Lake City, Utah, October 7, 2003.

Rood, A.S., "Spatial and Temporal Variations in Exposure and Risk at the Rocky Flats Plant: 1953–1989." Society for Risk Analysis Annual Meeting, Seattle WA, December 5, 2001.

Rood, A.S., "Estimating Uncertainty in Groundwater Modeling for a Performance Assessment of the Radioactive Waste Management Complex" John Horan Memorial Symposium on Radioactive Waste

Management Issues. Greater Salt Lake Chapter of the Health Physics Society, Salt Lake City, Utah, April 28, 2001.

Rood, A.S, "Measurement of ^{222}Rn Flux, ^{222}Rn Emanation, and ^{226}Ra Concentration from Injection Well Pipe Scale". 29th Midyear Topical Meeting of the Health Physics Society, Scottsdale, Arizona, January 7-9, 1996.

Rood, A.S, "GWSCREEN, A Model for Assessment of the Groundwater Pathway from Surface or Buried Contamination". American Nuclear Society, 1993 Winter Meeting, San Francisco, CA., November 14-18, 1993,

Rood, A.S, "A Performance Assessment of Radioactive Waste Encapsulated in Iron-Enriched Basalt and Disposed at the Idaho National Engineering Laboratory's, Radioactive Waste Management Complex", Spectrum 92, International Topical Meeting for Nuclear and Hazardous Waste Management, Boise, Idaho, August 23 - 27, 1992.

D. J. Thorne and **A. S. Rood**, "Contaminant Fate and Effects in Ground and Surface Water at a Remediated Dioxin Site", Hazardous Material Control, January, 1990.

R. G. Baca, J. C. Walton, **A. S. Rood**, M. D. Otis, "Organic Contaminant Release from a Mixed Waste Disposal Site: A Computer Simulation Study of Transport Through the Vadose Zone and Site Remediation", 10th Annual DOE Low Level Waste Conference, Denver Colorado, August, 1987.

Rood, A.S, M. J. Case, "The Role of Performance Assessment in the Evaluation of Remedial Action Alternatives for the Radioactive Waste Management Complex (RWMC) at the Idaho National Engineering Laboratory", 10th Annual DOE Low Level Waste Conference, Denver Colorado, August, 1987.

H. Justin Mohler

Bridger Scientific, Inc.

Education

M.S., Environmental Health Physics, Colorado State University, Fort Collins, Colorado, 1997
B.S., Biology, Southwest Missouri State, Springfield, Missouri, 1993

Professional Experience

Bridger Scientific, Inc.
President/Owner, Belgrade, Montana (2002–present)

President and owner of Bridger Scientific, Inc., which specializes in various aspects of environmental health physics, including environmental sampling and measurement, tabular and spatial data management and interpretation, environmental transport, exposure and risk assessment, database design and management, and communication and presentation of technical information.

Currently supporting Risk Assement Corporation (RAC) to evaluate exposure and dose related to radionuclides and chemicals released to the environment for a variety of projects. Specific involvement in these projects includes:

- Managing existing information and implementing dose calculation methodology to estimate doses for veterans involved with nuclear weapons tests at the Nevada Test Site and Pacific Proving Grounds
- Analyzing and interpreting monitoring data to characterize the extent and magnitude of site impact on the surrounding environment
- Evaluating potential human exposures to facility radionuclide releases and assessing and comparing predicted concentrations related to historical releases with observed environmental measurements
- Developing an independent and comprehensive data access and risk assessment process called RACER© to guide understandable, consistent, and transparent management and communication of risk from both chemical and radionuclide in the environment
- Implementing different aspects of the RACER process for various clients
- Presenting technical material to various panels and committees and interested members of the public and working with the public and Site personnel to obtain data and understand issues of concern.

Past projects with RAC have included studies for the Centers for Disease Control and Prevention and the Colorado Department of Public Health and Environment, which focused on reconstructing historical releases of radioactive and nonradioactive materials and estimating potential exposure and risk to surrounding populations.

For the Savannah River Site Dose Reconstruction Project, summarized environmental monitoring data and evaluated their usefullness for direct exposure assessment and source term model validation. For Task Order 5, reconstructed, screened, and prioritized historical radionuclide releases from the Idaho National Laboratory. For Task Order 6, managed and coordinated the review of historical documents to identify information useful for completing a future detailed dose reconstruction at the Idaho National Laboratory.

Participated in three technical audits focused on assessing the Los Alamos National Laboratory's compliance with the Clean Air Act. Evaluated the accuracy and completeness of radionuclide usage at Site facilities and reviewed various other compenents of the compliance program.

