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PROFESSIONAL EXPERIENCE

Senior R&D Staff Irradiation Engineer, Oak Ridge National Laboratory, Oak Ridge, TN — *2019 – Present*
R&D Staff Irradiation Engineer, Oak Ridge National Laboratory, Oak Ridge, TN — *2016 – 2019*
R&D Associate Irradiation Engineer, Oak Ridge National Laboratory, Oak Ridge, TN — *2011 – 2016*

Responsible for designing and developing experiments for various radioisotope, nuclear fuels, and materials research programs. Responsibilities include performing the research and development to create novel experiment designs, responsibility for project management & leadership, and producing/maintaining fabrication documentation to ensure quality assurance and control adherence (ASME NQA-1). This work requires expert knowledge in a wide range of physics (heat transfer, structural mechanics, neutronics), familiarity with common and advanced manufacturing techniques, and a sound ability to lead/work in large team environments. Notable successes include:

- Supporting projects sustaining Accident Tolerant Fuels (FeCrAl and Mo cladding development) research with a consortium of institutions including the Oak Ridge National Laboratory (ORNL), Idaho National Laboratory, and Los Alamos National Laboratory ($400K - DOE sponsored).
- Established safety basis for ^{227}Ac production capsules and supported the development of a capsule assembly process for building the capsules in a hot cell environment (Work for others).
- Task leader and lead engineer responsible for ^{238}Pu isotope cermet production target development at ORNL ($2M – NASA sponsored).
- Task leader and lead engineer responsible for developing a novel experiment format for radiating and qualifying nuclear thermal propulsion (NTP) fuel/instrumentation components ($250K – NASA sponsored).
- Task leader and lead engineer responsible for resumption of domestic ^{60}Co isotope production ($500K – DOE sponsored).
- Irradiation of Inconel X-750 to understand CANDU garter spring spacer embrittlement research; sponsored by the CANDU Owners Group and the Canadian Nuclear Laboratories ($3M – Work for others).

Other responsibilities include providing technical expertise and collaboration for various experiment development efforts, create and expand existing technical resources for ORNL or other sponsors to support new research needs, and lab space management that facilitates a safe state-of-the-art research and development environment.

- Development of a hot cell laboratory to encapsulate pre-irradiated samples in irradiation capsule (new capability established for ORNL).
- Deployed a capsule production program at ORNL to meet the national demands for High Specific Activity (HSA) ^{60}Co (exceeding schedule requirements while remaining under budget).

Research Assistant, North Carolina State University, Raleigh, NC — *2009 – 2011*

Explored the GE-14 BWR fuel assembly, specifically the part-length rod configuration, to simplify the geometry of the bundle and improve the thermal output, core design, and efficiency.

Undergraduate Research Assistant, Auburn University, Auburn, AL — *2008 – 2009*

Created experimental facility to understand loading failures in high-current electrical connectors for hybrid vehicles.

EDUCATION

Doctor of Philosophy in Mechanical Engineering
University of Tennessee, Knoxville, TN — *2019*
Dissertation Title: A High Temperature Out-of-Pile Experiment for Testing Nuclear Thermal Propulsion Surrogate Fuels.

Master of Nuclear Engineering - Minor in Mathematics
North Carolina State University, Raleigh, NC — *2012*

Bachelor of Mechanical Engineering
Auburn University, Auburn, AL — *2009*

SKILLS

Technical

Specializes in experiment design, thermal hydraulics, along with a neutron transport modeling using modern computational techniques. Strong background finite element methods, mechanics of materials, machine design, modern and advanced welding techniques, and friction/wear analysis. Competent analyst and designer with strong ability to systematically and efficiently find solutions for a diverse set of engineering problems.

Leadership

Holds many positions technical and administrative leadership roles on high visibility projects. Responsibilities include managing projects that utilize multiple organizations and subcontractors. Accountable for establishing statements of work, schedules & deliverables, and team performance on medium and large-scale projects.

Computer languages and applications

ANSYS, PTC Mathcad, MATLAB, SolidWorks, PTC Creo, Python, FORTRAN, LabVIEW, SCALE (neutronics simulation), COBRA-EN (thermal-hydraulics simulation), LINUX, Microsoft OSs, and Microsoft Office Suite

PROFESSIONAL AFFILIATIONS AND APPOINTMENTS

- Assistant General Chair, Nuclear and Emerging Technologies for Space 2021 conference, 2020-2021
- Adjunct Professor, University of Tennessee, Knoxville, Department of Nuclear Engineering, 2020
- Guest Lecturer, University of Tennessee, Knoxville on Nuclear Thermal Propulsion fuel and instrumentation testing and demonstration, 2019
- Assistant General Chair, Nuclear and Emerging Technologies for Space 2020 conference, 2019-2020
- Guest Lecturer, The Ohio State University on Isotope Production, 2017
- Technical Program Co-Chair, 9th International Conference on Isotopes & Expo, 2017
- Organizer, Isotope Target Design and Fabrication Workshop, Oak Ridge National Laboratory, 2017
- FE/EIT Certification, 2011
- American Nuclear Society (ANS), 2011
- American Society of Mechanical Engineers (ASME), 2006

