November 9, 2010

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
	)	
PROGRESS ENERGY FLORIDA, INC.	)	Docket Nos. 52-029 and 52-030
	)	
	)	
(Combined License Application for Levy County Nuclear Power Plant, Units 1 and 2)	)	

NRC STAFF LIST OF POTENTIAL WITNESSES

In its October 15, 2010, Notice, the Atomic Safety and Licensing Board (Board) asked the parties to provide "a list specifying the name, employer, position, and relevant background knowledge, or experience of each of the persons it intends to bring, as potential witnesses, to the November 17, 2010, argument. Licensing Board Notice (Scheduling Oral Argument and Testimony) at 3 (October 15, 2010) (unpublished). The NRC staff (Staff) hereby provides its list of potential witnesses for the November 17, 2010, argument. All of the Staff's potential witnesses will attend the argument in person. In addition, the Staff includes as Attachment 1 to this filing resumes that more fully set forth the potential Staff witnesses' relevant background and experience.

Potential Witnesses

Douglas Bruner
Project Manager
Environmental Projects Branch 3
Office of New Reactors
U.S. Nuclear Regulatory Commission

-Mr. Bruner is the lead project manager for the environmental review of the Levy County combined license application. As the lead project manager, Mr. Bruner keeps abreast of

most issues involved in the review of the Levy County draft Environmental Impact Statement (DEIS), and is knowledgeable about many of the details regarding how the Staff performs its environmental review.

Lance W. Vail
Senior Research Engineer
Hydrology Group
Environmental Technology Division
Pacific Northwest National Laboratory

Vince R. Vermeul
Senior Research Engineer
Environmental Systems Group,
Earth Systems Science Division
Energy and Environment Directorate
Pacific Northwest National Laboratory

-Mr. Vail and Mr. Vermeul are both NRC contractors from the Pacific Northwest National Laboratory and they are the lead reviewers for the groundwater hydrology portions of the DEIS. As a result, they are the primary authors of, and are prepared to discuss, the section in Chapter 2 of the DEIS entitled “model development”, as well as any other groundwater hydrology section of the DEIS. *See* Licensing Board Notice at 3. Additionally, Mr. Vail and Mr. Vermeul are familiar with the Applicant’s Environmental Report and the Requests for Additional Information regarding groundwater hydrology.

Respectfully Submitted,

/Signed (electronically) by/
Jody C. Martin
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U.S. Nuclear Regulatory Commission
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Dated at Rockville, Maryland
this 9th day of November, 2010

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
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PROGRESS ENERGY FLORIDA, INC.	)	Docket Nos. 52-029 and 52-030
	)	
	)	
(Levy County Nuclear Site, Units 1 and 2)	)	

CERTIFICATE OF SERVICE

I hereby certify that copies of the NRC Staff List of Potential Witnesses have been served upon the following persons by Electronic Information Exchange this 9th day of November, 2010:

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ATTACHMENT 1

DOUGLAS W. BRUNER

Environmental Project Manager
Environmental Projects Branch 3
Office of New Reactors
U.S. Nuclear Regulatory Commission

Mr. Bruner has approximately 14 years professional experience in the areas of geology, hydrogeology, environmental protection, and construction management. He has been with the Office of New Reactors, Division of Environmental Reviews, since joining the U.S. Nuclear Regulatory Commission (NRC) in 2007. He has been the lead environmental project manager for the Levy Nuclear Power Plant (LNP) Combined License Application (COLA) since 2008.

