



## The Consortium for Risk Evaluation with Stakeholder Participation III

Consortium Universities: **Vanderbilt University**, Howard University, Oregon State University, Robert Wood Johnson Medical School, Rutgers University, University of Arizona, University of Pittsburgh

June 5, 2007

Mr. Kenneth Wade, Federal Project Director  
U.S. Department of Energy  
Office of River Protection  
P.O. Box 450 MSIN: H6-60  
2440 Stevens Center Place  
Richland, WA 99354

RE: CRESP LAW Alternatives Review Team Letter Report 1

Dear Mr. Wade:

This letter is in response to your request that CRESP review the process that is being used to evaluate business cases for alternative treatment strategies for low activity waste (LAW alternatives review). LAW is to be treated in conjunction with removal and disposition of high level waste (HLW) currently stored in tanks at the Hanford site under the responsibility of the Office of River Protection (ORP). The scope of the requested CRESP review is provided in Appendix A. The CRESP LAW review team consists of David Kosson (lead), James Clarke, Kathy Higley and Charles Powers; brief biographies for each team member are provided in Appendix B.

We recognize that the LAW alternatives review has been on an extremely short schedule, and as a result, the CRESP review team has been asked to provide input to a process that is in progress. This first stage of CRESP review focuses on the two documents that describe the evaluation process as provided to us on May 17, 2007:

DOE, Office of River Protection (May 3, 2007). Hanford River Protection Project Tank Waste Treatment Mission Completion Business Cases – Development Plan, Rev. 1.

DOE, Office of River Protection (April 17, 2007). Review Plan for the Tank Waste Supplemental Treatment Program Technology Readiness Assessment.



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The following are our observations and recommendations regarding the evaluation process:

1. Overall, we are very impressed and supportive of the carefully structured process for the LAW alternatives review that is taking place.
2. The overall LAW alternatives review is being carried out on an extremely short time schedule, given the complexity of the task and the importance with respect to the ORP mission and future expenditures. The task seems more appropriate to a 6-9 month schedule rather than an approximately 3 month schedule.
3. The LAW alternatives review will result in evaluation of three primary business cases, each with 3-5 sub-cases representing variations on the respective primary business cases. Each case will be evaluated with 12 main assessment metrics<sup>1</sup>, with each metric reflecting multiple considerations. This will result in a very complex evaluation matrix. Processes should be in place to insure consistent scoring within and between evaluation teams<sup>2</sup>. In addition, guidance should be provided on the relative importance of each assessment metric and process(es) to be used to integrate this information as input for decisions.
4. The resulting LAW alternatives evaluation report should include descriptions of (i) the motivation for the overall consideration of alternatives to the current baseline, and (ii) the rationale for selecting the specific alternatives included for consideration in this evaluation.
5. Evaluation of each alternative should include (i) a high level process mass balance and flow diagram, indicating the approximate amount of material that will be treated and the complete disposition pathways (and their status) for all process outputs, (ii) a discussion of the assumptions, risks and uncertainties associated with the disposition pathway for each process output, and (iii) impacts on the WTP vitrification of HLW in terms of the composition and schedule of wastes to be treated. For example, each LAW alternative may produce different quantities of the primary and secondary waste forms that may impact assumed disposal at the integrated disposal facility (IDF), in terms of the needed IDF capacity and characteristics.
6. Presentation of results for cost and schedule should be in the form of ranges of values, with discussion of uncertainties, not single point estimates. These results should also distinguish between cost and schedule impacts that are technology or alternative independent and those impacts that are a function of the specific technology or alternative being evaluated.
7. The project has incorporated an effective method for evaluating technology readiness levels for the different technologies and alternatives. It is anticipated that different technologies will be at different technology readiness levels. The

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<sup>1</sup> The list of metrics in the report “Hanford River Protection Project Tank Waste Treatment Mission Completion Business Cases Development Plan Revision 1” contains 12 metrics, which has subsequently been reduced to 11 metrics by the deletion of the “Project Maturity” metric.

