Mackenzie Warwick

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EDUCATION

University of Michigan College of Engineering, Ann Arbor, MI

PhD Candidate: Nuclear Engineering Spring 2025
Thesis Topic: Ion Irradiations for Accelerated Creep Testing Using Tapered Geometries

Master of Science in Engineering: Nuclear Engineering December 2022
GPA 3.87/4.00
Coursework: Radiation Materials Science I and II, Nuclear Fuels, Computational Nuclear Materials, Nuclear Reactor Theory II, Nuclear Waste Management, Charged Particle Accelerators and Beams, TEM and Microscopy

Bachelor of Science in Engineering: Nuclear Engineering, Minor in Physics April 2020
Coursework: Nuclear Reactor Theory I, Nuclear Reactor Risk and Safety Analysis, Nuclear Power Reactors, Nuclear Engineering Materials

RESEARCH INTERESTS

Nuclear materials, radiation effects, ion irradiation, creep, extreme environments

RESEARCH EXPERIENCE

University of Michigan, Ann Arbor, MI, 48109

PhD Student in Nuclear Oriented Materials Examination (NOME) Group May 2020 - Present

- Completed initial microstructural characterization of as-is and ion irradiated 316SS thin foils.
- Led four (4) ion irradiation creep and two (2) thermal creep experiments at the Michigan Ion Beam Laboratory.
- Rebuilt the ion beam chamber, working on a redesign for the Generation II stage.

Idaho National Laboratory, Idaho Falls, ID

Computational Materials Group Intern August 2021 - Present

- Conducting a literature search and review of 316SS, specifically focused on microstructural properties and changes in the presence of radiation, stress, and temperature.
- Developing crystal plasticity models of 316SS for creep prediction using Marmot.

Fusion Safety Group Intern May 2020 - August 2021

- Tracked the production and build-up of activation and transmutation products from Inconel-718 (a fusion reactor material candidate), nine other Ni-based super-alloys, and two reduced-activation ferritic-martensitic (RAFM) steels using FISPACT-II.
- Evaluated each alloy's performance by calculating the waste disposal rating (WDR) for each alloy using the NRC 10 CFR 61.55 Class C waste requirements.
- Compared the transmutation and activation pathways for seven potential fusion spectra in first-wall and vacuum-vessel scenarios by writing Python scripts.
- Verified results by studying (n,n), (n,2n), (n,γ), and (n,α) cross section probabilities using JANIS and completing multiple literature reviews.

University of Michigan, College of Engineering, Ann Arbor, MI

Senior Design Project Sept. 2019 - April 2020

- Developed a load/burn sequence to burn Am, Cm, Np in the ABTR to reduce the amount of long-lived radioactive materials for waste management purposes.
- Implemented MATLAB to determine the initial minor actinide concentrations to be used as input into a full-core depletion study in MCNP.

University of Michigan, College of Engineering, Ann Arbor, MI

Undergraduate Research Assistant with Prof. Won-Sik Yang Sept. 2019 - Dec. 2019

- Used PROTEUS-MOC to determine the effects of various operational temperatures, fuel compositions, and fuel matrices on neutron flux within a micro-reactor core during operation.
- Refined my technical communication skills as a result of attending 2-hour weekly group meetings, presenting final results to the group, and writing a final paper.

University of Michigan, College of Engineering, Ann Arbor, MI

Undergraduate Research Assistant with Prof. Brian Kiedrowski April 2019 - Sept. 2019

- Wrote input files to optimize variance reduction and simulated fission reactions and neutron escape pathways for various light-water reactor core input files in MCNP.
- Developed effective skills in communication and time management as result of working independently in a deadline-oriented setting.

University of Michigan, College of Engineering, Ann Arbor, MI

Undergraduate Research Assistant with Prof. David Wehe, Dr. Niral Shah Sept. 2018 - April 2019

- Worked with a leading graduate student on a time-encoded hand-held imaging detector using CLLBC and CLYC scintillation crystals.
- Developed hands-on work experience by ensuring light-tight detector wrapping and experimental set-up for data acquisition, including detector calibration with a Cs-137 source.
- Developed programming experience by recreating a post-processing code in MATLAB that determined the optimal operating voltage based on gamma ray/neutron pulse separation, time delays, and source type.

PUBLICATIONS

2022

1. M.M. Warwick, P.W. Humrickhouse, K.G. Field. "Activation Analysis and Waste Disposal Rating Optimization of Ni-based Superalloys for Fusion Applications". *Fusion Engineering and Design Journal, In Preparation.*

INVITED PRESENTATIONS

University of Michigan, College of Engineering, Ann Arbor, MI

Idaho National Laboratory: NERS Research Poster Showcase May 2023

M.M. Warwick, W. Peterson, C.A. Hirst, K.G. Field. "Ion Irradiations for Accelerated Creep Testing Using Tapered Geometries".

