APPENDIX G

THE EVALUATION AND SCREENING TEAM

G-1. Introduction

The DOE-NE Office of Fuel Cycle Technologies has conducted an evaluation and screening of nuclear fuel cycle options, as documented in this report. The Charter for this activity, the Nuclear Fuel Cycle Evaluation and Screening, was approved and signed by DOE NE-1 on December 15, 2011.[G1] The Charter called for the establishment of an Evaluation and Screening Team (EST) to conduct the evaluation and screening activities, and stated that the EST was to be approved by the DOE-NE Deputy Assistant Secretary for Fuel Cycle Technologies (DOE NE-5). The purpose of this document is to describe the required qualification, management, and responsibilities of the EST, along with the names of members of the EST approved by DOE NE-5. The resumes of the EST members are listed in Section G-2.

DOE also established an Independent Review Team, described in Appendix H, to provide an ongoing review of the conduct of the Nuclear Fuel Cycle Evaluation and Screening throughout the process.

G-2. Evaluation and Screening Team

The EST was required to be a group of fuel cycle experts who are well-versed in all aspects of the nuclear fuel cycle and have substantial background in fuel cycle analysis, or in one or more aspects of the fuel cycle and issues related to nuclear power. EST members needed to have extensive and thorough fuel cycle knowledge, and most importantly, objectivity, both the ability to be objective and also having the reputation of being objective. Since there were subjective aspects to fuel cycle evaluation and screening, it was essential that the team members be compatible in the expected group working environment to both facilitate open discussion and prevent personality conflicts. The EST was also ultimately responsible for the entire conduct of the Nuclear Fuel Cycle Evaluation and Screening, as described below.

The team leader and the alternate team leader listed below managed the EST and activities. The team leader and alternate team leader were responsible for:

- Team direction
- Leading the conduct of the evaluation and screening activity
- Coordination of team activities with other parts of the Fuel Cycle Options campaign, other FCR&D campaigns, and groups external to FCR&D
- Organizing and conducting team meetings
- Coordination of report creation and submittal.

The EST participated in, and provided input to, all aspects of the development and conduct of the Nuclear Fuel Cycle Evaluation and Screening, particularly with the following specific activities conducted by the Fuel Cycle Options campaign.

Evaluation Criteria and Metrics

The Charter for the Nuclear Fuel Cycle Evaluation and Screening specified the nine high-level Evaluation Criteria and directed the development of appropriate Evaluation Metrics for each criterion: [G1]

1. Review of the initial proposed metrics from other FCR&D campaigns
2. Proposal of modifications to the metrics as needed to result in evaluation metrics that are relevant and suitable for comparative analysis of fuel cycle options
3. Development of metrics as needed to represent fuel cycle characteristics relevant to overall nuclear energy system performance
4. Engage in the development of consensus metrics with the other FCR&D campaigns, other groups within DOE, and other stakeholders including universities and industry

5. Contribute to development of metrics by the Fuel Cycle Options campaign
6. Contribute to development of the metric sensitivity function for converting changes in the value of a metric into a "score", incorporating the metric sensitivity factor
7. Creation of the final set of Evaluation Metrics for approval by NE-5 as specified in the charter.

Nuclear Fuel Cycle Options

The Charter for the Nuclear Fuel Cycle Evaluation and Screening directed the development of a set of fuel cycle options that must be as comprehensive as possible with respect to the potential performance of fuel cycle options: [G1]

1. Creation of the fuel cycle options list that is credibly comprehensive with respect to potential fuel cycle performance
2. Creation of the fuel cycle grouping approach
3. Identification of a fuel cycle option to be an Analysis Example for each fuel cycle group for the purpose of providing quantitative analysis results on fuel cycle performance to allow creation of the metric data for those metrics that depend on such information.

G-2.1 EST Responsibilities

The EST was responsible for the following activities in conducting the fuel cycle evaluation and screening:

1. Determination of the metric data for each Evaluation Group of fuel cycle options
2. Development of one or more factors for each metric that express the value of a change in the metric
3. Development of one or more sets of trade-off factors for the relative weighting of metrics for the high-level evaluation criteria that have more than one metric
4. Development of one or more sets of trade-off factors for the relative weighting of the high-level evaluation criteria when multiple criteria are considered simultaneously
5. Execution of an evaluation and screening of the Evaluation Groups of fuel cycle options for the purpose of determining a set of ordered lists based on one or more sets of relative weighting factors for the high-level evaluation criteria
6. Identification of R&D needs and assessment of viability, including development time and cost.

The EST was also responsible for conducting or supporting briefings on its activities to DOE NE-5/NE-51 management and external stakeholders as needed.

G-2.2 EST Members and Areas of Expertise / Background

Team Leader

- Roald Wigeland (INL; fuel cycles, reactors, safety, proliferation risk)

Alternate Team Leader

- Temitope Taiwo (ANL; fuel cycles, reactors & EDS, thorium)

Team Members

- Michael Todosow (BNL; fuels, fuel cycles, reactors & EDS, safety, thorium)
- Hans Ludewig (deceased 10/30/13, BNL; fuel cycles, reactors & EDS, safety, NRC regulation)

- William Halsey (retired from LLNL; fuel cycles, reactors & EDS, disposal, economics)
- Jess Gehin (ORNL; fuel cycles, reactors, thorium, economics)
- Robert Jubin (ORNL; separations, waste forms, environmental impact)
- James Buelt (retired from PNNL; fuel cycles, waste management)
- Siegfried Stockinger (DOE-NV; front-end, waste, environmental impact)
- Karen Jenni (Insight Decisions LLC; decision analysis)
- Brian Oakley (Scully Capital; financial services)

The resumes for each member of the EST are provided in Attachment 1 of this Appendix, in the order listed here.

References

G1. C*harter for the Evaluation and Screening of Fuel Cycle Options*, DOE Office of Nuclear Energy, December 15, 2011. (Provided in Appendix A, Attachment 1.)

ATTACHMENT 1

EVALUATION AND SCREENING TEAM

Roald A. Wigeland, Ph.D.

Nuclear Science & Technology
Idaho National Laboratory

Professional Experience

Idaho National Laboratory

Manager, Advanced Nuclear Energy Systems Integration 2/07 – present

- National Technical Director, Fuel Cycle Options – Systems Analysis and Integration campaign in the DOE Fuel Cycle Research & Development (FCR&D) program, beginning 5/11, responsible for nuclear fuel cycle evaluation and screening, FCR&D program integration, and planning for analyses supporting development of "most promising" nuclear fuel cycles in the FCR&D program.
- Led the multi-laboratory nuclear fuel cycle options study that examined the potential for alternative nuclear fuel cycles to address and resolve the issues with nuclear power to inform the U.S. DOE and other policy makers for planning future nuclear energy R&D. Participated in an OECD/NEA project on the benefits of partitioning and transmutation to nuclear waste management.
- Led and participated in proliferation risk assessments of advanced technologies, including defining the process of safeguards-by-design as part of the effort by the U.S. DOE National Nuclear Security Administration to develop the next generation of safeguards, studies on the use of thorium, and proliferation risk assessments of advanced separations technologies and advanced reactors.
- Managed and conducted research on the safety of sodium-cooled fast neutron reactors, including development of an overall safety approach using active, passive, and inherent safety features; analysis of advanced design features; evaluation of inherent safety concepts; and analysis of accident sequences for both design-basis accidents and beyond-design-basis accidents, including the effect of fuel properties on accident consequences. Participated in assessments of current technology gaps for safety phenomena and analysis tools to identify areas requiring R&D. Member of the ANS Standards Committee developing the new safety standard for sodium-cooled fast reactors. U.S. member of the GenIV task force on sodium-cooled fast reactor safety design criteria.
- Provided the main technical analysis on fuel cycle performance for the Programmatic Environmental Impact Statement for the Global Nuclear Energy Partnership program, and provided technical analysis and support for the Non-Proliferation Impact Assessment of the Global Nuclear Energy Partnership program, being developed by the U.S. DOE National Nuclear Security Administration, including assessment of proliferation risk for spent nuclear fuel reprocessing technologies and nuclear reactors

Argonne National Laboratory

Manager, Engineering Analysis Department 11/04 – 2/07

- Managed the department with 4 sections and 25-30 scientific and engineering staff, conducting research and engineering activities in fast neutron reactor safety (computer code development and analyses), advanced nuclear reactor system design (simulation and analyses), structural and seismic analyses, proliferation risk (methodology development and assessment), computational fluid dynamics (code development and applications), geologic repository performance (model development and analyses), digital signal processing (signal validation concepts and applications), nuclear reactor control (methods and applications), fuel cells (modeling and analyses), and hydrogen storage.
- Conducted research and analyses on the benefits of reprocessing and recycling spent nuclear fuel on geologic repository performance including utilization of repository space and reduction in dose rate, licensing and safety analyses for fast neutron reactors including the impact of fuel types and design choices, proliferation risk reduction assessments for advanced nuclear fuel processing, development of approaches and needs for the advanced simulation initiative, conceptual designs of advanced fuel reprocessing plants, design of advanced fuel processing equipment, material control and accountability for nuclear fuel processing, development of a computerized mass tracking system for spent nuclear fuel processing, and reviewing and evaluating advanced processing concepts

Manager, Fuel Cycle Modeling Section 9/01 – 11/04

- Managed a section with 6-8 scientific staff conducting research and engineering activities in geologic repository performance (model development and analyses), waste form degradation and radioactive release modeling, proliferation risk analyses, and material control and accountability for nuclear fuel processing

Roald A. Wigeland – Page 2

- Technical lead for MC&A support for the processing of EBR-II spent fuel in FCF at ANL/W, technical lead for development of the computerized mass tracking system for FCF, technical lead for repository performance assessment in the Spent Fuel Treatment Program, project manager for advanced centrifugal contactor design
- Developed and conducted the program that quantified the benefits to a geologic repository from the processing of spent nuclear fuel and the recycling of actinides in nuclear reactors

