



We Put Science To Work



NCoRE Workshop Summary

“Radioecology in the 21st Century – The science, tools and research goals needed to advance the field.”

Dr. Wendy Kuhne
Senior Scientist
November 13, 2012

STAR Workshop, Paris, France

Workshop Summary Briefing

Outline

- **Current status of programs in the U.S.**
- **What is NCoRE?**
- **Decision for NCoRE to host workshop**
- **Workshop details**
 - Objectives
 - Attendees
 - Research priority area summary
- **Path Forward**

Why Radioecology is Needed?

As long as there is an interest in these areas there is a need for a scientific field to provide *credible, consistent and defensible* information that can be used for clean up activities and conducting risk assessments:

- **Nuclear industry** (new facility start-ups, small modular reactors development and aging reactor and other nuclear facility closures)
- **Uranium mining and milling**
- **Emergency response**
- **Radioactive waste management**
- **Environmental releases from nuclear facilities**
- **Naturally occurring radionuclides in non-nuclear industries**
- **Education of the public about radiological risks**

Current Status of Radioecology Programs in U.S.

Research in radioecology:

- Is fragmented, with little coordination to identify national strategies and direct programs;
- Is suffering from a steadily decreasing funding base;
- Will soon be hampered by closure of key infrastructures and retirement of expertise;
- Requires training of young scientists to ensure continuation of the science;
 - Currently no graduate degree programs in the U.S.

Establishment of National Center for Radioecology (NCoRE)

- Savannah River National Laboratory took the lead to establish the National Center for Radioecology in an effort to maintain and grow the scientific discipline and expertise in the United States.



National Center for Radioecology

Managed by Savannah River National Laboratory

A Network of Excellence for Environmental Radiation Risk Reduction and Remediation

Establishment of National Center for Radioecology (NCoRE)

- 2010 - Signed MOU/MOA's with 6 Universities and 2 International Organizations
- Held an inaugural meeting with Key Partners in February 2011



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SRNL Postdoc Dr. Amanda Wright (left) and Colorado State University Ph.D. candidate Nicole Martinez (Right)

Workshop Preparations

- **Workshop planning began in April 2012**
- **Invitations to attend the workshop were distributed to members of**
 - Academia
 - Government (EPA, NRC, USGS, and other DOE Labs)
 - Consulting Firms (i.e. Risk Assessment Corporation)
 - Non-profit (i.e. Electric Power Research Institute, Nuclear Energy Institute)



NCoRE Workshop, August 15 and 16, 2012

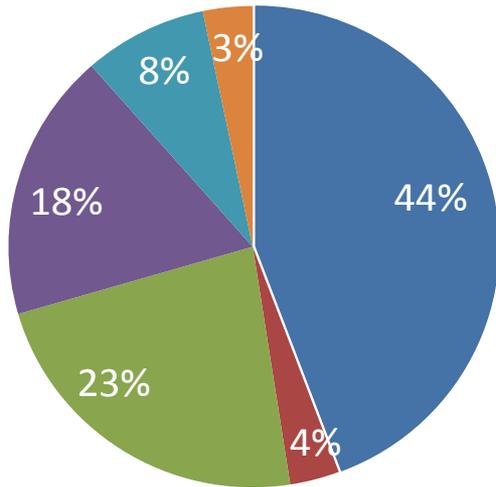
“Radioecology in the 21st Century – The science, tools and research goals needed to advance the field.”

- **A two day event to address the following objectives:**
 - Current status of radioecology research programs in the United States;
 - Immediate need for science driven discoveries, tool development and the generation of scientific data to support legislative decision making process for remediation strategies, long-term monitoring of DOE sites and protection of human health and the environment;
 - Discuss list of research priority areas identified by NCoRE partners;
 - Discuss the need for radioecology graduate education programs in the United States;
 - Discuss the Savannah River Site as a test bed for radioecology research.



Workshop Participants

- 61 registered participants



- Savannah River National Laboratory
- Other Federal Agencies
- Universities
- DOE (Headquarters, other labs)
- Savannah River Site
- Other (i.e. Non-Profits, Consulting Firms)



Radioecology Areas and Needs for Advancement

- **Radiological Risk Assessment** (Dr. John Till)
- **International Commission on Radiological Protection (ICRP)- Environmental Protection of the Environment** (Dr. Kathy Higley)
 - **ICRP Committee 5**
 - Framework development (modeled after human risk framework)
 - Selection of reference flora and fauna
- **Needs of the Department of Energy** (Dr. Wendy Kuhne)

Radiological Risk Assessment

- **Radioecological parameters are required in mathematical models to estimate risk.**

$$\text{Dose} = (S \cdot T \cdot E \cdot D \cdot R)_{uvcp}$$

where

S = source term (characterization of the quantity and type of material released)

T = environmental transport and fate of the material released

E = exposure factors (characteristics of individuals exposed)

D = conversion to dose

R = conversion to risk

u = uncertainty

v = validation

c = communication of results

p = public participation.



