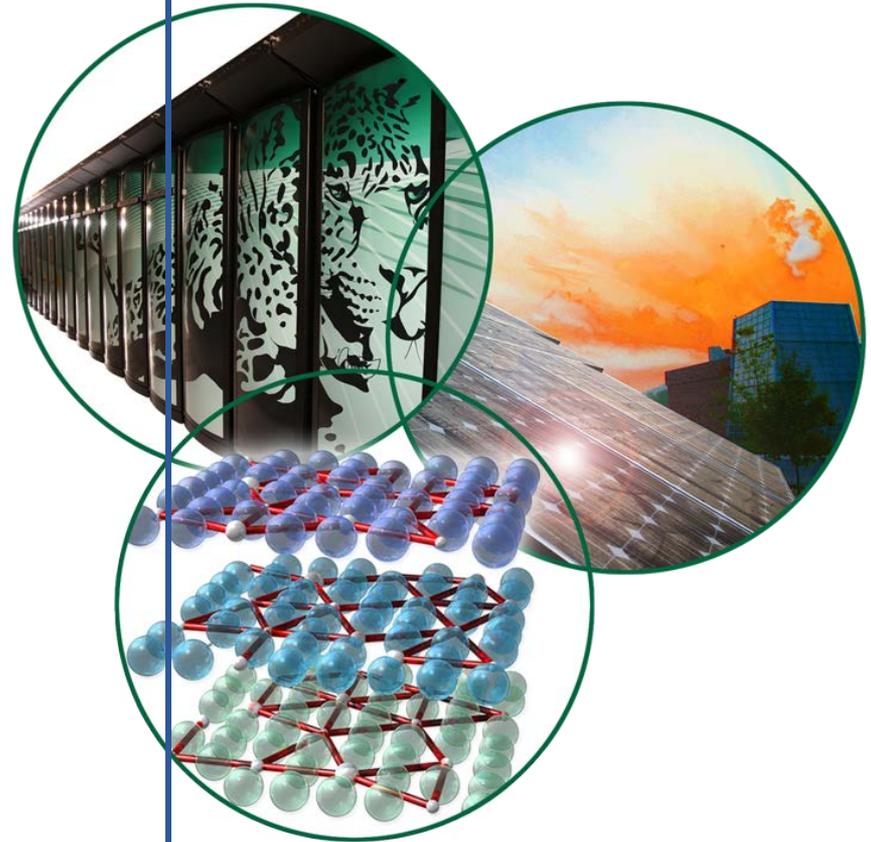


# NSED Monthly Report

July 2012

Nuclear Science & Engineering  
Directorate



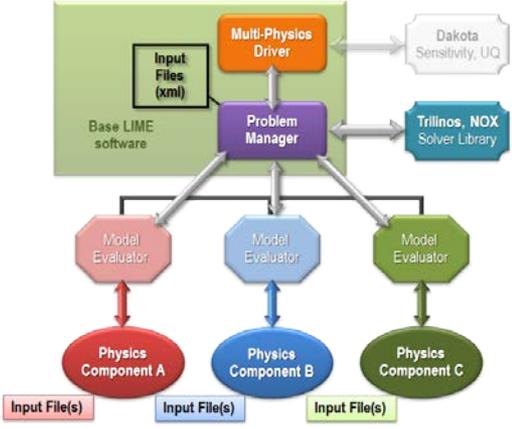
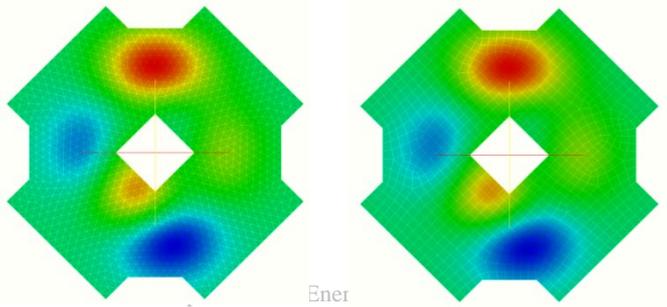
# Public release of CASL infra-structure software

Three key components of the VERA (Virtual Environment for Reactor Applications) infrastructure have been released and made publicly-available.

- DOE-reportable L3 milestone (VRI.VERA.P5.05, 7/11/2012)

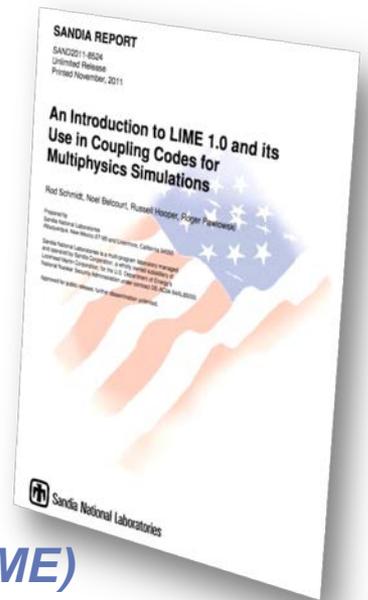
## DataTransferKit

- DataTransferKit (DTK) is being developed to implement the rendezvous algorithm and the associated parallel topology maps for massively parallel solution transfer problems.
- Available at: <http://cnerg.github.com/DataTransferKit/>



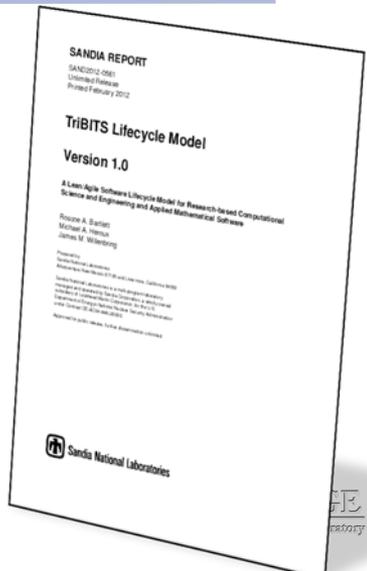
## Lightweight Integrating Multiphysics Environment (LIME)

- High-level software & interface reqs for coupled physics sim.
- Available at: <http://sourceforge.net/projects/lime1>

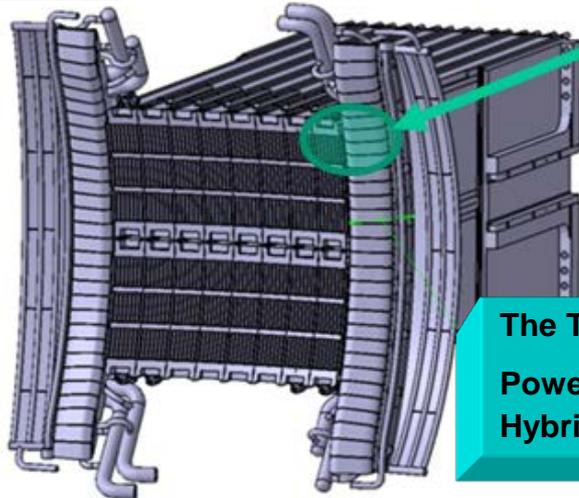


## TriBITS

- The Tribal Build, Integrate, and Test System is built on the open-source Kitware CMake, CTest, CDash tools and provides a solution for very large scale projects, especially meta-projects resulting from the integration of many different (but interrelated) projects.
- Available at: <http://code.google.com/p/tribits/>



