Charles F. Weber
Reactor and Nuclear Systems Division
Oak Ridge National Laboratory

Education:

1998 Ph. D. Chemical Engineering, University of Tennessee
1990 M. S. Chemical Engineering, University of Tennessee
1979 M. S. Mathematics, University of Tennessee
1976 M. S. Management Science, University of Tennessee
1975 B. A. Mathematics, University of Tennessee

Work Experience at ORNL:

2013-present Principal Investigator for a multi-laboratory collaboration on an NA-22 Project in Plutonium Production Detection. Coordinated technical work of researchers at the different labs, facilitated communications, and provided managerial support to the NA-22 Program Manager. The project includes tasks on reactor modeling, analytical chemistry, and synthesis of modeling and data analysis. Primary technical contributions in the area of data for code validation and inverse analysis. Responsible for oversight of documentation, Quarterly Progress Reports, and Program Reviews.

2012-present Principal Investigator for NA-22 Project to simulate SEM-EDS spectra using Monte Carlo calculations, and perform inverse analysis to determine elemental inventories. Supervised researchers performing code development, sensitivity analysis, and simulation of spectra. Primary technical involvement in the area of inverse analysis and applications to relevant areas of the nonproliferation mission. Contributing or principal author on publications; responsible for Quarterly Progress Reports, presentations, and Program Reviews.

2009-present Principal Investigator for NA-22 Project in Plutonium Production Detection Coordinated work of several other researchers to investigate connections between reactor effluents and plutonium inventories in reactor fuel. The work involves effluent data collection and evaluation, nuclide depletion/decay calculations, fission product chemistry and transport, and mathematical modeling/computing. Principal author of several subject matter reports to NA-22, as well as Quarterly Progress Reports, and Annual Program Review.

2009-2012 Principal Investigator for NA-22 Project in Simulation, Algorithms, and Modeling Worked as one of three principal investigators with a team that included capabilities in applied nuclear safeguards, radiation detector measurements, and inverse mathematics. Responsibilities included development of an inverse code for nuclear depletion/decay analysis, investigations of convergence and stability properties, and applications to actual

detector measurements. Principal author of several subject matter reports to NA-22, as well as contributions to Quarterly Progress Reports, and presentations at annual review meetings.

2007-2012 Principal Investigator for NRC Chemical Engineering Review of US-APWR.
Acted as a consultant to the U.S. Nuclear Regulatory Commission licensing effort for the Mitsubishi Heavy Industries Advanced Pressurized Water Reactor (US-APWR). Responsibilities included critical review of 11 sections of the US-APWR Design Control Document, and evaluation for consistency with licensing regulations and industry best practices. These sections focused mostly on water chemistry under normal and accident conditions. Reporting requirements of the work entailed requests to the applicant (MHI) for additional information, advising NRC staff, authoring a Technical Evaluation Report, and attendance at regulatory hearings.

2007-present Fallout Modeling for several different sponsors
This work began as a review of fallout from past weapons tests for the U.S. Environmental Protection Agency (EPA). It progressed to evaluations of possible scenarios for an urban nuclear detonation, and the likely characteristics of fallout from such a burst. The study involved evaluations of particulate formation, behavior, size distributions, compositions, and chemistry. Documentation consisted of: 1) co-author of a report to EPA documenting urban fallout characteristics, 2) presenter at the 4th Joint DoD/DOE Nuclear Survivability/Weapon Effects Modeling and Simulation Workshop (Huntsville, AL, Dec. 16-17, 2008), and 3) contributor to a report for the Defense Threat Reduction Agency (DTRA) describing thermodynamic calculation of solidification temperatures for urban soils and condensation temperatures of most fission and structural components of a nuclear burst.

2007-2008 Principal Investigator in Study of Accidents in Naval Reactors.
This work was performed for Bechtel Bettis, Inc. The nature of the work and the documentation are classified (C/RD).

2006-2008 Enrichment Cascade Modeling.
Worked as a participant in the National Uranium Enrichment Management Analysis Center (NEUMAC), consulting in code development, needs assessments, reviews, and documentation. Developed the code MSTAR2012 (a follow-on code to the IAEA code MSTAR) for enrichment cascades, incorporating more flexible input requirements and both inverse and forward modeling capabilities.

2003-2008 Code development for SCALE
Developer of several routines for use within the SCALE code system. Work involved mathematical analysis, formulation of algorithms, and code development using FORTRAN90.
A. Primary developer of the INDEPTH (INverse DEPletion THeory) code to obtain reactor operating parameters (burnup, decay time, etc.) from nuclide inventories. This code has been used to identify suspect nuclear material in several exercises sponsored the Department of Homeland Security (DHS) and DTRA.
B. Development of new SCALE procedure for handling actinide solution densities, based on the Pitzer method for electrolyte thermodynamics. This approach lends more rigor and

flexibility in calculations involving critical solutions, and was documented in open literature as well as the SCALE 6 Users' Manual.
C. Development of geometric input subroutines for the NEWT/TRITON code. These routines translated and subdivided simple geometrical shapes (user input) into computational cells for the actual neutron transport calculations.

2004-2005 Moderator Intrusion Accident Evaluation
Participated in a team to evaluate nuclear criticality accident scenarios in a spent-fuel shipping cask for the U.S. Nuclear Regulatory Commission (NRC). Was responsible for performing thermal-hydraulic analysis (using the RELAP code) for water ingress into the damaged cask, and coupling to the resulting reactivity excursion. This work required innovative and non-standard usage of codes not originally designed for this type of application.

