

**STATEMENT OF PROFESSIONAL QUALIFICATIONS OF
GEORGE F. WUNDER**

Current Position

Project Manager
Division of New Reactor Licensing
Office of New Reactors
U.S. Nuclear Regulatory Commission

Education

M.A., Applied Economics, Johns Hopkins University, Baltimore, Maryland, 2004
Master of Environmental Engineering, Johns Hopkins University, Baltimore, Maryland, 1997
B.S., Industrial Engineering, Northwestern University, Evanston, Illinois, 1981

Qualifications

In 1989, Mr. Wunder joined the Nuclear Regulatory Commission (NRC) headquarters office as a project engineer in the Division of Reactor Projects. After serving as backup project manager for Crystal River Unit 3 and completing several training assignments, Mr. Wunder was appointed NRC project manager of the Virgil C. Summer Station in Jenkinsville, S.C. in 1990.

Mr. Wunder continued in the division of reactor projects serving as project manager for Indian Point Unit 3, Seabrook Unit 1, Hope Creek, Peach Bottom Units 2 and 3, and Limerick Units 1 and 2. In January 2006 Mr. Wunder accepted a position in the Division of New Reactor Licensing where he became project manager for both the Grand Gulf Early Site Permit and the South Texas Project future Combined License.

Before joining the Agency, Mr. Wunder was a commissioned officer in the U.S. Navy. He attended Naval Nuclear Power School in Orlando Florida and Naval Prototype Training Unit in West Milton, New York. Mr. Wunder has four years of power reactor operating experience. He was qualified by the Director, Navy Nuclear Power Program, as ships nuclear engineering officer for Trident Class submarines.

Awards

Mr. Wunder has received numerous awards during his time at the Agency. He also holds the Navy Achievement medal.

**STATEMENT OF PROFESSIONAL QUALIFICATIONS OF
JAMES H. WILSON
NOVEMBER 2006**

CURRENT POSITION

Senior Environmental Project Manager
Environmental Technical Support Branch
Division of Site and Environmental Reviews
Office of New Reactors
U.S. Nuclear Regulatory Commission

Since joining the U.S. Nuclear Regulatory Commission in 1976, Mr. Wilson has been a Project Manager for a diverse set of licensing and operating reactor projects. His professional experience includes the coordination of licensing reviews for operating nuclear power and non-power reactor facilities, design certification reviews of advanced reactor designs, environmental license renewal reviews of operating reactors, and environmental early site permit reviews. These reviews require him to be acquainted with a broad spectrum of technical engineering and scientific areas related to the licensing, construction, and operation of nuclear facilities.

EDUCATION

B.S.	Virginia Polytechnic Institute and State University	1971
M.S.	Virginia Polytechnic Institute and State University	1973
Ph.D. (ABD)	Virginia Polytechnic Institute and State University	1976

CURRENT PROJECT

Senior Environmental Project Manager for the System Energy Resources, Inc. (SERI) Early Site Permit (ESP) Application Review (February 2003 - Present). Mr. Wilson was responsible for the overall coordination of the National Environmental Policy Act (NEPA) review of the SERI application for an ESP at the Grand Gulf site. In general, his responsibilities included coordinating the development of and issuing requests for additional information, the Draft Environmental Impact Statement (DEIS), and the Final Environmental Impact Statement. In this capacity, he coordinated the reviews of NRR technical staff and their contractors who independently evaluated the environmental impacts of constructing and operating a nuclear power facility. His duties included conducting public meetings to provide information to the public and to solicit comments on the scope of the review and the DEIS. In addition, he coordinated the disposition of public comments and interfaced with local, State, Tribal, and Federal officials regarding the NEPA review.

PAST ASSIGNMENTS

- 1. Senior Environmental Project Manager for License Renewal Application Reviews (March 1998 - May 2003).** Mr. Wilson was responsible for the overall coordination of the National Environmental Policy Act (NEPA) review of license renewal applications. In general, his responsibilities included coordinating the development of and issuing requests for additional information, the Draft Supplemental Environmental Impact

Statement (DSEIS), and the Final Supplemental Environmental Impact Statement for several projects. In this capacity, he coordinated the reviews of NRR technical staff and their contractors who independently evaluated the environmental impacts of operating a nuclear power facility for 20 years beyond the date of the original operating license. His duties included conducting public meetings to provide information to the public and to solicit comments on the scope of the review and the DSEIS. In addition, he coordinated the disposition of public comments and interfaced with local, State, Tribal, and Federal officials regarding the NEPA review. He has performed this function for the following commercial nuclear plants: Oconee Units 1, 2, and 3; Hatch Units 1 and 2; Turkey Point Units 1 and 2; McGuire Units 1 and 2; and Catawba Units 1 and 2.

2. **Senior Project Manager (June 1996 - May 2003)** As Senior Project Manager in the Generic Issues and Environmental Projects Branch, NRR, he managed reviews associated with DOE programs, including tritium production, plutonium disposition, and HEU blend-down, as well as the preliminary design and licensing requirements for the Advanced Neutron Source. He also managed activities associated with the environmental review relating to the application by Duke Energy for license renewal at Oconee Units 1, 2, and 3, and interactions with General Electric, the BWR Owners' Group, and EPRI.
3. **Senior Project Manager (October 1990 - June 1996)** As Senior Project Manager in the Standardization Branch, NRR, for the staff's review of the EPRI ALWR Requirements Document, he managed the staff's review of the utilities' proposed requirements for the next generation of advanced nuclear reactors (both evolutionary and passive), including the CE System 80+, ABWR, SBWR, and the AP600 and met with the Advisory Committee on Reactor Safeguards to discuss the results of the staff's review and address questions raised by the Committee. During this time, he developed several Commission papers on policy, technical, and scheduler matters. He also served as principal project manager for the GE Simplified Boiling Water Reactor and as one of a team of project managers conducting the design certification review of the Westinghouse AP600 reactor design.
4. **Assistant Director for Projects, Comanche Peak Project Division, Office of Special Projects (December 1987 - October 1990)** In 1987, Mr. Wilson was selected as the Assistant Director for Projects in the Comanche Peak Division of the Office of Special Projects. His responsibilities included supervising, managing, and directing the NRC project managers who coordinated the safety and environmental licensing reviews associated with Comanche Peak, Units 1 and 2, including the corrective action program. The licensing activities culminated in the issuance of the facility operating license, completion of the startup test program, and commercial operation.
5. **Project Manager/Nuclear Engineer (November 1982 - December 1997)** As a project manager in Licensing Branch #3, he became the project manager for the licensing of the then-troubled Waterford Steam Electric Station, Unit 3, bringing the plant through the licensing process, Cycle 1, and the first refueling outage. In this capacity, he managed and coordinated the safety and environmental reviews of NRR technical staff and national lab personnel who independently evaluated the adequacy of the application by TU Electric for an operating license for Waterford 3 with respect to matters related to

siting, design, construction, testing, and operation. Conducted the environmental review associated with the application by Houston Power and Light for an operating license for the South Texas Project, Units 1 and 2.

6. **Project Manager/Nuclear Engineer (July 1980 - November 1982)** As project manager for 26 research and test reactors licensed by NRC, he was responsible for preparation of safety evaluation reports, environmental statements, and environmental assessments associated with licensing actions for assigned cases. As the NRC project manager for DOE's Division of Naval Reactors, he conducted: porting reviews of nuclear-powered vessels; reviews related to the Shippingport Light-Water Breeder Reactor; reviews related to advanced reactor concepts (FFTF); reviews of nuclear propulsion cores; and reviews related to retrofitting ECCSs to land-based prototypes. He provided overall project support for safety and environmental reviews associated with the approval of: the initial standard power reactor design for the CESSAR; research and test reactor and critical facility applications; topical reports; and early site reviews for power and non-power reactors. Performed similar functions for naval reactors and DOE- and DOD-owned facilities exempt from licensing.
7. **Technical Reviewer/Environmental Scientist (February 1976 - July 1980)** As an aquatic ecologist in the Division of Operating Reactors, and later the Division of Site Safety and Environmental Analysis, NRR, Mr. Wilson was responsible for: evaluating specific aspects of the environmental impact of nuclear power plants; assisting in the development of guidelines and technical criteria for use by licensees in their environmental field programs and monitoring activities; providing technical assistance in preparation of environmental impact appraisals and environmental statements; and serving as an expert witness in public hearings to testify on matters for which he provided technical analysis and recommendations.

Key Publications

The following NRC publications are those for which Mr. Wilson was the principle Project Manager and coordinator for the publication or had significant input to the document.

Masnik, M. T. and Wilson, J. H., "Assessment of the Impacts of the Salem and Hope Creek Stations on the Shortnose Sturgeon, *Acipenser brevirostrum*, Le Seur." NUREG-0671. May 1980.

Final Environmental Statement related to license renewal and power increase for the National Bureau of Standards Reactor, Docket No. 50-184. NUREG-0877. August 1982.

Safety Evaluation Report related to the Renewal of the Operating License for the Washington State TRIGA Reactor, Docket No. 50-27. NUREG-0911. May 1982.

Safety Evaluation Report related to the Renewal of the Operating License for the Research Reactor at the University of Florida, Docket No. 50-83. NUREG-0913. May 1982.

Safety Evaluation Report related to the Renewal of the Operating License for the Worcester Polytechnic Institute Open-Pool training Reactor, Docket No. 50-27. NUREG-0912. December 1982.

Safety Evaluation Report related to the operation of the Waterford Steam Electric Station, Unit 3, Docket No. 50-382. NUREG-0787. December 1984.

Draft Environmental Statement related to the operation of South Texas Project, Units 1 and 2, Docket Nos. 50-498 and 50-499. NUREG-1171. March 1986.

Safety Evaluation Report related to the operation of Comanche Peak Steam Electric Station, Units 1 and 2. Supplement 21. Docket Nos. 50-445 and 50-446. NUREG-0797. April 1989.

Safety Evaluation Report related to the operation of Comanche Peak Steam Electric Station, Units 1 and 2. Supplement 22. Docket Nos. 50-445 and 50-446. NUREG-0797. January 1990.

Safety Evaluation Report related to the operation of Comanche Peak Steam Electric Station, Units 1 and 2. Supplement 23. Docket Nos. 50-445 and 50-446. NUREG-0797. February 1990.

Safety Evaluation Report related to the operation of Comanche Peak Steam Electric Station, Units 1 and 2. Supplement 24. Docket Nos. 50-445 and 50-446. NUREG-0797. April 1990.

Supplement 1 to the Final Environmental Statement related to the operation of Comanche Peak Electric Station, Units 1 and 2, Docket Nos. 50-445 and 50-446. NUREG-0775. October 1989.

NRC Review of Electric Power Research Institute's Advanced Light Water Reactor Utility Requirements Document - ALWR Policy and Summary of Top-Tier Requirements. NUREG-1242, Volume 1. August 1992.

NRC Review of Electric Power Research Institute's Advanced Light Water Reactor Utility Requirements Document - Evolutionary Plant Designs. NUREG-1242, Volume 2, Parts 1 and 2. August 1992.

NRC Review of Electric Power Research Institute's Advanced Light Water Reactor Utility Requirements Document - Passive Plant Designs, NUREG-1242. Volume 3, Parts 1 and 2. August 1994.

Supplement 1 to the Final Environmental Statement related to the operation of Watts Bar Nuclear Plant, Units 1 and 2, Docket Nos. 50-390 and 50-391. NUREG-0498. April 1995.

Safety Evaluation Report related to the Department of Energy's proposal for the irradiation of lead test assemblies containing tritium-producing burnable absorber rods in commercial light-water reactors, Project No. 697. NUREG-1607. May 1997.

Final Safety Evaluation Report related to the Certification of the AP600 Standard Design, NUREG-1512, September 1998.

Safety Evaluation Report related to the Department of Energy's topical report on the tritium production core, Project No. 687. NUREG-1672. March 1999.

Generic Environmental Impact Statement for License Renewal of Nuclear Plants. NUREG-1437. May 1996.

Supplement 2 to the Generic Environmental Impact Statement for License Renewal of Nuclear Plants regarding the Oconee Nuclear Power Plant. NUREG-1437. December 1999.

Supplement 4 to the Generic Environmental Impact Statement for License Renewal of Nuclear Plants regarding the Hatch Nuclear Power Plant, NUREG-1437. May 2001.