<sup>2</sup> For example, the underlying scoring for a each technology and alternative should be reviewed in detail by evaluation team members from more than one evaluation team to verify consistency in application of the scoring criteria across review teams.

evaluation results would be substantially more informative if the cost and schedule requirements to advance from the current to the next readiness level are included. The nature and size of the effort needed to move from one level to another will be highly technology dependent and the decision maker can better use the readiness evaluation, if these differences are explicitly assessed and described.

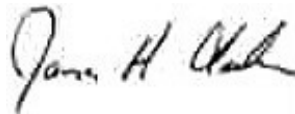
8. There appears to be an absence of direct discussion with or inclusion of representatives from the several regulatory communities (e.g., Washington Dept. of Ecology, EPA and NRC) as part of the evaluation process. Direct input from these stakeholders would provide additional clarity with respect to regulatory risk and provide an opportunity for greater transparency in DOE decision making processes. Such inclusion would also significantly help those regulatory communities understand the nature of the challenges the DOE is facing as it seeks to improve the efficiency and effectiveness of the tank waste management process.
9. Each primary business case should include analysis of sensitivity to the amount of LAW and sodium mass required to be treated (e.g., sensitivity of alternative assumptions of either 75,000 or 90,000 MT of sodium). This sensitivity may be technology dependent and influence subsequent decisions. Currently this key variable is included in only one of the three cases.

We look forward to discussing these observations and recommendations with you.


Sincerely,



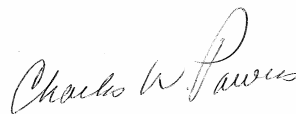
David S. Kosson, Ph.D.  
CRESP Review Team Chairman



James H. Clarke, Ph.D.



Kathryn A. Higley, Ph.D.



Charles W. Powers, Ph.D.

Cc: S. Olinger, (DOE-ORP)  
M. Gilbertson (DOE-HQ, EM-20)  
K. Gerdes (DOE-HQ)

# **Appendix A**

## **Scope of Work**

**Tank Waste Treatment Mission Completion Review:** The purpose of the review is to evaluate multiple Low Activity Waste (LAW) treatment approaches, including Waste Treatment Plant early LAW operations and supplemental LAW treatment technologies, and the related costs, schedules and risks with each approach. The first part of the review will include Technology Readiness Assessments (TRA) for supplemental pretreatment and treatment technologies. The TRA evaluations have completed and the initial draft report has been prepared. The results of the TRAs will be critiqued next week (5/14) by the TRA Team members. The final TRA report is expected to be prepared by May 25, 2007. The *Mission Completion Review* study started May 2, 2007 with participants from ORP, EM, ORP consultants and contractor staff. The evaluations of 13 LAW treatment approaches will continue this week. The draft *Mission Completion Review* report is due June 3, 2007 with the final report due June 30, 2007.

Task:

CRESP to serve as an Advisor to the *Tank Waste Treatment Mission Completion Alternatives Study* Core Team members and DOE Senior Sponsors. The intent is to provide an outside independent review of the Study evaluating objectivity, defensibility and quality. Tasks would include:

- Review materials related to the Study - Alternatives Study Charter, Alternatives Study Development Plan, Draft Alternatives Report, other documents as needed or requested e.g. Technology Readiness Assessment Report for LAW Treatment, Starting Low Activity Waste facility early report. The purpose would be to gain knowledge of the Study objectives, important data/facts, interpret information related to the Study objectives.
- Evaluate Study approach and results - e.g. interpret report to see if it meets objectives, identify potential bias/subjectivity, evaluate approaches and outcomes, data/facts consistently justify outcomes. Provide input to the Core Team and Senior Sponsors.
- Provide comments (factual accuracy review draft) to the Study approach or strategy by week of 5/21/06.
- Review draft report to ensure objectivity and defensibility and provide comments. (factual accuracy review draft week of June 11)
- Provide letter report to Senior Sponsor - Shirley Olinger (week of June 18) - outcome of the report, comments provided, resolved