## Static and Dynamic Electric Field Evaluations near RF-Antennas via Stark-Effect Optical Spectroscopy

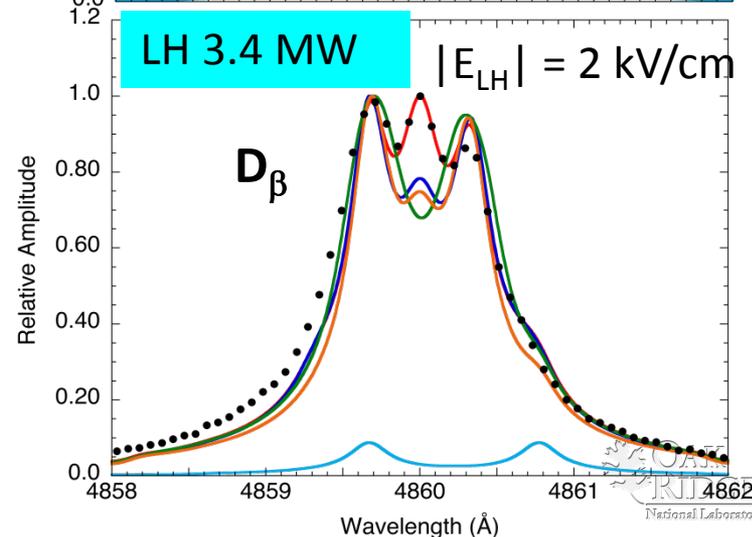
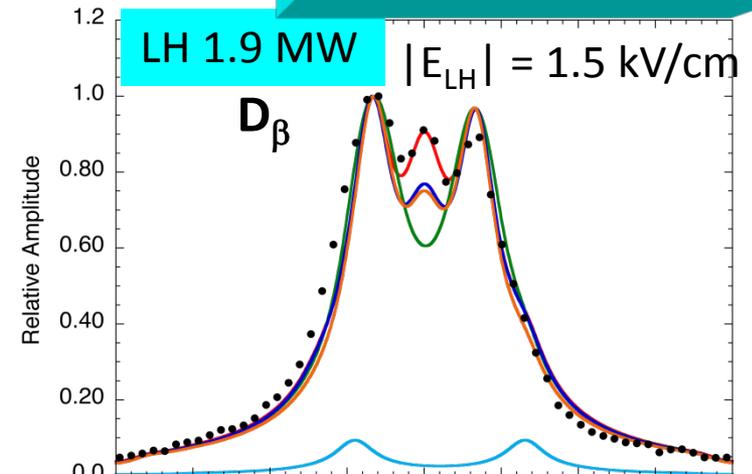


The measurement "footprint" on 3.7 GHz LH Wave Launcher "C3"



The Tore Supra C3 High-Power, Long-Pulse Lower Hybrid Wave-Launcher

Deuterium  $D_{\beta}$  line profiles from TS Shot 47915

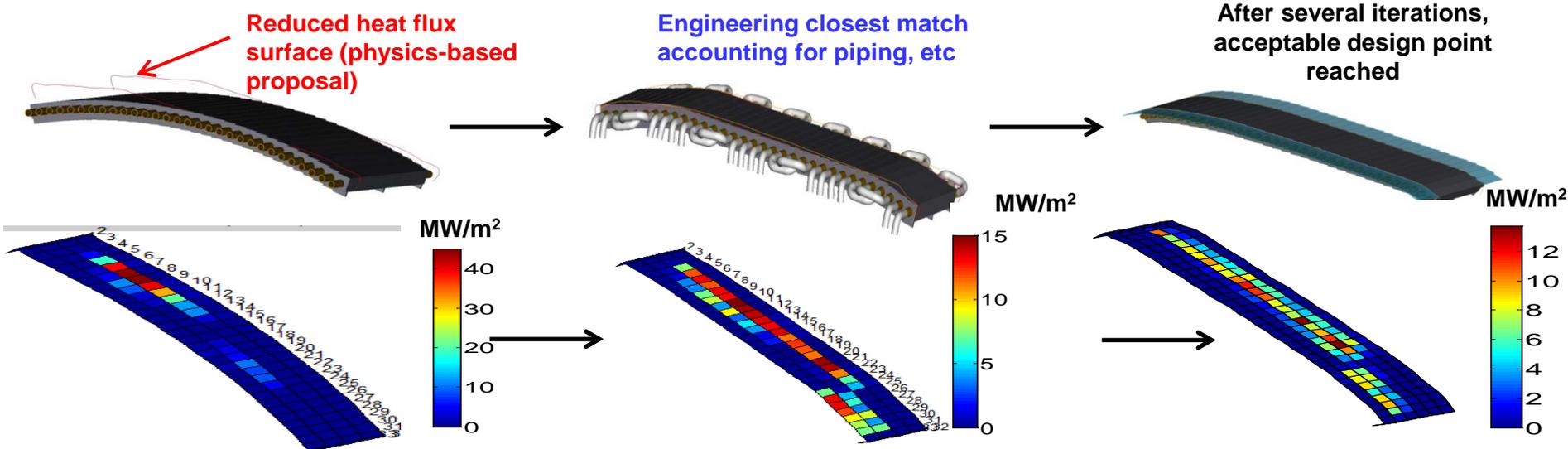
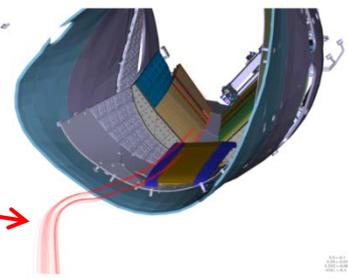


- First non-intrusive measurement of microwave-range, electric fields in a fusion plasma
- Solid lines represent models for a dynamic electric field in the **radial**, **poloidal**, and **toroidal** ( $E_{LH} // B_T$ ) directions.
- **Light blue** is parasitic emission from inner edge plasma (included in above models).
- Spectral profile modeling at ORNL/Fusion Energy; LH near-field modeling, including effects from plasma and launcher structures at CEA/IRFM (France)
- Direction ( $\sim$ radial) and magnitude ( $\sim$ 2kV/cm) of  $E_{LH}$  consistent with LH wave model prediction



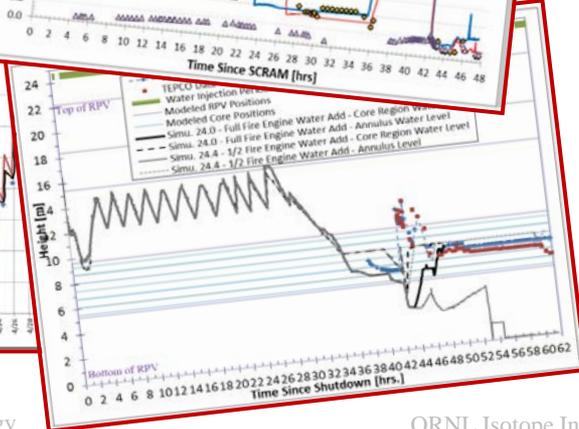
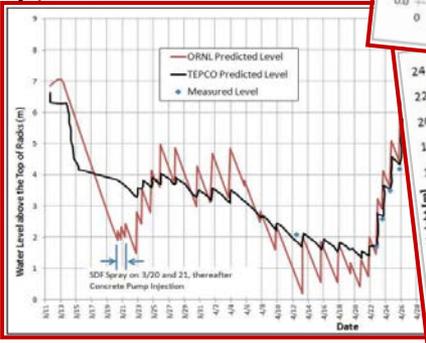
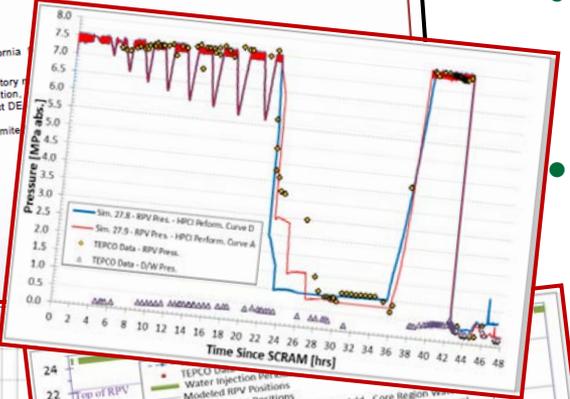
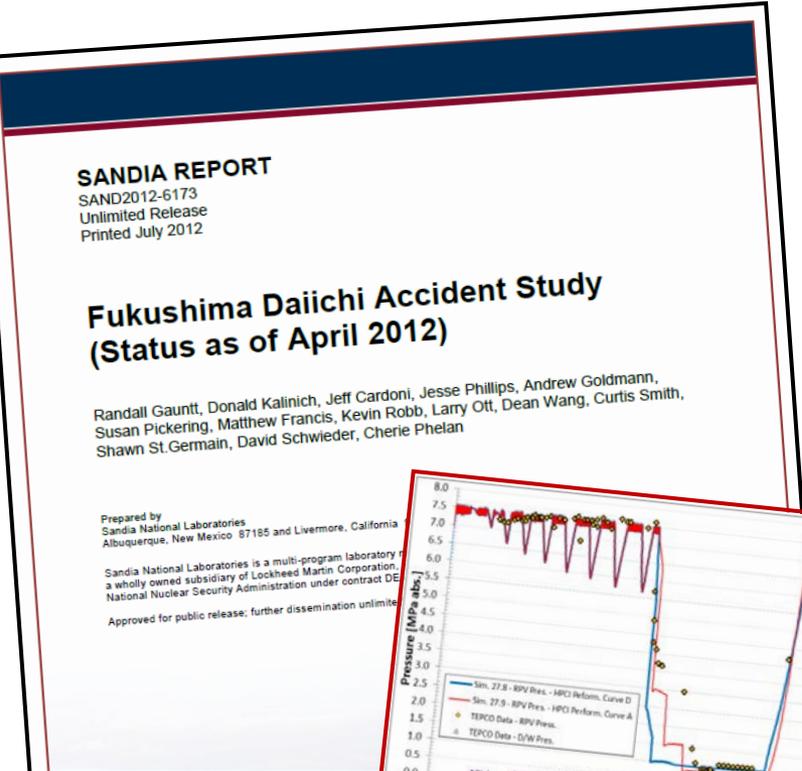
# Coupled physics and engineering design process used to determine scraper shape and position

