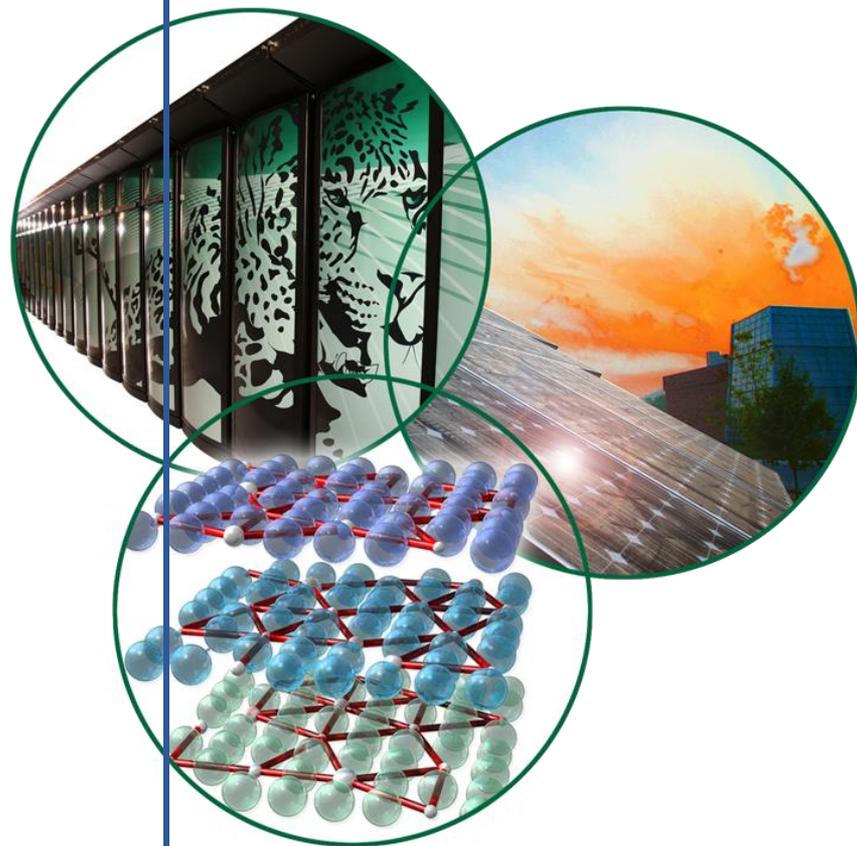


# NSED Monthly Report

## September 2012

### Nuclear Science & Engineering Directorate



# Element 117 confirmed !

**The discovery of element 117 reported in 2010 by Russia-US collaboration has been independently confirmed at GSI Darmstadt (Germany)**

- Discovery of new super heavy elements and nuclei expands the Periodic Table of Elements and Segré Chart of Nuclei
- The observed decay properties of heaviest nuclei point to the existence of theoretically expected Island of Stability.
- The super heavy nucleus  $^{294}117$  has been identified at GSI Darmstadt (Germany) among the products of  $^{249}\text{Bk} + ^{48}\text{Ca}$  reaction, see Figure 1. Ultra-pure  $^{249}\text{Bk}$  target material has been provided by ORNL.
- The decay properties of recorded long decay chain match the four events of  $^{294}117$  observed at JINR Dubna (Russia) by Russia-US collaboration [1,2] during 2010-2012 campaigns with ORNL-made  $^{249}\text{Bk}$  target material see Figure.

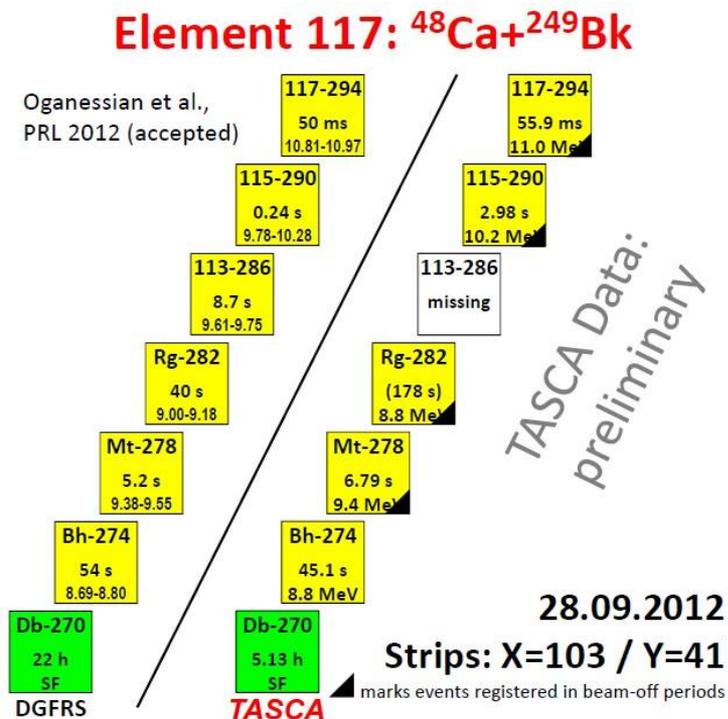
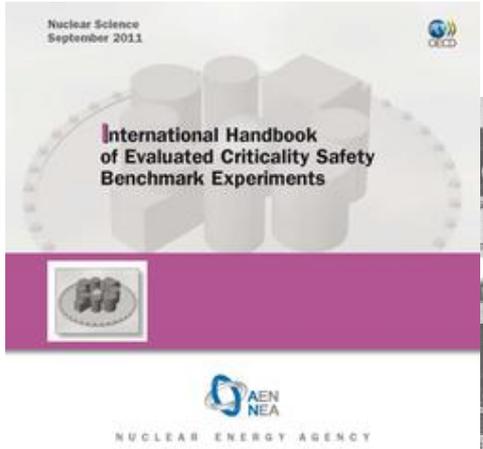


Figure 1. The decay properties of  $^{294}117$  super heavy nucleus synthesized in a fusion-evaporation reaction between  $^{249}\text{Bk}$  target and  $^{48}\text{Ca}$  beam at TASCA spectrometer (GSI Darmstadt) are compared to the average decay characteristic deduced from earlier observation of four  $^{294}117$  events at the DGFRS facility (JINR Dubna) [2]. All three experiments resulting in the synthesis of element 117 isotopes were performed using  $^{249}\text{Bk}$  target material provided by ORNL. The probability that the event observed at TASCA results from random correlations is below  $10^{-10}$ .

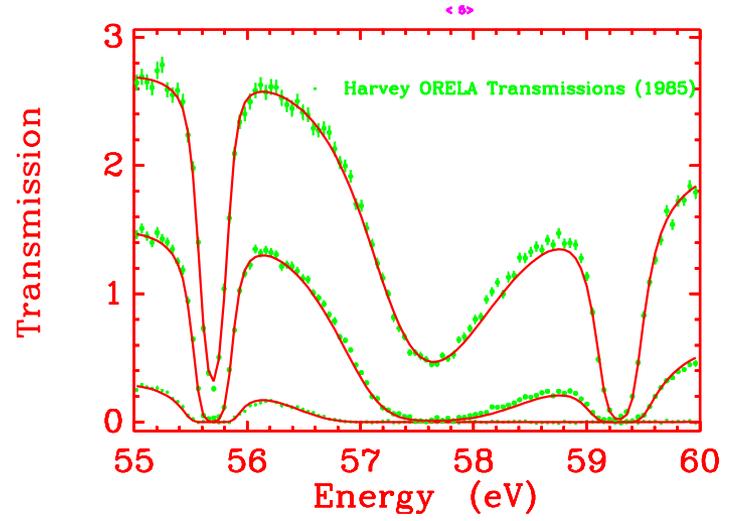
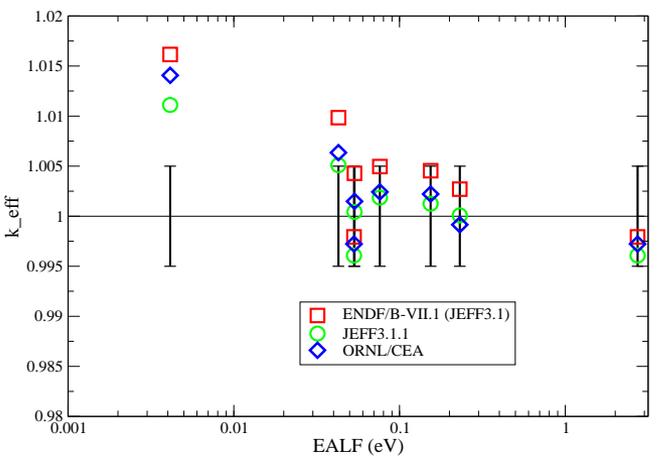
1. Yu. Ts. Oganessian *et al.*, Phys. Rev. Letters, 104, 142502, 2010.
2. Tu. Ts. Oganessian *et al.*, Phys. Rev. Letters, 2012, in press.

Contact: Krzysztof Rykaczewski, 865-576-2636, fpr@ornl.gov  
 Funding sources: DOE Office of Science, Office of Nuclear Physics  
 Resources: High Flux Isotope Reactor, Radiochemical Engineering Development Center, Holifield Radioactive Beam Facility, ORNL,

- Luiz Leal of RNSD led an international effort to complete a new  $^{239}\text{Pu}$  neutron resonance cross-section evaluation to address long-standing benchmark modeling issues for plutonium solution systems.



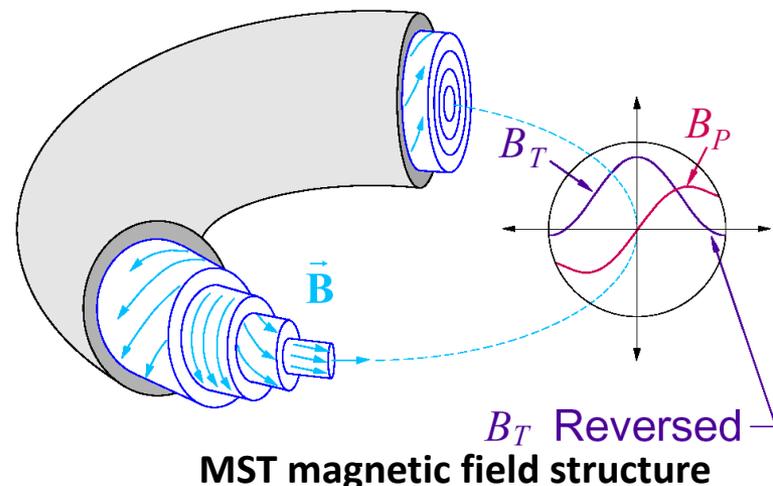
- Leal was invited to work at CEA/Cadarache for two months in FY12 to finalize and test the  $^{239}\text{Pu}$  evaluation
- The evaluation work was jointly sponsored by the DOE/NE Fuel Cycle R&D Program and the NNSA Nuclear Criticality Safety Program—the evaluation completion is a significant milestone accomplishment for both DOE/NE and NNSA.



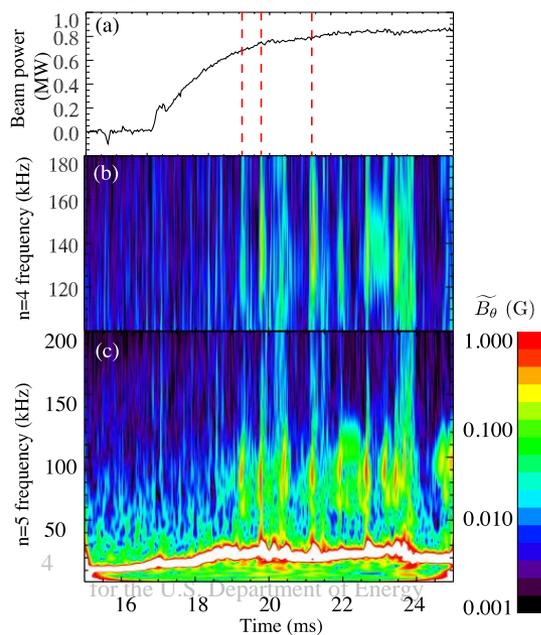
# ORNL theory/simulation codes used to identify neutral beam-driven Alfvén instabilities in MST experiment

*Fast-Particle-Driven Alfvénic Modes in a Reversed Field Pinch*, J. J. Koliner, C. B. Forest, J. S. Sarff, J. K. Anderson, D. Liu, M. D. Nornberg, and J. Waksman, L. Lin, D. L. Brower, and W. X. Ding, D. A. Spong, *Physical Review Letters* **109** (14 September, 2012) 115003.

