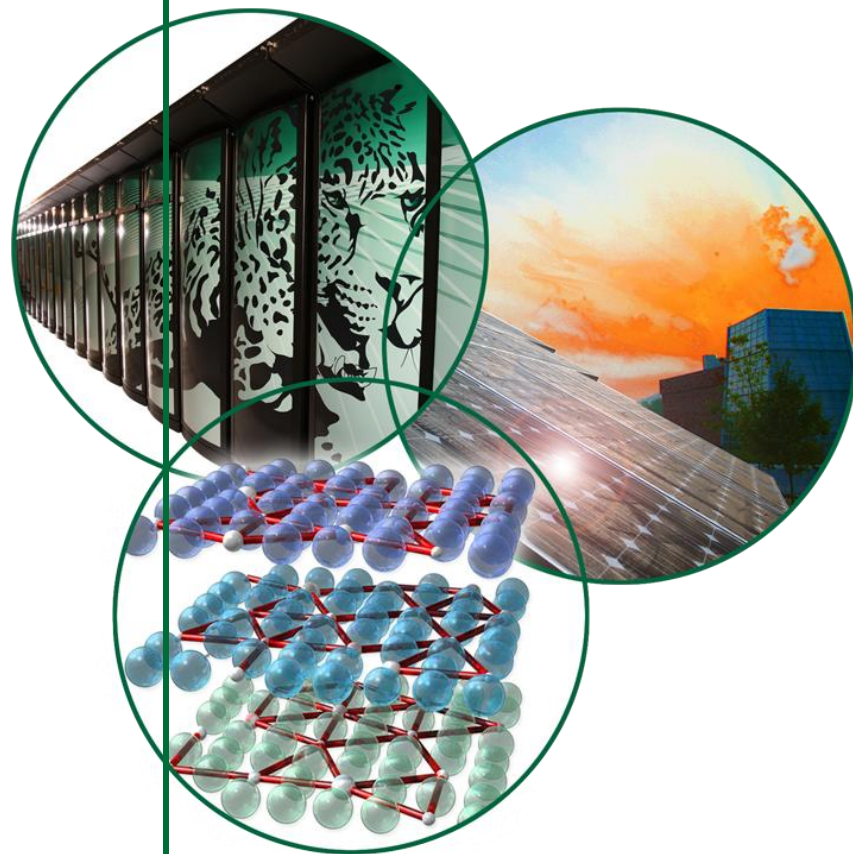


NSED Monthly Report

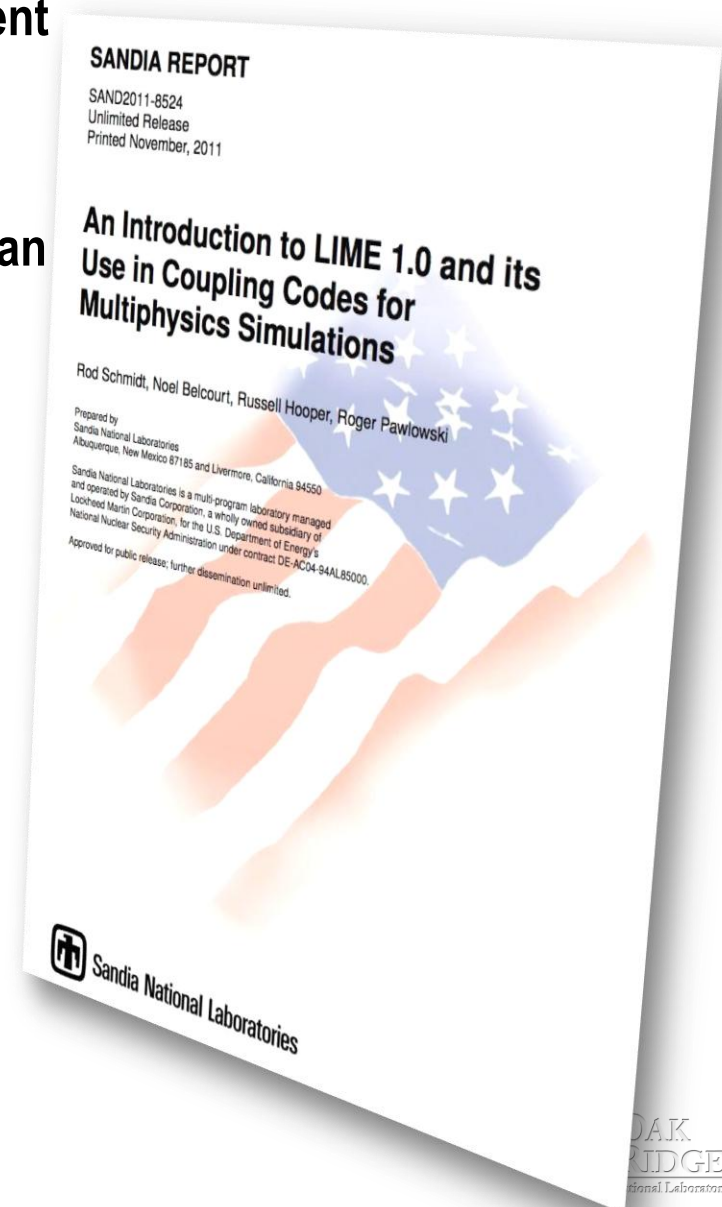
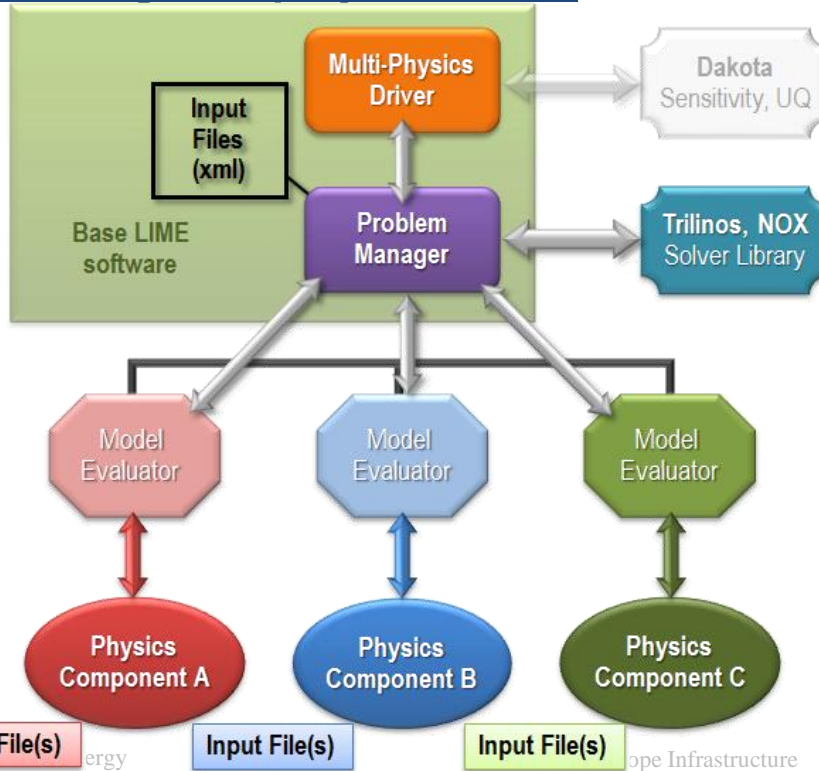
April 2012