- Scraper element must satisfy both engineering and plasma physics requirements
  - Engineering: Constraints set by geometric interferences, minimum piping bend radius, CFC monoblock shape, ...
  - Plasma physics: Incident angle minimized to reduce heat load ( $Q_{||} \sim 75\text{MW/m}^2$ ), neutral particle fueling considerations, protection of main targets, ...
- Strongly coupled design process with rapid interfacing
  - Physics codes directly read in and output CAD files
  - Fieldlines and heat flux trajectories directly loaded into CAD to aid positioning
  - Engineering constraints included in physics optimization
  - **Avoids 'perfect' physics solution that is not buildable or prohibitively expensive!**
- Scraper geometry is compromise between construction/engineering requirements and heat flux requirements



# Multi-lab report on Fukushima Dai-ichi accident reconstruction efforts published by SNL

- ORNL decades of experience in BWR severe accident progression and modeling was leveraged in study.
- ORNL investigated Unit 3 accident progression utilizing plant-specific MELCOR model.
- ORNL predicted the accident progression for the Unit 4 spent fuel pool using TRACE, an NRC thermal-hydraulics code.
- Currently working with ANL to examine the extent of ex-vessel core/concrete interaction within the Unit 1 containment using MELTSPREAD and CORQUENCH models.



Sponsored by: DOE, Office of Nuclear Energy and Nuclear Regulatory Commission

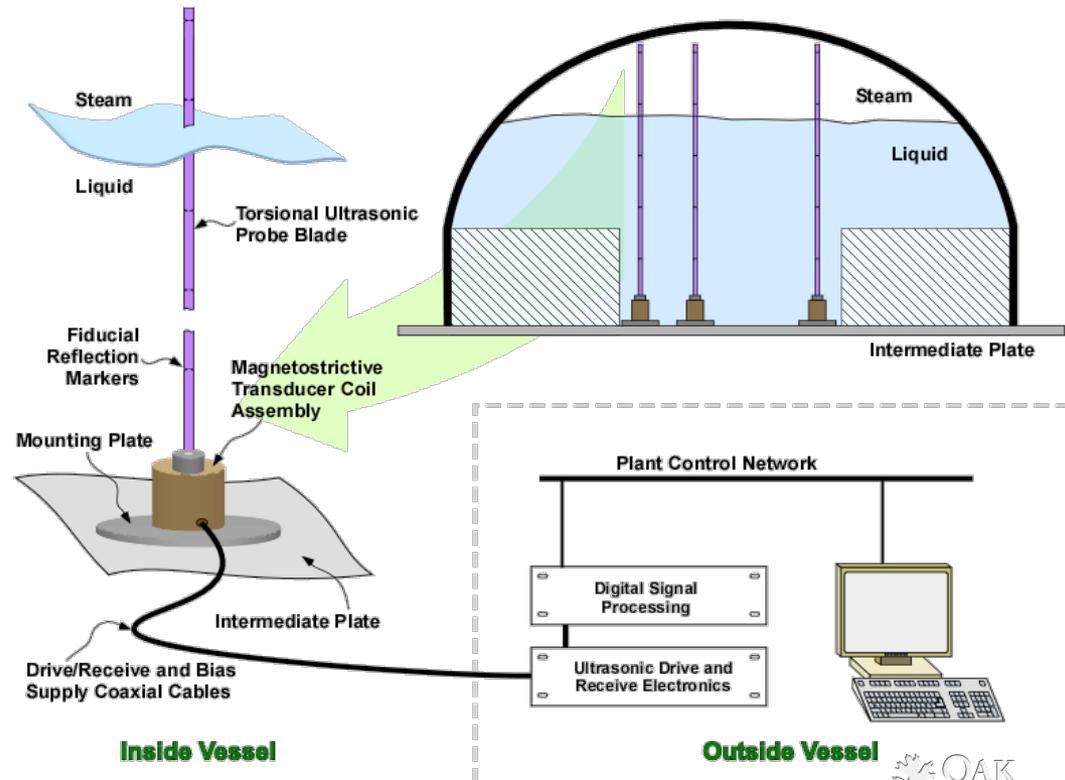
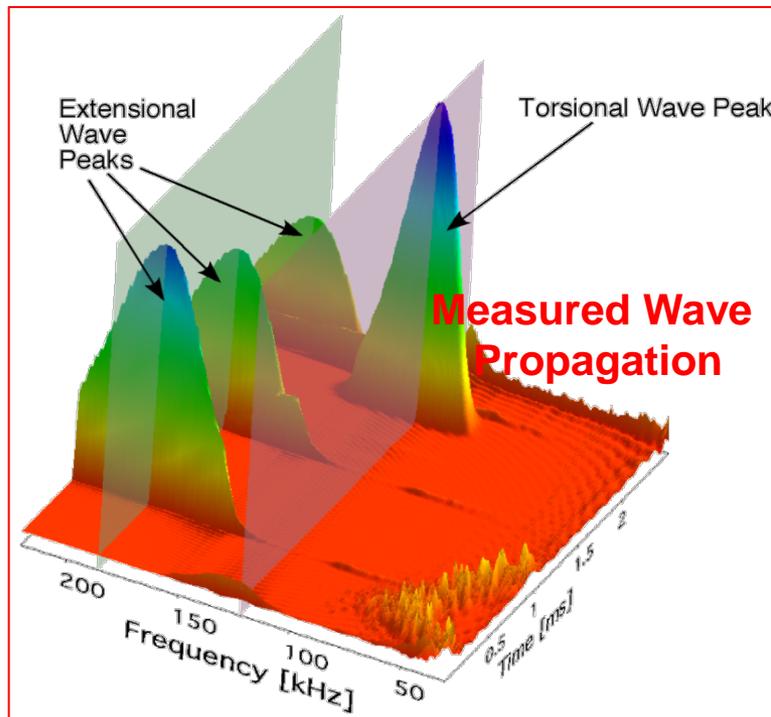
Joint Project performed by:



# U.S. Patent 8,218,396 granted for ultrasonic waveguide-based in-vessel level measurement

- Using only electrical penetrations of vessel, technique provides continuous map of fluid temperature and density along waveguide.
  - Torsional wave velocity varies directly with fluid density.
  - Extensional wave velocity varies with temperature.

## Mechanical Configuration



# DOE FES Materials Solicitation

*A materials solicitation with focus on structural materials, blanket first walls, and divertor plasma facing components was issued on October 17, 2011. Of the 79 full proposals submitted, 8 were selected to be funded. Fully half of those (4 of 8) were awarded to ORNL.*

***Steve Zinkle is Chief Scientist of the Nuclear Science and Engineering Directorate. His proposal on Structural Materials of Potentially Unique Irradiation Resistance was one of the proposals chosen from ORNL***



*The three others ORNL proposals were all from the Physical Sciences Directorate and were:*

**Silicon Carbide Joining Technology for Fusion Energy Applications**  
**PI: Yutai Katoh (ORNL) and Henager (PNNL)**



**Development of High-Cr ODS Alloys with Zr Additions for Fusion Reactor Applications**  
**PI: Hoelzer**



**Friction Stir Welding of ODS Steels and Advanced Ferritic Structural Steels** **PI: Zhili Feng**



# DOE NE - Nuclear energy innovation investments solicitations

Solicitations Awarded

DOE has announced a round of new nuclear energy innovation investments, and ORNL has received three of the 16 awards.