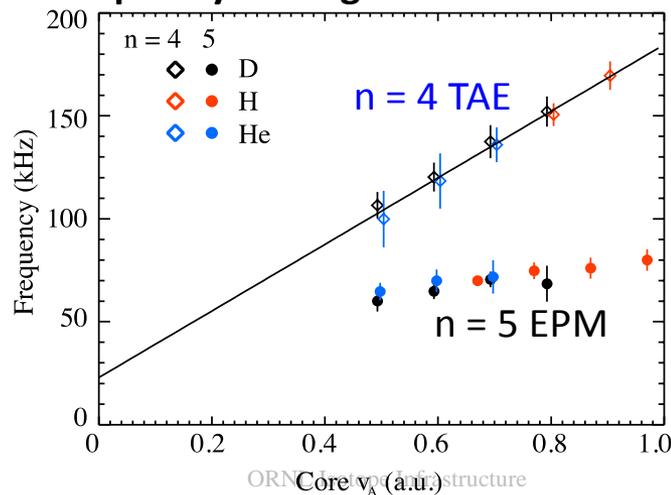
- Recently neutral beam heating has been added to the University of Wisconsin Madison Symmetric Torus (MST) reversed field pinch
- First indication of NBI-driven instabilities in an RFP
- Two modes observed – consistent with predictions from STELLGAP/AE3D
  - Energetic Particle Mode ( $n = 5$ ) – frequency scales with beam velocity
  - Toroidal Alfvén Mode ( $n = 4$ ) – frequency scales with  $v_{\text{Alfvén}}$



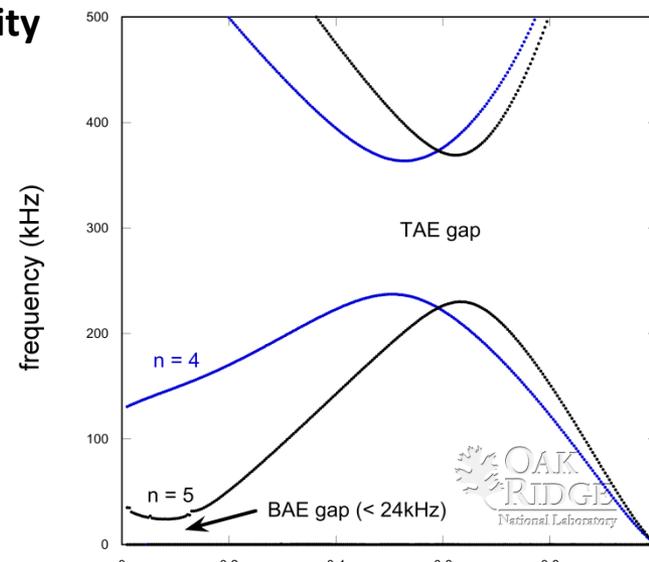
## Expt. spectrum vs. time



## Frequency scaling with Alfvén velocity

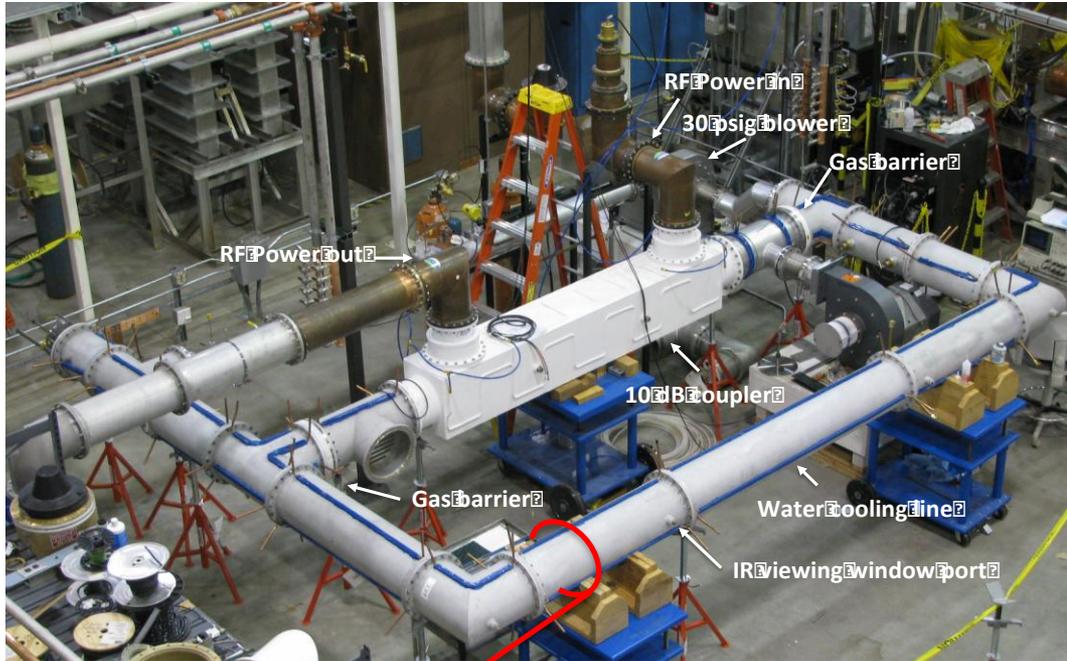


## Alfvén gaps (STELLGAP)

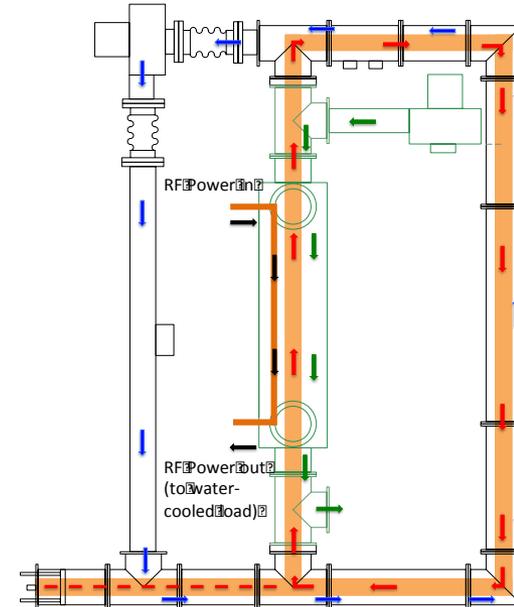


# Tests on a resonant ring configuration have confirmed the feasibility of forced gas cooling of the ITER ion cyclotron transmission lines

## Resonant Ring



## Gas and power flows



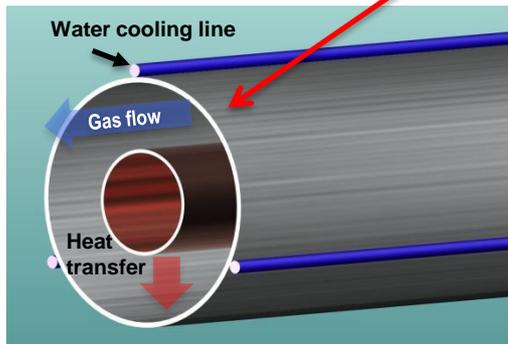
**Black:** rf power from transmitter = 320 kW

**Red:** rf power in ring = 6 MW

**Green:** gas flow through 10 dB coupler

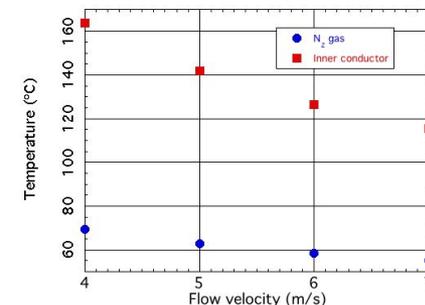
**Blue:** pressurized gas flow through resonant ring and stub

## Cutaway view



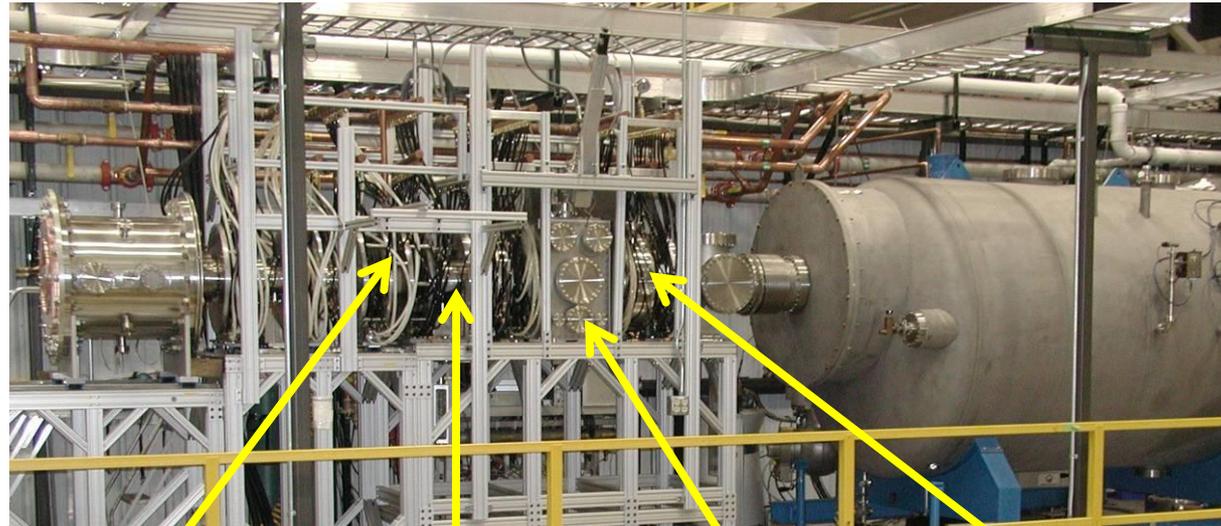
- RF current (up to 650 A) flows in copper inner conductor and aluminum outer conductor, generating heat (up to ~ 1.5 kW/m total)
- In the ITER transmission lines, turbulent gas flow between these conductors at an elevated pressure of 3 atmospheres efficiently transfers heat from inner to outer conductor, where it is removed through water cooling lines attached to the outer conductor
- In the general case, direct water cooling of the inner conductor would be difficult: a water leak occurring in any of the hundreds of joints in the > 1 km long transmission line network would immediately halt operation (water cooled inner conductors will necessarily be employed in a small subset of components).