Supplement 5 to the Generic Environmental Impact Statement for License Renewal of Nuclear Plants regarding the Turkey Point Nuclear Power Plant, NUREG-1437. January 2002.

Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors. NUREG-0586, Supplement 1, Volumes 1 and 2. November 2002.

Supplement 8 to the Generic Environmental Impact Statement for License Renewal of Nuclear Plants regarding the McGuire Nuclear Power Plant, NUREG-1437. December 2002.

Supplement 9 to the Generic Environmental Impact Statement for License Renewal of Nuclear Plants regarding the Catawba Nuclear Power Plant, NUREG-1437. December 2002.

Environmental Impact Statement for an Early Site Permit (ESP) at the Grand Gulf ESP Site, NUREG-1817, April 2006.

STATEMENT OF PROFESSIONAL QUALIFICATIONS OF GOUTAM BAGCHI

CURRENT POSITION

Senior Level Advisor for Civil Engineering and Geoscience, Division of Engineering,
United States Nuclear Regulatory Commission

EDUCATION

M.S. Mechanical Engineering, Northeastern University, Boston, MA, 1974
M.Sc. Structural Engineering, London University, London, United Kingdom, 1964
B.E. Civil Engineering, Calcutta University, India, 1959

PROFESSIONAL

American Society of Civil Engineers: Fellow, Member ASCE Nuclear Standards
Committee
American Society of Mechanical Engineers: Member
Earthquake Engineering Research Institute: Member
Professional Engineer: Massachusetts, Pennsylvania and New York

QUALIFICATIONS

Mr. Goutam Bagchi has over 47 years of professional work experience of which 39 years is in the design, evaluation, inspection, regulation of nuclear power plant structures, systems and components. He is currently a Senior Level Advisor in the Division of Engineering, NRR. He provides authoritative technical advice and assistance to the Director, Division of Engineering, as the Senior Level Advisor and Lead Coordinator on a broad variety of technical and regulatory issues. He serves as the agency's authority in performing and coordinating the evaluation and resolution of technical and regulatory issues related to structural mechanics involving structures, seismic geosciences and civil engineering areas in nuclear power plants under licensing review related to design certification and early site permit applications, under construction, in operation, under license renewal or in decommissioning.

Mr. Bagchi joined the NRC in 1975 as a technical reviewer. In 1976 he became a senior structural engineer. In 1978 he became the Branch Chief of the Structural Research Branch in the Office of Research. He was instrumental in developing the research program on containment capacity through testing of large scale containment structures to failure. In 1987 he joined the Senior Executive Service and became the Branch Chief for Structural and Civil Engineering Branch, NRR, DE. In 1999 he joined the Senior Level Service and has since served in DE, NRR. He was instrumental in the development of the endorsement of containment inspection requirements in 10 CFR Part 50.55a and maintenance of safety-related structures within the scope of the maintenance rule, 10 CFR 50.65.

In 1987 and 1997, he and his staff conducted the standard plant certification reviews for ABWR, CE System 80+, AP600, and AP 1000 in civil, mechanical and materials engineering areas. As a senior advisor he was involved in the discussions with stake holders on issues related to early site permit applications. He provided input for the ESP template, and the criteria to be used to determine permit conditions, site characteristics and COL action items. He is involved in the review of three ESP applications in the hydrology area. He participated in

a leadership role in all major seismic programs associated with NRR since 1978: Siting rule, 10 CFR Part 100.23, Appendix S to Part 50 and the associated Regulatory Guide 1.165 and corresponding Standard Review Plan Sections, Individual Plant Examination of External Events, Seismic Margins related Unresolved Safety Issues A 40 and A 46, Probabilistic Seismic Hazard Study update of 1993, Diablo Canyon Long Term Seismic Program review and evaluation, including determination of fragility of structures, systems and components. He participated and significantly contributed to the development of risk informed in-service inspection (ISI) of reactor coolant system piping, and was instrumental in the timely review and approval of ISI programs in the Chairman's Tracking List. He has made significant contributions to the development and acceptance of the performance-based seismic design of nuclear power plants.

Mr. Bagchi provided input for the hydrology portion of RS-002, by adapting the Standard Review Plan Section 2.4 for the review of ESP applications. In 2005, Mr. Bagchi represented the NRC, and served as co-chair of two sessions, at the International Workshop on External Flooding, which looked at issues related to tsunami hazards, and was held in Kalpakkam, India. He participated in the development of a tsunami guideline document for the IAEA in Trieste, Italy in 2006 under the joint sponsorship of the International Atomic Energy Agency and the International Center for Theoretical Physics. Currently he is the technical monitor for updating Section 2.4, Hydrologic Engineering, of the SRP.

SELECTED PUBLICATIONS AND PRESENTATIONS

Ashar, H, Bagchi G, NUREG 1522, "Assessment of Inservice Conditions of Safety-Related Nuclear Plant Structures." June, 1995.

Bagchi G. et al, "U. S. Regulatory Criteria on Nuclear Plant Protection against External Flooding," presented at the International Workshop in Kalpakkam, India in October, 2005.

Bagchi G. et al, "Containment Design, Performance Criteria and Research Needs for Advanced Reactor Designs," presented at the 12th International Conference on Nuclear Engineering.

Presentation in Trieste on U. S. Tsunami Hazard Protection.

LANCE W. VAIL

Senior Research Engineer II
Environmental Technology Division
Battelle, Pacific Northwest Division
Pacific Northwest National Laboratory

Since joining Battelle in 1981, Mr. Vail has been involved in projects covering a diverse set of water related issues. His professional experience includes basic and applied research, and regulatory compliance assessments. His areas of expertise cover a broad spectrum of areas related to water resources.

RESEARCH INTERESTS

Water resource management
Multiple objective tradeoff analysis in water resources
Uncertainty analysis in water resources
Advanced hydrologic process modeling
Impacts of climate on water resources
Neural networks, fuzzy logic, and genetic algorithms applied to water resource issues
Linking simulation models with optimization methods to water resource problems
Linkage of physical and biological models in fisheries management

EDUCATION

B.S.	Humboldt State University, environmental resources engineering	1979
M.S.	Montana State University, civil engineering	1982

PROFESSIONAL AFFILIATIONS

American Geophysical Union
American Society of Civil Engineers
American Water Resources Association

CURRENT PROJECTS

Hydrologic Site Safety Reviews for Early Site Permits. Principal Investigator and Project Manager. Three applications for an Early Site Permit (ESP) have been submitted to the Nuclear Regulatory Commission. This project provides an independent assessment of the hydrologic suitability of the proposed sites. Assessments include a broad range of considerations such as flooding, low water conditions, ice impacts, seiches, storm surge, and tsunamis.

Water-related Environmental Reviews for Early Site Permits. Task Manager. Three applications for an Early Site Permit (ESP) have been submitted to the Nuclear Regulatory Commission. This task provides an independent assessment of the proposed sites' environmental suitability. Assessments include a broad range of considerations such as water-use conflicts and changes in water quality.

Snohomish Basin Characterization. Technical Contribution. Advanced distributed watershed models were applied to provide the Tulalip Tribes of Western Washington state with a thorough understanding of the impacts of logging, development, and climate on the Snohomish River Basin.

Acid Rain TMDL. Principal Investigator and Technical Project Manager. The objective of this work assignment for Region II of the U.S. Environmental Protection Agency is to develop a preliminary assessment approach for TMDLs for pH impaired waters listed on the New York State Section 303(d) list. The intent is to enhance and further develop TMDL program capabilities by providing expertise in both acid deposition and TMDL development. The development of such an assessment approach requires that available models and data resources be reviewed. Systems engineering methods will be used in developing a conceptual model to ensure that the relationships

between models and data are fully understood. The assessment approach will be tested on one or more representative watersheds to be determined in close coordination with EPA, NYSDEC and Battelle.

Environmental Impact of License Renewal of Commercial Nuclear Power Plants. Contributor. Mr. Vail assesses the water use, water quality, and hydrologic impacts of license renewal for the Nuclear Regulatory Commission's NEPA process. He has performed this function for the following commercial nuclear plants: Calvert Cliffs, Oconee, Arkansas Nuclear One, and Hatch.; McGuire, Catawba, North Anna, Robinson, Ginna, and St. Lucie.

PAST PROJECTS

- ***Chehalis Basin Characterization.*** Principal Investigator and Project Manager. Advanced numerical modeling, and GIS methods were applied to assist the Corps of Engineers in characterizing the Chehalis Basin in Western Washington State. The Chehalis Basin is subject to frequent flooding. The native populations of anadromous fish have been stressed to adverse changes in habitat resulting from development and logging.
- ***Generic Environmental Impact Statement (GEIS) for Decommissioning Commercial Nuclear Power Plants.*** Contributor. Mr. Vail provided expertise in the development of a GEIS for decommissioning of nuclear plants. He provided expertise on water use, water quality, and hydrologic impacts for the Nuclear Regulatory Commission.
- ***Impact of Climate on the Lower Yakima Basin.*** Principal Investigator and Project Manager. The objective of this three-year EPA STAR Grant Project was to develop and demonstrate an integrated assessment of the impact of climate variability and climate change on a diverse set of interests in the Lower Yakima Valley in Central Washington State. Interests considered included: surface and groundwater supply, surface and groundwater quality, air quality, public health, farm and regional economics, and fisheries. The project considered the effectiveness of changes in land management (crop selection) and water management (reservoir operation) in adapting to an uncertain future climate. A diverse set of models was linked with an optimization procedure to ensure that the tradeoffs between various resource management objectives were clearly articulated.
- ***Use of NOAA's Seasonal Climate Forecast for Water Resource Management.*** Task Manager of Reservoir Optimization Task. The objective of this NOAA funded project was to show the potential value of improved climate forecasts in managing surface water reservoirs for multiple objectives. Using a pareto genetic algorithm, the reservoir operating rules were optimized to define the tradeoff curves for hydropower, flood control, and instream flow requirements in the Tennessee River basin. Changes in forecast reliability result in changes to these tradeoffs and thereby express the value of such improved forecasts.
- ***Accelerated Climate Prediction Initiative.*** Task Manager of Water Resources and Habitat Task. This project will provide a limited, systematic assessment of the potential effects of anthropogenic climate change over the next half-century on water resources in the western United States. This objective was accomplished by "downscaling" the results of global-scale simulations to the spatial and temporal resolution needed to drive impact assessment models. Downscaling is particularly important for the West, where topography is a dominant climate driver. An important aspect of the hydrology of almost all western rivers is water management. Other than a few headwater streams, the hydrology of most rivers in the west is strongly affected by water use, and artificial storage. Water management models were used to study the effect of reservoir operations and understand the implications of climate variability and change on the water resources of the west.
- ***Linking Physical and Biological Models.*** Principal Investigator and Project Manager. The objective of this three-year Laboratory Directed Research and Development project was to develop and demonstrate an integrated natural resource analysis framework. This framework: dramatically improves the ability to integrate physical and biological models, thereby encouraging the utilization of advanced process models; allows utilization of large, sparse, and distributed data sets (including model output); communicates high-level tradeoffs and their respective uncertainties; and assesses, communicates, and minimizes scales issues.

During the first year a significant obstacle to successful linking of physical and biological models was identified to be the fundamental structural differences between such models. The pervasive vagueness of rules and the multivaluedness associated with temporal/spatial upscaling, suggested an approach using "fuzzy methods." The second year of this project utilized a variety of fuzzy methods including: fuzzy arithmetic, fuzzy logic, fuzzy clustering, and adaptive neural fuzzy inference systems (ANFIS). A series of rules and a database from the Multispecies Framework Process were employed to test the various fuzzy methods. These rules and data are used to define aquatic habitat diversity in the Pacific Northwest. A tool called FuzzyHab was developed to estimate habitat diversity from a set of categorical statements about the environment. Each of these categorical statements is vaguely defined. Estimates for each categorical statement are derived from physical process models.