Assessed the appropriateness of soil action levels or cleanup criteria for the Rocky Flats Environmental Technology Site. Evaluated distributions and assessed uncertainty and sensitivity for the parameters used in a dose calculation model.

Evaluated exposure and risk through both the air and surface water pathways as a result of the Cerro Grande Fire at the Los Alamos National Laboratory. Managed the collection and compilation of all relevant environmental monitoring data, as well as data available for source term characterization of contaminated sites impacted by the fire. Documented observations and recommendations resulting from the process of completing this risk assessment.

Provided assistance to the San Ildefonso Pueblo in New Mexico with their Tribal Risk Assessment process and communicating human health impacts to the Pueblo community.

Independent Consultant
Belgrade, Montana (1997-2001)

Worked with RAC on several projects related to exposures and potential risks from both historical and contemporary releases of radionuclides and chemicals to the environment.

Colorado State University

Research Associate, Fort Collins, Colorado (September 1996–January 1997)

Performed gamma spectra analyses of Rocky Flats Plant soil samples. Operated and calibrated HPGe and Ge(Li) detector and conducted spectral analysis and interpretation.

Laboratory Technician (September 1993–May 1994)

Collected and prepared soil samples for actinide analysis.

Additional Experience

Courses Taught

Environmental Risk Assessment for the Nuclear Regulatory Commission, Bethesda Maryland, April 2015.

Courses Attended

Microsoft Access advanced programming course for application developers (summer 1999)

Enhanced understanding of the data modeling requirements for developing a relational database. Focused on the programming necessary for custom database design as well as the fundamental structural elements of a relational database.

Research
U.S. Department of Energy's Par Pond Radioecology Laboratory
Savannah River Site, Aiken, South Carolina (summer 1994)

Conducted M.S. thesis research, which focussed on evaluating temporal trends of ^{137}Cs in an aquatic system. Also involved the development of a multi-compartment model to predict the distribution of ^{137}Cs in various ecosystem compartments.

U.S. Department of Energy Health Physics Fellow

Idaho National Engineering Laboratory, Idaho Falls, Idaho (summer 1996)

Analyzed the effects of building downwash for facility regulatory compliance using current air dispersion codes (ISC3) and software (Surfer® and GIS ARC/INFO®).

Honors

U.S. Department of Energy Applied Health Physics Fellowship, 1994–1996
Burton J. Moyer Memorial Fellowship, 1994–1995
Colorado Graduate Fellowship, 1994–1995
Soutwest Missouri State University Scholar (undergraduate academic scholarship)
Graduated Magna Cum Laude in the Honors College
Member of Phi Eta Sigma (honor society)

Peer-Reviewed Publications

J.E. Till, H.L. Beck, J.W. Aanenson, H.A. Grogan, **H.J. Mohler**, S.S. Mohler, and P.G. Voillequé. 2014. "Military Participants at U.S. Atmospheric Nuclear Weapons Testing—Methodology for Estimating Dose and Uncertainty. *Radiation Research*, 181, 471-484.

Till, J.E., H.A. Grogan, **H.J. Mohler**, J.R. Rocco, and S.S. Mohler. 2012. "RACER: An Integrated Approach to Data Management, Risk Assessment, and Decision Making." *Health Physics* 102 (4). April.

Mohler, H.J., H.A. Grogan, J.R. Rocco, R.F. Kiefer, and J.E. Till. 2012. "RACER: Dynamic Use of Environmental Measurement Data for Decision Making and Communication." *Operational Radiation Safety* 102, Suppl 1. February.

Mohler, H.J., K.R. Meyer, H.A. Grogan, J.W. Aanenson, and J.E. Till. 2004. "Application of NCRP Air Screening Factors for Evaluating both Routine and Episodic Radionuclide Releases to the Atmosphere." *Health Physics* 86 (2): 135–144.

Till, J.E., A.S. Rood, P.G. Voillequé, P.D. McGavran, K.R. Meyer, H.A. Grogan, W.K. Sinclari, J.W. Aanenson, H.R. Meyer, **H.J. Mohler**, S.K. Rope, and M.J. Case. 2002. "Risks to the

Public from Historical Releases of Radionuclides and Chemicals at the Rocky Flats Environmental Technology Site." *Journal of Exposure Analysis and Environmental Epidemiology* 12: 355–372.

Mohler, H.J., F.W. Whicker, and T.G. Hinton. 1997. "Temporal Trends of ^{137}Cs in an Abandoned Reactor Cooling Reservoir." *Journal of Environmental Radioactivity* 37 (3): 251–268.

