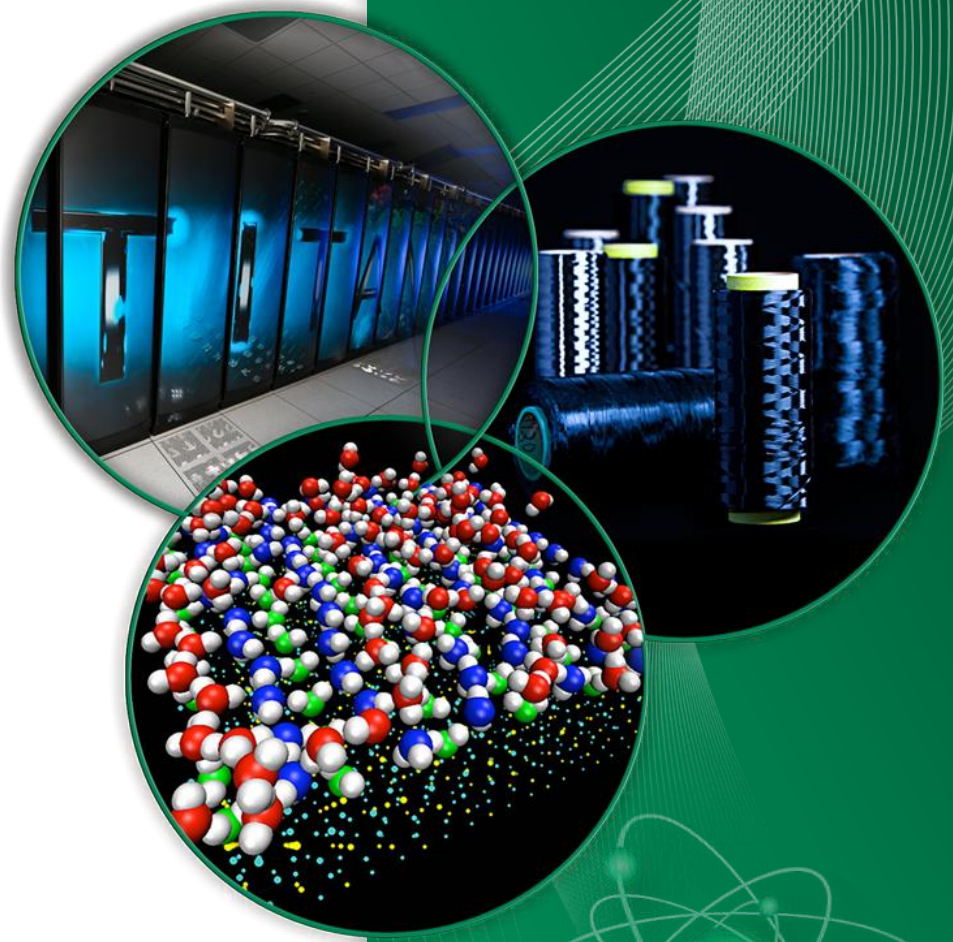
NSED Monthly Report



May 2013

Nuclear Science & Engineering Directorate

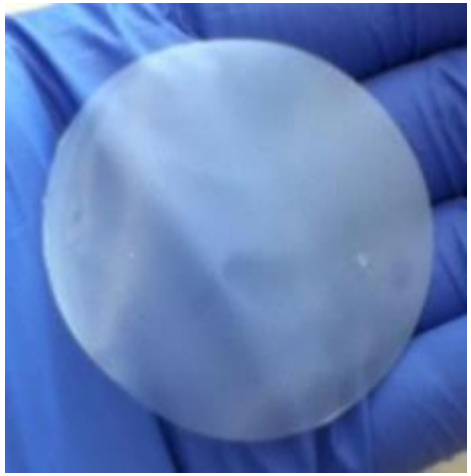
First Nuclear Energy Innovation milestone completed for radiation resistant nano-dielectrics

Science Highlight

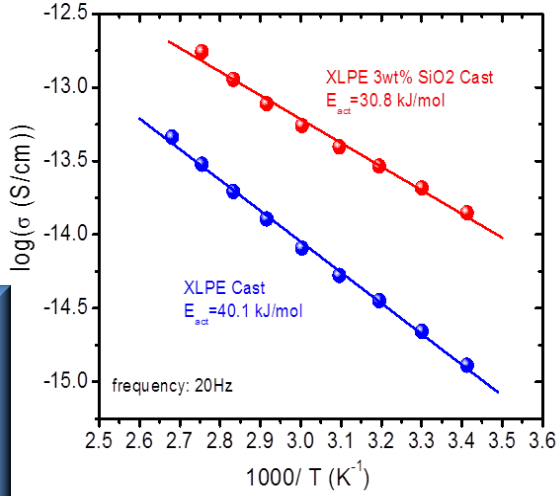
Milestone: Identify at least two nano-dielectric composite materials with XLPE base material or similar resin at various particle concentrations and determine their optimum processing conditions

- The approach is unique in that nano-particles are grown within resin (IN-SITU) instead of mixing in bulk materials (EX-SITU)
  1. XLPVA with TiO_2, MgO_2, SiO_2 ,and Gd_2O_3
  2. XLPE with SiO_2
- With respect to optimization, SiO_2 showed the most improvement in electrical properties. For specific concentrations:
  - XLPVA optimized near 1% SiO_2
  - XLPE optimized near 3% SiO_2
- Initial exposure of films to gamma radiation was completed on May 31, 2013

PVA/TiO_2 film



XLPE/SiO_2 film



Shift in XLPE resistance (1/σ) found with addition of SiO_2 nanoparticles

New materials are needed to provide low-cost, higher performance materials that can benefit new reactor power and instrument wiring

- **FNMSD is working to developing these radiation resistant materials as part of DOE Office of NE cross-cut initiative**

OAK RIDGE NATIONAL LABORATORY
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NSED Remote Systems collaborations on printed engines for small-scale applications

Science Highlight

Printed Engines for Small Scale Combustion Research is an ORNL Seed Money task to explore the issue of poor efficiency (typically 4%) in small internal combustion engines so that efficiency may be improved for uses in portable power and unmanned aerial vehicles

- **The project is a collaboration of four different groups across two ORNL directorates**

Additive manufacturing, or component printing, is key to this investigation

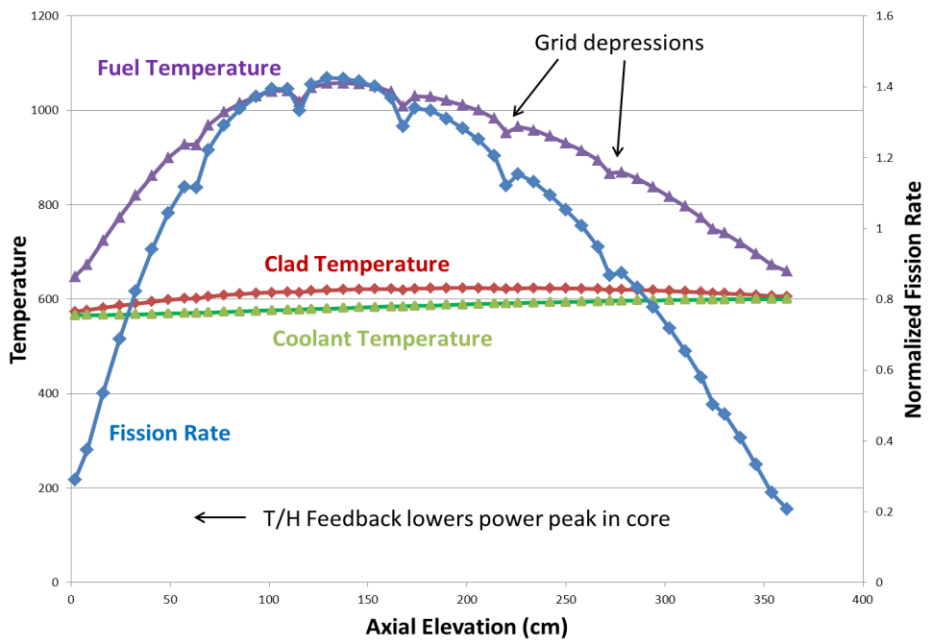
- Small components are modified to permit insertion of sensors for data acquisition
- Parts are designed and printed in plastic to verify the design; final parts are printed in titanium
- The ultimate goal is to advance the science of small scale combustion to produce what is believed to be the first instance of a completely printed internal combustion engine…and then fly it in an RC plane
- Testing of a 2-stroke printed cylinder head is in progress
  - Engine operation is comparable to the aluminum head engine with some results that warrant further study
- Nitriding of the reciprocating parts is being explored to alleviate titanium's tendency to gall on moving surfaces
- A 4-stroke titanium head has been designed to expand the study into the full spectrum of available power sources

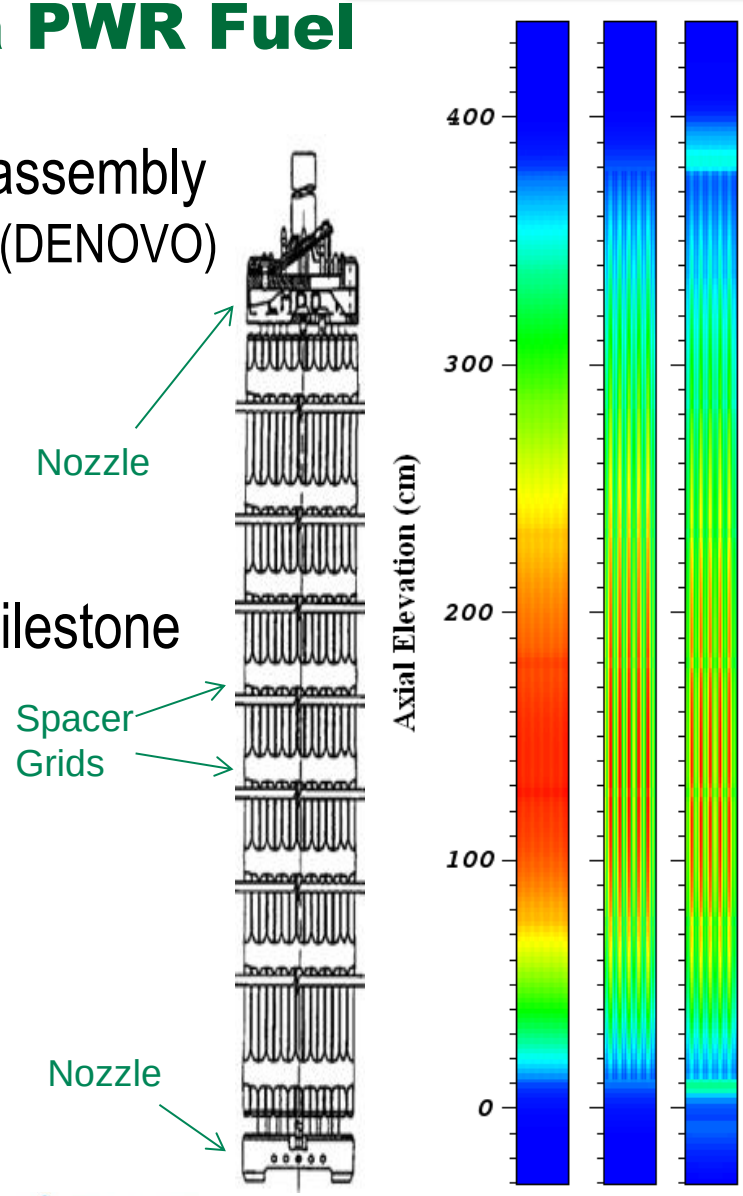
Oak Ridge National Laboratory
MANAGED BY UT-BATTELLE FOR THE U.S. DEPARTMENT OF ENERGY

Successfully completed the VERA high fidelity multiphysics model of a PWR Fuel assembly

Science Highlight

- Coupled multiphysics model of a PWR fuel assembly
  - Neutron transport to calculate power distribution (DENOVO)
  - Thermal-Hydraulics in coolant (COBRA-TF)
  - Heat conduction in fuel rods (COBRA-TF)
  - Neutron cross sections as function of temperature and density (SCALE)
- Next step is scaling up to a 1/4 reactor core simulation in support of a DOE reportable milestone





Fast, Epithermal, and Thermal Flux Profiles

OAK RIDGE NATIONAL LABORATORY
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Directorate meetings and visits

Tom Craig, Professional Staff Member in Senator Lamar Alexander's appropriations committee for Energy and Water Development, visited ORNL on May 2, 2013

- Jeff Binder presented an overview of ORNL's nuclear science and engineering strategy during his visit

Jeff Binder participated in the CASL Board of Director's meeting in May

The UT-Battelle Board of Governors' meeting was held at ORNL in May

- Jeff Binder presented an overview of ORNL's nuclear science and engineering strategy
- Jeff Binder, Alan Icenhour, Tim Powers, John Wagner, Jeremy Busby and Doug Kothe of The Nuclear Science & Engineering Directorate (NSED) gave presentations on their respective areas of responsibility

Shanghai Institute of Physics

- Cecil Parks, Division Director for Reactor and Nuclear Systems Division, hosted Dr. Hongjie Xu and Dr. Kun Chen of the Shanghai Institute of Physics on May 7-8, 2013
  - Dr. Xu is Director of the $350M Thorium Molten Salt Reactor Project initiated by the Chinese Academy of Sciences in 2011
  - Dr. Xu and Dr. Chen toured ORNL fuel and materials laboratories and discussed ongoing collaborations and potential funding to support