- ***Integrated Natural Resource Data System.*** Contributor. This project is to demonstrate INRDS. INRDS is an advanced, web-based environmental information system that will promote public understanding of natural resource management issues and assist planners and decision makers in accessing the most relevant information and analytical tools and evaluating the tradeoffs of alternate actions. <http://inrds.pnl.gov>
- ***Early Warning of El Niño Southern Oscillation (ENSO) Events for Regional Agriculture.*** Task Manager of Reservoir Optimization Task. This project is investigating the current predictability of interannual variability in climate conditions in the Pacific Northwest to determine whether and how early warning and seasonal climate forecasts by the Climate Prediction Center (CPC) of the National Oceanic and Atmospheric Administration (NOAA) forecasts can be used to reduce the vulnerability of irrigated agriculture to low water-availability conditions. The study is funded by a grant from the economics and Human Dimensions Program of the NOAA Office of Global Programs. The Economics and Human Dimensions program aims to improve our understanding of how social and economic systems are currently influenced by fluctuations in short-term climate (seasons to years), and how human behavior can be (or why it may not be) affected based on information about variability in the climate system. <http://elrino-northwest.labworks.org>
- ***Impact of Reservoir Operating Strategies on Resident Fish*** - Mr. Vail has employed several models to assess the impact on resident fish species of a variety of reservoir operating strategies. This study was undertaken as part of the Columbia Basin System Operation Review process. Mr. Vail helped define the values and value measures of the Resident Fish Work Group.
- ***Multiobjective Optimization*** - Mr. Vail was the project manager of an effort to assess the multiobjective optimization needs of Bonneville Power Administration. Objectives included: hydropower, resident fish, anadromous fish, irrigation, flood control, wildlife, and navigation. Mr. Vail developed definitions of the canonical mathematical form of each of these objectives. The resulting multiobjective statement will be used to define the required optimization tools.
- ***Integrated Environmental Monitoring Initiative*** - Mr. Vail was a co-principal investigator for the Integrated Environmental Monitoring Initiative. The objective of this initiative was to develop and demonstrate a comprehensive interdisciplinary methodology targeted to improve the effectiveness of environmental monitoring and restoration activities. This objective required comprehensive integration of monitoring regimes, analytical practices, design methodologies, and compliance needs.
- ***Coupled Simulation/Optimization of Ground Water Remediation*** - Mr. Vail developed a computer code that coupled a ground water flow model with an optimization procedure. The code was able to provide estimates of the pumping/injection rates that would mitigate or remove a plume at minimal cost.
- ***Simulation of Watershed Hydrologic Responses to Alternative Climates*** - Mr. Vail was the principal investigator of a project studying the impacts of global climate change on the hydrologic response of a watershed. The results of hydrologic simulations using distributed snowmelt and soil moisture accounting algorithms were graphically compared via video displays of daily simulated snow water equivalent, soil moisture, and runoff for the American River, Washington, which drains 204 square kilometers of the east slopes of the Cascade Mountains, Washington. Snow water equivalents and snowmelt were simulated using a simplified distributed temperature-index model augmented with seasonally estimated net solar radiation. A classification scheme was used to partition the empirical cumulative probability distributions

of precipitation (rain plus melt) and a topographic index over the basin into groups of near-equal membership. Topographically-based soil moisture capacities were assumed for each class and were estimated via automated calibration methods using historical data. The simulated soil moisture and snow water accumulations for each class were geographically mapped for visualization. Tests of the effect of alternative, warmer climates on snow accumulation, the seasonal distribution of soil moisture, and runoff were conducted by adjusting historical (daily) temperature and precipitation and repeating the analysis.

- ***Pacific Northwest Climate Change Case Study - Water Resource Impacts*** - Mr. Vail was investigating the effects of global climate change on water resources of the Pacific Northwest. Spatially distributed snowmelt, soil moisture, and runoff models have been combined with a graphics visualization package to understand the changes in snowpack, soil moisture, and evapotranspiration over time. A weather classification scheme has been developed which estimates point precipitation as a function of large-scale atmospheric variables. This allows the synthesis of point precipitation given large-scale meteorological information as might be produced by GCM simulations. Orographic effects also have a significant role in defining climate at the watershed scale. Efforts underway to develop a scientific basis to extend the sparse meteorological measurements available for any watershed in order to estimate the spatial distribution of precipitation, temperature, and wind speed within the watershed. A reservoir network model for the Columbia River Basin has been aggregated to fourteen nodes. This network model will be driven by a collection of index watersheds. A daily hydroclimatological data set has been developed to aid in the selection of index watersheds.
- ***Acid Rain Watershed Modeling Project*** - Mr. Vail directed the hydrologic part of a study to evaluate and apply several coupled hydrology/geochemical codes that were developed to model the impact of acid rain on surface water chemistry. The project involved extensive behavior and sensitivity analyses of three coupled geochemical/hydrological simulation codes.
- ***Incineration at Sea*** - The objective of this project was to assess the impact of incinerating toxic waste at sea on the aquatic environment. Mr. Vail developed a model on an IBM-PC to estimate the concentration of contaminant in the ocean.
- ***Aquifer Thermal Energy Storage*** - The objective of this project was to develop and apply computer codes that would simulate the trade-offs between different management policies of an Aquifer Thermal Energy Storage system. Mr. Vail independently developed, validated, and applied several computer codes for this purpose.
- ***Flow and Fractured Media*** - The objective of this study is to develop a state-of-the-art predictive capability for flow and transport in saturated fractured media. Mr. Vail was responsible for implementing, modifying, and testing a computer code that models steady flow in permeable media with discrete fractures. Mr. Vail has also developed a computer code that models steady flow through fractures in an impermeable rock mass. The fractures can either be specified or generated via Monte Carlo Methods. This code was applied in an investigation of the potential impact of a nuclear meltdown on groundwater.
- ***Modeling Flow With Certainty in Hydraulic Parameters*** - The objective of this study is to develop a methodology to analyze the uncertainty in predicting piezometric surfaces caused by uncertainty in groundwater flow parameters. Mr. Vail developed a computer code that couples perturbation and finite-element techniques to estimate the mean and variance of the piezometric surface.
- ***Stripa Mine Hydrogeologic Characterization*** - The objective of this study was to perform three-dimensional simulations with the CFEST code for ground water flow at the Stripa Mine in Sweden. Mr. Vail was the Battelle project manager of this effort.

PUBLICATIONS

- Coleman A, LW Vail, and A Savery. 2005. "Landscape Classification for Assessment of Impacts of Landuse and Climate on Water Resources." Presented by Andre M Coleman (Invited Speaker) at 25th Annual Environmental Systems Research Institute International User Conference, San Diego, CA on July 25, 2005. PNWD-SA-7118.
- Prasad R, LW Vail, CB Cook, and G Bagchi. 2005. "Establishment of Safety-Related Site Characteristics Based on Consideration of External Sources of Flooding at Nuclear Power Plant Sites in the United States of America." Presented by Rajiv Prasad (Invited Speaker) at IAEA-India External Flooding Hazards Workshop, Kalpakkan, Tamil Nadu on August 29, 2005. PNNL-SA-46005.
- Scott MJ, LW Vail, CO Stockle, A Kemanian, KM Branch, R Prasad, MS Wigmosta, and JA Jaksch. 2005. "Benefits and Costs of Options to Mitigate the Uncertain Effects of Climate Change on Irrigated Agriculture in the Yakima Basin. What Matters? What Doesn't?" Presented by Michael J. Scott (Invited Speaker) at 39th Annual Pacific Northwest Regional Economic Conference, Bellingham, WA on May 20, 2005. PNWD-SA-6980.
- Scott MJ, LW Vail, and R Prasad. 2005. "Managing Water for Irrigated Agriculture Under Extended Climate-Related Drought." Presented by Michael J. Scott at American Water Resources Association 2005 Annual.
- Scott MJ, LW Vail, CO Stockle, A Kemanian, KM Branch, R Prasad, MS Wigmosta, and JA Jaksch. 2005. "Benefits and Costs of Options to Mitigate the Uncertain Effects of Climate Change on Irrigated Agriculture in the Yakima Basin. What Matters? What Doesn't?" Presented by Michael J. Scott (Invited Speaker) at Pacific Northwest Regional Economic Conference, Bellingham, WA on May 20, 2005. PNWD-SA-6902.
- Vail LW. 2005. "Adaptive Management of Water Resources in the Puget Sound." Presented by Lance W. Vail (Invited Speaker) at Puget Sound Georgia Basin Research Conference, Seattle, WA on March 29, 2005. PNNL-SA-44581.
- Scott MJ, LW Vail, CO Stockle, A Kemanian, KM Branch, R Prasad, MS Wigmosta, and JA Jaksch. 2005. "Adapting Irrigated Agriculture to Climate Variability and Change." Presented by Michael J. Scott (Invited Speaker) at 2005 Annual Meeting, American Association for the Advancement of Science, Washington, DC on February 20, 2005. PNWD-SA-6848.
- Scott MJ, LW Vail, CO Stockle, A Kemanian, KM Branch, R Prasad, MS Wigmosta, and JA Jaksch. 2005. "Adapting Irrigated Agriculture to Climate Variability and Change." Presented by Michael J. Scott (Invited Speaker) at 2005 American Association for the Advancement of Science Annual Meeting, Washington, DC on February 20, 2005. PNWD-SA-6743.
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STATEMENT OF PROFESSIONAL QUALIFICATION OF THOMAS M. CHENG

CURRENT POSITION

Senior Structural/geotechnical Engineer, geosciences and Civil Engineering Branch A (EGCA), Division of Engineering, Nuclear Reactor Regulation, U. S. Nuclear Regulatory Commission

EDUCATION

Graduate Training: Massachusetts Institute of Technology, Boston, MA 1973-1978
Ph.D. Structural Mechanics, University of Massachusetts, Amherst, MA 1971
M.S. Structural Engineering, University of Massachusetts, Amherst, MA 1969
B.S. Civil Engineering, National Cheng-Kung University, Republic of China 1960

PROFESSIONAL

American Society of Civil Engineers (ASCE):	Member
Earthquake Engineering Research Institute (EERI):	Member
Professional Engineer:	Massachusetts

QUALIFICATION

Thomas M. Cheng has over 46 years of professional working experience of which 33 years of his experience relates to the analysis, design, evaluation, and regulation of nuclear power plant structures, systems, and components.

Immediately after he received my Ph.D. degree, Mr. Cheng was employed by McIntock, Craig and Wardlaw, Inc. as a Structural Engineer in charge of the design structures and foundations, including heavy machine foundations and industry buildings. At the same time, he served as a lecturer for graduate courses in the Civil Engineering Department of the University of Massachusetts.

Before joining the Commission, Mr. Cheng was employed for five and half years as a Senior Structural Engineer by the Stone & Webster Engineering Corporation, Boston, Massachusetts. During that time, he was responsible for the seismic analysis and design of containment buildings and other seismic Category I structures. In the last two years with the Stone & Webster, he was assigned as a Lead Engineer in charge of overall engineering analysis and design of seismic Category I structures, systems and components for the prototype large breeder reactor under various combination of loads including seismic.

In August 1978, Mr. Cheng joined the Commission as a Senior Structural Engineer in charge of the seismic evaluation of seismic Category I structures, systems and components, and the review of other structural and geotechnical issues for the Systematic Evaluation program (SEP). After the completion of the SEP seismic review, Mr. Cheng started to take the responsibility for the review of seismic and structural related issues for projects including the return to power application of TVA plants (Browns Ferry Units 1, 2 and 3; Sequoyah Units 1 and 2; and Watts Bar Units 1 and 2), and the design certification application of advanced reactors (GE advanced boiler water reactor, CE System 80+, Westinghouse AP600, and Westinghouse AP1000). Mr. Cheng was also assigned for the review of geotechnical issues of the Grand Gulf early site

permit (ESP) application. Currently, his assignments include the seismic review of the Efficient Simplified Boiler Water reactor (ESBWR) design certification application and the seismic and structural review of the design certification extension of the AP1000; and revising Standard Review Plan (SRP) Sections 3.7.1 (Seismic Ground Motion), 3.7.2 (Seismic System Analysis), and 3.7.3 (Seismic Subsystem Analysis).

PUBLICATIONS

Mr. Cheng has published a number of technical papers in the proceedings of ASCE, Structural Mechanics in Reactor Technology (SmiRT) Conference, and the 10th World Conference of Earthquake Engineering Conference.

STATEMENT OF PROFESSIONAL QUALIFICATIONS OF STEPHEN P. KLEMENTOWICZ

CURRENT POSITION

Senior Health Physicist
Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission

EDUCATION

M.S. Health Physics, University of Florida, Gainesville, FL, 1981
B.S. Radiological Science, Manhattan College, New York, NY, 1980

QUALIFICATIONS

Mr. Stephen Klementowicz joined the NRC in 1990 and has over 25 years experience in Health Physics, which includes extensive regulatory experience in radiological effluent monitoring programs, radiological environmental monitoring programs, radioactive material control programs. Mr. Klementowicz's current activities involve working as a Senior Health Physicist to prepare the Environmental Impact Statement for power reactor license renewal applications, in the areas of Occupational and Public radiation exposure from routine plant operation.