1998-2007 Safety Studies for the Spallation Neutron Source.
Performed safety evaluations for a number of postulated accidents in the SNS, involving chemistry and transport of spallation products in mercury coolant and in air. This work involved extensive literature searches on elemental solubilities, phase equilibrium calculations, chemical kinetics simulations, and accident phenomenology. It directly contributed to several internal reports and the SNS Final Safety Assessment Document for Neutron Facilities.

1993-2002 Tank Waste Studies for DOE
Primary modeler concerning handling and disposal of waste solutions in large storage tanks at Savannah River SC and Hanford WA. These tanks contain legacy wastes from many decades of chemical processing, primarily in support of U.S. nuclear weapons development. Contents were generally concentrated electrolytes (high in nitrate and hydroxide), containing many additional elements. Work was focused on understanding phase equilibrium of such complex solutions, in order to facilitate pumping supernatant, blending, or other processes, and minimizing unwanted precipitation in pipes, tanks, and equipment. The model development required extensive literature searches, nonlinear data regression/parameter estimation, convergence enhancement for the equilibrium code SOLGASMIX, and simulation studies. The work resulted in a number of novel applications of the Pitzer Method for thermodynamic calculations, and was documented in several literature publications and numerous reports.

1998-2000 Iodine Behavior in Nuclear Reactor Accidents (NRC)
Applications of iodine modeling work developed previously to several reactor accident sequences. Furnished pH calculational model to NRC staff, which included effects of common additives to reactor water. Assessment of iodine transport models in the MELCOR code and recommendations for improvements.

1990-1993 Safety Evaluations for High Flux Isotope Reactor (HFIR)
Performed fission product source term studies for several postulated HFIR accident sequences. Involved noble gases and iodine chemistry and transport calculations based on MELCOR thermal-hydraulic analyses for complex accidents. Applied LWR models or

developed modifications when LWR models were not directly applicable. Developed accident response models for the HFIR core, spent fuel pool, and other volumes in the HFIR site. Work was documented in HFIR reports, and contribution to HFIR SAR. This work was part of the team given special recognition at ORNL Awards Night (1993).

1990-1994 Containment Fission Product Behavior Program (NRC)
Follow-on for Post-Accident Chemistry Program, continued model development and simulation coding for iodine chemistry and transport in reactor accidents. Developed iodine speciation models for the CONTAIN code, acid formation from irradiation of cable jacketing and air-water systems, continued contributions of parameter estimation, mathematical optimization, and data analysis. Became Principal Investigator of the modeling work (1990-1992), and performed simulations contributing to review of Regulatory Guides 1.3 and 1.4. Participated in numerous NRC-sponsored meetings, including specialists meetings, Water Reactor Safety Information Meetings, and international collaborations.

1986-1990 Post-Accident Chemistry Program (NRC)
Follow-on work to Sever Accident Sequence Analysis Program, focused on chemistry of volatile fission products (notably iodine) under reactor accident conditions. Primary contribution was in modeling and simulation, involving modeling of experiments and parameter estimation for reaction rate constants. Also developed chemical models and simulation codes for water radiolysis, iodine hydrolysis, and iodine radiolysis, with applications to nuclear reactor accident scenarios. Calculation of radiation doses to containment water met requirements for an award-fee milestone in 1990. Participated regularly in NRC specialists meetings, including the Advanced Containment Experiments (ACE) Program, program review meetings, and international collaborations. Assisted with experimental efforts—wet bench chemistry and hot cell measurements.

1980-1986 Severe Accident Sequence Analysis Program (NRC)
Principal modeler for fission product transport studies of volatile nuclides in severe nuclear reactor accidents. Developed severe accident simulations using the MARCH code (thermal-hydraulic analysis of primary system and containment volumes). Used calculations from MARCH, CORCON, and CONTAIN codes to superimpose transport and chemical interactions of noble gasses, iodine, tellurium, and cesium for accident sequences. Developed TRENDS code to perform such calculations, and used it in modeling for NRC Source Term studies (including NUREG-0956 and NUREG-1150). Made several presentations at NRC Water Reactor Safety Information Meetings and other specialist meetings.

1978-1981 Sensitivity Analysis in Nonlinear Problems with Applications to Reactor Safety
Participated in development of differential sensitivity analysis for nonlinear problems, including theoretical underpinnings, test problems, and practical applications to problems in fluid flow and heat transfer. Developed novel space-marching scheme to solve inverse heat-conduction problem, contributing to efficient and stable solution for the forward problem itself and its sensitivity analysis. This work was applied to the code ORINC, which was used in heat transfer studies of simulated nuclear fuel rods.

Work Experience at The University of Tennessee:

1976-1978 Graduate Teaching Assistant in Mathematics

Taught lower-division mathematics courses, including Pre-Calculus, Calculus, Business Mathematics. Responsibilities included lesson plans, class lectures, homework assignments, testing, and assigning grades.

Related Professional Activities:

Reviewer for numerous articles in applied chemistry, chemical engineering, heat and mass transport

Member of Advisory Panel for NA-22 Simulation, Algorithms, and Modeling (SAM), Advanced Spectroscopy Group

Membership in American Nuclear Society (ANS), American Institute of Chemical Engineers (AIChE), and Society for Industrial and Applied Mathematics (SIAM)

Judge at Southern Appalachian Science and Engineering Fair (SASEF).

Awards:

Technical Achievement Award (1993). member of team for Operational Support (For outstanding accomplishment in completing the Safety Analysis Report of the High Flux Isotope Reactor).

Significant Event Award (2011). Member of a team that rendered special support to DOE in response to the crisis at Fukushima Dai-ichi damaged reactors.