## **Appendix B**

### **Brief Biographies**

## DAVID S. KOSSON

### PROFESSIONAL PREPARATION

Rutgers, The State University of New Jersey, B.S. high honors, Chem. & Biochem. Eng., 1983  
Rutgers, The State University of New Jersey, M.S., Chemical & Biochemical Eng., 1984  
Rutgers, The State University of New Jersey, Ph.D., Chemical & Biochemical Eng., 1986

### APPOINTMENTS

2000 - Present Professor and Chairman, Vanderbilt University, Department of Civil and Environmental Engineering; also Professor of Chemical Engineering (2000- ), Professor of Earth and Environmental Sciences (2005- )  
1996 - 1999 Professor I, Rutgers, The State University of New Jersey, Department of Chemical and Biochemical Engineering  
1990 - 1996 Associate Professor with Tenure, Rutgers, The State University of New Jersey, Department of Chemical and Biochemical Engineering  
1986 - 1990 Assistant Professor, Rutgers, The State University of New Jersey, Department of Chemical and Biochemical Engineering

### JOURNAL PUBLICATIONS (REPRESENTATIVE, >80 IN-PRINT OR IN-PRESS TO-DATE)

Van Gerven, T., Cornelis, G., Vandoren, E., Vandecasteele, C., Garrabrants, A.C., Sanchez, F. and Kosson, D.S. (2006) Effects of progressive carbonation on heavy metal leaching from cement-bound waste. *AIChE J.* 52(2):826-837.

Greenberg, M., Burger, J., Gochfeld, M., Kosson, D.S., Lowrie, K., Mayer, H., Powers, C., Volz, C. and Vyas, V. (2006) "End State Land Uses, Sustainable Protective Systems, and Risk Management: A Challenge for Multi-Generational Stewards." *Remediation Journal* 16(1): 91-105.

Mayer, H., Greenberg, M., Burger, J., Gochfeld, M., Powers, C., Kosson, D.S., Keren, R., Danis, C. and Vyas, V. (2006) "Using Integrated Geospatial Mapping and Conceptual Site Models to Guide Risk-Based Environmental Clean-Up Decisions." *Risk Analysis*, 25(2):429-446.

Sanchez, F. and Kosson, D. S. (2006) "Probabilistic approach for estimating the release of contaminants under field management scenarios," *Waste Management*, 25, 463-472.

Burger, J., M. Gochfeld, D. S. Kosson, C. W. Powers, B. Friedlander, J. Eichelberger, D. Barnes, L. K. Duffy, S. C. Jewett, and C. D. Volz. (2005) Science, policy, and stakeholders: developing a consensus science plan for Amchitka Island, Laeutiens, Alaska. *Environmental Management*, 35:557-568.

Garrabrants, A.C., Sanchez, F., and Kosson, D.S. (2004) Changes in constituent equilibrium leaching and pore water characteristics of a Portland cement mortar as a result of carbonation. *Waste Management*, 24(1):19-36.

Gervais, C., Garrabrants, A.C., Sanchez, F., Barna, R., Moszkowicz, P., and Kosson, D.S. (2004) The effects of carbonation and drying during intermittent leaching on the release of inorganic constituents from a cement-based matrix. *Cement and Concrete Research*, 34(1):119-131.

Shor, L., Kosson, D.S., Rockne, K.J., Young, L.Y., Taghon, G.L. (2004) Combined effects of contaminant desorption and toxicity on risk from PAH contaminated sediments. *Risk Analysis*, 24(5):1109-20.

Switzer, C., Slagle, T., Hunter, D., and Kosson, D.S. (2004) Use of rebound testing for evaluation of soil vapor extraction performance at the Savannah River Site, *Ground Water Monitoring and Remediation*, 24(4):106-118.

