

# Richard H. Howard

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## CAREER PROFILE AND NOTABLE OUTCOMES

Richard Howard is a recognized expert for leading innovations in nuclear research, development, and demonstration (RD&D). His efforts have made critical contributions to numerous technical areas including radioisotope production, qualification of nuclear fuels and materials, and nuclear thermal propulsion. Dr. Howard has extensive experience in leading complex research for the advancement nuclear power generation technologies; establishing and leading collaborative teams of experts to solve novel and complex engineering problems; planning and leadership roles for various medium and large-scale research programs; and the development of strategies for both Laboratory and programmatic interests. These accomplishments demonstrate a unique balance of knowledge and insight in a wide range of technical areas, excellent networking and communication abilities, and strong leadership skills. Notable successes include:

- Establishing recognition as an international leader in irradiation experimentation to support the development of radioisotopes, nuclear thermal propulsion, and advanced reactor technology.
- Supporting multi-organizational efforts to enable Advanced Reactor Demonstration Program research with a consortium of national laboratories and industry partners.
- Leading and support numerous domestic radioisotope production efforts that include  $^{238}\text{Pu}$ ,  $^{227}\text{Ac}$ ,  $^{60}\text{Co}$  through multi-laboratory collaboration,  $^{75}\text{Se}$ , and  $^{252}\text{Cf}$ .
- Decisive leadership to perform experiments that established the various safety and welding criteria required for the 2019 HFIR restart and supporting the ongoing justification for its continued operation.
- Developing and maintaining an international collaboration with Canadian Nuclear Laboratories to investigate degradation of critical nuclear components to support continuing operation of CANDU reactors and the Japan Atomic Energy Agency to research resilient materials for fusion applications.

Dr. Howard has also been instrumental in providing expertise to expand several technical resources including laboratory research and documentation protocols, maintaining the strong safety culture, and engaging with a wide range of various stakeholders to achieve a state-of-the-art research and development environment. He also strives to provide excellent technical mentorship to junior staff and students under his tutelage, including graduate students and interns.

## EDUCATION

Doctor of Philosophy in Mechanical Engineering  
University of Tennessee; Knoxville, TN 2016 – 2019  
Dissertation: *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 2009 – 2012

Bachelor of Mechanical Engineering  
Auburn University, Auburn, AL 2006 – 2009

## PROFESSIONAL EXPERIENCE

*Irradiation Engineering Group Leader, Oak Ridge National Laboratory, Oak Ridge, TN* 2022 – Present

- Leading numerous irradiation experiment design efforts to support Advanced Reactor Demonstration, additive manufacturing for nuclear technologies, and fusion materials research.
- Identify group and division personnel vulnerabilities and obtain talented and diverse candidates that can execute world class nuclear energy research at ORNL.
- Influence strategic planning within the Nuclear Energy and Fuel Cycle Division to establish and maintain critical research capabilities.
- Provide technical subject matter expertise and mentorship to the Irradiation Engineering Group.
- Mentor department staff researchers, Ph.D. candidates, and M.S. students.

*Department Manager, Idaho National Laboratory, Idaho Falls, ID* 2020-2022

- Identified departmental and division personnel vulnerabilities and obtained talented and diverse candidates that can ensure world class nuclear energy research is successfully executed at INL.
- Influenced strategic planning within the Nuclear Science & Technology Directorate to ensure research capabilities were maintained/created so that advanced reactor technologies were sufficiently demonstrated, qualified, and approved by regulators.
- Led the implementation of an auditable and defensible ASME NQA-1 software quality assurance program for irradiation experiment design and qualification analyses.
- Developed division research strategies and cultural paradigms that ensured INL mission and values are successfully met.
- Established meaningful RD&D networks within the Department of Energy (DOE) Laboratory complex and universities to promote mentorship, development of engineering talent, and innovation.
- Provided technical subject matter expertise and mentorship to the Irradiation Experiment Thermal Hydraulics Analysis Department.
- Performed departmental management duties, including coordination of department staff work in support of Laboratory goals and objectives; developing and increasing the department work portfolio; and collaborating with user facilities, programs and customers to improve integrated processes.
- Mentored department staff researchers, Ph.D. candidates, and M.S. students