## Calculated inner conductor temperature vs. gas velocity



# The Physics Integration eXperiment (PhIX) has been assembled

- PhIX integrates a helicon plasma source with microwave electron heating (whistler and electron Bernstein waves) to increase the plasma heat flux at a target
- The PhIX vacuum chamber has been assembled, pumped down, and leak checked
- Minor leaks are being repaired
- Magnet cooling line connections have been completed
- Magnet power supplies are being brought back on-line after new transformer installation

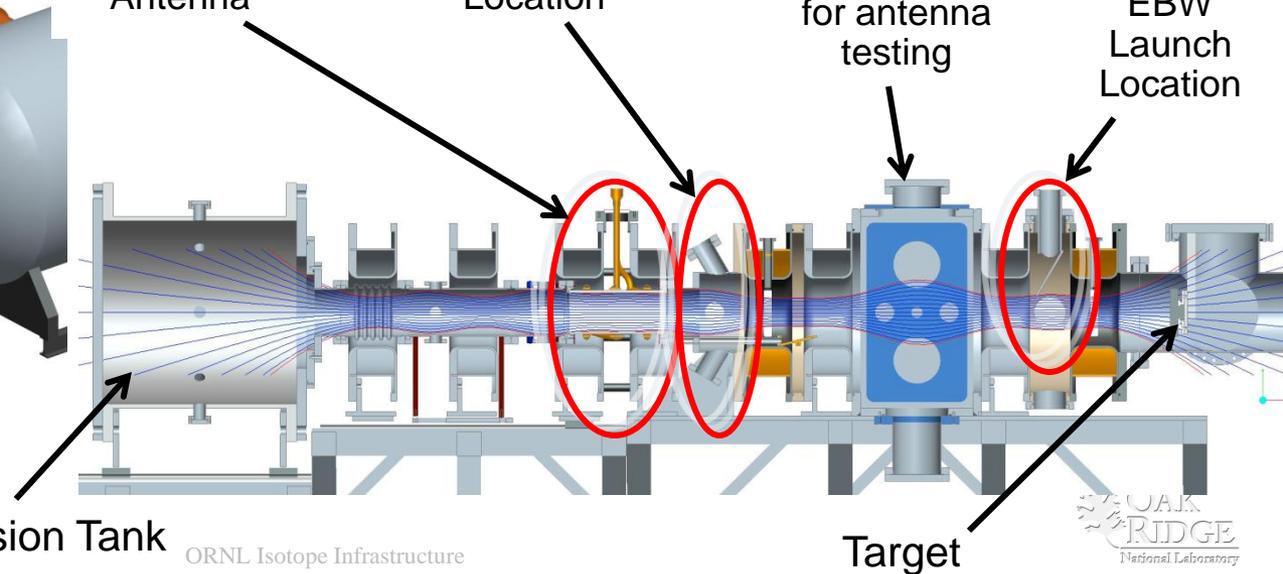


Helicon Antenna

Whistler Launch Location

Central chamber for antenna testing

EBW Launch Location



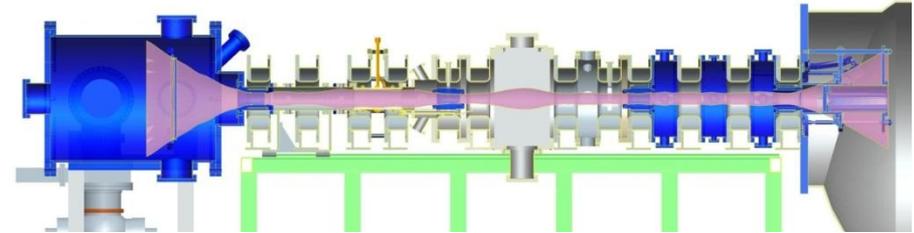
Expansion Tank

Target

# Castellated tungsten target designed to handle heat pulses $\leq 15 \text{ MJ/m}^2$ in PHISX prototype source experiment

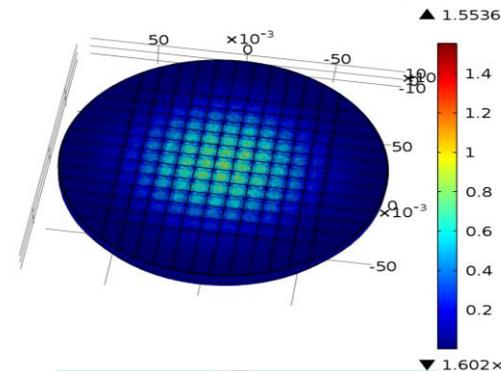
- China ASIPP is making in-kind contribution of key components to PHISX (FY13)
- Martin Peng, Prashant Jain (RNSD), Steve Meitner, Dean McGinnis reviewed and improved the engineering design
- Heat-induced stresses on tungsten target estimated to limit plasma heat pulses, and operating RF power and plasma conditions
- We used finite-element thermal-mechanical simulations of surface castellation to maximize the target heat pulse capability
- New castellation with staggered cut depths found to reduce stresses by over 2 times
- This allows  $15 \text{ MJ/m}^2$ , 1-s pulses without fracture due to heat induced stress, and allows wide testing parameter space

## Fusion Energy

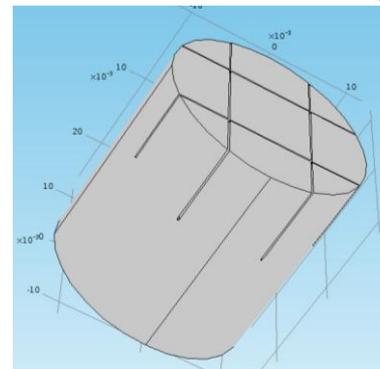


Prototype High Intensity Source Experiment (PHISX)

Qmax(3)=1.5e7 Time=1 Slice: von Mises stress (GPa)



Maximum von Mises stress down to 0.9GPa

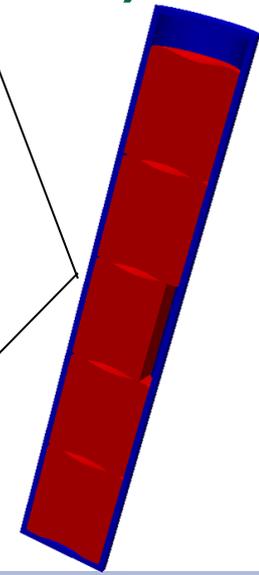


Detail of staggered cut depths

# Initial benchmark of Peregrine code – Fuel performance modeling for PCI (L2 Milestone – PO.P5.03)

## Description

- Peregrine is under development to model the multi-dimensional and multi-physics aspects of fuel rod behavior during operation
- Failure by Pellet-Cladding Interaction (PCI) is a complex multi-physics process throughout the life-time operation of the fuel
- Demonstrate the capability of Peregrine to calculate the thermal, mechanical, and irradiation behavior of a fuel rod – first step in developing PCI failure analysis methodology

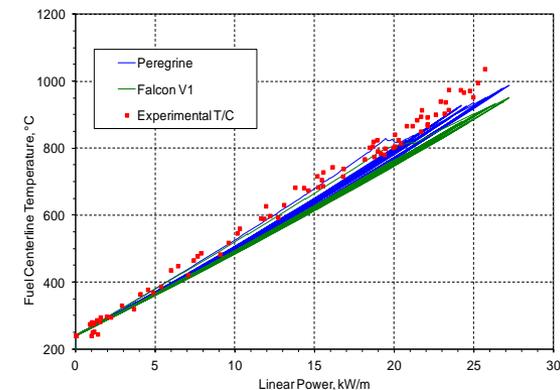


## Benchmarking Approach

- Use set of benchmark cases selected from the extensive Falcon V&V Database (+300 rods)
- Separate benchmark effort into 3 areas - temperature, deformations, and PCI failure
- Initial focus on Halden test rods to verify temperature calculation capabilities (3 Rods from IFA430, IFA504, and IFA505)
- Compare Peregrine to measured thermocouple data and Falcon results

## Analysis Results

- Good comparisons to experimental data and Falcon calculations – thermal/mechanical coupling is functioning
- Temperature  $\pm 100$  C to 23 GWd/tU
- Improvements needed in
  - Fission gas release
  - Gap conductance for closed gaps
  - Mechanistic crack and relocation modeling



### Milestone L2:AMA.P5 completed 8/31/2012

#### Purpose

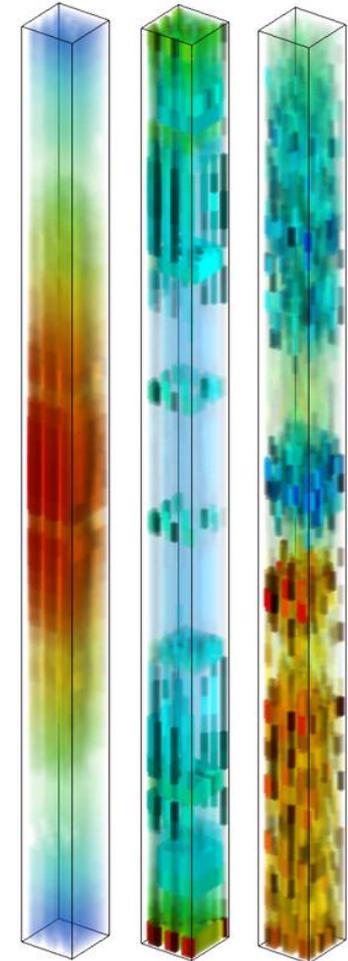
- Demonstration of capability to model basic PWR fuel assemblies like those in Watts Bar 1 Cycle 1
- Comparison of VERA-CS (SCALE/DENOVO) results with continuous energy Monte Carlo calculations
- Testing of mesh, parallelization, and runtime performance on Jaguar

#### Contributors

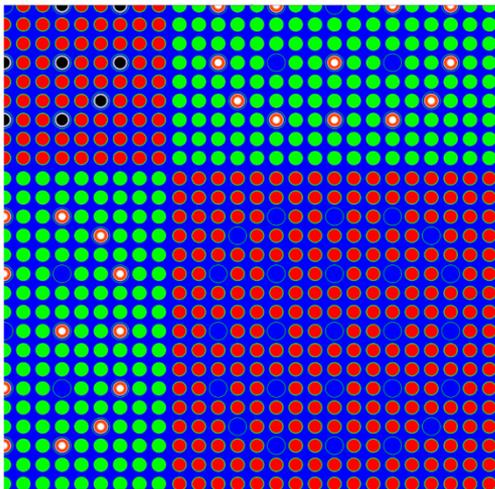
Andrew Godfrey  
Greg Davidson  
Tom Evans  
Cole Gentry  
Scott Palmtag  
Jess Gehin

#### Execution

- Developed detailed single and multiple fuel assembly models with VERA-CS and CE KENO-VI, including spacers, poisons, and control rods.
- Compared reactivity and fission rate distributions at zero power conditions
- Performed scaling and runtime studies for problem sizes up to whole core



17x17 Assembly Results



#### Results

- Successfully ran multi-assembly cases to support CASL DOE Annual Review
- Power distribution comparisons agree very well with RMS difference = 0.34%
- Reactivity bias >0.5%, needs improvement
- Additional work needed to reduce runtime to support applications: Estimated quarter core runtime of > 3 hours on > 10,000 cores

# DOE Secretary's Achievement Award Honorees



**Tim Powers, John Krueger and Brad Patton are among the team members recognized at the October 4<sup>th</sup> awards ceremony for their redesign of the disposition plan for U-233 stored at ORNL.**

# CONGRATULATIONS

# John Wagner elected an ANS Fellow

John Wagner, of the Reactor and Nuclear Systems Division was elected to the rank of Fellow within the American Nuclear Society this September in recognition of his contributions through the years to the advancement of nuclear science and technology. John will receive his award at the ANS Winter meeting in San Diego California at the Opening Plenary on Monday, November 12, 2012



**John also has been selected as the new DOE NE National Technical Director for the new Nuclear Fuels Storage & Transportation (NFST) Planning Project under the direction of Jeff Williams (DOE-HQ).**

# CONGRATULATIONS

# Appointments



**Diego Del-Castillo-Negrete** of the Fusion Energy Division has been elected **Chair of the Program Committee** and a member of the **Executive Committee** for the **Sherwood International Fusion Theory Conference**.



**Tom Evans** of RNSD has been appointed the **CASL Deputy Lead for Radiation Transport Methods**.



**Bryan Broadhead** of RNSD named as **Technical Advisor** for the **NA-22 Enabling Capabilities Program**.

# CONGRATULATIONS

# High level visits and tours

- Dan Stout of TVA visited ORNL on September 10 to discuss small modular reactors.
  - Hosted by Jess Gehin
- Robert Schleicher and Christina Back of General Atomics visited ORNL on September 18 to discuss potential collaboration on EM<sup>2</sup> reactor and fuel development.
  - Hosted by Jess Gehin
- Brett Acker (Bechtel Enterprise Holdings), Kevin Butterfield (Babcock & Wilcox Nuclear Energy), and Kevin Carter (Bechtel Power Corporation) visited ORNL on September 19 to see a demonstration of the OR-SAGE Siting Tool.
  - Hosted by Gary Mays
- John Kessler, Director of EPRI's Used Fuel and HLW Program, visited ORNL on September 27 along with Andrew Sowder and Keith Waldrop, also of EPRI. They toured several ORNL facilities, viewed demos of OR-SAGE and TRAGIS and attended meetings on used fuel R&D.
  - Hosted by Cecil Parks.



