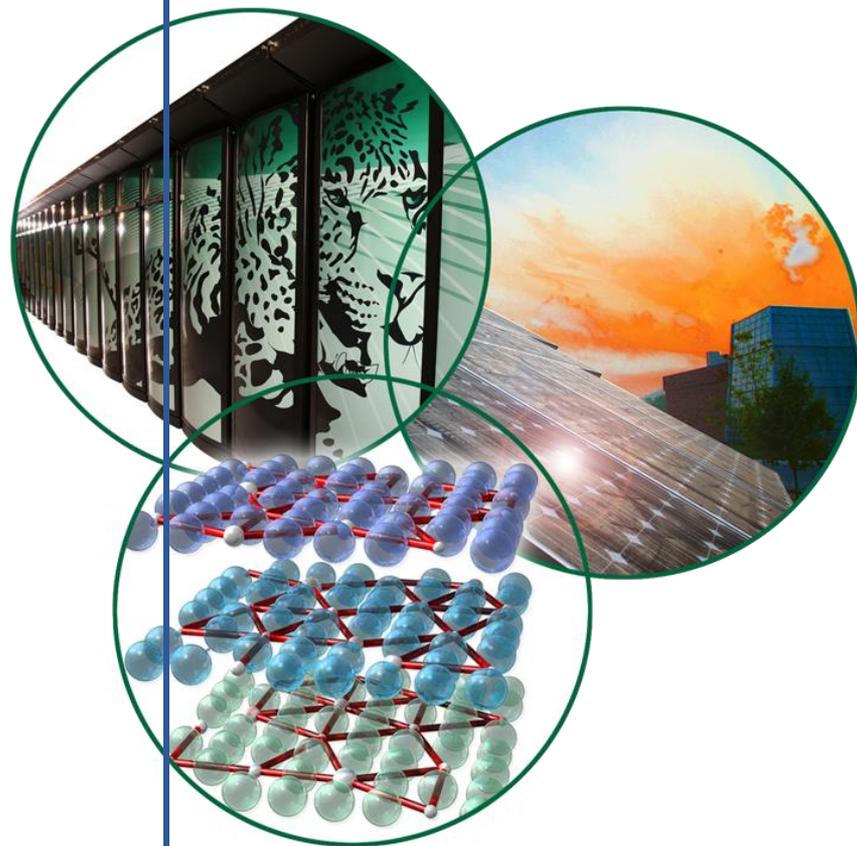


NSED Monthly Report

November 2012

Nuclear Science & Engineering Directorate



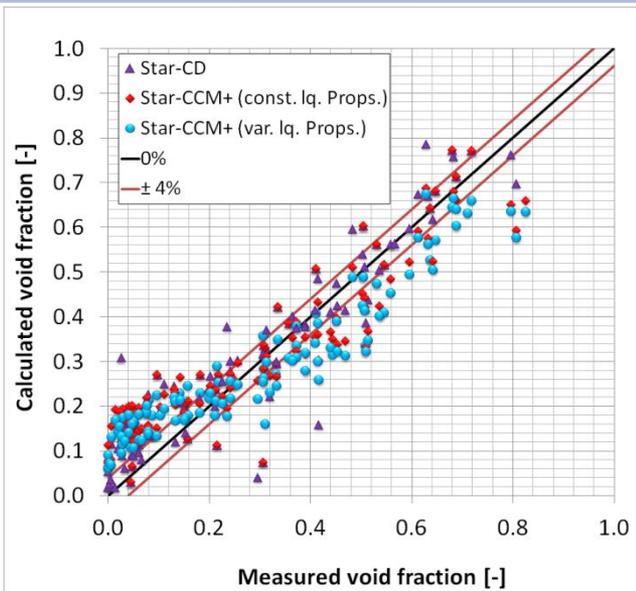
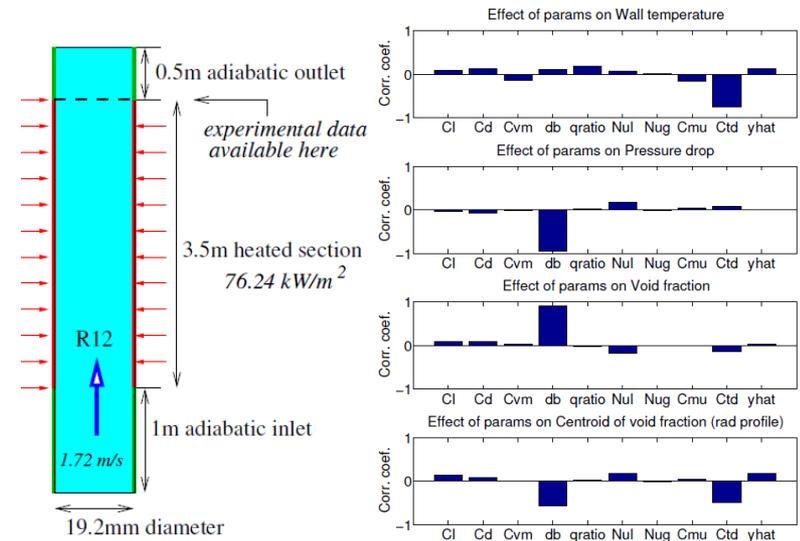
Sensitivity, verification, and validation studies of CFD boiling models (L3 milestone – THM.CFD.P5.03)

Description

- CFD boiling/multiphase models rely on tunable parameters
- We study sensitivities of key outputs of a CFD benchmark problem using two codes: Star-CD and NPhase-CMFD.
- We present validation of boiling models in Star-CD and Star-CCM+ for DEBORA and PSBT benchmark problems