Manager, Modeling and Analysis Section 3/99 – 9/01

- Managed a section of 6-8 scientific staff developing the computerized mass tracking system for the ongoing processing of EBR-II spent fuel in FCF at ANL/W, supporting the material control and accountability of special nuclear materials associated with these activities, developing models for process steps where measurements are not possible, and developing models of waste form performance in a geologic repository
- Technical lead for MC&A support, conducting research and development of process models, analyzing material balances for special nuclear materials, and resolving problems with inventory difference
- Conducted analyses with computational fluid dynamics of contaminant dispersion (radiological, chemical, or biological agents in subways) and natural circulation and freezing phenomena for low level radioactive waste production (sodium treatment at ANL/W)

Manager, Fuel Process Modeling Section 6/95 – 9/01

- Managed a section of 5-6 scientific and engineering staff analyzing the performance of equipment used in the pyroprocessing of EBR-II spent nuclear fuel, including the electrorefiner, cathode processor, and casting furnace, and development of a relational database for electrorefining experience
- Conducted research on the fundamentals of electrorefining (flow, mass transport, and electrodeposition), cadmium vapor transport and deposition, and induction heating to analyze and resolve operational difficulties and to lead to the design of improved processing equipment

Group Leader, Safety Analysis 9/91 – 6/95

- Managed a group of 3-5 scientific and engineering staff performing safety analyses of fast and thermal neutron reactors, including sodium-cooled, water-cooled, and gas-cooled systems
- Conducted research into the relative safety merits of metallic and oxide fuels for fast neutron reactors in severe accident conditions, demonstrating the superior performance of metallic fuels
- Supported the GE PRISM reactor project by providing safety analyses of severe accidents, and assisting the development of similar analysis capabilities within GE

Engineer, Model & Code Development 2/82 – 9/91

- Conducted research on the safety of fast and thermal neutron reactors (liquid metal fast reactors, heavy water reactors, light water reactors and gas-cooled reactors), including development of passive safety principles to avoid core damage in response to severe accident initiators
- Development and validation of computer models of reactivity feedback in fast neutron reactors to support the development of passive safety concepts, including radial core expansion feedback, leading to the development of design recommendations for sodium-cooled fast reactors
- Conducted studies with French, German, British, and Japanese researchers on the relative safety merits of metallic and oxide fuels
- Conducted safety analyses in support of both the GE PRISM project and the RI SAFR project as part of the DOE Advanced Liquid Metal Reactor program

Mechanical Engineer, Nuclear Fuel Cycle 1/81 – 2/82

- Analyzed behavior of centrifugal contactors for processing of spent nuclear fuel to identify the causes of intermittent or unacceptable operation and to develop the basic understanding of contactor operation
- Developed design changes for the centrifugal contactor to resolve the operational difficulties, resulting in a contactor design that can provide stable operation over extremely wide ranges of flow and fluid compositions

Roald A. Wigeland – Page 3

Illinois Institute of Technology

Visiting Assistant Professor, Mechanical Engineering 9/78 – 9/80

- Conducted and supervised research on a variety of experimental fluid mechanics projects, including turbulence (fundamental behavior of turbulence for many flow configurations), and atmospheric boundary layers (effects on dispersion and local environments)
- Developed specialized instrumentation for the experiments, designed and constructed experimental facilities, developed flow visualization techniques, developed analog and digital data acquisition and signal processing techniques, and developed new methods for the statistical analysis of turbulence data

Education

Ph.D. Mechanical and Aerospace Engineering, Illinois Institute of Technology, 1978
M.S. Mechanical and Aerospace Engineering, Illinois Institute of Technology, 1974
B.S. Mechanical Engineering, Valparaiso University, 1972
B.A. Chemistry, Valparaiso University, 1972

Selected Recent Publications

R.A. Wigeland and J.E. Cahalan, "Inherent Prevention and Mitigation of Severe-Accident Consequences in Sodium-Cooled Fast Reactors," Journal of Nuclear Science and Technology, FR'09 Special Issue, Vol. 48, No. 4, April 2011

R.A. Wigeland, W. Halsey, T. Taiwo, M. Todosow, J. Gehin, "Relationship Between Geologic Disposal Characteristics and Advanced Nuclear Fuel Cycles with Partitioning and Transmutation," Proceedings of the 11th Information Exchange Meeting on Actinide and Fission Product Partitioning and Transmutation (IEMPT), San Francisco, CA, November 1-4, 2010

R.A. Wigeland, T.A. Taiwo, M. Todosow, W. Halsey, and J. Gehin, "Options Study – Phase II," FCRD-TIO-2010-000167, Idaho National Laboratory, September 30, 2010.

R.A. Wigeland and J.E. Cahalan, "Fast Reactor Fuel Type and Reactor Safety Performance," Proceedings of Global 2009, Paris, France, September 6-11, 2009

R.A. Wigeland, T.A. Taiwo, M. Todosow, W. Halsey, and J. Gehin, "AFCI Options Study," FCRD-TIO-PMO-MI-DV-2009-000086, Idaho National Laboratory, September 30, 2009.

R.A. Wigeland, T.H. Bauer, R.N. Hill, and J.A. Stillman, "Impact on Geologic Repository Usage from Limited Actinide Recycle in Pressurized Light Water Reactors," Journal of Nuclear Science and Technology, Vol. 44, No. 3, pp. 415-422, 2007

R.A. Wigeland, E.E. Morris, and T.H. Bauer, "Criteria Derived for Geologic Disposal Concepts," Proceedings of the 9th OECD/NEA Information Exchange Meeting on Actinide and Fission Product Partitioning &Transmutation, September 28, 2006, Nimes, France

T.A. Todd and R.A. Wigeland, "Advanced Separations Technologies for Processing Spent Nuclear Fuel and the Potential Benefits to a Geologic Repository," Separations for the Nuclear Fuel Cycle in the 21st Century, p. 41, American Chemical Society, June 2006

TEMITOPE A. TAIWO, Ph.D.
Argonne National Laboratory

Educational Background

- Ph.D. Nuclear Engineering, Massachusetts Institute of Technology, Cambridge, U.S., 1985.
- B. Sc. Engineering Physics (Nuclear Option), University of Ife, Ile-Ife, Nigeria, 1980.

Professional Experience

July 1, 2010 – Present: Department Manager, Nuclear Systems Analysis, Nuclear Engineering Division, Argonne National Laboratory

- Provides technical direction and supervises technical activities of Department staff members; coordinate activities with external organizations.
- Administers Department in coordination with other departments and Laboratory Divisions.
- Maintains active involvement in execution and oversight of sponsored research; performs technical research and studies in advanced reactors and fuel cycle systems and communicates technical results to national and international research community.
- Currently, the Co-National Technical Director for the Fuel Cycle Options Campaign of the USDOE Office of Nuclear Energy, Fuel Cycle Technologies Program.

1990-1995, 1996-Present: Technical Staff Nuclear Engineer, Group Leader, and Section Manager Argonne National Laboratory

- Supervised the activities of researchers in the design and analysis of nuclear fission systems, fuel cycle, and waste management systems. Provided technical leadership; set assignments and priorities for researchers; performed administrative functions of line management.
- Performed scientific research in the field of nuclear technology.
- Served as Leader or Work Package Manager for various national and international projects supporting the USDOE advanced fuel cycle and advanced reactor programs.
- Reactor physics analyst and designer of conventional and advanced reactor systems; performed analysis of various reactor types, including U.S. and foreign fast and thermal reactors, material production reactors and fuel cycles.
- Developed advanced computer code DIF3D-K for the analysis of neutron kinetics in reactor cores. Also developed the PRPREB code for generating and executing the core loading and performance of EBR-II run cycles.
- Contributed to numerous technical papers for journals and international conferences, and laboratory reports.

1995-1996: U.S. Government – Analyst for Nuclear Security and Non-Proliferation
Performed assessments of international nuclear security and non-proliferation issues. Supported interagency interactions with USDOC, USDOS, USDOD and NSC on issues related to nuclear non-proliferation and counter-proliferation.

1985-1989: Northeast Utilities (NU) – Nuclear Reactor Analyst
Developed nuclear analysis computer models and methods in support of Light-Water-Reactor (LWR) core reloads. Designed reload cycles for the Connecticut Yankee Power Plant using vendor (Westinghouse) codes. Contributed to NU Reload Methodology Topical Reports submitted to the USNRC. Served as independent reviewer of core design analysis for NU nuclear power reactors, and technical reviewer of code documentation and quality control.

Temi A. Taiwo – Page 2

Professional Society Activities

- Member, American Nuclear Society (ANS)
- Alpha Nu Sigma (Nuclear Engineering Honors Society).
- Sigma Xi (Student).

National/International Committees

- Program Committee Member for various international reactor physics and nuclear engineering conferences.
- U.S. representative on the OECD/NEA Working Party on Scientific Issues of Reactor Systems; contributes to various technical Task Forces and Working Groups.
- Member of various American Nuclear Society Committees.
- Technical reviewer of international nuclear journal articles.
- Co-Dean, Modeling, Evaluation, and Validation School.

Awards and Honors

- Argonne National Laboratory, Pacesetter Awards in 2000 and 2009.
- Received various USDOE Office of Nuclear Energy Letters of Commendation and Appreciation in support of programmatic activities.
- ANS Reactor Physics Division Best Paper Awards in 2004 and 2010.
- Best Nuclear Engineering Paper at the ICONE-8, Baltimore, MD, April 2000.
- First Class Honor, University of Ife, 1980 Class. (Also, Best Student Prize, Faculty of Science, and Best Student Prize, Engineering Physics Program (Nuclear Option)).