Shor, L.M., Rockne, K.J., Young, L.Y., Taghon, G.L., and Kosson, D.S. (2004) Synergistic effects of contaminant desorption and toxicity: Implications for environmental risk assessment. *Risk Analysis*, 24(5):1109-1120.

Shor, L.M., Rockne, K.J., Taghon, G.L., Young, L.Y., and Kosson, D.S. (2003) Desorption kinetics for field-aged polycyclic aromatic hydrocarbons from sediments. *Environmental Science and Technology*, 37(8):1535-1544.

Garrabrants, A.C., Sanchez, F., and Kosson, D.S. (2003) Leaching model for a cement mortar exposed to intermittent wetting and drying. *AIChE Journal*, 49(5):1317-1333.

Sanchez, F., Massry, I.W., Eighmy, T., and Kosson, D.S. (2003) Multi-regime transport model for leaching behavior of heterogeneous porous materials. *Waste Management*, 23(3):219-224.

Kosson, D.S., van der Sloot, H.A., Sanchez, F. and Garrabrants, A.C. (2002) An integrated framework for evaluating leaching in waste management and utilization of secondary materials. *Environmental Engineering Science* 19(3):159-204.

Sanchez, F., Mattus, C., Morris, M. and Kosson, D.S. (2002) Use of a new leaching test framework for evaluating alternative treatment processes for mercury contaminated soils. *Environmental Engineering Science* 19(4):251-269.

Rockne, K.J., Shor, L.M., Young, L.Y., Taghon, G.L., and Kosson, D.K. (2002) Distributed sequestration and release of PAHs in weathered sediment: The role of sediment structure and organic carbon properties. *Environmental Science and Technology*. 36(12):2636-2644.

Hacherl, E.L., Kosson, D.S., Young, L.Y., and Cowan, R.M. (2001) Measurement of iron(III) bioavailability in pure iron oxide minerals and soils using anthraquinone-2,6-disulfonate oxidation. *Environmental Science and Technology*, 35(24):4886-4893.

Schaefer, C.E., Arands, R.R., and Kosson, D.S. (1999) Measurement of pore connectivity to describe diffusion through a trapped non-aqueous phase in unsaturated soils. *Journal of Contaminant Hydrology*, 40(3):221-238.

### **DOE Related Reports (typical)**

Switzer, C., Brown, K., Kosson, D.S., Clarke, J. and Parker, F. Preliminary Risk Evaluation of Calcined High-Level Waste Disposition at the Idaho Site. Consortium for Risk Evaluation with Stakeholder Participation, Institute for Responsible Management, Piscataway, NJ, 2005.

Brown, K., Switzer, C., Kosson, D.S., Clarke, J. and Parker, F. Preliminary Risk Evaluation of Options for Buried Waste Disposition at the Idaho Site. Consortium for Risk Evaluation with Stakeholder Participation, Institute for Responsible Management, Piscataway, NJ, 2005.

Powers, C.W., Burger, J., Kosson, D.S., Gochfeld, M. and Barnes, D., et al. Biological and Geophysical Aspects of Potential Radionuclide Exposure in the Amchitka Marine Environment. Consortium for Risk Evaluation with Stakeholder Participation, Institute for Responsible Management, Piscataway, NJ, 2005.

Kosson, D.S., Grogan, H., Higley, K., Maddalena, R., Whipple, C. Merit Panel Review of the C-Tank Farm Closure Performance Assessment. Consortium for Risk Evaluation with Stakeholder Participation, Institute for Responsible Management, Piscataway, NJ, 2004.

### **SYNERGISTIC ACTIVITIES**

Chairman, Department of Civil and Environmental Engineering.

Co-PI on NSF IGERT Interdisciplinary Reliability and Risk Engineering and Management Doctoral Prog.

National Research Council Committees (Board on Army Science and Technology):

Committee on Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons: Phase 2 (ACW II), Member 2000 to 2002.