- **UC Berkeley Undergraduate**
  - ~1,000 students attended
  - ORNL was the only national laboratory
  - Primary mission to promote ORNL's internship program



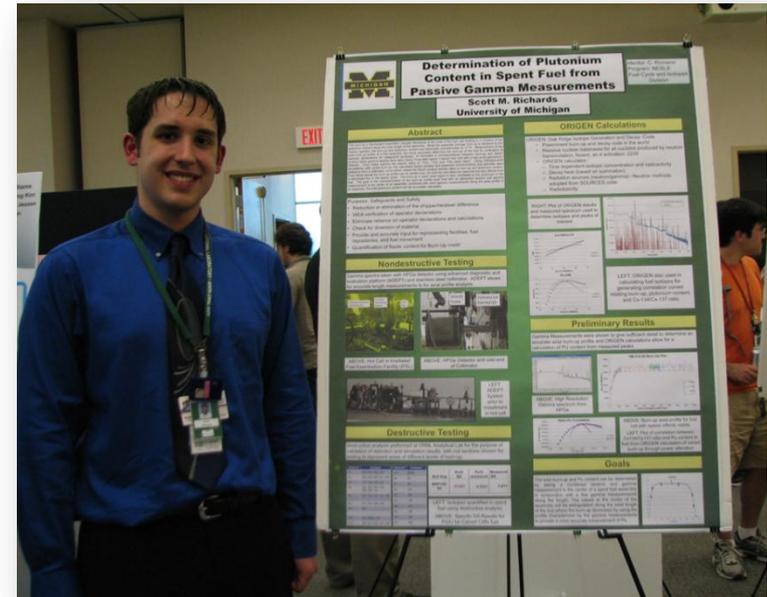
- **Texas A & M (Undergraduate and Graduate)**
  - ~3,000 students attended
  - ~350 companies attended
  - Promoted employment as well as internship opportunities

- **Attended NSBE/SHPE Career Fair Rensselaer Polytechnic Institute**
  - ~2,000 students attended
  - ~200 companies attended; including BNL, SNL, Boeing, IBM
  - Promoted employment as well as internship opportunities

# Intern activities

## NESLS intern wins 2<sup>nd</sup> place in student competition at the ANS/INMM 9<sup>th</sup> International Conference on Facilities Operations and Safeguards

Scott Richards worked on a project to determine the plutonium content in spent fuel from passive gamma measurements under the advisory of his mentor Catherine Romano. He wrote a paper about this work. Along with the paper submittal, a presentation was given summarizing the work. Scott won second place in the student competition out of the six students presenting.



# Radioisotope Production

- Consolidated materials from the primary separation runs of Campaign C-75 for recycle during the next campaign

Heavy Element  
Campaign C-75



- Began preparation of MK-18A disposition and cost estimates
- 20 capsule Mk-42 Campaign - successfully completed PUREX run.

Americium-Curium  
Processing



- Four year Cf-252 contract completed within budget
- Cf-252 customer audit passed without any findings or observations
- Shipped QSA-65-0010-3 on time
- Visited GE-Valleccitos customer
- Remote Hot-Cell Target Fabrication Refurbishment activities included assimilating a working library of as-built drawings and evaluating welding equipment and systems

Cf-252 Production



- Processed a Selenium Shipment

Selenium Processing



- Critical medical isotope, Actinium-225, produced from proton – irradiated thorium-232; Actinium-225 also produced from decay of Thorium-229
- Two shipments were sent to Memorial Sloan Kettering Cancer Center (MSKCC), 5.9 mCi on Sept. 4 and 8.1 mCi on Sept 17.

Actinium Production



# Enriched stable isotope technical services and shipping

## Twelve shipments of 57 enriched stable isotopes were made in September

- 167 shipments of 521 enriched stable isotopes have been made in FY12
- FY12 shipments rose by 10% over the FY11 total
- Individual isotopes dispensed rose 43% over the FY11 total

## Four custom technical services were completed in September

- 180 technical services have been completed in FY12
- FY12 custom technical services rose 29% over the FY11 total
- It is speculated that foreign supply problems and the higher visibility of the new Isotope Program web site contributed to these increases; however it is difficult to predict if they will be sustained.

# Radioisotope and Fuel Cycle R&D

## Isotopes & Fuel Cycle R&D

- Twelve sources enriched in Cf-251 have been recovered from the 7930 storage pool; eight have had their outer zirconium capsules removed
- New tooling and lathe have been successfully installed and used in the 7930 hot cell.

Californium-251  
Recovery LDRD



- Initiated development of isotope proposals: *Development of Thin Film Deposition Techniques for Actinide Elements; Optimization of Transcurium Isotope Production; and Simulation and Optimizing Isotope Production*

Proposal Initiatives



- In support of developing fuel for Advanced Gas Reactors, work is on-going to examine irradiated fuel compacts. Reports that have been generated to document this work are:
  - Completion of PIE on Compact 3-2-2
  - ORNL/TM-2012/285 - Compact 6-4-2
  - ORNL/LTR-2012/397 - 5 AGR-1 Compacts
  - ORNL/TM-2012/295 – Characterization Summary

AGR-1 Compact PIE



- Members of the voloxidation research team participated in the DOE Nuclear Separations Roadmap workshop.

Voloxidation R&D



- Continued testing of customer designed power output device with expectations to continue project for three more years
- Design of Po spontaneous deposition device has been completed.

Radioisotope Power  
Sources



- Additional in situ X-ray Diffraction data for NO<sub>2</sub> oxidation of U<sub>3</sub>O<sub>8</sub> was collected and refined. A manuscript is in preparation.
- An overview of the research over the past two years was presented at the LDRD poster session to close out the project
- Results aided in obtaining funding for fundamental research of NO<sub>2</sub> volox and accident scenario oxidation modeling

Gas Phase Separations  
LDRD



- **NpO<sub>2</sub> Powder Prepared for the Pu-238 Production R&D Project**
- **Target fabrication for the Pu-238 Production R&D Project**
- **Spectrophotometric study of N<sub>p</sub> Valence States for Pu-238 Production R&D Project**
- **Completed the production of 160 vanadium encapsulated neptunium-237 fission monitors for the High Flux Isotope Reactor**
- **Completed the first cycle of irradiation of 4 Single Pellet Test Target**
- **Started PIE of 3 targets at Bldg. 3525 and chemical dissolution of one target at 7920**
- **Completed dissolution of 30 dummy test targets at Bldg. 7920**
- **Contract for disposition of legacy Pu-238 sources extended to cover an additional 14 sources**

# Patent Issued for High Spatial Resolution Particle Detectors

US Patent 8,258,483 B1 for a High Spatial Resolution Particle Detection system was awarded to Lynn Boatner (MSTD) and John Mihalcz (GNSTD)

- This technology can be used in a variety of applications, including associated particle imaging and cold neutron scattering experiments, such as those performed at facilities like the Spallation Neutron Source and High Flux Isotope reactor.

**United States Patent**  
**Boatner et al.**

(10) Patent No.: **US 8,258,483 B1**  
 (45) Date of Patent: **Sep. 4, 2012**

(54) **HIGH SPATIAL RESOLUTION PARTICLE DETECTORS**

(75) Inventors: **Lynn A. Boatner**, Oak Ridge, TN (US);  
**John T. Mihalcz**, Oak Ridge, TN (US)

(73) Assignee: **UT-Battelle, LLC**, Oak Ridge, TN (US)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/101,741**

(22) Filed: **May 5, 2011**

(51) Int. Cl.  
*G01T 3/06* (2006.01)  
*G01T 1/20* (2006.01)  
*G01N 23/09* (2006.01)

(52) U.S. Cl. .... **250/390.11; 250/367**

(58) Field of Classification Search ..... **250/390.11, 250/367**  
 See application file for complete search history.

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 \* cited by examiner

Primary Examiner — Constantine Hannaber  
 (74) Attorney, Agent, or Firm — Klarquist Sparkman, LLP

(57) **ABSTRACT**

Disclosed below are representative embodiments of methods, apparatus, and systems for detecting particles, such as radiation or charged particles. One exemplary embodiment disclosed herein is particle detector comprising an optical fiber with a first end and second end opposite the first end. The optical fiber of this embodiment further comprises a doped region at the first end and a non-doped region adjacent to the doped region. The doped region of the optical fiber is configured to scintillate upon interaction with a target particle, thereby generating one or more photons that propagate through the optical fiber and to the second end. Embodiments of the disclosed technology can be used in a variety of applications, including associated particle imaging and cold neutron scattering.

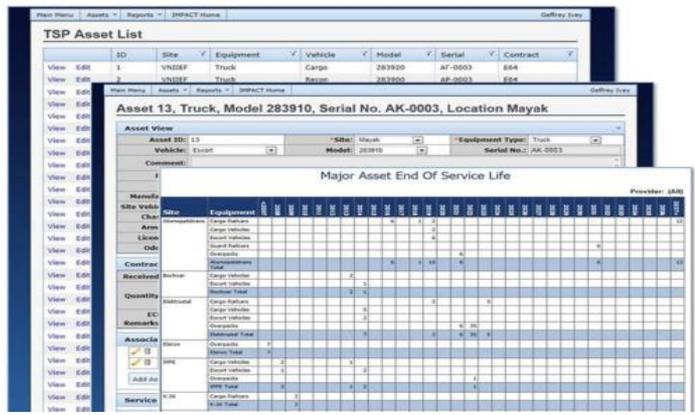
**31 Claims, 8 Drawing Sheets**

# Software Applications Deployed



## Transportation Security Project Asset Tracking Application

A new application that tracks the many properties of each Transportation Security Project (TSP) asset was recently deployed as part of the International Material Protection and Cooperation Tracking (IMPACT) system.



## INsight Dashboard Application Deployment

The INsight application was deployed to production in late September. This initial version focuses on financial management within the Office of Intelligence and Counterintelligence.



# New GNSTD facilities made available

## Russian Federation (RF) Ministry of Defense (MOD) Upgrades and Sustainability

GNSTD staff members participated in the commissioning of the Abramovo Counterterrorism Training Center (ACTC). The ACTC will be used by the MOD to train personnel for Russia's nuclear sites in security tactics and measures.

## Installation of Cf-Shuffler

The Y-12 Cf-shuffler was successfully disassembled and removed from Y-12 to ORNL for installation in the new safeguards expansion laboratory.



# Mobile Uranium Facility (MUF)

## Deployed to 12 Camp, Nevada National Security Site (NNSS)



The ORNL and Y-12 team deployed the MUF and performed the mock mission under the realistic conditions found at the NNSS. Upon completion of the mission, senior representatives from around the DOE/NNSA complex and other US Government Departments visited the MUF to learn about the MUF's capability for deployment. The success of this Mock Mission provides confidence the system can be deployed for future material recovery missions.

The Global Threat Reduction Initiative (NA-21) Emerging Threats Program is funding the MUF.

The MUF is designed to handle all the needs for:

- Identifying and characterizing uranium compounds
- Processing the material to a stable form
- Packaging the material for shipment to its final disposition location

A mock mission to the Nevada National Security Site demonstrated the capabilities of the MUF in the field.



