ROBERT L. HOWARD
Oak Ridge National Laboratory

SUMMARY

Brings over 20 years of directly relevant nuclear industry experience with notable results, as detailed below:

- Effectively implements design, modeling, safety analyses, testing, and licensing/regulatory interactions for spent nuclear fuel (SNF) and high-level radioactive waste management systems and facilities.
- Manages and integrates complex SNF storage, transportation, an disposal relatate projects across multiple disciplines and organizations.
- On a routine basis, interacts with regulators, oversight boards, industry representatives, and other stakeholders regarding highly visible, complex technical issues.

EDUCATION

M.S., Civil and Environmental Engineering, 1997, University of Nevada Las Vegas

M.A., English, 1990, Virginia Tech

B.S., Electrical Engineering, 1988, Virginia Tech

EMPLOYMENT HISTORY

2010–Present	**Oak Ridge National Laboratory**, Oak Ridge, TN Reactor and Nuclear Systems Division
2007–2010	**University of Nevada**, Las Vegas, NV National Supercomputing Center
2000–2007	**Bechtel SAIC, LLC**, Las Vegas, NV
1995–2000	**TRW Environmental Safety Systems**
1993–1995	**CER Corp./Quality Assurance Technical Support Services**
1992–1993	**Roy F. Weston, Inc.**
1990–1992	**Baltimore Gas and Electric/Calvert Cliffs Nuclear Power Plant**
1988–1990	**Virginia Tech English Department**, Blacksburg, VA English Department
1987–1988	**Virginia Tech Learning Resource Center**, Blacksburg, VA
1985–1987	**Newport News Shipbuilding**, Newport News, VA Reactor Services Project

Nuclear Fuels Storage and Transportation (NFST) Planning Project, US Department of Energy (DOE), ORNL, *Senior Project Engineer*

- Provides technical leadership and analyses for effective resolution of SNF transportation, interim storage, and regulatory issues.
- Leads systems integration and analysis activities to provide quantitative estimates of the impacts of utility and federal actions on the waste management system.
- Leads projects to discern the impacts of different storage design options, packaging, transportation throughput, and schedules.
- Works to establish functional and operational requirements for the waste management system based on the results of system studies and regulatory analyses of 10 CFR 71, 10 CFR 72, and associated guidance documents.
- Leads development of performance requirements for standardization of canisters for dry storage, transportation, and disposal systems, as well as vendor-specific standardized transportation casks.
- Supports development of NFST project plans, and presents NFST technical information to stakeholders such as the Nuclear Energy Institute and the Nuclear Waste Technical Review Board.

Used Fuel Disposition Campaign, US DOE (NE), ORNL, *Senior Project Engineer*

- Developed reference radioactive waste repository design concepts for shale, salt, and crystalline geologic media.
- Developed repository concepts and conducted engineering analyses on the feasibility of direct disposal of dual purpose storage canisters.
- Managed a project for vibration testing of high burnup SNF and development of surrogate high burnup cladding material using ORNL's High Flux Isotope Reactor (HFIR).

Lead Laboratory Licensing and Performance Assessment (PA), DOE Office of Civilian Radioactive Waste Management (OCRWM), University of Nevada Las Vegas, *Senior Scientist*

- Integrated and synthesized technical documentation to address regulatory requirements and Nuclear Regulatory Commission (NRC) Licensing Review Plan Acceptance Criteria.
- Coordinated and resolved reviews from DOE technical and regulatory staff and client legal counsel.
- Developed modeling and analysis tools.
- Identified and classified safety-related system features and associated management and engineering controls.
- Led coordination and integration of technical documentation in response to over 300 NRC staff requests for additional information (RAIs) regarding facility safety.

Licensing Defense / Performance Assessment (PA), DOE OCRWM, BSC, *PA Deputy Manager*

- Managed development of work transition packages and subsequent turnover of work scope from Bechtel-SAIC to Sandia National Laboratory, the lead laboratory for repository systems.
- Led several hundred scientists and engineers, maintaining baseline scope, cost, and schedule until the transition was complete.
- Simultaneously participated on the License Application Development Team for safety analyses sections on engineered barrier system performance and postclosure hazards analyses.