Nuclear Science & Engineering Directorate



The Lightweight Integrating Multiphysics Environment (LIME), which has formed the infrastructure for the simulation tools being developed within the Consortium for Advanced Simulation of Light-Water Reactors (CASL), has been publicly-released under an open-source license:

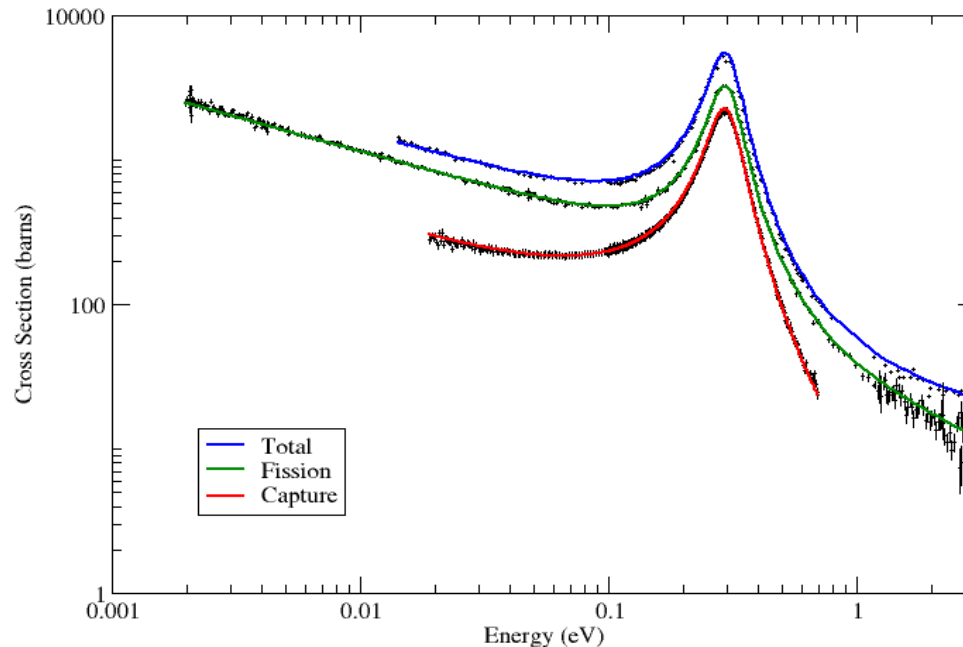
- <http://sourceforge.net/projects/lime1/>



Key Highlights and Activities



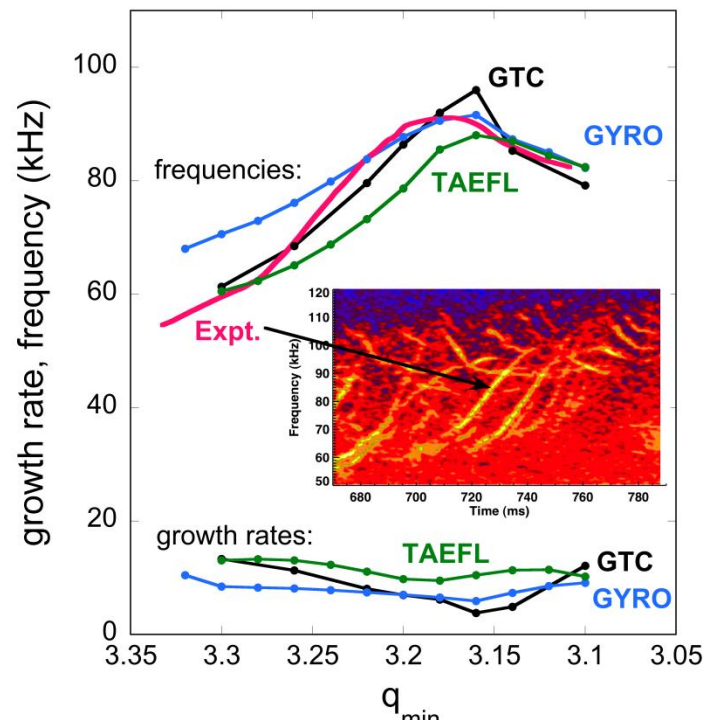
- Jess Gehin and Syd Ball participated in the Subgroup Technical Meeting under the US-Russia Civil NE Cooperation Action Plan as the respective US Leads for Small Modular Reactors and High-Temperature Gas Reactors.
- Through a NNSA cooperative activity with CEA in France, Luiz Leal completed an improved cross-section data evaluation for Pu-239 that provides better agreement with differential and integral data experiments.



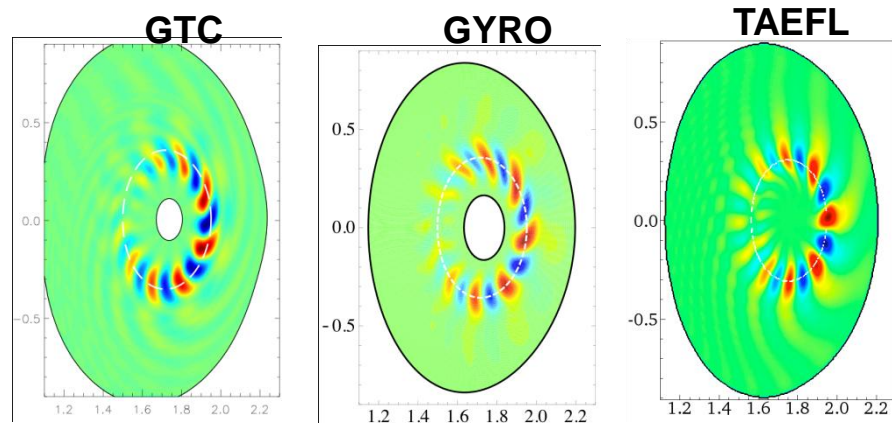
Fusion Energy Division

Gyrokinetic models (GTC/GYRO/TAEFL) have been verified and validated with DIII-D data:

- Reversed shear safety factor profiles are important for advanced tokamak operation
- However, these profiles are susceptible to fast-ion driven instabilities (RSAE mode)
- The RSAE frequency dynamically upshifts as q-profile evolves in time
- This has been successfully modeled
- Important to have validated simulation methods to evaluate the effects of alpha-driven instabilities in ITER
- Reference: “Verification and validation of gyrokinetic simulation of Alfvén eigenmodes in the DIII-D tokamak,” by D. A. Spong, E.M. Bass, W. Deng, W. W. Heidbrink, Z. Lin, B. Tobias, M. A. Van Zeeland, M. E. Austin, C. W. Domier, N. C. Luhmann, Jr.



Mode structure comparison for $q_{\min} = 3.16$:



Awards & Recognition



AMERICAN NUCLEAR SOCIETY

Mark Williams Elected ANS Fellow

The board of directors of the American Nuclear Society has elected Dr. Mark Williams to the grade of fellow.

Williams is a member of the Reactor and Nuclear Systems Division. He was recognized for “his extensive work in sensitivity/uncertainty methods, development of ‘contributon’ transport theory, development of new techniques for lattice physics and resonance self-shielding computations, and contributions to reactor pressure vessel fluence analysis.” Mark will be formally recognized during the 2012 ANS Annual Meeting to be held June 24-28, 2012, in Chicago.