# Industry & Science Council Meetings

## Joint Industry/Science Councils Meeting (9/11/2011)

- Focus:**
- Review of FY12 accomplishments
  - Gauging Challenge Problems' success
  - VERA and VERA-CS development path
  - Demonstrations of CASL developed capabilities



## Parallel Industry & Science Council Meetings (9/12/2012)

### Science Council

- Focus:**
- Presentation of FY13 plans
  - FY12 annual review of CASL S&T performance

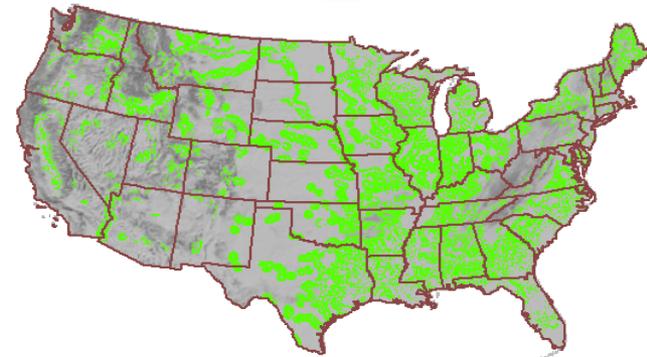
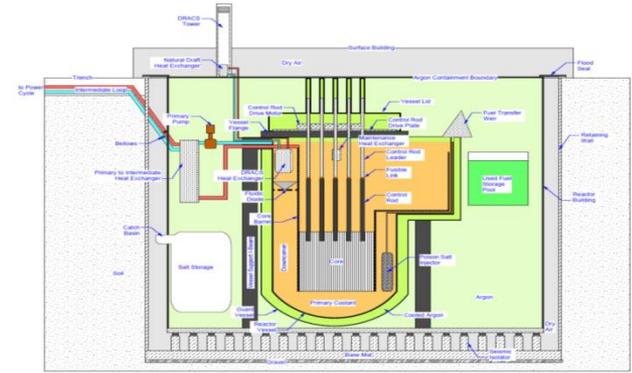


### Industry Council

- Focus:**
- Pilot study update
  - Test stands concept & deployment
  - Opportunity for industry access to HPC resource

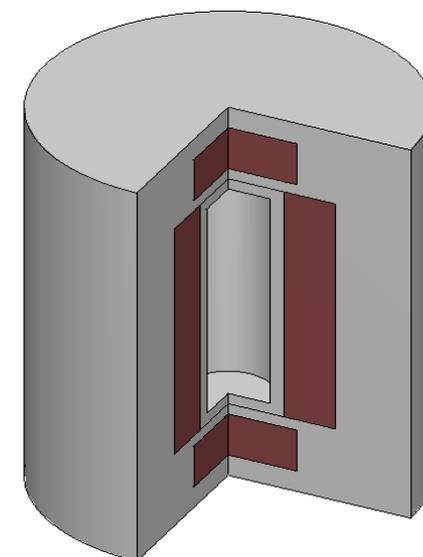
# RNSD highlights and activities

- The DOE Office of Nuclear Energy Advanced Reactor Concept program was provided a Level 2 milestone report
  - The report provides an overview of the mechanical, structural, and neutronic aspects of ORNL's pre-conceptual design of the Advanced High-Temperature Reactor (AHTR)
  - The AHTR is a nominal 3400 MW(t) reactor employing coated particle fuel and a low-pressure fluoride salt as coolant with a fully passive decay heat rejection design
- The DOE Office of Nuclear Energy advanced Small Modular Reactor (aSMR) program was provided a Level 3 milestone report
  - The first of three phases of analyses of identifying siting options and challenges for deploying SMRs
  - The available candidate areas for 50-acre SMR sites with no siting challenges for SMR is 26.9% of the contiguous United States, or 460 million acres
  - ORNL's siting tool, OR-SAGE (Oak Ridge Siting Analysis for power Generation Expansion) was used to support this work

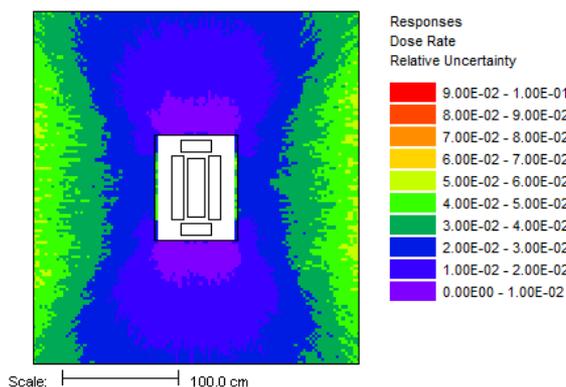
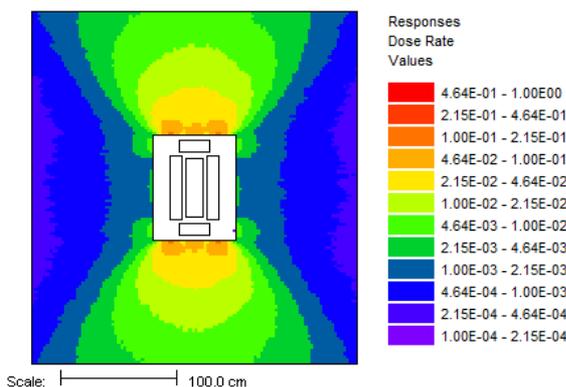
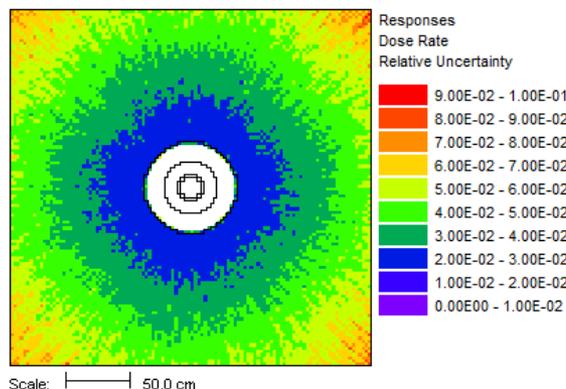
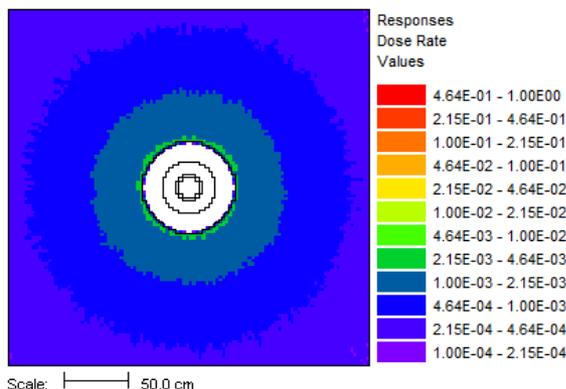


# RNSD highlights and activities

- An RNSD R&D team completed the development and testing of a SCALE fixed-source continuous-energy coupled neutron-photon radiation transport capability for the Nuclear Regulatory Commission



Simple AOS-100 cask geometry showing tungsten (brown) and steel (gray)



Dose rates (mrem/hr/Ci) and relative uncertainties from the continuous energy, SCALE/FW-CADIS calculation, showing the midplane views of the cask ( $z=0$  above and  $y=0$  below)

# RNSD highlights and activities

RNSD

- George Flanagan of RNSD was an instructor for the annual IAEA safeguards course on Design Information Verification of Research Reactors in Vienna, Austria.
- Ian Gauld chaired a 2-day meeting of the OECD/NEA Expert Group on Assay Data for Spent Nuclear Fuel in Paris, France. The 28 participants from 12 countries are working to develop an international data base for spent fuel assay measurements.
- RNSD and GNSTD staff completed and released a document to NA-26 titled, “The Use of MOX Fuel in the United States: Bibliography of Important Documents and Discussion of Key Issues.” The report provides a comprehensive reference on the issues associated with use of ex-weapons plutonium in MOX fuel for use in US reactors.
- Bob Grove and Tim Valentine of RNSD participated in the 12<sup>th</sup> International Conference on Radiation Shielding (ICRS-12) in Nara, Japan. Valentine served as one of the General Co-Chairs of the conference in his role as director of RSICC which has been one of the co-sponsors of this meeting for over 40 years.



12th International Conference on Radiation Shielding (ICRS-12)  
Topical Meeting of RPS Division of the American Nuclear Society (RPSD-2012)  
Sept. 2nd - 7th, 2012 / Nara Prefectural New Public Hall, Nara, Japan / Organized by the Atomic Energy Society of Japan

- Journal Articles - 2
- Letter Report - 14
- ORNL/TM - 6



Dean Wang, Ian C. Gauld, Graydon L. Yoder, Larry J. Ott, George F. Flanagan, Matthew W. Francis, Emilian L. Popov, Juan J. Carbajo, Prashant K. Jain, John C. Wagner, and Jess C. Gehin, “Study of Fukushima Daiichi Nuclear Power Station Unit 4 Spent-Fuel Pool,” *Nucl. Technol.*, Vol. 180, No. 2, November 2012, pp. 205–215.

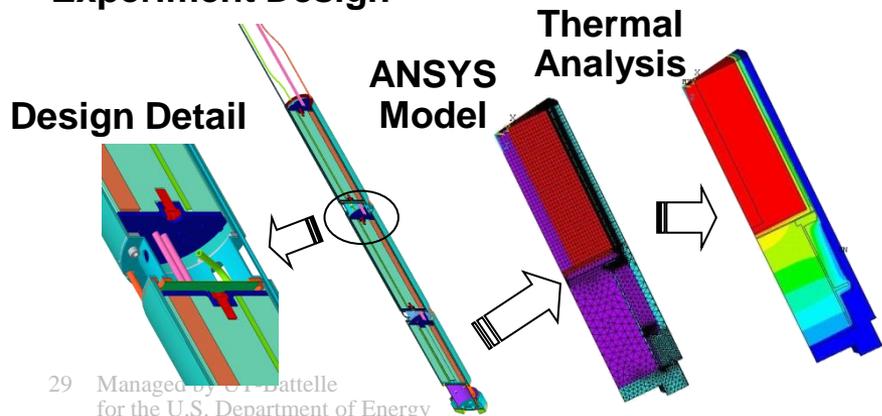
Kevin T. Clarno, Bobby Philip, William K. Cochran, Rahul S. Sampath, Srikanth Allu, Pallab Barai, Srdjan Simunovic, Mark A. Berrill, Larry J. Ott, Sreekanth Pannala, Gary A. Dilts, Bogdan Mihaila, Gokhan Yesilyurt, Jung Ho Lee, and James E. Banfield, “The AMP (Advanced MultiPhysics) Nuclear Fuel Performance code,” *Nucl. Engr. Design*, Vol. 252, November 2012, pp. 108–120.



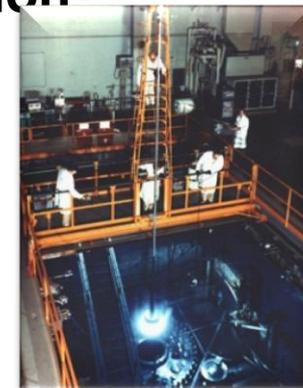
# Materials Irradiation - September

Project	Format	Sponsor	Stage					Notes
			Newly proposed	In Design	In Fabrication	In Reactor	Removed	
Titan Metal	Rabbit	DOE, FE US-Japan				18 in Cycle 443 2 in Cycle 445		Tungsten and steel
Titan Metal Perforated	Rabbit	DOE, FE US-Japan				9		Tungsten SiC, steel
Composite Flexure	Rabbit	DOE, FE			3	5		SiC
Mini-Composite	Rabbit	DOE, FE		4		Cycle 445		SiC
Round-bar Tensile	Rabbit	DOE, FE		4+				Steel
Hydrided Clad	Target	DOE, NE			3	1	2	Zircaloy
Ibiden	Rabbit	WFO, Ibiden			24	14		Graphite
Nippon	Rabbit	WFO, Nippon		31		2013		Graphite
UO2 TEM disks	Rabbit	Texas A&M			1	Cycle 445		UO2
Titan Tensile	Rabbit	DOE			19	Cycle 445		V-4Cr4Ti, SiC, Graphite, steel
EPRI	Large VXF	EPRI			3	2013		Steel, Inconel
Toyo Creep	Target	Toyo Tanso		3		2013		Graphite
PU238	Capsule	NASA			1	Cycle 445		Tensile

## Experiment Design



## Experiment Fabrication Irradiation



# Assembly of the thermal/hydraulic test loop for salt coolant continues

- Gas Cleaning System for FLiNaK Salt Loop
  - Began review of Activities Hazards Analysis form submitted by AES
  - Provided preliminary training requirements for AES personnel
  - Provided input to AES regarding PPE selection for inclusion in their ES&H Plan
  - Initiated SBMS variance for valves and regulators (ultra-high purity needs)



**Location for installation of AES Gas Cabinet**



**Installation of Mezzanine in D111**

# Major Contract Awarded to Build Mobile Mercury Transfer System (MMTS)

A \$2M contract in which ORNL has a major role, was awarded to complete detailed design-through-build and turnkey delivery of the Mobile Mercury Transfer System (MMTS).

