ATR
National Scientific User Facility

*The Energy of Collaboration*

# August/October 2011 Combined Bimonthly Report

## Accomplishments and Look Ahead

**August 2011**

- Hosted Dr. Hannu Hanninen, of Finland's Aalto University who is currently on sabbatical at MIT.
- Dr. Meimei Li of ANL completed her APS experiment. This experiment utilized ATR NSUF partner IIT who operate the MRCAT at the APS.
- The first experiments to use ATR NSUF partners U of Nevada, Las Vegas (UNLV) & North Carolina State University (NCSU) are underway.
  - ⇒Two U of Wisconsin researchers (Yina Huang & Alicia Certain) will travel to UNLV to utilize the analytical capabilities in the radiochemistry laboratory.
  - ⇒Arizona State Professor Nate Newman will utilize the PULSTAR reactor to perform a short irradiation experiment.

**September 2011**

- ATR NSUF was both an exhibitor and sponsor of the 2011 Test Research and Training Reactors (TRTR) Annual Meeting in Idaho Falls, Idaho which ran from September 12-15.

**October 2011**

- NSUF will host an exhibit at the ANS Winter Meeting & Nuclear Technology Expo in Wash. DC from Oct.30-Nov. 3.
- Colloquium speaker Haitham El Kadiri of Mississippi State will present on atomic scale modeling of Zr alloy performance Oct 25.

## Noteworthy News

### Follow the ATR NSUF Users Working Group on Twitter!

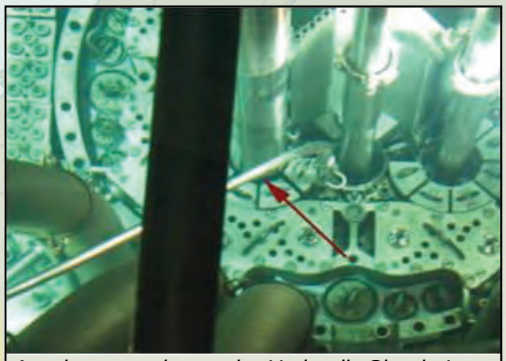
Follow the ATR NSUF Users Working Group chair Dr. Jeff Terry on twitter at http://twitter.com/#!/ATRNSUOchair to keep up-to-date on member activities.

### Dr. James Cole Selected as ATR NSUF Chief Scientist

Please join us in welcoming Dr. James Cole to the position of Chief Scientist. In his new position, Cole will provide technical assistance to proposing researchers, along with technical oversight to the program. Prior to this role, he worked as an Idaho National Laboratory (INL) Senior Staff Scientist, Materials Scientist, and Principal Investigator on several ATR NSUF projects. Cole specializes in the area of materials and fuels for nuclear energy systems, particularly in understanding the relationship between radiation-induced changes in material structure and the degradation of properties under extreme reactor environments. Most recently, Cole's efforts have focused on managing projects related to fast reactor cladding development, the study of actinide bearing fuels for transmutation applications and the identification and acquisition of advanced PIE characterization tools for the INL. Cole formally started his position with ATR NSUF on August 20th. You can contact him at: james.cole@inl.gov.

### ATR National Scientific User Facility Experiment First to use ATR Hydraulic Shuttle Capability

On June 27, the first ever Advanced Test Reactor (ATR) hydraulic shuttle irradiation system (HSIS) experiment was successfully completed on an ATR National Scientific User Facility (NSUF) project. The lucky "first" experiment was performed in two phases, and is part of a larger University of Illinois (UI) ATR NSUF irradiation project.



*A red arrow points to the Hydraulic Shuttle Irradiation System Transport Tube in the Advanced Test Reactor vessel.*

The UI HSIS experiment contained several alloy specimens for potential use in advanced reactor designs. The experiment was inserted into the reactor for a ten-day irradiation period using the HSIS. Six of the capsules contained alloy specimens and eight capsules were empty, providing spacing between the loaded capsules. The second UI capsule train was inserted for a one-day irradiation period from July 11-12.

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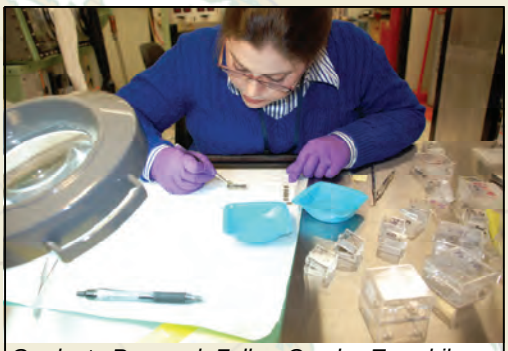
The UI experiment aims to shed light on the processes that happen when steels are put into a reactor. Everything from simple model steels to developmental steels are being tested. The results of this experiment will help in the development of better steels for reactors and provide input to optimize which steels are the best option for various reactors and experiments. Researchers are hoping their UI experiment will serve as a benchmark for the future.