NAME: MICHAEL TODOSOW **TITLE: SR. NUCLEAR ENGINEER**

CONTACT INFORMATION: (631) 344-2445; todosowm@bnl.gov

FIELD OF EXPERTISE:

- Nuclear Science and Engineering: Particle Transport, Reactor Physics and Core Design, Criticality Safety, Analysis of Advanced Reactors and Accelerator-Driven Systems, Computational Methods
- Applied Mathematics: Numerical Analysis

EDUCATION:

Ph.D., Nuclear Engineering, Massachusetts Institute of Technology, 1977
M.S., Nuclear Engineering, Columbia University School of Engineering, 1970
B.S., Nuclear Engineering, Columbia University School of Engineering, 1969

PROFESSIONAL EXPERIENCE:

1977-Present: Nuclear Science and Technology Department, Brookhaven National Laboratory

Major technical and management responsibilities have included: Head of the Nuclear Science and Technology Division and manager for DOE-NE programs in advanced reactors and fuel cycles (Advanced Fuel Cycle Initiative/Fuel Cycle R&D, Generation-IV, GNEP, FCRD, and Space Reactor Technology Development); program manager for several RD&D projects under the Initiatives for Proliferation Prevention (IPP) program. Technical activities include design and assessment of advanced/innovative nuclear reactor and accelerator-driven concepts and fuel cycles, including thorium-based fuels and fuel cycles, and space applications. Also involved in the development of accelerator-based concepts for Homeland Security and medical applications.

Additional activities have included: serving on the Initial Screening Evaluation Panel for Fuel Cycle Options, DOE White Paper on accelerator-driven systems, and the Spent Fuel, and Pu Vulnerability Assessment Groups in criticality safety; the nuclear design of particle bed reactors for space applications in the Space Nuclear Thermal Propulsion program, and nuclear waste burning; analyses in support of the operation of the High Flux Beam Reactor and Medical Research Reactor, including criticality safety and design of a fission converter system for boron neutron capture therapy; technical consulting to the U.S. Nuclear Regulatory Commission on reactor physics and neutron transport problems, including performing assessments of spent fuel storage rack designs, pressure vessel damage fluence calculations, and review of licensee reload and topical report submittals on nuclear analyses; review of experience on metallic fuel for USNRC.

Participated in several DOE/NE planning groups, including long-term R&D and TOPS for NERAC; Member of Steering Committee which managed Roadmap for Accelerator Transmutation of Waste (ATW) in FY99; Member of BNL Reactor Safety Committee overseeing safe operation of on-site reactors (1985-2000); Extensive technical interactions with the Former Soviet Union in space nuclear power, nuclear design/safety, etc. Fluent in Russian and Ukrainian.

1970-1972: Combustion Engineering, Nuclear Engineer

Extensive experience in fuel management, core design and safety related neutronics calculations.

Michael Todosow – Page 2

PROFESSIONAL SOCIETY ACTIVITIES AND AWARDS

Fellow of American Nuclear Society (ANS).
Member Reactor Physics Executive and Program Committees of ANS.
Member of Technical Program Committees for several international meetings related to nuclear energy.
Member Tau Beta Pi, Engineering Honor Society.
Atomic Energy Commission Fellowship

SELECTED PUBLICATIONS:

Author/coauthor of numerous technical papers, reports, etc., including:

Michael Todosow and Gilad Raitses, *"Thorium Based Fuel Cycle Options for PWRs"*, Proceedings of ICAPP '10, Paper 10305, San Diego, CA, USA, June 13-17, 2010

Michael Todosow, Alexei Morozov, and Alexander Galperin, *"Heterogeneous Assembly Design For Utilization Of Thorium In VVER Reactors"*, Advances in Nuclear Fuel Management IV (ANFM 2009) Hilton Head Island, South Carolina, USA, April 12-15, 2009.

Todosow, M., Galperin, A., Herring, S., Kazimi, M., Downar, T., and Morozov, A., *"Use of Thorium in Light-Water Reactors"*, Nuclear Technology, v. 151 n2, August 2005, pp. 168-176.

Todosow, M., Kazimi, M., *"Optimization of Heterogeneous Utilization of Thorium in PWRs to Enhance Proliferation Resistance and Reduce Waste"*, BNL-73152-2004/MIT-NFC-065, August 2004.

M. Todosow, A. Galperin, G. Raitses, *"A Thorium-Based Fuel Cycle for Eliminating the Discharge of Trans-Uranium Isotopes from Light Water Reactors"*, GLOBAL-2003,176-183, November 2003.

H. Ludewig, M. Todosow, N. Simos, S. Shapiro, and J. Hastings, *"Very High Flux Steady State Reactor and Accelerator based Sources"*, ICONE-12- 49442, Arlington, VA., (April 2004).

H. Ludewig, J. Powell, M. Todosow, G. Maise, R. Barletta, D. Schweitzer, *"Design of Particle Bed Reactors for the Space Nuclear Thermal Propulsion Program"*, Progress in Nuclear Energy, Vol. 30(1):1-65, 1996.

PATENTS:

Method and Apparatus for Generating Low-Energy Nuclear Particles

NAME: Hans Ludewig (deceased 10/30/13) **CLASSIFICATION:** Senior Physicist

FIELD OF EXPERTISE: Nuclear Science and Engineering, Heat Transfer, and Fluid Dynamics

EDUCATION:
1959 – B.Sc. Mechanical Engineering, University of Natal (South Africa).
1961 – M.Sc. Mechanical Engineering, University of Natal (South Africa).
1962 – M.S. Applied Mechanics, California Institute of Technology.
1966 – Ph.D. Applied Mechanics and Physics, California Institute of Technology.

EXPERIENCE:

I have been employed at the Brookhaven National Laboratory since Jan. 1966. During this period I have worked in a variety of areas including reactor physics, heat transfer, fluid dynamics, stress analysis, fission product release and transport, and particle accelerator design.

- Carried out studies of material damage of candidate accelerator targets. The experiments were carried out at the BLIP facility, and the analysis was carried out using MCNPX.
- Developed the design for the Spallation Neutron Source (SNS) collimators for installation in the RING, HEBT line, and RTBT line. Determining the dose during machine operation and following shutdown, and estimate component radiation induced heating as input to stress analysis.
- Involved in the design of an accelerator driven filter/target for use in the Boron Neutron Capture Therapy (BNCT) of tumors.
- Participating in the space reactor technology program as a member of the NTP – DAST. This work considered variations of the original NERVA space propulsion design
- Participating in an INERI with ANL, on the safety analysis of a gas cooled fast reactor concept.
- Working with NRC-NRR in the pre-application review of the ACR-700, ESBWR, US-APWR, and EPR designs.
- Assisted in directing and managing a division involved in the design and development of light weight space propulsion and power reactors. The activities of the division involved both analytic and experimental work. This project was managed out of the SDI office and was known as the SNTP project.
- Participated in the evaluation of various LMFBR, HWR, and accelerator driven sub-critical reactor designs for the Non-proliferation Alternative System Assessment Program (NASAP).
- Involved in the design and analysis of the Fast Mixed Spectrum Reactor (FMSR), whose aim it was to minimize the proliferation of fissile material.

PUBLICATIONS:
H. Ludewig, A. Aronson, and W. Weng, “Study of Multi-beam Accelerator Driven Thorium Reactor”, PAC-11, New York. (2011)

G. Raitsis, H. Ludewig, A. Aronson, N. Simos, M. Todosow, and J. Gehin, “Initial Assessment of the Impact of Particle Fuel on the PWR Operating and Safety Envelopes”, BNL-FCRD-AFC-2011-004. Oct. 2011.

L-Y Cheng and H. Ludewig, “ATWS Transient for a Gas-Cooled Fast Reactor,” Int. Conf. On the Phys. of Reactors, Interlaken, Switzerland, September 2008.

“Solid Target Studies for Muon Colliders and Neutrino Beams,” Nuclear Physics (Proc. Suppl.), 155, pp. 88-290, 2006.

N. Simos, et al., “Material Irradiation Damage Studies for High Power Accelerators,” Proceedings of EPAC 2006, Paper No. TUPLS133, July 2006.

“A Proof-of-Principle Experiment for High Power Target System,” Proceedings of EPAC 2006, Paper No. THPCH196, July 2006.

Hans Ludewig – Page 2

Final Report on Review of AECL Work to Measure, Analyze and Predict Power Coefficient of Reactivity for the MAPLE 1 Initial Core, Brookhaven National Laboratory, Upton, NY, BNL-AECL-M003R0, December 2005.

Final Report on BNL Review of MAPLE 1 Tests Relevant to the Power Coefficient of Reactivity (PCR), Brookhaven National Laboratory, Upton, NY, BNL-AECL-005R0, October 2006.

H. Ludewig, L-Y. Cheng, L. Ecker, M. Todosow, "An Integrated Analysis of a NERVA Based Nuclear Thermal Propulsion System," Space Technology and Applications International Forum – 2006. Albuquerque, NM, February 2006.

A. Hanson, H. Ludewig, D. Diamond, "Calculation of the Prompt Neutron Lifetime in the NBSR," Nuc. Sci. Eng.:153, 26-32, 2006.

N. Simos, H. Kirk, H. Ludewig, P. Thieberger, W-T. Weng, K. McDonald, J. Sheppard, G. Evangelakis, K. Yoshimura, "Target Material Studies for High-Intensity Accelerator Beams," Nuclear Physics B, 149, 259-261, 2005.

H. Ludewig, M. Todosow, N. Simos, S. Shapiro, and J. Hastings, "Very High Flux Steady State Reactor and Accelerator based Sources," ICONE-12-49442, Arlington, VA, April 2004.

N. Simos, H. Ludewig, D. Rapparia, N. Catalan-Lasheras, S. Cousineau, and D. Davino, "Integration of Proton Beam Collimation Scheme in the Spallation Neutron Source Accumulator Ring, Including Dose and Activation Estimates," ICONE-12-49443, Arlington, VA, April 2004.

N. Simos, H. Kirk, H. Ludewig, P. Thieberger, W-T. Wang, K. Mc Donald, and K. Yoshimura, "Material Studies for Pulsed High Intensity Proton Beam Targets," ICONE-12-49441, Arlington, VA, April 2004.