Awards & Recognition

Mark Walker receives the UT Torchbearer Award

Mark Walker – GNSTD’s Nuclear Material Detection & Characterization Group

Mark Walker, a senior at the University of Tennessee and ORNL intern in the Global Nuclear Security Technology Division, received the Torchbearer Award, the highest honor the university gives to its students. As a nuclear engineering major, Mark works in leadership roles with engineering organizations to help recruit students into the field.



Global Nuclear Security Technology Division

High level visits and events in NSED



Honorable Marsha Blackburn, United States Representative from Tennessee, visited ORNL on April 10th. While here she toured the CASL facilities in Building 5700 as well as the Carbon Fiber Technology Facility



Admiral John Grossenbacher, Idaho National Laboratory Director, was given a walk-through and overview of CASL facilities and science including a live virtual collaborative session and a CASL Reactor Physics 3D interactive demonstration.



Alexander Bychkov, International Atomic Energy Agency (IAEA) Deputy Director General and Head of the IAEA Department of Nuclear Energy, visited on April 2 & 3 with Randy Beatty. Many NSED facilities were toured during this ORNL protocol visit hosted by Jeff Binder. Dr. Bychkov's objective was to increase technical participation from the national labs in collaborative projects and learn more about ORNL's capabilities.



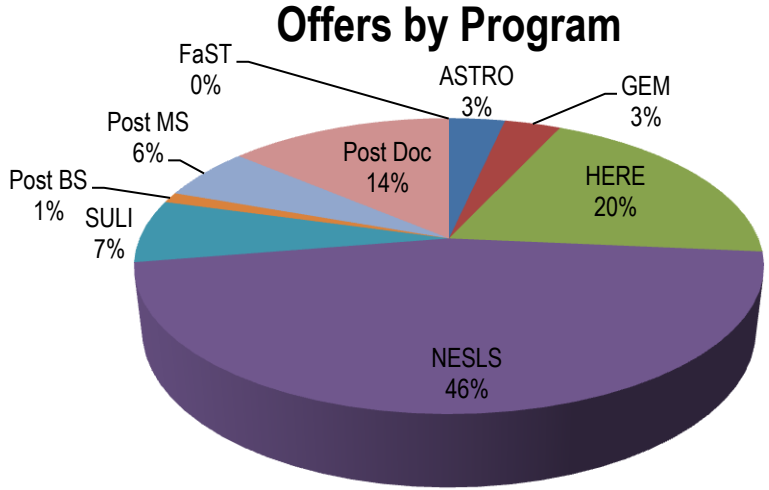
A delegation from the Chinese Academy of Sciences (CAS) visited ORNL hosted by David Holcomb/Cecil Parks as part of an DOE-CAS MOU on Nuclear Energy cooperation. Jeff Binder gave the welcome and opening remarks.



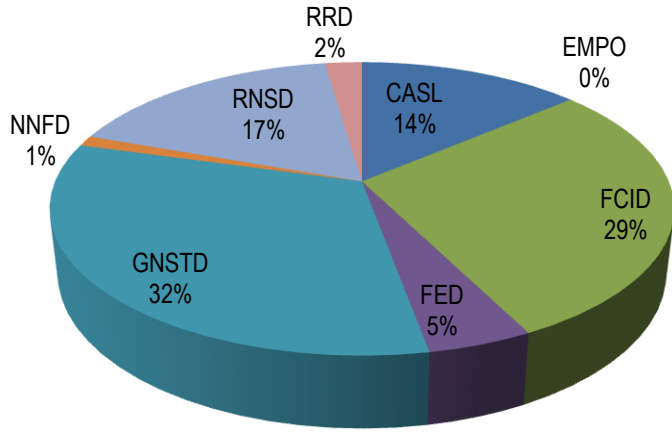
Honorable Steve Womack, United States Representative from Arkansas, toured CASL, REDC and HFIR on April 4th. He was hosted by Thom Mason.

NSED Education Outreach Committee Summer Interns

Student Program	Applications	Offers as of 4/30/12
ASTRO	69	3
GEM	24	3
HERE (UG+Grad)	524	35
NESLS	269	40
SULI	300	6



Offers by Organization



NSED Education Outreach Activities

Farragut Intermediate School Science Fair Over 100 projects were evaluated



ORNL Display Booth at the 2012 Student ANS Conference Career Fair hosted by University of Nevada-Las Vegas ~400 students in attendance



Other Events:

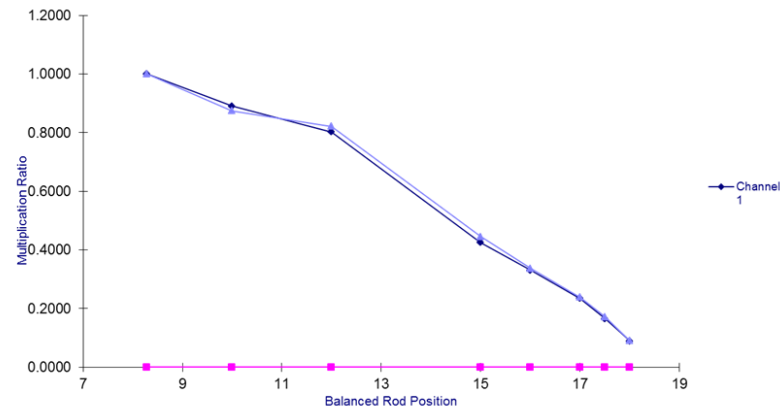
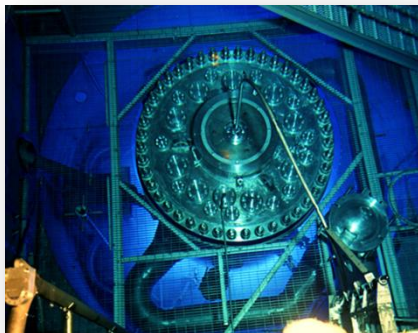
- **Farragut Primary School Career Day**
- **Meeting with ORNL University Outreach Director**
- **DOE National Science Bowl Participation**
- **NGSI funded support of UT NE's "Radiation Detection & Measurements" class visits to Safeguards Laboratory**
- **PHYSOR Conference: "Embedding Nuclear Security Concepts in the Nuclear Engineering Curriculum"**

Seth Johnson was a volunteer for the DOE National Science Bowl held in Washington, D.C., during the week of April 26 to culminate a year-long DOE outreach program for talented STEM high school students.