Technical Reports

Risk Assessment Corporation (RAC). 2009. Contributing Authors: J.W. Aanenson, H.A. Grogan, B. Jacobs, G.G. Killough, K.R. Meyer, **H.J. Mohler**, S. Mohler, J.R. Rocco, A.S. Rood, P. Shanahan, E.A. Stetar, L. Hay Wilson, J.E. Till. *Risk Analysis, Communication, Evaluation, and Reduction at LANL. Ranking Tool Methodology*. RAC Report No. 35-RACER LANL-2008-FINAL. Risk Assessment Corporation. Neeses, South Carolina. April.

Hay Wilson, L., J.R. Rocco, S.S. Mohler, and **H.J. Mohler**. 2005. *Decision Support Tool Methodology*. *RAC* Report No. 18-RACER LANL-2005-DRAFT. *Risk Assessment Corporation*, Neeses, South Carolina. November.

Aanenson, J.W., J. Goldberg, H.A. Grogan, L. Hay Wilson, G.G. Killough, K.R. Meyer, **H.J. Mohler**, S. Mohler, J.R. Rocco, A.S. Rood, P. Shanahan, W.K. Sinclair, C. Slack, E.A. Stetar, P.G. Voillequé, J. Wilson, and J.E. Till. 2004. *Risk Analysis, Communication, Evaluation, and Reduction at LANL. Contemporary Risk Assessment: Demonstration of an Integrated Methodology*. RAC Report No. 11-RACER LANL-2004-DRAFT. July.

K.R. Meyer, **H.J. Mohler**, J.W. Aanenson, and J.E. Till. 2002. *Identification and Prioritization of Radionuclide Releases from the Idaho National Engineering and Environmental Laboratory*. Task Order 5-Center for Disease Control and Prevention. RAC Report No. 3-CDC Task Order 5-2000-FINAL. Risk Assessment Corporation, Neeses, South Carolina. October 8.

Aanenson, J.W, H.A. Grogan, S.J. Maheras, **H.J. Mohler**, A.S. Rood, P.G. Voillequé, J.E. Till. 2002. *Independent Technical Audit of Los Alamos National Laboratory for Compliance with the Clean Air Act, 40 CFR 61, Subpart H in 2001*. RAC Report No. 6-DOJ-LANL Audit-2002-FINAL. Risk Assessment Corporation, Neeses, South Carolina. October.

Rood, A.S., J.W. Aanenson, S.S. Mohler, P.D. McGavran, **H.J. Mohler**, H.A. Grogan, and J.E. Till. 2002. *Analysis of Exposure and Risks to the Public from Radionuclides and Chemicals Released by the Cerro Grande Fire at Los Alamos. Task 1.7: Final Report on Estimated Risks from Releases to Air*. RAC Report No. 3-NMED-2002-FINAL(Rev.1). June 12.

Rocco, J.R., K.R. Meyer, **H.J. Mohler**, J.W. Aanenson, L. Hay Wilson, A.S. Rood, P.D. McGavran, and J.E. Till. 2002. *Analysis of Exposure and Risks to the Public from Radionuclides and Chemicals Released by the Cerro Grande Fire at Los Alamos. Task 2.7: Estimated Risks from Releases to Surface Water*. Final Report, *RAC* Report No.4-NMED-2002-FINAL(Rev.1). *Risk Assessment Corporation*, Neeses, South Carolina. June 12.

Mohler, H.J., K.R. Meyer, J.W. Aanenson, H.A. Grogan, and J.E. Till. 2002. *Analysis of Exposure and Risks to the Public from Radionuclides and Chemicals Released by the Cerro Grande Fire at Los Alamos. Task 3: Calculating and Communicating Risks: Observations and Recommendations*. *RAC* Report No.15-NMED-2001-FINAL(Rev.1). *Risk Assessment Corporation*, Neeses, South Carolina. June 12.

Aanenson, J.W., Boelter, P.J., M.J. Case, M. Dreicer, H.A. Grogan, M.O. Langan, P.D.

McGavran, K.R. Meyer, R. Meyer, **H.J. Mohler**, A.S. Rood, R.C. Rope, S.K. Rope, L.A. Stetar, J.E. Till, P.G. Voillequé, T.F. Winsor, W. Yang. 2001. *Evaluation of Materials Released from the Savannah River Site. Savannah River Site Environmental Dose Reconstruction Project.* Phase II: Source Term Calculation and Ingestion Pathway Data Retrieval. RAC Report No.1-CDC-SRS-1999-Final. *Risk Assessment Corporation*, Neeses, South Carolina. April 30.