Dr. John Till

Dr. John Till (Risk Assessment Corporation) - "Although our understanding of these parameters and models has evolved over many years of research and we have an extensive database there is still much work to be accomplished in order to reduce the uncertainties in estimates of risk to people."

ICRPs Radiological Protection of the Environment



Dr. Kathy Higley

- In its 1990 Recommendations, the ICRP indicated that it believed that the standards of environmental control needed to protect man to the degree currently thought desirable would ensure that other species are not put at risk.
- No internationally agreed criteria or policies explicitly address protection of the environment from ionizing radiation, and it is difficult to determine or demonstrate whether or not the environment is adequately protected from potential impacts of radiation under different circumstances.
- Publication 91 (2003) suggests the development of a framework, based on scientific and ethical-philosophical principles, by which a policy for the protection of non-human species could be achieved.

Needs of the Department of Energy

- **Historically radioecology programs were a vibrant part of the research programs at**
 - **Hanford (Washington)**
 - **Oak Ridge (Tennessee)**
 - **Savannah River Site (South Carolina)**
- **The primary purpose of these programs was to address releases of radionuclides from these facilities to the local environments.**
 - **Driven primarily by societal concerns.**
- **Funding for these programs was strong until the 1970s when funding levels began to fade.**



Dr. Wendy Kuhne

What Research Questions Remain for the DOE?

- **Development of remedial technologies to treat some of these harmful and challenging radionuclides (i.e. Technetium 99)**
- **Information on long-term monitoring and modeling for radionuclides.**
- **Need a better understanding of the environmental radionuclide contamination and what the impact is to the environment.**
- **Need a better way to quantify what are sub lethal effects, both from environmentally relevant low doses and high doses.**
- **We also need to know what quantities of specific radionuclides can be released to the environment without causing an undesirable effect.**
- **How do we define “undesirable effect”?**

Discussion Breakout Sessions

- Participants were asked to consider and expand upon the following topic areas to prioritize research needs and identify potential funding sources for external grant development.



Dr. Brian Looney (SRNL) Session Leader – Tool Development



Science Drive Research	Tool Development
Translocation and uptake kinetic studies of “lesser studied” radionuclides.	Development of tools for assessment of site specific spatial transport and temporal geochemical cycling
Multi-contaminant effects	Development of rapidly deployable techniques and tools to mitigate widespread contamination of the environment.
Radiation impacts on ecosystems	Development of reliable computational tools for estimation of radiological risk assessment–
Chronic low level radiation impacts on ecosystems	Utilization of chemometric approaches to predict environmental behaviors of exotic radionuclides
Genomics based changes within radiation exposed and radionuclide-contaminated biota using state of the art analytical methods, such as transcriptome, proteome and metabolomics measurements,	Expansion of radioecological models to include kinetic predictions of movement (the goal is to reduce conservatism in assessment models and to take into account the effect non equilibrium conditions have on radionuclide uptake and transfer rates).
Radiation-induced epigenetic effects with a particular emphasis on the occurrence and magnitude of transgenerational effects	Incorporation of scaling and extrapolation methods (the goal is to maximize the availability of defensible data without having to conduct expensive research).
Enhanced dosimetry in experimental designs to accurately assess effects that may be slightly above or below background levels.	

Results from Science Driven Research Discussions

- **Filling in data gaps on “lesser known” radionuclides (Tc-99, I-129, Pu-239 and H-3)**
- **Improving environmental dosimetry for non-human biota (i.e. external and internal exposures)**
- **Trans-generational effects**
 - Better understanding of individual effects
 - Linking to population effects
- **Comparative approach across more species**
- **Functional genomics – using biomarkers such as micronuclei test, chromosome aberrations, transcriptomics, proteomics and metabolomics to assess changes in phenotype or to assess injury that affects growth, survival, and/or reproduction**
- **Mixed contaminant exposures (radionuclides and metals and chemicals)**
- **Understanding enhanced microbial effects (positive radiotaxis)**
- **Savannah River Site Species of Interest (development of Reference Animals and Plants list for future research)**



