ANS NCSD Newsletter Winter 2025

Member Highlight- Mackenzie Gorham

Mackenzie is the Program Coordinator for the Nuclear Operations Technology Program at Idaho State University (ISU). Mackenzie received her B.S. in Nuclear Engineering from Missouri S&T, and holds two M.S. degrees in Nuclear Engineering and in Environmental Science from the University of Idaho. Mackenzie is also a senior reactor operator, and previously worked at INL as a Criticality Safety SME, Safety System Oversight Officer, and RAP federal team leader, for 10 years. Thus far in her career, she has published two benchmarks for the ICSBEP, developed student operator training for the Missouri S&T research reactor, and performed oversight of the TREAT restart at INL, and helped recreate a compliant system engineering program after decades of shutdown.

Mackenzie is the social chair for the NCSD topical this fall, which entails creating a STEM outreach event in cooperation with UT Austin's existing uTeach program, which seeks to unite area middle and high school students with SMEs in various STEM fields, to inspire youth to pursue STEM careers. She was also the founder of the NCSD young members challenge that is featured at many of the ANS national meetings. Mackenzie notes that moving from industry to academia has been a really good fit, as she has always enjoyed spreading passion for learning and trying to excite others about the nuclear industry. She remarks “It's very rewarding to help prepare young people to succeed in a career I have found so rewarding and fulfilling.”

Mackenzie is also currently chair of the NCSD Special Committee on Outreach to Military, Trades and Operations and working to try and grow membership in this area. This effort has strong overlap with the program she runs at ISU, which is an Associate's program geared towards creating well-trained and education early career operators and technicians to support operations groups across the DOE complex as well as in commercial reactors.

Site Highlight- Idaho National Laboratory

Idaho National Laboratory (INL) stands at the forefront of nuclear research and safety, pioneering innovative solutions in criticality safety for molten salt activities, including electrorefining of EBR-II fuel elements and chloride fuel salt production for the Molten Chloride Reactor Experiment (MCRE). Electrorefining occurs in the argon hot cell in the Fuel Conditioning Facility (FCF) while chloride fuel salt production occurs in the Fuel Manufacturing Facility (FMF). Our state-of-the-art facilities and rigorous safety protocols ensure the highest levels of protection for personnel, the public, and the environment, while advancing the frontiers of nuclear technology.

EBR-II operated from 1964 to 1994 and tested a variety of fuels and structural materials. FCF currently contains two electrorefiners that are used to process spent fuel from the 30 years of EBR-II operation. Chopped fuel is lowered into the electrorefiners which contain a molten LiCl- KCl eutectic salt electrolyte. Voltage is applied between the basket (anode) holding element segments and a cathode causing metallic uranium in the spent fuel to undergo electrochemical oxidation forming uranium chloride (UCl_3). Fission products, plutonium, and other TRU metals remain as chlorides in the salt and are eventually disposed of as waste. Simultaneously at the cathode, uranium chloride undergoes electro-chemical reduction and deposits uranium metal. This metal is then further processed into HALEU that can be used for fuel production for a variety of proposed reactor concepts. Criticality safety controls for the electrorefiners include fissionable material mass limits, holdup limits, and minimum salt mass limits. Fissionable material mass is tracked by weighing material that goes in and out of the electrorefiners as well as with periodic salt samples.

The MCRE is a fast spectrum, molten chloride salt fueled reactor that is planned to be constructed and operated in the Laboratory for Operation and Testing in the U.S. (LOTUS) testbed, formerly known as the Zero Power Physics Reactor (ZPPR) cell. Production of MCRE fuel salt, a UCl_3 -NaCl eutectic salt, is scheduled to begin in the spring of 2025 in FMF. Fuel salt is prepared from HEU ZPPR fuel plate feedstock and synthesized into MCRE fuel in an inert atmosphere glovebox. Synthesis takes place at elevated temperatures in furnaces with geometry controls and fissionable material mass limits on each batch. Fuel salt is then transferred out of the glovebox and stored in containers until MCRE is ready for fuel loading. MCRE will have a geometry controlled fuel tank to maintain the fuel inventory subcritical when fuel is not in the reactor.

In both molten salt applications, the eutectic salt acts as a diluent and as a poison because of the chlorine. This allows for limits that are much higher than minimum subcritical limits. Crediting chlorine is done by conservatively addressing cross section uncertainties, benchmarks limitations, upset conditions including chemistry upsets, and providing large margins of safety.

UPCOMING EVENTS

Trainings/Classes:

- Manager CSO Course at NCERC (March 17-21, 2025)
- SCALE Criticality Safety Calculations at ORNL (March 17-21, 2025)
- Manager CSO Course at SNL (Apr 14-18, 2025)
- Criticality Calculations with MCNP6 at LANL (May 5-9, 2025)
- Two-week CSE course at NFO/NATM and NCERC/SNL (Aug 4-15, 2025)

Meeting Reminders:

- ANS Student Conference (April 3-5, 2025, Albuquerque, NM)
- ICSBEP TRG at Jožef Stefan Institute (April 14-18, 2025; Ljubljana, Slovenia
- ANS Annual Meeting (June 15-18, 2025, Chicago, IL)
- ANS NCSD 2025 (Sept 14-18, 2025, Austin, TX)
    - Papers due April 21