Approach

- We use DAKOTA to drive sensitivity studies of both STAR-CD and NPHASE-CMFD



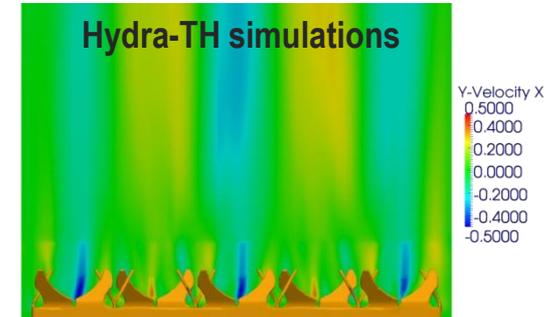
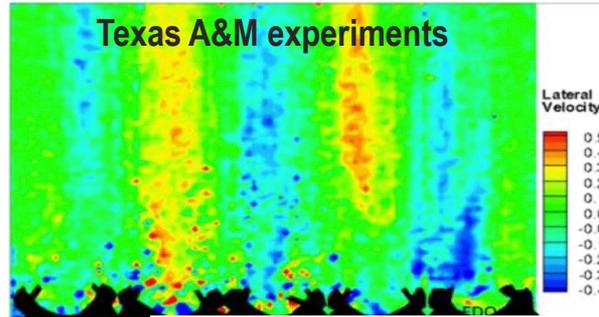
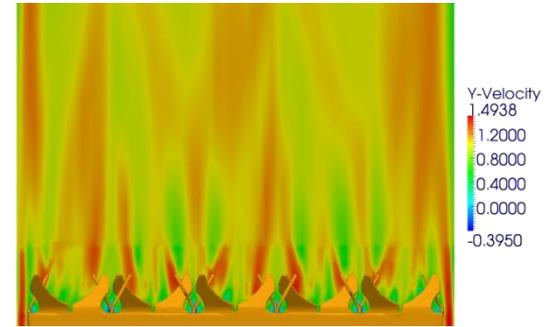
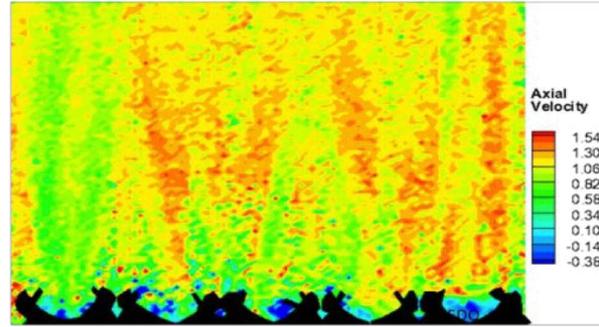
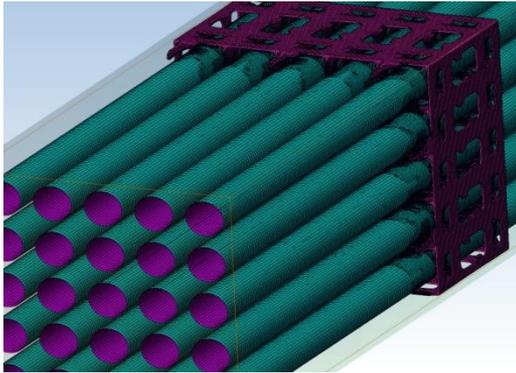
Results

- Nphase will require wall boiling models in order to faithfully simulate CASL-relevant applications
- We observed the largest sensitivities to the bubble diameter, the lift coefficient, and the turbulence dispersion model
- For current boiling models, a systematic overestimation of the cross-section averaged void fraction is observed in the low void-fraction range.
- Agreement with experimental data improves in the low void-fraction range if the S-gamma formulation is used instead of Kurul-Podowski for the estimation of the bubble size
- Further improvements are needed in the high void-fraction range

Key personnel: I. Asher, V. Petrov, T. Drzewiecki, T. Grunloh, K. Fidkowski, A. Manera

Computational / experimental study of 5x5 Westinghouse fuel subassembly shows good agreement

CFD turbulence forcing simulations of PWR grid-to-rod fretting phenomena

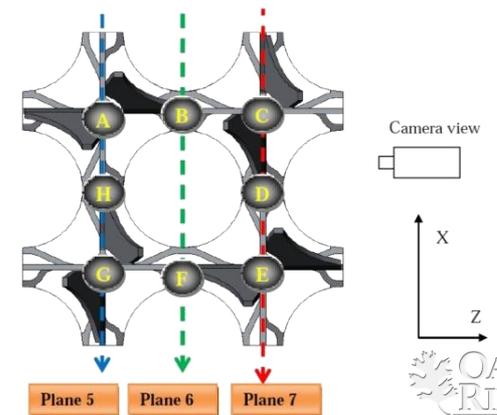
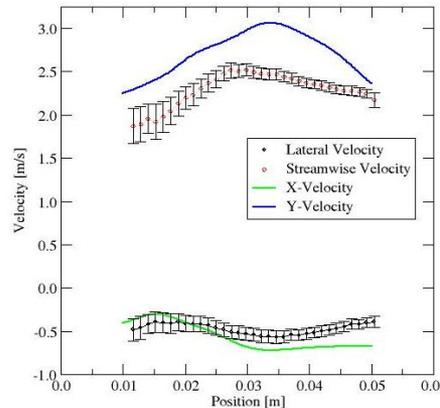
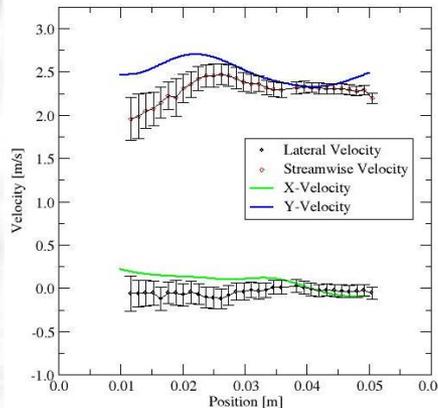


Predicted mean peak velocities within 5% of experiments



Position A

Position H



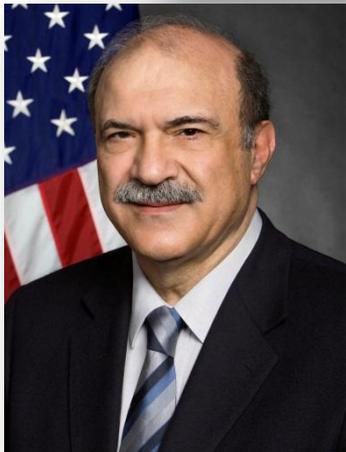
Time-averaged velocity profiles downstream of mixing vanes

CASL technical seminar presented to the NRC Commissioners



A CASL technical seminar was presented to NRC Chairman Allison Macfarlane and commissioners George Apostolakis and William Ostendorff at NRC headquarters

- Jeff Binder and Doug Kothe along with CASL leadership presented an overview of CASL capabilities and their relevance to the current U.S. LWR fleet
- Jeff Binder discussed other ORNL capabilities available to the NRC



Russian collaborators hosted

Four Russian scientists from the Joint Institute of Nuclear Research, Dubna, Russia visited ORNL in November as part of an international collaboration for the discovery of super-heavy elements

- The group toured Buildings 7920 and 7930 at REDC
- The development of target foils for next experiment scheduled for Spring 2013 was discussed



ORNL Isotope Infrastructure

Jim Gulliford, OECD-NEA Nuclear Science Committee Chairman, visited ORNL

Dr. Gulliford presented a seminar on November 9 entitled, “Overview of the Nuclear Energy Agency’s Nuclear Data Bank and Nuclear Science Activities: Linkages with RSICC.”

- Dr. Gulliford was hosted by RSICC Director Tim Valentine



Possible Canadian collaborations discussed

A delegation from Atomic Energy of Canada, Limited (AECL) led by Bob Speranzini visited ORNL on November 28 to discuss possible collaborations

- The delegation was hosted by Jeff Binder and met with NSED leadership
- Tours included the CASL-VOCC Lab and the SNS



Professional awards and recognition

- John Wagner was recognized by Dr. Monica Regalbuto, DOE Deputy Assistant Secretary, at the Fuel Cycle Technologies Annual Review Meeting
 - For leading the technical assessment of the total current inventory of used nuclear fuel in support of research, development, and demonstration needs and national security interests
- Mark Williams was featured in a spotlight article of the DOE-NE NEAMS Update Quarterly Report published in November 2012



UT-ORNL Governor's Chair for Global Nuclear Security named AAAS Fellow

Howard Hall, UT-ORNL Governor's Chair for Global Nuclear Security is one of seven professors named by the American Association for the Advancement of Science (AAAS) to their 2012 class of fellows



CONGRATULATIONS !