*Senior R&D Staff Irradiation Engineer, Oak Ridge National Laboratory, Oak Ridge, TN* 2019 – 2020

- Supported and led a wide range of irradiation experiment and radioisotope programs.
- Provided subject matter expert support to the Research Reactor Division to ensure continued operation of the High Flux Isotope Reactor.
- Extensive leadership and technical effort to ensure HSA <sup>60</sup>Co capsules were successfully modeled, assayed, and delivered to the sponsor.
- Led design and irradiation efforts to support Nuclear Thermal Propulsion technology research and development.
- Led a cross-cutting modeling and simulation working group to promote collaboration between a multi-directorate userbase at ORNL.
- Mentored various junior staff and post-doctoral researchers, Ph.D. candidates, and M.S. students.

*R&D Staff Irradiation Engineer, Oak Ridge National Laboratory, Oak Ridge, TN*

2016 – 2019

- Led the reimaging of the  $^{238}\text{Pu}$  cermet production target and ensure the Plutonium Supply Project successfully met the target production requirements on schedule.
- Developed in-cell welding capabilities to enable the encapsulation of Canadian Nuclear Laboratories ex-service garter spring material and  $^{227}\text{Ac}$  production feedstock.
- Championed the Labware LIMS software package currently used in the ORNL Low Activation Materials Development and Analysis (LAMDA) laboratory and is being developed for other organizations in the irradiation target workflow.
- Participated in various working groups to establish recommendations and strategies for organizations such as the Isotope Enterprise Strategic Team and Irradiated Specimen Management Investigation team.
- Led the Isotope Target Design and Fabrication Workshop to investigate methods for improving radioisotope target production efficiency.
- Mentored various junior staff and post-doctoral researchers.

*R&D Associate Irradiation Engineer, Oak Ridge National Laboratory, Oak Ridge, TN*

2011 – 2016

- Provided extensive support to the development of a novel  $^{238}\text{Pu}$  cermet production target platform.
- Established various Accident Tolerant Fuels capsule designs to support the research and qualification of advanced FeCrAl steel cladding.
- Designed a full-length passive creep irradiation experiment to support nuclear graphite radiation performance and led the irradiation campaign.
- Supported many irradiation programs for radioisotope and nuclear materials research efforts.

## 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 find solutions systematically and efficiently 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, COBRA-EN (thermal-hydraulics simulation), LINUX, Microsoft OS, and Microsoft Office Suite

## PROFESSIONAL CREDENTIALS, AFFILIATIONS, AND APPOINTMENTS

- Granted DOE 'Q' clearance.
- Invited speaker, "Irradiation Testing: Facilities, Capabilities, and Experiment Designs" symposium at the 2024 TMS Annual Meeting and Exhibition 2024 TMS Annual Meeting & Exhibition
- Committee Chair, Aerospace Nuclear Science & Technology Division, 2023-present

- Vice Chair, Aerospace Nuclear Science & Technology Division, 2022-2023
- Secretary, Aerospace Nuclear Science & Technology Division, 2021-2022
- Assistant General Chair, Nuclear & 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 & 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)
- American Society of Mechanical Engineers (ASME)

#### **GRADUATE STUDENT COMMITTEE PARTICIPATION**

- Tyler Steiner, Ph.D. candidate, University of Tennessee, Knoxville (completed 2021)
- Taylor Duffin, Ph.D. candidate, University of Tennessee, Knoxville (completed 2022)
- Ryan Gallagher, Ph.D. candidate, The Ohio State University (completed 2022)
- Emily Hutchison, Ph.D. candidate, University of Tennessee, Knoxville (exp. graduation 2024)