HFIR-centered lecture and laboratory exercise presented to UT Nuclear Engineering seniors



- Dr. David Cook, Research Reactors Division, provided a lecture and laboratory exercise to about 50 students in the Spring Semester NE 401 class
 - The lecture covered reactor theory on subcritical multiplication, a description of the High Flux Isotope Reactor (HFIR) with emphasis on features relevant to startup subcritical multiplication measurements, an overview of the HFIR shutdown margin safety basis
 - A lab overview was presented on preparing inverse multiplication plots to verify shutdown margin, and reactor startup data for analysis as a short Lab exercise
 - The lab was based on data sets from past HFIR beginning of cycle startup tests that included estimated symmetric control element positions, count rate data during shutdown margin verification tests, and actual critical control element positions recorded during the startups. Lab groups were provided data sets for performance of the data analysis exercise.
 - The lab Professor, Dr. Jason Hayworth, was also provided with sample exam questions associated with this Lab for use in his final exam testing



Consortium for Advanced Simulation of LWR

Collocation April 16 – 20, 2012

- **Focus Area Strategic Planning, AMA, MPO, VRI, RTM, THM, VUQ**
- **Data Center Proposal Discussions**
- **GTRF Workshop**
- **Structural Mechanics Meeting**
- **Hydra Repository Setup**

VOCC Tours - 14 Tours for April

- **Admiral John Grossenbacher, INL Director**
- **Honorable Marsha Blackburn**
- **Gil Indwald (Acting Deputy Asst for Permitting, Siting and Analysis, DOE)**

Meetings:

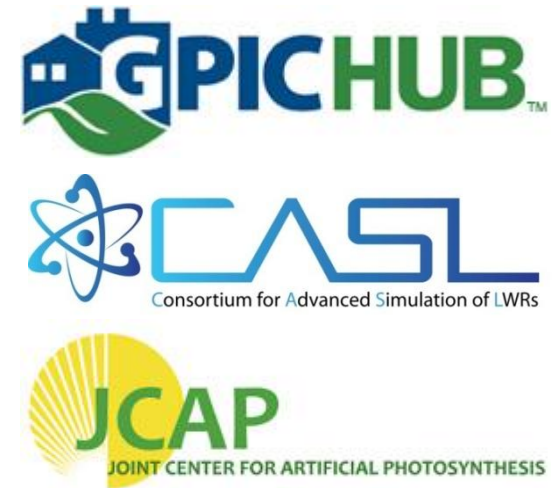
- **Physor 2012, April 15-20, Knoxville, TN**
- **PoR-4 Milestone Review, April 24-25, Huddle**
- **Student ANS, April 13-14, Las Vegas, NV**
- **Education Program Student Webinar: Bolotnov, April 27**

Milestones

- **Two L3 Milestones completed: PA.P4.06 – Class Patent Waiver for CASL Partners**
- **And THM.CFD.P5.06 - Report on 7-equation model development and results.**

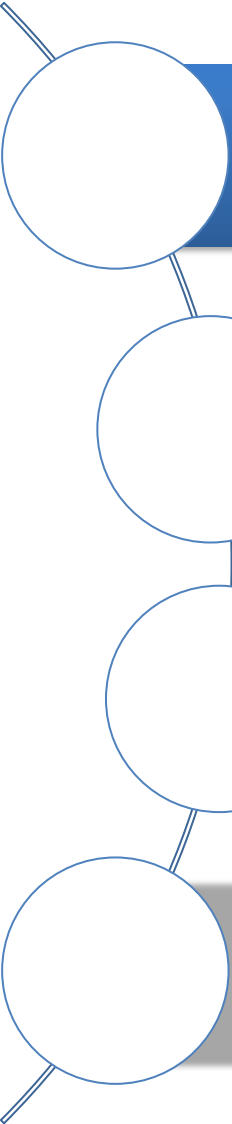
DOE All Hubs Meeting

The first “All Hubs Meeting” was held April 3 & 4 in Philadelphia, PA. The event was hosted by Hank Foley, GPIC Executive Director. It was attended by DOE NE Alex Larzelere and leadership members representing GPIC, CASL and JCAP.



Members from each hub, with DOE NE listening and participating, shared information about their organization, best practices, challenges and issues. Lines of communication in place between hubs enabling a strengthening of community.

Fuel Cycle and Isotopes Division



The Facility for Rare Isotope Beams (FRIB) project received an outstanding DOE SC project management "Lehman Review" though Office of Nuclear Physics budget restraints may push facility construction start to FY2013

FRIB flow mockup ready for phase I testing - A mockup to test the baseline rotating, water-filled beam dump for the FRIB has been assembled in the D111 Laboratory in Building 5800. The beam dump for the tests will be supplied to ORNL by Michigan State University later this summer.

An LDRD pre-proposal entitled "Advanced Mitigation of Ion Beam Space-Charge" was submitted - The proposal combines electromagnetic simulations and ORNL's experimental capabilities to investigate advanced methods of neutralizing the ion beam space-charge in high-current (100mA) electromagnetic isotope separation devices.

Modified Direct Denitration Conversion for Pu-238 Production - Batch denitration studies are being conducted in support of the Pu-238 Production Program. This work has indicated that Np nitrate can be processed at a ratio of 1 mol NH_4 :1 mol Np in the continuous process.

Radioisotope R&D

- LDRD for ^{251}Cf target development.
- LDRD for Eu/Sm separations
- ARPA-E concept paper for betavoltaic battery development.
- DTRA proposal – Radioisotope Doped Scintillator for use in a Beta Battery.

Proposals Submitted



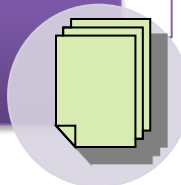
- 10 μg of ultrapure ^{249}Bk to ANL - ingrowth of ^{249}Cf was minimized by processing the sample within 24 hrs of the shipment.

Berkelium Purification



- Completed cost estimate for NA-22/DNDO proposal lead by GNSTD for Radiation Signature Test Device development.
- “Planned Closeout of the ^{252}Cf Loan Program”, draft to DOE OSO and DOE HQ NA-73.
- Presentation on study of $^{178\text{m}2}\text{Hf}$ under development

Proposal Initiatives



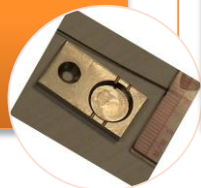
- Developed a plan for processing remaining inventory of Mk-42 targets to recover Am/Cm and submitted to DOE-HQ NA-73.

Americium-Curium Processing



- Preparing for a 5 μg ^{252}Cf electrodeposition (3 mm dia.) source.
- Total of 7 μg of ^{252}Cf was separated and purified for use.
- Successfully test mounted source disk onto 0.6”x 1” plate with coverage by 0.00004” Ni foil.

Californium-252 Electrodepositions



- ^{225}Ac Production Campaign #99 was completed April 2-6.
- First Production Campaign was in 1997 - Plans to celebrate campaign #100 are underway.
- 73 mCi ^{225}Ac were shipped in eight different shipments to five different customers in April.

Actinium-225 Production



- Procured and tested new equipment for measuring the thermal conductivity of ^{237}Np target pellets.
- Completed installation of equipment into the pellet pressing glove box.

Pu-238



Irradiated Fuels and Materials R&D



Fusion

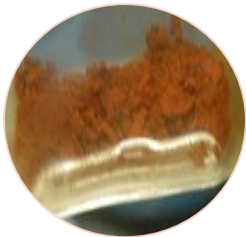
Completed cutting fracture surfaces from 3-pt bend specimens and shipped them to LAMBDA for SEM evaluation

Shipped 15 irradiated specimens to Univ. of Michigan

Shipped FCM pellets to LAMBDA

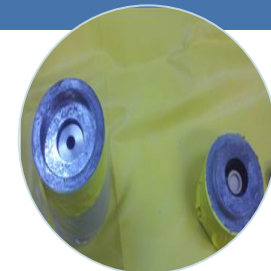
DOE-NE Fuel Cycle Program for Advanced Fuel Campaign

In order to secure fundamental data to support fuel modeling and simulation code development for fast reactor transmutation fuels the 2nd and 3rd of a series of Gd shielded rabbits, each containing three depleted uranium U-8.2wt%Zr TEM disks were irradiated in the HFIR hydraulic tube in late March. Both irradiated capsules were repackaged for quick shipment to INL. One was shipped in April. The other is awaiting INL's approval to receive.