In his work for the Health Physics Branch in the Division of Inspection Program Management, Mr. Klementowicz was the lead NRR technical staffer for radiological effluent and environmental issues and was frequently called upon to review difficult and complex radioactive effluent and environmental monitoring program issues, in order to determine whether licensee actions were in conformance with NRC regulatory requirements and Commission policy and direction.

Mr Klementowicz was a member of the Liquid Lessons Learned Task Force, which dealt with abnormal spills and leaks of liquid radioactive material at nuclear power reactor plant sites. He prepared a thorough discussion of the regulatory requirements and guidance for the radiological effluent and environmental monitoring programs and made recommendations to enhance the effectiveness of the NRC regulatory programs.

Mr Klementowicz was the Lead for the Public Radiation Safety Cornerstone within the NRR Reactor Oversight Process inspection program. He was responsible for the following inspection program areas: radioactive material control, radiological effluent monitoring program, and the radiological environmental monitoring program. In his role as Lead for the Public Radiation Safety Cornerstone, he provided programmatic and technical support to Regional Inspectors during their on-site inspections and assisted in the review and comment of inspection findings in the final report.

Over his career with the NRC, in the areas of effluent and environmental monitoring, he has frequently led or been a prominent speaker at public meetings with a wide variety of stakeholders.

Mr. Klementowicz was also a Team Leader for the Health Physics Branch. In that role, he provided guidance, direction, and technical support to co-workers. He planned and directed their development, providing challenging and meaningful assignments that allowed the individuals to grow in their professional careers.

Mr. Klementowicz is a member of the NRC's Emergency Response Organization. He performs dose assessment calculations to assess the radiological dose impact to members of the public from a nuclear power reactor accident.

Awards

Mr Klementowicz has received numerous performance awards for his outstanding work as a Health Physicist with the NRC. He also received an award for his work as a mentor to new NRC employees in the Nuclear Safety Professional Development Program.

Reports/Publications

Liquid Radioactive Release Lessons Learned Task Force Final Report, 2006, S. Richard, T. Frye, J. Shepherd, T. Nicholson, G. Kuzo, R. Allen, U. Shoop, S. Sakai, M. Shannon, A. Keim, S. Klementowicz, R. Nimitz, S. Orth, S. Burnell. Prepared for the NRC's Executive Director of Operations.

STATEMENT OF PROFESSIONAL QUALIFICATIONS OF YONG LI

CURRENT POSITION

Senior Geophysicist

Office of Nuclear Reactor Regulation

U.S. Nuclear Regulatory Commission

Since joining the NRC in 2002, Dr. Li has been involved in projects covering a diverse set of seismic related issues. His professional experience includes regulatory development and seismic and geologic subject review. His areas of expertise cover a broad spectrum of areas related to the geosciences.

PROFESSIONAL INTERESTS

Earthquake Source Characterization

Paleoseismology

Probabilistic Seismic Hazard Analysis

Remote Sensing

EDUCATION

Ph.D. University of Memphis, Geophysics, 1995

M.S. University of Science and Technology of China, Seismology and Geology, 1985

Postgraduate Diploma, International Institute for Aerospace and Earth Sciences, The Netherlands, 1988-1989

B.S. Changchun Technological University, Geology, 1981

PROFESSIONAL AFFILIATIONS

American Geophysical Union

Seismological Society of America

Member of Working Group of American Nuclear Society Standard -2.30, "Assessing Capability for Surface Faulting at Nuclear Facilities."

CURRENT PROJECTS

Seismic and Geologic Site Safety Reviews for Early Site Permits. Lead reviewer for geology, seismology, and geotechnical engineering sections for Grand Gulf site. Reviewed North Anna and Clinton ESP applications.

Standard Review Plan Update. Update of NUREG-0800, "Standard Review Plan For The Review of Safety Analysis Reports For Nuclear Power Plants," in the areas of geology and seismology and probable maximum tsunami.

Regulatory Guide Development. Key participant for development a new

regulatory guide for determining performance-based site-specific earthquake ground motion. Incorporated public comments and finalized regulatory guides related to site investigations, soil liquefaction and laboratory investigation.

PAUL L. HENDRICKSON

Staff Scientist
Engineered Systems Group
Environmental Technology Division

EDUCATION

B.S. Chemical Engineering, University of Washington
J.D. University of Washington Law School
M.S. Industrial Management, Purdue University

EXPERIENCE

Since joining the Pacific Northwest National Laboratory (PNNL), Mr. Hendrickson has worked extensively in the areas of legal and regulatory policy analyses, environmental studies, and analysis of the impact of regulations on technology. He has conducted and managed a wide variety of studies in such areas as the licensing and regulation of power plants and nuclear fuel cycle facilities; energy resources, development, and conservation; environmental control and impact; natural resources; and energy materials transportation. Mr. Hendrickson is a member (inactive status) of the Washington State Bar Association. Some of the programs in which he has been a major contributor include:

- Clean Air Act Support for DOE. Mr. Hendrickson has provided extensive support under the Clean Air Act (CAA) for the U.S. Department of Energy (DOE) Office of Air, Water, and Radiation Protection Policy and Guidance. He has supported the Office in several ways including 1) preparing draft comments on proposed rules issued by the Environmental Protection Agency (EPA) under the CAA, 2) collating DOE staff comments on such rules, 3) providing technical support for DOE's preparation of guidance documents for DOE field and program offices on final rules issued by EPA under the CAA, and 4) providing technical review of CAA materials prepared for the Office by other DOE laboratories and contractors.
- Environmental Impact Statement (EIS) Support. Mr. Hendrickson has supported the preparation of a number of draft EISs that PNNL has prepared for DOE and the Nuclear Regulatory Commission (NRC). His work has focused on examination of regulatory issues including permit and license requirements for the alternatives under consideration in the EIS. He has examined land use impacts of alternatives, related Federal project activities, prepared draft versions of Federal Register Notices related to EISs, and prepared responses to public comments on draft EISs. He has also prepared analyses of alternatives to the renewal of operating licenses for existing nuclear power plants and for early site permit applications. Specific EISs he has worked on include the Dual Axis Radiographic Hydrodynamic Test Facility, Hanford K Basins spent nuclear fuel, Hanford solid waste management, Waste Isolation Pilot Plant, the medical isotopes production plant, decommissioning of the Fast Flux Test Facility at Hanford, early site permit applications to the NRC for the Grand Gulf and North Anna sites, and various supplemental EISs associated with applications to the NRC to renew the operating license of individual commercial nuclear power plants.
- Hanford Site NEPA Characterization. PNNL annually prepares a document for the DOE

Richland Operations Office covering background environmental data to be used in the preparation of Hanford-related EISs and environmental assessments. Mr. Hendrickson prepares the portion of this document covering statutory and regulatory requirements.

- Preparation of DOE Directives. Mr. Hendrickson assisted the DOE Office of Office of International Regimes and Agreements in the revision of a DOE Order covering DOE requirements and responsibilities related to the Safeguards Agreement between the U.S. and the International Atomic Energy Agency. He also assisted the Office with the preparation of a revised Order and an accompanying Manual to reflect the pending Additional Protocol to the Safeguards Agreement.
- Regulatory Analysis Guidelines and Handbook. Mr. Hendrickson managed a project for the NRC involving providing technical assistance to the NRC for its preparation of Regulatory Analysis Guidelines and an associated Handbook to aid analysts in preparing regulatory analyses. The Guidelines and Handbook are used to analyze proposed requirements to be imposed on NRC licensees. This project also involved presenting a training course to NRC staff on use of the Handbook in performing regulatory analyses.
- Support for Privatization of Tank Waste Treatment at Hanford. Mr. Hendrickson supported a project managed by PNNL for DOE involving the privatization of certain treatment functions for radioactive waste stored in tanks on DOE's Hanford Site. Mr. Hendrickson's work focused on regulatory, permit, contractual, and real estate transfer issues associated with the proposed privatization. Mr. Hendrickson also supported the DOE Regulatory Unit set up to regulate the radiological safety aspects of the privatization contractor.
- Review of Impact of DOE Orders on Environmental Remediation. Mr. Hendrickson conducted a study for the DOE Office of Environmental Restoration that examined whether any of DOE's internal orders were unnecessarily inhibiting environmental remediation activities at DOE sites. The project involved interviewing selected DOE and contractor field personnel, examining DOE orders and their impact on remediation, and preparing several recommendations for DOE consideration.
- Preconstruction Schedules, Costs, and Permit Requirements for New Power Resources in the Northwest. Mr. Hendrickson was project manager and an author for this study conducted for the Bonneville Power Administration. The study developed estimates for preconstruction schedules, costs, and federal and state permit requirements for new electric power generating resources in the Pacific Northwest. Mr. Hendrickson wrote the section of the report covering permit requirements.
- Financial Qualifications Review of Applicants for Nuclear Power Plant Construction Permits. Mr. Hendrickson managed a study for the NRC that involved an investigation of whether there is any empirical evidence of a relationship between a utility's financial health at the time of its construction permit application and the subsequent safety performance of the operating plant.
- Impact of Financial Assurance Requirements on Materials Licensees. Mr. Hendrickson managed a study for the NRC relating to a proposed rulemaking that would impose financial assurance requirements on materials licensees to assure the availability of cleanup funds

for accidental releases. The study involved an investigation of types of financial assurance mechanisms, their availability and costs, and the impacts on licensees of obtaining financial assurance.

- Fitness for Duty of Nuclear Power Plant Workers. Mr. Hendrickson participated in a study for NRC that analyzed regulatory options for assuring the fitness for duty of workers at commercial nuclear power plants. The project provided the technical basis for NRC's rulemaking on drug and alcohol abuse.
- Role of State PUC Regulation on QA During Nuclear Power Plant Construction. PNNL conducted a multiyear study for NRC on quality control and assurance during nuclear power plant construction. As part of this work, Mr. Hendrickson completed a report on the role that state public utility commissions have played and potentially can play in assuring construction quality and in allocating construction costs between the utility, its shareholders, and ratepayers when quality is deficient.
- Methods to Assure the Availability of Decommissioning Funds. Mr. Hendrickson wrote chapters on the relative merits of alternative approaches to assuring the availability of decommissioning funds for seven different studies for the NRC. Each study examined the decommissioning of a separate type of fuel cycle facility.
- Legal/Regulatory Issues Affecting the Aquifer Thermal Energy Storage and the Compressed Air Energy Storage Concepts. PNNL conducted a multiyear investigation of these concepts for DOE. Mr. Hendrickson conducted an investigation of legal and regulatory issues that will affect implementation of each concept. Issues examined included environmental protection requirements, property rights issues, and potential liability.

SELECTED PUBLICATIONS

D.A. Neitzel, editor, P.L. Hendrickson, et al., Hanford Site National Environmental Policy Act (NEPA) Characterization, PNL-6415 Rev. 17, September 2005.

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P.L. Hendrickson, et al., "Revision of DOE Directives to Implement the US/IAEA Safeguards Protocol," presented at the 41st Annual Meeting of the Institute of Nuclear Materials Management, July 2000.

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P.L. Hendrickson and K.K. Daellenbach, "Regulation of Hazardous Air Pollutants Emitted from Fossil-Fired Boilers," Proceedings of the 3rd Environmental Technology Congress, Atlanta, Georgia, October 1993; also published in Energy Engineering Journal, Association of Energy Engineers, vol. 91, no. 4, 1994.

O.H. Paananen and P.L. Hendrickson, Selection of a Discount Rate For Use in NRC Regulatory Analyses And Application of Discount Rates to Future Averted Health Effects, PNL-8970, January 1993.

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P.L. Hendrickson, "Incorporating Energy Efficiency Into Residential Appraisals," The Real Estate Appraiser and Analyst, the Journal of the Society of Real Estate Appraisers, Summer 1989.

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Ecology Technical Group Manager

EDUCATION

B.S., Zoology, Oregon State University
Ph.D., Zoology, Duke University

QUALIFICATIONS

Dr. Brandt is manager of the Ecology Group at the Pacific Northwest National Laboratory (PNNL), where he has managed projects and personnel for over 15 years. He is an ecologist specializing in biological fate and effects of contaminants. His research is in ecosystem management, ecological risk assessment, and environmental characterization and monitoring.