Dr. William G. Halsey

Lawrence Livermore National Laboratory (retired)

Position at Retirement

Associate Program Leader - Advanced Nuclear Technology

E Program, Global Security Directorate, Lawrence Livermore National Lab

Dr. William (Bill) Halsey served as Associate Program Leader for Advanced Nuclear Energy at Lawrence Livermore National Lab, and has been an engineer at the lab for over 30 years. He focused on development of advanced nuclear energy technologies, and leads the Nuclear Fuel Cycle R&D at LLNL. This included research for the US Department of Energy Office of Nuclear Energy, Science and Technology in the areas of fuel cycle alternatives, fuels and reactors, spent fuel management, safety and security, small modular reactors and fusion-fission hybrids. Through this work he endeavored to enable the safe, secure and sustainable use of nuclear energy throughout the 21st century. Earlier in his career, Bill worked in areas including Laser Fusion, Nuclear Test, Radioactive Waste Management and Fissile Material Disposition.

Education

- Ph.D - Nuclear Engineering (Materials), University of Michigan, 1980
  (Thesis: Experimental study of He inside fusion reactor first wall materials using nuclear reaction methods.)
- MSE - Metallurgical Engineering, University of Michigan, 1978
- MSE - Nuclear Engineering, University of Michigan, 1976
- BSE - Nuclear Engineering, University of Michigan, 1975
  - Applied Physics, Michigan Technological University, 1971-1973

Experience

2007 - 2013: Associate Program Leader - Advanced Nuclear Technology, E Program, LLNL

Responsible for execution, funding and project control oversight of the LLNL work packages for DOE-NE in Fuel Cycle R&D and Gen-IV Reactor R&D. Work package lead for 6 activities in 'Fuel Cycle Options' (Systems Analysis, Screening), 'Used Fuel Disposition' and 'Advanced Reactor Concepts'. Provides support for international cooperation (NEA, Japan, China, Russia) for DOE-NE and DOE-RW.

1998 - 2013: LLNL Lead: Fuel Cycle R&D and predecessors (ATW/AAA/AFCI/GNEP/AFCR&D)

Beginning with the Accelerator Transmutation of Waste (ATW) Roadmap, Bill participated in the areas of systems analysis, technology evaluation and radioactive waste management, and has been the LLNL lead in these programs. He has led or contributed to numerous multi-lab milestone reports evaluating fuel cycle technologies.

2001 - 2013: LLNL Lead: DOE-NE-Gen-IV Reactor R&D & Lead-cooled Fast Reactor

Starting with the Gen-IV Reactor R&D Roadmap, Bill has participated in the Gen-IV program and advanced reactor R&D. In the roadmap, he led development of the sustainability criteria for the selection methodology. In addition, Bill served as System Integration Manager for the Lead-cooled Fast Reactor from 2003-2005.

1981 – 2010: LLNL Group Leader Assignments:

Responsible for personnel management, staff development and performance for groups ranging from 10-18 in size:

- 2007-2010 'Nuclear & Risk Science Group', Atmospheric Earth & Energy Division
- 2003-2005 'Nuclear Fuel Cycle & Reactor Technology Group', Energy & Environment Directorate
- 1981-1986 'Target & Material Measurement Group', Inertial Confinement Fusion Program

2001 - 2004: Special Assistant to the Associate Director for Energy & Environment

As LLNL combined the two directorates of Energy Programs and Environmental Science into one directorate, Bill assisted the Associate Director in the reorganization for this ~$100+M/yr and ~160 FTE hybrid directorate.

William Halsey – Page 2

He then pursued program development in nuclear energy, and led efforts to develop multi-lateral (5-nation) cooperation in international radioactive waste management and fuel cycle development.

1991 – 1998: Technical Area Leader for Performance Assessment: LLNL Yucca Mountain

Working on the national geologic repository program at Yucca Mountain, Bill led a multi-lab team responsible for waste form and waste package performance assessment, including model development, abstraction, integration with the rest of the PA models and documentation. Co-authored the Waste Package Performance Strategy.

1994 - 1996: Project Leader for Deep Borehole Disposition of Excess Plutonium

Led a successful 2-year multi-lab project to bring the deep borehole concept to sufficient maturity to permit comparison with other alternatives. Provided portions of the Fissile Material Disposition Program PEIS. Initiated the Repository Impacts program for FMDP to interface with YMP. Wrote the initial repository plan for Russia.

1987 – 1991: Principal Investigator for Container Material Selection for Yucca Mountain

Responsible for development of criteria, metrics and selection of the waste package material for YMP, and conducted the first YMP NQA-1 formal peer-review on the results.

1984 – 1986: Task Leader for ICF laser experiment target fabrication

Led a team responsible for target fabrication for the initial experiments on the NOVA laser.

1980 – 1981: Physicist - Surface & Material Analysis Group, Laser Program, LLNL.

Conducted materials research and microanalysis as a staff scientist.

Awards, Panels

- Letter of Commendation and Award from Deputy Assistant Secretary of Energy for Fuel Cycle Technologies – for the Initial Screening of Nuclear Fuel Cycles, May, 2011.
- LLNL internal awards: E-Program and Energy & Environment Program Awards (2000, 2002, 2011)
- Subject Matter Expert – Nuclear Fuel Cycle Systems Engineering, Chair – ISEP, FCR&D 2010-2011
- Nuclear Energy & Technology Capability Review Panel – Los Alamos National Lab (2008, 2011)
- International Reviewer for Japan Nuclear Cycle Development Institute milestone report: H12 Project to Establish the Scientific and Technical Basis for HLW Disposal in Japan (2000)
- Panel Organizer: Impacts of Fuel Cycle/Waste Form on Repository Development, DOE International Conference on Geologic Repositories, Denver, CO, (1999)
- Sandia Program Performance Award (1998), for Yucca Mountain Viability Assessment
- Outstanding Graduate Student of the Year: Nuclear Engineering, Univ. of Michigan (1978)

Publications, Programmatic Reports and Presentations

Author or Co-author of over 100 publications and programmatic reports, and over 100 presentations and invited talks.

Selected Recent Reports and Presentations:

"Energy Return on Investment – Fuel Recycle", A.J. Simon, M. Fratoni, C. Smith, W. Halsey, LLNL-TR-497511, FCRD-SYSA-2011-000317, August 2011.

"Fuel Cycle Assessment of Innovative Fuel Concepts", W. Halsey, LLNL-MI-489331, FCRD-SYSA-2011-000247, May 2011.

"Initial Screening of Fuel Cycle Options", D. Sevougian, M. Gross, E. Hardin, R. Mackinnon, L. Price (SNL), E. Hoffman (ANL), Initial Screening Evaluation Panel: W. Halsey - Chair (LLNL), J. Buelt (PNNL), J. Gehin (ORNL), M. Mullen (LANL), T. Taiwo (ANL), M. Todosow (BNL), R. Wigeland (INL), FCRD-SYSE-2011-000040, March 2011.

William Halsey – Page 3

"Nuclear Fuel Cycle Options Study Phase II," R. Wigeland, T. Taiwo, M. Todosow, W. Halsey, and J. Gehin, FCRD-TIO-2010-000167, September 30, 2010.

"Fusion-Fission Hybrid Fuel Cycle Technology Assessment", W. G. Halsey, LLNL-TR-451392, Lawrence Livermore National Laboratory, August 2010.

"Assessment of Boundaries and Limits in Nuclear Fuel Cycles", T. Taiwo, et. al. ANL-FCRD-305, August, 2010.

"AFCI Options Study," R. Wigeland, T. Taiwo, M. Todosow, W. Halsey, and J. Gehin, AFCI-TIO-PMO-MI-DV-2009-000086, September 30, 2009.

"GNEP Basis Document - Integrated Strategy for Nuclear Material Transportation, Storage & Disposal Strategy Under the Global Nuclear Energy Partnership", W. G. Halsey – lead author, November, 2006.

"Advanced Nuclear Fuel Cycles and Radioactive Waste Management", (OECD-NEA 66 2006 05 1 P), ISBN 92-64-02485-9, W. G. Halsey – contributing author, U.S. technical representative and working group lead. OECD May, 2006.

"Nuclear Energy: Long-Term Sustainability", UCRL-PRES-209667, Invited presentation at Platts Nuclear Energy Conference, Washington, DC, February 17, 2005.

Dr. Jess C. Gehin
Lead, Reactor Technology R&D Integration
Reactor and Nuclear Systems Division
Oak Ridge National Laboratory
Phone: (865) 576-5093; Fax: (865) 574-9619; email: gehinjc@ornl.gov

AREAS OF EXPERTISE: Advanced reactor technologies, nuclear reactor core physics design, analysis, and computational methods; commercial reactor licensing review, research reactor design and analysis; nuclear fuel cycle systems

EDUCATION: Ph.D. (Nuclear Engineering), 1992, Massachusetts Institute of Technology; S.M. (Nuclear Engineering), 1990, Massachusetts Institute of Technology; B.S. (Nuclear Engineering), 1988, Kansas State University.

EXPERIENCE:

Lead, Reactor Technology R&D Integration, Reactor & Nuclear Systems Division, Oak Ridge National Laboratory 2011-present.

Senior Program Manager, Nuclear Technology Programs Office and Reactor and Nuclear Systems Division, Oak Ridge National Laboratory, 2008 – 2011. Responsible for developing and coordinating research and development activities with key programmatic sponsors including DOE Office of Nuclear Energy, Nuclear Regulatory Commission, and the nuclear industry. Project manager for NRC Office of Regulatory Research, advanced reactor neutronics methods development project at ORNL; Principle Investigator on DOE/NE International Nuclear Energy Research Initiative (I-NERI) project on minor actinide burning in LWRs and CANDU Reactors; and active in the development of projects and programs related to advanced reactors.

Leader, Reactor Analysis Group, Nuclear Science & Technology Division, Oak Ridge National Laboratory, 2003 – 2008. Responsible for managing a group of 15 technical staff supporting reactor analysis including reactor physics, source terms, methods, and safety analysis. Directly involved in the review of license applications for BWR Extended Power Uprate and neutronics methods for NRC Office of Nuclear Reactor Regulation; Enhancement and validation of reactor physics methods for ACR-700, PWRs, and BWRs for NRC Office of Regulatory Research; advanced fuel cycle analysis for DOE Office of Nuclear Energy, Science and Technology. Deputy Systems Campaign Director for Global Nuclear Energy Partnership Project, DOE Office of Nuclear Energy.