Amount Awarded	Project Aims
\$849,000	To develop novel high-temperature, high-strength steels using computational modeling
\$940,000	To develop a transformative materials system that will improve upon the performance of electrical insulating materials
\$800,000	To decrease the costs and increase the efficiency of both light water reactors and advanced reactors through the use of SiC-SiC composite

***"The awards will help train and educate our future nuclear energy scientists and engineers, while advancing the technological innovations we need to make sure America's nuclear industry stays competitive in the 21st century."***

**Energy Secretary Steven Chu**

# New leadership for the pellet ELM pacing WG

Announcement

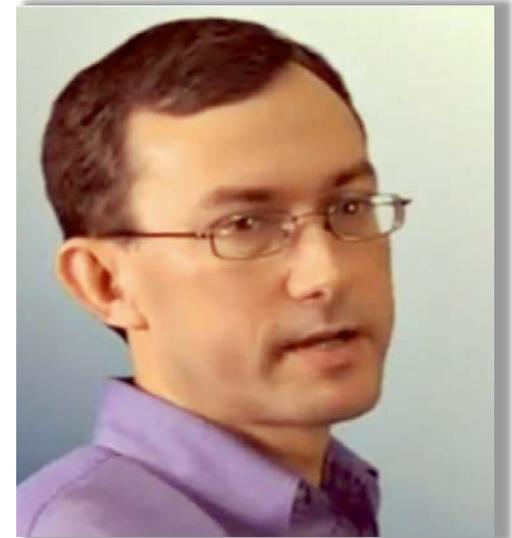


Larry Baylor has been named the leader of the pellet ELM pacing working group in the International Tokamak Physics Activity (ITPA) Pedestal Edge Plasma group. This position reports on the international group's activities at each ITPA meeting and organizes joint experiments on different machines around the world throughout the year.

# High level visits and tours

## Visits and Tours

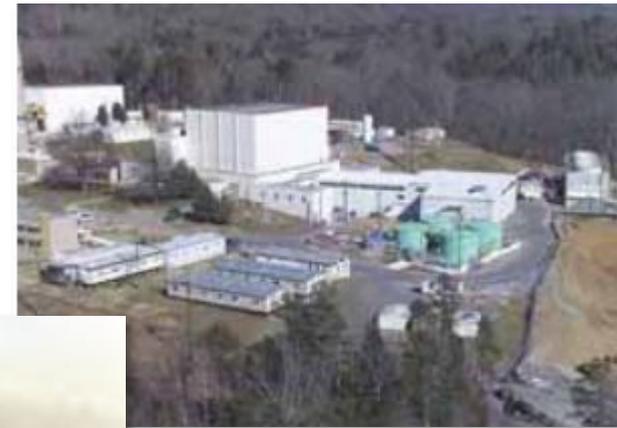
**Everett Redmond**, Director for Nonproliferation and Fuel Cycle Policy, visited ORNL on July 26 to meet with Jeff Binder and other senior NSED staff and visited key nuclear facilities. Dr. Redmond also met with Thom Mason to discuss national policy issues related to nuclear energy.



# FBI Tours HFIR

**A delegation from the Federal Bureau of Investigation visited Oak Ridge on July 11, 2012. While they were here they toured various facilities at Y-12 Security Complex, East Tennessee Technology Park and here at Oak Ridge National Laboratory.**

**The group toured Spallation Neutron Source and the High Flux Isotope Reactor. After their tours they lunched at the ORNL**



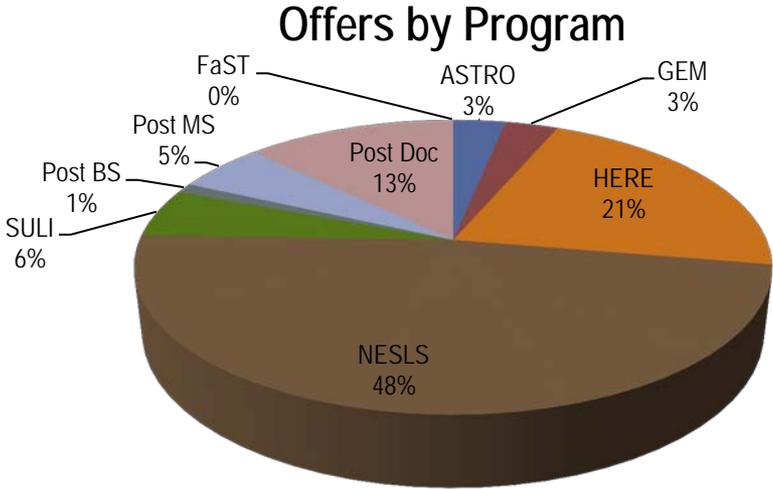
**HFIR**



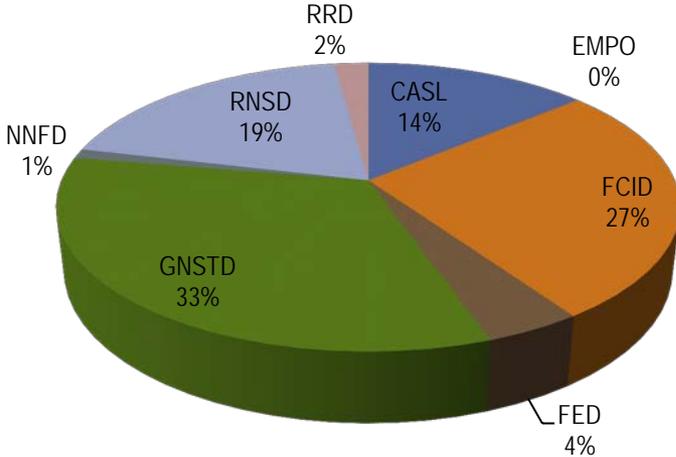
**SNS**

# Educational Outreach Committee summer interns

Student Program	Applications	Offers as of 5/24/12
ASTRO	69	3
GEM	24	3
HERE (UG+Grad)	524	38
NESLS	269	45
SULI	300	5



Offers by Organization



# NSED Education Outreach Committee - intern activities

## Tours:

- ~120 Students attended
- SNS, Safeguards Lab, CNMS, Graphite Reactor, Stable Isotopes, NTRC, HFIR/REDC, CASL
- Registration via SharePoint site
- Twice as many tours as last year



## Seminars:

- Predrag Krstic, Tuning Nuclear Fusion at the Nanoscale
- Vincent Jodoin, Post-Detonation Nuclear Forensics
- Cathy Romano - Nondestructive Spent Fuel Analysis

## Nonproliferation Seminars:

- Adam Williams, SNL, “Gulf Nuclear Energy Infrastructure Institute (GNEII) Safeguards and Physical Protection Curriculum”
- Hal Udem, PNNL “Tags and Seals for Safeguards”
- Mark Schanfein, INL, “Unattended Monitoring Systems”
- Karen Miller, LANL, “Technology Development for Safeguards Applications”
- Michael Whitaker, ORNL, “Enrichment Plant Safeguards”

# NSED Education Outreach Committee activities

- Attended recruitment event at the INMM Conference (Dawn Eipeldauer – GNSTD)
- Supported Nuclear Science Teachers workshop (Denise Lee – FCID)
- Provided tour of REDC to Siemen's STARS Academy & Appalachian Regional Commission Programs (Dean Campbell - NNFD)
- Provided a presentation on advanced reactor issues to middle and high school teachers as part of ORISE Workshop – “Educator Focus Group On Science Curriculum The Harnessed Atom Middle School Edition” (Jesse Gehin – RNSD)



# Radioisotope production & irradiated materials examination

## Isotopes & Irradiated Materials

- Completed two Hydroxide Precipitation Runs on Cm-244
- Cm-244 material will be stored in preparation for future HFIR targets

Heavy Element Campaign C-75



- Receipt and Storage of LANL Cm-244 Material - Ongoing

Curium Receipt



- Processing of Mk42 AmCm Containers – a total of 14 capsules have been cut open and dissolved

Americium-Curium Processing



- Cf source fabrication is ongoing

Cf-252 Source Fab



- Received and processed shipment of HFIR Se75 target rabbits

Selenium Processing



- Operations are ongoing; next campaign scheduled for August 6th

Actinium Production



- Inserted 6 capsules into HFIR the week of July 23rd
- Completed assembly of Np/Al pellet and was dissolved successfully
- Received Np pellet for method development studies for PIE dissolution.
- Alpha plug has been completed next will be installation
- Received new fiber optic cables and they are being tested

Pu-238



- Performed welding of pre-test tensile specimens (KAPL)
- Completed troubleshooting and installing the Hardness Test Equipment into 3025E Cell 2.
- Hardness Testing of disc compact tension specimens
- Received, catalogued and examined HFIR target rabbits

Irradiated Materials Examination



# Enriched stable isotope fabrication and shipping

Ten shipments of 19 enriched stable isotopes were made in July

- 133 shipments of 323 enriched stable isotopes have been made in FY12 to date

Thirty-three custom technical services were completed in July

- 123 technical services have been completed in FY12 to date
- Included among these were a cast, formed and machined Mg-25 disc for neutron cross section measurements and sputter-coated gold layers on 28 samples.