Dr. Brandt is the manager of several projects for DOE, DOD, and industrial clients, including ecological resource compliance, ecological risk assessment, and ecological characterization. Work on these projects includes developing and evaluating habitat-based assessment and restoration methods, developing and applying risk assessment tools, and studies of contaminant uptake and transport in biota. Work areas include metals, radionuclides, and oil and oil byproducts in terrestrial systems.

Dr. Brandt's past experience at PNNL includes management of a number of ecological risk assessment and environmental impact analyses projects. His work includes development of environmental monitoring and assessment programs related to environmental contaminants, analysis of bird and mammal population dynamics, quantifying habitat use dynamics and predictive habitat associations of endangered species, developing in-situ bioindicators, and developing and using models to predict effects of human actions and contaminants on biota. Dr. Brandt has a quantitative ecology background with specific expertise in field and laboratory methodologies, statistical analyses, animal behavior, and population and community ecology of plants, birds, and small mammals.

Dr. Brandt is Adjunct Professor in the Zoology Department at Washington State University. He serves as a peer reviewer for several technical journals in the areas of mammalian field studies and risk assessment. He also serves on several Technical Advisory Groups for ecological risk assessments.

RELEVANT EXPERIENCE

Regional Environmental Impact Assessments, PEMEX Oil Company

Dr. Brandt manages a multimedia assessment of environmental impacts of petroleum exploration and production operations (onshore and offshore) by PEMEX in the Yucatan region of Mexico. This project includes comprehensive analyses of routine and accidental releases and discharges, effects of operations and discharges on human and biological systems, and design/operations changes to minimize impacts. Chemical fingerprinting techniques, multimedia transport models, and effects models are used to differentiate contaminants and effects arising from PEMEX operations from those arising from other human activities in the region, as well as

natural background conditions. The project has identified a number of processes leading to unacceptable impacts and identified remediation cost-effective approaches.

Ecological Risk and Damage Assessment, AGIP Oil Company, Treccate, Italy

Dr. Brandt is involved in analyzing the ecological effects of a large oil spill at AGIP's Treccate oil field. This project includes biological characterization of the affected area and background sites in this large agricultural region. He has been involved in the collection of field tissue samples of aquatic and terrestrial organisms, bioassays to determine effects at the individual level as well as population index measurements. The results of these studies have been used to develop ecological exposure models to estimate hazards of petroleum residuals. The results of the models are being used to evaluate ecosystem recovery during and after clean up operations.

Comprehensive Ecological Risk Assessments, US Department of Energy, Richland, Washington.

This is an ongoing project evaluating the ecological and human health risk of organic and inorganic contaminants from the US Department of Energy's Hanford Site on almost 100 miles of the Columbia River in south central Washington and north central Oregon. Dr. Brandt is the technical lead for ecological transport, exposure and effects modeling, which includes over 50 contaminants in over 50 aquatic and terrestrial organisms. Modeling incorporates food webs and accommodates exposure of mobile species. It also provides input to human health exposure models, including residential, agricultural, and Native American scenarios. The stochastic model has been used to predict risks over the next 1000 and 10,000 years from contaminants entering and moving through the groundwater/river system.

Project Manager: Civilian Nuclear Power Plant Relicensing Environmental Analysis, U.S. Nuclear Regulatory Commission, Washington, DC

Dr. Brandt manages a number of projects for the US NRC dealing with NEPA compliance requirements for relicensing nuclear power plants in the civilian sector.

PROFESSIONAL AFFILIATIONS

Society for Environmental Toxicology and Chemistry
American Chemical Association
Ecological Society of America

PUBLICATIONS

Books:

Brandt, C. A. 1992. "Social Factors in Emigration and Immigration." In Animal Dispersal: Small Mammals as a Model, N. Chr. Stenseth and W. Z. Lidicker, Jr., Eds. Chapman & Hall. pp. 96-141.

Refereed Papers:

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Friant, S. L., and C. A. Brandt. 1994. "Ecological Risk Assessment of Radionuclides in the Columbia River System - A Historical Assessment." pp. 3-1 - 3-40, In A Review of Ecological Assessment Case Studies from a Risk Assessment Perspective, EPA/630/R-94/003, Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C.

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Presentations:

A.L. Bunn, J.A. Stegen, R.J. Fellows, C.A. McKinstry and C.A. Brandt. 2002. ⁹⁹Techneium Uptake and Depuration through Water- and Food-Exposure by Rainbow Trout. Society of Environmental Toxicology and Chemistry Annual Meeting, Salt Lake City, UT.

R.J. Fellows, A.L. Bunn, J.A. Stegen, C.A. McKinstry and C.A. Brandt. 2002. ⁹⁹Techneium Uptake and Depuration in Columbia River Periphyton Communities. Society of Environmental Toxicology and Chemistry Annual Meeting, Salt Lake City, UT.

C.A. McKinstry, A.L. Bunn, R.J. Fellows, J.A. Stegen and C.A. Brandt. 2002. Pharmacokinetic Modeling of ⁹⁹Techneium in Aquatic Organisms. Society of Environmental Toxicology and Chemistry Annual Meeting, Salt Lake City, UT.

P.W. Eslinger, T.B. Miley, A.L. Bunn and C.A. Brandt. 2002. Probabilistic Ecological Risk in the Columbia River from Hanford Site Contaminants. Society of Environmental Toxicology and Chemistry Annual Meeting, Salt Lake City, UT.

Brandt, CA, and N.J. Aimo. 2001. Diagnóstico integrado del proyecto ambiental Región Sur. Invited presentation, Simposium sobre Evaluación Ambiental en el Sureste Mexicano. Universidad Juárez Autónoma de Tabasco, 21-23 February 2001, Villahermosa, Tabasco, Mexico.

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Brandt, CA. 1998. Ecological risk assessment: Introduction and Examples. 30 September 1998, Invited presentation, III Foro Técnico de Protección Ambiental, El Instituto Mexicano del Petroleo, Mexico City.

Brandt, C.A., M.H. Huesemann, and A. Porta. 1998. Bioavailability of Petroleum-derived PAHs in an Agricultural Wetland. 1-5 June, 1998, Exploration and Production of Hydrocarbons in Sensitive Areas, Villahermosa, Mexico.

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Brandt, C.A. 1998. Ecological Risk Analysis in Planning Weapons Testing. 1998 DoD Natural Resource Training Workshop, 22-30 March, 1998, Orlando, Florida.

Brandt, C.A., W.H. Rickard, and J. R. Parrish. 1998. Predicting Occurrences of Endangered Species: A Modeling Approach Using Available Field Data. 1998 DoD Natural Resource Training Workshop, 22-30 March, 1998, Orlando, Florida.

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Brandt, C.A., R.J. Fellows, D. D. Dauble, S. L. Friant, and J. M. Becker. 1994. Biological Risk Assessment, Eielson Air Force Base Sitewide Remedial Investigation/Feasibility Study. U.S. Air Force, Eielson AFB, Alaska.

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Brandt, C. A., N. A. Cadoret, and R. Mazaika. 1993. "Plant Growth on Barrier Test Plots: Colonization and Rooting." pp. A.1 - A.10 In B. G. Gilmore and W. H. Walters, Water Erosion Field Tests for Hanford Protective Barriers: FY 1992 Status Report. PNL-8949, Pacific Northwest Laboratory, Richland, Washington.

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Marr, N. V., C. A. Brandt, R. E. Fitzner, and L. D. Poole. 1988. Habitat Associations of Vertebrate Prey Within the Controlled Area Study Zone. PNL-6495, Pacific Northwest Laboratory, Richland, Washington.

STATEMENT OF PROFESSIONAL QUALIFICATIONS OF R. BRAD HARVEY

CURRENT POSITION

Physical Scientist
Division of Risk Assessment
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission

EDUCATION

M.S. Atmospheric Science, University of Michigan, Ann Arbor, MI, 1976
B.S. Physics, Rensselaer Polytechnic Institute, Troy, NY, 1975

PROFESSIONAL AFFILIATIONS

American Meteorological Society
American Nuclear Society
Nuclear Utility Meteorological Data Users Group

CERTIFICATIONS

Certified Consulting Meteorologist, American Meteorological Society, 1992

INDUSTRY COMMITTEE ACTIVITIES

ANS-3.11 Working Group. One of the primary authors for ANSI/ANS-3.11-2005, "Determining Meteorological Information at Nuclear Facilities"

NEI Control Room Habitability Task Force. Participated as an industry member coordinating and authoring Appendix D, "Atmospheric Dispersion," and Appendix G, "Toxic Gas Assessments," to the original (June 2001) version of NEI 99-03, "Control Room Habitability Assessment Guidance"

QUALIFICATIONS

Mr. Harvey is a Certified Consulting Meteorologist with over 29 years of experience in performing and reviewing meteorological monitoring, atmospheric dispersion modeling, climatic evaluations, and air quality licensing analyses for the nuclear power industry. Mr. Harvey's experience includes performing atmospheric dispersion analyses and dose assessments for nuclear plant routine release and design basis accident applications. Mr. Harvey has also participated in developing emergency response dose assessment models and in performing toxic gas analyses for control room habitability evaluations. In addition, he has assisted nuclear plants in completing air emission inventories and air quality licensing documents. Mr. Harvey has been active on industry committees concerned with control room habitability and meteorological monitoring.

Mr. Harvey joined the NRC in 2003. Prior to joining the NRC, Mr. Harvey was employed by an NRC licensee (Yankee Atomic Electric Company) and several consultants (Sargent & Lundy, Duke Engineering and Services, and Framatome-ANP).

NRC Experience

Meteorological Site Safety Reviews for Early Site Permits. Mr. Harvey reviewed the Site Safety Analysis Report (SSAR) submittals supporting the Clinton, Grand Gulf, and North Anna Early Site Permit (ESP) applications, including preparing the associated Safety Evaluation Report (SER) sections related to climatology, meteorological monitoring, and design-basis accident and routine release atmospheric dispersion modeling. These reviews established that (1) site climatic characteristics to ensure potential threats from severe weather will pose no undue

risk to the type of facility proposed to be located at the site, and (2) site atmospheric dispersion characteristics to ensure radiological effluent release limits associated with normal operation and radiological dose consequences associated with postulated accidents can meet regulatory criteria.

Meteorological License Amendment Reviews for Alternative Source Term Implementation. Mr. Harvey reviewed onsite meteorological data sets and control room and offsite atmospheric dispersion analyses submitted in support of nine license amendment requests related to implementation of the Alternative Source Term (AST) pursuant to 10 C.F.R. 50.67.

Revision to Regulatory Guide 1.23, "Onsite Meteorological Programs." Mr. Harvey served as technical lead in the development of DG-1164 (Third Proposed Revision 1 of Regulatory Guide 1.23), "Meteorological Monitoring Programs for Nuclear Power Plants." This regulatory guide describes a suitable onsite meteorological monitoring program for collecting the basic meteorological data needed to support new reactor licensing and operating plant needs. The draft regulatory guide revision updates the discussion of applicable regulations and references to associated regulatory guides, provides new guidance to reflect current meteorological monitoring equipment and practices, and clarifies monitoring criteria for supporting emergency planning requirements.

Revision to Regulatory Guide 1.76, "Design Basis Tornado for Nuclear Power Plants." Mr. Harvey served as project manager coordinating the development of DG-1143 (Proposed Revision 1 of Regulatory Guide 1.76), "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants." DG-1143 provides new guidance for use in selecting the design-basis tornado and design-basis tornado-generated missiles that a nuclear plant should be designed to withstand. The new guidance is based on a more extensive set of historical tornado data and improved methods for estimating the frequency of exceedance of tornado wind speeds. Mr. Harvey's associated activities included (1) co-authoring SECY-04-0200, "A Risk-Informed Approach to Defining the Design Basis Tornado for New Reactor Licensing," and (2) serving as co-program monitor for Revision 1 to NUREG/CR-4461, "Tornado Climatology of the Contiguous United States."

Member of NRC's Incident Response Organization. Mr. Harvey was assigned as a weather and dispersion analyst on the protective measures team (PMT) for responding to reactor, fuel cycle, and material transportation incidents.