OAK RIDGE NATIONAL LABORATORY
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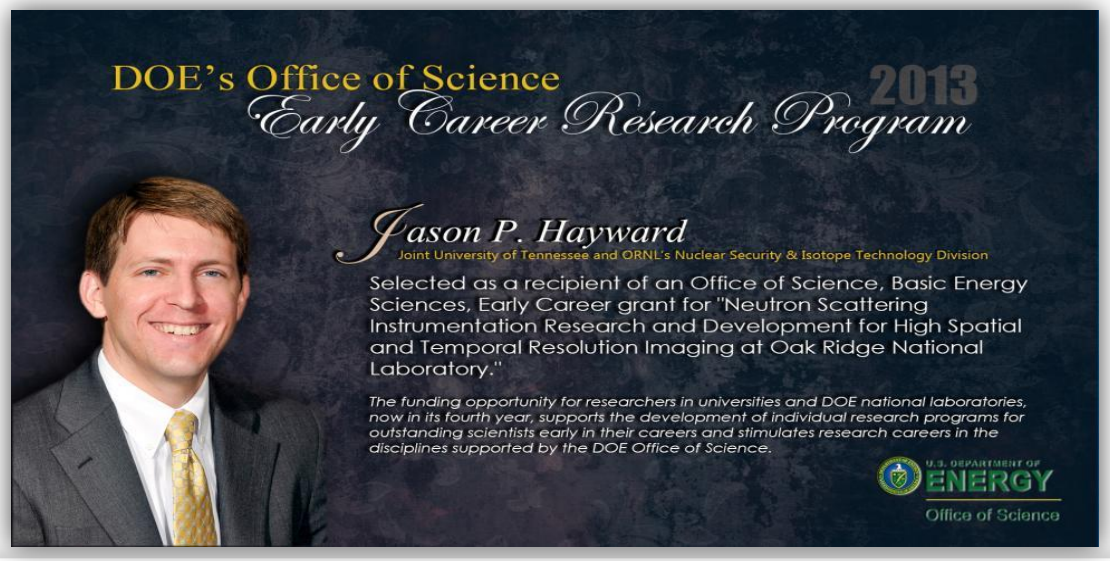
Jason Hayward Receives DOE's Office of Science Early Career Award

Jason Hayward, University of Tennessee joint faculty researcher in the Nuclear Security & Isotopes Technology Division (NSITD), was selected as a recipient of an Office of Science, Basic Energy Sciences, Early Career grant for "Neutron Scattering Instrumentation Research and Development for High Spatial and Temporal Resolution Imaging at ORNL."

- Hayward's proposal focuses on developing new detectors with increased spatial and temporal resolution to aid experimental research at high-intensity pulsed sources such as ORNL's Spallation Neutron Source. Success in this research will be transformational to neutron imaging, a powerful tool to investigate materials for such energy-related applications as fuel cells, energy storage, hydrogen storage and nuclear technology

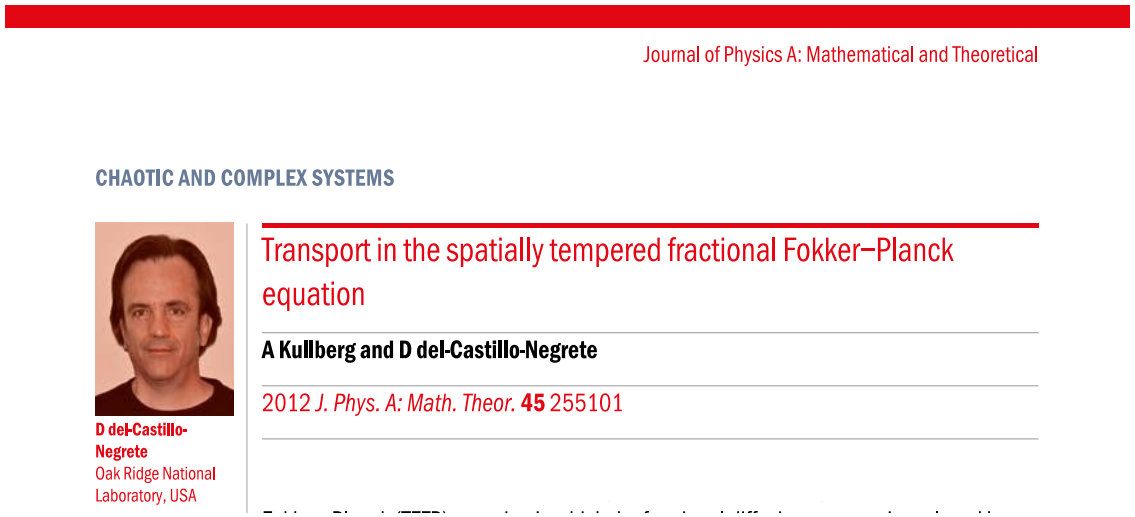


ORNL's George Flanagan elected as Fellow of the American Nuclear Society

The American Nuclear Society has elected Dr. George Flanagan of the Reactor and Nuclear Systems Division to the grade of Fellow. He is recognized for his leadership in the field of nuclear safety, especially in the area of liquid metal reactor safety, space reactor safety and the safety of smaller research reactors and the applications of probabilistic risk assessment to reactors. George is a recognized expert on research reactor design and safety and is the author of the IAEA training manuals on research reactors.

Journal of Physics A selects Diego del-Castillo-Negrete's paper as among the best published in 2012

Diego is a member of the Plasma Theory Group in NSED's Fusion & Materials Nuclear Systems Division



http://iopscience.iop.org/1751-8121/45/25/255101

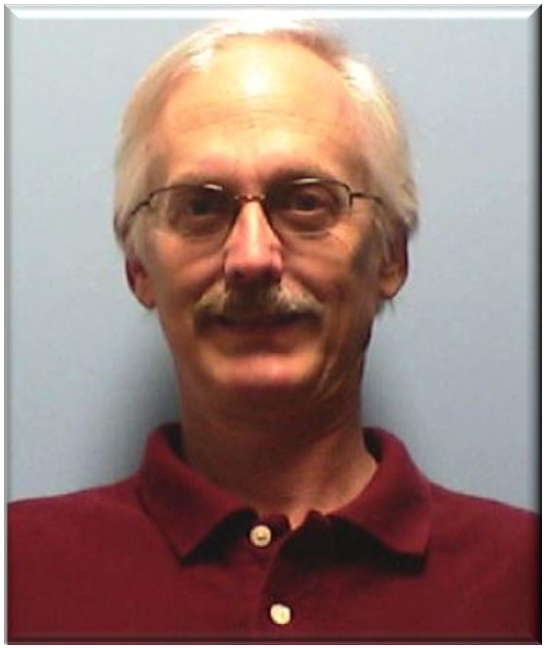
- First study on the role of spatial tempering on super-diffusive transport in the presence of an external potential
- Key contribution to the understanding of fluctuation-driven transport in the presence of non-Gaussian noise
- Work done in collaboration with A. Kullberg, Physics PhD student at UCLA
    - Thesis advisor: D. del-Castillo-Negrete

Larry Baylor elected to the US Burning Plasma Organization (USBPO) Council

Appointed to a three-year term

The Council, as the advisory body of the USBPO, provides oversight of USBPO activities and is responsible for long-term strategic planning of burning plasma research. The Council sets the policies and procedures of the USBPO, including the by-laws governing USBPO operations.

http://burningplasma.org/organization.html



Larry is a member of the Plasma Technology and Applications Group in NSED's Fusion & Materials for Nuclear Systems Division

UT-Battelle Scholarship winner

This year's UT-Battelle Scholarship winner is Meredith Graves, a senior at Hardin Valley Academy and daughter of Van Graves of the Nuclear Science and Engineering Directorate. Meredith has been accepted into the University of Tennessee's Bachelor of Architecture program, where she hopes to apply her interest in STEM-related fields to the design of energy-efficient and environmentally friendly structures.

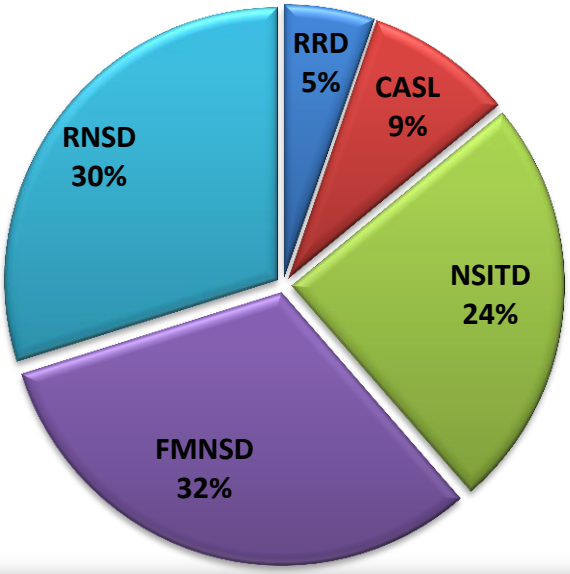
Cecil Parks honored for 35 years of company service

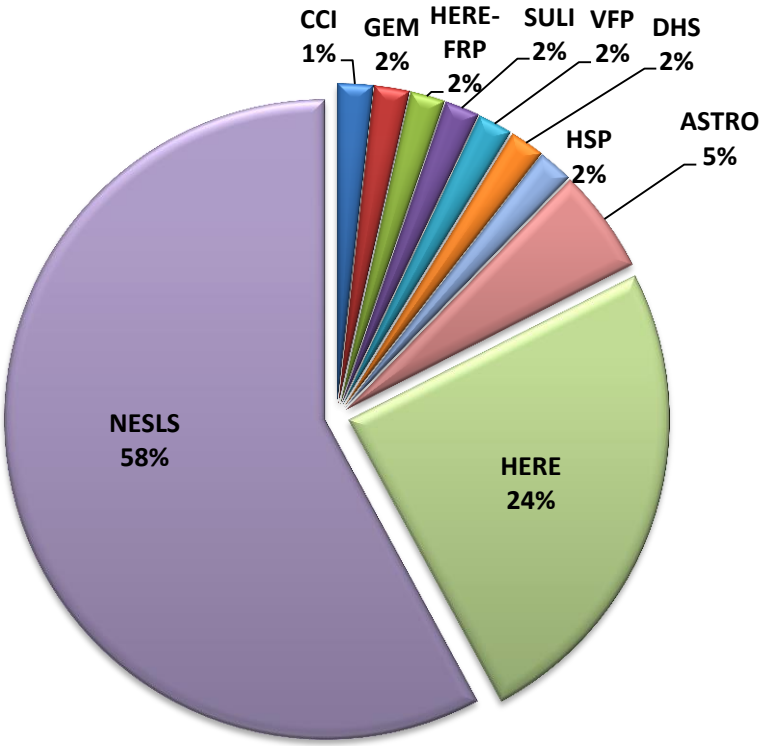
Cecil Parks, Director for the Reactor and Nuclear Systems Division (RNSD) in the Nuclear Science & Engineering Directorate completed 35 Years of Company Service on May 23, 2013. RNSD provides R&D needed to address issues facing the current and future utilization of nuclear reactors and the supporting nuclear systems infrastructure. Nuclear Engineering analysis software has been the focus for much of Cecil's career here at ORNL and he continues to participate in the line management responsibilities for the SCALE Code System for which he was the Project Leader for 15 years.

Thank you Cecil for your commitment to ORNL

NSED Summer Internship Program kicked off in May

- 57 Students
- 26 Institutions represented
- Top 3 Universities participating:
  - UT-Knoxville – 17
  - NCSU – 6
  - GaTech – 4



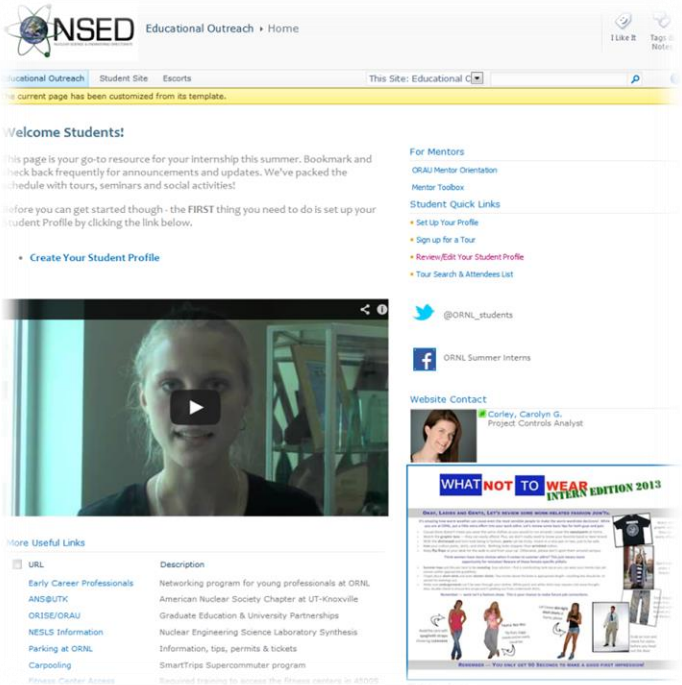


KEY:

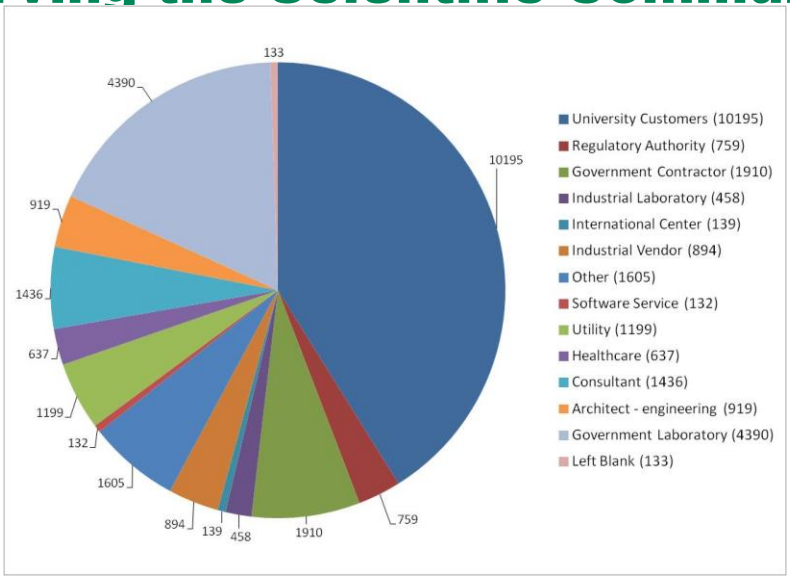
CCI	Community College Internship
GEM	National Consortium for Graduate Engineering Degrees for Minorities
HERE-FRP	Higher Education Research Experiences- Faculty Research Program
SULI	Science Undergraduate Laboratory Internship
VFP	Visiting Faculty Program
DHS	Department of Homeland Security
HSP	High School Program
ASTRO	Advances Short-Term Residence Opportunity
HERE	Higher Education Research Experiences
NESLS	Nuclear Engineering Science Laboratory Synthesis