Senior R&D Staff, Radiation Transport & Physics Group, Nuclear Science & Technology Division, Oak Ridge National Laboratory, 1992-2003; Major research projects include: Core design and analysis of IRIS Generation IV reactor. Fissile materials disposition in U.S. and Russian VVER-1000 reactors including weapons-grade MOX assembly design, core design, fuel cycle analysis, and transient analysis. Research reactor design and analysis of the High Flux Isotope Reactor (beryllium reflector design, irradiation target and experiment design, and cold source design) and the Advanced Neutron Source Reactor (all aspects of core and reflector facility design). Nuclear facility hazard prediction and assessments for counter-proliferation including source term calculations and fuel cycle modeling. Other areas of research include radioisotope production, nuclear reactor kinetics, reactor physics methods development and benchmarking, engineering software development.

Joint Associate Professor of Nuclear Engineering, University of Tennessee, 1/11 – present

Jess Gehin – Page 2

MAJOR PROJECTS

Consortium for Advanced Simulation of Light Water Reactors (CASL), 2010-present

As technical lead for the Advanced Modeling Applications (AMA) Focus Area for the CASL Energy Innovation Hub coordinates and directs work of national laboratory (ORNL, INL) and Industry (EPRI, Westinghouse, TVA, CD-adapco) participants in projects on modeling requirements, modeling TVA reactors, defining challenge problems, model validation, and NRC engagement. As part of proposal team, developed winning proposal for five-year, $122M project.

Project Sponsor: Office of Nuclear Energy, Department of Energy

Fuel Cycle Research & Development Program, 2007-present

As Deputy National Technical Director for Systems Analysis (2007-2011) performs work planning, budget planning, guidance, direction and review to technical work, and represents system analysis campaign at DOE, national, and international meetings. Leads ORNL systems analysis and systems engineering activities (note program formerly known as Advanced Fuel Cycle Initiative).

Project Sponsor: Office of Nuclear Energy, Department of Energy

Safety Evaluation of Vermont Yankee Power Extended Power Uprate, 2006-2008

Supported the review of the nuclear analysis methods supporting extended power uprates of boiling water reactors providing input on the NRC safety evaluation report and presenting findings at meetings of the Advisory Committee on Reactor Safeguards.

Project Sponsor: Office of Regulatory Research, Nuclear Regulatory Commission

Fissile Materials Disposition Program, 1997-2004

Responsible for reactor physics analysis of the use of weapons-grade mixed oxide fuel in Russian VVER-1000 reactors working as part of ORNL team and in collaboration with Russian team from the Russian Research Center (RRC) “Kurchatov Institute” in Moscow and the Institute of Physics and Power Engineering (IPPE) in Obninsk. Responsible for negotiation of Russian workshop and review of deliverables.

Project Sponsor: Office of Fissile Material Disposition, National Nuclear Security Administration

Hazard Predication Assessment Capability (HPAC) Development, 1996-2000

Responsible for development of reactor radionuclide inventories and dispersal models to support development of forward-deployable software tool in support of the U.S. Department of Defense working as part of a team of national laboratory and DoD contractors.

Project Sponsor: Defense Threat Reduction Agency, Department of Defense

Advanced Neutron Source, Department of Energy, 1992-1995

Responsible for the reactor physics of the Advanced Neutron Source working as part of the design team. Developed advanced core designs, performed safety assessments, benchmarked and validated physics design codes, performed analysis of conversion of design to low-enriched uranium.

Project Sponsor: Office of Energy Research, Department of Energy

HONORS & PROFESSIONAL ACTIVITIES:

PROFESSIONAL ACTIVITIES: American Nuclear Society (ANS) Reactor Physics Division, **Chair**, 2005-2006; **Vice Chair/Chair Elect,** 2004-2005; **Secretary,** 2003-2004, **Chair, Technical Program**

Jess Gehin – Page 3

Committee, 2000-2003, **Executive Committee,** 1998-2001, **Program Committee,** 1995-1998; **Technical Program Committee**, ANS, topical and national meetings, 1995-present; **Technical Program Chair**, ANS 2007 Winter Meeting. **General Chair,** PHYSOR-2012 Reactor Physics Topical meeting, 2012

HONORS & AWARDS: **UT Battelle Legacy Impact Award**, Oak Ridge National Laboratory, 2010; **Lockheed Martin Technical Achievement Award**, Oak Ridge National Laboratory, 1997; **Engineering Physics & Mathematics Division Extra-Effort Award,** Oak Ridge National Laboratory, 1994; **DOE Nuclear Science & Engineering Fellowship,** 1988-1992;

PROFESSIONAL & HONORARY SOCIETIES: American Nuclear Society; Alpha Nu Sigma, Tau Beta Pi, and Phi Kappa Phi honor societies.

REVIEW & ADVISORY PANELS: **Reactor Operations Review Committee,** Oak Ridge National Laboratory, 2000-2002; **Experts Group on Reactor-Based Plutonium Disposition** and **Working Party on the Physics of Plutonium Fuels and Innovative Fuel Cycles,** Organization for Economic Cooperation & Development, Nuclear Energy Agency, 1998-present; **Scientific Advisory Committee,** 2001 OECD/NEA Workshop on Advanced Reactors with Innovative Fuel; **Nuclear Forensics Science Panel,** NNSA, 2004-2007. **DOE NEER Reviewer,** 1999-2006, **DOE NEUP Reviewer**, 2009-2012.

ROBERT T. JUBIN

Home Address:
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(865) 938-8029

Office Address:
Fuel Cycle and Isotopes Division
Oak Ridge National Laboratory
Mail Stop 6243
Oak Ridge, TN 37831-6243
(865) 574-4934 (office)
(865) 574-6872 (FAX)

Dr. Robert T. Jubin is the Project Manager for ORNL's Fuel Cycle Research and Development (FCR&D) Advanced Fuel Cycle Science and Technology activities. He leads a multi-laboratory R&D effort on the capture and immobilization of volatile radionuclides. He was the lead author for the Volatile Gas Recovery and Waste Form portion of the Baseline Document for the GNEP Integrated Waste Management Strategy.

Dr. Jubin is also a member of the ORNL team that has led the planning and development for the Oak Ridge Integrated Facilities Disposition Plan (IFDP). He has a lead role the planning for the removal and processing capabilities required to address the legacy materials currently located on the ORNL site. This includes the planning for hot cell facilities to process the most difficult materials on site. In the early phases of this multi-year effort he was part of the seven person team honored as the winning Operations Support Team at the 2005 UT-Battelle Awards Night for developing the vision and providing leadership for nuclear program planning and facility consolidation to secure ORNL's future capability to perform nuclear work. He was also recognized at the 2009 UT-Battelle Awards Night as part of an eleven person team for contributions that laid the ground work for the receipt and allocation of $170 million of American Recovery and Reinvestment Act funding to clean up the central campus over the next 2.5 years.

Dr. Jubin has provided key leadership to the ORNL hot cell consolidation efforts. During 2005-2006 he developed novel strategies to relocate critical isotope operations from aging, underutilized nuclear facilities in the central ORNL campus to strategic nuclear facilities thus clearing the way to ultimately reduce the total number of Category 2 and 3 non-reactor nuclear facilities at ORNL from 10 to 3.

He is a Principal Investigator for a Department of Homeland Security Southeast Regional Research Initiative focused on predicting the fate of dispersed WMD materials in waste and storm water treatment facilities. He is also the Principal Investigator for a Laboratory Directed Research and Development (LDRD) project focused on the development of CERMETS as high level waste forms. Previously he was the Principal Investigator for a suite Department of Homeland Security (DHS) research and development tasks focused on Radiological Event Progression. In this role, he was instrumental in formulating a robust multi-laboratory R&D program to provide answers to the key Scientific and Technical questions surrounding the effects of radiological dispersal devises and the attribution of source material.

Previously he served as the group leader for the Process Engineering Research Group within the Nuclear Science and Technology Division at ORNL. Prior to this, he was the head of the 100+ person Chemical and Energy Research Section formed in 1997 following the merger of the Chemical Development Section and the Energy Research Section of the Chemical Technology Division. Before the section merger, he served as section head for the Chemical Development Section of the Chemical Technology Division.

Prior to this role, he was on a seventeen month assignment to France working with the French Atomic Energy Commission at Fontenay-aux-Roses. This assignment was focused on the development of the DIAMEX process for separation of actinides and lanthanides from high level liquid wastes. Prior to

Robert Jubin – Page 2

undertaking this foreign assignment for the US DOE Tanks Focus Area, he was the group leader for Chemical Process Research and Development group within the Robotics and Process Systems Division at ORNL. In addition to responsibilities for chemical process related research in the division, he was the Technical Correspondent for Chemical Process Technology in the Department of Energy (DOE) / Japan Nuclear Power Corporation (PNC) collaboration in the field of Nuclear Fuel Reprocessing. Dr. Jubin was also the technical contact for a US DOE / United Kingdom Atomic Energy Authority (UK AEA) exchange agreement in the areas of nuclear fuel reprocessing. He has been associated with ORNL since 1977.

Dr. Jubin has an extensive background in all aspects of nuclear fuel reprocessing. One of his focuses is in the area of solvent extraction. He has worked on waste treatment processes in support of the Savannah River DOE facility and a study for DOE Headquarters addressing the disposition of weapons grade plutonium by conversion to Mixed Oxide Fuel for power reactors. His work has been directed toward the implementation and improvement of new solvent extraction equipment and processes with primary attention on the application of advanced centrifugal contactors. He is a recognized leader in this area worldwide. His work in this area has included the design of centrifugal contactors for use in the Idaho Chemical Processing Plant development and in the US DOE Oak Ridge Y-12 uranium recovery areas. He has authored a number of reports and papers in the area of solvent extraction and holds two patents for improvements to the centrifugal contactors. His papers have been presented at a number of national and international meetings including the International Solvent Extraction Conferences and American Institute of Chemical Engineers Annual Meetings. He has also been responsible for the development and/or improvement to a number of solvent extraction computer models.