Intern electrodeposition projects completed

Electrodeposition Method Evaluation

Matt Torrico, Nuclear Materials Processing Group

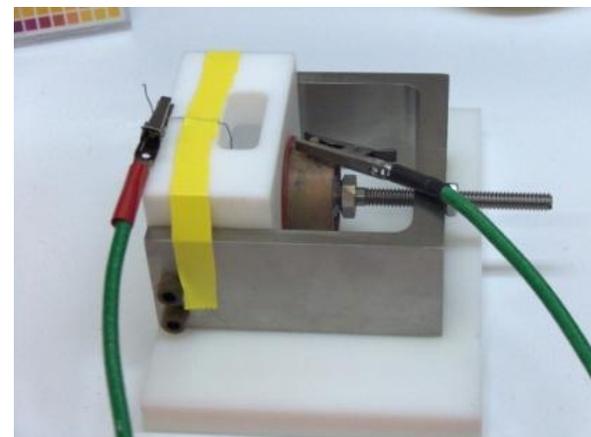
Research on the ammonium acetate electrodeposition methods evaluated the use of UV/Vis as a tool for measurement of the effectiveness of the electrodeposition processes. The pictures to the right compare the amount of gas production.



Separation and purification of Bk using resins and oxidation changes

Chris Jensen, Nuclear Materials Processing Group

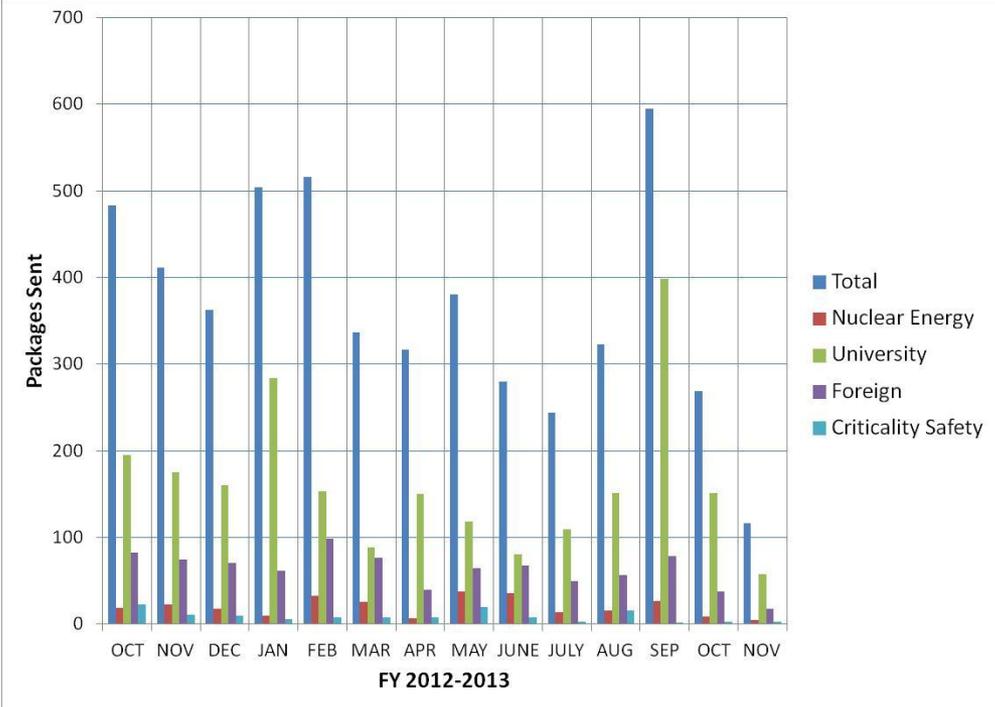
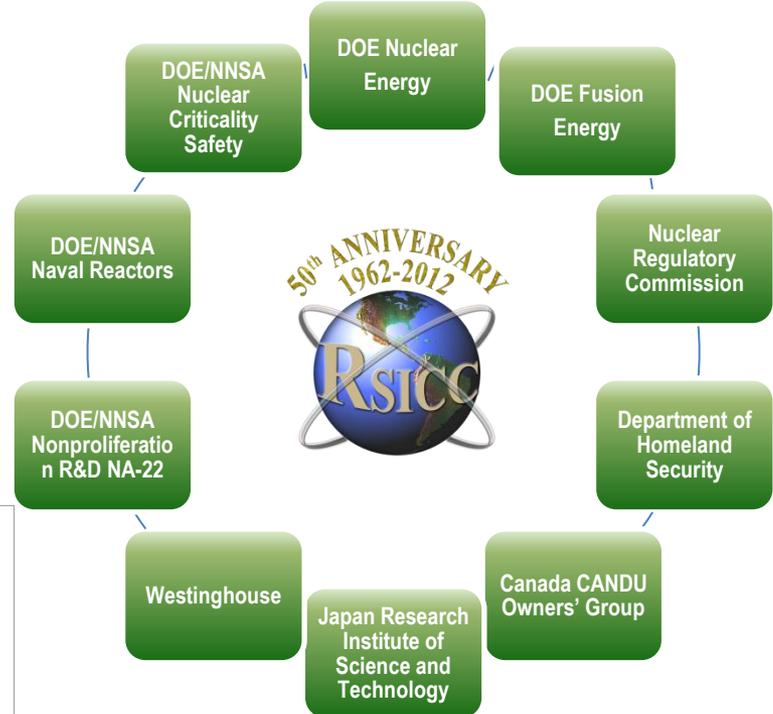
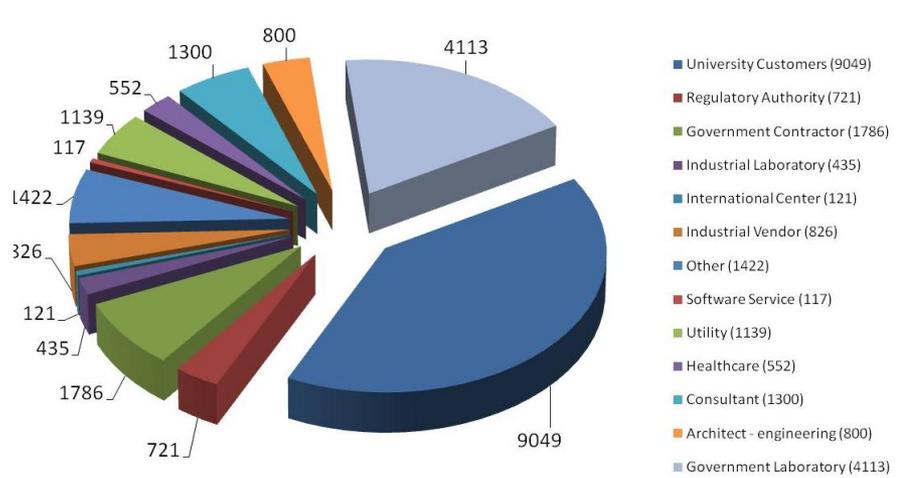
This project evaluated measurement methods for determining Bk-249 beta and Cf-249 gamma activities



Electrodeposition Unit 

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

RSICC Customer Base



- **Software and data packages distributed FY2013: 389**
- **3 package updates and revisions November 2012**

- Completed consolidation of Campaign 75 rework material which will be stored until Heavy Element Campaign 76.