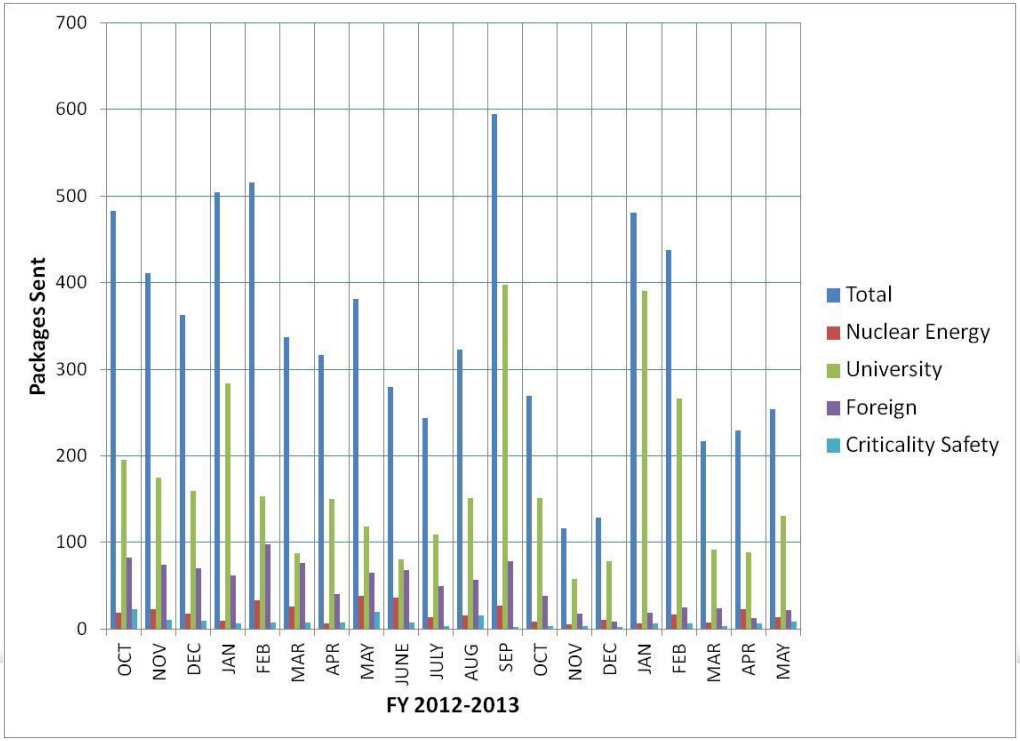
NSED Summer Internship Program support activities

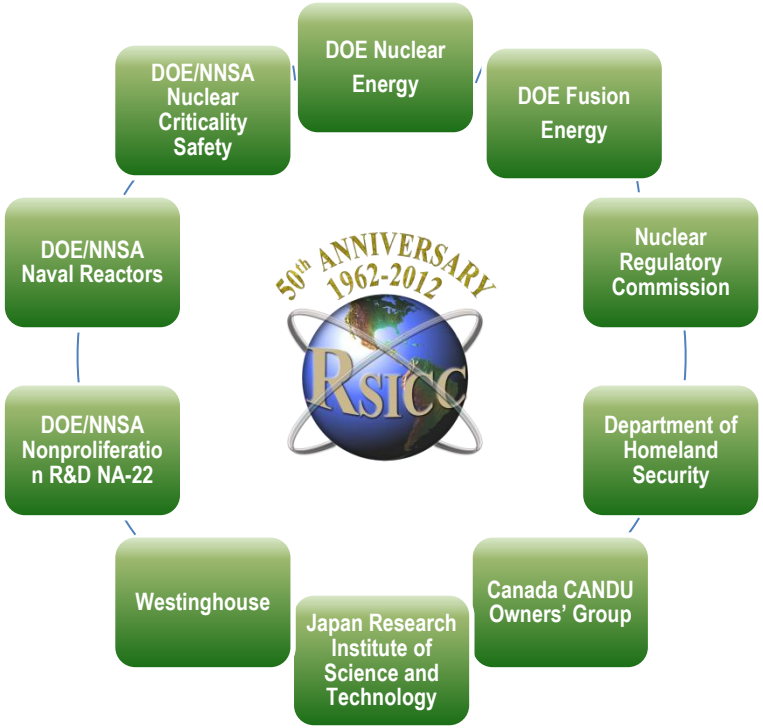
- Student and mentor orientation training launched
- Mentors are completing NSED Guest Work Plans for each student
- New student SharePoint site developed
- Six seminars scheduled for Thursdays at 2:00 in the JICS Auditorium
- ORNL facility tours scheduled throughout the summer
- Judged poster session for NESLS students scheduled for August 8th



Radiation Safety Information Computational Center: Serving the Scientific Community for 50 years







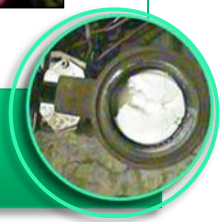
- **Software and data packages distributed FY2013: 2133**
- **5 package updates and revisions May 2013**

Radioisotope production

- Work Plan for the Catalyzed Electronic Plutonium Oxide Dissolver (CEPOD) for acid consumption evaluation in progress.
- Working on fabrication of power cables to be integrated with in-cell power leads for CEPOD equipment.

Curium Feedstock Processing

- Completed consolidation of Mk42 rework material.

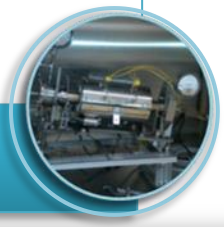


Americium-Curium Processing

- Campaign 74 Rework: Ongoing for upcoming Cf-252 orders.
- One shipment made early per customer's request.
- Other order on schedule for June shipment.

Cf-252 Production

- Pu-238 material was transferred from 7930 Cell F to 7920 Hot Cells.
- New batch of material was purified to remove Pa-233.
- The purified material was converted to oxide, calcined, and pressed into pellets for the fully loaded targets.



Pu238 Operations

- Shipments: Five Ac-225 shipments to three different customers with a total of 38.5 mCi shipped.

Actinium Production

- Cubicle 1 transfer arm fabrication of components in progress.
- Cubicle 2 conceptual design of swaging equipment complete; detailed design in progress.
- Cubicle 3 hoist repair continues.

Target Fabrication Equipment Upgrade

Radioisotope production

- Installation of the new glove box to support this activity continues.

Cm-248 recovery from Cf-252 Decay

- Received the 3rd cask of PuBe sources, which contained two source capsules.
- Capsules were cut opened, source material recovered, and calorimeter measurements taken on the material.
- Processing of material from 3rd shipment continues.
- Source material in the 1st capsule was dissolved.

PuBe Operations

- Transferred material to process evaporator in preparation for feed adjustment for oxalate precipitation operations.

Heavy Curium Processing for Targets

- Completed installation of new Cf glove box.
- Isobutanol deposition method being tested on Cf-252 sample.

LDRD Cf-251 Separations

- Poster presentation at the Targeted Alpha Therapy Conference.
- Purification of the Ra-228 sample continues.

Th-229 Project

- 7930 Cell G Waste Operations to pull last waste drum on May 30th for a total of 15 drums removed.
- Waste Casks are staged ready for shipment on 3rd floor of 7930.

Waste Operations to support radioisotope production

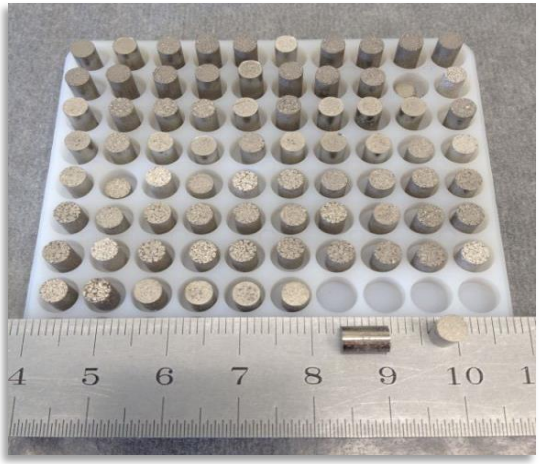
Enriched stable isotope technical services and shipping

Twelve shipments of 37 enriched stable isotopes were made in May

- 94 shipments of 279 enriched stable isotopes have been made in FY13 to date

Eighty-seven custom technical services were completed in May

- 179 technical services have been completed in FY13 to date including a Pt-198 foil, 2.5 cm x 2.5 cm x 98 mg/cm^2, a custom conversion of mercuric oxide (Hg-200) by electrolytic reduction to mercury metal and the others below.



Ni-62 pellets for irradiation to Ni-63

Ca-48 for US customer

He-3 cylinders of which 7 were shipped in May

Oak Ridge National Laboratory
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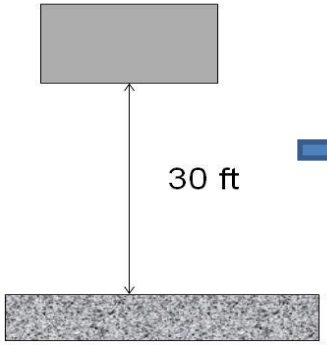
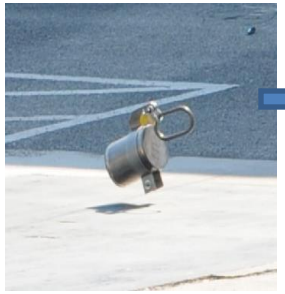
LEU Annular Casting Capsule drop test completed successfully

A 9-m (30-ft) drop test of the Low Enriched Uranium (LEU) Annular Casting Capsule was conducted at the National Transportation Research Center on May 9, 2013

- The capsule is designed to meet Department of Transportation (DOT) "Special Form" requirements
- It showed minimal damage as a result of the drop test and passed a subsequent leak test
- Certification of this capsule as Special Form per DOT and Nuclear Regulatory Commission (NRC) requirements will allow ORNL to possess a fairly large mass of just under 20% U-235 material for testing specialized nuclear material identification and visualization detection systems
- This achievement will advance ORNL's capabilities for active interrogation, nondestructive examination, and analysis of nuclear material for nuclear nonproliferation and security concerns

Cask suspended at 30 ft.

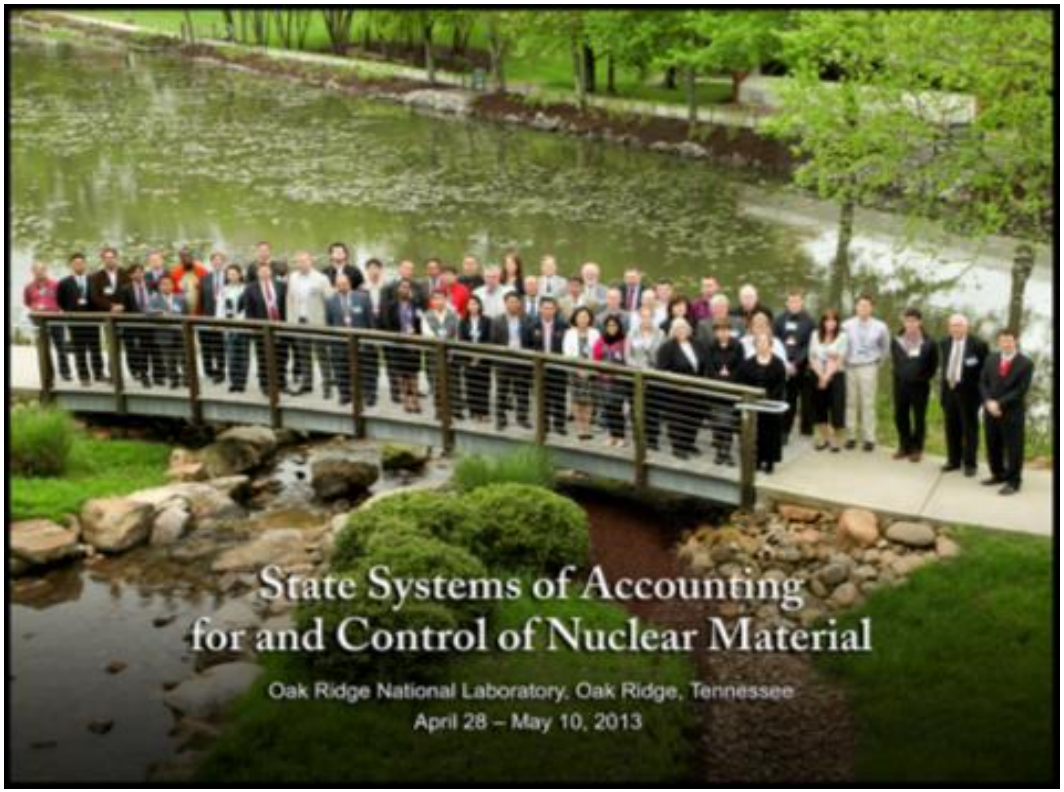




Impact

Damage assessment photos

State Systems of Accounting for and Control of Nuclear Materials Training



ORNL hosted the State Systems of Accounting for and Control (SSAC) of Nuclear Material Training from April 28 to May 10, 2013

This course was established to train state system's representatives from around the world to effectively prepare for and implement international safeguards as applied by the International Atomic Energy Agency to support the Nuclear Safeguards and Security realm.

