Gateway for Accelerated Innovation in Nuclear
October 2017 Highlights Report

NE Voucher Program

October 2017: The final report, "**Assessment of the Neutronic and Fuel Cycle Performance of the Transatomic Power Molten Salt Reactor Design**," under the GAIN NE Voucher Program, has been finalized and issued to Transatomic Power (TAP). Results from the simulation tools at ORNL show agreement with TAP-calculated performance metrics for core lifetime, discharge burnup, and salt volume fraction, verifying the viability of reducing actinide waste production with this concept. Additional analyses of mass feed rates and enrichments, isotopic removals, tritium generation, core power distribution, core vessel helium generation, moderator rod heat deposition, and reactivity coefficients provides additional information to make informed design decisions. This work demonstrates capabilities of ORNL modeling and simulation tools for neutronic and fuel cycle analysis of molten salt reactor concepts.

Workshops

October 3-4, 2017: The 3rd Annual **GAIN Molten Salt Reactor Workshop** was held at ORNL. This year, over 225 participants represented the advanced reactor industry (developers, utilities, and suppliers), DOE, NRC, national labs, and international organizations. More than 200 attendees heard presentations from advanced reactor technology developers, NRC, DOE national laboratories, GAIN, and universities. ORNL's Andrew Worrall, the new deputy director of GAIN, believes the private-public partnerships will help deliver on the next generation of nuclear reactors. "It's about taking this amazing intellectual horsepower that the labs have—in terms of facilities and capabilities—and enabling access for our industry colleagues," Worrall said. "It's that tremendous investment over decades by DOE in the labs, people, and facilities that has pushed the United States to its leadership position in nuclear energy, and industry couldn't be expected to do that alone."*https://www.ornl.gov/news/workshop-highlights-importance-advanced-reactors-us-nuclear-energy-future*

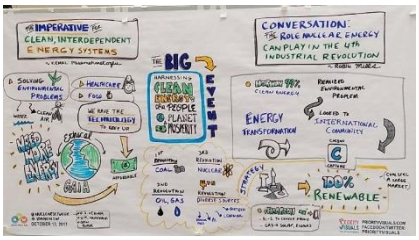
Industry Engagement/Outreach

October 3-4, 2017: John Jackson, GAIN Technical POC presented an overview of GAIN at the **Advanced Manufacturing and Supply Chain Innovation Leadership Summit**, sponsored by the U.S. Nuclear Infrastructure Council (USNIC) in cooperation with the Idaho National Laboratory (INL). Keynotes featured the Chief of Staff for the U.S. Department of Energy's Office of Nuclear Energy, Suzanne Jaworowski; Concurrent Technologies Corporation President and CEO Edward Sheehan; nationally syndicated columnist and commentator Llewellyn King; INL Laboratory Director Mark Peters; Vedigris Capital Managing Director Walter Howes and Idaho Falls Mayor Rebecca Casper.

Discussions included technology developer and supplier challenges and opportunities; transformative technologies in advanced manufacturing; additive manufacturing on nuclear components and fuels; meeting future energy system demands; X-energy/Centrus collaboration on advanced nuclear fuel; cyber security for direct digital manufacturing; regional supply chains and factory assembly of small reactors; human capital; the Nuclear Energy Infrastructure Database; and the new Pennsylvania-headquartered Center for Advanced Nuclear Manufacturing.

October 10-11, 2017: The annual joint meeting of the **Consortium for Advanced Simulation for Light Water Reactors (CASL) Industry and Science Councils** was held in Knoxville, Tennessee. The CASL Industry Council includes nuclear plant owner/operators, fuel vendors, engineering design and service providers, and independent software vendors. The CASL Team provided an update on their modeling and simulation progress to address challenges with existing and future LWRs. Dr. Rita Baranwal, GAIN Director, discussed GAIN and activities underway to connect the nuclear community with national laboratory capabilities.

October 12-13, 2017: GAIN was one of the sponsors of the **Big Event kickoff to Nuclear Science Week**. Nuclear Science Week is an international, broadly observed weeklong celebration that focuses public interest on all aspects of nuclear science. "Our New Energy Horizon" was the title of the forum to engage panel speakers in discussions around nuclear energy. Featured speakers included INL Lab Director Mark Peters, author Robin Mills, Kirsty Gogan of Energy for Humanity, and Kathryn McCarthy with the Canadian Nuclear Laboratories. GAIN Director Rita Baranwal was one of the panel speakers for the session on Advancing Nuclear Energy. A graphic recorder captured each of the panel discussions separately in a cartoon-like drawing.