PA Strategy & Scope, DOE OCRWM, BSC, *Deputy Project Manager*

- Managed a team of engineers and scientists in the iterative development of total system PA; the performance confirmation program; and features, events and processes screening evaluations.
- Developed decision criteria and analysis to determine project scope for license application submittal.
- Developed the technical bases to support risk-informed responses to NRC Key Technical Issue Agreement Items.
- Implemented critical path activity management; baseline management; integrated safety management; and environmental, safety and health programs and corrective actions.

Science and Analysis Project, DOE OCRWM, BSC, *Science and Analysis Integration Manager*

- Managed and integrated process models and abstractions for engineered barriers required for analyzing post-closure performance of a proposed high-level radioactive waste repository for the site recommendation phase of the project.
- Developed the models required to evaluate repository performance over a range of thermal operating modes, as well as the quantification of uncertainties associated with those performance evaluations.

Civilian Radioactive Waste Management System (CRWMS) M&O PA, DOE OCRWM, TRW, *Deputy Manager, Performance Assessment*

- Managed a team of approximately 70 engineers and scientists in the development of process models and abstractions for analyzing post-closure performance of the natural system, engineered system, and integrated total system of a proposed high-level radioactive waste repository.
- Developed and managed the PA annual work plan, schedule, and budget.
- Interfaced with regulatory and oversight bodies such as the NRC and the Nuclear Waste Technical Review Board.

CRWMS M&O Data and Software Qualification Project, DOE OCRWM, TRW, *Project Manager for Data and Software Qualification*

- Managed a team of 35 engineers and scientists in the development of data verification and qualification packages supporting inputs to facility analyses and design reports.
- Led the development, integration, and documentation of software qualification and testing reports.
- Implemented a graded approach for data verification based on the facility safety strategy.

CRWMS M&O Engineered Barrier System PA/ License Application Design Selection, DOE OCRWM, TRW, *Manager, Engineered Barrier System PA Department*

- Managed 20 engineers and scientists developing process models and abstractions used for analyzing post-closure performance of the engineered portion of a proposed high-level radioactive waste repository.
- Responsible for development, integration, and defensibility of analyses of the near-field environment, waste package degradation, waste form degradation and mobilization, and contaminant transport through the engineered barrier system.
- Served as the PA operations leader for license application design selection activities.

Product Integrity/Design Basis Modeling, DOE OCRWM, TRW, Senior Systems Engineer, Product Integrity

- Managed the initial startup of the Product Integrity Group in response to NRC and client concerns regarding architect/engineer (A/E) design control deficiencies.
- Evaluated preliminary hazard analyses safety calculations, systems engineering documents, design analyses, drawings, and specifications for technical adequacy and proper translation of regulatory requirements into defensible design solutions.
- Identified and translated regulatory requirements into program requirements and procedures to support CRWMS.
- Identified and graded requirements in design analyses, and integrated requirements into construction and procurement specifications and processes.
- Led readiness reviews for program participant assessments.
- Performed design reviews and engineering assessments of A/E design products and change requests.
- Developed design guides for site-generated radioactive waste management.
- Performed thermal hydrology and contaminant transport calculations using computational fluid dynamics software for post-closure PAs.

Nuclear Quality Assurance, DOE OCRWM, Weston/CER, *Lead Quality Engineer*

- Managed quality assurance (QA) staff and conducted annual budget planning.
- Identified and translated regulatory requirements into the QA program requirements and administrative procedures to support CRWMS.
- Planned and led quality system audits and surveillances of program participants.
- Identified risk-based criteria for items and activities important to safety.
- Reviewed and commented on program technical and management documents such as system engineering management plans, system requirement documents, and conceptual design reports.

Nuclear Quality Assurance, Department of Environmental Resources, Weston, *Lead Quality Engineer*

- Provided oversight and QA support for the Pennsylvania Low-Level Radioactive Waste Disposal Facility project.
- Performed quality system audits on project contractors and subcontractors to (1) demonstrate compliance with the applicable federal and Pennsylvania codes and (2) ensure collection of valid scientific and technical information during site characterization and license preparation activities.
- Provided review and comment on contractor-approved and proposed plans, procedures, subcontract requirements documents, and technical documents submitted to the program.
- Assisted the department in developing an internal QA program that included a structured hierarchy of QA and management procedures.