ORNL hosted this training in 2011, and due to the positive feedback, was asked to host it again in 2013.

Four new Isotope Program glove boxes being installed in building 4501

Two of the glove boxes will allow low-activity isotope dispensing, such as Technicium-99 and Nickel-63, to be moved from REDC to 4501

- This frees up valuable space in REDC for other processes that require a Nuclear Facility

The two other glove boxes will be used for isotope R&D

- Completion of the installation is targeted for September 2013

The installation work plan for four new 4501 glove boxes is approved

Installation of new ventilation piping is approximately 50% complete

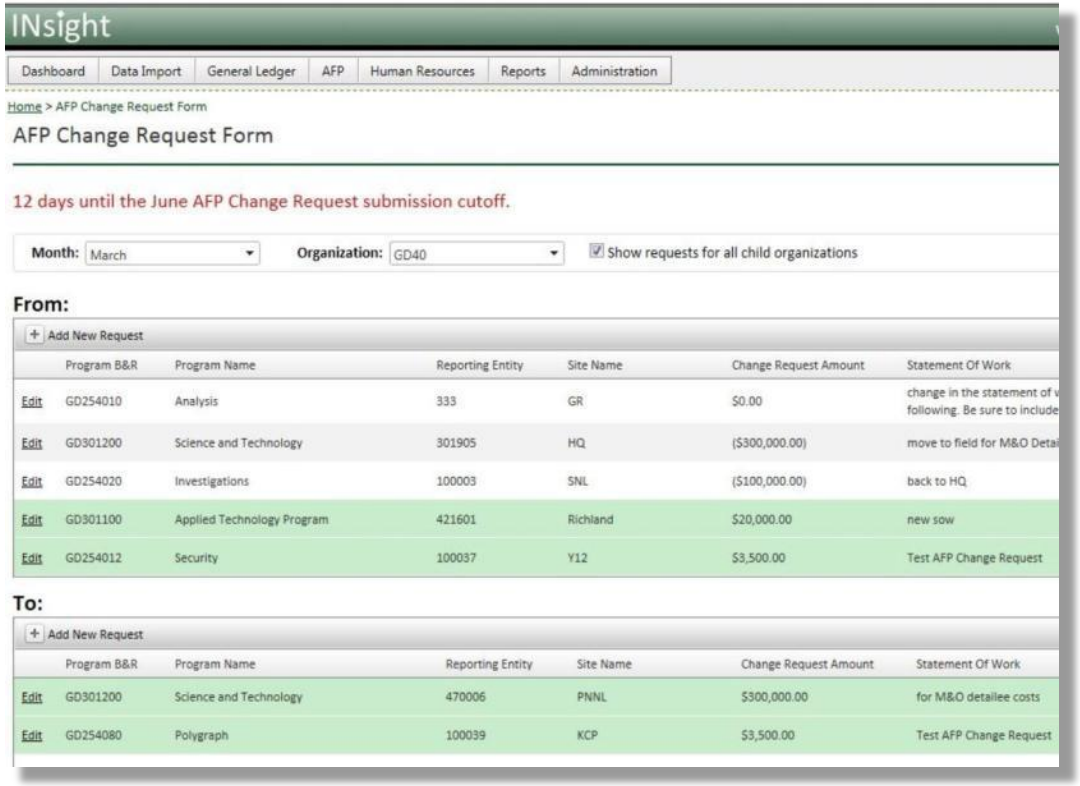
Associated filter systems have been assembled and delivered for installation

INsight version 1.2 dashboard application deployment

INsight version 1.2 was deployed to production in May

This release introduces the new Approved Financial Plan (AFP) change request module, allowing users to submit, review and manage AFP change requests through INsight.

INsight is funded by the Office of Intelligence and Counterintelligence.



University of Tennessee students & staff complete NaI detector tests

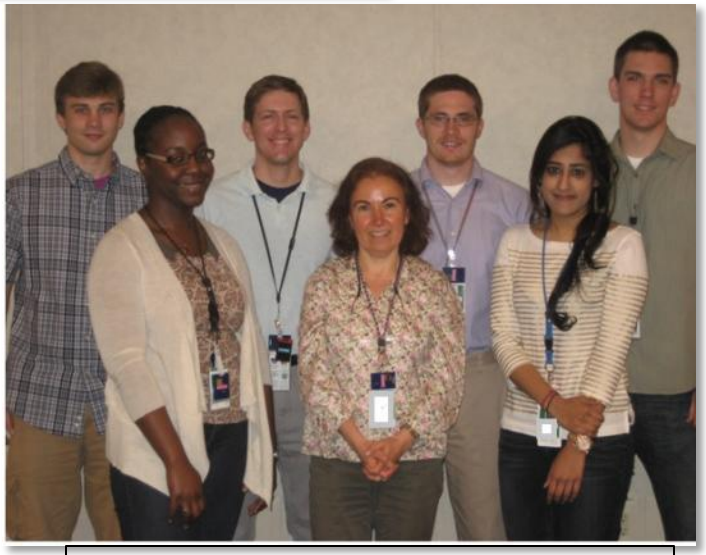
A group of University of Tennessee student and staff researchers working with the Nuclear Materials Detection and Characterization group banded together to complete acceptance tests of 96 NaI(Tl) detectors over a 1 week time period, each taking 4-8 hour shifts.

Jason Hayward performing NaI Detector Tests

This group of volunteers included Tracey Wellington, Blake Palles, Anagha Iyengar, Tim Jackson, Birsen Ayaz-Maierhafer, and John Sparger.

- Tracey and Tim are also associated with the UT-ORNL Bredesen Center interdisciplinary program.
- Blake is a Haslam Scholar at the University of Tennessee.

The effort was coordinated by Randy Logsdon, Jason Hayward, and Deb Austin.



University of Tennessee NaI Detector Team

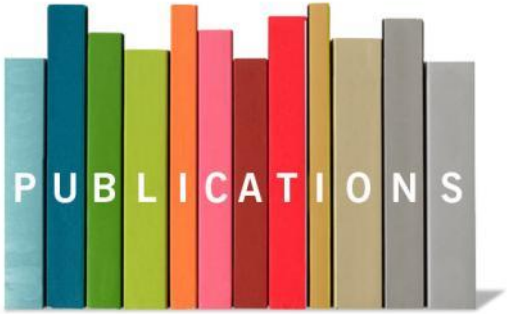
Russian Federation Ministry of Defense upgrades and sustainability

Ministry of Defence of the Russian Federation

Members of the Threat Reduction Initiatives Group participated in the 22nd meeting of the Joint Coordination Group (JCG) held 14-17 May in Chicago, IL. The JCG is chaired by DOE/NNSA Office of Nuclear Warhead Protection and his counterpart from the Russian Federation (RF) Ministry of Defense (MOD) 12th Main Directorate. The JCG reviewed the achievements and progress of the DOE-MOD nuclear security efforts and discussed opportunities for future cooperation.

Mr. Larry Ross, NA-251, and Colonel Roman Gromyshev, RF MOD 12th Main Directorate, complete the formal Record of Meeting of the 22nd Joint Coordination Group.

NSITD Publications - May

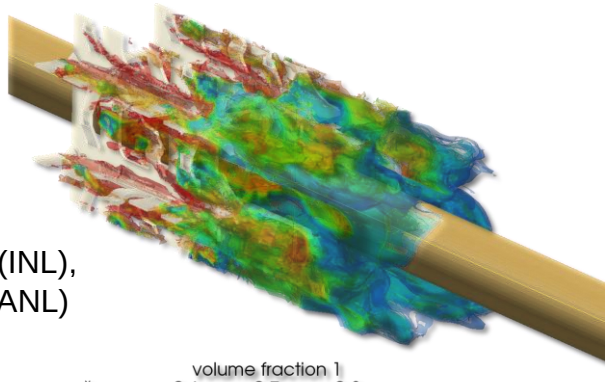


- Journal Article – 1
- Letter Report – 3
- ORNL/TM – 10
- Paper in Conference Proceedings (Books, CD, etc.) – 12

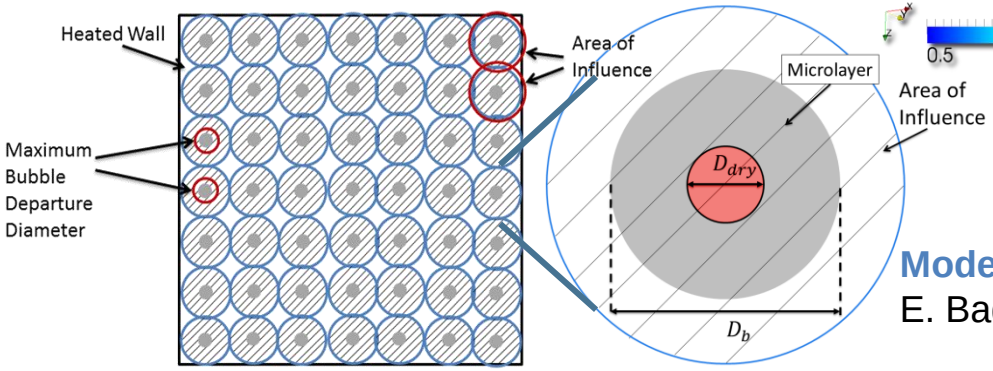
CASL Research highlighted at the15th International Topical Meeting on Nuclear Reactor Thermal – Hydraulics (NURETH-15)

CASL

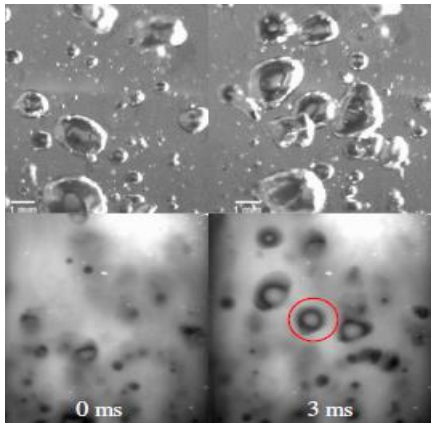
- 12 papers presented
- Science-based development for next generation Departure from Nucleate Boiling (DNB) models & predictions
  - Fundamental science
  - Modeling
  - Simulation

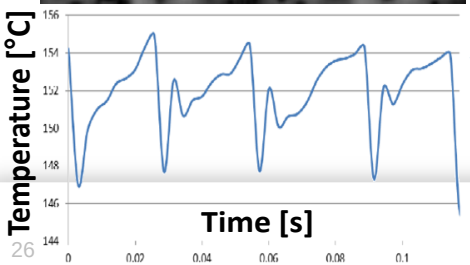


Simulation: R. Nourgaliev (INL), M. Christon (LANL) et al.



Modeling: L. Gilman, E. Baglietto (MIT)





Science: B. Phillips, J. Buongiorno (MIT), et al.

CASL Thermal Hydraulics Methods Team at NURETH-15

- **Science:** M. Z. Podowski (RPI), B. Phillips, J. Buongiorno T. McKrell (MIT)
- **Modeling:** D. R. Shaver, S. P. Antal (RPI), V. Petrov, A. Manera (UMICH), L. Gilman, E. Baglietto (MIT), G. Tryggvason (ND)
- **Simulation:** R.R. Nourgaliev (INL), M.A. Christon, J. Bakosi, R.B. Lowrie, L.A. Pritchett-Sheats (LANL)

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CASL Board of Directors Meeting
May 2, 2013

CASL

Meeting Objectives

- Communicate CASL status and challenges
- Discuss path forward solutions for 3 current CASL challenges
  - Modeling & Simulation Infrastructure Needs and Plans
  - Technology Deployment Opportunities and Strategies
  - Phase 2 (2015-2020) Strategic Roadmap Options

Information

- First virtual meeting for the CASL Board of Directors using's CASL VOCC Laboratory and technology
  - Saved Travel
  - Saved Time
  - Saved Money
- Attended by 11 of the 14 board members and senior leadership

Actions for CASL Leadership Moving Forward

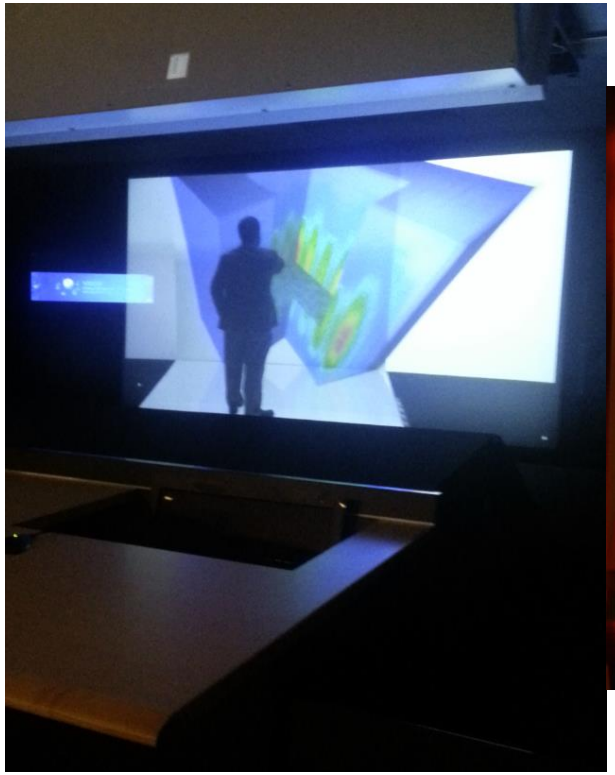
- Continue regular interactions with NRC
- Work with Board in finalizing IP Management Plan
- Finalize CASL technology deployment plan and vet with DOE NE
- Develop a return on investment analysis from Phase 1 outcomes
- Work with DOE to define renewal proposal requirements
- Brief DOE NE on modeling and simulation infrastructure requirements for CASL