EDUCATION

M.S.	Purdue University, Engineering Geology	1995
B.A.	University of Southern Maine, Geology	1987

LICENSES AND REGISTRATIONS

Professional Geologist, Minnesota, License No. 30419	1998
National Registry of Radiation Protection Technologists	1991

PUBLICATIONS

Development of a Procedure to Identify Aggregates for Bituminous Surface Overlays, Purdue University, School of Engineering, Indiana Department of Transportation, FHWA/IN/JHRP-95/11, 1996

An Assessment of Aggregate Properties Influencing the Frictional Performance of Bituminous Surfaces in Indiana, Purdue University, School of Engineering, Master's Thesis, 1995

PROFESSIONAL AFFILIATIONS

Health Physics Society
Association of Environmental and Engineering Geologists

CURRENT PROJECT

Levy Nuclear Power Plant Combined License Application, Environmental Project Manager, U.S. Nuclear Regulatory Commission, 2008-Present.
Mr. Bruner coordinates the environmental review of the LNP COLA commensurate with NRC commitments under the National Environmental Policy Act (NEPA). He leads and coordinates a team of technical staff producing a complex environmental impact statement (EIS) and reviews of the document for technical content and compliance with NEPA and NRC rules and regulations. The team consists of subject matter experts comprised of surface water and ground water hydrologists, terrestrial and aquatic ecologists, cultural resource specialists, socioeconomists, meteorologists, and health physicists. Mr. Bruner also manages two cost-plus contracts for support staff consisting of commercial contractors and Department of Energy scientists and engineers. He also coordinates and leads outreach and scoping meetings to brief

public stakeholders, and Federal, State and local officials, on the status of the application and content of the EIS. The U.S. Army Corps of Engineers (USACE) is a cooperating agency with the NRC for development of EIS' through a Memorandum of Understanding. Mr. Bruner serves as the NRC point of contact for USACE, which is responsible for addressing issues under the Federal Water Pollution Control Act and the Rivers and Harbors Act of 1899 for the LNP COLA. He interacts extensively with USACE, including participation in meetings between USACE, the U.S. Environmental Protection Agency (USEPA), the applicant, and NRC staff. Mr. Bruner also serves as the NRC point of contact for the USEPA and Florida Department of Environmental Protection on siting and environmental review considerations for the LNP project.

PAST PROJECTS

Afghan National Police Facilities, Project Manager, U.S. Army Corps of Engineers, 2006-2007.
Mr. Bruner served as a project manager in Kabul, Afghanistan, managing contractors constructing Afghan National Police facilities. He identified, organized and presented essential information used for decision-making by program managers, project engineers, and resident engineers; and he reviewed and made recommendations on planning and engineering construction documents. He was responsible for managing contracts, budgets and schedules, and served as Chairman on source selection evaluation boards to evaluate proposals submitted in response to formal requests for proposals. He was responsible for managing contractors for twenty-three projects valued at $88 million in awarded contracts.

Formerly Used Defense Sites, Geologist, U.S. Army Corps of Engineers, 2004-2006.
As a geologist with the Albuquerque District in New Mexico, Mr. Bruner served as a senior technical specialist on hazardous, toxic, and radiological waste (HTRW) projects for the Engineering and Construction Division and as a consultant to management for complex scientific and technical issues. He was primarily responsible for initiating and managing project activities under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This included preliminary assessment through investigation and remediation, under the Defense Environmental Restoration Program (DERP) for Formerly Used Defense Sites (FUDS). Mr. Bruner was also responsible for communicating with state and local officials to inform and mediate competing interests associated with the projects. FUDS evaluated under his guidance were Moriarty AFS, Camp Haan, Fort Bayard, and Las Cruces Air Base.

McCormick & Baxter Superfund Site, Geologist, U.S. Army Corps of Engineers, 2005-2006.
Mr. Bruner served as the senior technical lead and liaison to the USEPA coordinating either specialists or managers from three USACE districts - Sacramento, Seattle and Albuquerque, for research, monitoring, and remediation activities at this CERCLA site in Stockton, California. He was responsible for ensuring that each of the USACE districts was kept informed of the activities of the competing districts and to coordinate and secure project activities with the USEPA. He facilitated meetings and teleconferences for this project and coordinated discussions leading to annual groundwater sampling events at the site and the capping of creosote impacted sediment. Prior to transitioning the project, he began coordinating the districts and USEPA for additional capping activities and efforts to initiate natural attenuation activities at the site.