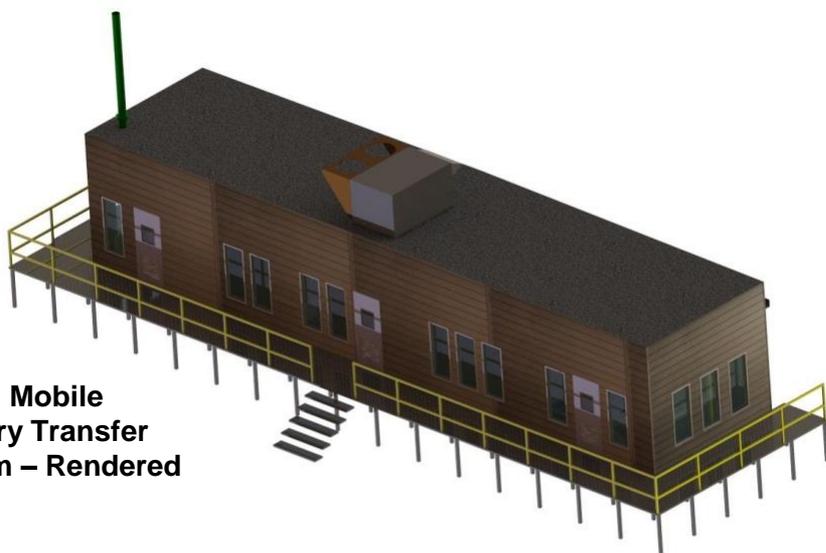
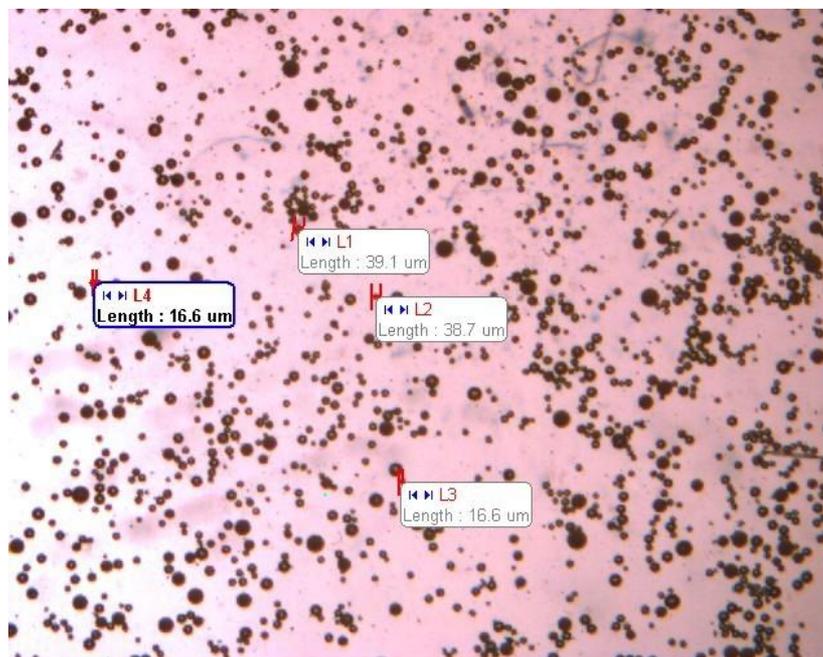


Fig. 2. Mobile Mercury Transfer System – Rendered Image

This facility will be re-containerizing 3-L flasks of mercury into new metric ton contains in Hawthorne Army Depot in Nevada

# Fuel kernel development

Two proof of principle experiments were performed using the internal gelation system in Building 4501. These microspheres are a part of NASA's thermal nuclear propulsion effort. The objective is to produce microspheres of a diameter between 10 and 50  $\mu\text{m}$



Air dried uranium microspheres  
between 16 and 150  $\mu\text{m}$

# Fuel Cycle and Isotopes Division Activities

Page 1 of 2

- ❖ ISO 9001 Comprehensive internal assessment performed
- ❖ Proposal for 100 mA Electromagnetic Isotope Separation Technology Development submitted to DOE Office of Nuclear Physics
- ❖ Pu-242 inventory batch re-weighed and ready to send to Los Alamos National Lab as they requested.
- ❖ Remote hot-cell target fabrication equipment upgrade project underway
- ❖ Actinide R&D and other collaborative effort opportunities discussed with the Experimental Radiochemistry Group at LLNL
- ❖ Mk-42 Spectral analysis on in-process M19RTL-1 completed for Mark-42 Dispositioning Project

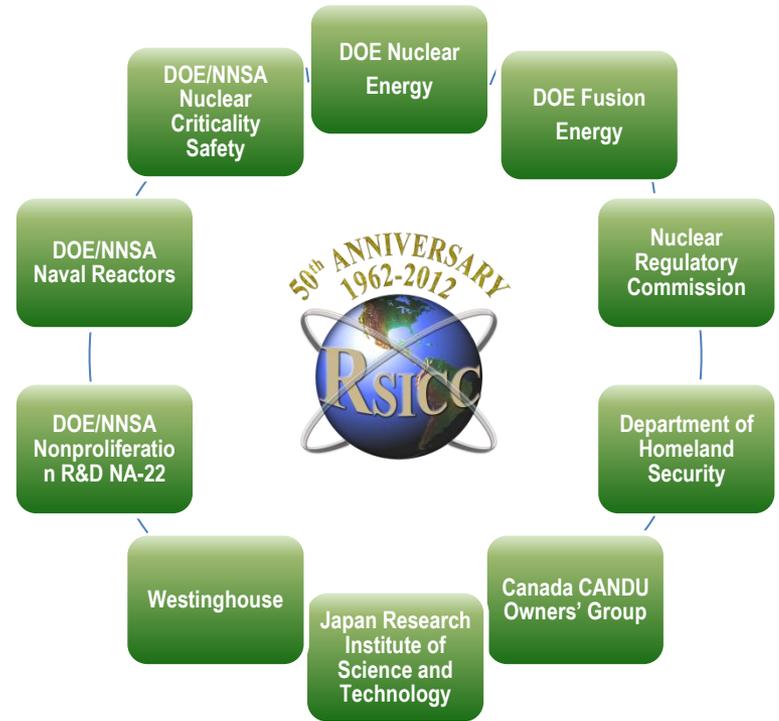
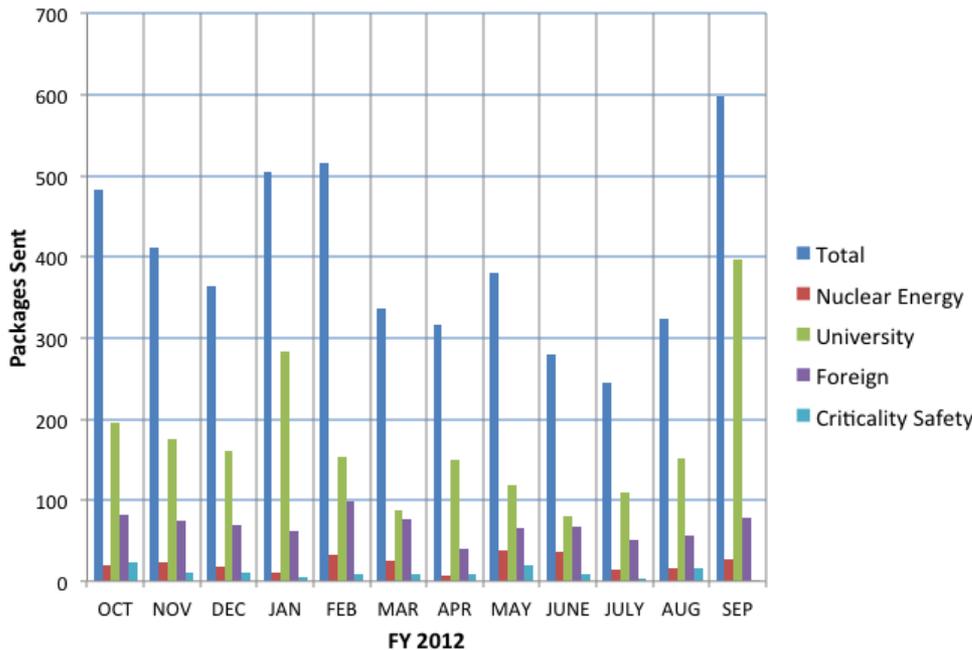
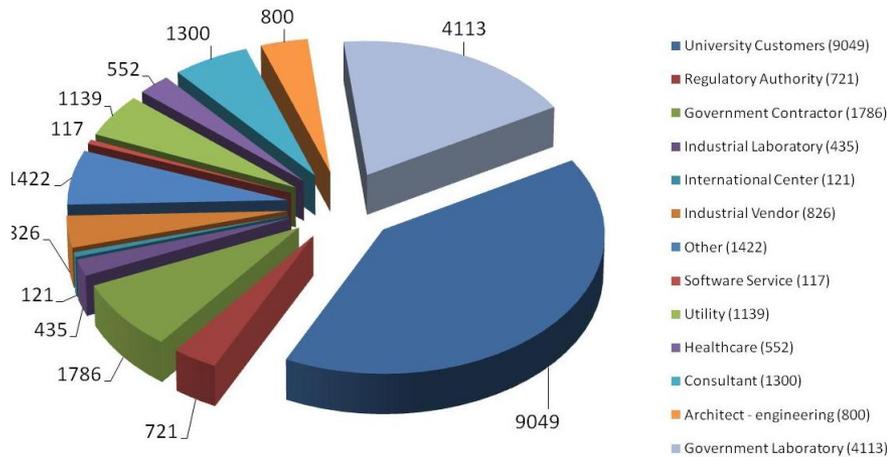
# Fuel Cycle and Isotopes Division

## Activities (continued)

- ❖ **Summaries on 70 separate strategic materials of high interest completed for Defense Logistics Agency**
- ❖ **Advanced High Temperature Reactor Level 2 Milestone Report successfully completed.**

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

RSICC Customer Base



- Software and data packages distributed FY2012: 4,758
- 14 package updates and revisions September 2012

# 4500 Area Gaseous Waste Reconfiguration and Stabilization Project

- Completed installation of 4501 Stack
- Removed lead shielding from east inlet duct in 4556 Filter Pit
- Isolated 4556 west blower ventilation branch from 3039 stack
- Isolated 4556 filter housings from 4507 hot cells and sealed penetrations
- Removed/size-reduced remaining ductwork in 4556 Filter Pit
- Reconfiguration contractor continued installation of HEPA Filter housings, fans and duct work
- Continued assembly/installation of the electrical panels and associated conduit



Stack Installation at 4501



Loading Out Ventilation Duct Sections from 4556



Installing Glovebag - East Inlet Duct at 4556

# EM project integration support

- UT-B loaded and shipped the SNAP-7B to NNSS
  - The RTG contained over 84,000 Ci of  $^{90}\text{Sr}$ -Titanate
  - Empty cask/ trailer returned on September 28<sup>th</sup>
- UT-B successfully performed the stack-up of the SNAP-7C/ Weather Bureau RTG spacers in support of the Miscellaneous Facilities Project
- EM Contractor SEC/ Perma-Fix continued their investigations of 3026D Cell A
  - UT-B assisting in determining the material types and origins of numerous apparently metallic objects in the cell
- EM Contractor SEC/ Perma-Fix removed the roof plugs and began their investigations of 3026D Cell B
- EM Contractor SEC/Perma-Fix continued efforts to transition Building 3038 to UCOR
  - Removed numerous waste items for final disposition
  - Transition to occur on October 1<sup>st</sup>
- UT-B put an MPO put in place with UCOR to fund the transition of Building 3038