Chair, Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program (Standing Committee), July 1998-July 2000; Member, 1993-2000.

Panel on Review and Evaluation of Alternative Chemical Disposal Technologies, Member, 1995-1996.

Chairman of Leadership Committee - Vanderbilt Institute for Environmental Risk and Resources Management.

The Consortium for Risk Evaluation with Stakeholder Participant (CRESP) – Chairman of Remediation and Risk Mitigation Technology Center of Expertise

### **COLLABORATORS AND CO-EDITORS**

David Stensel, University of Washington; Joel Massman, University of Washington, Mark Benjamin, University of Washington, David Stahl, University of Washington, Joanna Burger, Rutgers University, Micheal Greenberg, Rutgers University, Panos Georgopolous, Rutgers University, Lily Young, Rutgers University, Gary Taghon, Rutgers University, Taylor Eighmy, University of New Hampshire, William Rixey, University of Houston, Paul Lioy, University of Medicine and Dentistry of New Jersey. Institutional Conflict: Rutgers University

Thesis Advisor: Dr. Robert C. Ahlert (currently emeritus)

Total number of graduate students as primary advisor: 33 completed, 4 current

Total number of post-docs supervised: 10 completed, 2 current



## **JAMES H. CLARKE**

### **Professional Preparation**

Rockford College, Chemistry (with honors) B.A. 1967 The Johns Hopkins University, Theoretical Chemistry Ph.D. 1973

### **Appointments**

2000 - Present Professor of the Practice, Vanderbilt University, Department of Civil and Environmental Engineering 1998 – 2000 Senior Vice President, Brown and Caldwell 1984-1998 Chairman, President and CEO, ECKENFELDER INC.

### **Publications (5 most closely related)**

Kostelnik, K. M., Clarke, J. H., Harbour, J. L., Sanchez, F. and Parker, F.L. (2005) A Sustainable Environmental Protection System for the Management of Residual Contaminants. accepted for publication in Research in Social Problems and Public Policy.

Kostelnik, K. M., Clarke, J. H., and Harbour, J. L., (2005) The Integration of Engineered and Institutional Controls. A Case Study Approach with Lessons Learned from Previously Closed Sites. Proceedings of the 2005 Waste Management Conference.

Clarke, J. H., Everett, L. G., and Kowall, S. (2004) Containment of Legacy Wastes during Stewardship. International Seminar on Nuclear War and Planetary Emergencies 30<sup>th</sup> Session. World Scientific Publishing Co. Pte. Ltd.

Performance and Verification of Barriers Through Prediction and Monitoring (in press) Contributor to Chapter One – Damage and System Performance Prediction.

Clarke, J. H. , MacDonell, M. M., Smith, E.D., Dunn, R. J., and Waugh, W. J. (2004) Engineered Containment Systems: Nurturing Nature. Risk Analysis 24(3): 771-779.

### **Publications (5 others)**

Clarke, J. H. and Clarke, A. N. (2002) A Critical Review of Contaminant Release Dating Techniques. Proceedings of the Annual Meeting of the American Academy of Forensic Sciences.

Campbell, A.C., Clarke, J. H., Shewmon, P. G., Steindler, M. J., and Wymer, R. G. (2001) Review of Chemistry Issues and Related NRC Staff Capability for the Proposed High Level Waste Repository at Yucca Mountain. White Paper prepared for the Nuclear Regulatory Commission.

Committee on Remediation of Buried and Tank Wastes, (2000) Long-Term Institutional Management of Department of Energy Legacy Waste Sites. National Research Council, National Academy Press.

Clarke, J. H. and Witherspoon, P. A. (eds) (1997) Barrier Technologies for Environmental Management. National Research Council, National Academy Press.

Committee on Remediation of Buried and Tank Wastes. (1996) The Potential Role of Containment in Place in an Integrated Approach to the Hanford Reservation Site Environmental Remediation, National Research Council, National Academy Press.