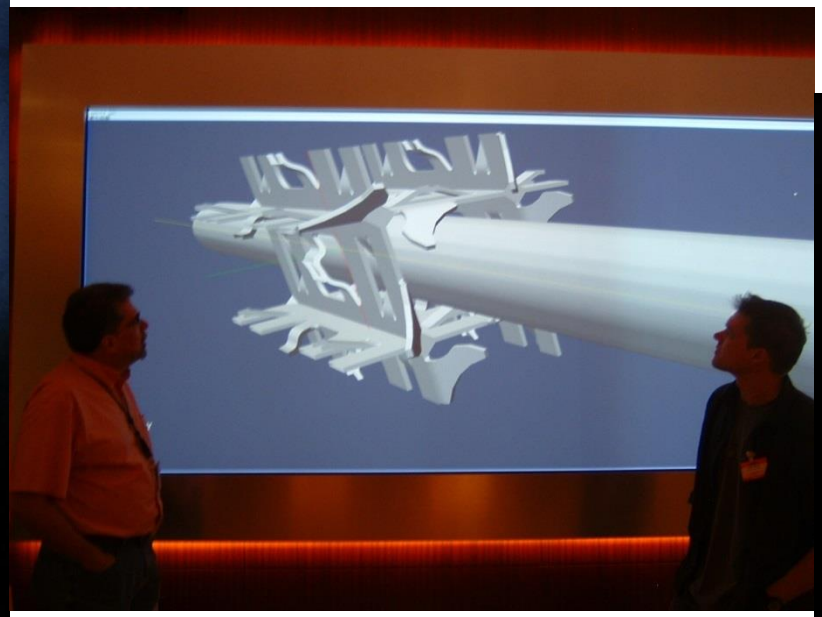
CASL VOCC data visualization capabilities are maturing

CASL

Virtual Office, Community, and Computing

Innovation at the speed of Insight





VOCC is working closely with CASL modelers to visualize significant milestone results. They have been successful in moving data between collaborative visual venues and scaling systems to accept much bigger, and more complex results.

VOCC cited by Scientific Computing and E-Science as "leading the way" in trans-disciplinary collaboration

CASL

Virtual Office, Community, and Computing

SOUNDS LIKE IT'S TIME FOR A BREAKTHROUGH.

Scientific Computing

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ORNL Develops Innovative Virtual Environment for Scientific Collaboration

Tue, 04/30/2013 - 2:01pm

by Oak Ridge National Laboratory

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Consortium for Advanced Simulation of Light Water Reactors staff members Teresa Robison and A.J. Ierulli (on the screen) confer with April Lewis and John Shaw in the VOCC. With the VOCC, researchers who are thousands of miles apart appear to be sitting just across the table — and communicating with "true eye contact."

The Consortium for Advanced Simulation of Light Water Reactors, the Department of Energy's first Innovation Hub, has enlisted top scientists and engineers from around the U.S. to improve the nuclear reactors that provide about 20 percent of the nation's electricity.

But the researchers don't all have to be in one place: CASL, which opened in 2011 and is based at Oak Ridge National Laboratory (ORNL), is using state-of-the-art telepresence and video communications technology to enable the scientists to collaborate over great distances.

"Breakthroughs and innovation occur when smart people are challenging one another face to face. It's that give and take, questioning and debating, that yields the best solutions in the shortest amount of time," said April Lewis, CASL's Collaboration and Ideation Officer and developer of the Virtual Office Community and Computing (VOCC) Laboratory. The VOCC Laboratory houses this unique technology and enables researchers to connect from remote sites.

In person, the VOCC features multiple small-group, digital collaboration work areas with laptop connections that enable shared information display on flat-panel screens, a multi-touch computer display and development environment, touch screen computers connected to high performance clusters and power walls supporting high resolution, 3D modeling and simulation — and even a wall of whiteboards for brainstorming called the "Battlefield of Ideas."

The most creative solution to the collaboration challenge, however, lies in the VOCC's custom "telepresence rooms" — small conference rooms equipped with systems of hidden cameras and transparent image planes that make researchers who are thousands of miles apart appear to be sitting just across the table — and communicating with "true eye contact."

"About 70 percent of all communication is facial," said Lewis. CASL's systems, known as VOCC Edge Units, make traditional teleconferences look rough by comparison.

By combining uncannily realistic teleconferencing with data and simulations, the VOCC Laboratory lets researchers share and discuss essential information with key colleagues without the time and expense of travel.

"It substantially reduces collaboration costs over traditional technologies," Lewis said. "VOCC allows three or 300 people to meet, interact, and collaborate in a way that can only be enhanced through face-to-face meetings. VOCC gives me scalability with just the right amount of security. It's easy to use and more reliable than more conventional options. We wanted researchers to essentially 'plug and play' so they can focus on their research."

The CASL Hub has distributed various forms of this technology to all of its research partners. This technology is compatible with mobile devices like tablets and smart phones as well as fixed devices such as legacy conferencing systems, computer desktops, and high-end visualization rooms.

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Transdisciplinary Collaboration: The Future of U.S. Research

Posted by: T. Lacoma Posted date: May 23, 2013 In: News, Research, Technology

Other transdisciplinary measures could include new policies to share core research facilities (if applicable) and new postdoctoral training programs that integrate goals and concepts between physical and life sciences. If these new levels of collaboration can be reached, the result should be greater innovation, new commercial success for American firms, and a much deeper impact on key societal issues, such as sustainability and long-term health care.

Universities and organizations that want to attain such collaborative heights can look toward the strides taken in online research and communication. Scientists are proving more willing than ever to work together through online portals.

Oak Ridge National Laboratory's recent Innovation Hub, for example, recruits scientists from across the nation through the latest "telepresence" technology, creating digital conference rooms that mimic real, monitored rooms in labs throughout the country. The technology has already been utilized by the Department of Defense for CASL, one of its Nuclear Energy projects drawing in support from around the country.

Meanwhile, the National Science Foundation is already doing its part to fuel transdisciplinary collaboration with an announcement earlier in 2013 that it would expand public access to the results of all NSF-related research. The primary objective behind the new transparency is to encourage innovative scientists in all disciplines to use the research to make strides in their own fields, regardless of NSF affiliation. NSF partners like the USDA and NASA hailed the change as a chance for new work in the agricultural and space sciences. With such strides by major organizations, cross-industry collaboration — and its related economic benefits — are becoming a fast-realized dream.

CASL activities

CASL Collocation

- Radiation Transport Methods Update
- Validation & Uncertainty Quantification (VUQ) Planning and Coordination
- VERA QA & VUQ
- Round Table Planning
- Challenge Problem Integration Meeting
- Express Meshing Experience & Meshing Plan going forward
- Peregrine Integration Update
- Grid-to-rod-fretting (GTRF) Mechanics Path Forward
- Hydra Development and L2:THM.P7.01 Status
- CASL Cobra-TF Working Group
- Update on L2:VUQ.P7.02
- Dept. of Energy Annual Review Prep
- Westinghouse Electric Company Test Stand
- MAMBA Integration
- Polaris Planning
- Extended Leadership Team Meeting on FY14 Level 1&2 milestones

VOCC Tours

13 Tours for May 2013

- ISO (International Organization for Standardization) Assessors
- TVA Technology Innovation Group
- Andrew Richards, DOE
- LWRS Group
- Clemson Visual Computing Division

Meetings

Education Webinar, May 28

CASL CIO Invited Speaker at:

HPC User Forum, May 1

IBM Exceptional Web Experience, May 20-23

Enterprise Search Summit, May 21-22

Guest Speaker: Dale Klein, May 2

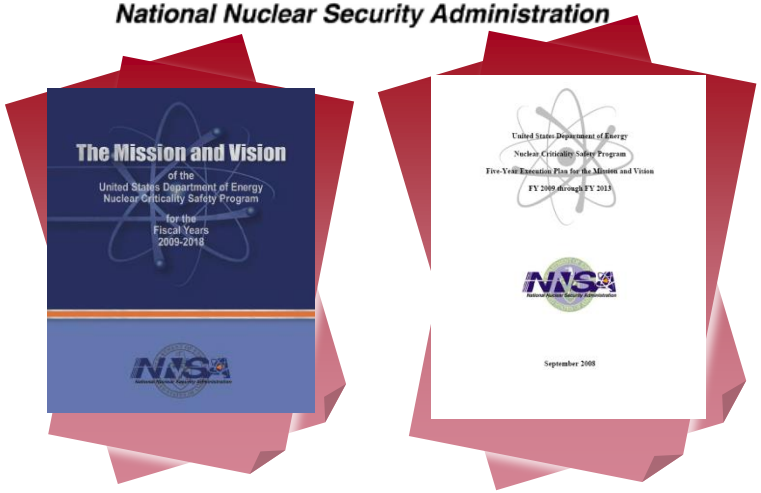
Misc.

Prepare for 5 Summer interns

US Nuclear Criticality Safety Program (NCSP) review

- ORNL hosted the annual NCSP Review Meeting at the Battelle Offices in Washington, DC, May 30, 2013
- Participants included federal and contractor staff from NCSP sites throughout the DOE Complex
- During the review meeting, NCSP task managers and research staff provided detailed technical presentations covering work accomplishments at their respective sites
- Mike Dunn and Thomas Miller gave presentations summarizing ORNL analytical methods and NCS analysis work during FY12

National Nuclear Security Administration



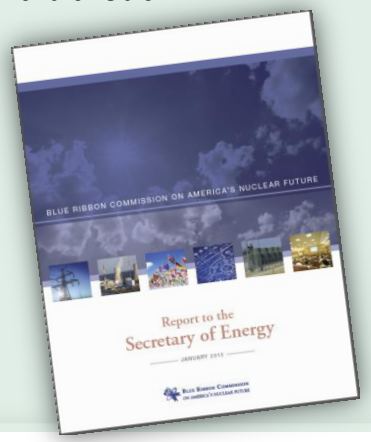
CURIE
curie.ornl.gov/

BRC-recommended siting experience database now on CURIE

Objective

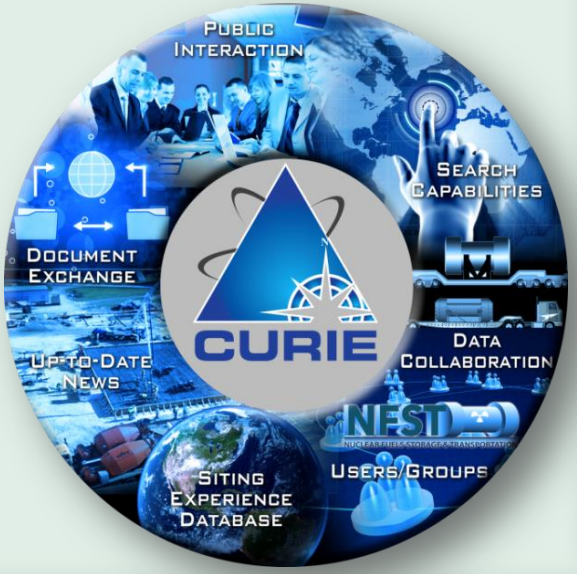
- Complete the **Blue Ribbon Commission** near-term recommendation:

  To ensure that future siting efforts are informed by past experience, ***DOE should build a database*** *of the experience that has been gained and relevant documentation produced in efforts to site nuclear waste facilities,* ***in the United States and abroad****.*



Process

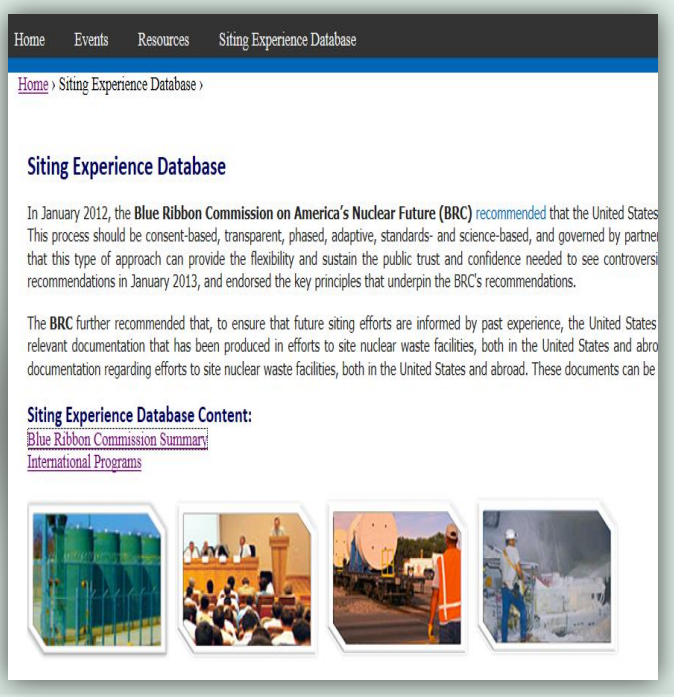
- Sandia found and consolidated documents related to 8 siting efforts and 4 international programs
- ORNL-led team (GIST and RNSD) integrated Sandia's database of documents into the CURIE website