AWARDS AND ACADEMIC HONORS

- UT-Battelle 2013, 2015, 2016, and 2018 Supplemental Performance Award
- UT-Battelle 2017 Significant Event Award supporting the qualification and irradiation of ^{227}Ac production targets
- ANS 2015 Materials Science and Technology Significant Contribution Award
- UT-Battelle Awards Night 2019 – Mission Support
- UT-Battelle Awards Night 2013 – Engineering Research and Development
- UT-Battelle 2012 Significant Event Award, "Irradiation of single pellet targets to support the ^{238}Pu supply project"
- Tau Beta Pi Engineering Honor Society
- Pi Tau Sigma Mechanical Engineering Honor Society
- Graduated *Cum Laude* from Auburn University

SELECT PUBLICATIONS (h-index of 10)

Journal Articles

1. **Howard, R. H.**, Ruggles, A. E., *Design and Out-of-pile Testing of a Novel Irradiation Experiment Vehicle to Support Qualification of Nuclear Thermal Propulsion Components*, Nuclear Engineering and Design, 361, 2020, https://doi.org/10.1016/j.nucengdes.2020.110516.

2. Zhang, D., Briggs, S. A., Edmondson, P. D., Gussev, M. N., **Howard, R. H.**, Field, K. G., *Influence of welding and neutron irradiation on dislocation loop formation and α' precipitation in a FeCrAl alloy*, Journal of Nuclear Materials, Volume 527, 2019, https://doi.org/10.1016/j.jnucmat.2019.151784.

3. **Howard, R. H.**, Gallagher, R. C, Field, K.G., *Mechanical performance of neutron-irradiated dissimilar transition joints of aluminum alloy 6061-T6 and 304L stainless steel*., Journal of Nuclear Materials, 508, 348-353, 2018.

4. Field, K. G., Briggs, S. A., Sridharan, K., Yamamoto, Y., **Howard, R. H.***, Dislocation loop formation in model FeCrAl alloys after neutron irradiation below 1 dpa.*, Journal of Nuclear Materials, 495, 20-26, 2017.

5. Gussev M. N., **Howard, R. H.**, Terrani K. A., Field, K. G., *Sub-size tensile specimen design for in-reactor irradiation and post-irradiation testing, Nuclear Engineering and Design.*, 320, 298-308, 2017.

6. Field, K. G., Briggs, S. A., Sridharan K., **Howard, R. H.**, Yamamoto, Y., *Mechanical properties of neutron-irradiated model and commercial FeCrAl alloys.*, Journal of Nuclear Materials, 489,118-128, 2017.

7. Briggs, S. A., Edmondson, P. D, Littrell K. C., Yamamoto, Y., **Howard, R. H.**, et al., *A combined APT and SANS investigation of α' phase precipitation in neutron-irradiated model FeCrAl alloys.*, Acta Materialia, 129, 217-228, 2017.

8. Edmondson, P. D., Briggs, S. A., Yamamoto, Y., **Howard, R. H**., Sridharan, K., Terrani, K. A., & Field, K. G., *Irradiation-enhanced α' precipitation in model FeCrAl alloys.*, Scripta Materialia, 116, 112-116, 2016.

Technical Reports

1. Smith, K. R., **Howard, R. H**., and Bryant, D. E., *Destructive Testing of HFIR Irradiation "Rabbit" Capsules to Establish Containment Safety Limitations.* 2018. Web. doi:10.2172/1479754.

2. **Howard, R. H.,** Smith, K. R., *Development of a Flexible Design for Irradiation of Miniature Tensile and Charpy Test Specimens in the High Flux Isotope Reactor: ORNL/TM-2018/872*, 2018.

3. Le Coq, A. G., **Howard, R. H.**, Linton, K. D., Field, K. G., *Design and Thermal Analysis for Irradiation of Tensile Specimens from Wrought, Powder Metallurgy, and Additive Processed Alloys in the HFIR: ORNL/SPR-2018/959*, 2018.

4. **Howard, R. H.**, Miller, R. G., *Flow experiments and destructive testing to support the HFIR qualification of the 2nd Generation Pu-238 Target Rod Assembly: ORNL/TM-2017/65*, 2017.

5. **Howard, R. H.**, Harrison, T. J., Rader, J. D., *Technology Implementation Plan: Irradiation Testing and Qualification for Nuclear Thermal Propulsion Fuel: ORNL/TM-2017/376*, 2017.

6. Field, K. G., Briggs, S. A., Edmondson, P.D., Haley, J. C., **Howard, R. H.**, Hu, X., Littrell, K. C., Parish, C. M., Yamamoto, Y., *Database on Performance of Neutron Irradiated FeCrAl Alloys: ORNL/TM-2016/335*, 2016.