#### **STUDENT MENTORSHIP**

- David Lanade, INL Summer/Fall internship, 2021, Ph.D. student, Texas A&M (exp. graduation 2025)
- Ryan McGuire, INL Summer internship (alternate mentor), 2021
- David Sikorski, Ph.D. student, University of Tennessee, Knoxville (graduated 2022)
- Dan Floyd, Ph.D. student, University of Tennessee, Knoxville (graduated 2023)
- Elizabeth Anderson, ORNL Summer internship, 2018
- Nicholas Russell, ORNL Summer internship, 2016
- James Cahill, Joao Galvao, Adam Mafi, Landin Moore, Virginia Commonwealth University Mechanical and Nuclear Engineering Dept. Senior Design, 2021-2022
- Chris Busch, Kayla Sims, Madison Tippet, Austin Welsh, University of Tennessee, Knoxville Nuclear Engineering Dept. Senior Design, 2020-2021

#### **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  $^{227}\text{Ac}$  production targets.
- ANS 2015 Materials Science and Technology Significant Contribution Award
- UT-Battelle Awards Night 2019 – Mission Support for restarting the High Flux Isotope Reactor
- UT-Battelle Awards Night 2013 – Engineering Research and Development
- UT-Battelle 2012 Significant Event Award, “Irradiation of single pellet targets to support the  $^{238}\text{Pu}$  supply project.”
- Tau Beta Pi Engineering Honor Society

- Pi Tau Sigma Mechanical Engineering Honor Society
- Graduated Cum Laude from Auburn University

**PUBLICATIONS (h-index of 11 from Web of Science, 14 from Google Scholar)***Journal Articles*

1. Qu, H. J., Higgins, M., Abouelella, H., Cappia, F., Burns, J., He, L., Massey, C., Harp, J., Field, K. G., **Howard, R. H.**, Umretiya, R. V., Hoffman, A. K., Wharry, J. P., Rebak, R. B., *FeCrAl fuel/clad chemical interaction in light water reactor environments*, Journal of Nuclear Materials, <https://doi.org/10.1016/j.jnucmat.2023.154717>.
2. Russell, N. G., **Howard, R. H.**, Smith, K. R., *Development of the generation III (ATR generation I) Plutonium-238 production target design*, Applied Radiation and Isotopes, <https://doi.org/10.1016/j.apradiso.2023.110912>.
3. Zillmer, A., Green, W., Tyler, C., Gross, B., Rosvall, E., Fradeneck, A., Fishler, J., Reeder, D., Marlow, R., Urban-Klaehn, J., Reichenberger, M., Hill, M. **Howard, R. H.**, *Recent Pu-238 Production Activities at Idaho National Laboratory*, Nuclear Technology, 2022, <https://doi.org/10.1080/00295450.2022.2105774>.
4. Steiner, T. R., **Howard, R. H.**, Systematic Component Investigation of the Steady-State High-Temperature In-Pile Nuclear Thermal Propulsion Experimental Test Bed, Nuclear Technology, 2022, <https://doi.org/10.1080/00295450.2022.2072652>.
5. Reichenberger, M. A., Urban-Klaehn, J. M., Brookman J. V., Peterson-Droogh, J. L., Navarro, J., **Howard, R. H.**, *In-Canal Assay of High Specific Activity Cobalt-60 at the Advanced Test Reactor*, Nuclear Technology, 2021, <https://doi.org/10.1080/00295450.2021.1903299>.
6. Steiner, T. R., Hutchins, E. M., **Howard, R. H.**, *Steady State In-Pile Nuclear Thermal Propulsion Experimental Testbed Initial Demonstration at the Ohio State University Research Reactor Nuclear Technology*, Nuclear Technology, 2021, <https://doi.org/10.1080/00295450.2021.1879582>.
7. **Howard, R. H.**, Reichenberger, M.A., Urban-Klaehn J.M., Peterson-Droogh J.L., Brookman J.V., Gross, B., Tyler, C., Navarro J., Lillo M., Zillmer, A., *Overcoming challenges to support us resumption of high specific activity Cobalt-60*, Applied Radiation and Isotopes, Volume 169, March 2021, <https://doi.org/10.1016/j.apradiso.2020.109494>.
8. Petrie, C. M., Sweeney, D. C., **Howard, R. H.**, Schrell, A. M., Felde, D. K., McDuffee, J. L., *Single-Phase, Natural Circulation Annular Flow Measurements for Cartridge Loop Irradiation Experiments*, Nuclear Engineering and Design, Volume 370, 15 December 2020, <https://doi.org/10.1016/j.nucengdes.2020.110900>.
9. Benensky, K., **Howard, R. H.**, Steiner, T., *Assessment of Near-Term Fuel Screening and Qualification Needs for Nuclear Thermal Propulsion Systems*, Nuclear Engineering and Design, October 2020, Volume 367, <https://doi.org/10.1016/j.nucengdes.2020.110765>.