**Mg-25 metal produced by reduction/distillation of MgO**

**Mg-25 disc, 3.6 cm diameter x 1.2 cm, containing 21.2 grams (\$359K)**



# GNSTD highlights and activities



GNSTD

The countries of Malta and Lithuania recently received hands-on maintenance training for the Radiation Portal Monitors (RPMs) provided to them by the NA-256 Second Line of Defense program. With this tool, our partner countries will be able to better operate and maintain their radiation detection systems.

Completed Transfer of Custody for \$40K of materials to be used by the Russian Ministry of Defense (MOD) in support of the Personnel Reliability Program.

ORNL hosted students and faculty from the University of Missouri Nuclear Forensics Summer School Class, the goal of which was to provide students with exposure to DOE laboratory facilities and expertise with respect to nuclear forensics. Feedback from the University of Missouri faculty and from DHS was extremely positive.



**Krystee Conaway and Terry Donaldson instructed at a DOE NA-24 International Nonproliferation Export Control Program workshop in Amman, Jordan on July 9–10, 2012. The workshop was attended by about 30 government officials of Jordan, and was funded by the Department of State's Export Control and Related Border Security program.**

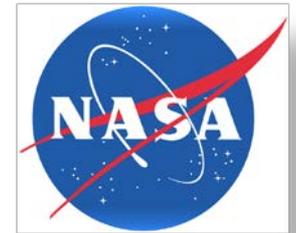
**Kim Gilligan participated in a joint Additional Protocol (AP) workshop with the Vietnam Agency for Radiation and Nuclear Safety, the Japan Atomic Energy Agency, and the International Atomic Energy Agency. Gilligan introduced AP-relevant software and ran an exercise for the participants to practice using the software**



# RNSD highlights and activities

RNSD

- The Radiation Transport Group released a beta version of the ADVANTG variance reduction generator to the Radiation Safety Information Computational Center for selected release and testing by external sponsors and collaborators.
  - ADVANTG is an automated hybrid radiation transport capability that uses the Denovo deterministic solver to provide variance reduction information that allows full-field, high-fidelity flux solutions from the MCNP Monte Carlo code.
- RNSD staff supported target development and safety analysis review for the six NpO<sub>2</sub> pellets loaded into HFIR Cycle 443.
  - This is the first step in starting Pu-238 production for NASA in HFIR.
- A recent HPCwire article ranked RNSD's Denovo code as the No. 2 code for providing improved computational speed with GPUs with nearly a factor of 3.5 in improved run times.
  - The article compared the performance of 11 science applications with graphical processing units (GPUs) and "standard" CPUs
- John Wagner presented RNSD work on burnup credit to an ACRS subcommittee meeting held July 10.
  - The 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.



- Jess Gehin chaired an international technical review of the Chinese Academy of Sciences (CAS) program for development of salt-cooled flow loops and test reactors. Kevin Robb and Dane Wilson (MSTD) also participated the review held July 11-13 in Shanghai, China.
- T. Jay Harrison hosted a meeting of the Generation IV International Forum Economic Working Group in Washington, DC.
- George Flanagan participated in a Generation IV International Forum working group that is developing design criteria for sodium fast reactors. The meeting was held July 17-18 in Paris, France.
- Bob Grove was an invited participant in the 7<sup>th</sup> ITER Neutronics Meeting held in the UK at the Culham Centre for Fusion Energy (CCFE). He presented a seminar on “Radiation Transport (Neutronics) Methods and Capabilities at ORNL”.



**Participants in the CAS Technical Review**

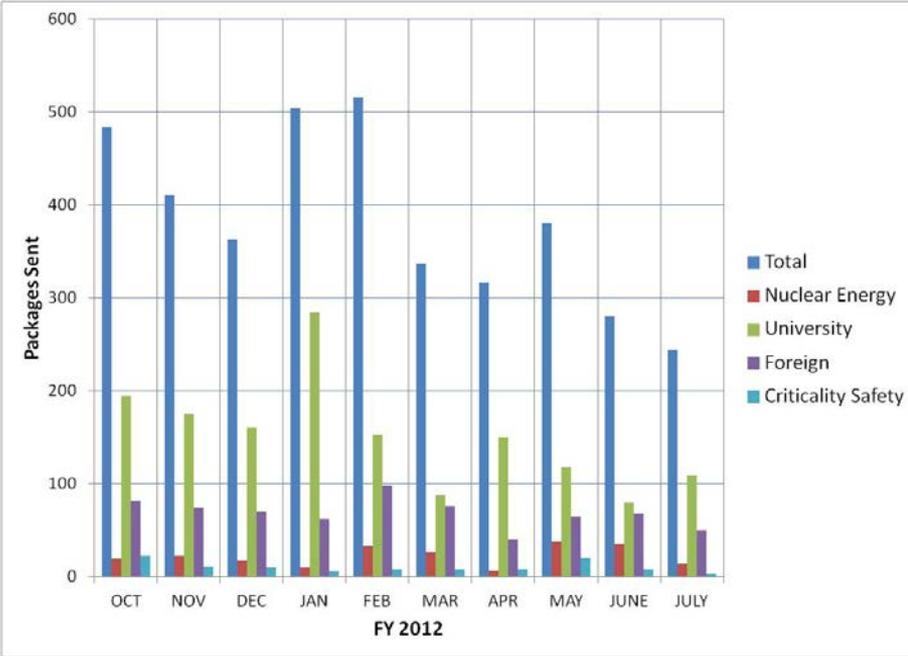
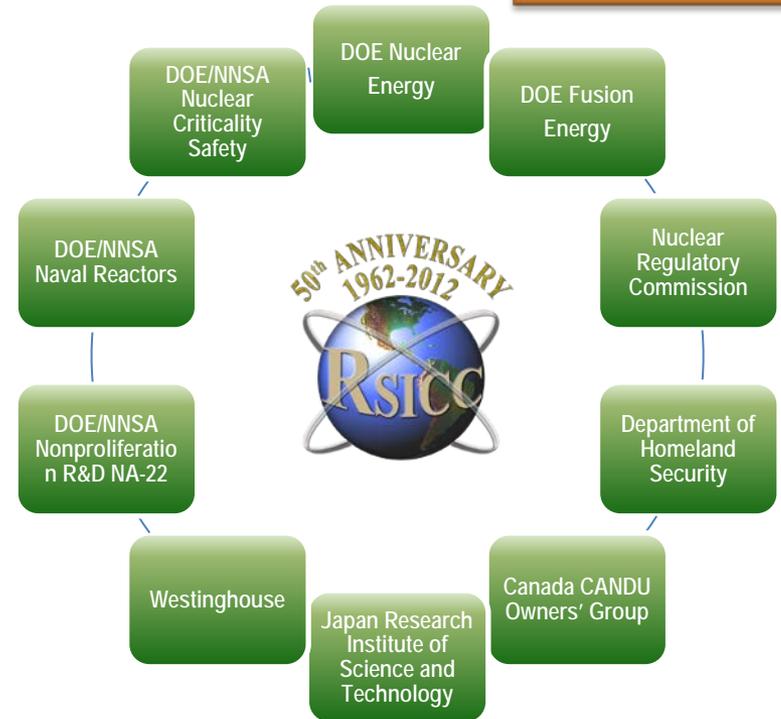
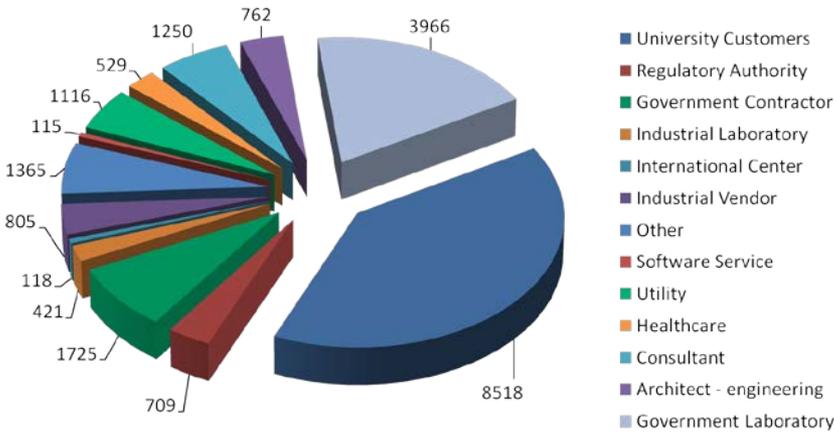