Nellis AFB Site Phase II Site Investigation, Geologist, U.S. Army Corps of Engineers, 2005-2006.
As a project delivery team member, Mr. Bruner was responsible for developing and managing a soil and groundwater investigation at a heavily impacted petroleum, oil, and lubricants (POL) yard at Nellis AFB, Nevada. The yard was selected to support construction of an aircraft hangar under the Base Realignment and Closure (BRAC) program. As the HTRW team lead, he contracted resources, coordinated, and led the soil and groundwater investigation at the site. He also researched and briefed the Albuquerque District's Engineering Division and Air Force personnel on potential human health concerns and construction issues associated with building on the site.

Civil Works Projects, Geologist, U.S. Army Corps of Engineers, 2004-2006.
Mr. Bruner served as an HTRW project delivery team member on six civil works projects in New Mexico, some of which were for Tribal programs. The civil works projects included environmental feasibility studies for flood control projects and water resource development (San Acacia to Bosque del Apache), ecosystem restoration (Espanola Valley), flood control (East Mesa Las Cruces), wastewater improvements (Las Cruces Industrial Park), Flood Protection (Las Cruces Dam), and flood protection and ecosystem restoration (Middle Rio Grande).

Restore Iraqi Electricity Program, Program Manager, U.S. Army Corps of Engineers, 2004.
Mr. Bruner served in Iraq, North and Central, as a Program Manager for Restore Iraqi Electricity (RIE) New Generation construction projects for the USACE Gulf Region Division. His primary responsibility was to manage cost-plus construction contracts for the maintenance and/or construction of electrical generation projects for the two largest New Generation RIE sites totaling $343 million in contract awards. He also resolved complex issues related to fuel resources for electrical power generation. The position included representing the Corps at meetings between the Coalition Provisional Authority, the Ministry of Electricity, and the Ministry of Oil to brief the status of the RIE projects.

Crandon Mine Environmental Impact Statement, Environmental Protection Specialist, U.S. Army Corps of Engineers, 2002-2004.
Mr. Bruner was a project manager and hydrogeologist responsible for overseeing development of the groundwater and geotechnical portions of the EIS being prepared for the Crandon Mine project, a proposed sulfide mine in Crandon, Wisconsin. He prepared scopes of work, and reviewed work and quality assurance plans, including groundwater modeling, groundwater hydrology, and groundwater quality reports. He actively participated in meetings between representatives from the mining company, Native American Indian tribes, cooperating agencies, and consultants. He was later promoted to serve as the EIS Project Manager in charge of budgets and schedules for the mining project while coordinating critical studies such as cultural resources, socioeconomics, mineral resources, threatened and endangered species, and surface water hydrology and quality. He also served as a technical advisor to the St. Paul District for the implementation and coordination of HTRW projects.

Environmental Programs in South Korea, Construction Manager, IT Corporation/Shaw Environmental & Infrastructure, 2001-2002.
As a construction manager in South Korea, Mr. Bruner was responsible for launching and coordinating environmental programs and providing technical assistance to USACE and the U.S. Air Force Center for Environmental Excellence. He was the liaison and point of contact between the U.S. Military and subcontracted Korean

personnel. He provided construction surveillance of underground and aboveground storage tank and fuel transfer system removals and upgrades, including installation of oil/water separator systems for pollution control. He also ensured compliance with quality control requirements to include the installation of piping, welding inspections, and the reinforcement, pouring and testing of concrete. Mr. Bruner also performed field inspections and negotiated, coordinated and integrated various engineering, construction, waste management, and site restoration activities.