He was involved in the successful use of the ASPEN process simulator to model an entire nuclear fuel reprocessing plant. This effort was the largest simulation ever attempted with the ASPEN simulator in the mid 1980's.

Other technical fields of expertise include off-gas handling and process control. He made significant contributions to the design of a proposed off-gas system for the Canadian AECL Chalk River Molybdenum-99 facility. During 1983, he was one of two DOE representatives at the International Atomic Energy Agency working group on off-gas cleaning from nuclear facilities. He has co-authored book a chapter on the recovery and retention of radioactive Iodine and NO_x from nuclear facilities. He has also presented a number of papers on iodine retention at Nuclear Air Cleaning Conferences and other conferences. He has had programmatic responsibility for the direction of research in a number of areas related to off-gas treatment including Krypton and Carbon-14 recovery and retention.

Dr. Jubin has served as a member of the program committee for the DOE / NRC Nuclear Air Cleaning Conference which provided an international forum for research on all aspects of air treatment technology and regulatory issues. He was also a member of the DOE Solvent Extraction Working Group that was chartered to define the current status of solvent extraction technology in the US DOE defense complex and to make recommendations for development needs in this area for the 21st century.

Dr. Jubin retired from the U.S. Air Force Reserves in 2007 holding the rank of Colonel. Col Jubin's final assignment was as the Wartime Assistant Chief of Staff, (J2) Intelligence, United States Forces Korea, Yongsan Garrison, Seoul, Korea. As a Mobilization Assistant in the Air Force Intelligence Reserve Program, he provided guidance and mentoring to more than 300 intelligence individual mobilization augmentees (IMAs) supporting U.S. Forces Korea, U.S. Pacific Command, and Pacific Air Forces.

Robert Jubin – Page 3

received a Bachelor of Science degree in chemical engineering from the University of Akron in 1977. He completed his Master of Science degree in engineering management from the University of Tennessee in 1981, and received his Doctor of Philosophy in chemical engineering from the University of Tennessee in 1994. The topic of his dissertation was the adsorption kinetics associated with the trapping of radioactive iodine on silver exchanged mordenite. He is also a registered Professional Engineer in the State of Tennessee (inactive).

JAMES L. BUELT
Pacific Northwest National Laboratory (retired)

POSITION AT RETIREMENT

Manager, Nuclear Energy Sector
Energy and Environment Directorate

SCOPE OF ACCOUNTABILITIES:

Jim is currently the General Manager of JLB EnvEn Solutions, LLC, providing consulting services in the field of nuclear fuel cycles and nuclear waste management. Up until retirement in November, 2012, Jim was the manager of the Nuclear Energy Sector at Pacific Northwest National Laboratory. In this role, he was responsible for developing the relationship and business with the DOE Office of Nuclear Energy and the nuclear industry, which currently totals approximately $15 million/yr at PNNL. He served as the face to the client for all of PNNL's nuclear energy science and engineering activities. He was responsible for the development and execution of the nuclear energy strategy for the Laboratory on how to best deploy its scientific and facility resources for the safe, secure, and economic expansion of nuclear power.

EXPERIENCE:

During Jim's 37-year career with Battelle at PNNL, he has been a sector manager, technical group manager, nuclear facility manager, product line manager, project manager, and senior development engineer. His responsibilities have centered on the development of radioactive and chemical waste treatment and immobilization processes. He is the holder of several patents on In Situ Vitrification and other environmental cleanup methods. From 1976 to 2002, Jim was the product line manager for one of Battelle's most prominent product lines; Process and Measurement Technology. In this role, he was responsible for building and managing a business of over $40 million in contract R&D composed of approximately 130 active projects.

In 2002, Jim became the lead technical manager for the Radiochemical Processing Laboratory, PNNL's Hazard Category II Nuclear Facility, designed to conduct research on highly active and dispersible radioactive and nuclear materials. He was responsible for the safety basis of the facility, as well as the development and performance of over 80 research and support staff and held this position for four years.

Prior to becoming the sector manager, he was the acting manager of the Nuclear Safety and Technology Product Line, responsible for the expert delivery of the nuclear technology portfolio of projects at the Laboratory, totaling approximately $40 million/yr in annual sales and business volume.

1. EDUCATION

B.S., Oregon State University, Chemical Engineering, 1975

Siegfried L. Stockinger, P.E.

U. S. Department of Energy
Office of Nuclear Energy
Used Nuclear Fuel Disposition R&D
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Office Phone (702)295-2389
Siegfried.Stockinger@doe.gov

Education	**MSCE**, Civil & Environmental Engineering, Loyola University, 1973 **BSME**, Engineering-Mechanical/General, Stevens Institute of Technology, 1965
Clearances	Active **DOE L Clearance.** DOD Top Secret (inactive 2008) & DOE Q (inactive 2006)
Key Areas of Experience	Designed primary and secondary systems for Boiling Water (BWR); Pressurized Water (PWR); Heavy Water; High Temperature Gas Cooled; and DOE production Nuclear Reactors. Systems included the water chemistry, unit operations, incineration, waste solidification and stabilization and disposal of all radioactive gaseous, liquid, and solid effluent from numerous nuclear power plants. On the design team for the New York & Texas low activity waste (LAW) and Yucca Mountain Project HLW repository/disposal sites. Designed systems and components for waste stabilization. Nuclear products and systems for all fuel cycle technologies, used (spent) fuel pool design (racks, cooling water and chemistry control, and re-racking), on-site storage, off gas treatment, containment hydrogen control, desiccant dryers, HEPA and activated charcoal filters/absorbers. Facility startup including Operational Readiness Reviews and assessments, Safety Analysis and Authorization Basis, Probabilistic Assessments, Quality Assurance, Project Management, Team Leadership and Supervision.
Summary of Professional Experience and Accomplishments	Over 40 years of professional experience in nuclear engineering related fields, including naval nuclear reactor plant systems design, testing and refueling; nuclear performance assessment; startup of the waste processing facility, regulatory compliance and licensing. Four (4) High-Level Waste (HLW) Vitrification Plant designs and design of the Yucca Mountain Repository. Transformed nuclear related technology into operating designs, experience in planning, design, research, development, licensing, construction and debottlenecking of process, packaging, and transportation systems.
Professional Memberships	Member, American Nuclear Society (ANS) American Society of Mechanical Engineer (ASME) Registered Professional Engineer (**PE**) active in **CA & WA** states
Employment History	2010-Present **DOE**, Office of Nuclear Energy (NE-53), Las Vegas, NV 2008-2010 **DOE**, Office of Civilian Waste Management, Las Vegas, NV 2000-2008 **Jacobs Engineering Group,** Program,& Engineering Manager 1977-2000 **MSI,** Program/Engineering Manager; **MMT Inc.,** Productivity Manager; **Parsons, Inc.** Principal Project Manager; **Foster Wheeler Corp,** Program Manager; **Fluor Daniel, Inc,** Project Manager; **EBASCO Services, Inc,** Project Manager, Chief Engineer-VQA. 1965-1977 **Cosmodyne**, Chief Engineer; **Litton Industries**; **Mobil**; **General Dynamics.**

Siegfried Stockinger – Page 2

BULLET SUMMARY

Transformed nuclear technology into operating designs, experience in planning, design, research, development, licensing, construction and debottlenecking of solid, gaseous and liquid processes, packaging, and transportation systems. Managed multiple engineering groups in transforming concepts to operations. Contract, cost analysis, scheduling and quality control skills. Fabricated nuclear equipment and process systems. Designed uranium processing systems from extraction to fuel fabrication plants, nuclear waste processing design, fabrication, start-up and deployment, environmental restoration and D & D in compliance with EPA, NRC, and DOE requirements.

- DOE-NE53: Lead for UFD R&D Investigations and Systems Engineering and support Lead for Test & Evaluation Capability Development control accounts/work activities.
- OCWM-Yucca Mountain Project: IDDM Project Manager responsible for three IPTs to identify the scope, desired end-state, plan, obtain the resource requirements for the Configuration and Requirements Management functions of the YMP. Supported the preparation for the ASLB hearings of Contentions litigation on YMP's License Application to the NRC. On the Condition Reporting Screening Team and the yearly Business Plan Preparation and reporting group.
- Project Manager of Chemical Demilitarization Program for Army/CMA
- Processing of nuclear materials (uranium & plutonium), equipment, and worldwide nuclear power and US weapons production; Design of the Pit Disassembly and Conversion Facility.
- Low and High Activity Waste Vitrification for the WTP. Developed designs for hot cell decontamination for high level waste processing for WVDP.
- Operations and Design of a newly patented Tritium Resin Separation (TRS™) treatment and tritium concentration process.
- Operations and started-up of recycling technology-quantum catalytic extraction processing-QCEP™.
- Developed methods for decontamination, removal and handling/packaging and disposal of equipment, piping, concrete, duct work, wiring, and coatings.
- Designed, built, and licensed: metallic, polymer and plastics encapsulation processes; nuclear containers; mobile processing systems, casks, and transportation systems for nuclear material and waste disposal; designed processing systems for a nuclear metals D&D and recycle facilities.
- Peer reviewed study of DOE TRU Waste for D&D, liquid and sludge processing and packaging.
- Developed disposition methods for the Stockpile Stewardship Program's HEU and Pu processes.
- Performed technical and financial audits, ICEs, schedule/budget validations of projects and sites in support of DOE key (now critical) decisions.
- Managed and defined the Isotopes Facilities Deactivation Project of ORNL buildings/facilities.
- PM-for Engineering the Hanford Waste Vitrification Project, developed the Detail Design Criteria Guide, training, and Value Engineering.
- Directed the New Bedford Harbor Superfund Project (EPA Region I). Piloted hydraulic dredging alternatives, water treatment, and PCB/heavy metal confinement with EPA & USACE.
- Managed the Availability/Reliability Team Upgrade Projects and led Emergency Response Teams for Nuclear Power Plants (NPP).
- Designed advanced radioactive waste processing systems for NPPs and DOE production sites.
- Designed most primary and secondary NPP systems.
- Delivered the first tritium delivery and cleanup systems for the Tokomak Fusion Test Reactor. Analyzed and produced the design packages for the NY and TX LAW disposal sites.
- Produced Safety Analysis Reports (SARs) for commercial NNP and LAW disposal sites.