- **NO₂ Voloxidation studies with used fuel to form UO₃ were conducted.**
- **Dissolution studies were performed on gas nitrated used fuel in organic solutions.**
- **Zr recovery from used fuel by chlorination sublimation has continued to show promise.**

Fuel Recycle



Radioisotope Production

- Heavy Element Campaign 75: Clean up and processing of rework material; Purification of ^{252}Cf material in preparation for loading on to "Nut Packages"
- ~120 mg (~75%) of the Campaign 75 product was loaded onto storage/transport packages

Heavy Element Campaign C-75



- Planning activities for transfer of LANL Curium

Curium Recovery



- Performed Calorimetry operations on 20 containers that will be processed over the next 3-4 months.

Americium-Curium Processing



- GE Order 65-0094-1 for 2.4 mg Cf/Pd bulk wire: Primary encapsulation complete, Leaching
- QSA Order 65-0010-2, 1.0 mg of 250 mic/in Cf/Pd bulk wire outer encapsulated and leaching. 2.0mg of 640 mic/in cut into 3.5 mm segments. Cuts complete and assayed

Californium Wire Production



- Received and shipped two ^{75}Se shipments from HFIR which were processed and shipped to USQA-Global

Selenium Processing



- Shipped 75.8mCi during the month of April

Actinium Production



- Installation of Spectrophotmetric Equipment which will measure Np and Pu solutions and valences

- Installation, testing and checkout of the pellet pressing glove-box components

Pu-238



Enriched stable isotope technical services and dispensing

Twenty-one shipments of 56 enriched stable isotopes were made in April

- 92 shipments of 241 enriched stable isotopes have been made in FY12 to date

Ten Work Authorizations involving 11 technical services were completed in April

- 79 technical services have been completed in FY12 to date
- Included among these were the fluorination, calcium reduction, hot and cold rolling of ^{157}Gd to make a 2.5 cm x 2.5 cm x 1.4 mg/cm² metal foil for a US company.

Nonproliferation training & education services



Global Nuclear Security Technology Division

Arms Control & Nonproliferation Course

The last session of the Arms Control & Nonproliferation course was conducted at the University of Tennessee (Knoxville) during the week of April 23rd. The class was taught by Professor Brandon Prins and Ambassador Thomas Graham, Jr. along with assistance from GNSTD intern, Ann Pederson. Students ended the course with a five-week negotiations simulation on establishing a Nuclear Weapons Free Zone in the Middle East.

**Ambassador Thomas Graham Jr. is a former senior-level diplomat and a world-renowned authority on nuclear nonproliferation who has been involved in the negotiation of every major arms control and nonproliferation agreement from 1970 to 1997. He has participated in nuclear talks with more than 100 countries and has advised five U.S. presidents on issues related to nuclear nonproliferation. Ambassador Graham is an active lecturer and has authored numerous articles and books in the nonproliferation field.*

NA-242 Nonproliferation & Export Control Dual-Use Missile Technology Workshop

Terry Donaldson was an instructor for NA-242's Nonproliferation and Export Control Dual-Use Missile Technology Workshop held at the Kansas City Plant April 3-5, 2012.

Highlights



Global Nuclear Security Technology Division

ORNL hosted the NA-221, Office of Proliferation Detection Material Production and Weaponization Detection Program Review from April 10-13, 2012.

ORNL was chosen to host this event for the fourth time in 5 years due to the quality of our meeting facility and our professional and competent staff. The review has grown from 3 to 5 programs since 2008, and attendance has increased 65% to over 200 people. Feedback from the meeting participants and the sponsor has been positive.

Issues/Concerns: Due to the planned downsizing of the building 5300 meeting facility, ORNL may not be able to host this event (or any other similar large group) in the future.

The NA25 Financial Database has been modified.

The modifications include updated screens and an associated report to provide the headquarters Budget Officer a quicker and more accurate experience when approving funding change requests. Also, the NA21 Financial Database has been modified to include an updated report to provide the headquarters Budget Officer more detailed information on overall program finances.

Special Form Testing of the 10 kg HEU Equivalent RSTD was completed.

The resulting test report was submitted to the U.S. Department of Transportation (DOT) as an application for a Certificate of Competent Authority (CoCA). Prior to submission, the report was reviewed internally by ORNL Facilities and Operations Directorate and then reviewed externally by DOE Oak Ridge Operations, and the DOE Packaging Certification Program. It is expected that the CoCA will be issued by DOT within 90 days of submission.

Testing of cesium-iodide detectors manufactured by the All-Russian Research Institute of Automatics in Moscow, Russia was completed.

A draft report was prepared for internal review. The detectors are used in both pedestrian and vehicle radiation portal monitors (RPM) deployed at some Russian facilities. Unlike plastic scintillators, the CsI detectors are smaller. However, configuration geometry for an effective RPM would require tripling the detector quantity; making the overall RPM more complex and expensive.

Ultra-Trace Forensic Science Center (UFSC)



Phase II Renovation

- The Nuclear Forensic Science Thrust Area team produced a cost estimate for renovation of Phase II laboratories within the UFSC to allow for ultra-trace sample preparation in class 1,000 and class 100 clean room space.
- The proposed cost and scope was presented to senior laboratory management in late March 2012 and funding in the amount of \$1.4 million was awarded to complete the conversion of two laboratories within the footprint.
- A multi-directorate team has assembled to complete the clean room retrofit and chemical laboratory outfitting, complete with chemical fume hoods and isolated laboratory ventilation systems.
- Demolition activities were initiated in April as well as relocation of existing operations to temporary laboratories within building 1005.
- In addition, as part of the DOE Office of Nonproliferation Research and Development Multiprogram review held at ORNL in April, several sponsor and potential sponsor personnel visited the laboratories within the UFSC and expressed significant positive feedback in the capabilities and expertise housed within the facility.
- Feedback from DOE and WFO sponsors is extremely positive regarding the capability development and operations, and FY12 has shown a significant increase in forensics related business that is a direct result of the UFSC investment in FY11.



Global Nuclear Security Technology Division

Fusion Energy



Luis Chacon of the Plasma Modeling Group of Fusion Energy organized the **2012 International Sherwood Fusion Theory Conference** in Atlanta GA, from April 1-3. The conference was attended by 150 participants working on fusion theory, both from the US and abroad (China, Japan, Korea and Europe).



Stan Milora will present the summary talk on Fusion Technology at the IAEA Fusion Energy Conference 2012 in San Diego this October.



David Green of the Plasma Theory and Modeling Group – RF Theory collaborated with researchers at the University of Newcastle in Australia to develop a possible means of including kinetic effects with their newly developed finite-difference-time-domain algorithm for the simulation of ultra-low-frequency wave propagation in the Earth's near-Earth space environment.