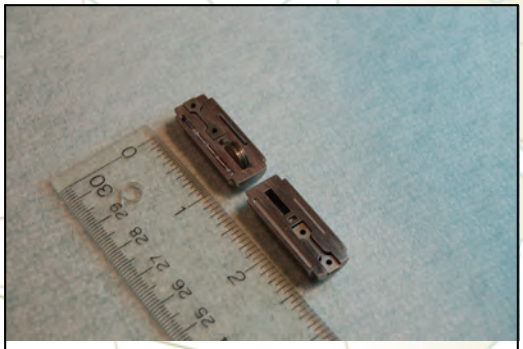


*Graduate Research Fellow Carolyn Tomchik loads transmission electron microscopy (TEM) disks into UI capsules.*

The UI experiment demonstrates the tremendous amount of collaboration that the ATR NSUF offers experimenters. The research team includes investigators at the Idaho National Laboratory, University of Illinois, Georgia Tech, North Texas University, Los Alamos National Laboratory, Argonne National Laboratory, and General Electric Nuclear. “This is the first of many experiments planned for the HSIS - yet another successful irradiation experiment to come out of the ATR NSUF,” said project engineer Gregg Wachs. The next ATR NSUF experiment in line to use the HSIS is a ten day irradiation for Drexel University in Philadelphia followed by a University of Central Florida experiment being prepped for insertion next summer.

The HSIS was installed in September of 2008 with the assistance of Idaho State University and a loan from the State of Idaho. Since that time, experiment preparation and safety and operational documentation reviews were underway to prepare the system for use. Researchers began loading the University of Illinois capsules with samples on Feb 2, 2011. The University of Illinois experiment (“Irradiation Performance of Fe-Cr Base Alloys”) was one of the initial project proposals awarded by the ATR NSUF in 2008.

The addition of the HSIS adds yet another capability to the Advanced Test Reactor – the only reactor of its kind with the ability to perform different types of experiments simultaneously, at different power, temperature, and pressure levels. “The HSIS allows us to do short term experiments while the reactor is operating,” explained Joe Palmer, INL’s lead engineer on the UI experiment. Prior to the HSIS, samples could only be inserted or removed manually during reactor outages and had to remain in the reactor for at least one full reactor cycle (usually 7-8 weeks in length). With HSIS, sample irradiation periods can be tailored to meet experiment specifications. “It is crucial to have the low dose irradiation capability under relevant neutron flux and irradiation temperature to investigate the radiation effects by experiment and modeling,” said Dr. Jian Gan, the INL principle investigator assigned to this UI project.



*Two capsules with ruler to show scale.*

The shuttle operates like a drive-up bank’s canister transport system, but instead of using air, capsules are water transferred into and out of the reactor core through 100 foot long stainless steel transfer pipes. Also, the capsules transported in the ATR shuttle are much smaller than the canisters used in the bank system - ATR experiment capsules are smaller than a roll of pennies.

The versatile shuttle transport system allows for a wide variety of experiment configurations. “The system transports 14 individual shuttle capsules into the reactor each time it is used,” explained Palmer. “Each shuttle capsule can be from a different sponsor, so it is possible to conduct 14 unique experiments simultaneously. The shortest turnaround would be about 10 minutes. The longest could be several full ATR cycles – possibly six months or more.”

The shuttle opens up research opportunities that previously did not exist at ATR. “One of the biggest advantages of the hydraulic shuttle is that it allows for very short irradiation periods. Researchers are able to analyze defects in materials at the very start of the problem,” said Dan Ogden, ATR NSUF Irradiation Experiment Project Manager.

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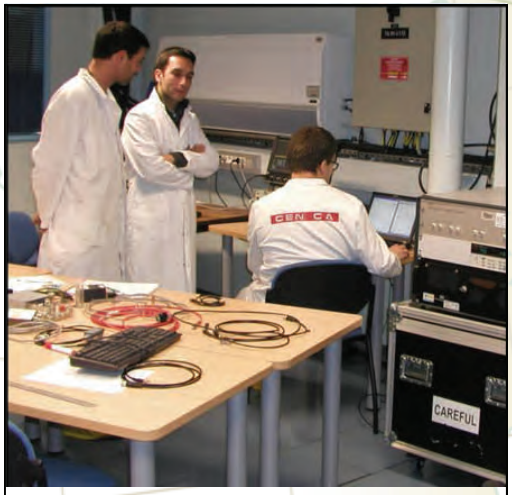
## Student ANS Presentation Winner visits INL and Presents Research

On July 13, 2011, ATR NSUF hosted student American Nuclear Society (ANS) presentation winner Laren Marus, of UC Berkeley. Marus was one of nine presenters competing at the student ANS conference meeting held in Atlanta, Georgia in April this year. The award for the top four presentations was an all-expense-paid trip to Idaho National Laboratory (INL) or Oak Ridge National Laboratory (ORNL) plus $500.

In July, Marus toured INL facilities and gave a colloquium presentation on her research on “Atomistic Simulations of Y-Ti-O Nanoclusters in Ferritic Alloys.” Erik Johnstone, of UN Las Vegas, also won a trip to INL and a cash award for his presentation on “Synthesis and Characterization of Low-Valent Binary Technetium Chlorides.” He will visit INL October 24-25. The other two presentation winners visited ORNL.

