

## REVIEW SCOPE

### **CRESP Independent Review of Technical Concerns Regarding Groundwater Monitoring at the Sandia National Laboratories Mixed Waste Landfill**

#### **Review Scope**

DOE Office of Environmental Management (EM) has requested The Consortium for Risk Evaluation with Stakeholder Participation (CRESP) to carry out an independent review of technical concerns regarding the monitoring well system and resulting groundwater monitoring information for the Sandia National Laboratories Mixed Waste Landfill (SNL-MWL), as identified in the report “Defective Groundwater Protection Practices at the Sandia National Laboratories’ Mixed Waste Landfill-The Sandia MWL Dump” (Gilkeson and McCoy, 2011). The purpose of this review is to support the evaluation of the effectiveness of the implemented remediation actions and long-term monitoring as documented in the Corrective Measures Implementation Report (DOE/SNL, Jan. 2010) and the Long-Term Monitoring and Maintenance Plan (DOE/SNL, Sept. 2007). The SNL-MWL is an approximately 3 acre site that was used for disposal of a range of wastes in unlined trenches and pits over the period from 1959 to 1988. The specific technical questions to be addressed by this review in response to the technical concerns raised by the Gilkeson and McCoy report are:

1. Is the current conceptual model for evaluating potential contaminant migration from the SNL-MWL appropriate and consistent with the current scientific understanding of water flow and contaminant migration, for the purposes of supporting evaluation of the effectiveness of the implemented remediation actions and long-term monitoring?
2. Are the locations and screen depth of installed monitoring wells appropriate and sufficient for evaluating water flow and potential contaminant migration for the purposes of supporting evaluation of the effectiveness of the implemented remediation actions and long-term monitoring ?
3. Are the monitoring well installation and construction methods and materials appropriate and sufficient for evaluating water flow and potential contaminant migration for the purposes of supporting evaluation of the effectiveness of the implemented remediation actions and long-term monitoring?
4. Are the proposed sampling and analysis methods appropriate for the purposes of evaluating the effectiveness of the implemented remediation actions and long-term monitoring?
5. How should currently available results of groundwater elevation and groundwater contaminant analysis be used for evaluation of the effectiveness of the implemented remediation actions and long-term monitoring ?

This review will be focused solely on the technical issues and sufficiency of the technical understanding of water flow and contaminant migration (including potential vapor phase migration through the vadose zone) as identified above, for the intended use of supporting evaluation of the effectiveness of the implemented remediation actions and long-term monitoring. Historical information that has direct

relevance on the adequacy of the current monitoring will be considered as part of this review. This review will not address specific issues of regulatory compliance, or prior regulatory decisions.

The review will be carried out with an initial public open meeting in Albuquerque, NM for the CRESPP team to describe the scope of the review, receive background information from the New Mexico Environment Department, DOE, the report authors, and the public. The CRESPP review team will review the report by Gilkeson and McCoy (2011) and other supporting and related information the CRESPP review team considers necessary to address the technical merits of the review focus. The outcome will be a single consensus report without any dissenting views indicated separately; however, differing perspectives will be included when needed to reflect the breadth of the committee's views. Sources of information used to develop the review will be included as a list of references. A final draft of the report will be provided to DOE, the New Mexico Environment Department and Concerned Citizens for Nuclear Safety (J. Arends on behalf of Gilkeson and McCoy) for factual accuracy review only prior to issuing the final report. Once the final report is issued, the CRESPP review team chair will provide a briefing of the review report in an open public meeting for the New Mexico Environment Department, DOE, the report authors and the public.

DOE and the New Mexico Environment Department will each designate a liaison for the purposes of communicating with the review team and providing additional requested information. Requests from the committee for additional information will be distributed electronically to DOE, NMED and Concerned Citizens for Nuclear Safety.