Loading Area for SNAP-7B



SNAP 7C/ Weather Bureau RTGs in spacers

# Central Campus Legacy Material Removal Project

NNFD/EMPO

## –2026 Clean out

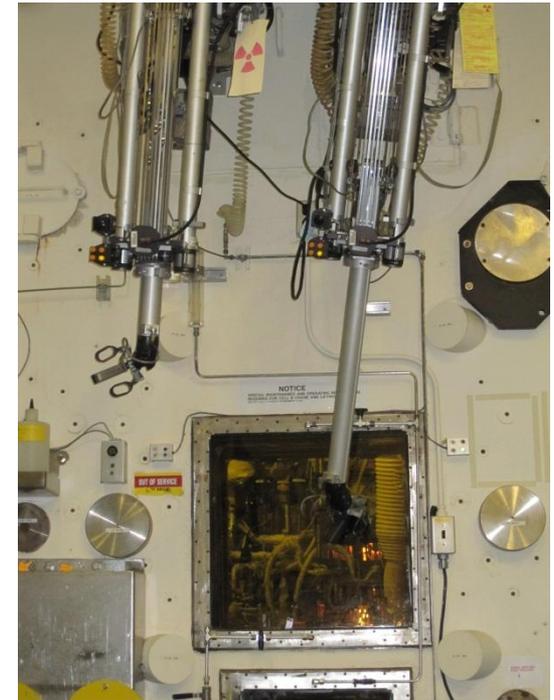
- Completed initial segregation of the waste
- Began waste removal in the Air Lock and the Cell Access Area

## –4501D Cell Clean Out

- Completed initial checkout of the electrical systems, manipulators and cell lighting
- Completed nitrogen purge of the “dry” side of the system
- Completed initial purges of the “wet” side of the system



2026 Initial Waste Segregation



# NNFD FY2012 Cumulative Facility Metrics

## Hot Cell Availability

97.40 7920

97.50% 7930

96.00% Irradiated Fuels Examination Laboratory (3525)

98.00% Irradiated Material Examination and Testing Laboratory (3025E)

## Facility Upgrades and Maintenance Activities

7920

- Programmed maintenance operations

7930

- Programmed maintenance operations

3525

- Programmed maintenance operations

3025E

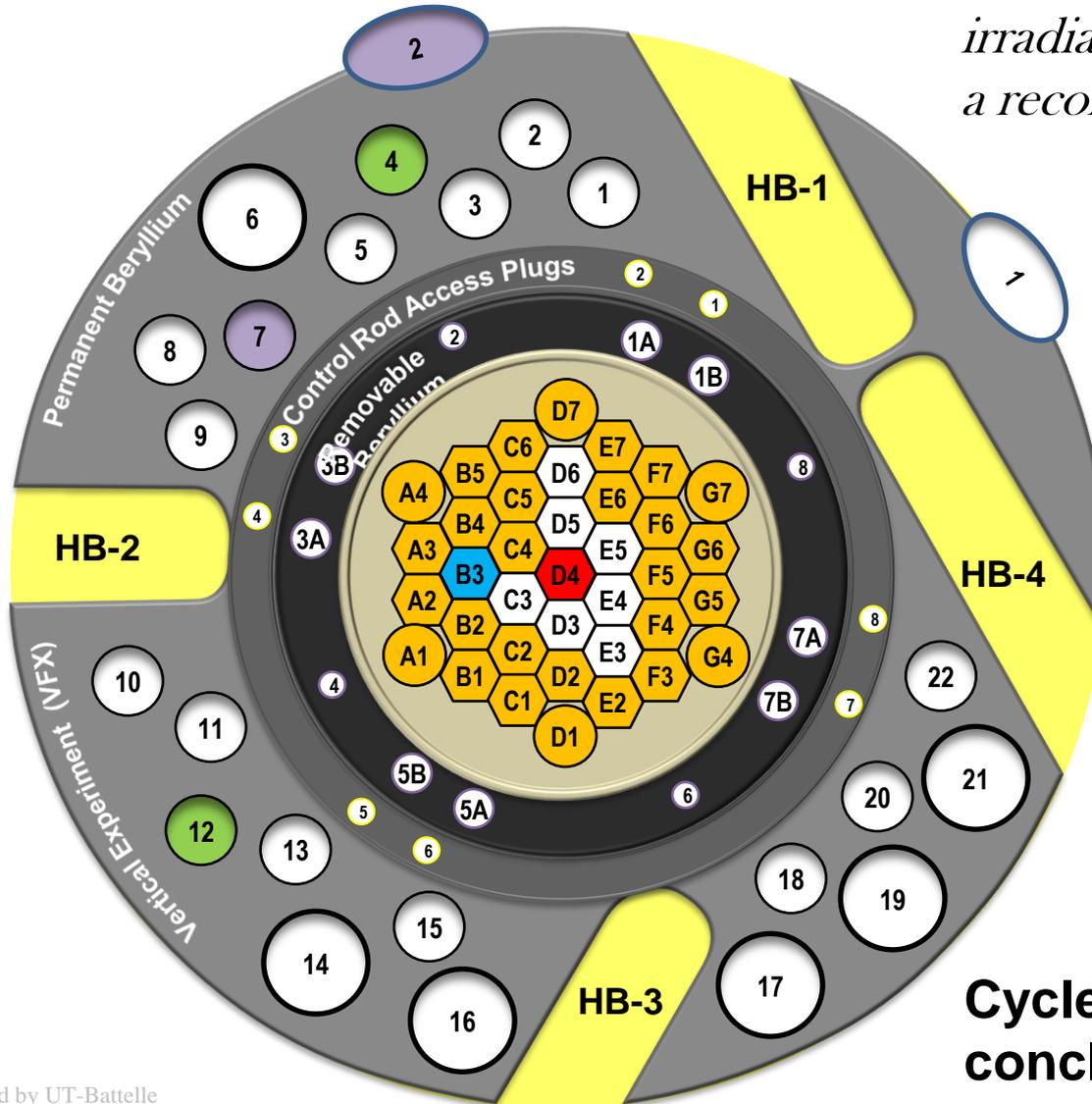
- Programmed maintenance operations

# HFIR had no operating cycle during September

HFIR

*“FY12 in-vessel irradiations reach a record high”*

September 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						
Reactor OFF						



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

**Cycle 443 just concluded in August**

# The number of HFIR irradiations for Cycle 443 that are being driven by materials and isotope research have reached a new high

HFIR

## 113 Materials and Fuels Experiments

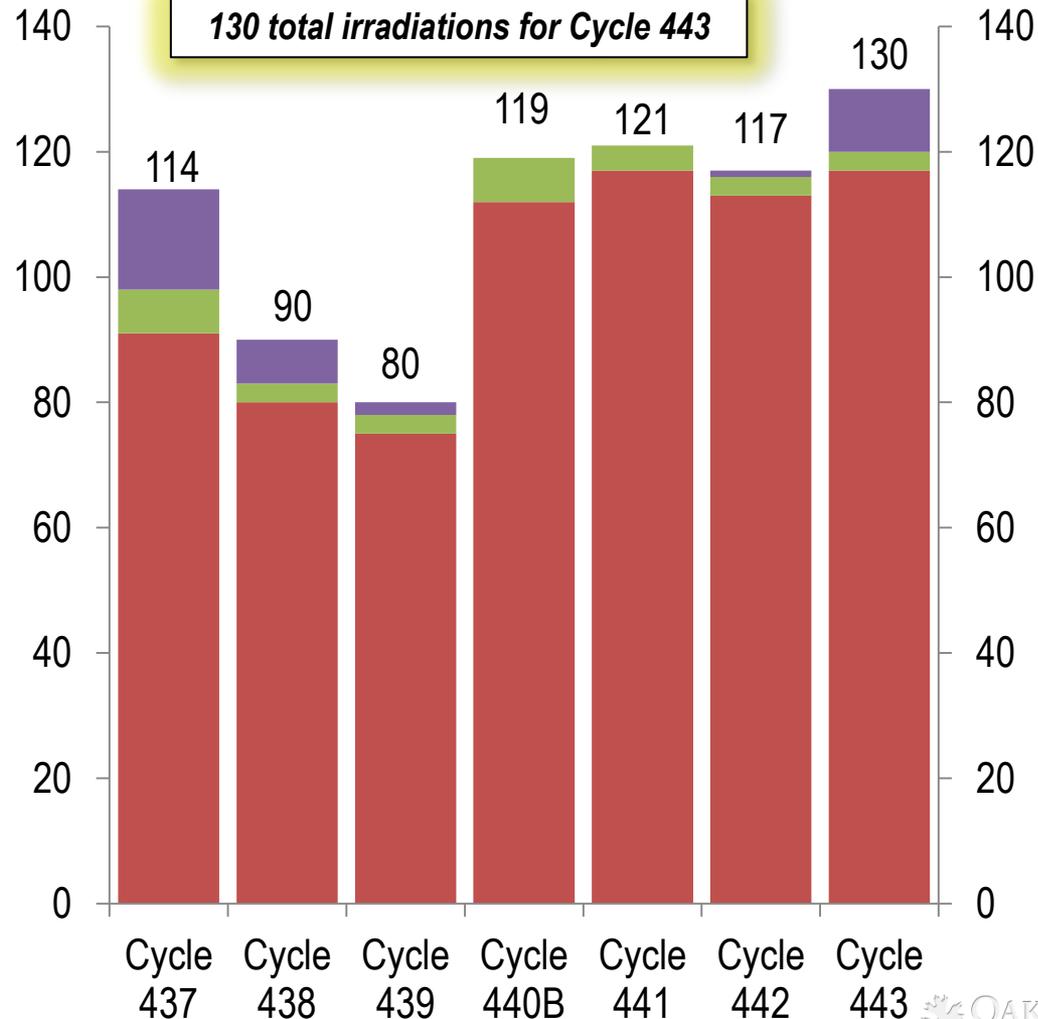
- Silicon Carbide
- V, Mo, & Cu alloys
- Zircaloy
- UO<sub>2</sub> Fuels
- Graphite
- Uranium
- Steels
- UCN Fuels