10. **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>.
11. 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  $\alpha'$  precipitation in a FeCrAl alloy*, Journal of Nuclear Materials, Volume 527, 2019, <https://doi.org/10.1016/j.nucmat.2019.151784>.
12. **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.
13. 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.
14. 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.
15. 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.
16. Briggs, S. A., Edmondson, P. D, Littrell K. C., Yamamoto, Y., **Howard, R. H.**, et al., *A combined APT and SANS investigation of  $\alpha'$  phase precipitation in neutron-irradiated model FeCrAl alloys.*, Acta Materialia, 129, 217-228, 2017
17. Edmondson, P. D., Briggs, S. A., Yamamoto, Y., **Howard, R. H.**, Sridharan, K., Terrani, K. A., & Field, K. G., *Irradiation-enhanced  $\alpha'$  precipitation in model FeCrAl alloys.*, Scripta Materialia, 116, 112-116, 2016.

#### *Selected Technical Reports*

1. Le Coq, A. G, Collins, D. A., Russell, N. G., Howard, R. H., Hyer, H. C., Dryepondt, S. N., Taylor, C. C., Hoelzer, D. T., Massey, C. P., *Status report on HFIR irradiation of optimized alumina forming alloys*. ORNL/TM-2024/3309, 2024.
2. **Howard, R. H.**, Bryant, D., Wallen, Z., Massey, C., *Testing and Qualification of Molybdenum Subcapsule Welds for MiniFuel Experiments*. ORNL/SPR-2022/2575, <https://doi.org/10.2172/1906590>

3. Champlin, P., Burns, J., Petrie, C., Hu, X., Linton, K., **Howard, R.H.**, Terrani, K.A, *Capsule and Specimen Geometries for HFIR Irradiation Testing Supporting the Transformational Challenge Reactor*, ORNL/TM-2019/1310, 2021.
4. **Howard, R. H.**, Navarro, J., *Outcomes, Lessons Learned, and Best Practices taken from the Efforts to Resume Domestic Production of High Specific Activity Cobalt-60*, ORNL/TM-2020/1575, 2020.
5. Sweeney, D. C., Petrie, C. M., Chapel, A. S., **Howard, R. H.**, Schrell, A. M., Felde, D. K., McDuffee, J. L., *Versatile Test Reactor Program: 2020 ORNL Summary Report*, ORNL/SPR-2020/1587, 2020.
6. Rader, J., Smith, M. B. R., **Howard, R. H.**, Greenwood, M., Ezell, N. D., Harrison, T. J., *Nuclear Thermal Propulsion Summary Report FY19*, ORNL/SPR-2019/1282, 2020.
7. Piela, S., **Howard, R. H.**, Le Coq, A. G., Linton, K.D., Li, J., *Assembly and Delivery of Rabbit Capsules for Irradiation of Prototype Metal and Nanocomposite Specimens in the High Flux Isotope Reactor*, ORNL/SPR-2019/1306, 2019.
8. McDuffee, J. L., Petrie, C. M., Mulligan, P. L., **Howard, R. H.**, Cetiner, S. M., Huning, A., Greenwood, M., Thoms, K., *Summary Progress Report supporting the Development of a Molten Salt Cartridge Experiment in the Versatile Test Reactor*, ORNL/SPR-2019/1193, 2019.
9. Carathers, C., Byers, S., Betzler, B., Cook, D., Kendrick, B., Pinkston, D., Kilgore, C., Blanchard, D., Tobin, P., Bryan, C., Ramsey, C., Meszaros, J., Crowell, M., Chandler, D., Hurt, C. J., Joseph, M., Fudurich, V., Jain, P., Curtis, F., Howard, T., Kirk, G., **Howard, R. H.**, Dominguez-Ontiveros, E., Miller, R., *Oak Ridge National Laboratory HFIR OFE-488 Fuel Element Failure Causal Theory Evaluation Final Report*, ORNL/TM-2019/1120, 2019.
10. **Howard, R. H.**, Nuclear Thermal Propulsion Irradiation Vehicle Design: FY18 End-of-Year Report, ORNL/SPR-2018/972, 2018.
11. 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.
12. **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.
13. 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.
14. Gallagher, R., **Howard, R. H.**, Smith, K., Analysis and Design of Ex-Service Garter Spring Irradiation Capsules, ORNL/TM-2018/874, 2018.
15. **Howard, R. H.**, Gallagher, R., Petrie, C. M., Smith, K., *Design Scoping Analysis to Support the Irradiation of Ex-Service CANDU Non-Optimized Garter Springs in HFIR*, ORNL/SPR-2017/434, 2017.