Heavy Element Campaign C75



- Completed Cleanex Extraction for Zirc removal.
- Performed M19RTL-1A MXS Run for separation of Actinides and Lanthanides.
- Completed Feed Adjustment for M19CL-1 Cleanex MXS Run.

Americium-Curium Processing



- Continued processing of received customer orders.

Cf-252 Production



- Conducted analysis of the gap between the tube and pellets after hydrostatic compression using surrogate materials.
- Placed six tensile targets into HFIR

Pu-238 Operations



- Shipments: Two Ac-225 Shipments with a total of 14.5 mCi shipped
- ORNL will host the 8th International Symposium on Targeted Alpha Therapy (TAT) during June 2013 at ORNL. Planning is underway.

Actinium Production



- The Remote Hot-Cell Target Fabrication Equipment Upgrade Project is in progress at REDC - Continued design of the transfer arm for Cubicle 1; initiated solicitation of vendor concepts and budgetary proposals for replacing the Cubicle 2 target assembly machine; and, continued troubleshooting of the Cubicle 3 pellet fabrication systems with initial emphasis on hoist repair.

Target Fabrication Equipment Upgrade



Enriched stable isotope technical services and shipping

Nine shipments of 28 enriched stable isotopes were made in November

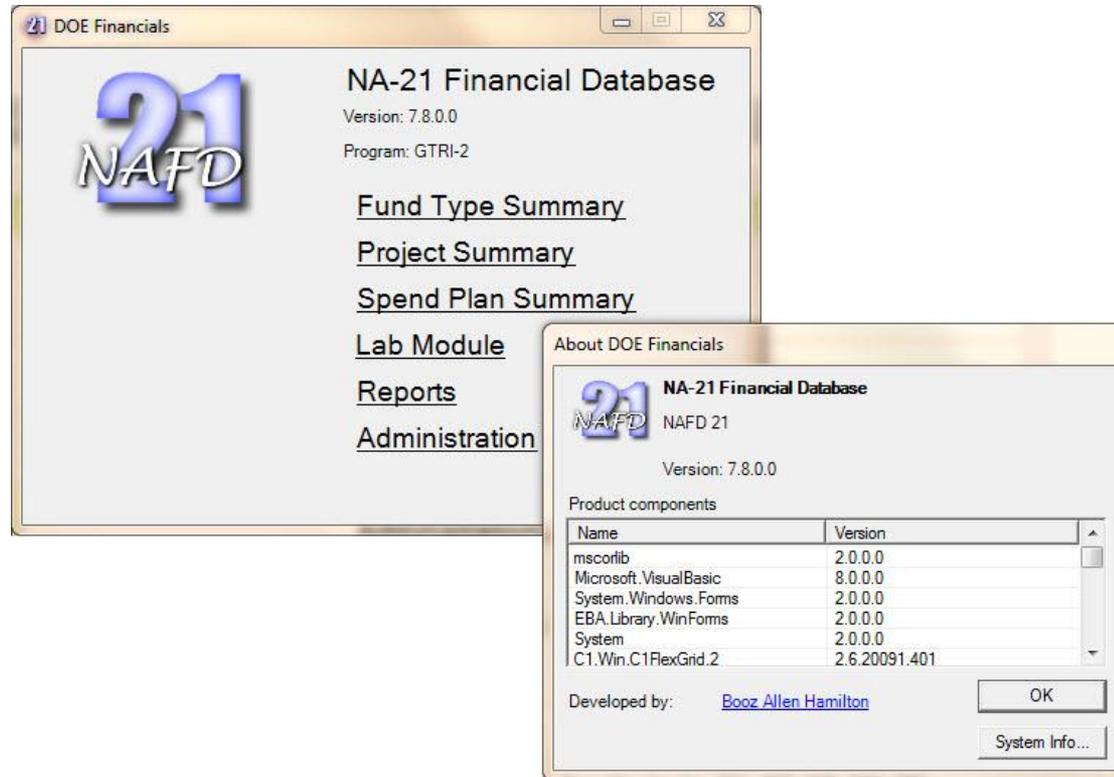
- 26 shipments of 76 enriched stable isotopes have been made in FY13 to date

Thirteen custom technical services were completed in November

- 30 technical services have been completed in FY13 to date
- Included among the 13 in November were:
 - pressed Gd-152 oxide and Zr-92 oxide discs of various sizes that were encapsulated in custom HDPE holders for leases,
 - a Pt-195 foil was prepared by rolling
 - 400 mg of highly reactive Ba-137 metal was subdivided into 10 portions and vacuum sealed in ampoules for shipment to the customer.

NA Financial Database Application (NAFD) version released

A new standalone version of the NA Financial Database Application (NAFD) was recently released for the NA-21 program office. The NAFD application is used by several Defense Nuclear Nonproliferation program offices for submitting monthly cost and commitment data at the project level.





Ministry of Defence of the Russian Federation

Russian Federation Ministry of Defense Upgrades and Sustainability – ORNL assisted DOE in drafting a joint position paper with the Defense Threat Reduction Agency (DTRA) for a proposal on continuing joint efforts with the Russian Federation (RF) Ministry of Defense (MOD) after the expiration of the current umbrella agreement. This will be discussed at the upcoming 21st DOE Office of Nuclear Warhead Protection Joint Coordination Group meeting scheduled for December 4–7, 2012 in Moscow, Russia.

ORNL also participated in sustainability assurance activities to the Kola Technical Center and two RF Navy Sites located in Northern Russia to ensure the systems and facilities supported by DOE at these sites are being maintained and utilized in accordance with the agreements between DOE and RF MOD.

Other GNSTD project highlights

- The contract ORNL has with the NRC to provide support for Regulatory Guide development and revision has been extended for 1 year
 - The extension will take the period of performance of the contract to 6/27/2014
- Researchers from ORNL's Nuclear Material Detection and Characterization Group were instrumental in providing support for an NNSA-sponsored Warhead Measurement Campaign held recently at the Pantex Plant near Amarillo, Texas
- Ron Cain (ORNL), Linda Hansen (ANL), Mark Killinger (PNNL), and Roberta Burbank (PNNL), met with the Vietnam Agency for Radiation and Nuclear Safety (VARANS) and Vietnamese policy makers on November 27–28, 2012
 - Provided information on the obligations of the International Atomic Energy Agency's Additional Protocol (AP)
 - Vietnam ratified the AP in September of this year and their initial declaration is due in March of 2013



Nuclear security training & education activities

Security in the Transport of Nuclear Materials – Jakarta, Indonesia –

ORNL's NTRC Team (Paul Singley, David Duhamel, and Dyrk Greenhalgh) traveled to Jakarta, Indonesia to instruct BAPETEN government officials on Security in the Transport of Nuclear Materials. Sandia National Laboratory was the organizer of the 2 ½ day event.

Regional Training Course on Security in the Transport of Radioactive Material –

Kimberly Anderson was an invited lecturer at the IAEA's Regional Training Course on Security in the Transport of Radioactive Material. The course attempts to provide the participants with the necessary knowledge to develop and implement national transport security requirements.