**Schedule** (to be determined based on updated availability of committee members)

Initiate review of Gilkeson and McCoy (2011) and background information	xxxx 2011
Meeting in Albuquerque, NM for CRESPP team to receive background briefing and information	xxxx 2011
Factual Accuracy Review draft report	xxxx 2011
Final Report issued	xxxx 2011
CRESPP Chair briefing of the review report in Albuquerque, NM	xxxx 2011

**CRESPP Review Team**

George Hornberger, Chair, Michael Barcelona, Craig Benson, James Clarke, Shlomo Neuman, Dan Stephens, and Jon Chorover.

**Team Biographies**

**George Hornberger, Ph.D., NAE**

George Hornberger is Distinguished University Professor at Vanderbilt University where he holds appointments as the Craig E. Philip Professor of Civil & Environmental Engineering and Professor of Earth & Environmental Sciences. Professor Hornberger is the Director of the Vanderbilt Institute for

Energy and Environment which fosters research, teaching and outreach on social, economic, legal, and technical aspects of critical issues at the energy-environment intersection. He previously for many years was a member of the faculty at the University of Virginia, where he held the Ernest H. Ern Chair in Environmental Sciences. He received a Ph.D. in Hydrology from Stanford University in 1970. In addition to interdisciplinary research underway through VIEE, he continues his longstanding research on the transport of dissolved and suspended constituents through soils, groundwater, and catchments. Hornberger is a Fellow of the American Geophysical Union, of the Association for Women in Science, and of the Geological Society of America. He is a recipient of the Robert E. Horton Award of the Hydrology Section of AGU, the Biennial Medal for Natural Systems of the Modelling and Simulation Society of Australia, the John Wesley Powell Award for Citizen's Achievement from the USGS, the Excellence in Geophysical Education Award from AGU, and the William Kaula Award from AGU. He was the 2002 Langbein Lecturer of the American Geophysical Union. He was selected as Outstanding Scientist in Virginia in 2007. He is a member of the U.S. National Academy of Engineering.

**Michael J. Barcelona, Ph.D.**

Dr. Michael Barcelona received a Ph.D. in Marine Chemistry at the University of Puerto Rico-Mayaguez in 1977. He then completed a National Institute for Environmental Health Sciences Postdoctoral Fellowship with Dr. James J. Morgan in Environmental Engineering Sciences at the California Institute of Technology. He then accepted a position at the Illinois State Water Survey – University of Illinois conducting research in ground water and hazardous chemical waste evaluation and management. Much of this work was incorporated into federal and state ground water sampling and monitoring guidance in the federal RCRA and CERCLA (Superfund) programs. In 1984-1985, he served as the founding Director of the Illinois Hazardous Waste Research and Information Center now the Illinois Sustainable Technology Center. In 1989, he accepted a tenured professorship at Western Michigan University where he directed the Institute for Water Sciences and expanded his research efforts to develop ground water remediation approaches. In 1994, Dr. Barcelona became a Research Scientist in Environmental and Water Resources Engineering at the University of Michigan and directed the National Center for Integrated Bioremediation Research and Development with the Department of Defense and U.S. EPA support. He returned to WMU in 2001 as Professor and later Chair of the Chemistry Department (2002-2007) where he continues to teach and conduct research. Overall, he has authored or co-authored more than 100 papers, book chapters, and reports, and served as editor of Ground Water Monitoring and Remediation from 1992-2002. He currently serves on the editorial board as an associate editor for that publication.

**Craig H. Benson, Ph.D., PE, DGE**

Craig H. Benson, PhD, PE, DGE is Wisconsin Distinguished Professor and Chair of Geological Engineering at the University of Wisconsin-Madison. He also serves as Director of the Recycled Materials Resource Center (RMRC), a federally funded research center focused on sustainable construction of transportation infrastructure, and the Bioreactor Partnership, a industry-academic partnership on sustainable solid waste management. He is a member of the Management Board of the Consortium for Risk Evaluation with Stakeholder Participation (CRESP). Dr. Benson has a BS from Lehigh University and MSE and PhD degrees from the University of Texas at Austin. Dr. Benson has been conducting experimental and analytical research in geoenvironmental engineering for 27 yr, with the primary focus in environmental containment, beneficial use of industrial byproducts, and sustainable infrastructure. His research has included laboratory studies, large-scale field experiments, and computer modeling. Dr. Benson has received several awards for his work, including the Huber Research Prize, the Alfred Nobel Prize, and the Croes (twice), Middlebrooks, Collingwood, and Casagrande Awards from the American