Aanenson, J.W., **H.J. Mohler**, P.G. Voillequé, S.J. Maheras, A.S. Rood, H.A. Grogan, and J.E. Till. 2000. *Independent Technical Audit of Los Alamos National Laboratory for Compliance with the Clean Air Act, 40 CFR 61, Subpart H in 1999. RAC* Report No. 4- DOJ-LANL Audit-2000-Final. *Risk Assessment Corporation,* Neeses, South Carolina. November.

Weber J.M., S.J. Maheras, **H.J. Mohler**, P.G. Voillequé, and J.E. Till. 1999. *Independent Audit of Los Alamos National Laboratory for Compliance with the Clean Air Act, 40 CFR 61, Subpart H. RAC* Report No. 3-DOJ-LANL Audit-1998-Final. *Risk Assessment Corporation,* Neeses, South Carolina. November.

Grogan, H.A., P.D. McGavran, H.R. Meyer, K.R. Meyer, **H.J. Mohler**, A.S. Rood, W.K. Sinclair, P.G. Voillequé and J.M. Weber. 1999. *Technical Summary Report for the Historical Public Exposures Studies for Rocky Flats Phase II.* RAC Report No. 14-CDPHE-RFP-1999-FINAL. *Radiological Assessments Corporation*. Neeses, South Carolina. September.

Whicker, F.W., T.E. Hakonson, and **J. Mohler**. 1997. *Environmental Plutonium at Hanford: A Review of Literature and Monitoring Data*. Prepared for Kirkland and Ellis, Chicago, Illinois. May.

Other Papers

Rood, AS, B. Jacobs, P. Shanahan, **H.J. Mohler**, J.W. Aanenson, J.R. Rocco, L. Hay Wilson, H.A. Grogan, and J.E. Till. 2009. "Overview of Environmental Transport Models Contained in the Risk Analysis, Communication, Evaluation, and Reduction (RACER) Software Tools at Los Alamos National Laboratory." Paper number 9070. Waste Management for the Nuclear Renaissance, WM09 Conference, Phoenix, Arizona, March 1–5.

H.A. Grogan, J.W. Aanenson, P.D. McGavran, K.R. Meyer, S.S. Mohler, **H. J. Mohler**, J.R. Rocco, A.S. Rood, J.E. Till and L.H. Wilson. 2006. "Applied Modeling of the Cerro Grande Fire at Los Alamos: An Independent Analysis of Exposure, Health Risk, and Communication with the Public." In *Applied Modeling and Computations in Nuclear Science*. ACS Symposium Series 945. Edited by T.M. Semkow, S. Pommé, S.M. Jerome, and D.J. Strome. American Chemical Society, Washington, D.C.

Mohler, H. Justin, Jill Weber Aanenson, Helen Grogan, and John Till. 2005. "Creating Spatially-Linked Data and Risk Evaluation Tools to Support Community Participation and Decision Making for a Contaminated Site." Presented at the 19th International Conference on Informatics for Environmental Protection, Masaryk University Brno, Brno, Czech Republic, Informatics for Environmental Protection – Networking Environmental Information (Volume 2), ISBN: 80-210-3780-6, p. 937–940, September 7–9.

Grogan, H.A., J.E. Till, K.R. Meyer, and **H.J. Mohler**. 2004. "Involving Stakeholders and Tailoring Environmental Databases for Shared Analysis of a Contaminated Site." Proceedings of the 18th International Conference Informatics for Environmental Protection,

Sharing, CERN, Geneva, Switzerland, Editions du Tricorne, ISBN: 28 29 30 275-3, p. 242–245. October 21–23.

Emily A. Caffrey, Ph.D.

Education

Ph.D. Radiation Health Physics with minor in Statistics, Oregon State University, 2016
M.S. Radiation Health Physics with minor in Statistics, Oregon State University, 2012
B.S. Nuclear Engineering, Oregon State University, 2010

Professional Experience

Risk Assessment Corporation
Consultant (2016-present)

Currently working with Risk Assessment Corporation as an independent consultant.

University of Alabama at Birmingham
Adjunct Faculty (2016-present)

Currently assisting in the development of a new health physics master's program by writing course syllabi, assisting in the creation of a health physics website, and writing funding grants.

Oregon State University School of Nuclear Science and Engineering
Graduate Research Assistant (2010-2016)

Performed original research in environmental protection and risk assessment. Completed two projects for the Electrical Power Research Institute, one in examining dose calculation methodologies for Carbon-14 emissions from nuclear power plants and the second in investigating tritium separation technologies for groundwater. Developed substantial analytical and technical skills in statistical analysis and data interpretation through minor degree coursework. Created and taught graduate level course in Liquid Scintillation Counting. Taught introductory course in Nuclear Engineering and Radiation Health Physics. Served as a teaching assistant and lecturer for Radioecology and Radiobiology. Led a multicultural research group of 10 graduate students for over two years.