CASL highlights

CASL Collocation

Product Applications and Product Integrator Plan of Record Milestone

Thermal Hydraulics Progression Problems

Virtual Reactor Integration Milestone review

Code Verification

Define Plan of Record 7 Level 1 Crud Milestone - Assembly Modeling

VOCC Tours:



Milestone Deliverables

Completed an initial steady-state turbulence validation study of Thermal Hydraulics CFD test cases

A convergence, sensitivity, and validation study on two CASL-relevant multiphase computational fluid dynamics codes, including code-to-code verification and validation against several experimental benchmarks.

RNSD highlights and activities

- RNSD staff provided the DOE Forensics Operations Team with a two-day training session on ORNL's DELFIC Fallout Planning Tool. Lead PI: Vince Jodoin
- RNSD radiation transport capabilities (ADVANTG and Denovo) are being integrated into the operational modeling and simulation toolset being developed by the Defense Threat Reduction Agency (DTRI). Lead PI: Bob Grove
- Mike Dunn led a six-person team from RNSD that participated in four days of meetings on the status of nuclear data in the US. They reported on improvements in data evaluations and processing methodologies and participated in the Nuclear Data Advisory Group for the US Nuclear Criticality Safety Program.
- Luiz Leal participated in an OECD Nuclear Energy Agency Working Group investigating the possibility of deploying an international nuclear data evaluation file to replace current evaluated files developed and released separately by the US, EU, and Japan.



Assembly of the thermal/hydraulic test loop for salt coolant progressed

• Gas Cleaning System for FLiNaK Salt Loop

- Completed/ approved AES' Activities Hazards Analysis and 851 Implementation Matrix
- Obtained hot work and penetration permits
- Received approval of SBMS variances for regulator (ultra-high purity needs) and continued pursuit of variance for relief valves
- AES mobilized to site and began work with completion planned for early December



AES H2 Control Panel
as of 11/28/12

AES Argon Control
Panel as of 11/28/12



AES Demonstration of Orbital Welder

EMPO is providing project management assistance with this project

Materials irradiation – November

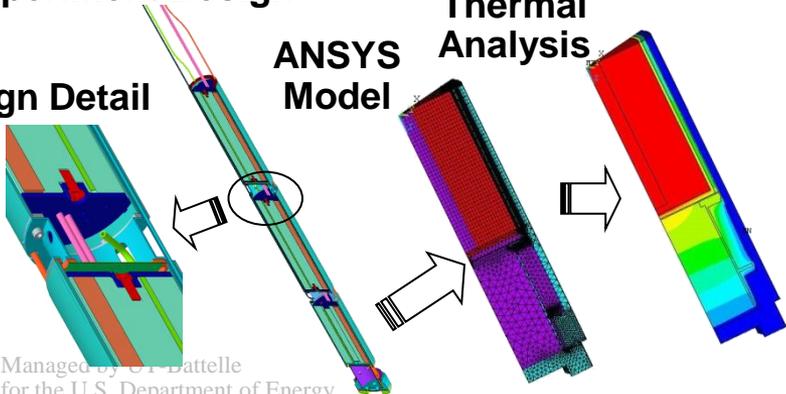
Project	Format	Sponsor	Stage					Notes
			Newly proposed	In Design	In Fabrication	In Reactor	Removed	
Titan Metal	Rabbit	DOE, FE US-Japan				18 (Cycle 443) 2 (Cycle 446)		Tungsten and steel
Composite Flexure	Rabbit	DOE, FE				8		SiC
Mini-Composite	Rabbit	DOE, FE		4		2013		SiC
Round-bar Tensile	Rabbit	DOE, FE		4+		2013		Steel
Hydrided Clad	Target	DOE, NE			2	2	2	Zircaloy
Ibiden	Rabbit	WFO, Ibiden				26 (10 waiting)	2	Graphite
Nippon	Rabbit	WFO, Nippon		31		2013		Graphite
UO2 TEM disks	Rabbit	Texas A&M			1	Cycle 446		UO2
Titan Tensile	Rabbit	DOE			12	6		V-4Cr4Ti, SiC, Graphite, steel
EPRI	Large VXF	EPRI			3	2013		Steel, Inconel
Toyo Creep	Target	Toyo Tanso			3	2013		Graphite
PU238	Capsule	NASA					7	Tensile
PU238	Capsule	NASA			9	Cycle 446		Single pellet
Inconel springs	Rabbit	AECL		~40		2013		Inconel
Graphite Creep	Rabbit	EDF		5		2013		Irr. Graphite
SHINE	Rabbit	DOE		TBD				Mo-99
Exotic Ceramic	Rabbit	DOE, FE		9		2013		TiSiC Ceramic
SiC Joining tests	Rabbit	DOE, FE		21		2013		SiC

Experiment Design

Thermal Analysis

ANSYS Model

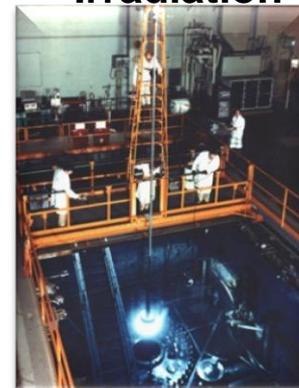
Design Detail



Experiment Fabrication

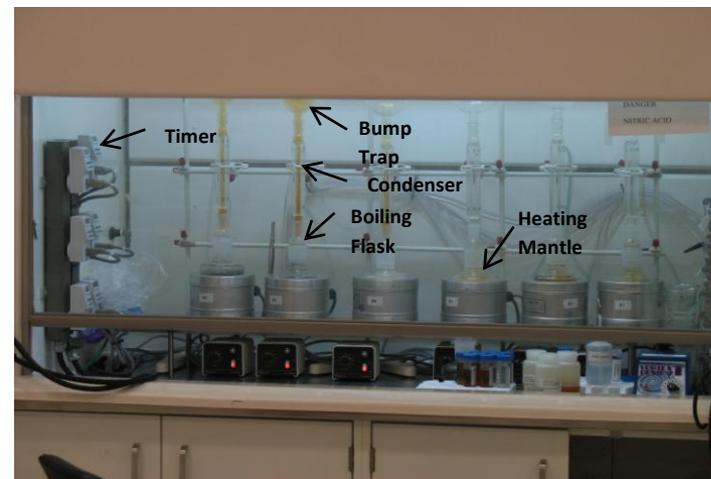


Irradiation



Coated Particle Fuel Development Team demonstrates leach-burn-leach (LBL) procedures to Babcock and Wilcox – Nuclear Operations Group (B&W-NOG)

During a recent visit, scientists and technicians from B&W were provided demonstrations of the fuel compact electrolytic deconsolidation used to liberate coated fuel particles from the surrounding graphite matrix, acid leaching used to detect impurities and provide statistical data on fuel defect fraction, and relevant nuclear analytical chemistry techniques.



Six-station LBL hood.

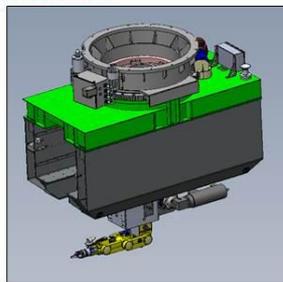
ORNL's successful development and demonstration of high-quality coated particle fuel fabricated at laboratory-scale is now being transferred into a production-scale capability at B&W-NOG, a commercial fuel vendor. Important characterization and quality control methods, such as LBL, developed at ORNL in support of the lab-scale fuel fabrication, are also being duplicated.