**Participants in the 7<sup>th</sup> ITER Neutronics Meeting,**

# Radiation Safety Information Computational Center (RSICC): Serving the scientific community for 50 years

**RSICC**

RSICC Customer Base



- Software and data packages distributed FY2012: 3,836
- 7 package updates and revisions July 2012

# CASL education summer student workshop

CASL

Creating a new generation of LWR designers, Scientists, and Nuclear Power Professionals

## Workshop Purpose:

- ✧ Orient and integrate undergraduate, and graduate students, and post-docs into the CASL project in an intense two day experience
- ✧ Feature CASL program details in selected Focus Areas – Radiation Transport and VUQ
- ✧ Feature student and post-doc presentations on CASL work in posters and oral format



## Workshop Activities:

- ✧ Presentations by CASL leadership
- ✧ Presentations by CASL FA leaders
- ✧ Featured speakers from DOE and NRC and TVA
- ✧ Tours of Super Computer/Jaguar and VOCC, HFIR nuclear reactor
- ✧ Student Presentations and Awards
- ✧ Student Feedback sessions

## Workshop Highlights:

Organized by Education Program: John Gilligan, Sherry Bailey, Linda Weltman

Workshop held at ORNL during July collocation

- ✧ 25 student/post doc attendees (seven universities)  
many students at ORNL as interns
- ✧ 10 CASL staff attendees
- ✧ 7 Education Program attendees (four universities)
- ✧ VERA Demonstration
- ✧ FA and challenge problem identification exercise by students



**A strategic advisory group containing the following members were focused on the VOCC Collaboration Environment/Paradigm this year:**

- **Mr. Ken Bruner**

**US Pacific Command (USPACOM) Science and Technology Advisor National Security Division, Strategic Advisory Group(SAG)**

- **Tom Ridge**

**Former Secretary of Department of Homeland Security(DHS), and Governor of Pennsylvania**

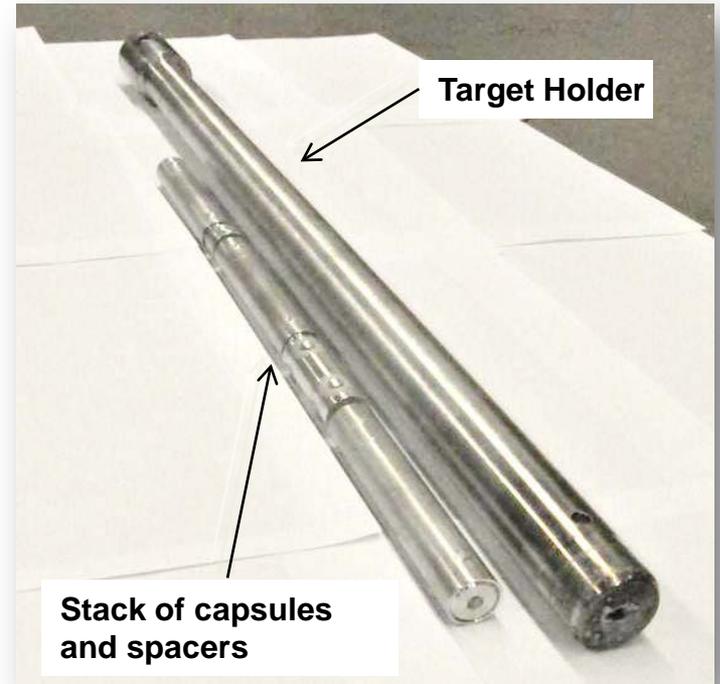
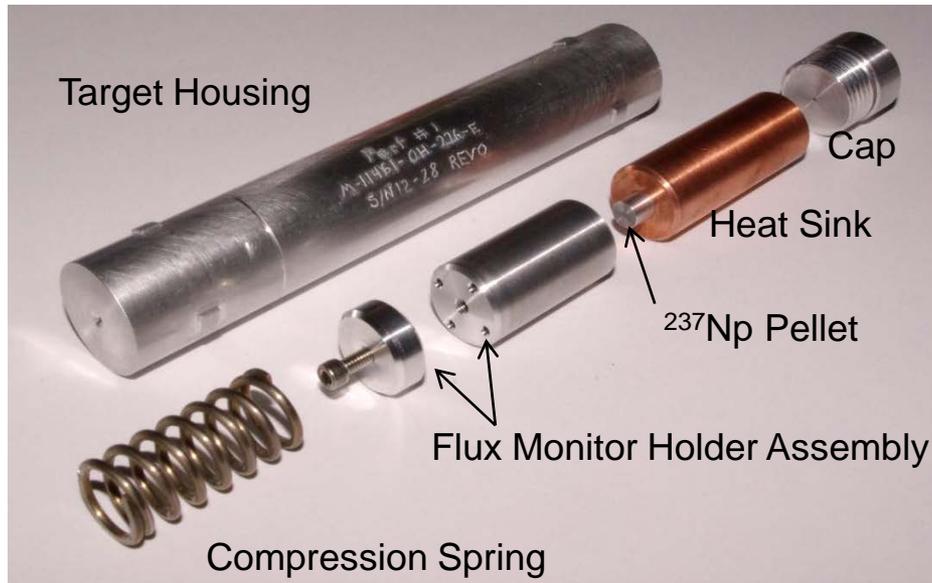
- **Dr. Norm Kahn**

**Director of Science & Technology, Central Intelligence Agency (CIA)**

- **Lisa Gordon Haggerty**

**Leg LLC Chief Executive Officer (CEO), formerly at the U.S. Department of Energy (DOE) where she held positions overseeing several DOE programs including emergency management, operational emergency response and the safety of the country's nuclear weapons program. She has served as a counter-terrorism and security expert to the White House National Security Council, U.S. Department of Energy and the Committee on Energy and Commerce in the U.S. House of Representatives.**

**$^{237}\text{Np}$ : Six  $^{237}\text{Np}$  pellet capsules have been transferred into the HFIR Reactor for Cycle 443 as part of the  $\text{Pu}^{238}$  production capsule development**



**Replacement of conveyor drive chains at Building 7920 benefited many REDC R&D groups**



# NNFD FY2012 cumulative facility metrics

## Hot Cell Availability

## Facility Upgrades and Maintenance Activities

- 95.50 REDC (7920)
- 95.00% REDC (7930)
- 92.00% Irradiated Fuels Examination Laboratory (3525)
- 90.00% Irradiated Material Examination and Testing Laboratory (3025E)

### 7920

- TSR Calibrations and Functional Testing (Cave A and glove box ventilation system)
- Facility glove box change outs – Labs 108/211
- Refurbishment of steam reducing station