Society of Civil Engineers. Dr. Benson is a member of the ASCE Geo-Institute (GI) and is former Editor-in-Chief of the ASCE/GI *Journal of Geotechnical and Geoenvironmental Engineering*. He currently serves as Treasurer for the ASCE/GI Board of Governors and is a member of the Executive Committee of ASTM Committee D18 on Soil and Rock. Dr. Benson is a member of the University of Texas Academy of Distinguished Alumni.

#### **Jon Chorover, Ph.D.**

Dr. Jon Chorover received a Ph.D. in Soil Chemistry at University of California, Berkeley (1993) and then completed an NSF International Postdoctoral Fellowship in the Department of Analytical Chemistry at University of Geneva, Switzerland (1994-1995). He was appointed Assistant and then Associate Professor of Environmental Soil Chemistry at the Pennsylvania State University (1995-2001) before moving to the Department of Soil, Water and Environmental Science at the University of Arizona in 2001, where he is Professor of Environmental Chemistry. He is current chair of the Soil Chemistry Division of the International Union of Soil Sciences, and is actively involved in interdisciplinary and international working groups in environmental and earth sciences. Dr. Chorover has authored over 90 peer reviewed journal articles and book chapters.

At Arizona, Dr. Chorover maintains an active research and teaching program focusing on soil and water chemistry and biogeochemistry, using novel experimental approaches and state-of-the-art tools in analytical chemistry to understand how mineral-organic interactions influence the weathering of soils and the speciation of pollutants. He is Co-Director of a core analytical chemistry facility, the *Arizona Laboratory for Emerging Contaminants* (<http://www.alec.arizona.edu/>), which he created with National Science Foundation (NSF) and State of Arizona funding. Dr. Chorover is also lead PI of the UA-led Jemez River Basin – Santa Catalina Mountains Critical Zone Observatory (<http://www.czo.arizona.edu/>). This observatory, funded by NSF for five years (9/09-9/14) at \$4.35M, brings together a diverse group of faculty from five units at UA and several partner institutions to study coupled physical, chemical and biological processes operating in the Earth's near surface environment. In addition to NSF funding, Dr. Chorover's research program is supported by the National Institute for Environmental Health Sciences, the Department of Energy, the Water Research Foundation, and the U.S. Department of Agriculture. He serves as an editor for the journals *Environmental Chemistry*, *Geoderma*, and *Geochimica et Cosmochimica Acta*.

#### **James H. Clarke, Ph.D.**

Dr. Jim Clarke is Professor of the Practice of Civil & Environmental Engineering, Professor of Earth & Environmental Sciences and Director of Graduate Studies for graduate degree options in environmental engineering, environmental science and environmental management at Vanderbilt University.

His research interests include risk analysis and risk-informed regulation, investigation, remediation and long term management of legacy chemical and radioactive waste sites and assessment of the risks and environmental impacts of conventional and emerging energy technologies and approaches. Prior to joining Vanderbilt University, Jim spent 25 years in private practice leading a nationally known consulting and engineering firm specializing in the investigation and remediation of contaminated sites, risk analysis and industrial wastewater treatment.

Dr. Clarke is a consultant to the Nuclear Regulatory Commission (NRC) Advisory Committee on Reactor Safeguards and was a member of their former Advisory Committee on Nuclear Wastes and Materials where he was the lead member for decommissioning and risk-informed regulation.

Dr. Clarke received a BA in Chemistry with honors from Rockford College and a PhD in Theoretical Chemistry from The Johns Hopkins University.