University of Michigan, College of Engineering, Ann Arbor, MI

Engineering Research Symposium: Emerging Graduate Student November 2021

M.M. Warwick, P.W. Humrickhouse, K.G. Field. "Design of Ni-based Superalloys for Fusion Energy through Life Cycle Analysis".

PROFESSIONAL DEVELOPMENT

Tokyo Institute of Technology, Tokyo, Japan

2023 Nuclear Innovator Cultivation Camp - Participant January 8-19, 2023

- Participated in the inaugural Nuclear Innovator Cultivation Camp hosted by the Tokyo Institute of Technology as one of four U.S. university students.
- Observed the International Symposium on Zero-Carbon Energy Systems at Tokyo Tech.

- Met with TEPCO representatives to discuss the Fukushima Daiichi NPP Accident Progress and Current Clean-up Status.
- Focused on two directives: "Innovative Nuclear Energy System Development for a Carbon Neutral Society based on Current Research" and "The Development of Innovative Nuclear Energy Systems Resilient to Natural Disasters".

Oak Ridge National Laboratory, Oak Ridge, TN

13th MEV School Participant - Accelerated Fuels Qualification July 18-29, 2022

- One of 40 students competitively selected to participate in the Accelerated Fuels Qualification program through the MEV School hosted by ORNL.
- Presented on "Machine Learning Assisted Exploration of Radiation-Resistant High Entropy Alloys".

PROJECT EXPERIENCE

Idaho National Laboratory, Idaho Falls, ID

LDRD in Collaboration with the Michigan Ion Beam Laboratory January 2021 - April 2021

- Worked with Dr. Colin Judge (INL), Marcus Parry (INL), Prof. Gary Was (UM), Ovidiu Toader (UM), and Robert Hensley (UM) to define a work-plan to prepare for the upcoming irradiation creep testing in June 2021.
- Managed and aided 3 undergraduate students and their project progress on the load-train, stage and chamber, and laser extensometer portions of the experimental set-up.
- Developed project management experience by attending weekly meetings, keeping digital meeting minutes, and communicating with INL project management.

University of Michigan, College of Engineering, Ann Arbor, MI

Nuclear Grand Energy Challenge Sept. 2019 - April 2020

- Proposed a project that utilized the radiation from spent nuclear fuel to strengthen non-recyclable plastics to replace 1.5% of the new concrete produced, which would reduce global carbon emissions by 21.9 M tons.
- Participated in entrepreneurship classes to produce a well-rounded investor pitch.
- Contacted various green concrete companies, nuclear industry mentors, and irradiated materials specialists to determine technical feasibility of our project.

The GREEN Program, Fukushima, Japan

Nuclear to Renewables Transition March 2019

- Participated in a short-term, experiential study abroad to Fukushima, Japan to observe the communities directly impacted by the 2011 disaster, as well as how the Japanese government has been making the transition from nuclear energy to renewable energies.
- Visited the Fukushima Renewable Energy Agency, the Japan Atomic Energy Agency, and toured inside the decommissioned Fukushima Daini power plant.
- Enrolled at the Fukushima Institute of Technology and took an introductory radiation-interaction-with-matter course and history course that covered the 8-year period between the 2011 disaster and present-day.
- Completed a Capstone project with 2 other students that focused on disaster mitigation and immediate action for affordable and sustainable housing for those who cannot be relocated by utilizing destroyed infrastructure debris.

University of Michigan, Earth Sciences, Ann Arbor, MI, 48109

Oceanography in Italy, Ferrara and Rome June 2018 - July 2018

- Participated in a for-credit field course in Italy that connected the topics we learned in the Winter 2018 semester, which focused on oceanography and the effects that climate change and human involvement have on our oceans and smaller environments.

- Completed a personal project on the possible implications of a nuclear power plant on either Italian coast (east or west) and how a country's political climate can affects whether nuclear power is invested into, phased out, or non-action.

TEACHING EXPERIENCE

University of Michigan, College of Engineering, Ann Arbor, MI, 48109

Instructional Aid for Senior Design (NERS 491/492) September 2022 - Present
Graduate Student Instructor for Senior Design (NERS 491/492) September 2020 - April 2022

- Selected to receive the Richard and Eleanor Towner Prize for Outstanding GSIs award (March 2023) as one of four College of Engineering graduate student instructors.
- Selected to receive the Rackham Graduate School Outstanding Graduate Student Instructor award (March 2022) as one of 20 graduate student instructors.
- Worked with 58 students across 18 design teams to complete their senior design projects.
- Implemented a recurring safeguards lecture from PNNL in Fall 2020; introduced Technical Communication and Engineering Economics lectures in Fall 2021; introduced an Engineering Ethics lecture in Winter 2022.
- Completed 90% of the requirements for the Graduate Teaching Certificate Program (GTC).
- Held weekly office hours and multiple opportunities for written and oral communication feedback; met with individual teams on a monthly basis.
- Graded oral presentations and reports.
- Taught lectures on project management and organization.
- Sent bi-weekly emails updating project mentors (department faculty and external mentors) on project presentations.
- Refined project management, technical and general communication, and some programming skills.