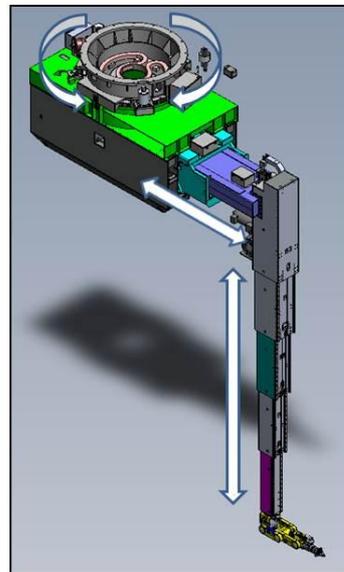
Building 7930 Cell-G PaR Manipulator System Detail Design Complete

- Remote Systems Group assisting with replacement of Building 7930's Cell-G PaR manipulator system.
- Assisted with preparation procurement specification for detail design, fabrication, testing, and delivery of the new manipulator system by PaR, Inc.
- Continuing to work on the detailed design of related equipment required for installation.

Status: PaR completed detail design under ORNL guidance



- Retracted position will fit through Cell G shield plug opening
- Extended position provides nearly equivalent remote handling coverage in Cell G



Mobile Mercury Transfer System (MMTS) design review

The initial remote process systems design review of the MMTS was completed

- ❖ A quarterly program review was conducted with the Defense Logistics Agency (DLA) sponsor November 7
- ❖ \$1.9+ M in FY-2013 funding was received



Iodine separations from used nuclear fuel

A method to quantify iodine removal from used nuclear fuel after NO_2 voloxidation is under development



Loaded CSI for Separation Process Validation

Cold trials for the extraction with CCl_4 , separation with caustic containing thiosulfate and precipitation with AgNO_3 of iodine as AgI have been initiated for proof of process



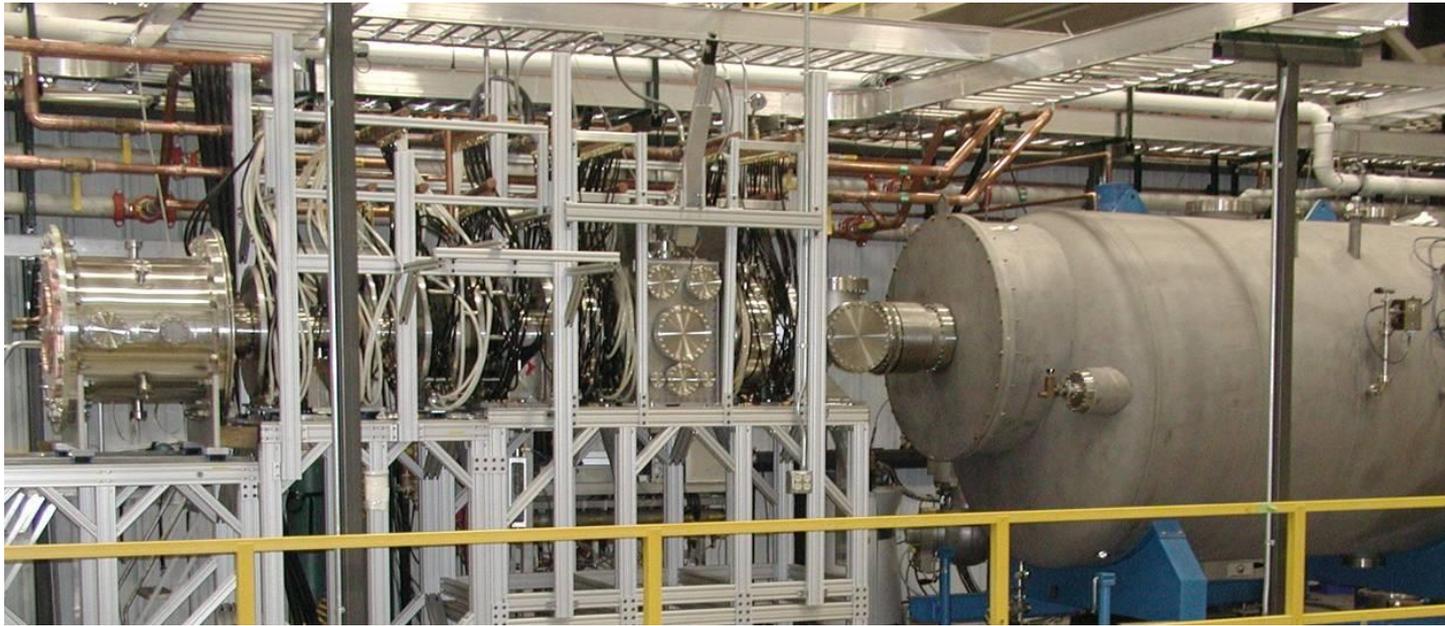
Precipitated AgI product

Initial results show desired separation and are being verified by XRD analysis

Papers presented at the 6th International Topical Meeting on High Temperature Reactor Technology

- C.A. Baldwin, J.D. Hunn, R.N. Morris, F.C. Montgomery, C.M. Silva, and P.A. Demkowicz, "First Elevated Temperature Performance Testing of Coated Particle Fuel Compacts from the AGR-1 Irradiation Experiment," Proceedings of the 6th International Topical Meeting on High Temperature Reactor Technology (HTR2012), Tokyo, Japan, October 28–November 1, 2012.
- J.D. Hunn, R.A. Lowden, J.H. Miller, B.C. Jolly, M.P. Trammell, A.K. Kercher, F.C. Montgomery, and C.M. Silva, "Fabrication and Characterization of Driver Fuel Particles, Designed-to-Fail Fuel Particles, and Fuel Compacts for the US AGR-3/4 Irradiation Test," Proceedings of the 6th International Topical Meeting on High Temperature Reactor Technology (HTR2012), Tokyo, Japan, October 28–November 1, 2012.
- P.A. Demkowicz, J.D. Hunn, R.N. Morris, J.M. Harp, P.L. Winston, C.A. Baldwin, F.C. Montgomery, "Preliminary results of post-irradiation examination of the AGR-1 fuel compacts," Proceedings of the 6th International Topical Meeting on High Temperature Reactor Technology (HTR2012), Tokyo, Japan, October 28–November 1, 2012.
- S.A. Ploger, P.A. Demkowicz, J.D. Hunn, J.S. Kehn, "Microscopic analysis of irradiated AGR-1 coated particle fuel compacts," Proceedings of the 6th International Topical Meeting on High Temperature Reactor Technology (HTR2012), Tokyo, Japan, October 28–November 1, 2012.