16. **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.
17. **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.
18. Petrie, C. M., **Howard, R. H.**, Smith, K., Daily, C., *Analysis and Experimental Qualification of an Irradiation Capsule Design for Testing Pressurized Water Reactor Fuel Cladding in the High Flux Isotope Reactor*, ORNL/TM-2017/67, 2017.
19. Field, K. G., Yamamoto, Y., **Howard, R. H.**, *Status of Post Irradiation Examination of FCAB and FCAT Irradiation Capsules*, ORNL/TM-2016/558, 2016.
20. Field, K. G., **Howard, R. H.**, *Status of FeCrAl ODS Irradiations in the High Flux Isotope Reactor*, ORNL/TM-2016/394, 2016.
21. 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.
22. Field, K. G., **Howard, R. H.**, *Status Report on Irradiation Capsules Designed to Evaluate FeCrAl-UO<sub>2</sub> Interactions*, ORNL/TM-2016/267, 2016.
23. Field, K. G., **Howard, R. H.**, *Status Report on Irradiation Capsules Containing Welded FeCrAl Specimens for Radiation Tolerance Evaluation*, ORNL/TM-2016/78, 2016.
24. **Howard, R. H.**, *Examination of Worn AECL-style Rabbit Capsules in the IMET Facility*, ORNL/SR-2016/600, 2016.
25. Field, K. G., Gussev, M., Hu, X., Yamamoto, Y., **Howard, R. H.**, *First Annual Progress Report on Radiation Tolerance of Controlled Fusion Welds in High Temperature Oxidation Resistant FeCrAl Alloys*, ORNL/TM-2015/770, 2015.
26. 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.
27. Field, K. G., **Howard, R. H.**, Yamamoto, Y., *Design of Experiment for Irradiation of Welded Candidate Fe-Cr-Al Alloys*, ORNL/TM-2015/375, 2015.
28. **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.
29. Field, K. G., Gussev, M., Hu, X., Yamamoto, Y., **Howard, R. H.**, *Preliminary Studies on the Fabrication and Characterization of Fe-Cr-Al Alloys Designed to Have Enhanced Weldability and Radiation Tolerance*, ORNL/TM-2015/192, 2015.



30. 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.
31. 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.
32. **Howard, R. H.**, Yan, Y., Wang, J., Ott, L., Howard, R. L., *FY 2013 Summary Report: Post-Irradiation Examination of Zircaloy-4 Samples in Target Capsules and Initiation of Bending Fatigue Testing for Used Nuclear Fuel Vibration Integrity Investigations*, ORNL/LTR-2013/474, 2013.