**Synergistic Activities**

Member, Nuclear Regulatory Commission Advisory Committee on Nuclear Waste

Member, Executive Board of the Environmental Sciences Division of the American Nuclear Society

Fellow, American Academy of Forensic Sciences

**Collaborators**

Kevin Kostelnik and Jerry Harbour, Idaho National Laboratory; Calvin C. Chien,

DuPont Company; Lorne C. Everett, Shaw Group; Ann N. Clarke, ANC Associates, Inc.

**Institutional Conflict:** None

**Thesis Advisor:** Dr. Everett A. Thele

**Thesis Advisees (2000 – Present)**

Kevin Brown, Kevin Kostelnik, Vindi Ndulute, Ravi Palakodeti, Leah Spradley, Carrie Stokes

**Kathryn A. Higley**  
NUCLEAR ENGINEERING & RADIATION HEALTH PHYSICS  
OREGON STATE UNIVERSITY

**Phone: 541.737.0675**

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**ACADEMIC HISTORY**

Ph.D., Radiological Health Sciences, 1994. Colorado State University, Fort Collins, CO.  
M.S., Radiological Health Sciences, 1992. Colorado State University, Fort Collins, CO.  
B.A., Chemistry, 1978. Reed College, Portland, OR.

**ACADEMIC POSITIONS**

**Professor**, Radiation Health Physics Program Coordinator, Radiation Health Physics,  
Department of Nuclear Engineering, Oregon State University, Corvallis, OR 97221-5902;  
2005- present  
**Associate Professor**, Radiation Health Physics, Department of Nuclear Engineering, Oregon  
State University, Corvallis, OR 97221-5902; 2000-2005  
**Assistant Professor**, Radiation Health Physics, Department of Nuclear Engineering, Oregon  
State University, Corvallis, OR 97221-5902; 1994-2000  
**Faculty Appointee/Staff Technical Associate**, Environmental Assessment Division,  
Argonne National Laboratory; 1994-present  
**Research Assistant/Teaching Assistant**, Washington State University, Pullman, WA., 1979  
- 1980

**NON-ACADEMIC POSITIONS**

**Strategic & Technical Analysis Response Team**, Department of Homeland Security,  
Science and Technology Directorate, Weapons of Mass Destruction, 2004 - present  
**Consultant**, US Department of Energy, 1997 – present  
**Consultant**, Mitretek Systems, 2004 - present  
**Consultant**, CH2MHill, Hanford Group, Tank Farm Closure, 2003-2004  
**Consultant**, US Army PMCDF, Umatilla Weapons Depot, 1999-2002  
**Consultant**, GeoCenters, Inc., 1998- 1999  
**Affiliate Staff Scientist**, Pacific Northwest Laboratory, Richland, WA, 1994-1997  
**Sr. Research Scientist**, Pacific Northwest Laboratories, Richland, WA, 1980 - 1994  
**Radioecologist**, Portland General Electric Company, Portland, OR, 1976-1979.  
**Reactor Supervisor/Reactor Operations**, Reed College, Portland, OR, 1974-1978

**COURSES TAUGHT**

- NE 114 Introduction to Nuclear Engineering
- RHP 588 Radioecology<sup>a</sup>
- NE/RHP 581 Radiation Protection<sup>a</sup>
- RHP 582 Applied Radiation Safety<sup>a</sup>
- RHP 583 Radiation Biology<sup>a</sup>
- RHP 486/586 Radiation Dosimetry
- RHP/NE 319 Societal Aspects of Nuclear Technology
- RHP 585 Environmental Aspects of Nuclear Systems
- NE/RHP 531 Radiophysics
- RHP 493/593 Non Reactor Radiation Protection
- RHP 539 Radiological Risk Assessment