- Replacement of conveyor drive chains

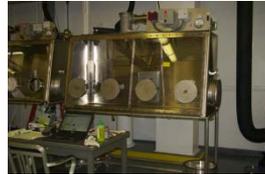


### 7930

- Programmed maintenance operations
- Replacement of E-9 Control System

### 3525

- Completed installation and final testing of new glove box exhaust system

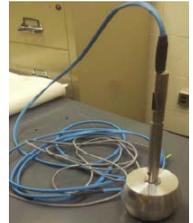


### 3025E

- Repair of broken motor mount for CAA roof fan



- Completed fabrication of new carrier magnet assembly



# The HFIR Cycle 443 continues strong demand for materials and fuels irradiation as well as isotope research

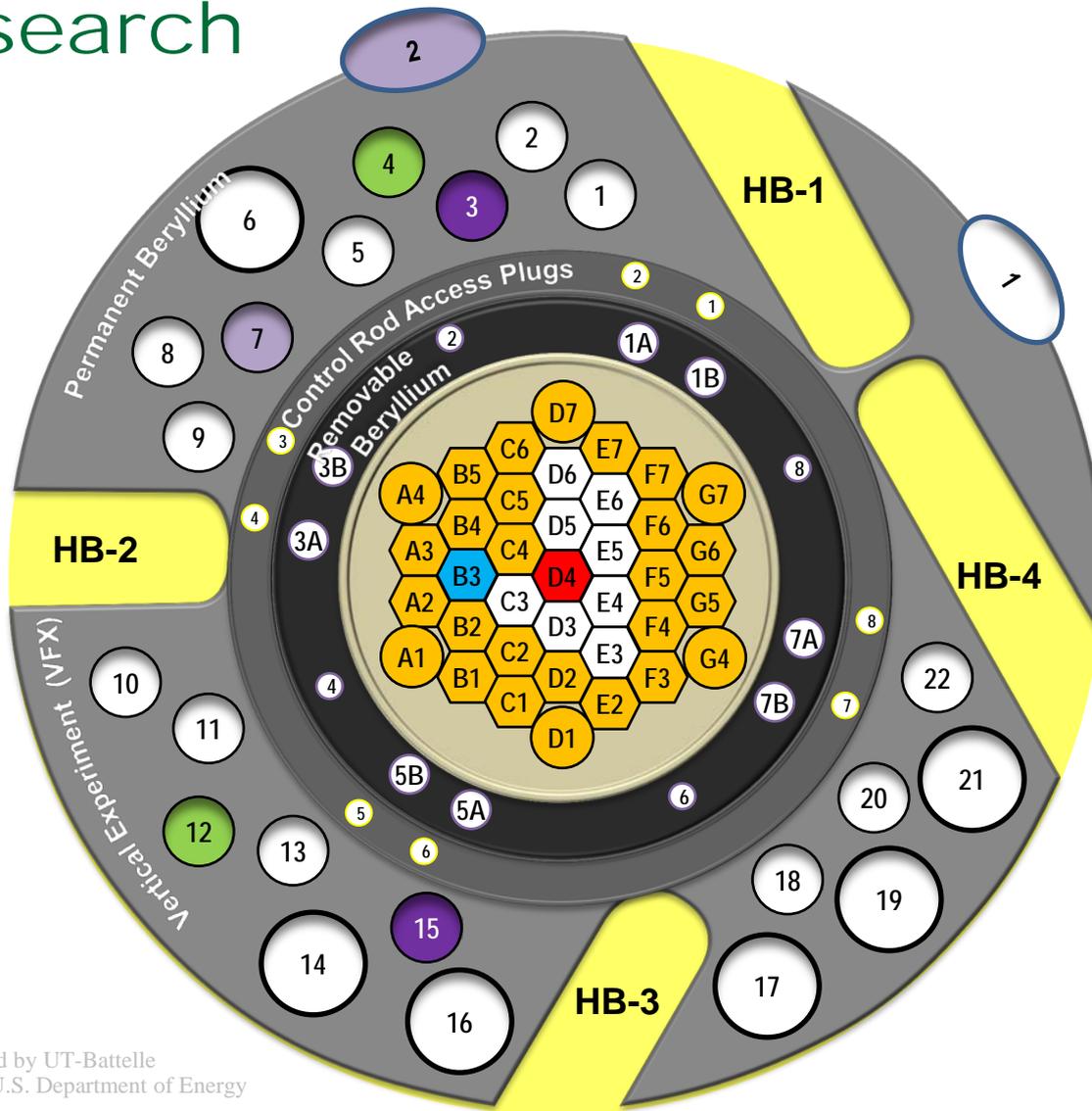
HFIR

July 2012

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

Cycle 442

Cycle 443



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

# The number of HFIR Cycle 443 irradiations rises to a new high - driven by materials and $^{238}\text{Pu}$ research

HFIR

## 113 Materials and Fuels Experiments

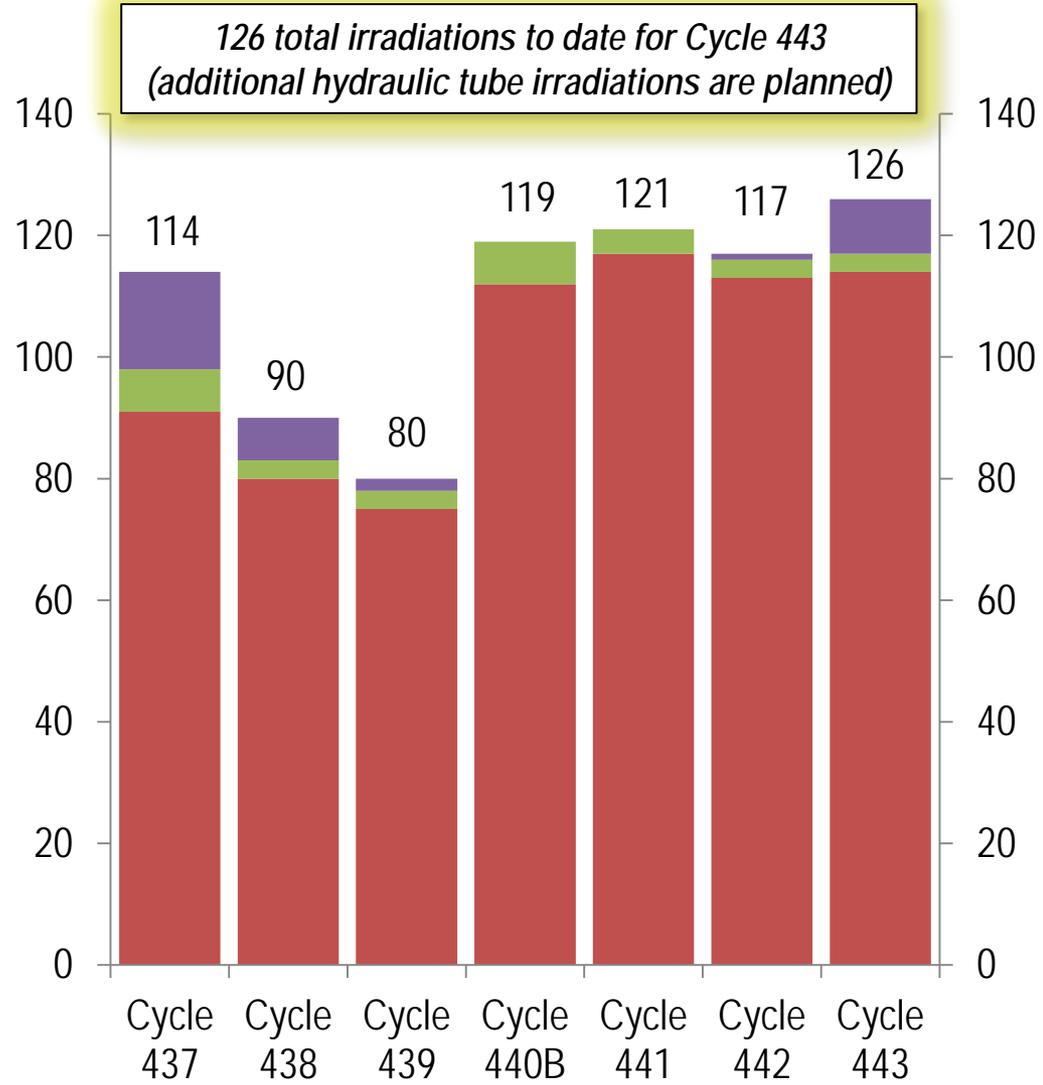
- Silicon Carbide
- V, Mo, & Cu alloys
- Zircaloy
- $\text{UO}_2$  Fuels
- Graphite
- Uranium
- Steels
- UCN Fuels