October 16, 2017: GAIN's director, Rita Baranwal, participated in a **Q&A Reddit AMA** (ask me anything) forum along with the HTGR NTD, Hans Gougar, SMR's George Griffith, NSUF's Brenden Heidrich, and INL's Phil Sharpe. They answered more than a dozen questions from Reddit users. The Idaho Falls Post Register featured an article on this event on October 17, 2017. "We thought it would be great to start a conversation about the future of advanced nuclear energy, including reactor designs, fuel types, industry engagement and some of the ideal uses for advanced nuclear systems," INL Director of Nuclear Systems Design and Analysis Phil Sharpe wrote in the AMA introduction.


Idaho National Laboratory holds Reddit AMA

Officials answer public questions

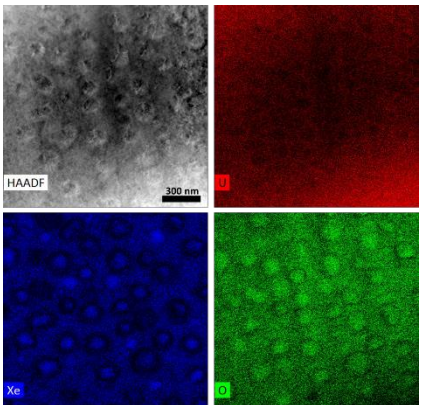
October 25, 2017: Rita Baranwal and John Jackson attended a meeting with DOE Associate General Counsel, DOE-Chicago IP Counsel, INL Chief Counsel, INL OF Counsel, and a DOE agreements expert in Germantown, MD. The objective of the meeting was to discuss potential changes in **DOE contracting mechanisms** that would facilitate industry interactions with DOE laboratories. Based on this meeting, a path forward for instituting appropriate changes will be formulated and implemented.

October 28, 2017: **Advanced Nuclear Designs Imagined in Third Way Exhibit**, by Dan Yurman. The Washington, DC, think tank Third Way commissioned a stunning collection of six possible use cases and artistic renderings of how advanced nuclear reactor technologies would fit in various communities. The images and use cases are online in a new web page that is now part of the Third Way's innovative advocacy effort for clean energy. Considerable technical expertise was brought in as part of the development effort from the INL's GAIN program and the sustainable design team of the Gensler Design office in Washington, DC. https://neutronbytes.com/2017/11/04/advanced-nuclear-designs-imagined-in-third-way-exhibit/

October 29-November 2, 2017: Rita Baranwal, Lori Braase, and Alison Conner staffed the GAIN booth at the **American Nuclear Society (ANS) Winter Meeting and Expo 2017**, in Washington, DC. The GAIN booth was co-located with booths from NSUF, NEUP, LWRS, and INL NS&T. The coordination between the programs was visible and acknowledged by many of the visitors to the booths. In addition, Rita participated on two separate panels, "The GAIN Initiative for Advanced Nuclear Power Plants," and "Research Opportunities in Advanced Fission and Fusion Materials," to provide a GAIN overview.

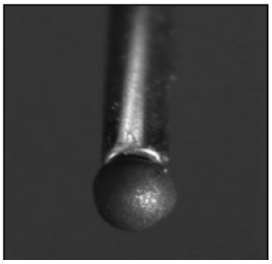
Technology Advances at INL Materials and Fuels Complex

Evolution of fission gas in uranium was observed during postirradiation examination at INL. Ion implantation is used to simulate the effects of irradiation on reactor material and components. It allows the acceleration of testing that would require long reactor irradiation times. Depleted uranium oxide (UO_2) was irradiated with xenon (Xe) ions up to 340 displacements per atom using the IVEM-Tandem Facility at Argonne National Laboratory. Both nanoscale Xe bubbles and Xe-enriched circular features approximately 100-200 nm in size were observed by STEM with EDS at the Irradiated Material Characterization Laboratory (IMCL). In addition, a Xe-depleted zone around the circular Xe-rich features was observed for the first time. Understanding and quantifying fission gas bubble precipitation in UO_2 will lead to better understanding of fuel swelling as well as improve the modeling and simulation of nuclear fuels.