## SELECTED PUBLICATIONS

- Higley, K.A. and Bytwerk, D., “Generic Approaches to Transfer”, *J. Environ. Radioactivity (in press)*, 2007.
- Higley, K.A., “*Effects of Radioactivity on Plants and Animals*” in Radionuclide Concentrations in Food and the Environment. M. Poschl, L. Nollet, ed., Food Science and Technology Series Taylor Francis / CRC Press *Publication Date: 7/15/2006*
- Binney, S.E., and Higley, K.A., Palmer, T.S. and Hamby, D.M. " Status Report: Distance Learning Oregon State University," *Trans. American Nuclear Society* 2005.
- Binney, S.E., and Higley, K.A., "WNSA "Nonproliferation Instrumentation and Measurements" Summer Course Experience," *Trans. American Nuclear Society* 2004.
- Binney, S.E., and Higley, K.A. "Distance Learning Revival at Oregon State University," *Trans. American Nuclear Society* 2004.
- Loveland, W., Paulenova, A., Higley, K.A., “Nuclear and Radiochemistry at Oregon State University”, *Trans. American Nuclear Society*, 2004.
- Higley, K.A., Domotor, S.L., Antonio, E.J. A kinetic-allometric approach to predicting tissue radionuclide concentrations for biota. *J. Environ. Radioactivity* 66 (2003) 61–74.
- Higley, K.A., Domotor, S.L., Antonio, E.J. A probabilistic approach to obtaining limiting estimates of radionuclide concentration in biota. *J. Environ. Radioactivity* 66 (2003) 75–87.
- Higley, K.A., Domotor, S.L., Antonio, E.J., Kocher, D.C. Derivation of a screening methodology for evaluating radiation dose to aquatic and terrestrial biota. *J. Environ. Radioactivity* 66 (2003) 41–59.
- Jones, D. Domotor, S.L., Higley, K.A., Kocher, D.C., and Bilyard, G.L. Principles and Issues in Radiological Ecological Risk Assessment. *J. Environ. Radioactivity* 66 (2003) 19–39.
- Marianno, C.M., Higley, K.A., Moss, S. C., and Palmer, T.S., “An Experimental Determination of FIDLER Scanning Efficiency at Specific Speeds”. *Health Phys.*, 84(2):197-202.
- Hart, K. Duffy, W., Higley, K. Marianno, C., and Moss, C., “Predicting instrument detection efficiency when scanning point and small area radiation sources”, *Health Phys.*, 84(5):616-625.
- Marianno, C.M., Higley, K.A., and Hunter, D., "An Innovative Technique in Scanning Land Areas with a Multi-Fidler System." *Operational Radiation Safety*, Vol 80. No 5, May 2001, pps S77-79.
- Marianno, C.M., Higley, K.A., Palmer, T.S., Theoretical Efficiencies for a FIDLER Scanning Hot Particle Contamination. *Radiation Protection Management*. Vol 17, No. 3, pps 23 – 30.
- Povetko, O.G., Higley K.A., “Application of autoradiographic methods for contaminant distribution studies in soils.” *Journal of Radioanalytical and Nuclear Chemistry*, Vol 248, No. 3(2001) 561-564.
- Higley, K.A. and Marianno, C.M., "Making Engineering Education Fun" Jan 2001, ASEE *Journal of Engineering Education*, pps 105-107.
- Higley, K.A., “*Modeling Intermittent Processes in Radionuclide Migration in Soil Systems*” I. Linkov and W.R. Schell (ed’s), Contaminated Forests, Kluwer Academic Publishers. 1999. Printed in the Netherlands. pps 231-238.
- Higley, K.A., “Public Dose Assessment,” in *Applications of New Technology: External Dosimetry*, J.F. Higginbotham, Editor, Medical Physics Publishing, Madison, WI, p. 377-402, 1996.
- Brock Kathryn M., Neumann Catherine M., Higley Kathryn A., Chang Wushou P., Rossignol Annette M. “A Dose Reconstruction of <sup>60</sup>Co-Contaminated Window Frames in a Taiwanese School”. *Health Phys.*, 81(1):3-7; 2001.