Private Sector Experience

Supervisor, Radiological Engineering. Mr. Harvey directed the technical, administrative, and business development activities of more than 20 radiological engineering professionals. He managed many functions including radiological design engineering (activation analysis, shielding, equipment qualification, accident analysis, source term), effluent and environmental monitoring (RETS/REMP, waste management, pathway dose), and meteorological services (database management, dispersion analyses). Clients included operational commercial power reactors, facilities undergoing decommissioning, and other firms requiring radiological support (e.g., biotech).

Onsite Meteorological Monitoring Support. Mr. Harvey developed nuclear plant meteorological monitoring system design basis documents, instrumentation specifications, and data collection algorithms. He wrote procedures for the review and validation of onsite meteorological data and supervised meteorological data reduction and validation activities for the Yankee Rowe, Vermont Yankee, Maine Yankee, and Seabrook nuclear plants. He developed a Program Manual for the Millstone Station meteorological monitoring program that identified and coordinated the resolution of over 200 regulatory and guidance document criteria that were applicable to the monitoring program.

Meteorological Sections of Safety Analysis Reports and Environmental Reports. Mr. Harvey prepared the meteorological sections of the Safety Analysis Reports and Environmental Reports supporting the operating license applications for the Byron, Braidwood, and Seabrook nuclear plants, addressing such topics as climatology, onsite meteorological monitoring, and atmospheric dispersion modeling.

Atmospheric Dispersion Analyses for Nuclear Power Plant Applications. Mr. Harvey managed the development of a software code, AEOLUS-2, for calculating atmospheric dispersion factors for routine gaseous releases from nuclear plants, and he generated atmospheric dispersion factors for use in nuclear plant offsite dose calculation manuals (ODCMs). He calculated offsite dose estimates resulting from routine liquid and gaseous effluent releases for the Annual Radioactive Effluent Release Reports for the Yankee Rowe and Seabrook nuclear stations. He generated atmospheric dispersion analyses to evaluate control room habitability for potential accident radiological and toxic gas releases for several nuclear plants.

Emergency Response Dose Assessment Support. Mr. Harvey developed near real-time atmospheric dispersion modeling tools for use during radiological emergencies at several nuclear plants, including a variable-trajectory plume-segment atmospheric dispersion model called METPAC, which handled the site-specific topographic features of flat terrain (e.g., Maine Yankee), river valley (e.g., Yankee Rowe, Vermont Yankee), and coastal (e.g., Seabrook) sites. He trained nuclear plant emergency response personnel in atmospheric dispersion modeling techniques and provided meteorological support during nuclear plant radiological emergency response drills and exercises for the Yankee Rowe, Vermont Yankee, Maine Yankee, and Seabrook nuclear plants.

Consequence Analysis for Domestic Licensing of Special Nuclear Material. Mr. Harvey developed and implemented the consequence analysis methodology (e.g., estimating and classifying worker and public exposures to potential accident UF_6 releases) in support of the Louisiana Energy Services (LES) Gas Centrifuge Facility Integrated Safety Analysis (ISA) in accordance with Subpart H of 10 CFR 70 and NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility."

SELECTED PRESENTATIONS AND PROCEEDINGS

"ANSI/ANS-3.11-2005: American National Standard for Determining Meteorological Information at Nuclear Facilities," presented at the 16th Annual RETS/REMP Workshop, Mashantucket, CT, June 2006.

"Climatic Site Characteristics for Early Site Permits," presented at the 2005 ANS Annual Meeting, San Diego, CA, June 2005.

"The ARCON96 Atmospheric Dispersion Model," presented at the 2004 ANS Winter Meeting, Embedded Topical Meeting: 2004 Operating Nuclear Facility Safety (2004 ONFS), Washington, DC, November 2004.

"Using ARCON96 for Control Room Radiological Habitability Assessments," co-authors Steve LaVie and Leta Brown, presented at the Ninth Nuclear Utility Meteorological Data Users Group Meeting, Chattanooga, TN, October 2003.

"Atmospheric Dispersion Factors: What Are They and Why Do We Use Them," co-author Ted A Messier, presented at the 2002 RETS/REMP workshop, Atlantic City, NJ, June 2002.

"Meteorological Data Processing for Commercial Nuclear Power Plants," co-author Ted A Messier, presented at the 2002 RETS/REMP workshop, Atlantic City, NJ, June 2002.

"NEI 99-03 Appendix D, Atmospheric Dispersion, and Appendix G, Toxic Gas Assessments," presented at the NEI Control Room Habitability Workshop, Clearwater Beach, FL, August 2001.

"Ongoing Developments in Atmospheric Dispersion Analyses for Control Room Habitability Evaluations," presented at the 2001 ANS Annual Meeting, Milwaukee, WI, June 2001.

"NEI 99-03: Control Room Habitability Assessment Guidance," presented at the Seventh Nuclear Utility Meteorological Data Users Group Meeting, Las Vegas, NV, October 2000.

"Millstone Station Meteorological Monitoring Program Manual," co-authors Gary W Johnson and John Leavitt, presented at the Seventh Nuclear Utility Meteorological Data Users Group Meeting, Las Vegas, NV, October 2000.

"Time-Dependent Atmospheric Dispersion Factors for Use in Offsite Dose Calculation Manuals," co-author M. S. Strum, presented at the 2000 RETS/REMP Workshop, Falmouth, Mass., June 2000.

"A Methodology for Calculating Meteorological Channel Accuracies," presented at the Sixth Nuclear Utility Meteorological Data Users Group Meeting, Syracuse, N.Y., May 1999.

"A Review of the NRC Emergency Response Code RASCAL Version 2.1," presented at the Fourth Nuclear Utility Meteorological Data Users Group Meeting, San Francisco, Calif., April 1996.

"Atmospheric Dispersion Modeling Applications in the Nuclear Power Industry," presented at the ASTM 1995 Johnson Conference on Performance Evaluation of Atmospheric Dispersion Models, Johnson, Vt., July 1995.

"Meteorological Aspects of Emergency Action Level Schemes: NUREG-0654 Versus NUMARC-007," presented at the Third Nuclear Utility Meteorological Data Users Group Meeting, Charlotte, N.C., October 1994.

"Experience in Implementing a 10m Backup Meteorological Tower," co-author T. A. Messier, presented at the Second Nuclear Utility Meteorological Data Users Group Meeting, Boston, Mass., April 1993.

"Regional Weekly Background Variations in REMP-Reported Airborne Gross-Beta Activity; Influence of Meteorological Factors," co-author S. Farber, presented at the 1992 RETS/REMP Workshop, Concord, Mass., June 1992.

"Technical Specification and Off-Site Dose Calculation Manual Meteorological Requirements," presented at the First Nuclear Utility Meteorological Data Users Group Meeting, Chattanooga, Tenn., November 1991.

STATEMENT OF PROFESSIONAL QUALIFICATIONS OF JAY Y. LEE

CURRENT POSITION

Senior Health Physicist
Accident Dose Branch
Division of Risk Assessment
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission

EDUCATION

B.S.	University of Minnesota, Chemical Engineering	1962
M.S.	Catholic University of America, Radiation Protection	1978

PROFESSIONAL AFFILIATIONS

American Nuclear Society
American Health Physics Society

INDUSTRY COMMITTEE ACTIVITIES

ANS-18.1 Working Group, "Radioactive Source Term for Normal Operation of Light Water Reactors."
ANS-55.6, Working Group, "Liquid Radioactive Waste Processing System for Light Water Reactor Plants."
ANS-55.4, Working Group, "Gaseous Radioactive Waste Processing System for Light Water Reactor Plants."

QUALIFICATIONS

Mr. Lee joined the NRC in 1974 and has over 40 years of experience in design, construction, operation, and licensing of nuclear power reactors.

Prior to joining the NRC in 1974, Mr. Lee worked at Pathfinder Atomic Power Plant (decommissioned) of (then) Northern States Power Company in Sioux Falls, SD as a nuclear chemist (1962 to 1966) and at Rancho Seco Nuclear Generating Station (decommissioned) of the Sacramento Municipal Utility District in Sacramento, CA as a chemical engineer and a health physicist (1969 to 1974). From 1966 to 1969, Mr. Lee worked at Bechtel Corporation in San Francisco, CA as a nuclear engineer and worked on design and construction of the Radioactive Waste Management Systems and the Reactor Water Treatment Systems for nuclear power plants (Palisades and Peach Bottom Nuclear Stations).

Current NRC Work

Site Characteristics and Radiological Consequence of Design Basis Accident Reviews for Early Site Permits. Mr. Lee reviewed the Site Safety Analysis Report (SSAR) submittals supporting the Clinton, Grand Gulf, and North Anna Early Site Permit (ESP) applications, including the preparation of the associated Safety Evaluation Report (SER) sections related to site characteristics and radiological consequences of design basis accidents. He reviewed draft and final Environmental Impact Statements prepared by an NRC contractor for the Clinton, Grand Gulf, and North Anna Early Site Permit (ESP) applications.

Standard Reactor Design Certification Review. He is reviewing General Electric ESBWR standard reactor design certification application Chapter 6, "Containment systems," and Chapter 15, "Safety Analysis."

License Amendment Reviews for Alternative Source Term (AST) Implementation. He is reviewing the radiological consequence analyses in support of licensing amendment requests related to implementation of the AST pursuant to 10 CFR 50.67.

He is participating in the NRC's new rulemaking of 10 CFR 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

He is preparing Regulatory Guide and Standard Review Plan Development for COL Applications.

He is developing reactor accident source terms for high burnup fuel and MOX fuel.

Recent Selected NRC Experience

Review Standard (RS)-002, "Processing Applications for Early Site Permits." He prepared selected sections of Chapter 2 and Chapter 15, "Radiological Consequences of Design Basis Accidents," of RS-002.

Standard Reactor Design Certification Reviews. He reviewed the standard reactor design certification of GE/ABWR, CE System 80+, Westinghouse AP600, and ACR 700 reactors and prepared safety evaluation reports for the radiological consequence analyses of the postulated reactor design basis accidents. Mr. Lee also completed the review of EPRI Advanced Light-Water Reactor Requirement Documents for Evolutionary and Passive Designs.

He helped refine the NRC Severe Accident Computer Code (MELCOR) and Consequence Computer Code (MACCS)

SELECTED PUBLICATIONS AND PRESENTATIONS

- NUREG-0016, Revision 1, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors (BWR-Gale Code)." 1979.
- NUREG-0017, Revision 1, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (PWR-Gale Code)." 1985.
- ANSI/ANS Standard 18.1 (as a working member), "Radioactive Source Term for Normal Operation of Light Water Reactors." Revision 0 (1976), Revision 1(1984), and Revision 2 (1999).
- SECY-94-302, "Source Term Related Technical and Licensing Issues Pertaining to Evolutionary and Passive Light-Water Reactor Designs" (1994).
- Presentation to 2004 ANS Winter Meeting, "Reactor Accident Source Term Program at U.S. Nuclear Regulatory Commission," Washington, D.C. November 2004.
- Presentation to 2006 ANS Annual Meeting, "Alternative Source Term Implementation at U.S. Reactors," Reno, NV, 2006.
- Presentation to 14th Pacific Basin Nuclear Conference, "Implementation of Alternative Source Term at U.S. Power Reactors," Honolulu, Hawaii, March 2004.

- Presentation to 2006 Cooperative Severe Accident Research and MELCOR code Assessment Technical Review Meeting, "Alternative Source Term Implementation at U.S. Power Reactors," Albuquerque, NM, September 2006.

RESUME

JAMES V. RAMSDELL, JR.

Staff Scientist
 Applied Atmospheric Science
 FUNDAMENTAL SCIENCE DIRECTORATE
 Battelle, Pacific Northwest Laboratories

EDUCATION

B.S.	General Sciences, Oregon State University, Corvallis, Oregon	1961
M.S.	Meteorology, Oregon State University	1962
	Graduate Study, Atmospheric Sciences, University of Washington, and Joint Center for Graduate Study, Richland, Washington	1968-1976

EXPERIENCE

Mr. Ramsdell has been a member of the Battelle staff since 1967. He has worked as an individual contributor, as a member of intra- and interdisciplinary research teams, and as a project leader for intra- and interdisciplinary research teams. His areas of expertise include: research planning and organization, dispersion modeling, and applied atmospheric boundary layer description. He has reviewed manuscripts for the editors of: *Science*, *Journal of Climate and Applied Meteorology*, *Atmospheric Environment*, *Health Physics*, *Nuclear Technology*, *Solar Energy*, and the *Journal of Energy*, and he has been on review teams for the U.S. Department of Energy, the U.S. Nuclear Regulatory Commission, the U.S. Environmental Protection Agency, and the National Research Council. In addition, he has made presentations to National Academy of Sciences Review Panels and to the U.S. Nuclear Regulatory Commission's Advisory Committee on Reactor Safeguards.