Procedures Upgrade Project, Calvert Cliffs Nuclear Power Plant, MD, Baltimore Gas and Electric, *Procedure Analyst/ Engineer*

- Led the program for maintenance, modifications, and design authority control processes and quality administrative procedures development.
- Performed management assessments of existing QA processes to baseline program and identify deficiencies.
- Evaluated and reported on contractor performance.
- Defined new administrative processes and procedures based on assessment findings and management recommendations.
- Developed procedures for preventive maintenance and performance monitoring programs.
- Recommended and implemented quality system improvements.

- Interpreted and translated regulatory requirements into QA procedures. Procedural development and implementation contributed to utility being removed from NRC Watch List.

Reactor Services Project, Newport News Shipbuilding, *Electrical Engineer Co-Op*

- Participated as a design team member on overhaul designs and planning for US Navy nuclear plant electrical control, power, lighting, and instrumentation systems
- Conducted product audits, system inspection, and witnessed operational testing of electrical equipment.
- Major projects included long-term decay heat removal instrumentation and control systems and primary plant instrumentation systems.
- Prepared and revised Navy technical manuals.
- Served as a liaison engineer between waterfront and shop trades and customers.

Other Professional Work

Taught college writing and technical writing at Charles County Community College and Virginia Tech. Courses taught covered subjects such as the following:

- Technical definition
- Specification writing
- Procedure writing
- Proposal writing
- Graphics and visuals
- Analytical report writing

Professional Organizations and Affiliations:

- Voting Member, ASTM International, Nuclear Fuel Cycle Committee
- Member, American Geophysical Union (AGU)
- Member, American Nuclear Society (ANS)

Select Publications:

J. Jarrell, R. Joseph, **R. Howard**, R. Hale, G. Peterson, B. Wilkerson, J. Fortner, E. Kalinina, "Initial Standardized Canister System Evaluation," FCRD-NFST-2014-000084 ORNL/LTR-2014/330, prepared for the US Department of Energy, Nuclear Fuels Storage and Transportation Planning Project, August 29, 2014.

J.C. Wagner, J. Carter, M. Feldman, **R. Howard**, M. Nut, and J. Williams, "Overview of the Department of Energy's Nuclear Fuels Storage and Transportation Planning Project.," in *Proceedings from the Institute of Nuclear Materials Management (INMM)-55th Annual Meeting,* Atlanta, Georgia, July 20–24, 2014.

R.L. Howard and B. van den Akker, "Considerations for the Disposition of Dry Cask Storage System Materials at the End of Life," *Symposium on Recycling of Metals Arising from Operation and Decommissioning of Nuclear Facilities,* Nykopiong, Sweden, March 2014.

E Hardin, D. Clayton, **R. Howard**, J. Clarity, J Scaglione, J. Carter, W. Nutt, and R. Clark, "Evaluation of Direct Disposal of Spent Fuel in Existing Dual-Purpose Canisters," *Radwaste Solutions* **21**, 26–39, 2014.

E. Hardin, D. Clayton, **R. Howard**, J. Scaglione, E. Pierce, K. Banerjee, M. Voegele, H. Greenberg, J. Wen, T. Buscheck, J. Carter, T. Severynse, and W. Nutt, *Preliminary Report on Dual-Purpose Canister Disposal Alternatives (FY13)*, FCRD-UFD-2013-000171 Rev. 1, prepared for the US Department of Energy, Office of Used Nuclear Fuel Disposition, December 2013.

L. Ott, R.J. Howard, **R.L. Howard**, J. McDuffee, and Y. Yong, "Preparation of Prototypic Irradiated Hydrided-Zircaloy Cladding for UFDC Programs," *LWR Fuel Performance Meeting/Top Fuel 2013*, Charlotte, NC, September, 15–19, 2013.