Canadian Pacific Railway, Hydrogeologist, IT Corporation, 1998-2001.
As a hydrogeologist and project manager, Mr. Bruner developed work plans, quality control plans, and groundwater sampling plans to evaluate creosote impacts from former industrial wood preservation activities, chemical storage, a former petroleum service station, a railroad landfill, and areas historically impacted by railroad operations at this former railroad yard in Minneapolis, Minnesota. He provided third-party oversight of field activities involving the advancement of soil borings, installation of groundwater monitoring wells, sampling of soil and groundwater, and environmental monitoring. He designed exploration and sampling programs for the railroad landfill and prepared sampling reports summarizing investigation activities. Mr. Bruner also evaluated laboratory data collected from sampled media for contaminants of concern in impacted areas based on Minnesota and USEPA regulations to determine potential environmental hazards and reporting requirements.

Duncan Township Landfill, Hydrogeologist, IT Corporation, 1998-2001.
As a hydrogeologist, Mr. Bruner developed work plans, quality control plans, and groundwater sampling plans to evaluate the Duncan Township Municipal Landfill located in Houghton County, Michigan for capping and closure. He led groundwater sampling events at the site and physically delineated the extent of the landfill for capping. Mr. Bruner was also responsible for assessing laboratory data associated with the sampling events and drafting sampling and analysis reports.

DDT Drum Burial Site, Hydrogeologist, IT Corporation, 1998-2001.
As a team member and hydrogeologist, Mr. Bruner developed work plans, quality control plans, and soil and groundwater sampling plans to evaluate the DDT site located in the Ottawa National Forest in Michigan. He led annual groundwater sampling events and sampled soil at the site to investigate additional sources of pesticides. Mr. Bruner was also responsible for assessing laboratory data associated with the sampling events and drafting sampling and analysis reports.

Field Hydrogeologist, Keramida Environmental, Inc. 1996-1998.
Mr. Bruner served as a field hydrogeologist initiating Phase I Assessments and performing Phase II soil and groundwater investigations. The primary work performed included the removal of underground storage tanks, and installation of soil borings and groundwater monitoring wells, and soil and groundwater sampling at active and brownfield industrial sites. Mr. Bruner was also responsible for assessing laboratory data associated with the sampling events, drafting sampling and analysis reports, and providing recommendations for clean-up under the State's Voluntary Remediation Program.

Senior Chemistry & Radiological Controls Technician, Maine Yankee Atomic Power Company, 1987-1992.
As a senior chemistry and radiological controls technician with Maine Yankee Atomic Power Company, Mr. Bruner was responsible for ensuring plant compliance with NRC regulations and plant procedures. He conducted radiochemical and wet chemistry laboratory analyses on aqueous samples from plant systems to determine radioisotope concentrations. Mr. Bruner prepared release permits for radioactive gas and effluent discharges from the plant. He also controlled radioactive material and processed radioactive waste for shipment; performed atmospheric monitoring for confined spaces and airborne contaminants; and supervised maintenance personnel and contractor technicians. He was trained to respond to radiological, fire and first-aid emergencies.

JOB RELATED TRAINING

Federal Acquisition Certification for Contracting Officer Technical Representative, 40 hours, Federal Acquisition Institute	11/2010
Modern Subsidence, Sea-Level Rise, and the Future of the Gulf Coast, 20 hours, Shlemon Specialty Conference, AEG	05/2010
Project Management Training, 40 hours, University of Virginia	10/2009
Project Management Systems Approach, 32 hours, Montgomery County College	04/2009
Tribal Consultation (NEPA), 20 hours, Duke University	08/2008
Preparing and Documenting Environmental Impact Analyses (NEPA), 36 hours, Duke University	05/2008
Reactor Concepts, 14 hours, NRC	01/2008
Scoping, Public Involvement and Environmental Justice (NEPA), 28 hours, Duke University	01/2008
Implementation of NEPA, 20 hours, Duke University	02/2008
Licensing Reactor Under 10 CFR 52 (G-110), 8 hours, NRC	09/2007
GE BWR/4 Technology Overview, 35 hours, NRC	09/2007
Radiation Detection and Measurement, 40 hours, Technical Management Services	08/2003

LANCE W. VAIL

Senior Research Engineer
Hydrology Group
Environmental Technology Division
Pacific Northwest National Laboratory

Since joining Pacific Northwest National Laboratory 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, regulatory compliance assessments, and project management. His areas of expertise cover a broad spectrum of areas related to water resources and the nexus of water and energy.