- Review of Early Site Permit Applications. Mr. Ramsdell is the manager of a project assisting the U.S. Nuclear Regulatory Commission in reviewing applications and preparing environmental impact statements for Early Site Permits (ESP) for new nuclear power plants. These permits are authorized in a part of the NRC's regulations that has not been tested. Three ESP applications were submitted in the fall of 2003. Draft EISs for public comment were completed in late 2004 and early 2005. More than 1,000 sets of comments were received on each the first two EISs. Final EISs will be completed in 2006.

- Generic Environmental Impact Statement for License Renewal of Nuclear Plants. Mr. Ramsdell is the manager of a project that is performing the 10-year update of the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG-1437. This document lists and evaluates environmental issues related to renewal of operating licenses for nuclear power plants. Where possible, the document reaches generic conclusions on the environmental impacts. These conclusions, along with the conclusions reached in site specific supplements, form the bases for staff recommendations to the Nuclear Regulatory Commission on the environmental acceptability of renewing nuclear power plant operating licenses.
- Environmental Impact Statements for Nuclear Power Plant License Renewal. Mr. Ramsdell is the manager of a project that is preparing site specific supplements to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG-1437. Seventeen of these supplements have been completed, and work is underway on supplements for several more nuclear plants. These supplements contain site-specific reviews of environmental issues related to renewal of nuclear power plant operating licenses for which generic conclusions could not be reached in NUREG-1437. In addition, the supplements address issues that were not considered previously, or for which there is new information.
- Tornado Climatology. In April 2005, Mr. Ramsdell completed an update of the 1986 climatology of tornadoes in the contiguous United States that was prepared for the U.S. Nuclear Regulatory Commission. The climatology, which covers more than 46,000 tornado segments observed between 1950 and August 2003, estimates tornado strike probabilities for 1°, 2°, and 4° latitude and longitude boxes. Design wind speeds with probabilities of being exceeded of 10^{-5} , 10^{-6} , and 10^{-7} per year are also estimated for these boxes. Design wind speeds are also estimated for three regions of the country at the three probability levels.
- Generic Environmental Impact Statements for Decommissioning Nuclear Power Plants. Mr. Ramsdell was part of a PNNL team that reviewed the environmental impacts of decommissioning nuclear power reactors. Based on the results review, the team prepared an update to NRC's *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, NUREG-0586.
- Dispersion Modeling. Mr. Ramsdell is a lead scientist in development of applied atmospheric dispersion models at Battelle. He specializes in development of models for atypical applications. He has developed and validated models for dispersion under low wind speed conditions and for dispersion in the vicinity of buildings. He developed a set of models to evaluate potential consequences of a release of material associated with a potential collapse of the shelter covering the Chernobyl Unit 4 reactor. He developed and validated the dispersion model used in Hanford Environmental Dose Reconstruction (HEDR) Project, which examined the consequences of the release of ^{131}I from the Hanford Site, and he developed the atmospheric dispersion model that is part of the U.S. Nuclear Regulatory

Commission's Radiological Assessment System for Consequence Analysis (RASCAL).

Each of these models represented an advance in the state of the art of applied dispersion modeling. The models of dispersion in low wind speed conditions and in the vicinity of buildings are being considered by the U.S. Nuclear Commission for use as standard models for regulatory purposes. The Chernobyl model included multiple plumes with variation of particle sizes and densities as a function of distance within a Gaussian model framework. The RATCHET code, developed for the Centers for Disease Control and Prevention as part of the HEDR Project, explicitly treats uncertainty in the input data to produce a range of estimates of concentration in the environment that are consistent with the available data and has become the standard dispersion model for use in Dose Reconstruction Studies for DOE sites. RASCAL is used by the U.S. Nuclear Regulatory Commission and others to estimate source terms, atmospheric dispersion, and doses during emergencies at nuclear power plants. Version 3.0 of RASCAL includes a model for UF_6 releases at fuel cycle facilities. This new model combines a dense-gas dispersion model with a thermodynamic model of the reaction of UF_6 and water.

Mr. Ramsdell also assisted in upgrading the atmospheric dispersion models in the GENII code; upgrading the atmospheric dispersion models used for assessing nuclear power plant control room habitability; and development of a Monte Carlo model to estimate release rates from environmental monitoring data.

- Environmental Impacts of Extending Reactor Fuel Burnup Above 60 GWd/MTU. Mr. Ramsdell led a study to evaluate the environmental impacts of increasing the burnup of reactor fuel (increasing the energy extracted from the fuel). This study included evaluation of changes in the radionuclide inventory in the fuel and releases of radionuclides to the gaps in fuel rods as burnup increases, changes in impacts associated with the front-end of the nuclear fuel cycle and normal reactor operations, changes in potential impacts of postulated reactor accidents, changes in impacts of transportation of spent nuclear fuel, and the economic effects of increasing fuel burnup.
- Environmental Review Plans. Mr. Ramsdell managed a project to review and update the U.S. Nuclear Regulatory Commission's *Environmental Standard Review Plans for the Environmental Review of Construction Permit Applications for Nuclear Power Plants*. These environmental standard review plans (ESRPs) had not been updated since they were written in the late 1970s. The updated document, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants*, NUREG-1555, was published for public comment in October 1997. The final document was published in March 2000. A supplement to the ESRPs, dealing specifically with environmental reviews associated with nuclear power plant license renewal, was also published in March 2000.

As part of this project, PNNL assisted the NRC staff in preparation of a supplement to its *Final Environmental Statement Related to the Operation of the Watts Bar Nuclear Plant, Units 1 and 2*. Another portion of the project involved assisting the NRC staff in

identification of the measures necessary to ensure that activities in and around nuclear power plants comply with and further the purposes of the Endangered Species Act.

- Emergency Response Planning. Mr. Ramsdell has been an NRC observer for nuclear power plant emergency exercises and a member of emergency response facility appraisal teams. He has been involved in several studies related to emergency response planning. He led a team that reviewed criteria used by NRC to evaluate dispersion models for emergency response applications. The review covered the areas of: non-buoyant releases from buildings and building vents, elevated release diffusion rates, and identification of fumigation conditions and fumigation climatology.
- Extreme Wind Analyses. Mr. Ramsdell was lead scientist in the development of techniques for estimating extreme winds for use by the NRC in probabilistic risk assessments. This work has led to new techniques for adjusting extreme winds to a standard measurement height and computation of tornado strike probabilities. Published products include a tornado climatology for the contiguous United States and a report that describes a procedure for estimating extreme winds using readily available wind data.
- Environmental Impact Statements. Mr. Ramsdell has contributed to both the preparation of environmental impact statements for Battelle's industrial customers and the review of statements submitted to the Nuclear Regulatory Commission. In 1974 he wrote a detailed review of the instrumentation for meteorological monitoring programs at nuclear power plant sites. Mr. Ramsdell is involved in the continuing evaluation of the environmental impacts of the development of the Department of Energy's Hanford Area.
- Wind-Induced Bridge Motions. The Federal Highway Administration sponsored a Battelle study of wind-induced motions of the cable-stayed bridge between Pasco and Kennewick, Washington. Mr. Ramsdell was responsible for the installation and maintenance of wind instruments and the data collection and analysis for this study. Data analysis included description of winds associated with bridge motion in terms of threshold speeds, critical approach angles for the onset of motion and gust spectra. Coherence of the horizontal and vertical wind components along the span was also examined.
- Wind Energy Conversion. Battelle provided technical and management support for the Wind Characteristics Program Element of the Department of Energy's Wind Energy Program. From Battelle's initial involvement in February 1976 through June 1977, Mr. Ramsdell was the Principal Investigator of the Program Element. In that capacity, he coordinated the wind characteristics research funded through the Program Elements. He participated in the program as a scientist and contract monitor. He has organized and conducted several wind characteristics workshops.

- Wind Measurement. As a part of the research for the Department of Energy's Wind Energy Program, Mr. Ramsdell pursued various aspects of wind measurement. He has helped develop a short course on selection of sites for the installation of wind energy conversion systems; he has written chapters on wind instrumentation and measurement for several books and reports; he has conducted a wind tunnel evaluation of inexpensive anemometer systems, and he has examined strategies for efficient use of a limited number of instruments for estimating the wind recourse at a large number of locations.
- Wind Speed Time Series Simulation. The economic evaluation of large wind energy conversion systems requires the matching of available wind energy with energy demand on an hour-by-hour basis. Mr. Ramsdell developed a Monte Carlo simulation model to generate wind speed time series that have the correct statistical characteristics. The model is capable of duplicating known seasonal and diurnal variations in the mean wind, as well as the hour-to-hour correlation between wind speed observations.
- Nuclear Energy Center Evaluations. In the middle and late 1970s, Mr. Ramsdell was involved in the evaluation of the energy center concept. He concentrated on the environmental impact of the energy releases from energy center cooling systems, and has considered both wet and dry cooling systems. He also examined the meteorological factors associated with multiple-reactor contamination following an accidental release of radioactive material in a nuclear energy center. In 1976, Mr. Ramsdell was the project leader for an interdisciplinary study of the postulated weather modification effects of large energy releases. That study examined the potential ecological and economic effects that might result from the weather modification as well as estimated the magnitude of the modification.
- V/STOL Air Craft Operations in an Urban Area. From 1972 through 1974, Mr. Ramsdell was principal investigator for an extensive state-of-the-art review and analytical and experimental study of meteorological problems associated with terminal area operations of Vertical/Short Take-Off and Landing (V/STOL) aircraft. The first phase of this study included identification of those meteorological parameters that significantly affect V/STOL operation. In the second phase of the study, an extensive data collection program was completed that included the measurements of both temporal and spatial features of models of turbulence below an altitude of 200 feet. Analysis of these data led to models of turbulence in an urban area.
- Atmospheric Diffusion and Transport. Mr. Ramsdell has been involved in atmospheric transport and diffusion studies since 1967. His experience includes collection and analysis of diffusion data from Hanford, Vandenberg Air Force Base in California, and Plowshare nuclear cratering experiments at the Nevada Test Site. He published the diffusion data collected at Hanford between 1959 and 1974.

PROFESSIONAL AFFILIATIONS

American Meteorological Society
Health Physics Society

EVA ECKERT HICKEY

Staff Scientist, Environmental Health Sciences
Environmental Technology Division

Education

M.S.	Health Physics, Georgia Institute of Technology	1980
B.S.	Biology, with an option in Health Physics, Virginia Polytechnic Institute and State University	1978

Experience

Ms. Hickey has worked at Battelle for twenty five years as a project manager and technical group manager. Her areas of health physics expertise include emergency preparedness for nuclear and hazardous material facilities, environmental impact evaluation, decontamination and decommissioning, operational health physics, air monitoring instrumentation and environmental monitoring.

Emergency Preparedness/Management. Ms. Hickey has worked in the area of emergency preparedness since 1979. She was a member of National Council on Radiation Protection and Measurements Scientific Committee 46-14, "Radiation Protection Issues Related to Terrorist Activities that Result in the Dispersal of Radioactive Material", and co-authored the NCRP report, which was published in late 2001. Currently she is supporting a major project for the Department of Homeland Security, where her primary focus is assessing the status of comprehensive emergency preparedness for the Seattle Washington region. She is also assisting King County in enhancing its emergency response plan to respond to an event resulting in radiological materials in the County sewer system.

Ms. Hickey has been involved in the U.S. Nuclear Regulatory Commission and U. S Department of Energy Emergency Management programs, has observed and assessed over 70 NRC/FEMA evaluated exercises at 50 sites in the U.S., and has conducted in-depth emergency preparedness appraisals at many sites. She was involved in the development of the NRC guidance for post-Three Mile Island requirements (NUREG-0654, NUREG-0696, NUREG-0814, NUREG-0737) and was involved in the development of the NRC's comprehensive emergency preparedness appraisal program and subsequent inspection programs. These programs not only involved on-site emergency response, but also in-depth review of local emergency planning and coordination.