Results

- Publicly available siting experience database with 700+ searchable documents to satisfy the BRC recommendation

http://curie.ornl.gov/SED/pages/sed-homepage

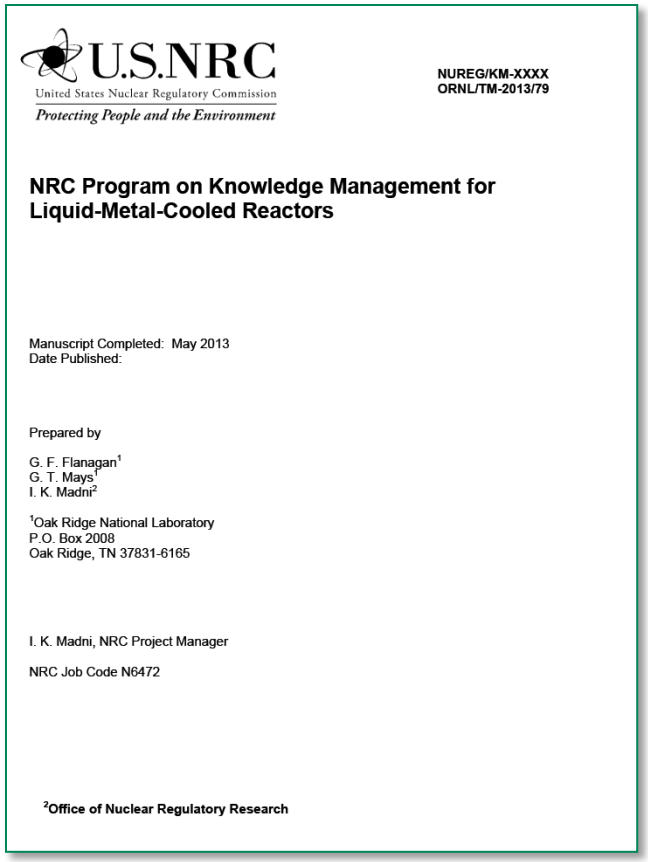


RNSD research presented at international conference on modeling and simulation

- Nine staff members and two post-docs participated in the International Conference on Mathematical and Computational Methods Applied to Nuclear Science and Engineering, Sun Valley, ID, May 5-9, 2013
- 15 papers presented on following topics
  - Cross-section physics
  - Advanced reactor modeling and analysis
  - Computational fluid dynamics
  - Multi-physics simulations of LWRs
  - Spatial and angular discretization for high-performance analysis
  - Global variance reductions for Monte Carlo analysis
  - Algorithms for accelerating Monte Carlo analysis on modern architectures
  - Sensitivity and uncertainty methods
- Plenary talk by David Pointer on "A Vision for a New Era of Computer Aided Engineering"
- Ron Ellis served as Honorary Chair

Knowledge Management report on LMRs completed for NRC

- Program was initiated in 2007 by NRC RES to develop and compile information on Liquid Metal Reactors (LMRs) as part of a NRC Knowledge Management program for LMRs
  - Developing a taxonomy
  - Collecting and uploading more than 100 documents to the NRC Knowledge Management (KM) ctr. (focused on design and safety)
  - 3 Invited lectures from experts (FFTF, LMR design, and EBR II-safety) presented to RES symposium (video was made for KM)
  - Creation of a desk reference for easy access to information
- Developed 3-day technology course including lecture notes for NRC staff training
- LMR Safety analysis code compilation and evaluation
- Total Activity was summarized in a NUREG report



U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

NUREG/KM-XXXX
ORNL/TM-2013/79

NRC Program on Knowledge Management for Liquid-Metal-Cooled Reactors

Manuscript Completed: May 2013
Date Published:

Prepared by

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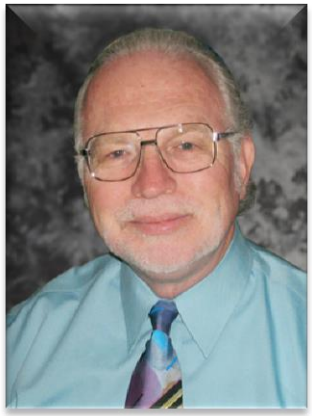
New publication in Nuclear News

"Overview of the U.S. DOE Light Water Reactor Sustainability Program," Nucl. News, Vol. 56, No. 6, May 2013 p. 47-55

- **Shannon M. Bragg-Sitton, Jeremy T. Busby, Bruce P. Hallbert, Kathryn A. McCarthy, Richard A. Reister, Curtis L. Smith, and Donald L. Williams**

ORNL Co-authors

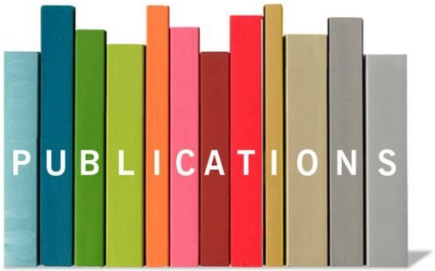


Donald L. Williams
Sr. R&D Staff Member, Reactor & Nuclear Systems Division

Jeremy T. Busby
Nuclear Fuel Materials Group Leader, Fusion & Materials for Nuclear Systems Division

Publications

- Conference Papers - 15
- Letter Reports – 2



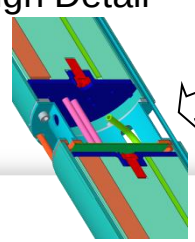
Materials irradiation – May 2013

RNSD

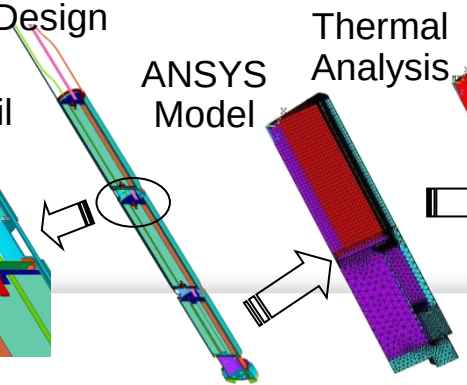
Project	Format	Sponsor	Stage					Notes
			Newly proposed	In Design	In Fabrication	In Reactor	Removed	
Titan Metal	Rabbit	DOE, FE US-Japan				9	26	Tungsten and steel
Composite Flexure	Rabbit	DOE, FE				8		SiC
Mini-Composite	Rabbit	DOE, FE			4	Cycle 447		SiC
Round-bar Tensile	Rabbit	DOE, FE		4+		TBD 2013		Steel
Hydrided Clad	Target	DOE, NE					4	Zircaloy
Ibiden	Rabbit	WFO, Ibiden				30 (6 waiting)	2	Graphite
Nippon	Rabbit	WFO, Nippon		31		4Q 2013		Graphite
UO2 TEM disks	Rabbit	Texas A&M					1	UO2
Titan Tensile	Rabbit	DOE				9	8	V-4Cr4Ti, SiC, Graphite, steel
EPRI	Large VXF	EPRI			3	unknown		Steel, Inconel
Toyo Creep	Target	Toyo Tanso			3	Cycle 449		Graphite
Inconel springs	Rabbit	AECL		~40		Cycle 449		Inconel
Graphite Creep	Rabbit	EDF			5	Cycle 449		Irr. Graphite
SHINE	Rabbit	DOE		TBD		FY 2014		Mo-99
Exotic Ceramic	Rabbit	DOE, FE		9		Cycle 449		TiSiC Ceramic
SiC Joining tests	Rabbit	DOE, FE		21		Cycle 450		SiC
HTV Capsule	Target	DOE NE		1		TBD		Graphite
FCR&D Rabbits	Rabbit	DOE NE		1		1Q 2014		DU fuel samples
General Atomics Rabbits	Rabbit	General Atomics		5		Cycle 449		SiC
FeCrAlY	Rabbit	Fusion		8+		Cycle 449		FeCrAlY
Metallic glass, High entropy alloys	Rabbit	Fusion		TBD	3		3	Metallic glass, high entropy alloy

Experiment Design

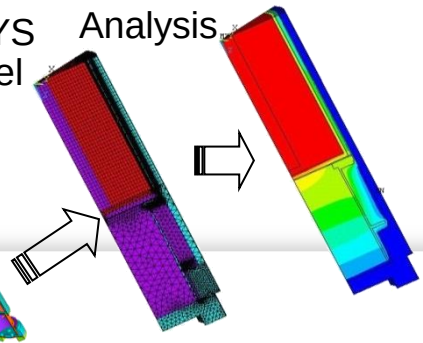
Design Detail



ANSYS Model



Thermal Analysis



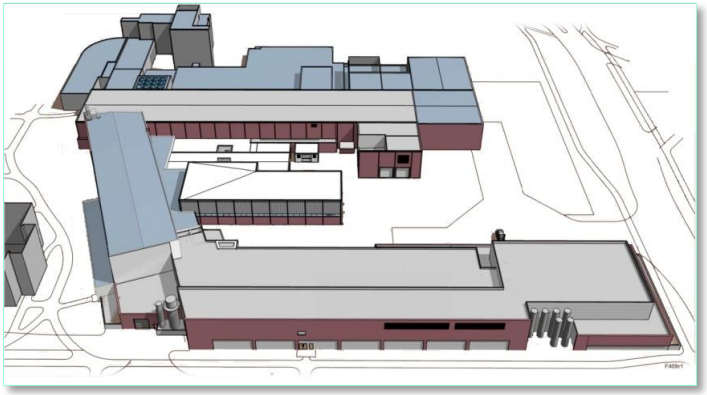
Experiment Fabrication

Irradiation

OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE U.S. DEPARTMENT OF ENERGY

Facility for Rare Isotope Beams (FRIB) May 2013 reviews and R&D successful

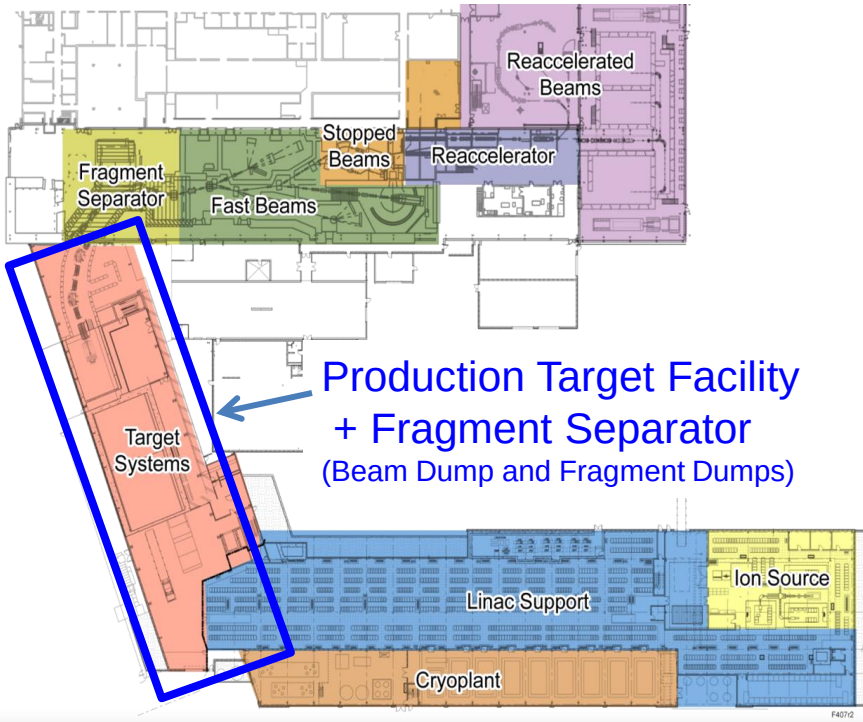
- ORNL led a very successful 60% design review of the Superconducting Magnet Remote Handling System on May 9th
- ORNL has successfully performed hydrodynamic testing of FRIB Beam Dump Mockup and is in process of extending scope and funds
  - MSU has identified further tests they desire with the mockup and is in the process of funding a revised SOW



DOE-SC National User Facility for rare isotope production with primary beams up to 400 kW, 200 MeV/u uranium

- **Hot cell and remote handling and maintenance required for Fragment Separator isotope production**

ORNL supporting Target Systems technology R&D, design, and procurement



Coolant Salt transfer to Czech Republic makes World News in May

Embassy of the United States

2013 PRESS RELEASES

Energy Department Completes Salt Coolant Material Transfer to Czech Republic for Advanced Reactor Research

PRAGUE, May 17, 2013

The U.S. Department of Energy recently joined with the U. S. Embassy in Prague and the Czech Republic's Ministry of Industry and Trade to complete the transfer of 75 kilograms of fluoride salt from the Department's Oak Ridge National Laboratory (ORNL) to the Czech Nuclear Research Institute Řež for experiments at Řež's critical test facility.

This partnership builds on a strong history of U.S.-Czech energy collaboration and follows President Obama's speech in Prague in April 2009, where he laid out the importance of international civil nuclear cooperation for the safe, secure, and peaceful use of nuclear energy around the world.

With this transfer, the United States and the Czech Republic are reaffirming their commitment to strengthen cooperation between U.S. and Czech universities and national laboratories, inspire the next generation of nuclear engineers and scientists, and advance nuclear energy technologies that can lead to economic growth and job creation in both countries. As part of this commitment, the two countries will share results from the salt coolant material testing by Řež and in other technical areas of mutual interest.

"The United States is committed to working closely with the Czech Republic to advance our shared energy goals and to support the development of safe and secure nuclear energy resources," said Acting Energy Secretary Dan Poneman. "We have a long history of nuclear cooperation with the Czech Republic, as demonstrated by the recent conversion of the Řež reactor and subsequent removal of all remaining highly enriched uranium from the Czech Republic this past April, and look forward to further strengthening this important partnership."

Data resulting from the testing of this coolant material will be instrumental in advancing U.S. and Czech research and development on a new generation of more efficient, high temperature, lower cost and passively-safe reactors, such as liquid fluoride salt-cooled high temperature reactors. ORNL Director Thom Mason noted, "The experiments using the fluoride salt coolant in Řež's critical test facility will provide valuable data that can verify our understanding of the physics and help strengthen analysis tools needed for conceptual design of advanced reactors that might utilize molten fluoride salt coolants."

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Gift of salt for Czech research program

20 May 2013

A Czech nuclear research institute has received a shipment of fluoride salt from the US Department of Energy. The Řež research institute is conducting studies into the use of the salt as a coolant in high-temperature nuclear reactors.