## 3 Commercial Isotope Production Capsules

- 3 Selenium (Se-75) - production

## Isotopes for Research

- Pneumatic Tube Isotopes research
- Np-237 Capsules for Pu-238 production research



# Significant number of NAA irradiations during the first day of HFIR Cycle 443

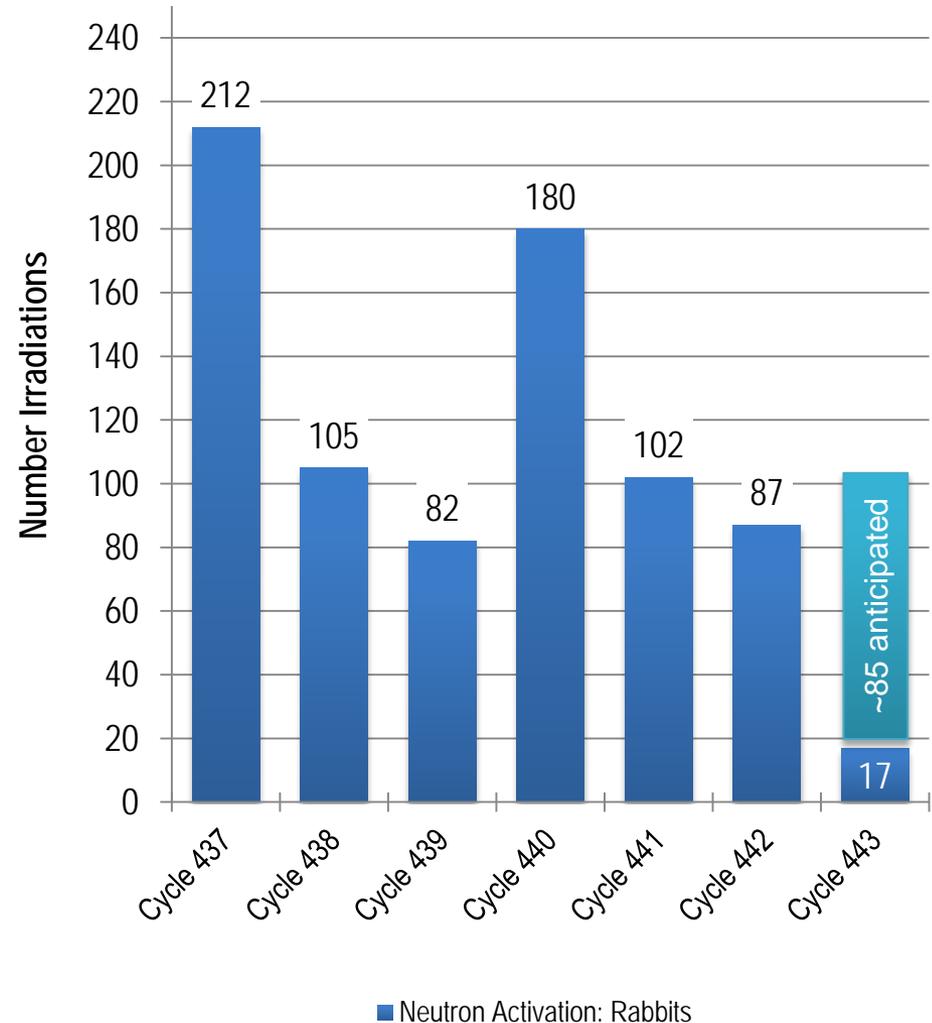
HFIR

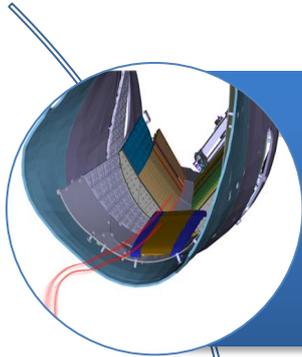
## NAA irradiations during the first day of cycle 443

- Low power irradiations of various flux monitors to validate computer models of HFIR NAA facility. These included both shielded and unshielded HFIR irradiations at 10, 30, 50, 70 and 100 percent power.
- Sodalite samples for material characterization for Environmental sciences research

## NAA irradiations during the first day of cycle 443

- Delayed Neutron Activation Analysis data deconvolution to simultaneously determine U, Pu
- PIC Samples for IAEA





J.H. Harris, J.D. Lore, A. Lumsdaine, and D. McGinnis, along with collaborators from IPP-Garching and IPP-Greifswald, completed a successful design review of a new divertor component for the W7-X stellarator. This component, the 'scraper element', consists of actively-cooled carbon fiber composite monoblocks of the same type qualified for ITER, and is expected to receive steady-state convective heat loads of ~12MW per square meter. (See accompanying ppt slide.)



R. Maingi presented "The steps by which lithium wall coatings lead to ELM avoidance in NSTX" at the 6th US-PRC magnetic fusion workshop in San Diego from July 10-12. The extension of the NSTX experiments to EAST was discussed.



Testing of the high heat-flux test facility is underway with non-irradiated thin W specimens. The photo to the left shows the quartz plate on the top of the chamber, the molybdenum sample holder on the top of the copper cooling rod assembly is enveloped by an end-capped cylindrical quartz tube (right photo) to confine any possible radioactive material released from irradiated specimen. The enclosure has been designed to accommodate the larger samples required for the high heat flux prototype component testing anticipated in the PHENIX program.

- ORNL North-West Quad Soils and Slabs D&D and Remediation
  - Prepared D0 version of Phased Construction Completion Report (PCCR)
  - Submitted PCCR for DOE/EPA/TDEC review



**Overview of Restored 2001/2024/2000 Site**

# EMPO highlights

EMPO

- 4500 Area Gaseous Waste Reconfiguration and Stabilization Project
  - 4556 Filter Pit clean out subcontractor mobilized facilities, equipment, and personnel to ORNL
  - Completed construction of ventilated containment structure over the 4556 Filter Pit
  - Shipped 2.6 yds of 4507 Mixed Waste to ES-Clive for disposal
  - Reconfiguration contractor continued assembly/installation of the electrical panels and associated conduit
  - Continued shop fabrication of Hot Off Gas and Cell Vent Ducting
  - Began installation of HEPA filter housings
  - Received and placed new back-up diesel generator



Placing Generator on Pad at 4505



HEPA Housings in BG-74



Constructing Containment at 4556

- **Enhanced Power Supply to Building 7625/7627**
  - Materials ordered and conduit and cable tray installation commenced
  - T-Rex #1 and #2 disconnected and re-cabling commenced



- **Isotopes Area Legacy Material Removal**
  - Received TDEC comments to D1 Phased Construction Completion Report (PCCR)
  - Shipped remaining waste to Energy Solutions – Clive and Permafix for disposal

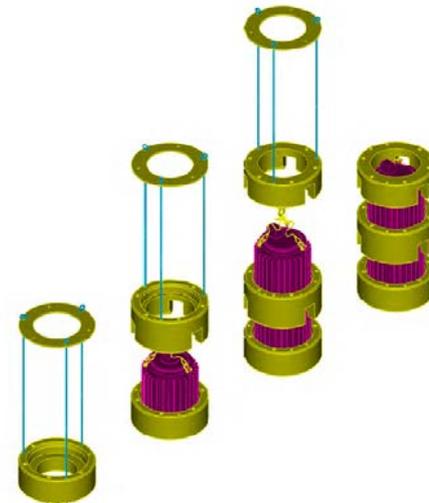


- Integration Support

- UT-B began the fabrication of the SNAP-7C/ Weather Bureau RTG spacers; test fit scheduled for late August/early September for Miscellaneous Facilities Project
- UT-B personnel continued to support NNS in their preparations to receive/ unload RTGs for Miscellaneous Facilities Project.
- EM Contractor Perma-Fix completed the 3026D Management Assessment and began preparations to remove the roof plugs from 3026D Cell A
- EM Contractor Perma-Fix began efforts to demobilize from Building 3038 in anticipation of returning responsibility to UCOR.
- UT-B submitted and EM approved the BCP (\$1.9M) for the 4501 Cell D Cleanout and the Building 2026 Legacy Material Removal.



3026D Hot Cell Roof Prep for Roof Plug Removal



SNAP 7C/ Weather Bureau RTGs in Spacers