H. Wang, J-Y. J. Wang, T. Tan, H. Jiang, T. S. Cox, **R. Howard**, B. Bevard, and M. Flanagan, "Development

of U-Frame Bending System for Studying the Vibration Integrity of Spent Nuclear Fuel," *J. Nucl. Materials* **440**(1–3), 201–213, September 2013.

J. Wang, H. Wang, B. Bevard, **R. Howard**, and M. Flanagan, "Reversible Bending Fatigue Test System for Investigating Vibration Integrity of Spent Nuclear Fuel during Transportation," in *Proceedings of 2013 PATRAM: 17th International Symposium on the Packaging and Transportation of Radioactive Materials*, San Francisco, CA, August 18–23, 2013.

R. Howard, D. Giuliano, T. Lessard, J. Carter, and P. Rodwell, "A Modular Design Concept for Spent Nuclear Fuel Repackaging Facility," in *Proceedings of the 14th International High-Level Radioactive Waste Management Conference (IHLRWMC)*, Albuquerque, NM, April 28–May 2, 2013.

A. Bevill, G. Radulescu, J. Scaglione, and **R. Howard**, "ADVANTG Shielding Analysis for Closure Operations in an Open-Mode Repository," in *Proceedings of the 14th International High-Level Radioactive Waste Management Conference (IHLRWMC)*, Albuquerque, NM, April 28–May 2, 2013.

R. H. Howard, Y. Yan, **R. L. Howard**, J. McDuffee, and L. Ott, "Production of Simulated High-Burnup Used Fuel Cladding in the HFIR," in *Proceedings of the 14th International High-Level Radioactive Waste Management Conference (IHLRWMC)*, Albuquerque, NM, April 28–May 2, 2013.

E. Hardin, T. Hadgu, D. Clayton, **R. Howard**, H. Greenberg, J. Blink, M. Sharma, M. Sutton, J. Carter, M. Dupont, and P. Rodwell, "SNF Disposal Concepts for Small and Large Waste Packages," in *Proceedings of the 14th International High-Level Radioactive Waste Management Conference (IHLRWMC),* Albuquerque, NM, April 28–May 2, 2013.

M. Nutt, **R. L. Howard**, I. Busch, J. Carter, P. Rodwell, A. Delley, E. Kalinina, E. Hardin, and T. Cotton, "Used Fuel Management System Architecture and Interface Analyses," in *Proceedings of the 14th International High-Level Radioactive Waste Management Conference (IHLRWMC)*, Albuquerque, NM, April 28-May 2, 2013.

J. Wang, H. Wang, B. Bevard, **R. Howard**, and M. Flanagan, "Test System for Evaluating Spent Nuclear Fuel Bending Stiffness and Vibration Integrity," in *Proceedings of the 14th International High-Level Radioactive Waste Management Conference (IHLRWMC)*, Albuquerque, NM, April 28–May 2, 2013.

R. Howard, I. Busch, M. Nutt, E. Morris, F. Puig, J. Carter, A. Delley, P. Rodwell, E. Hardin, E. Kalinina, R. Clark, and T. Cotton, "Used Fuel Management System Interface Analyses," in *Proceedings of WM 2013*, Phoenix, Arizona, February 24–28, 2013.

E. Hardin, T. Hadgu, D. Clayton, **R. Howard**, H. Greenberg, J. Blink, M. Sharma, M. Sutton, J. Carter, M. Dupont, and P. Rodwell, *Repository Reference Disposal Concepts and Thermal Management Analysis,* FCRD-USED-2012-000219 Rev. 2, prepared for the US Department of Energy, Used Fuel Disposition R&D Campaign, November 2012.

M. Nutt, E. Morris, F. Puig, J. Carter, P. Rodwell, A. Delley, **R. Howard**, and D. Giuliano, *Used Fuel Management System Architecture Evaluation, Fiscal Year 2012*, FCRD-NFST-2013-000020 Rev. 0, prepared for the US Department of Energy Used Fuel Disposition Campaign and Nuclear Fuel Storage and Transportation Planning Project, October 31, 2012.