While at Battelle, Ms. Hickey served as the Technical Leader for NRC's multi-million dollar Emergency Preparedness program, which had over 20 staff and a like number of contractors. She managed a variety of projects that supported the overall program. Her primary areas of expertise are in emergency dose assessment, environmental monitoring, emergency instrumentation, in-plant surveys, contamination and exposure control and protective actions. Ms. Hickey has performed similar activities for DOE in emergency management guidance development, exercise observation and program evaluation.

Ms. Hickey has been involved in the development and conduct of many training courses and workshops, both for NRC and DOE, in the areas of emergency exercise observation and evaluation, scenario development, exercise conduct, emergency plan reviews and overall emergency preparedness and management. She has also been involved in the development and conduct of exercises, for both NRC and DOE, for fixed facilities and for hazardous material transportation.

Ms. Hickey currently manages an emergency preparedness project for DOE. This project provides technical support in development of regulatory guidance, emergency program enhancement and evaluation, exercise observation, and scenario development for exercises for all types of hazardous material facilities.

Environmental. Ms. Hickey has supported NRC in the preparation of numerous environmental impact statements, including Supplemental Environmental Impact Statements for the relicensing of commercial nuclear reactors as well as environmental impact statements for early site permits for new nuclear power reactors. These reviews include site audits and discussions with state, local and federal representatives associated with the action. She provided technical support to the NRC on updating and revising a standard review plan for the review of environmental protection issues related to nuclear power plant licensing and is currently the task lead for the Environmental review of one of the first three early site permit applications.

Instrumentation and Air Sampling. Ms. Hickey managed a joint NRC and DOE project that developed the ANSI standards for instrument performance and testing. Ms. Hickey was the manager and lead author for an NRC project that developed NUREG-1400, *Air Sampling in the Workplace*, which is a guide for operational health physicists for developing or improving air sampling programs at NRC licensed facilities to support the implementation of the revised 10 CFR Part 20 requirements. In addition, Ms. Hickey provided technical assistance to NRC licensed fuel fabrication facilities in adjusting Derived Air Concentrations to meet the requirements in 10 CFR 20. She has been involved in performing qualitative air flow studies (i.e., smoke testing) at selected Hanford facilities as a means of evaluating the adequacy of air sampler and monitor locations.

Program Evaluation and Assessments. Since joining Battelle, Ms. Hickey has managed and been involved in numerous projects related to the development and conduct of appraisals, program assessments and inspections. She was project manager and technical group leader supporting a major NRC project that developed and conducted intensive appraisals and inspections in support of emergency preparedness following the accident at Three Mile Island. She has conducted more than 70 appraisals, audits and inspections at NRC licensed and DOE facilities. In many cases she was the team leader for a PNL team including health physicists, nuclear engineers, human factors experts, computer scientists and safety and security experts. In addition to her NRC emergency preparedness support, she was a major contributor to a project for DOE HQ that

developed assessment procedures for evaluating the oversight of DOE in the areas of health physics, industrial hygiene and emergency management.

Decommissioning. Ms. Hickey was the task leader for the development of the revision to NUREG-0586, *Generic Environmental Impact Statement of Decommissioning of Nuclear Facilities*. Ms. Hickey also assisted in the development of regulatory guidance for the NRC to provide to licensees of nuclear power plants that are planning to or have permanently ceased power operations. Ms. Hickey provided technical support to the NRC during its review of the Trojan Nuclear Plant's Decommissioning Plan.

Operational Health Physics. Ms. Hickey has provided technical support to DOE and NRC in health physics and industrial hygiene. Ms. Hickey has been involved in the preparation of guidance to support the DOE Orders with respect to 10 CFR 835 and the Radiological Control Manual (RCM), and NRC guidance to support 10 CFR 20 requirements. She has conducted radiological audits and appraisals at various Hanford facilities. She has contributed to the preparation of radiological sections of Safety Analysis Reports (SARs). Ms. Hickey was the project manager and primary contributor to the draft Pantex Radiological Control Manual and has been involved in projects at Pantex related to the implementation of the RCM and 10 CFR 835. Ms. Hickey has been a technical contributor to projects, for both NRC and DOE, related to residual radioactivity and contamination surveys at nuclear power plants and other nuclear facilities.

From February through August 1985, Ms. Hickey was a Senior Radiological Engineer for Hydro Nuclear Services, Inc. (HNS). She was project manager for a six person team providing technical assistance to Georgia Power Company (GPC) in the areas of health physics, chemistry and emergency preparedness. In addition, Ms. Hickey was project manager for the development and conduct of the Hatch Nuclear Plant 1985 emergency preparedness exercise.

In 1979, Ms. Hickey (Eckert) was an environmental engineer (co-op) for the Nuclear Regulatory Commission, Region II and provided support to NRC inspectors during nuclear reactor inspections and during the Three Mile Island accident investigation.

Professional Affiliations

National Council on Radiation Protection and Measurements Scientific Committee 46-14, "Radiation Protection Issues Related to Terrorist Activities that Result in the Dispersal of Radioactive Material"

Member of the Board of Directors for the Health Physics Society 2004-2007

Member of the Health Physics Finance Committee 2004-2007

President of the Columbia Chapter Health Physics Society 1994-95.

Member of the national Health Physics Society since 1981.

HPSSC Working Group "Methods for evaluating radiation protection requirements for handling radioactive material."

HPSSC Working Group "Air Sampling"

Member and Chair of the Health Physics Society Summer School Committee 1986 - 1989 and member 1992 - 1999.

Member of the Columbia Chapter Health Physics Society (CCHPS) since 1980. President-elect for 1993-94.

Member of the CCHPS Public Information and Publicity Committee 1983 - 1984.

CCHPS Assistant Newsletter Editor 1984 - 1986.

CCHPS Newsletter Editor 1987 - 1989.

CCHPS Member of the Program Committee 1990 – 1995

Publications and Presentations

E.E. Hickey and JW Poston Sr. 2002, "An Overview of NCRP Report No. 138 on Terrorist Activities". Presented at the 8th Topical Meeting on Emergency Preparedness and Response, Washington DC, November 2002.

National Council on Radiation Protection and Measurements. 2001. *Management of Terrorist Events Involving Radioactive Material*. NCRP Report No. 138. National Council on Radiation Protection and Measurements, Bethesda, Maryland.

E.E. Hickey. 1999, "The Care and Feeding of Your Emergency Program: Enhancing Effectiveness" Presented at the 7th Topical Meeting on Emergency Preparedness and Response, Santa Fe New Mexico, September 1999.

E.E. Hickey, R Harty, L.H. Thonus, M.T. Masnik, "A Look at the Postulated Accidents for Permanently Shutdown Reactors" Presented at the 7th Topical Meeting on Emergency Preparedness and Response, Santa Fe New Mexico, September 1999.

T.A. Kevern, E.E. Hickey, "Emergency Event Classification with Imperfect Information" Presented at the 7th Topical Meeting on Emergency Preparedness and Response, Santa Fe New Mexico, September 1999.

Strom, D.J., R. Harty, E.E. Hickey, R.L. Kathren, J.B. Martin, and M.S. Peffers. 1998. *Collective Dose as a Performance Measure for Occupational Radiation Protection Programs: Issues and Recommendations*. PNL-11934. Pacific Northwest National Laboratory. Richland, Washington.

G.J. Vargo, J.S. Durham, E.E. Hickey, P.S. Stansbury, G.R. Cicotte, "Review of ALARA Plan for

Activities at the 105K-East Fuel Storage Basin," PNL-9826 Rev.2, Septemeber 1994.

E. E. Hickey, G. A. Stoetzel and S. A. McGuire, "Air Sampling In The Workplace - A Document To Support the Revised Regulatory Guide 8.25," PNL-SA-19011A presented at the Annual Health Physics Society, July 1991.

E. E. Hickey, G. A. Stoetzel, D. J. Strom, G. R. Cicotte, C. M. Wiblin, S. A. McGuire, "Air Sampling in the Workplace," NUREG-1400, U.S. Nuclear Regulatory Commission, September 1993.

Eva Eckert Hickey, "Optimization of Emergency Preparedness Planning", PNL -7380. Prepared for the Department of Energy

Eva Eckert Hickey, "Optimization of Emergency Preparedness Planning", PNL-SA-17740A, presented at the Annual Health Physics Society meeting in June 1990.

J. G. Stephen, L. G. Faust, J. M. Selby, E. E. Hickey, "Population and Worker Doses at DOE Sites and Commercial Generating Stations", PNL-SA-16698S, presented at the American Nuclear Society meeting in June 1989.

W. E. Kennedy, and E. E. Hickey, "Estimated Collective Exposures from U.S. Department of Energy Operations", PNL-SA-16617, presented at the American Nuclear Society meeting in June 1989.

E. E. Hickey, and W. E. Kennedy, "A Review of Environmental Radiological Data from U.S. DOE Nuclear Sites", PNL-SA-16516A, presented at the Health Physics Society meeting in June 1989.

J. M. Selby, E. E. Hickey, K. L. Swinth, "Radiation Protection Instrumentation - A Comparison of U. S. International Standards", PNL-SA-16265, presented at the Health Physics Society Midyear Topical Meeting on Instrumentation in December 1988.

J. M. Selby, E. E. Hickey, K. L. Swinth, "Comparison of U. S. and International Standard for Radiation Protection Instrumentation", PNL-SA-14747, presented at the 7th International Radiological Protection Agency Congress.

E. E. Hickey, V. L. Magnus, "Reducing Exposure to ALARA When Refueling DOE's N Reactor", PNL-SA-13644A, presented at the Annual meeting of the Health Physics Society, June 1986.

J. L. Kenoyer, E. E. Hickey, B. J. Greenspan, K. L. Swinth, "Performance Evaluation of Radioactive Aerosol Monitors Used in the Workplace", given at 1987 AIHA Meeting in Montreal, May 1988.

E. E. Hickey, A. E. Desrosiers, T. J. McKenna, "The Relationship Between Emergency Action Levels and Protective Action Decision Making", PNL-SA-11066, presented an the Annual

Health Physics Society Meeting in June 1983.

M. P. Moeller, G. F. Martin, J. D. Jamison, and E. E. Hickey, "A New Method for Presenting Offsite Radiological Monitoring Team Data at Annual Emergency Preparedness Exercises", presented at the American Nuclear Society Topical Meeting in September 1986.

G. F. Martin, E. E. Hickey, G. A. Stoetzel, E. F. Bates, "The Emergency Preparedness Evaluation Program for Research and Test Reactors", PNL-SA-11969, presented at the Annual American Nuclear Society Meeting in June 1984.

G. F. Martin, E. E. Hickey, M. P. Moeller, F. Kantor, "Radiological Data For Scenarios Used During Annual Exercises At Nuclear Generating Facilities", PNL-SA-12906, presented at the Annual Health Physics Society Meeting in July 1985.

G. F. Martin, E. E. Hickey, M. P. Moeller, D. H. Schultz, G. W. Bethke, "Report to the NRC on Guidance for Preparing Scenarios for Emergency Preparedness Exercises at Nuclear Generating Stations", PNL-6931, NUREG CR-3365.

E. E. Hickey, G. A. Stoetzel, J. B. Martin, F. G. Pagano, "Emergency Exercises: Commonly Observed Problems", given at the American Nuclear Society Winter Meeting in November 1983.

E. E. Hickey, J. R. Lewis, M. Lindell, "Criteria for Evaluation of emergency Response Facilities", PNL-3929, NUREG 0814 (draft for comment).

C. D. Corbit, E. E. Hickey, J. G. Myers, "Production Assurance Program Radiological Engineering Studies Status Report", UNI-3615.

E. E. Hickey, R. O. Zimmerman, and G. V. DeLisle, "A Passive Automated Personnel Accountability System for Reactor Emergency Preparedness", PNL-SA-15527A, presented at the Annual Meeting of the Health Physics Society, July 1988 and presented at the ANS Topical Meeting in September 1988.

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U.S. Nuclear Regulatory Commission. 2002. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 10 NUREG-1437 Regarding St. Lucie Nuclear Power Plant Units 1 and 2*. NUREG-1437 Supplement 10. U.S. Nuclear Regulatory Commission, Washington, DC.

U.S. Nuclear Regulatory Commission. 2002. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 8 NUREG-1437 Regarding North Anna Power Station Units 1 and 2*. NUREG-1437 Supplement 8. U.S. Nuclear Regulatory Commission, Washington, DC.

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U.S. Department of Energy. 1997. *Emergency Management Guide, Program Elements Volume IV*. DOE G 151.1-1. U.S. Department of Energy, Washington, D.C.