### **Shlomo P. Neuman, Ph.D., NAE**

Shlomo P. Neuman is Regents' Professor of Hydrology and Water Resources at the University of Arizona in Tucson. Dr. Neuman's research has spanned the development and application of hydraulic and pneumatic field tests for the characterization of aquifer, aquitards and fractured rock hydrologic properties; geostatistical methods for multiscale spatial analyses of hydrologic data; development and application of stochastic methods to describe mathematically fluid flow and solute transport when soil and rock properties vary randomly in space, and with scale; development of computational algorithms and computer programs to predict subsurface flow, and solute concentrations, under uncertainty, and to assess the associated prediction errors; estimation of flow and transport model parameters under uncertainty; and use of such computational models to help assess subsurface contamination, identify contaminant sources, design groundwater monitoring networks, and aid the design of remedial operations. Professor Neuman has summarized his scientific contributions in over 310 professional papers, books and reports. His name appears on two ISI lists of Highly Cited Researchers, one in Engineering and one in Environmental Science. Professor Neuman is a member of the U.S. National Academy of Engineering; Fellow of the American Geophysical Union, the Geological Society of America, and the Galileo Circle of the U of A College of Science; Concurrent Professor of Nanjing University in China; and Honorary Professor of the Nanjing Hydraulic Research Institute in China. Professor Neuman has received numerous awards and honors including the Robert E. Horton Medal and the Hydrology Award from the American Geophysical Union, the O.E. Meinzer Award from the Geological Society of America, the M.K. Hubbert Award from the Association of Groundwater Scientists and Engineers, the C.V. Theis Award from the American Institute of Hydrology, and a certificate of appreciation by the U.S. Department of Agriculture. He has been named Birdsall Distinguished Lecturer by the Geological Society of America, and fourth Langbein Lecturer in Hydrology by the American Geophysical Union. Over 34 doctoral students and 26 master students have completed their degrees under Professor Neuman's supervision at the U of A by 2009, many of whom have gone on to hold prominent positions in academia, government and industry. In 1998 and 2008, Professor Neuman's students and colleagues had organized international symposia in Tucson to honor his 60<sup>th</sup> and 70<sup>th</sup> birthdays, one of which resulted in a published Geological Society of America Memoir. An Autobiography of Professor Neuman has been published by the journal *Ground Water* in 2008, and a taped interview has been prepared for The Hydrogeologist Time Capsule at <http://timecapsule.ecodev.ch/video.html>.

### **Daniel B. Stephens, Ph.D.**

Daniel B. Stephens, Ph.D. is Principal Hydrologist and Chairman of the Board of Daniel B. Stephens & Associates, Inc., a firm of over 110 employees providing hydrology and engineering services with offices in New Mexico, Texas, and California. Dr. Stephens received his Ph.D. in Hydrology from the University of Arizona in 1979; his M.S. in Hydrology from Stanford University in 1974; and his B.S. in Geological Science (with honors) at Pennsylvania State University in 1971. Dr. Stephens, formerly Chairman of the Geoscience Department at New Mexico Institute of Mining and Technology (NMIIT) in Socorro, New Mexico, began private consulting in 1976 and founded Daniel B. Stephens & Associates, Inc. (DBS&A) in

1984. Dr. Stephens also is an adjunct professor of geology at the University of New Mexico in Albuquerque, and an adjunct professor of hydrology at NMIMT.

Dr. Stephens, an internationally recognized hydrogeologist specializing in vadose zone processes, has been a technical director of hundreds of environmental and hydrogeological consulting projects at dozens of sites, including mines, mills, manufacturing facilities, electronics industries, as well as petroleum producers and refineries. He served on DOE review panels at Hanford, Yucca Mountain, Los Alamos National Laboratory, and Fernald. Dr. Stephens has also served as Executive Committee Chairman for the National Roadmap for Vadose Zone Science and Technology, Idaho National Engineering and Environmental Laboratory. He has published extensively in peer-reviewed professional journals and given over 100 presentations and articles in symposia proceedings. He is the author of *Vadose Zone Hydrology*, a widely used text that blends theoretical and practical aspects of hydrology.