G. Mays, R. Belles, M. Cetiner, **R. Howard**, C. Liu, D. Mueller, O. Omitaomu, S. Peterson, and J Scaglione, *Application of Spatial Data Modeling Systems, Geographical Information Systems (GIS), and Transportation Routing Optimization Methods for Evaluating Integrated Deployment of Interim Spent Fuel Storage Installations and Advanced Nuclear Plants*, ORNL/TM-2012/237, Oak Ridge National Laboratory, Oak Ridge, Tenn., June 2012.

E. Hardin, J. Blink, J. Carter, F. Massimiliano, H. Greenberg, and **R. Howard**, "Generic Repository Concepts and Thermal Analysis for Advanced Fuel Cycles," in *Proceedings of the Waste Management Symposia Conference*, Phoenix, AZ, February 26–March 1, 2012.

K. Clarno and **R. Howard**, *Problem Specification for FY12 Modeling of Used Nuclear Fuel during Extended Storage*, ORNL/TM-2012/80, Oak Ridge National Laboratory, Oak Ridge, Tenn., February 2012.

J. Gehin, D. Holcomb, G. Flanagan, B. Patton, **R. Howard**, and T. Harrison, *Fast Spectrum Molten Salt Reactor Options*, ORNL/TM-2011/105, Oak Ridge National Laboratory, Oak Ridge, Tenn., July 2011.

P. Swift, K. Knowles, J. McNeish, C. Hansen, **R. Howard**, R. MacKinnon, and S. Sevougian, "Long-Term Performance of the Proposed Yucca Mountain Repository, USA," in N. Hyatt, D. Pickett, and R. Rebak, *Scientific Basis for Nuclear Waste Management XXXI, Materials Research Society Symposium Proceedings*, Vol. 1124, p. 3–14, symposium held December 1-5, 2008, Boston, MA (2009).

R. Andrews, G. Neider-Westermann, J. Bailey, and **R. Howard**, "Repository Design-Postclosure Safety Analyses Iterations—A Retrospective Evaluation of the Last Decade of Development of the Yucca Mountain Repository" (invited paper), *Scientific Basis for Nuclear Waste Management XXXI, Materials Research Society Symposium Proceedings*, Vol. 1124, p. 3–14, symposium held December 1–5, 2008, Boston, MA (2009).

P. Swift, K. Knowles, J. McNeish, C. Hansen, **R. Howard**, R. MacKinnon, and S. D. Sevougian, "Yucca Mountain 2008 Performance Assessment: Summary," in *Proceedings of the 2008 International High Level Radioactive Waste Conference, Las Vegas, NV, September 7–11, 2008,* American Nuclear Society, p. 575–581 (2008).

P. Swift and **R. Howard**, "The Role of Uncertainty in Performance Assessment for Radioactive Waste Repositories" (abstract), invited presentation at *Symposium CC, Scientific Basis for Nuclear Waste Management,* Materials Research Society Spring Meeting, April 12–16, 2004, San Francisco, CA (2004).

J. McNeish, P. Swift, **R. Howard**, D. Sevougian, D. Kalinich, and R. MacKinnon, "Proceeding Toward a License Application for US Nuclear Waste Repository: Total System Performance Assessment Approach," in *Proceedings of the 9th International Conference on Environmental Remediation and Radioactive Waste Management,* September 21–25, Oxford, England (2003).

E. Siegmann, J. McCoy, and **R. Howard**, "Cladding Evaluation in the Yucca Mountain Repository Performance Assessment," *Scientific Basis for Nuclear Waste Management XXI,* Materials Research Society (1999).

R. Howard, W. Culbreth, and J. Cardle, "Hydrothermal Modeling of the Oklo Natural Reactors," in *Proceedings of the 1998 High Level Radioactive Waste Management Conference,* American Nuclear Society (1998).

R. Howard and R. Clark, "Application of Quality Assurance Program Criteria to Performance Assessment Activities," in *Proceedings of the 1998 High Level Radioactive Waste Management Conference,* American Nuclear Society (1998).

R. Howard and R. Murthy, "The Application of Quality Assurance to Site Characterization," in *Proceedings of the 1993 High Level Radioactive Waste Management Conference,* American Nuclear Society (1993).