## 3 Commercial Isotope Production Capsules

- 3 Selenium (Se-75) - production

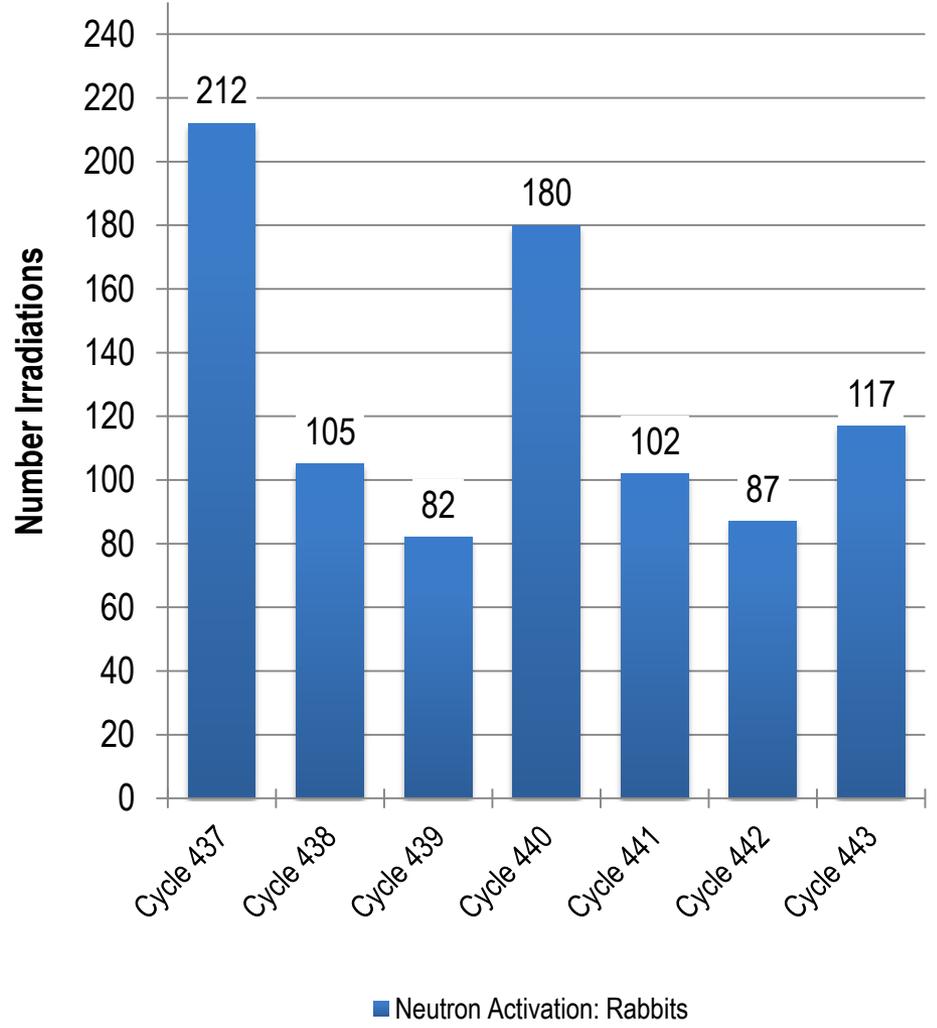
## Isotopes for Research

- Pu-238 research
- Th-229 research



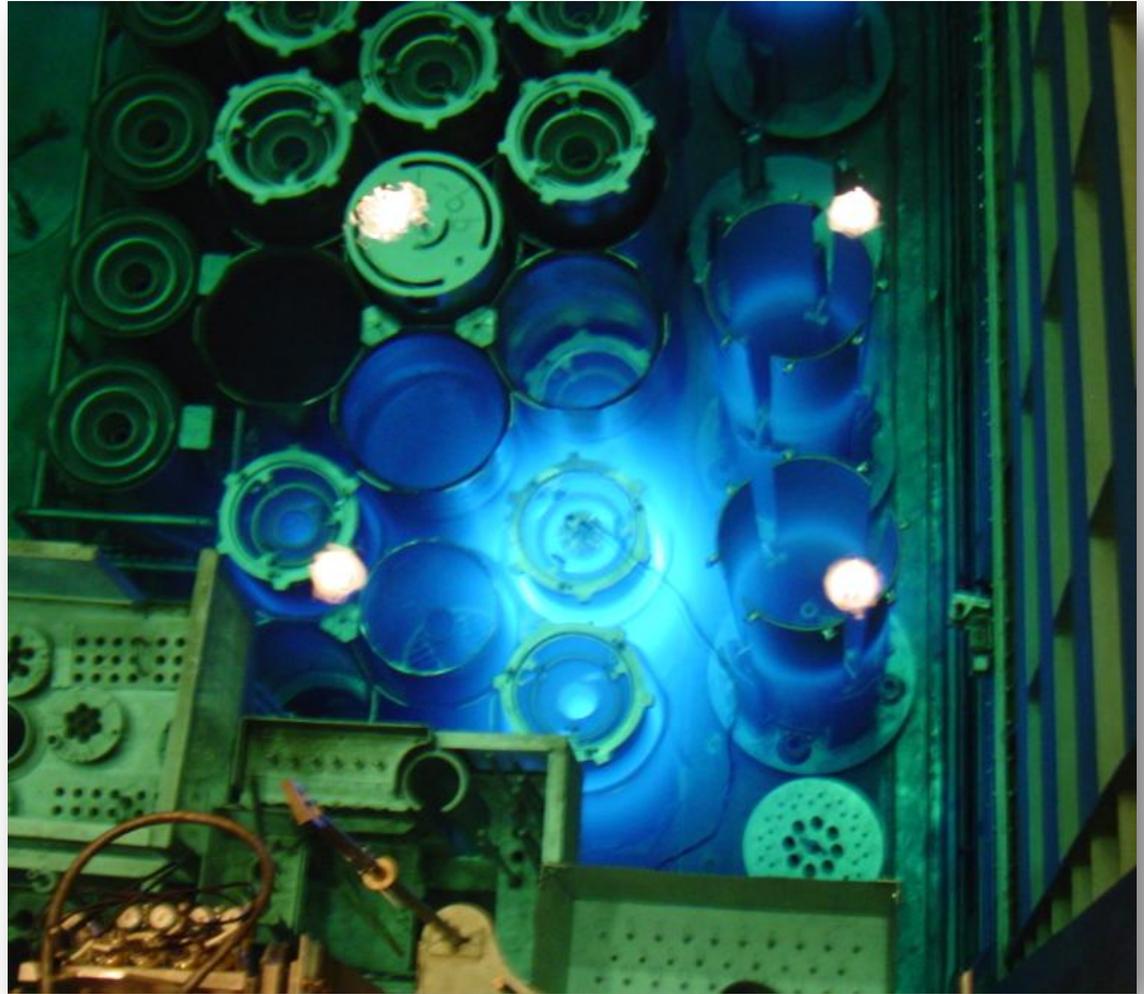
# Significant number of NAA irradiations during cycle 443 at HFIR

- NAA irradiations during Cycle 443 include**
- 74 IAEA Pre-inspection checks
  - 2 Yb-169 production for Y-12
  - 4 containing thermal and threshold flux monitors
  - 5 normal flux monitors
  - 5 trace elements in human hair
  - 16 iodine and silver on zeolite sorbents
  - 1 radium 228 source for measurement of fundamental nuclear parameters for production of Th-229 (for Alpha Therapy radioisotope production)
  - 1 rabbit for trace elements in an advanced material from US SOCOM
  - 8 rabbits for neutron damage studies by VT graduate students
  - 1 rabbit for trace elements in HFIR pool filter debris for summer student
- Total 117**



# Gamma irradiations continue to support NASA and the FDA

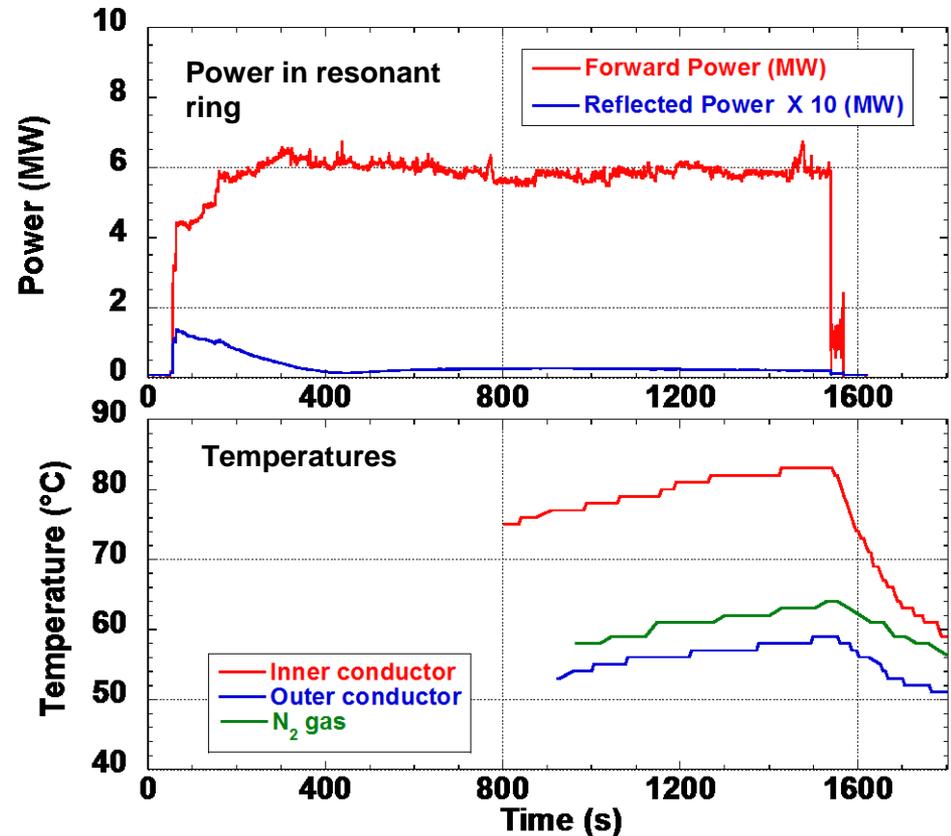
Performed second of three planned instrumented NASA experiments supporting the fission surface power project



# A 25 minute long pulse was achieved at the design power level of 6 MW

- Reliable system operation was observed, with no arcs occurring during pulse, and very little reflected power
- Maximum inner conductor temperature measured was 83 °C, far below the design limit of 150 °C.
- System did not reach equilibrium, but appears close, with  $(T_{\text{inner}} - T_{\text{outer}}) \sim \text{constant}$
- In order to meet ITER requirements, 1 hour pulses will be run after modification to transmitter output cavity needed for very long pulse duration tests

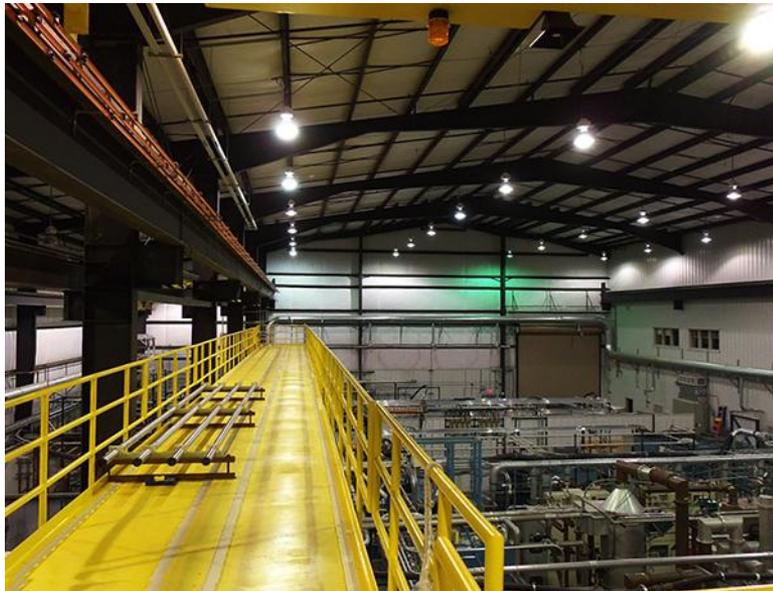
## Resonant Ring Experiment



# East Complex Facilities Team brightens building 7625 research space

- Building's 400-watt metal halide fixtures were replaced by approximately 50 high-output T-5 fluorescent fixtures
  - Provides more light
  - Reduces energy consumption by about 40 percent
  - Saves money over time

Before



After



# Building 7625/7627 power supply enhanced to support PMTS development

- Two new 2.5MW unit substations purchased, installed and operational to supply power for FED experiments in 7625 and 7627
- Set, tested, and refurbished transformer for Gyrotron power supply in 7627



New Unit Substation in 7625



New Unit Substation in 7627



Refurbished transformer in 7627

**EMPO provided project management assistance on this project**

# Fusion Energy Division Support Activities

FED

## – Building 7625

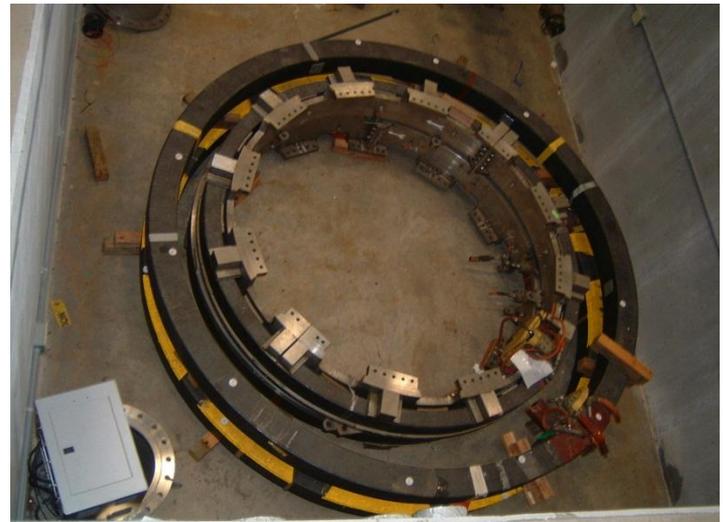
- Removed unfinished coil casting (4-ton) from EPP Pit and staged for pickup in north gravel yard
- ATF coils removed from Y-12 and stored in EPP Pit
- Service schedule for 7626 E&W Cooling Towers reviewed and updated; spare parts purchased and stored on-site; and created a startup/shutdown procedure



7626 E&W Cooling Towers



Unfinished coil ready for pickup by salvage



ATF coils stored in 7625 pit

**NNFD provided assistance on  
these activities**