The provision of such raw materials is provided for under a memorandum of understanding signed by the two countries in December 2012. The 75kg of lithium and beryllium fluoride salt supplied by the Oak Ridge National Laboratory (ORNL) will be used for experiments to investigate the coolant material at Řež's critical test facility. The two countries will share the results.

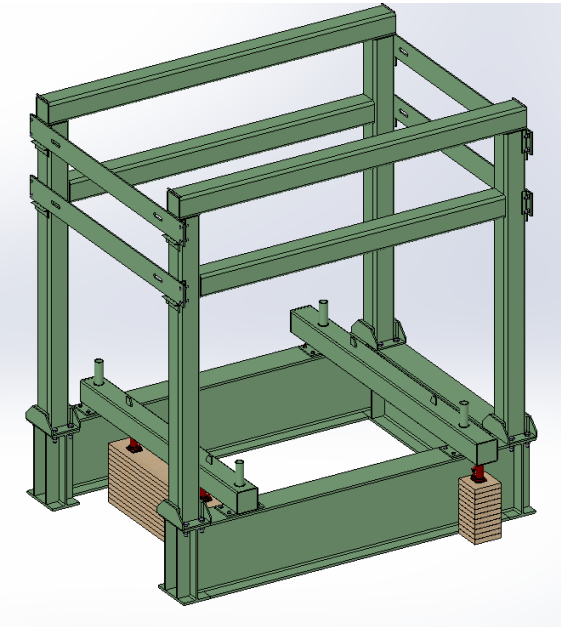
Research into molten salt reactors using lithium and beryllium salts as the primary coolant has been ongoing for many years, and a prototype operated at Oak Ridge during the 1960s. The concept has seen renewed interest with the possibility of a new generation of high-temperature, low-cost and passively safe reactors.

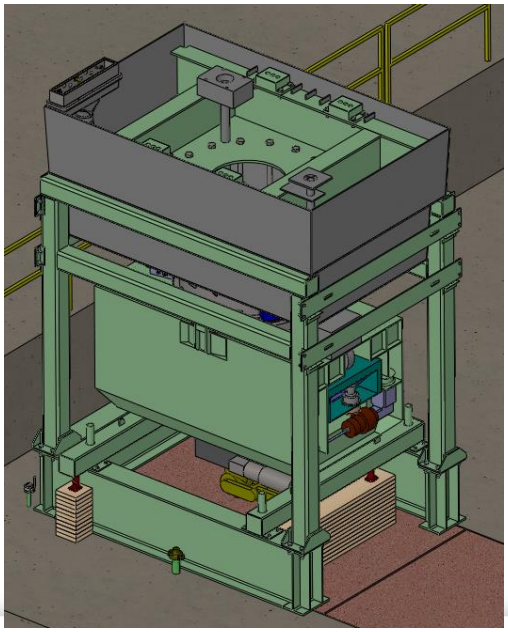
According to the US Embassy in Prague, the tests to be carried out at Řež will feed into US and Czech research and development on such reactors. "The experiments using the fluoride salt coolant in Řež's critical test facility will provide valuable data that can verify our understanding of the physics and help strengthen analysis tools needed for conceptual design of advanced reactors that might utilize molten fluoride salt coolants," according to ORNL director Thom Mason.

Researched and written by World Nuclear News

Bldg. 7930 Manipulator System replacement progressing

- **Remote Systems (RS) personnel are assisting with the design and replacement of the Bldg. 7930 Cell-G failed remote manipulator system**
  - Detail Design was completed for the Maintenance Stand (CAD images below)
  - Maintenance Stand supports the manipulator system and shield plug for assembly and maintenance
  - Following delivery of the manipulator system by PaR Systems, the manipulator and shield plug will be assembled in building 7930 for on-site acceptance testing
  - RS personnel continuing work on the design of related equipment required for installation in Bldg. 7930, and the remote manipulator system overall





Multi-Program High Bay Facility (7625/7627) electrical safety improvements progressing

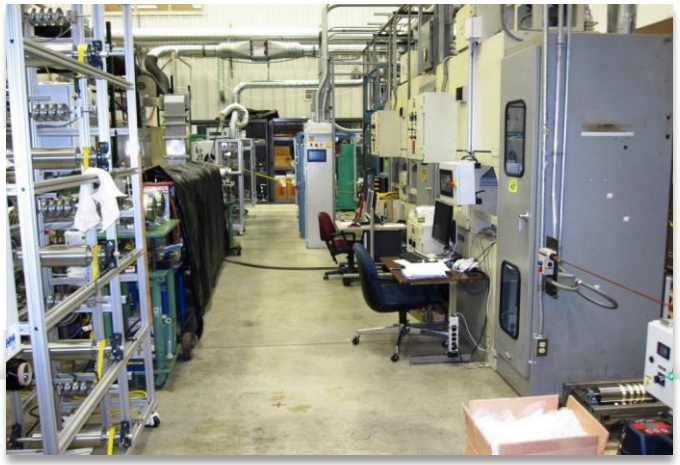
FMNSD

- Equipment-specific Lockout/ Tagout procedures initiated
  - Table top reviews held for the FRT-86, FMIT Transmitter, FMIT Transmission Lines, and FRT-85
  - The equipment specific procedure for the FRT-86 was completed and approved
- Facilities walked down with subcontractor (Fosdick & Hilmer) performing arc flash calculations
- Several Work Control Evaluation Group walk downs completed
- Developed division specific training requirements for FMNSD Qualified Electrical Workers required to perform LOTO
- Issued training matrices for all facility RSSs
- Plan of the Week meetings initiated

FRT-85 for LOTO

FRT-86 for LOTO

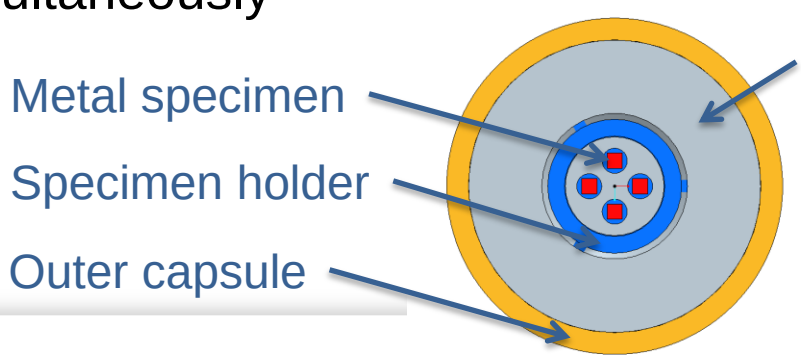
Carbon Fiber Pilot Line and Microwave Assisted Plasma Line walked down

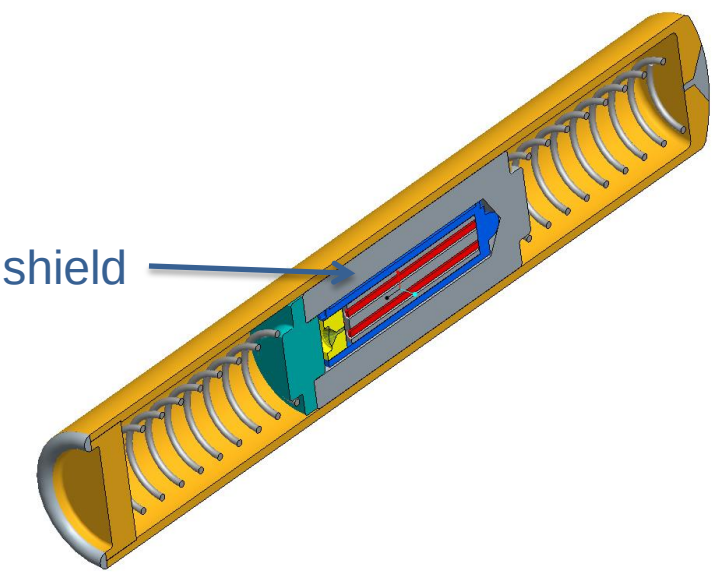


OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE U.S. DEPARTMENT OF ENERGY

Design work on capsule capable of containing depleted uranium

- Design work, including MCNP reactivity calculations, continues on the modified capsule capable of irradiating multiple specimens containing depleted uranium (DU), DU-10Zr, pure Zr, or HT-UPS steel.
  - Large variability is expected in specimen geometry (side width 200-500 µm, length 5-20 mm)
  - Current design places all specimens inside a ZrO_2 lattice with holes approximately 600 µm in diameter
  - Thickness of Gd in the sleeve and end caps will be kept to 1 mm
- Preliminary temperature calculations indica temperature can be controlled
  - Allows multiple eccentric specimens to simultaneously





4500 area gaseous waste reconfiguration and stabilization project

- Received roughing filter sample results from the 3106 facility and confirmed waste classification of the filters
- Conducted inspections (visual and air flow) of 4500 area cell ventilation duct interior at five locations
- Identified and began developing alternate approach (grouting) for stabilizing the 4500 area ventilation duct after sole-source duct foaming subcontractor rescinded proposal
- Shipped one B-25 box of 4556 Filter Pit waste to Permafix for final disposition

Conducting Smoke Check at Duct Access Port

3106 Roughing Filters in Intermodal Container

Central campus legacy material removal project

2026 Activities

- Continued Phase II cleanup work planning and scheduling activities
- Completed work plan for chemical removal
- Continued packaging of general waste from Rooms 101, 102, 103, 136 and 140
- Completed clean-out of Room 133
- Waste materials loaded into sealand container – 50% full

Worker Training on Cell Manipulator in Preparation for Cell1 Clean-out

Segregation of general waste on Phase II work

Soil and slab characterization and removal in the southeast quadrant

- Completed sampling of the builidng 3550 slab and underlying soil on May 8, 2013
- Sample analysis is underway
- Completed demolition specification package and submitted to Procurement

Concrete Sampling at 3550

Soil Sampling at 3550

EM project integration support

NNFD

- EM Contractor SEC continued to work with NNSS for shipment of the one remaining RTG (BUP-500) at building 3517
  - Shipment is currently scheduled for mid-September
  - UT-Battelle completed a review of the structural soundness of the RTG cage and loading tie-down plan
- UCOR and UT-Battelle consummated a MOU to remove the 6 manipulators from the cells in the Alpha Handling Area of Building 3038
  - The work plan and RWP have been approved
  - UT-B is awaiting DOE approval of the UCOR SRAD
- UCOR and UT-Battelle consummated a MOU to assure full coordination on the connection of the permanent power supply to Building 3038

Manipulators to be removed in AHA of Building 3038

BUP 500 - Awaiting Disposition Path Decision

OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE U.S. DEPARTMENT OF ENERGY

NNFD FY 2013 cumulative facility metrics

Hot Cell Availability

100% **Bldg. 7920**

59% **Bldg. 7930**

(72 hours in Limited Operations Mode for Cell G Waste Pull Operations)

100% **Bldg. 3525**

100% **Bldg. 3025E**

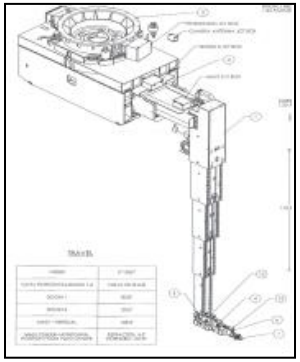
Facility Upgrades and Maintenance Activities

7920

- Programmed maintenance operations.
- Facility glove box installations.
- Target fabrication equipment refurbishment – continued with repairs to the Cubicle 3 in-cell hoist.

7930

- Fabrication and assembly of new PaR in progress at PaR Systems.

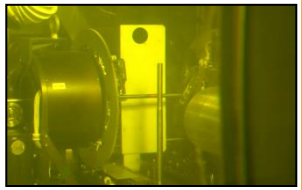


- PaR Test Stand fabrication in progress.
- Performed S.R. 4.1.1.4 Instrument Calibrations and S.R. 4.1.1.5 Low Differential Pressure Alarm System Functional Tests.
- Performed routine PMs.

3525

- Asbestos Removal from Room 202 to bring the station up to code.

- Installed Gamma Scanning Mirror to reflect rays from spent nuclear fuel into the detector at very shallow angles and within specific range of energies.



- Beginning a search for weaker Pu K-alpha radiation as well as ^{239}Pu nuclear emissions at 130 keV.

3025E

- Failed circuit board sent for analysis and repairs supporting crane radio control function failure.
- Continued work rebuilding vacuum roughing pumps.
- SPL Air Handler preventative maintenance.
- Completed instrument maintenance on roof.
- Completed CAA Door preventative maintenance.
- Engineer preparing package to support removing OOS roots blower and motors from Cell 6 ventilation.
- Utilities preparing to replace leaking water line north of entrance.
- Completed corrective maintenance to R&D mill in Cell 6.