Publications and Patents upon request

INSIGHT DECISIONS LLC

Karen E. Jenni

QUALIFICATIONS

Dr. Jenni has over 20 years of experience in the consulting industry as a professional decision analyst. Since founding Insight Decisions in 2005, she has focused her consulting practice on the analysis of energy and environmental policy issues for both public and private sector clients. Areas of expertise include decision analysis, multi-attribute analysis, expert elicitation, behavioral decision theory, and integrated risk modeling. Representative project descriptions are included below.

EDUCATION

Ph.D., Engineering and Public Policy, Carnegie Mellon University (1997)
Thesis: *Attributes for Risk Evaluation*
Advisor: Baruch Fischhoff
NSF Graduate Research Scholar, Carnegie Foundation Scholar

M.S., Engineering and Public Policy, Carnegie Mellon University (1994)
Herbert J. Toor Award for Outstanding Research Paper Submitted in the Qualifying Examinations of the Department of Engineering and Public Policy, 1994

B.S., Mathematical and Computational Sciences, Stanford University (1986)

PROFESSIONAL HISTORY

Founder and Principal, Insight Decisions LLC, Denver CO (December 2005 to present)

Principal Decision Analyst, Geomatrix Consultants, Inc., Denver, CO and Oakland, CA (July 1999 to December 2005). *Member of the Board of Directors, 2003-2005*

Senior Manager, Applied Decision Analysis/PricewaterhouseCoopers (1997-1999)

Research Analyst – Senior Associate, Applied Decision Analysis, Inc. Menlo Park, CA (1987-1992, summer 1993). *ADA was acquired by PricewaterhouseCoopers in September 1998*

Instructor, Careers in Applied Science and Technology (CAST) Program, Carnegie Mellon University, Pittsburgh, PA (Summers 1994-1995)

EXAMPLE PROJECTS

R&D Program Evaluation and Planning. Applied decision analysis approaches in a variety of contexts to help clients evaluate the benefits of applied R&D projects, and to use that evaluation to assist in planning a long-term R&D program. In one such project, served as a consultant to the National Academies *Committee on Prospective Benefits of DOE's Energy Efficiency and Fossil Energy R&D Program* charged with implementing the Committee's decision-analytic evaluation approach consistently across six program areas, working with a unique group of NAS-selected experts to evaluate each area. Work involved facilitating two meetings with each group to guide them through the process of identifying and evaluating major technical and market uncertainties affecting the benefits of R&D funding in their area of expertise, and then building (or modifying existing) models incorporating the expert inputs into an independent, expert-driven evaluation of the uncertainty about the benefits of different R&D funding scenarios.

KAREN E. JENNI – Page 2

Led or participated in several similar projects conducted for the US DOE. For the Yucca Mountain Performance Confirmation (PC) Program, the focus of the work was on selecting a portfolio of projects that would comprise a long-term research and testing programs. Along with colleagues at Geomatrix Consultants, developed a process and model to help define, formally evaluate and rank over 300 candidate activities for the program using a modified value-of-information analysis, and to develop a logical and defensible set of alternative research portfolios from which DOE selected a set of activities as the basis for the PC Plan. During the establishment of a new Science and Technology Program for the Office of Civilian Radioactive Waste Management, the focus of the work was on developing and applying a set of clearly defined criteria that would enable the evaluation and a comparison of potential areas of focus for the program, as well as consideration of portfolio-level consideration, to ensure a robust program. Most recently, participated in the development of the "R&D Roadmap" for Used Nuclear Fuel within DOE's Office of Nuclear Energy, helping to evaluate activities and establish research priorities to enable storage and disposal of used nuclear fuel *absent* a Yucca Mountain Repository.

Probabilistic Volcanic Hazard Analysis for Yucca Mountain. Served as the normative expert for a large scale expert elicitation conducted for the Yucca Mountain project, focused on evaluating the potential for volcanic events to disrupt the planned nuclear waste repository. The project was a first-ever *update* of a large scale expert elicitation, and as such involved some unique methodological challenges in terms of expert selection and avoidance of biases. Participated in and facilitated as many as three separate assessment interviews with each of ten experts, and worked with them and other project team members to convert their conceptual models in to mathematical models of volcanic activity in the area. Developed several new approaches for improving feedback to experts on the implications of their assessments.

Support for DOI's Landscape Conservation Cooperative (LCCs). Provided technical and facilitation support for three LCCs during their initial framing and set-up processes. This work included a framing workshop for the Western AK LLC (with their Steering Committee), and helping to structure and facilitate their "state of the science" workshop; a framing workshop with the technical committee of the Plains and Prairie Potholes LCC, including developing a process for prioritizing their near-term science needs; and a framing workshop and development of a Charter for the North Pacific LLC, leading to ongoing work with the Science the Traditional Ecological Knowledge subcommittee developing their 4-year Strategy for Science and TEK activities.

Decision Analysis for the USGS. Co-leader of several projects with the US Geological Survey to provide hands-on Decision Analysis training, and to apply DA methods to significant multi-disciplinary issues within the USGS in order to ensure that the resulting science is as useful to decision-makers and end-users as possible. Over the past several years this work has included: modeling the effects of climate change and water management related decisions on stream flow, environmental conditions, and social and economic impacts in the Methow River Basin, with possible extensions to the greater Columbia River Basin; similar work examining stakeholder interests and perspectives on climate change effects in the Yakima River Basin; working in conjunction with a University of Rhode Island team developing a "decision support system" for Appalachian Trail managers using a combination of remote-sensed data and field data; the development of a modeling framework to facilitate in integrated assessment of the effects of energy development on ecosystems in SW Wyoming and similar work related to the current development activities in the Bakken formation in North Dakota; and a model quantifying uncertainties in the health and environmental impacts of Selenium releases from mountain top removal – valley fill coal mining and other large ground disturbances in the eastern US. These projects have involved hundreds of USGS scientists, numerous workshops, and a significant amount of detailed modeling.

Expert elicitations of carbon capture technologies. Currently working with academic partners on an NSF-funded project evaluating the potential effects of different policy "levers" on the development of carbon-capture technologies for coal plants. We are exploring the implications of different scenarios through

KAREN E. JENNI – Page 3

formal expert elicitation of the likelihood of various technological breakthroughs under different policy scenarios.

PROFESSIONAL SERVICE AND AFFILIATIONS

Committee member, National Research Council Committee on Ranking FDA Product Categories by Health Consequences, Phase 2. 2009 - 2011

Committee member, National Council on Radiation Protection and Measurements (NCRP) Committee SC 1-15, "Radiation Protection for Astronauts in Short-Term Lunar Missions." 2005-2007.

Member of the Institute for Operations Research and Management Science (INFORMS). Council Member of the Decision Analysis Society (DAS), a subdivision of INFORMS, 2005-2008;.

Fellow of the Society of Decision Professionals (SDP).

Editorial Board, *Decision Analysis.*

PUBLICATIONS

Committee on Ranking FDA Product Categories Based on Health Consequences, Phase II. A Risk-Characterization Framework for Decision-Making at the Food and Drug Administration. National Academies Press, Washington, DC. 2011. National Academies Press, Washington, DC. 2011.
http://www.nap.edu/catalog.php?record_id=13156

Karen E. Jenni and Abe van Luik. "Assessing expert judgments," in Geological Repositories for Safe Disposal of Spent Nuclear Fuels and Radioactive Materials: Advanced Technologies, Ahn, J., and Apted, M. (Eds), Woodhead Publishing, Cambridge, UK. 2010.
http://www.woodheadpublishing.com/en/book.aspx?bookID=1560

Kevin J. Coppersmith, Karen E. Jenni, Roseanne C. Perman and Robert R. Youngs, "Formal expert assessment in probabilistic seismic and volcanic hazard analysis." Invited contribution for Volcanic and Tectonic Hazard Assessment for Nuclear Facilities, Connor, Charles B., Neil A. Chapman and Laura J. Connor (Eds): Cambridge University Press (2009).
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Theresa S. Presser, Karen E. Jenni, Timothy Nieman, and James Coleman, "Decision Analysis Framing Study: In-Valley Drainage Management Strategies for the Western San Joaquin Valley, California," U.S. Geological Survey Open-File Report 2009-1121. 2009.
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Dawn Kaback, Karen Jenni, Jeffrey Ross, Karen Vangelas, and Brian Looney, "A Risk-Based Decision Tool to Support Remediation Decision-Making for Groundwater Contaminated with Chlorinated Solvents," Proceedings of the WM '07 Conference, February 25-March 1, 2007.

James L. Coleman, Jr, Ione L. Taylor, Tim Nieman and Karen Jenni, "A Workshop Investigating the Potential for Application of Decision Analysis Principles and Processes to Geoenvironmental Situations: Selenium in West Virginia," U.S. Geological Survey Open-File Report 2006-1283. 2006.
http://pubs.usgs.gov/of/2006/1283/USGS%20Open-file%20Report%202006-1283.pdf

DeKey, Florig, Fischbeck. Morgan, Morgan, Fischhoff, and Jenni, "The Use of Public Risk Ranking in Regulatory Development." in Improving Regulation, (Fischbeck and Farrow, Eds), Resources for the Future, 2001.

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H. Keith Florig, M. Granger Morgan, Kara M. Morgan, Karen E. Jenni, Baruch Fischhoff, Paul S. Fischbeck and Michael L. DeKay, "A Deliberative Method for Ranking Risks (I): Overview and test bed development," *Risk Analysis*, 21(5), 913-921, 2001.