## BIOGRAPHICAL SKETCH

<b>NAME</b> Charles W. Powers, Ph.D.	<b>POSITION TITLE</b> Professor of Environmental Engineering, Vanderbilt University Co-PI Consortium for Risk Evaluation with Stakeholder Participation (CRESP)		
<b>EDUCATION/TRAINING</b>			
<b>INSTITUTION AND LOCATION</b>	<b>DEGREE</b>	<b>YEAR(s)</b>	<b>FIELD OF STUDY</b>
Haverford College	B.A.	1963	Philosophy
Oxford University	Diploma.	1965	Theology
Union Theological Seminary	M. Div.	1966	Philosophy of Religion
Yale University	M.Ph..	1968	Ethics
Yale University	Ph.D.	1969	Ethics

### Professional Experience:

1969	Visiting Lecturer, Haverford College
1969-71	Assistant Professor of Social Ethics, Yale University
1972-75	Associate Professor of Social Ethics, Yale University
1975-80	Vice-President, Public Policy, Cummins Engine Company
1977-79	Executive Director of Public Policy/Chief Environmental Officer, Cummins Engine Company
1980-93	Founding Executive Director/Treasurer, then Member of Board of Directors, Health Effects Institute, Cambridge, MA
1984-98	President and Founding CEO, then member of Board of Directors, Clean Sites Incorporated (CSI), Alexandria, Virginia
1984-90	Board of Directors Health Effects Institute (HEI), Cambridge, Massachusetts
1988-89	Founder and Acting President, The Institute for Evaluating Health Risk, Irvine, California
1989-93	President, Resources for Responsible Site Management and Custodial Trustee, the Industriplex Superfund Site, Boston, MA.
1992-93	Adjunct Lecturer, Harvard University, Cambridge, MA
1993-2000	Principal Investigator, Cooperative Agreement with USEPA to Initiate EPA's Brownfields Pilot Program (Institute for Responsible Management, recipient institution)
1995-2006	Founder and Executive Director, the Consortium for Risk Evaluation with Stakeholder Participation, Piscataway, N.J. (a DOE Science and Technology, cooperative agreement)
1995-2006	Professor of Environmental and Community Medicine, Robert Wood Johnson Medical School, Piscataway, NJ.
1999-present	Chair, the New York/New Jersey Harbor Consortium, New York Academy of Sciences, NY, NY
2000-present	Principal Investigator, The Consortium for Risk Evaluation with Stakeholder Participation II, a Department of Energy grant, (IRM, New Brunswick, NJ, the recipient institution)
2006-presnt	Professor of Environmental Engineering, Vanderbilt University

### HONORS AND KEY PROFESSIONAL AFFILIATIONS:

- Committee for Economic Development and the Conservation Foundation, Advisory Committee on Energy Pricing (1979-81)
- Kennedy School of Government Harvard University, Institute of Politics Fellow, (1980)
- Rene Dubos Environmental Achievement Award (1991)
- Carnegie Commission on Science and Government, Member of the Advisory Council (1991-1995)
- The National Research Council, Group on Conflict of Interest, Government, University and Industry Roundtable (1993-1997)
- EPA's Environmental Quality Award as Chair to the New York Academy of Science's NY/NJ Harbor Consortium (2005)

### SELECTED PUBLICATIONS (1998-present):

Powers, C., Hoffman, F., Brown, D., and Conner, C. (2000) A Great Experiment: EPA Brownfields Pilots Catalyze Revitalization, New Brunswick.

Burger, J., Gochfeld, M., Powers, C., Waishwell., Warren, C., Goldstein, B. (2001) Science, policy, stakeholders and fish consumption advisories: Developing a fish fact sheet for the Savannah River. *Environmental Management*, 27 (4) 501-514. 2001

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