R. Maingi – Leadership Roles

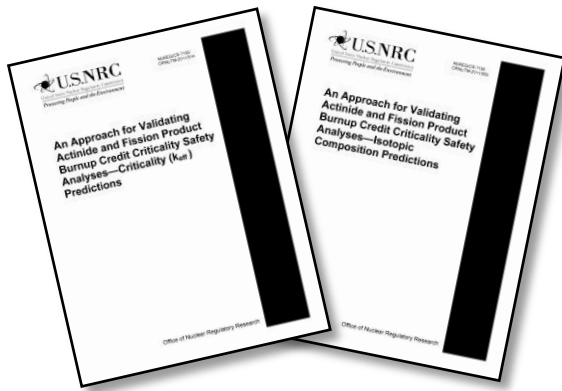
- Leader of a new USBPO task force to prepare for US scientific participation in ITER
- Vice-chair for the ITPA Pedestal end Edge Physics group , China
- Served on the TTF Executive Committee and presented a paper at the TTF workshop in Annapolis, MD
- One of the US representatives for the program committee of the 2012 IAEA Fusion Energy Conference, Vienna

Key Highlights and Activities

- Staff participated in a training workshop April 17-19 for nuclear spent fuel safeguards inspectors of the European Atomic Energy Community (EURATOM) on the use of state-of-the-art verification software developed by RNSD under a NNSA/EURATOM cooperative agreement.

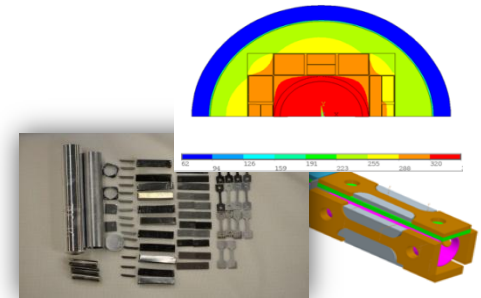


EURATOM Course Attendees



- Technical reports prepared by RNSD were basis for new NRC regulatory guidance for transportation and storage casks issued in the Federal Register for public comment.

- Led by RNSD, four multi-year, multi-division projects were initiated under the DOE/NE Advanced Sensors and Instrumentation Program.
- Ten irradiation rabbits were designed and fabricated to investigate effects of neutron irradiations on bonded and coated materials of interest to fusion applications.
- Don Williams, Deputy Director of DOE LWR Sustainability Program, coordinated preparation of an update to the joint R&D plan between DOE and EPRI.



Professional leadership and training Services

PHYSOR 2012 International Conference

- Major role in organizing PHYSOR 2012 International Conference on Reactor Physics held at Knoxville Convention Center in April.
 - Attended by 460 professionals and students
 - 20 papers from ORNL/RNSD staff
 - General Chair, Technical Program Chair, and 6 committee members from ORNL RNSD
 - Plenary presentation by ORNL Director Thom Mason



SCALE spring training courses

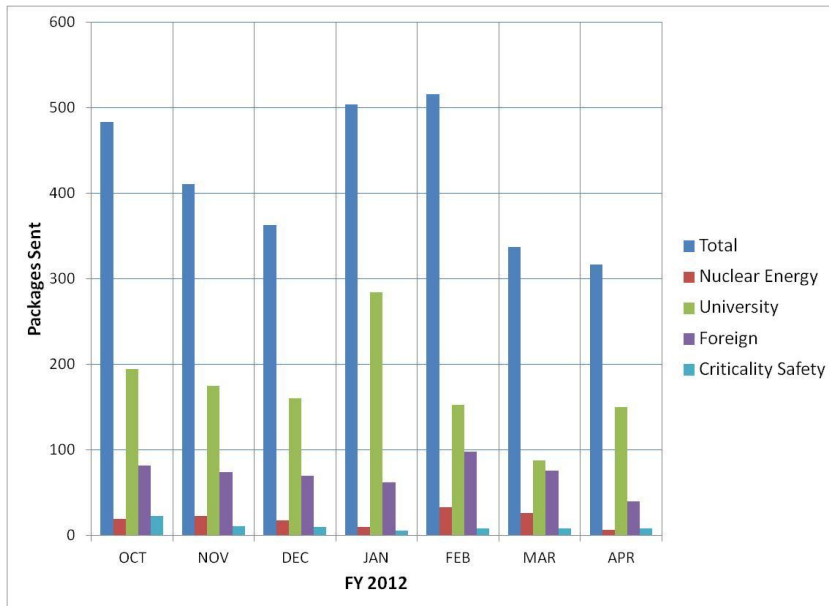
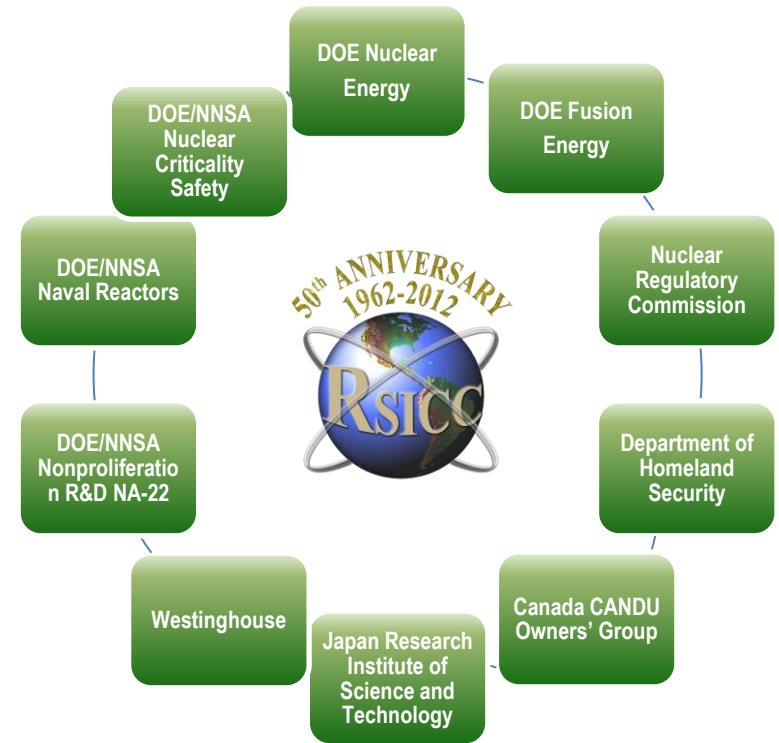
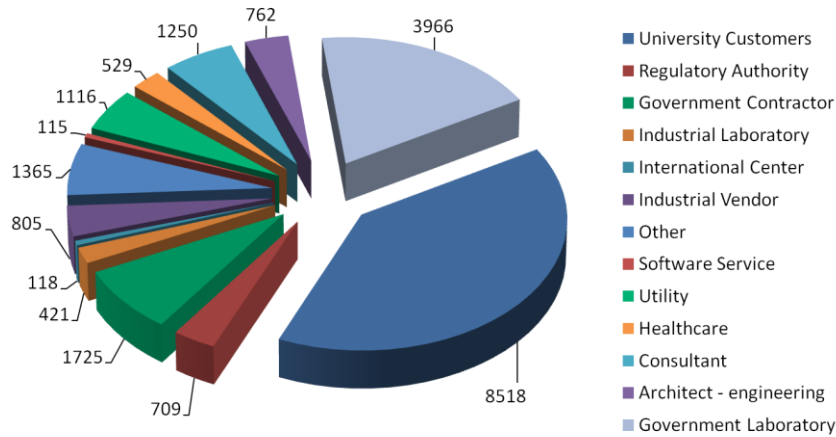


- Four hands-on training courses offered:
 - Lattice Physics and Depletion
 - Depletion, Activation, and Decay
 - Criticality and Shielding
 - Sensitivity and Uncertainty
- 32 attendees representing nine countries represented: USA, Brazil, Canada, Czech Republic, Germany, Italy, Slovakia, Spain, Taiwan.
- Two ½-day SCALE workshops presented at PHYSOR 2012 in Knoxville with approximately 40 attendees per workshop.