Progress continues to be made on the Physics Integration eXperiment (PhIX)



- PhIX integrates a helicon plasma source with microwave electron heating (whistler and electron Bernstein waves) to increase the plasma heat flux at a target
- Subsystem connections are nearly complete:
 - Vacuum system: Major leaks have been repaired, second turbo pump connection complete
 - RF Helicon system: New water-cooled antenna connection finished, interface with transmitter is complete
 - Magnet system: new magnet configuration connections are in-process and nearly complete
 - Microwave system: safety review for X-ray generation completed, interlock with chamber pressure is in-progress
- Magnet power supplies are waiting for new transformer commissioning: close to complete
- Plasma operation expected in early January



Diego Del-Castillo-Negrete is an author on a publication entitled, “Self-Consistent Dynamics of Impurities in Magnetically Confined Plasmas: Turbulence Intermittency and Nondiffusive Transport,” that was published in ***Phys. Rev. Letters* 109, 185005 (2012)**.

- ✓ Diego and his co-authors carried out the first-ever simulation of self-consistent turbulent transport due to high-concentration impurities using a three-dimensional nonlinear fluid global turbulence model that includes ion temperature gradient and trapped electron mode instabilities.

<http://prl.aps.org/abstract/PRL/v109/i18/e185005>



Juergen Rapp is an author on a publication, “Radiative Type-III ELMy H-mode in All-tungsten ASDEX Upgrade,” that was published in ***Nuclear Fusion* 52 (2012)**.

<http://iopscience.iop.org/0029-5515/52/12/122002/>

- Development of an FY13 infrastructure requirements schedule is underway
- Building 7625 activities
 - LOTO Assessment closeout meeting conducted and final report in process.
 - Cost estimate (\$1.2M) completed for installation of vertical material lift and modification/update of exhaust ventilation system to support R&D use



7625 Exhaust Ventilation System



LOTO Assessment

EM project integration support

- UT-B shipped SNAP-7C/ Weather Bureau RTG “double stack” in support of the SEC Miscellaneous Facilities Project
- The total of the 5 RTGs loaded and shipped contained over 220,000 Ci of ^{90}Sr
- EM Contractor SEC continued their investigations of 3026D Cell A and continued removal of LLW items from 3026D Cell B
- EM Contractor UCOR completed Phase I and began development of the estimate for Phase II on the transition of Building 3038



SNAP-7C/ Weather Bureau Double Stack Ready for Shipment

4500 area gaseous waste reconfiguration and stabilization project

- Completed commissioning of the new ventilation and HOG systems at 4501/4505/4500N
- NNFD completed tie-ins and began hot operation of 4501/4505 cell ventilation system, 4501 hood exhaust system, and 4505 HOG system
- FMD initiated tie-in of 4500N HOG system
- Completed preparation of safety basis documentation for 3106 Filter Pit, 4500 Area Vent Duct, and 4500 Area HOG system in preparation for receipt of facilities from EM
- Consummated DOE-EM to DOE-SC MOA for ops transfer of 3106 Filter Pit and vent duct
- Conducted remote visual inspection and radiological survey of 3106 Filter Pit interior



New 4500N HOG HEPA Housing



New 4501/4505 Hot Cell Vent HEPA Housing



Preparing to Remove Observation Port Shield Plug at 3106 Filter Pit

Central Campus Legacy Material Removal Project

NNFD

2026 Activities

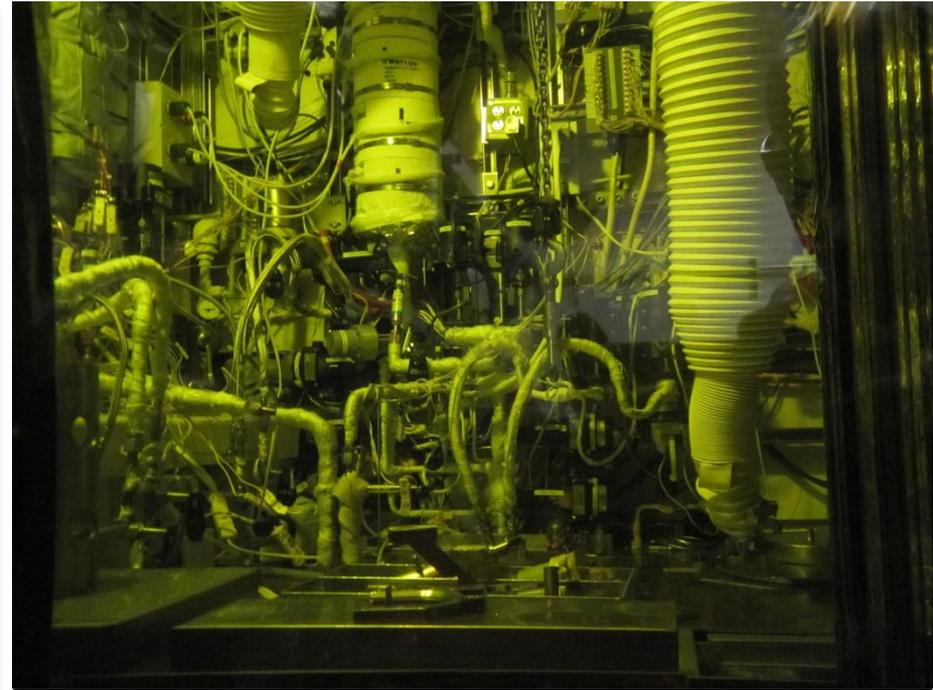
- Continued waste sorting and segregating activities
- Loaded full waste boxes into sealand
- Packaged 240cf of waste for a cumulative project total of 720cf

4501 D Cell Activities

- Initiated equipment removal activities
- Received characterization data from lab
- Preparing for manned entries for equipment removal



Waste Staged for Disposal in Sealand at 2026



Hot Cell D at 4501

Hot Cell Availability

Facility Upgrades and Maintenance Activities

99.8% Bldg. 7920

97.5% Bldg. 7930

100% Bldg. 3525

100% Bldg. 3025E

7920

- Programmed maintenance operations.
- J113A Recirculating Cooling Water pump replacement.
- Lab 108 Renovation.
- Cubicle 9 Re-lamping Operations.
- J-161 Perimeter Heat Recirculating Pump repairs.