Australian Nuclear Science and Technology Organization
Endeavor Research Fellow (2015)

Provided innovative computational modeling capabilities to support several research projects. Collected and prepared soil samples for plutonium particle analysis. Performed fieldwork at nuclear waste site near Sydney by obtaining tree cores for radionuclide analysis. Selected to present Ph.D. research to the Australian Radiation Protection and Nuclear Safety Agency.

Oregon State University
Radiation Safety Student Technician (2008-2010)

Monitored personnel and laboratories for radiation exposure. Authored operating procedures for the Liquid Scintillation Counter. Managed acquisition, storage, handling, and disposal of

radioactive materials. Assisted in performing annual inspections of on-campus radiation use laboratories. Assisted in verifying that veterinary radiography facilities were in compliance with regulatory requirements.

Mathematics Tutor (2008)

Tutored small groups of students in advanced algebra and integral calculus.

Honors

Australian Endeavor Research Fellowship Recipient in 2015
Inducted into Alpha Nu Sigma Honor Society in 2013
Selected as an ARCS Scholar in 2012

Affiliations

Alumna of Phi Sigma Rho National Engineering Sorority
Health Physics Society Member since 2010
American Nuclear Society Member since 2006

Presentations and Publications

Caffrey, E.A., 2016. Development and Application of Voxelized Dosimetric Models for Biota: Characterization of the Uncertainty in the International Commission on Radiological Protection's Wildlife Dosimetry System. *Oregon State University Doctoral Dissertation.* Oregon State University. Available at: http://hdl.handle.net/1957/58187.

Caffrey E.A., Johansen MP, Higley KA. Organ Dose Rate Calculations for Small Mammals at Maralinga, the Nevada Test Site, Hanford, and Fukushima: A Comparison of Ellipsoidal and Voxelized Dosimetric Methodologies. *Radiat Res*. 2015:184:433–41.

Higley, K., Ruedig, E., **Caffrey, E.**, Jia, J., Comolli, M., & Hess, C. Creation and application of voxelised dosimetric models, and a comparison with the current methodology as used for the International Commission on Radiological Protection's Reference Animals and Plants. *Annals of the ICRP*. 2015:44(s2).

Caffrey E.A., Johansen MP, Higley KA. Voxel Modeling of Rabbits for Use in Radiological Dose Rate Calculations. *J Environ Radioact*. 2016:151(ICRER Barcelona 2014):480–6.

Johansen, M. P., Child, D. P., **Caffrey, E. A.**, Davis, E., Harrison, J. J., Hotchkis, M. A. C., Beresford, N. A. Accumulation of plutonium in mammalian wildlife tissues following dispersal by accidental-release tests. *J Environ Radioact.* 2016:151(ICRER Barcelona 2014):387-94.

Caffrey, E.A. The Creation of Voxel Phantoms for the Purpose of Environmental Dosimetry. Presentation given at Third International Conference on Radioecology and Environmental Radioactivity 2014. 7-12 September, Barcelona Spain.

Ruedig, E., **Caffrey, E.A.**, Hess, C., Higley, K.A. Monte Carlo Derived Absorbed Fractions for a Voxelized Model of Oncorhynchus Mykiss, a Rainbow Trout. *Radiation and Environmental Biophysics*. 2014:53(3):581-7.

Caffrey, E.A. et al., 2014. Radioecology: Why Bother? *Journal of Environmental Protection*, 5(3).

Caffrey, E.A., Higley, K.A. Creation of a voxel phantom of the ICRP reference crab. *J Environ Radioact*. 2013:120:14–18.

Cardarelli, R., Wendland, B., Higley, K.A., Paulenova, A., **Caffrey, E.A.**, Ruirui, L. 2013. Assessment of Tritium Removal Technologies. Electric Power Research Institute Interim Report #3002000608.

Cardarelli, R., Oliver, G., Hood, D., **Caffrey, E.A.**, Higley, K.A. 2013. Carbon-14 Background, Pathway, and Dose Calculation Analysis for Nuclear Power Plants: A Sourcebook for Accurate Carbon-14 Dose Calculations. Electric Power Research Institute Report #3002000545, Palo Alto, CA.

Caffrey, E.A., 2012. Improvements in the Dosimetric Models of Selected Benthic Organisms. *Oregon State University Master's Thesis.* Oregon State University. Available at: http://ir.library.oregonstate.edu/xmlui/handle/1957/34305.