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
- 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 AFFILITATIONS

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

CURRENT PROJECTS

- ***Hydrological Environmental and Safety Reviews of Combined Construction and Operating Licenses Applications (COLA) for New Commercial Nuclear Plants***. Technical Resource Manager and Task Manager. Mr. Vail leads hydrology reviews for many of the ongoing COLA reviews and provides mentorship to other site reviews. Mr. Vail is currently leading the hydrology reviews for Calvert Cliffs, Bellefonte, Lee, North Anna, Vogtle, and Grand Gulf. Additionally, Mr. Vail is supervising staff on Levy, Harris, South Texas and Summer. These reviews include a diverse set of water resources considerations including: sustainable water management; conjunctive surface and water management; flooding from extreme precipitation and wave action; thermal impacts on fisheries; etc.

- ***Water and Energy Management for Agriculture in the Pacific Northwest.*** Principal Investigator. An adequate and reliable supply of water and electricity is essential to all modern societies. Nowhere in the United States is the connection between water and electricity more obvious than in the Pacific Northwest and in no sector of the Pacific Northwest's regional economy is this interdependence of water and electricity clearer than agriculture. Water is the driver that powers the region's vast hydropower resources. The agriculture sector is also a large consumer of the region's electrical power supply, spending over $150 million per year for electrical power to pump water alone. Water is also a valuable way to store energy. The effective capacitance of water as a power demand shifting resource means that significant demand-side and supply-side improvements in both water and energy resources are possible for sectors such as agriculture with its reliance on an adequate, affordable and reliable supply of both water and energy. While newly emerged technologies are available to dramatically improve water and energy management, institutional barriers have slowed the development of such conjunctive management systems. The vision of adaptive management has generally

failed to be realized in practical resource management due to limitations of information infrastructure and institutional constraints. Mr. Vail is developing an information management infrastructure that will improve the conjunctive management of water and energy for the agriculture sector.

PAST PROJECTS

- ***Electrical Infrastructure Operation Initiative.*** Co-Principal Investigator. This LRDR project made significant advances in three critical science challenges that currently obstruct the functioning of a "water and energy control room of the future". These challenges were the three key themes of this project. The three themes of this project were:
  Water budget characterization. Managing any resource requires knowledge of the amount of the resource, the distribution of the resource, the rates at which the resource will increase, decrease, or redistribute. By linking physically-based process models with remotely-sensed spatial data, this project demonstrated the ability to significantly improve the accuracy and reliability of water budget estimates.
  Water supply and demand forecasting. Resource management actions are based on an estimate of the current state of the resource and forecasts of the likely future state of the system. Forecasts, by their nature, are subject to a degree of uncertainty. By generating and providing to the decision making process large ensembles of streamflow and energy demand projections, the resource management paradigm will shift from one focused nearly exclusively on reducing uncertainty to one more focused on managing uncertainty. By creating ensembles of streamflow forecasts based physical process models uncertainty is addressed explicitly. Generation and management of large ensembles generally results in significant computational capabilities. This project demonstrated a viable approach to generating and managing large ensembles of hydrological forecasts.
  Water and energy optimization. Modern natural resource managers are constantly required to balance multiple, conflicting, incommensurate objectives in an environment characterized by high levels of uncertainty, varying data quality and availability, and competing models and approaches. In attempting to sift through the vast number of feasible management options it is generally infeasible to evaluate each possible action evaluated for each feasible conceptual model through exhaustive enumeration. Optimization techniques provide an intelligent process to sift through the set of possible options. Optimization for control of water and energy resources requires a cautious, probing, adaptive approach, the success of which depends upon improved understanding, predictive accuracy, and iterative performance assessment. This project demonstrated a novel optimization approach based on evolutionary computing methods.