University of Michigan, College of Engineering, Ann Arbor, MI

Glow Blue Student Instructor - Program Lead November 2021 - March 2022
Glow Blue Student Instructor January 2021 - March 2021

- Competitively selected as one of four graduate students to lead the NERS department's Glow Blue program to teach introductory nuclear engineering to 7th-9th grade students participating in DAPCEP (Detroit Area Pre-College Engineering Program).
- Introduced fun projects to learn about nuclear engineering: a candy nuclear reactor, Skittles to simulate radioactive decay and half-lives, and a thought exercise using multi-colored Jolly Ranchers to represent the four fundamental decay modes ($\alpha, \beta\pm, \gamma$, and neutron).
- Refined technical communication skills to communicate information to young audiences without a nuclear engineering background.

University of Michigan, College of Engineering, Ann Arbor, MI

Instructional Aide for Introductory Nuclear Engineering for Non-NERS Majors (NERS 211) January 2020 - April 2020

- Prepared teaching material for weekly lectures and taught review material during weekly recitation sessions for 30+ students.
- Developed, reviewed, and graded course quizzes, homework assignments, and exams on a weekly basis for 53 students.
- Reviewed course content and provided assistance on homework problems during weekly office hours and monthly study sessions in preparation for midterm exams.
- Won the NERS Outstanding IA award for my work with this course.

EDUCATIONAL OUTREACH

University of Michigan, College of Engineering, Ann Arbor, MI

NERS Department Student Recruiter May 2019 - Present

- Working with the undergraduate program manager, Michelle Sonderman, to recruit potential students to the department.
- Participated in four online Campus Day recruiting events with Michelle.
- Represented the department at the summer orientation tabling events.
- Toured the department and some research labs, along with answered any questions (coursework and typical schedule, research and experience opportunities, AP/IB credits, financial aid, housing, etc.) for eight families; successfully recruited five of these students.

Skype-A-Scientist Virtual Program

Nuclear Engineer January 2021 - Present

- Participating in a volunteer-based virtual program that matches scientists with classrooms across the U.S.
- Presented introductory nuclear engineering topics, with a focus on clean energy generation, to 30 8th-grade students in Northern California.

Garden City Public School District, Garden City, MI

Girls in STEM Program January 2021 - Present

- Introducing a Girls in STEM pilot program (similar to the Glow Blue program and Xplore/Discover Engineering programs at UM) to the Garden City area, which includes surrounding school districts in Livonia, Wayne-Westland, Dearborn, and Dearborn Heights.
- Partnering with the Garden City school district superintendent and curriculum director to develop a work-plan for the course starting in Spring 2022.

University of Michigan, College of Engineering, Ann Arbor, MI

Anti-racism and Accountability Workshop Partner October 2020 - November 2020

- Partnered with Prof. Todd Allen, Dr. Aditi Verma, Dr. Katlyn Turner, Dr. Denia Djokić (authors of "A call for anti-racist action and accountability in the US nuclear community") to develop and participate in our department's own workshop.
- Continued partnership with the authors and another current PhD student to develop a for-credit course that discusses the impacts of the nuclear industry on indigenous peoples and their lands.

University of Michigan, College of Engineering, Ann Arbor, MI

Common Reading Experience Facilitator Fall 2019, Fall 2020

- Became a liaison between the NERS department, current students, and the Honors and Engagement Program for student facilitators.
- Compiled and distributed a list of courses for incoming students to take if they were interested in climate change and clean energy.
- Facilitated over 10 discussion sessions of approximately 350 incoming engineering students.
- Discussed the required book, "Full Body Burden: Growing Up in the Nuclear Shadow of Rocky Flats" by Kristen Iverson and facilitated a confidential atmosphere for students to ask questions freely.
- Improved my communication skills regarding technical nuclear information and students' concerns and questions.
- Recruited 5 potential students to the NERS department.

University of Michigan, College of Engineering, Ann Arbor, MI

Nuclear Discussion Panel October 2019

- Partnered with Prof. Todd Allen to provide an opportunity for university students to ask questions to nuclear industry representatives; the panel was direct result of the Common Reading Experience book.
- Recruited over 50 students to the event through direct communication at discussion sessions.