7930

- Programmed maintenance operations.
- iCAM Remote Monitoring Upgrade underway

3525

- Programmed maintenance operations

3025E

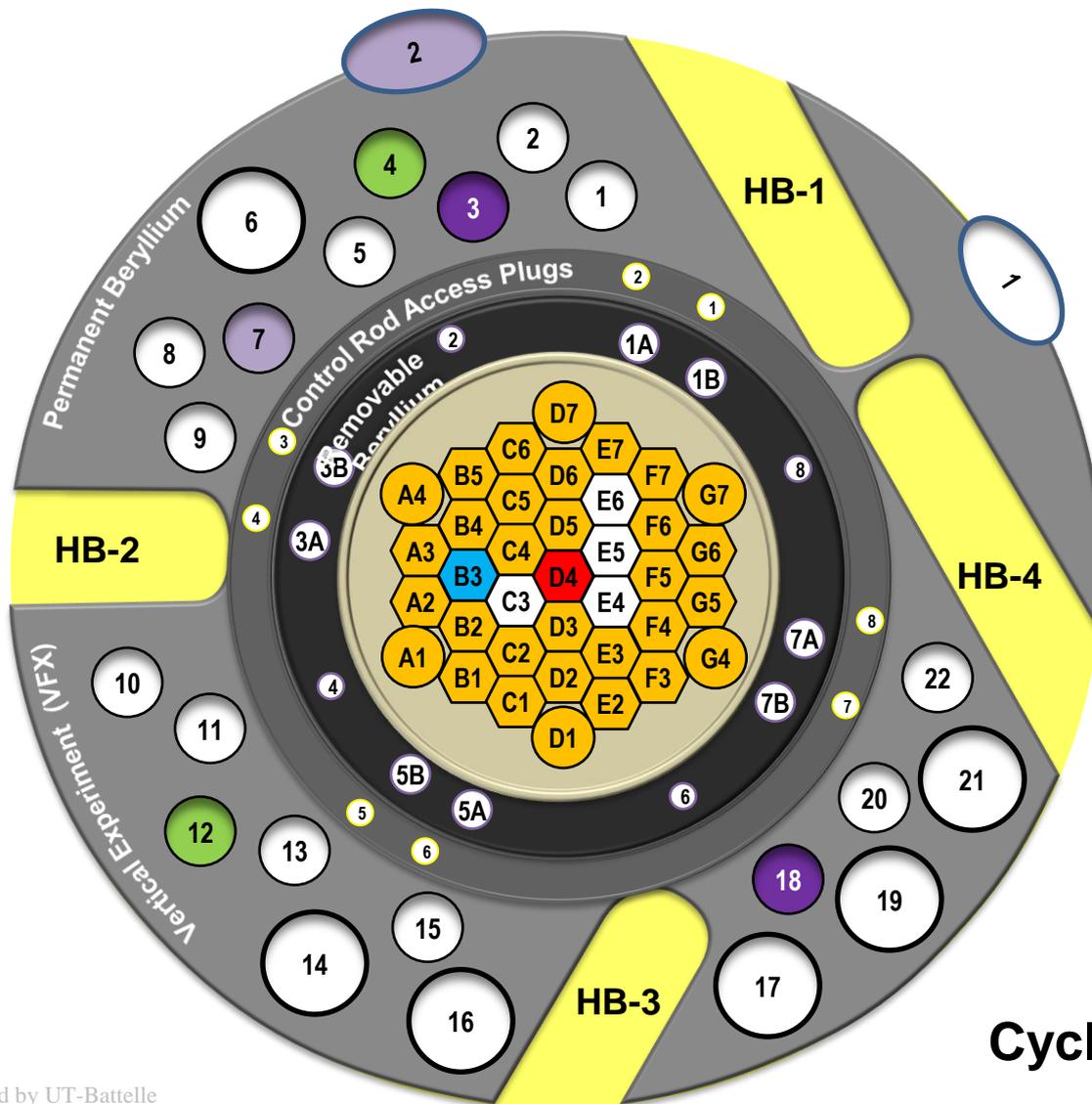
- Programmed maintenance operations

Materials irradiations remain near record levels in cycle 445 during November

HFIR

November 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 ON



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

Cycle 445 summary

The number of Cycle 445 irradiations being driven by materials research and Pu-238 research

Materials and Fuels Experiments

- Silicon Carbide
- V, Mo, & Cu alloys
- Zircaloy
- UO₂ Fuels
- UCN Fuels
- Graphite
- Steels

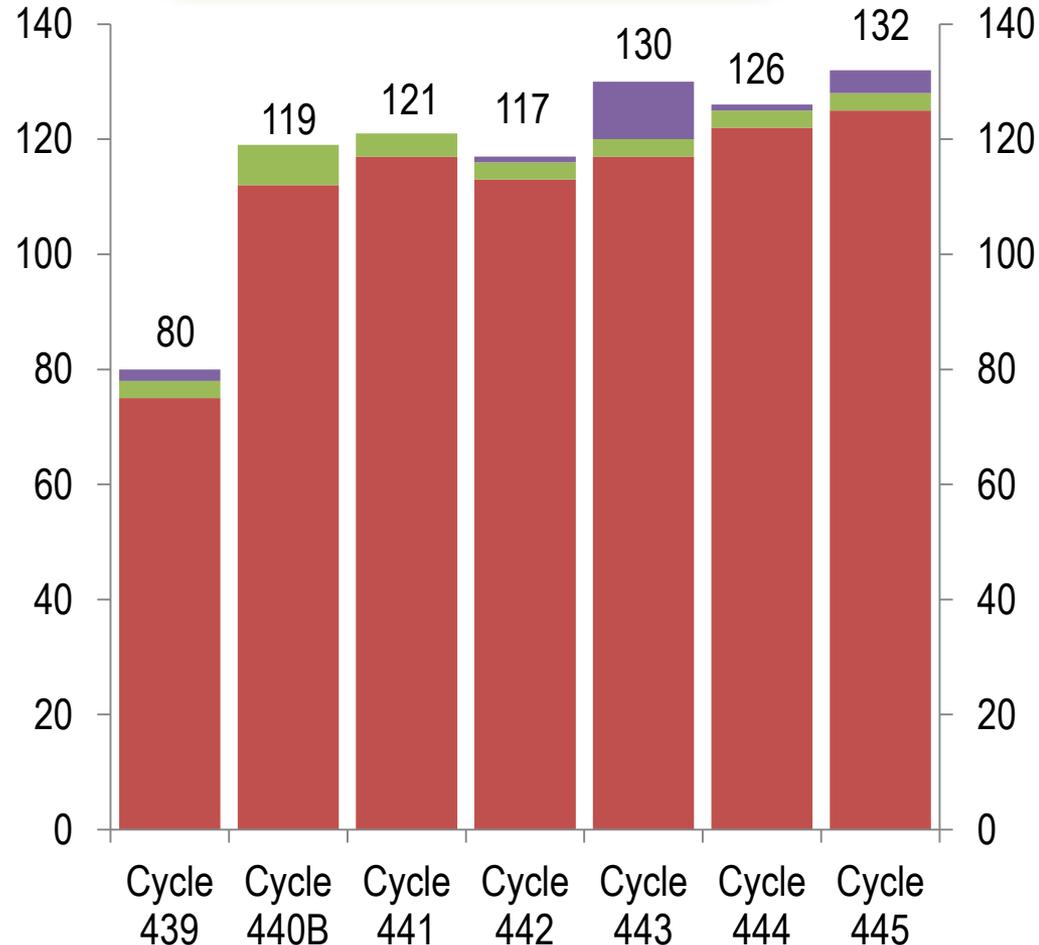
Commercial Isotope Production Capsules

- Selenium (Se-75) - production

Isotopes for Research

- Pu-238 Tensile specimen samples
- Pneumatic Tube irradiations

132 total irradiations for Cycle 445



Neutron Activation Analysis (NAA) irradiations during cycle 445

NAA irradiations during Cycle 445 include

- 72 IAEA Pre-inspection checks
- 74 Trace element analysis for Ionomics project to determine how trees will behave during climate change
- 12 Flux monitors both shielded and unshielded at 10% and 100% power
- 34 Trace elements in hair
- 4 Plant spores for Mutagenics Project to determine how moderate neutron doses affect the germination of these organisms
- 2 Thorium targets for investigation of the burnup and yield of Pa-233
- 1 Diamond detectors for CERN experiments on the LHC
- 1 Graduate student research at Virginia Tech on radiation effects on graphene and carbon nanotubes
- 1 Enriched Sm-102 for tracer production of Sm-103 for separations research from Eu

Total 201