- ***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 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.*** Principal Investigator. Advanced distributed watershed models were applied to provide the Tulalip Tribes of Western Washington state 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 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 anadramous 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 is providing expertise in the development of a GEIS for decommissioning of nuclear plants. He provides 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 include: 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 are 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 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 the global-scale simulations described above 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 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.

- 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 is the project manager of an effort to assess the multi-objective optimization needs of Bonneville Power Administration. Objectives include: hydropower, resident fish, anadramous fish, irrigation, flood control, wildlife, and navigation. Mr. Vail is developing 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 is a co-principal investigator for the Integrated Environmental Monitoring Initiative. The objective of this initiative is 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 is 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. Test 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 is 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 are under way to develop a scientific basis to extend the sparse meteorological measurements basis to extend the sparse meteorological measurements available for any watershed 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 of 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 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 Uncertainty 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 couple 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.

Book Chapter

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Vail LW. 2000. "Application of Fuzzy Logic in Estimating Impact of Water and Land use Practices on Aquatic Habitat Diversity ." Presented by Lance W Vail (Invited Speaker) at Society for Environmental Restoration, Bellevue, WA on April 5, 2000. PNNL-SA-34213.

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Presented by Rajiv Prasad (Invited Speaker) at IAEA-India External Flooding Hazards Workshop , Kalpakkan, Tamil Nadu on August 29, 2005. PNNL-SA-46005.

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.

VINCE R. VERMEUL

Senior Research Engineer
Environmental Systems Group, Earth Systems Science Division
Energy and Environment Directorate, Pacific Northwest National Laboratory

Education

B.S. Agricultural Engineering, Oregon State University, Corvallis, Oregon, 1988
M.S. Civil Engineering (Environmental), Oregon State University, Corvallis, Oregon, 1990

Experience

Mr. Vermeul has 20 years of experience in hydrologic and geochemical characterization, designing, instrumenting, conducting, and managing field tests, interpreting hydrologic test data, and developing/demonstrating groundwater remediation technologies. Since joining Pacific Northwest National Laboratory in 1990, Mr. Vermeul has gained the following experience:

- Key contributor on several interdisciplinary teams developing innovative groundwater remediation technologies including: 1) manipulation of in situ redox conditions to create a permeable reactive barrier (PRB) to prevent migration of groundwater contaminants, 2) injection of colloidal-scale ZVI for source area treatment and PRB installation, 3) emplacement of injectable apatite to create a PRB for containment of strontium-90 contaminated groundwater, 4) In situ uranium stabilization through phosphate amendment injection/infiltration, 5) In situ biostimulation for the creation of a reducing barrier, and 6) the use of shear-thinning fluids for improved delivery or retention of remedial amendments. Primary technical contribution to these technology development projects has been hydrologic and geochemical characterization of the field test sites, design/integration of systems required to deploy and monitor the technologies at the field-scale, performance assessment of the in situ treatment technologies, management of field operations, and technology transfer.
- Key contributor on DOE-SC Integrated Field Research challenge project focused on providing improved understanding of mass transfer processes.
- Conducted numerous remedial investigations at Department of Energy, Department of Defense, and Environmental Protection Agency sites.
- Hydrology subject matter expert for environmental and safety reviews of combined construction and operating license applications for new commercial nuclear plants (Levy Nuclear Plant).
- Lead effort to evaluate the fate a transport of tritium in groundwater associated with a Hanford burial site. Simulation results indicated that monitored natural attenuation was a viable remedial alternative.
- Experienced in the development and interpretation of regional and local-scale groundwater flow and contaminant transport models, including both forward and inverse modeling approaches.
- Project management experience in remedial investigation, technology development, and predictive simulation projects.