7. **Howard, R. H.**, Leonhardt, T., Field, K. G., *Status Report on the Fabrication of Coated Molybdenum Clad Test Articles for ATR Irradiations: ORNL/TM-2015/436*, 2015.

8. Edmondson, P. D., Okuniewski, M.A., McDuffee, J. L., & **Howard, R. H.**, *Report on Integrated Characterization and Irradiation of Metallic Fuels, FCRD Milestone Report: ORNL/TM-2015/554*, 2015.

9. Field, K. G., Briggs, S. A., Edmondson, P., Hu, X., Littrell, K. C., **Howard, R. H.**, Parish, C. M. & Yamamoto, Y., *Evaluation on the Effect of Composition on Radiation Hardening and Embrittlement in Model FeCrAl Alloys, FCRD Milestone Report ORNL/TM-2015/518 M2FT- 15OR0202243*., 2015.

10. Field, K.G., Hu, X., Littrell, K., Yamamoto, Y., **Howard, R.H.**, & Snead, L.L*., Stability of Model Fe-Cr-Al Alloys Under the Presence of Neutron Radiation, FY-14 FCRD Milestone Report: ORNL/LTR-2014/451*,

2014.

Conference Proceedings

1. Gallagher, R. C., **Howard, R. H.**, Bickel, G. A., *Design and Encapsulation of Irradiation Experiments for Previously Irradiated Materials*. 2019 ANS Annual Meeting, Minneapolis, MN, USA, June 9-13, 2019.

2. **Howard, R. H.**, *Overview of the Plutonium-238 Supply Program's CERMET Production Targets*. Nuclear and Emerging Technologies for Space (NETS) 2019, Richland, WA, USA, February 25-28, 2019.

3. **Howard, R. H.**, Gallagher, R. C., Buyers, A., Design and Development of CANDU Ex-Service Garter Spring Irradiation Experiments in the HFIR. 2018 ANS Annual Meeting, Philadelphia, PA, USA, June 17-22, 2018.

4. **Howard, R. H.**, Development of High Temperature Out-of-Pile Experiments for Testing Nuclear Thermal Propulsion Fuel Surrogates. Nuclear and Emerging Technologies for Space (NETS) 2018, Las Vegas, NV, USA, February 25-March 2, 2018.

5. **Howard, R. H.**, The Evolution of HFIR Cermet Pu-238 Production Targets. Nuclear and Emerging Technologies for Space (NETS) 2018, Las Vegas, NV, USA, February 25-March 2, 2018.

6. Petrie, C. M., McDuffee, J. L., Cetiner, N. O., **Howard, R. H.**, Mulligan, P. L., Nuclear Science User Facility Irradiation Capabilities at Oak Ridge National Laboratory.2017 ANS Annual Meeting, San Francisco, CA, USA, June 11-15, 2017.

7. Rapp, J., Biewer, T. M., Bigelow, T., Caughman, J. B. O., Duckworth, R., Giuliano, D., Goulding, R.H., Hillis, D.L., **Howard, R. H.**, et al., *The Material Plasma Exposure eXperiment MPEX: Pre-design, development and testing of source concept.*, 26th Symposium on Fusion Engineering, May 1-8, 2015.

8. **Howard, R. H.**, Schnitzler, B., Sprenger, M., Soderquist, L*., Irradiation Capsule Design to Support DOE Resumption of US Co-60 Isotope Production.* Proc. 2014 International Group of Research Reactors (IGORR 2014), Bariloche, AR., November 17-21, 2014.

9. Ott, L. J., **Howard, R. H.**, Howard, R. L., McDuffee, J. L., and Yan, Y., *Preparation of Prototypic Irradiated Hydrided-Zircaloy Cladding for UFDC Programs.* Proc. LWR Fuel Performance Meeting/Top Fuel 2013, Charlotte, North Carolina., September 15-19, 2013.

10. **Howard, R. H.**, McDuffee, J. L., and Katoh, Y., *Graphite Compressive Creep Capsule Design for Irradiation in the HFIR.* Proc. 2013 American Nuclear Society Annual Meeting, Atlanta, Ga., June 16-20,2013.

11. **Howard, R. H.**, Yan, Y., Howard, R. L., McDuffee, J. L., and Ott, L. J., *Production of Simulated High-Burnup Used Fuel Cladding in the HFIR.* Proc. 2013 International High-Level Radioactive Waste Management (2013 IHLWRM), Albuquerque, N. Mex., April 28-May 2, 2013.

12. **Howard, R. H.**, McDuffee, J. L., Fechter M. A., and Katoh, Y., *Development of HFIR Target Experiment for Graphite Irradiation Creep. Proc.* 12th International Graphite Specialist Meeting (INGSM-13), Meitingen, Germany, September 23-26, 2012.