This is the third year students were given the opportunity to compete for a trip to the national labs by giving presentations at the student ANS meeting. Todd Allen and Frances Marshall, of the ATR NSUF, judged the presentations and picked the top four winners based on a combination of the best technical work and presentation skills. ATR NSUF, ORNL, and ANS Materials Science and Technology Division (MSTD) sponsored the competition.

## ATR NSUF R&D Scientist Performs Research across the Atlantic




*Troy Unruh (right) operates neutron detection equipment in the control room of the Minerve research reactor under the direction of CEA researchers Benoit Geslot (center) and Christophe Domergue (left).*

As part of an Advanced Test Reactor National Scientific User Facility (ATR NSUF) effort, Troy Unruh, an R&D Scientist/Engineer at the Idaho National Laboratory, completed a six month assignment at the French Atomic Energy Commission (CEA) Cadarache research center from September 2010 to February 2011. The assignment was an ATR NSUF collaboration between Idaho State University and CEA. At CEA Unruh was involved in research to characterize CEA-developed miniature fission chambers in the critical mock-up Minerve research reactor. His research activities focused on the characterization of the miniature fission chambers in the Campbelling mode of operation. This mode of operation allows for reliable and precise neutron measurements in a high-level mixed gamma and neutron field.

In his role as a visiting researcher at CEA Cadarache, Unruh had the opportunity to learn about numerous topics relevant to his research. “My foreign assignment enhanced my knowledge in fission chamber design, construction, signal analysis, and detector behavior as well as provided me knowledge of various other French nuclear facilities and their general operational and research practices,” he remarked.

During his time abroad, Unruh was able to tour various facilities throughout France including the JHR reactor site, ITER site, EOLE reactor, Minerve reactor; and the 70 MW Osiris Material Test Reactor.

As part of his responsibilities, Unruh conducted experiments and performed calculations to asses a new characterization technique that has the potential to provide the detector calibration coefficient independent from the neutron spectrum and thus prior to experimental use without the need for calibration. Results from these tests can be applied to experiments in similar environments.

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"My foreign assignment in France has proved very useful in my research for ATR NSUF at INL," Unruh commented. "I am able to use what I learned in France to supplement my current research activities that focus on improving real time in-pile instrumentation for INL's ATR and ATR-C facilities." Since returning to INL, Unruh has been using knowledge gained from this CEA research to supplement an ongoing ATR NSUF experiment awarded to Idaho State University in 2009. This collaborative ISU/CEA/ATR NSUF project is evaluating real-time flux sensors at the Advanced Test Reactor-Critical (ATRC) facility (a low-power prototype of ATR), to support efforts to improve ATR software tools, computational protocols and in-core instrumentation under the ATR Modeling, Simulation and Verification and Validation (V&V) Upgrade initiative, and to assist with work to replace nuclear instrumentation under the ATR Life Extension Project (LEP).

*Troy Unruh operates neutron detection equipment in the control room of the Minerve research reactor.*

However, the benefits of Unruh's assignment at CEA go beyond the specific research projects. His time in France has also helped with relationship-building between CEA and ATR NSUF. CEA Cadarache has expressed a strong desire to increase communication/collaboration with ATR NSUF. This includes future staff exchanges and/or additional in-pile tests of fission chambers.

"While nothing has been finalized at this point, we are exploring the potential for continued international collaboration with the French on fission chamber research of their current designs as well as newer designs to be developed at the INL through collaboration with Kansas State University," said Unruh. "There is also potential to return to France and perform additional research in their facilities as well as in INL's ATR NSUF facilities to bring mutual benefits to US and foreign research organizations seeking to enhance test reactor instrumentation."

Other contributors on this project included Benoit Geslot and Christophe Domergue, of France, who traveled to INL in October 2010 to perform testing in the ATR-C, Dr. Joy Rempe, of INL, who set up the collaboration between INL and CEA and serves as the INL principal investigator of ATR NSUF in-pile instrumentation development efforts, and Ben Chase, of INL, who also contributes technically to the INL ATR-C testing effort.

## ATR NSUF researchers receive NEUP Award

NEUP
Nuclear Energy University Programs

Please join us in congratulating three ATR NSUF researchers on their award of the Department of Energy's Nuclear Energy University Programs (NEUP) projects. Dr. Robert Odette, University of California, Santa Barbara; Dr. Michel Barsoum, Drexel University and Dr. Darryl Butt, Boise State University each received one of the 51 total research grants awarded to universities across the U.S. NEUP funds nuclear energy research and equipment upgrades at U.S colleges and universities, playing a key role in helping the Department of Energy accomplish its mission of leading the nation's investment in the development and exploration of advanced nuclear science and technology.

ATR NSUF is working now to align its call for proposals with NEUP to provide university proposers who require NEUP funds and ATR NSUF capabilities the simplicity of submitting a single proposal. Look for more details on this exciting opportunity on the ATR NSUF website (http://atrnsuf.inl.gov) in the near future.