Results from Tool Development/Ecological Relevancy Session

- **Optimized scenario based ecosystem modeling: Coupled biogeochemical transport, exposure and impacts modeling.**
- **Development of comprehensive-authoritative data source to support radioecology.**
 - European Union currently has the ERICA database
- **Radioecology case study site (Selection of test bed sites on the Savannah River Site).**
 - Tim's Branch and Steed's Pond (Uranium and Nickel)
 - Pond B (Cesium-137)
- **Consequence management tools for response, remediation and restoration.**



Tim's Branch Study Site

Results of Discussion Sessions

- **The participants felt that there is a significant opportunity to apply some of the latest scientific advances and tools to advance the field and provide valuable information to support safe operation and development of nuclear facilities.**
 - Examples of new technologies include – genomics, proteomics, voxel phantom development, and remediation technologies
- **Participants strongly supported the use of sites with existing contamination and baseline data as case study sties. This would provide the most defensible information on radioecological impacts in real environments and ecosystems.**
 - Proposed sites included Savannah River Site and Oak Ridge National Lab (baseline information in the mid-20th century).

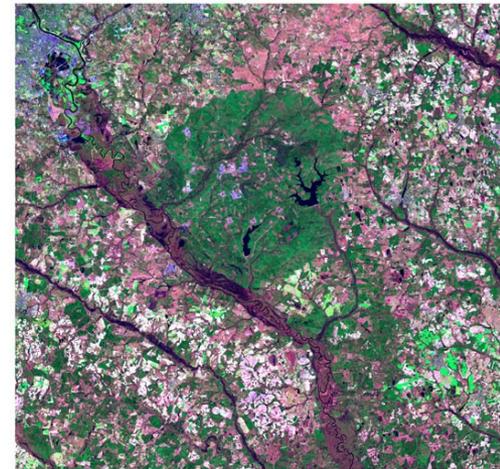
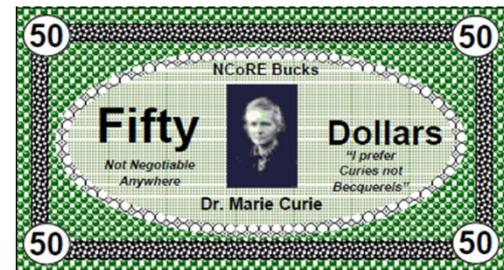
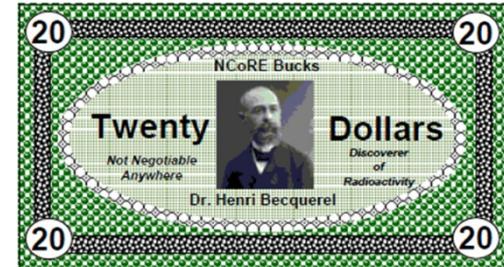
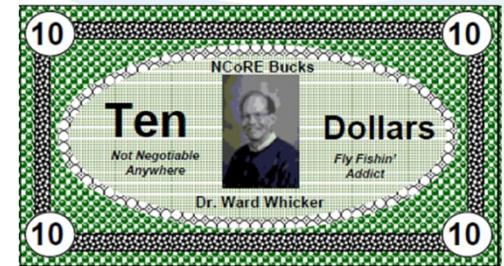
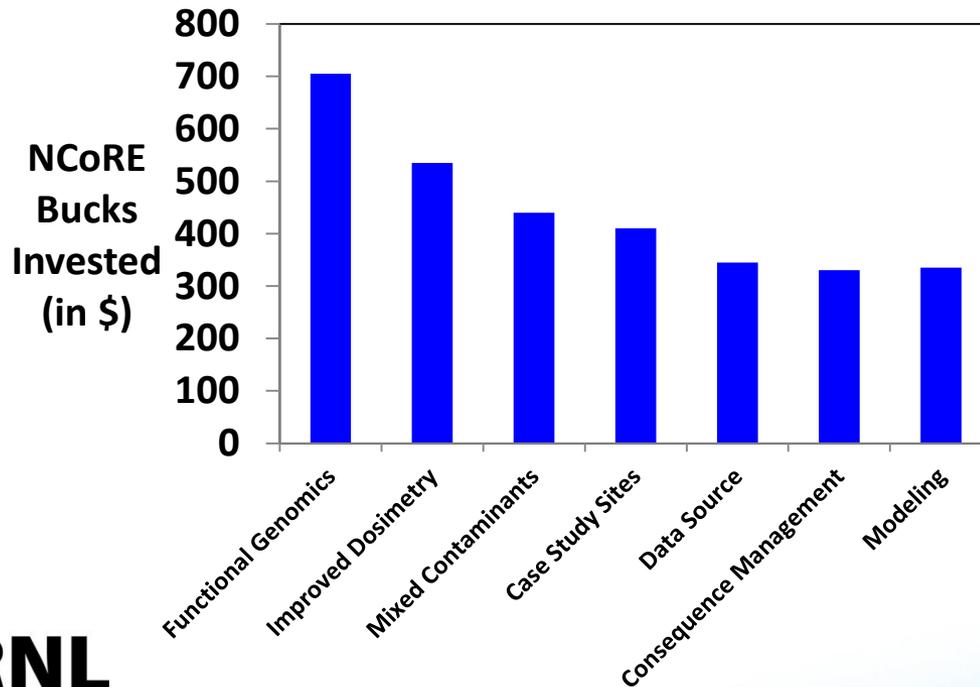