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

RSICC Customer Base



- **Software and data packages distributed FY2012: 2,931**
- **6 package updates and revisions April 2012**

Non-Reactor Nuclear Facilities Division

Building 3525 continues supporting Advanced Gas Reactor (AGR) wall by receiving additional irradiated compacts from Advanced Test Reactor (ATR).



NNFD FY2012 cumulative facility metrics

Hot Cell Availability

96.8% REDC (7920)

95.0 REDC(7930)

92% Irradiated Fuels Examination Laboratory (3525)

90% Irradiated Material Examination and Testing Laboratory (3025E)

Facility Upgrades and Maintenance Activities

7920

- 10 Year change out of HEPA Filters for Hot Cell Support Area and Lab Area systems



- Chemical MUA Tank Islands Refurbishment
Before



After



7930

- Steam Reducing Station Upgrade



- Programmed maintenance operations
- Preservation and Painting of E-1 Exhaust System Duct.



3525

- Newly Installed Building 3039 Stack Alarm System



- Facility water heater replaced with "on demand" system

Before



After



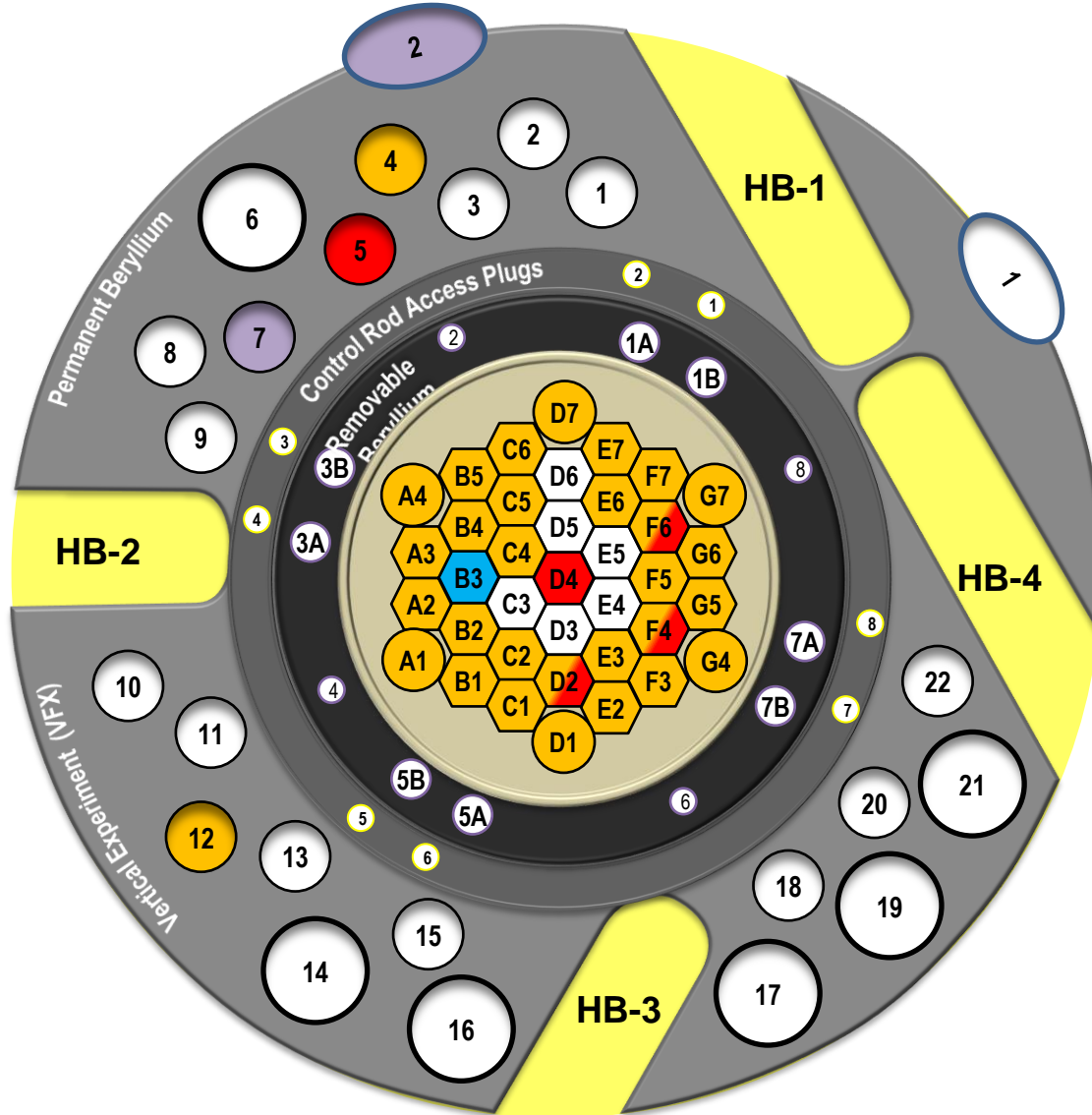
3025E

- Routine ongoing maintenance activities
- Completed replacement of a mod 8 Master Slave Manipulator (MSM) with a Mod E MSM in cell 3
- Completed several minor MSM repairs
- Completed annual S-10 cask inspections supporting the Isotope Program