Professional and Educational History

2000 - Pres.	Senior Research Engineer II, Environmental Systems Group, Earth Systems Science Division, PNNL, Richland WA.
1996 - 2000	Senior Research Engineer I, Field Hydrology & Chemistry Group, Environmental Technology Directorate, PNNL, Richland WA.
1992 – 1996	Research Engineer, Geosciences Department, Environmental Technology Division, PNNL, Richland WA.
1990 – 1992	Engineer, Hydrology Section, Geosciences Department, PNNL, Richland WA.
1988 – 1990	Graduate studies in Environmental Engineering. Emphasis: Groundwater hydrology – Numerical modeling of groundwater flow and solute transport - Water quality/hazardous waste – Information management with geographical information systems.
1984 – 1988	Undergraduate studies in Agricultural Engineering. Emphasis: Surface and groundwater hydrology - Water resource management and development - Fluid mechanics and hydraulic design.

Awards and Professional Affiliations

Trained in Hazardous Waste Operations, HAZWOPER Supervisor, and Medic First Aid

R&D 100 Award, 1998, Development of the In Situ Redox Manipulation Technology

PNNL Outstanding Performance Award, ISRM technology field demonstration

PNNL Outstanding Performance Award, Transient inverse groundwater modeling

PNNL Outstanding Performance Award, Proposal Generation/Business Development with EPA

BHI Gold Award, ISRM deployment for remediation of Cr(VI) contaminated groundwater

U. S. Patent 6,438,501; Flow Through Electrode with Automated Calibration

Certified by the Oregon State Board of Engineering Examiners as an Engineer-in-Training.

Selected Publications

Cole, C. R., R. M. Cooper, J. F. Fletcher, B. P. Hay, B. P. McGrail, I.C. Nelson, L.H. Sawyer, R. J. Serne, S. M. Short, V. R. Vermeul. 1992. *Final Report, Rokkasho Shallow-Land Low-Level Waste Disposal Study, Volumes 1-3.* Prepared for Radioactive Waste Management Center Under Contract 17943 by Battelle Pacific Northwest Laboratory.

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Istok JD, Amonette JE, Cole CR, Fruchter JS, Humphrey MD, Szecsody JE, Teel SS, Vermeul VR, Williams MD, and Yabusaki SB. 1999. In Situ Redox Manipulation by Dithionite Injection: Intermediate-Scale Laboratory Experiments.
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Luttrell, S. P., D. R. Newcomer, S. S. Teel, and V. R. Vermeul. 1992. *Hydrogeologic Controls on Ground-Water and Contaminant Discharge to the Columbia River Near the Hanford Townsite.* PNL-8167, Prepared for the Department of Energy, Richland, Washington.

Newcomer, D. R., L. A. Doremus, S. H. Hall, M. J. Truex, V.R. Vermeul, and R. E. Engelman. 1995. *Geology, Hydrology, Chemistry, and Microbiology of the In Situ Bioremediation Demonstration Site.* PNL-10422, Pacific Northwest Laboratory, Richland, Washington.

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Spane, F. A. and V. R. Vermeul. 1994. *Summary and Evaluation of Hydraulic Property Data Available for the Hanford Site Upper Basalt Confined Aquifer*. PNL-10158, Pacific Northwest Laboratory, Richland, Washington.

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Szecsody, J., J. Phillips, V. Vermeul, J. Fruchter, and M. Williams. 2005. *Influence of nitrate on the Hanford 100D area In Situ Redox Manipulation barrier longevity*. PNNL-15262, Pacific Northwest National Laboratory.

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Solution Injection and Sr-90 Immobilization in 100-N Sediments. PNNL-16891, Pacific Northwest National Laboratory, Richland, WA.

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