Photo Credit: SREL GIS LAB

NCoRE Bucks Investment Exercise

- In an effort to prioritize the lists from the two discussion sessions participants were given \$100 of NCoRE bucks and asked to spend it on research priority areas.
- The NCoRE bucks were assigned numbers to track the demographic spending on the research priority areas.



Path Forward

- **Develop research priority areas into research proposals for internal and external funding opportunities (DOE Office of Science, NRC, EPA, NNSA, USGS, EPRI etc.)**
- **Contribute to the STAR Alliance Strategic Research Agenda – a suggested prioritization of research topics in radioecology for the EU for the next 20 years.**
 - French Institute of Radiation Protection and Nuclear Safety (IRSN, France)
 - Belgian Nuclear Research Centre (SCK•CEN, Belgium)
 - Norwegian Radiation Protection Authority (NRPA, Norway)
 - Radiation and Nuclear Safety Authority (STUK, Finland)
 - Natural Environment Research Council (NERC, United Kingdom)
 - Research Centre in Energy, Environment and Technology (CIEMAT, Spain)
 - Stockholm University (SU, Sweden)
 - German Federal Office for Radiation Protection (BfS, Germany)
 - Norwegian University of Life Sciences (UMB, Norway)

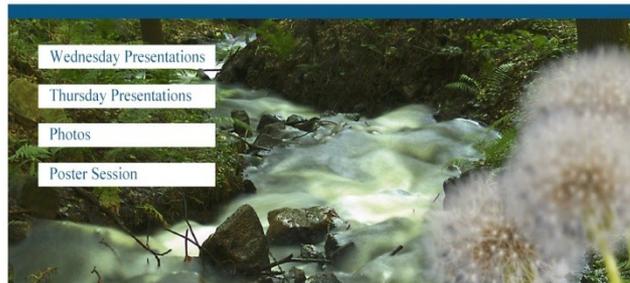


Products from workshop

- Workshop Summary Report
- DVD of presentations and discussion session.
 - Link on NCoRE website (<http://srnl.doe.gov/NCORE/>)



Workshop on Radioecology in the 21st Century
August 15 - 16, 2012



NCoRE National Center for Radioecology
Managed by Savannah River National Laboratory

U.S. DEPARTMENT OF ENERGY

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National Center for Radioecology

With the renewed and growing interest in nuclear energy and with the continuing decommissioning and subsequent transitioning of legacy waste sites to long-term stewardship, there is now an immediate need to build the pool of radioecology expertise both here and abroad. To address this need, radioecologists from the Savannah River National Laboratory (SRNL) worked with key partners from universities across the U.S. and from laboratories in France and the Ukraine to form the National Center for Radioecology (NCoRE), a network of excellence for environmental radiation risk reduction and remediation.

Managed by:
Savannah River National Laboratory

Other Member Organizations:

SRNL
SAVANNAH RIVER NATIONAL LABORATORY

CLEMSON **Colorado State** **Duke** **OSU**
UNIVERSITY UNIVERSITY UNIVERSITY Oregon State

IRSN **SOUTH CAROLINA** **The University of Georgia**

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Resources

Upcoming Workshop: Radioecology in the 21st Century
August 15-16, Aiken, SC

NCoRE Fact Sheet (1.95MB PDF)

NCoRE Purpose Poster (494KB PDF)

SRNL is the DOE Office of Environmental Management's National Laboratory

Path Forward

Radioecology Education Programs

- **Will continue to work with Key Partners on the establishment of radioecology graduate education and training programs.**
- **Many of the programs are in need of additional faculty to teach core components of the radioecology curriculum. Will explore options including:**
 - **Web based courses (share academic resources)**
 - **Faculty development grants (NRC, Department of Education and National Science Foundation)**

Expanding Reach of NCoRE and radioecology

- **Signed Memorandums of Agreement with**
 - **International Union of Radioecology**
 - **McMaster University (Hamilton, Ontario, Canada)**