University of Michigan, College of Engineering, Ann Arbor, MI

Engineering Summer Camp Program May 2019 - August 2019
May 2022 - July 2022
May 2023 - July 2023

- Led the "Radiation is All Around Us" workshop where students used Geiger counters to examine every-day household items for radiation; conversations around radioactivity occurring naturally and why you would see radioactivity from certain items.
- Discussed the atom, periodic table, and chart of nuclides.
- Represented the NERS department in the Xplore and Discover Engineering programs.
- Worked closely with Sandra Hines to schedule rooms, transportation, and completed training for minor chaperoning and supervision.
- Scheduled over 15 lab tours, a hands-on cloud chamber activity, and led program participants through all lab tours and activities.

Garden City High School, Garden City, MI

AP Chemistry Nuclear Debate February 21, 2017

- Partnered with two AP teachers from my alma mater to present introductory nuclear engineering topics to high school juniors and seniors for use in their nuclear energy debate term project.

WORK EXPERIENCE

University of Michigan, College of Engineering, Ann Arbor, MI

Michigan Ion Beam Laboratory December 2020 - Present

- Trained as an irradiation watcher for the Wolverine 3 MV Pelletron accelerator. Special equipment: computer interface for the accelerator, FLIR A600 thermal camera.

University of Michigan, College of Engineering, Ann Arbor, MI

NERS Department Student Temp November 2019 - February 2020

- Focused on data entry to help with the retirement of the previous department administrator and the acclimation of the current administrator.
- Helped with general office management, especially when one of the permanent secretaries worked from home during the week.

University of Michigan, College of Engineering, Ann Arbor, MI

MTV Consortium Outreach Coordinator May 2019 - August 2019

- Assisted in planning for the Monitoring, Technology, and Verification Consortium kick-off event in May 2019, which included emailing and confirming the guest list of over 100 faculty and students from partner universities across the country, producing name badges and table place cards, running the sign-in table at the event, and general assistance.
- Photographed the event during the kick-off dinner and conference; used the photos to create and update the MTV website, LinkedIn group, and social media accounts (Twitter and Facebook).
- Networked with over 50 professors whose research pertained to the advancement of nuclear nonproliferation and the detection of special nuclear materials.

Panera Bread, Canton, MI

Associate Trainer October 2014 - August 2019

- Trained over 20 associates and managers in the areas of service zone prep and operation: front cashier, bakery, table runner, food production and preparation, drive-thru, specialized in opening and lunch rush operation.
- Responsible for co-worker management and position deployment during peak production times and ensured co-workers were following food safety protocol at all times.
- Promoted to associate trainer within six months of my hire date.
- Excelled at multi-tasking and customer service, especially while deployed in the drive-thru.
- Awarded 'Employee of the Quarter' 3 times.

AWARDS AND ACHIEVEMENTS

Women in Nuclear
Best Overall Student Chapter Award — July 2021

American Nuclear Society
Student Section Commendations Undergraduate Leadership Award — April 2020

University of Michigan College of Engineering
Richard and Eleanor Towner Prize for Outstanding GSIs — March 2023
Rackham Graduate School Outstanding Graduate Student Instructor Award — March 2022
Harry B. Benford Entrepreneurial Leadership Award — March 2020
Outstanding NERS GSI/IA Award for NERS 211 — March 2020
Nominated for Michigan's Senior of the Year — March 2020
Dean's List — April 2017, December 2019
William Kerr Scholarship Recipient — March 2019
James W. Butt Scholarship Recipient — March 2019
Paul and Karen Fessler Scholarship Recipient — March 2018

ORGANIZATIONS

American Nuclear Society - National and Student Member — **September 2016 - Present**
Student Chapter Grad Student Mentor — September 2020 - April 2021
Student Chapter President — April 2019 - September 2020
Student Chapter Treasurer — April 2018 - April 2019
Student Chapter Marketing Chair — September 2017- April 2018

Women in Nuclear - National and Student Member — **June 2019 - Present**
WIN Auxiliary Mentoring Pilot Program, Mentee — June 2021 - June 2022
Idaho WIN Intern Engagement Chair — June 2021 - Present
Student Chapter President — June 2019 - Present
Student Chapter Founder — June 2019

Materials Research Society - National Member — **October 2022 - Present**

NERS Department
Peer Mentor/Mentee Program — September 2021 - Present
DEI Representative — September 2021 - Present
Congressional Outreach Volunteer — May 2021 - Present

University of Michigan Engineering Student Government
Peer Mentor/Mentee Program — September 2019 - May 2020

The GREEN Program
University Student Ambassador — September 2019 -May 2020

SKILLS

Computer Skills, Generic: Microsoft Office Suite - Excel, Word, PowerPoint, Google Workspace, Python, MATLAB, LaTeX
Software Experience: MCNP6.2, FISPACT-II, SIESTA (DFT), LAMMPS, MMC, MD simulations, LabVIEW
Languages: Proficient in Japanese
Certifications: UM Graduate Teaching Certificate *In Progress*, Rackham Professional Development Diversity, Equity, and Inclusion Certificate *In Progress*