M. Granger Morgan. H. Keith Florig, Michael DeKay, Paul Fischbeck, Kara Morgan, Karen Jenni, and Baruch Fischhoff, "Categorizing Risks for Risk Ranking," *Risk Analysis*, 20(1), 49-58, 2000.

L. Painton Swiler and Karen Jenni, "The ABC's of Risk Assessment," *Society of Women Engineers Magazine*, March-April 2000.

Karen E. Jenni and George Loewenstein "Explaining the Identifiable Victim Effect," *Journal of Risk and Uncertainty*, vol. 14, pp. 235-257, 1997.

Karen E. Jenni, Miley W. Merkhofer, and Carol Williams, "The Rise and Fall of a Risk-Based Priority System: Lessons from DOE's Environmental Restoration Priority System," *Risk Analysis*: 15(3), pp. 397-409, 1995.

M. Merkhofer, T. Cotton, K. Jenni, J. Lehr, and T. Longo, "A Program Optimization System for the Cleanup of DOE Hazardous Waste Sites - An Application to Fiscal Year 1990 Funding Decisions," In *Waste '89*, Proceedings of the Waste Management Symposium sponsored by the American Nuclear Society FCWMD, Tucson, Arizona. 1989.

SCULLY CAPITAL

Brian T. Oakley, Principal

Mr. Oakley has over 22 years of experience in providing project financial advisory services to domestic and international clients in both the private and public sectors. He has assisted federal agencies, local authorities, municipalities and corporations with financial analyses and risk assessments. This work has ranged from the development of financial and economic criteria for federal programs to assessment of project feasibility and creditworthiness. With regard to energy and infrastructure projects, Mr. Oakley has a broad range of experience, including planning and procurements, business case studies, project development, financial structuring and analyses and deal structuring and negotiation.

Mr. Oakley serves as Chief Financial Officer of Scully Capital Securities Corporation and is registered with the Financial Industry Regulatory Authority as a General Securities Representative, a Municipal Securities Representative and a Financial and Operations Principal.

EDUCATION

Duke University, Master of Business Administration.

Duke University, Master of Environmental Management, Specialization in Resource Economics and Policy.

Trinity College, Bachelor of Arts, Economics.

REGISTRATIONS & AFFILIATIONS

Financial Industry Regulatory Authority:

- Financial & Operations Principal (Series 27)
- Municipal Securities Representative (Series 52)
- Uniform State Securities Agent (Series 63)
- General Securities Representative (Series 7)

RELEVANT EXPERIENCE

Financial Advisor to the Department of Energy's Office of Nuclear Energy

Mr. Oakley assisted in Scully Capital's role as financial advisor to the Department of Energy's Office of Nuclear Energy ("DOE-NE"). With Scully Capital's assistance, DOE-NE developed a highly responsive and innovative credit instrument to help nuclear energy projects address an uncontrollable risk that if left unmitigated, would render projects unfinanceable. This effort culminated in the design and development of a risk targeted insurance program ("Standby Support") to protect lenders against specific regulatory delay risks.

- **Analyze Business Case:** In 2002, Mr. Oakley assisted in developing a business case analysis ("Business Case for New Nuclear Power Plants") for nuclear power financing prior to the establishment of the Energy Policy Act of 2005 or the Loan Guarantee

Brian Oakley – Page 2

- Program. Mr. Oakley assisted in developing government financing incentives that addressed specific risks, including the high financial barriers, associated with the development of nuclear power plants.
- **Develop Program Methodologies:** Mr. Oakley assisted in the development of legislative options, credit support options, and program rules and regulations for the credit support programs that were considered for the Energy Policy Act of 2005 ("EPAct 2005").
- **Develop Credit Subsidy Model:** Mr. Oakley assisted in the development of a credit subsidy methodology for Standby Support to provide a preliminary estimate of the credit subsidy cost that would be paid by the sponsor when applying for the Standby Support Program.

Financial Advisor on Vogtle Plant Loan Guarantees: Mr. Oakley is currently advising DOE on loan guarantees related to the expansion of the Alvin W. Vogtle Electric Generating Plant. Mr. Oakley serves as a member of the credit policy group. His role involves analyzing the project against criteria established under DOE's internal risk rating system. In addition, Mr. Oakley provides analytical support in DOE's interactions with OMB related to credit subsidy scoring.

Financial Advisor on Uranium Enrichment Plant Development: Mr. Oakley is currently advising DOE on a loan guarantee related to the design, licensing, construction and operation of a $3.2 billion uranium enrichment plant with a nominal capacity of 3.2 million separative work units ("SWUs") per year. The project will utilize gas centrifuge technology and will consist of 4 cascade halls, each with 12 cascades with each cascade comprised of more than 1,000 maintenance-free centrifuges.

Business Case Analysis for Gasification with Co-Production: Mr. Oakley is directing the firm's efforts for the Business Case for Coal Gasification with Co-Production. In this role, he is coordinating the inputs from Department of Energy, Department of Defense, Environmental Protection Agency, and various industry groups. The business case is intended to understand the financial and economic issues that prevent financing of coal and biomass gasification to transportation fuels and other co-products. It will analyze Wall Street perceptions of risks in those projects and determine the structure and effect of various federal incentives on project economics and the federal budget.

Assessment of Financial Feasibility of IGCC / CO2 Sequestration Project: Mr. Oakley directed the firm's efforts in an independent assessment of a proposed IGCC project in Michigan. The purpose of the project was to provide an independent financial review as part of the developer's submission to DOE for certification under the IRS guidelines for Section 49(A) investment tax credits. Under the current design, the project will utilize 80% of the CO2 produced by the facility in an enhanced oil recovery project.

Financial Advisor to U.S. Department of Energy Loan Guarantee Program Office ("LGPO"): Since 2007, Mr. Oakley has directed Scully Capital's efforts in its engagement as a financial advisor to the U.S. Department of Energy for its Title XVII Loan Guarantee Program. As part of this engagement, Mr. Oakley has provided the following services to the LGPO.

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Brian Oakley – Page 3

- **Establish Underwriting Criteria and Credit Policies:** Mr. Oakley developed underwriting guidelines that detailed the LGPO's approach to estimating the credit subsidy cost associated with each loan guarantee provided under the Program. This included a step-by-step guide for reviewing applications and assessing project risks and
- the tools to be utilized in screening applications. He also helped craft necessary forms and established the criteria for requirements to ensure applications were standardized.
- **Develop Credit Subsidy Scoring Model:** Mr. Oakley assisted in the development of a financial model for use by the LGPO to determine credit subsidy costs. Mr. Oakley assisted in crafting the methodology for estimating the cost by looking at a variety of factors, including debt amortization schedules, probability of default and loss given default rates.
- **Assess Projects:** Mr. Oakley currently serves as a member of the Program's Credit Team. As such, he performs numerous functions related to the review of loans for creditworthiness and adherence to the established credit policies and procedures. This analysis extends through the closing process and involves several calculations of credit subsidy cost that are presented to OMB for approval.

Private Financing for Waste Vitrification Services for DOE: For over five years, Mr. Oakley provided financial structuring and modeling support to the U.S. Department of Energy's Office of River Protection for the privatization of the Tank Waste Remediation System ("TWRS"). Under this project, a key consideration included obtaining desired scoring treatment under OMB Circular A-11. Mr. Oakley assisted DOE in all stages of the process from performing an initial privatization feasibility study, through planning and executing the procurement process, evaluating bids, and contractor selection. As a public-private partnership with substantial risk transfer, this project required up-front budget authority with annual budget outlays that were in time with the payments made to the contractor. However, since DOE was providing a credit enhancement via the contract, the project had to be structured carefully in order to avoid falling under rules governing loan guarantees.

Financial Advisor to the U.S. Department of Transportation's TIFIA Joint Program Office: Mr. Oakley directs the firm's engagement in providing financial advisory services to the U.S. Department of Transportation ("DOT") with respect to the TIFIA Program. He has evaluated numerous requests for credit assistance totaling over $3.4 billion and assisted with structuring and negotiating term sheets and credit agreements for direct loans, loan guarantees and lines of credit for selected TIFIA applications. Based on the findings of the credit analyses, Mr. Oakley prepares reports and recommendations to present to the TIFIA Credit Committee for loan application acceptance or rejection.

Financial Advisor to the Federal Railroad Administration's ("FRA") Railroad Rehabilitation and Infrastructure Financing ("RRIF") Program: Mr. Oakley directs the firm's efforts in providing independent credit analysis to FRA's RRIF program. He has reviewed over eight loan application requests with a wide range of credit structures and has performed financial and credit analyses for projects requesting over $4.7 billion in RRIF assistance. For these credit analyses, Mr. Oakley has reviewed and analyzed financial models, financial structures and business plans.

Brian Oakley – Page 4

Financial Advisor to U.S. Department of Transportation's Maritime Administration: Mr. Oakley serves as director for the firm's engagement in reviewing the economics and financial viability of Title XI applications on behalf of the Maritime Administration ("MARAD"). To date, he has reviewed four applications requesting over $1.5 billion of MARAD assistance.

Analysis of Public-Private Partnership Opportunities for Waste Transportation Services – DOE: Mr. Oakley advised the Office of Civilian Radioactive Waste Management ("OCRWM") in analyzing privatization options and structures for the transport of nuclear waste from the electric utility industry to interim storage facilities. In addition, he advised the Savannah River site on developing a strategy and structuring alternatives for the construction and operation stages of a privately-financed and owned interim storage facility for spent nuclear fuel.

Financial Advisor to U.S. Department of Treasury's CDFI Program: Mr. Oakley currently provides advisory services to the Community Development Financial Institutions ("CDFI") Fund. Pursuant to the Small Business Jobs Act of 2010, the CDFI Fund will administer a bond guarantee program which seeks to provide long-term, low cost term financing to CDFIs. Mr. Oakley has assisted the program in developing a risk rating framework. The framework will be utilized in the evaluation of eligible CDFIs, which have applied for funding under the program. The risk rating framework encompasses numerous attributes related to capital adequacy, asset quality, management capability, performance and liquidity and represents a key tool to be utilized in the underwriting process.