#### Conference Proceedings

1. **Howard, R. H.**, *Developing irradiation experiments to enable characterization and qualification of advanced nuclear materials*. TMS 2024 Annual Meeting & Exhibition, Orlando, FL, Mar. 3-7, 2024
2. **Howard, R. H.**, Schrell, A., *Molybdenum weld development for applications in the High Flux Isotope Reactor*. Materials in Nuclear Energy Systems (MiNES) 2023, New Orleans, LA, Dec. 10-14, 2023
3. Zillmer, A. J., Fradeneck, A. D., Marlow, R. L., **Howard, R. H.**, Noss, P., *BRR Cask Use for Pu-238 Isotope Production*. 20th International Symposium on the Packaging and Transportation of Radioactive Materials, Jaun-les-Pins, France, Jun. 11-15, 2023
4. Bhowmik, P. K., Sabharwall, P., Heidrich, B. J., **Howard, R. H.**. 2023. *Accelerating Nuclear Fuels and Materials Qualification by Multi-Level Irradiation Experiment Campaign*. 2023 ANS Annual Meeting, Indianapolis, June 11-14, 2023
5. Chen, X, Field, K. G., **Howard, R. H.**, Massey, C. P., Nelson, A. T., *Post-Irradiation Fracture Toughness Characterization of Generation II FeCrAl Alloys*. ASME Pressure Vessels & Piping Conference 2022, Las Vegas, NV Jul. 17-22, 2022.
6. Zillmer, A. J., Green, W. S., Lower, J. D., Mitchell, J. R., Grayson, B. J., Rosvall, E. S., Fradeneck, A. D., Fishler, J. D., Reeder, D. F., Marlow, R. L., Hill, M. A., O'Donnell, P. F., Peterson-Droogh, J. L., **Howard, R. H.**, and Tyler, C., *Progress on Pu-238 Production at Idaho National Laboratory From March 2021 to February 2022*, Nuclear and Emerging Technologies for Space (NETS) 2022, Cleveland, OH, May 8-11, 2022.
7. Fradeneck, A. D., **Howard, R. H.**, *Safety Analysis of the Irradiation System for High-throughput Acquisition Capsule*, ANS Winter Meeting and Nuclear Technology Expo, Washington, D.C. USA, Dec. 1-3, 2021.

8. Sweeney, D. C., Petrie, C. M., **Howard, R. H.**, Felde, D. K., McDuffee, J. L., *Transient Testing of Natural Circulation Flow in Cartridge Experiments*, ANS Winter Meeting and Nuclear Technology Expo, Chicago, IL USA, Nov. 15-19, 2020.
9. Le Coq, A. G., Linton, K.D., Champlin, P., **Howard, R. H.**, Hu, X., Byun, T. S., Terrani, K. A. *HFIR Irradiation Testing Supporting the Transformational Challenge Reactor*, 2020 ANS Annual Meeting, Virtual, June 8-11, 2020.
10. **Howard, R. H.**, *Design of the In-pile experiment Set (INSET) apparatus to support Nuclear Thermal Propulsion fuel and component testing*, Nuclear and Emerging Technologies for Space (NETS) 2020, Knoxville, TN, USA, April 6-9, 2020.
11. McDuffee, J. L., Felde, D. K., Weaver, K., Farmer, M., Subharwall, P., **Howard, R. H.**, Mulligan, P. L., *Flow Test Plan to Support the Development of Cartridge Loops in the Versatile Test Reactor*, ANS Winter Meeting and Nuclear Technology Expo, Washington, D.C. USA, Nov. 17-21, 2019.
12. 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.
13. **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.
14. Petrie, C. M., Koyanagi, T., **Howard, R. H.**, Field, K. G., Burns, J. R., Terrani, K. A., *Accelerated Irradiation Testing of Miniature Nuclear Fuel and Cladding Specimens*, Top Fuel 2018, Prague, Czech Republic, September 30 - October 4, 2018.
15. **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.
16. Navarro, J., Peterson-Droogh, J. L., Brian Gross, B. J., **Howard, R. H.**, Cowherd, W., Dwight, C., *Data-Driven Methodology for Predicting Isotope Production at Material Testing Reactors*, 2018 ANS Annual Meeting, Philadelphia, PA, USA, June 17-22, 2018.
17. Peterson-Droogh, J. L., **Howard, R. H.**, *Current Neutronic Calculation Techniques for Modeling the Production of Ir-192 in HFIR*, PHYSOR 2018 - Cancun, Mexico – April 22-26, 2018.
18. **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 26-March 1, 2018.

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