HFIR Cycle 440B Irradiations

March 2012						
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 On



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

Cycle 440B sets a decade record for the number of irradiation capsules

112 Materials and Fuels Experiments

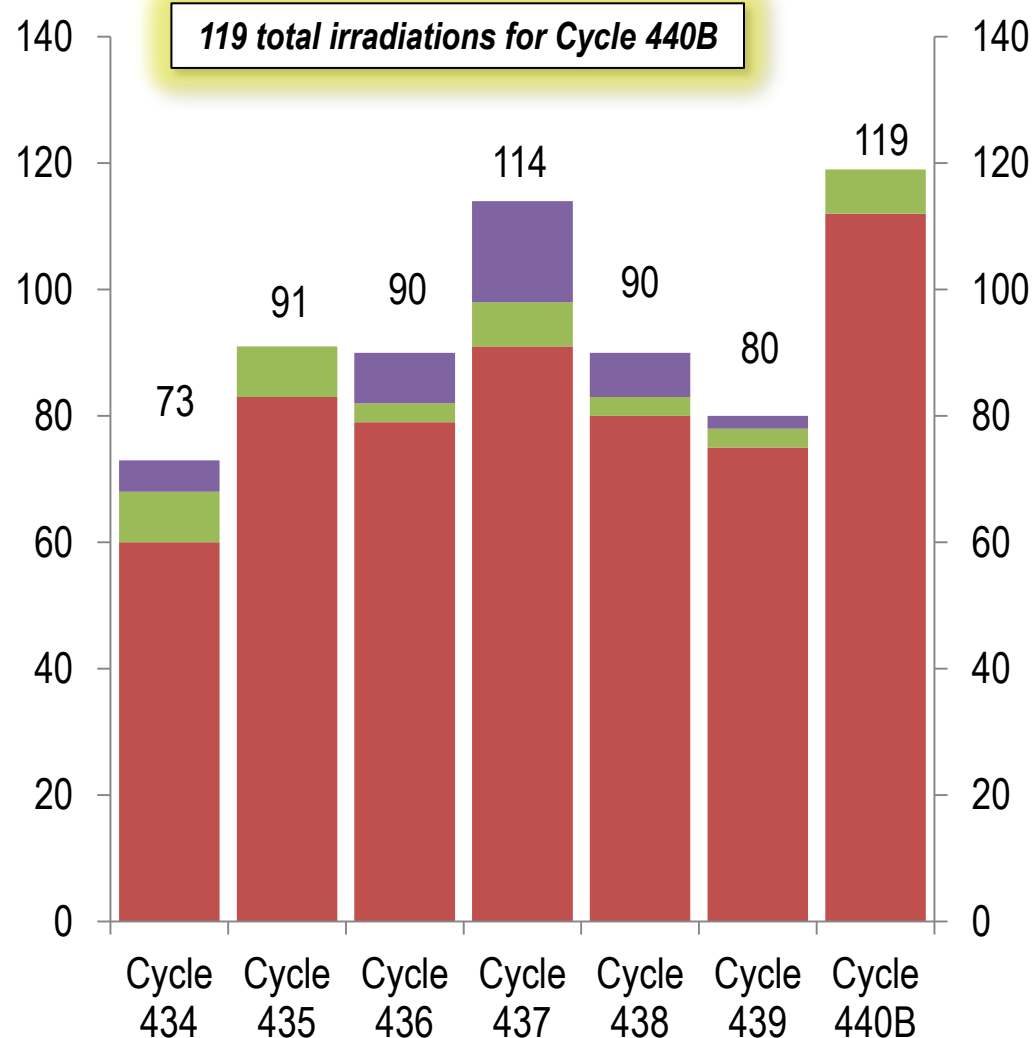
- Silicon Carbide
- V, Mo, & Cu alloys
- Zircaloy
- UO₂ Fuels
- Graphite
- Uranium
- Steels
- UCN Fuels
- Flux Monitors for Pu-238 program

7 Commercial Isotope Production Capsules

- 6 Selenium (Se-75) - production

Isotopes for Research

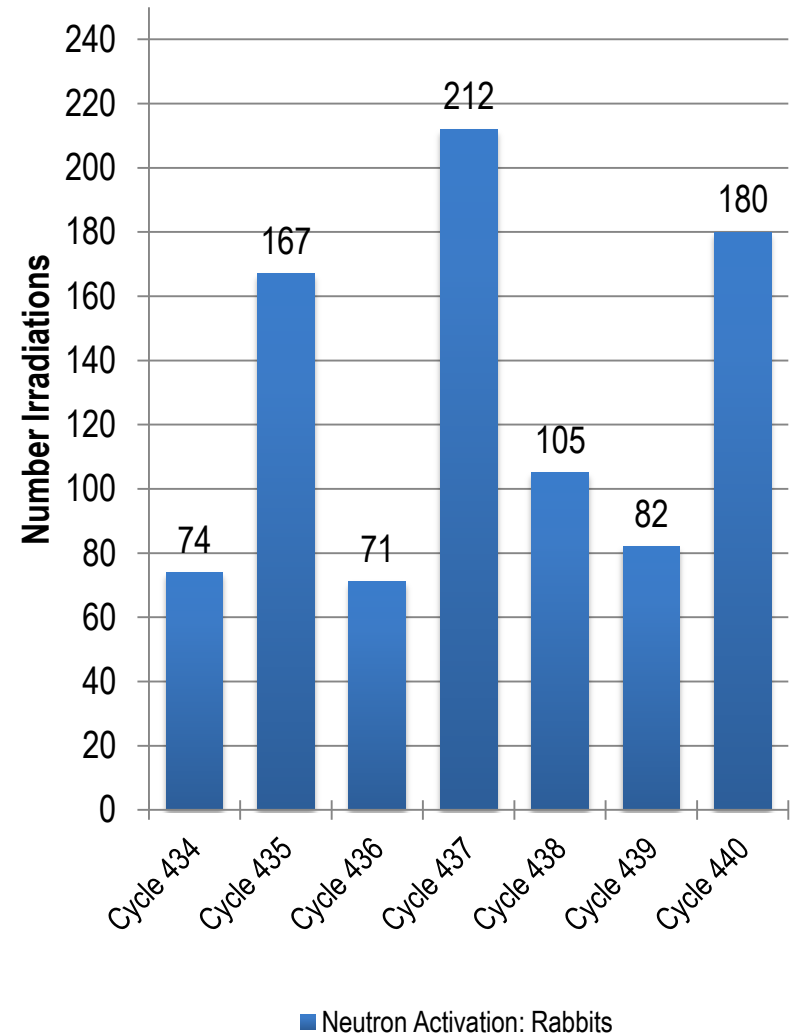
- None this cycle



Significant number of NAA irradiations during cycle 440B

NAA irradiations during Cycle 440B include

- Irradiation of carbon nanotubes and graphene for research with Virginia Tech in conjunction with CNMS
- IAEA Pre-Inspection-Check (PIC) samples
- HFIR pool filter sediment
- Yb-169 for Y-12
- Ultra Pure diamonds for UT research
- Counting of flux monitor wires for Pu-238 program immediately following Cycle 440B shutdown
- DU metal sample for LLNL research focused on short-lived fission and activation products. This was a highly-anticipated irradiation that is key to the LLNL research program.
- Cadmium-shielded diamond irradiation and flux wires for the development of a novel Large Hadron Collider radiation detector
- Various flux monitors



Environmental Management Program Office

- ORNL North-West Quad Soils and Slabs D&D and Remediation
 - Completed demolition of the 2013 slab with demolition currently underway at the 2016 slab
 - Completed site restoration at 2009, 2010, 2018, and 2013
 - Waste shipments to date total 337 loads to EMWMF and 91 loads to the Y12 landfill



- Isotopes Area Legacy Material Removal

- Performed ISOCS shot of two drums of waste lead to verify final disposal locations
- Prepared intermodal container with palletized lead for shipment



Environmental Management Program Office

- 4500 Area Gaseous Stabilization Project
 - Completed temporary power supply installation for 4556 Filter Pit Clean Out
 - Completed utility isolations to 4556 Filter Pit
 - Collected samples from 4556 filter housings
 - Awarded 4556 Filter Pit Clean Out task order
 - Installed new cell ventilation HEPA skid and associated ductwork in 4507
 - Reconfiguration contractor mobilized
 - Completed vendor testing of HEPA filter housings for 4501 and 4500N with delivery planned for 5-7



- Beta 3 (9204-3) Project at Y-12
 - Project Completion Report completed, DOE comments incorporated, and D0 document transmitted to the regulators
 - Six waste containers shipped from ORNL to NNSS with two containers remaining at ORNL for offsite disposal

Environmental Management Program Office

- Integration Support

- EM Contractor SEC completed demolition of the last 2 of the 34 Miscellaneous Facilities (Buildings 3503 & 3508)
- EM Contractor SEC completed demolition of Cellbanks 1 and 2 at 3026C
- EM Contractor UCOR completed remediation of Tank W1A
- UT-B completed the isolation of the building steam line, sampling of perchlorates and gamma imaging of unknown capsules in AHA glove boxes in support of the 3038 project
- UT-B completed the steam line relocation necessary to isolate 3038