OAK RIDGE NATIONAL LABORATORY
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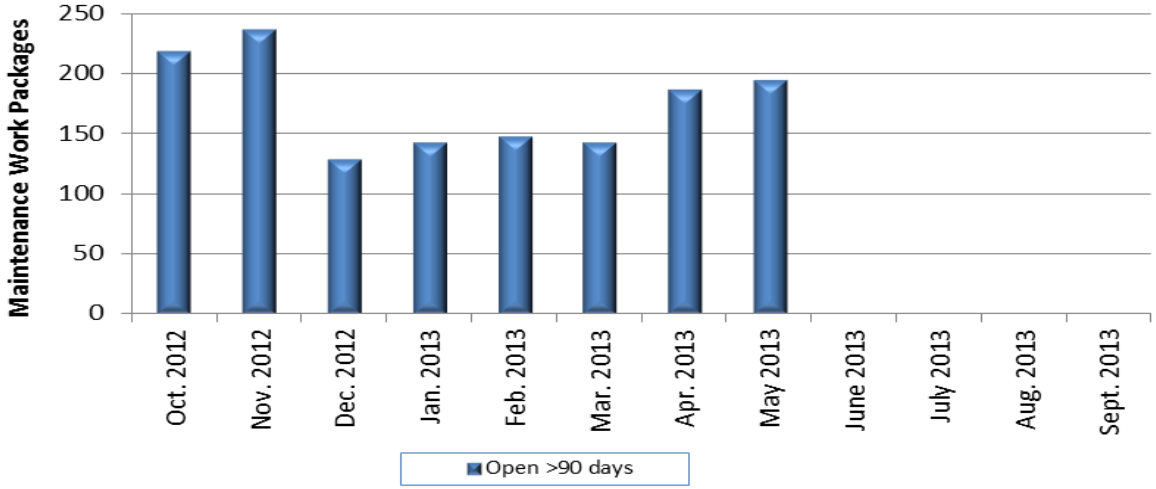
NNFD Maintenance Program performance for FY 2013 to date

NNFD

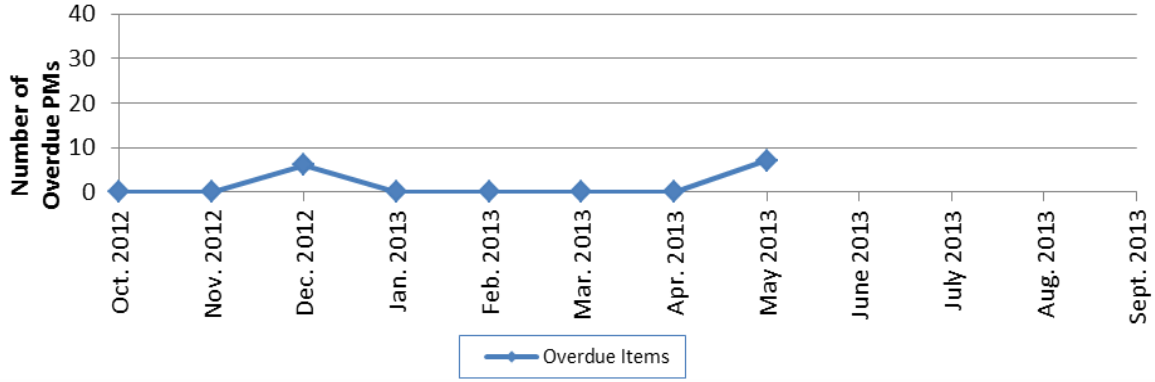
195 work orders open >90 days
Nuclear Maintenance backlog close to goal



Goal: <175

* Work scope that could affect the operation of a CAT 1, 2, or 3 Nuclear Facility (safety and non-safety; corrective, preventive, experiment, and modification)

7* overdue NNFD repetitive maintenance actions



Goal: Zero overdue

* Nuclear Safety Related Equipment PMs only; 6 of 7 missed PMs were first time evolutions for electrical equipment needing execution coincident with surveillance.

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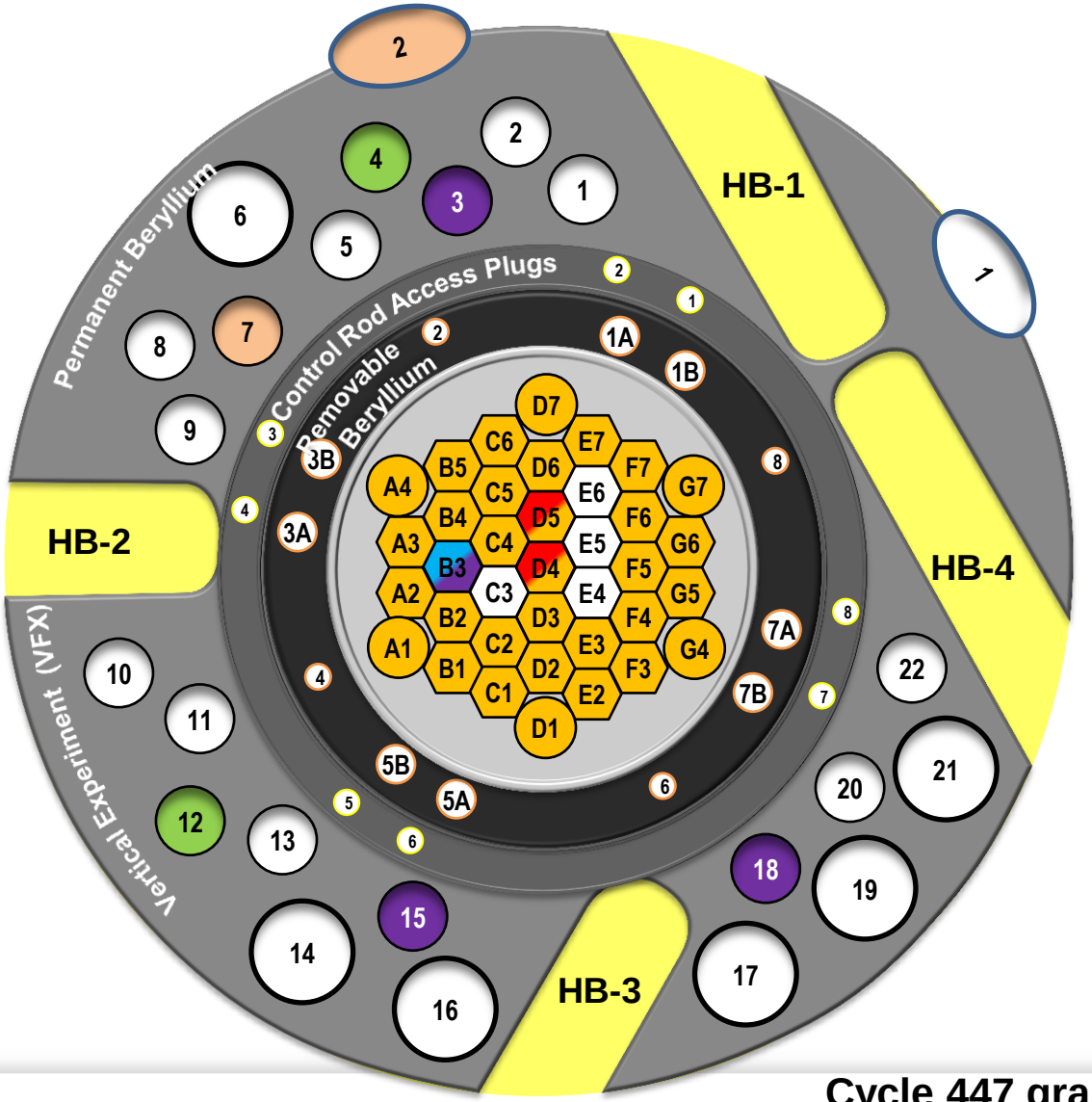
HFIR Cycle 447 continues at the end of May

May 2013						
SU	M	T	W	TH	F	SA
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

Reactor OFF

Reactor ON



- Isotope Production
- Isotopes for Research
- Materials Experiment
- Fuels Experiment
- Pneumatic Facility NAA
- Hydraulic Facility
- Neutron Scattering
- Available Positions

Cycle 447 graphical summary

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Number of irradiations in Cycle 447 remain high, driven by Pu-238 research

Materials Experiments

- Silicon Carbide
- V, Mo, & Cu alloys
- Zircaloy
- Graphite
- Steels

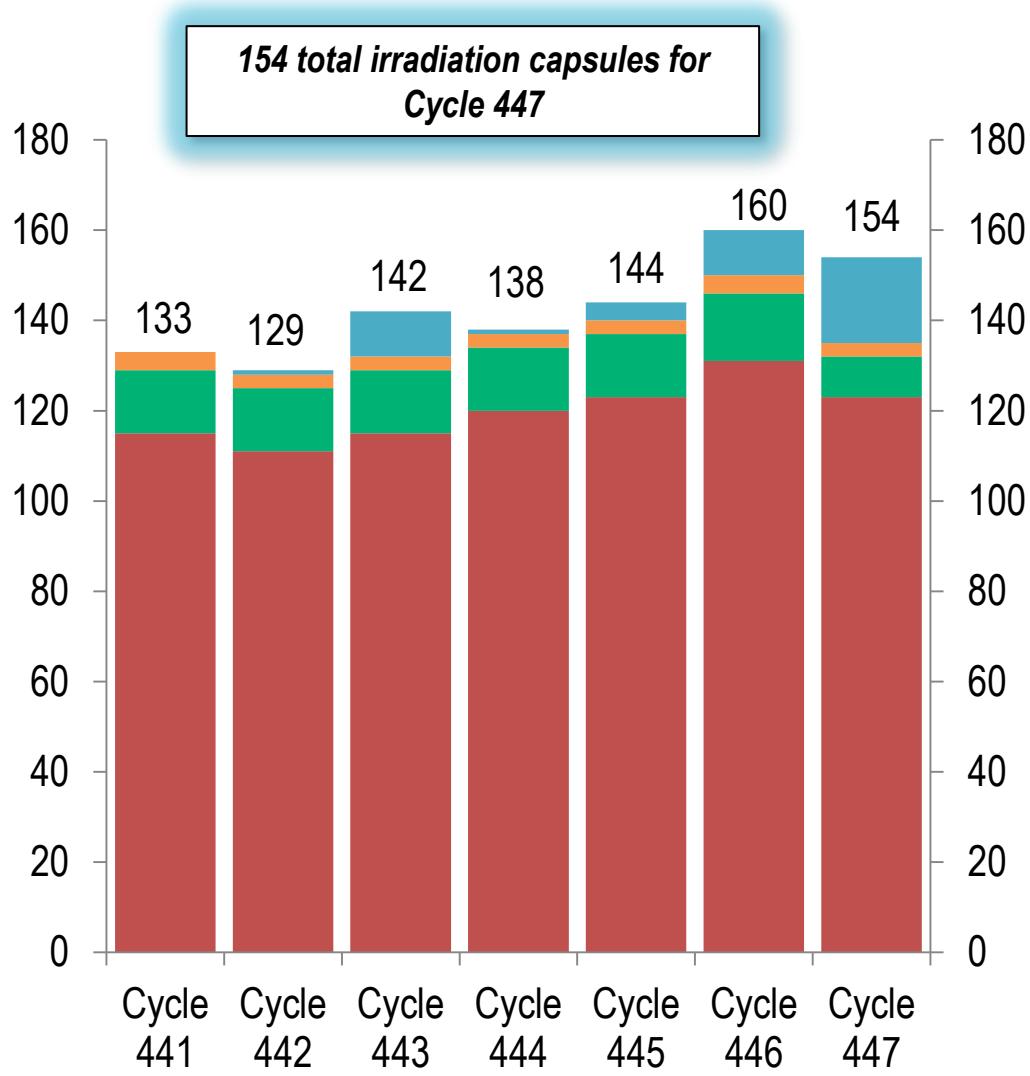
- **Fuels Experiments**
- UO_2 Fuels
- UCN Fuels

Commercial Isotope Production

- Selenium (Se-75) - production

Research Isotopes

- Pu-238 Single Pellet and Partially Loaded Targets



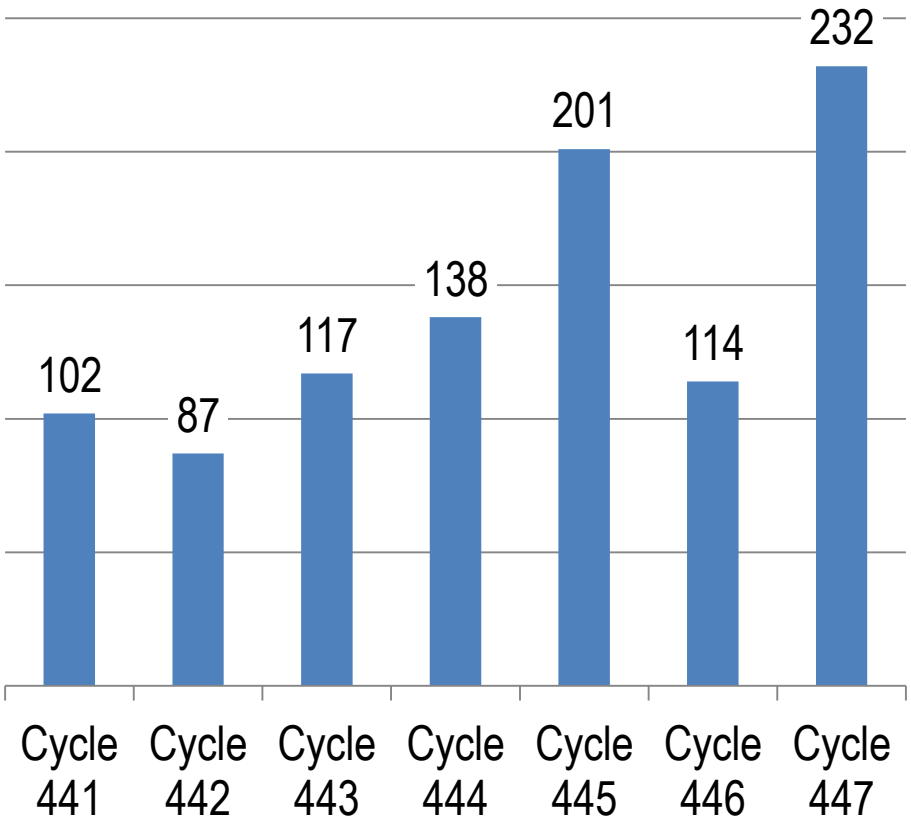
Large number of pneumatic tube irradiations and NAA work performed in May

NAA irradiations during Cycle 447 include

183 IAEA Safeguards and Environmental Sampling programs

46 Iodine and Silver NAA on zeolites and aerogels for iodine sequestration experiments

2 Nickel NAA for manganese impurity determination

1 Irradiated about 5 days in PT-1 to produce Yb-169 for the Y-12 National Security Complex

232 TOTAL