Stem-EDS images showing circular features in Xe-implanted UO_2

The INL Analytical Laboratory's Gas Mass Spectrometry Group constructed, characterized, and filled a series of containers for **gas standards to improve characterization** of the AFC-4B rodlets by the gas assay sample and recharge instrument located at the Hot Fuel Examination Facility (HFEF). In the Analytical Laboratory hot cells, individual TRISO fuel particles irradiated as part of the AGR project, were selected, photographed, and transferred using a vacuum capillary apparatus, microscope, and attached camera. Approximately 5,000 particles were released by the deconsolidation of a single fuel compact. Roughly 140 of them, some representative of breached fuel, were chosen for further characterization.


A vacuum-immobilized AGR fuel particle

The INL **Experimental Fuels Facility (EFF)** is undergoing changes to better support fuel development activity. After commissioning, the existing contaminated machining area will be expanded to include a computer numerically controlled Haas mini-mill. This will expand the tools and abilities to machine uranium and contaminated materials.

New milling machine in EFF

The ability to produce and perform research on ceramic fuels is being expanded to include uranium oxide (the commercial power industry standard), as well as nitrides, silicides, and other compound fuels that are being investigated as next generation fuels. To support this effort, two new items will be purchased, (1) a 9-in. hearth tri-arc arc melter that will allow for larger scale alloy production, and (2) a high-temperature sintering furnace accessible from an inert glovebox to provide a larger and better platform to process ceramic fuels.

Regulatory

October 2017: The **Advanced non-LWR Technologies Regulatory Development Plan** was issued. The goal, or "end state," of the integrated activities summarized in the plan is the establishment of a licensing pathway for non-light water reactor (LWRs) that is sufficiently well defined so that reactor developers, their sponsors, and interested owner/operators can move forward with increased clarity and reasonable assurance of successful deployment. The timeframe for establishing the licensing pathway is similar to that of the technology research and development (R&D) pathways, and consists of near-term and mid/long-term activities. In particular, it is intended that the resolution of the key licensing issues discussed in this plan do not impact the "critical path" to non-LWR development, demonstration, and commercialization.

2017 Summary Statistics: 59 nuclear technology developers involved with GAIN

27 companies participate in a Technology Working Group	2016 NE Vouchers awarded to 8 companies (**5** are not in a TWG)	2017 NE Vouchers awarded to 14 companies (**9** are not in a TWG)	**18** companies involved with GAIN are not in a TWG or a NE voucher recipient

GAIN Look Ahead

2017 Date(s)	Title	Location	GAIN's Role
October 2:	Molten Salt Reactor Technology Working Group (TWG) Meeting	ORNL, Knoxville, TN	
October 3-4:	USNIC/INL Advanced Manufacturing & Supply Chain Innovation in Nuclear Energy Leadership Summit	Shilo Inn, Idaho Falls, ID	Present, Attend
October 3-4:	GAIN ORNL Molten Salt Reactor Workshop	ORNL, Knoxville, TN	Present, Support, Attend
October 10-11:	CASL Industry Council	Knoxville, TN	Present, Attend
October 13-18:	Nuclear Science Week	INL, Idaho Falls, ID	Present, Attend
October 25:	GAIN DOE Partnership Agreement Meeting	Germantown, MD	Attend
October 29 – November 2:	ANS Winter Meeting	Wardman Park, Washington DC	Present, GAIN Booth, Attend
November 2:	NRC Public Meeting on Advanced Reactors	NRC, Bethesda, MD	Attend
November 7:	GAIN Executive Advisory Committee Meeting	INL Office, Washington DC	Support, Attend
November 14-15:	NSUF Annual Meeting	DOE, Germantown, MD	Present, Attend
December 6:	NEI ARWG Meeting	NEI, Washington DC	Present, Attend
December 7:	NEAMS Executive Advanced Reactor Industry Council (NEARIC) Meeting	NEI Office, Washington DC	Present, Support, Attend
December 11-13:	Deep Decarbonization Symposium	San Francisco, CA	Present, Attend
December 14:	NRC Public Meeting on Advanced Reactors	NRC, Bethesda, MD	Attend

For questions or additional information, please contact Lori Braase, GAIN, lori.braase@inl.gov.

@GAINnuclear

gain.inl.gov