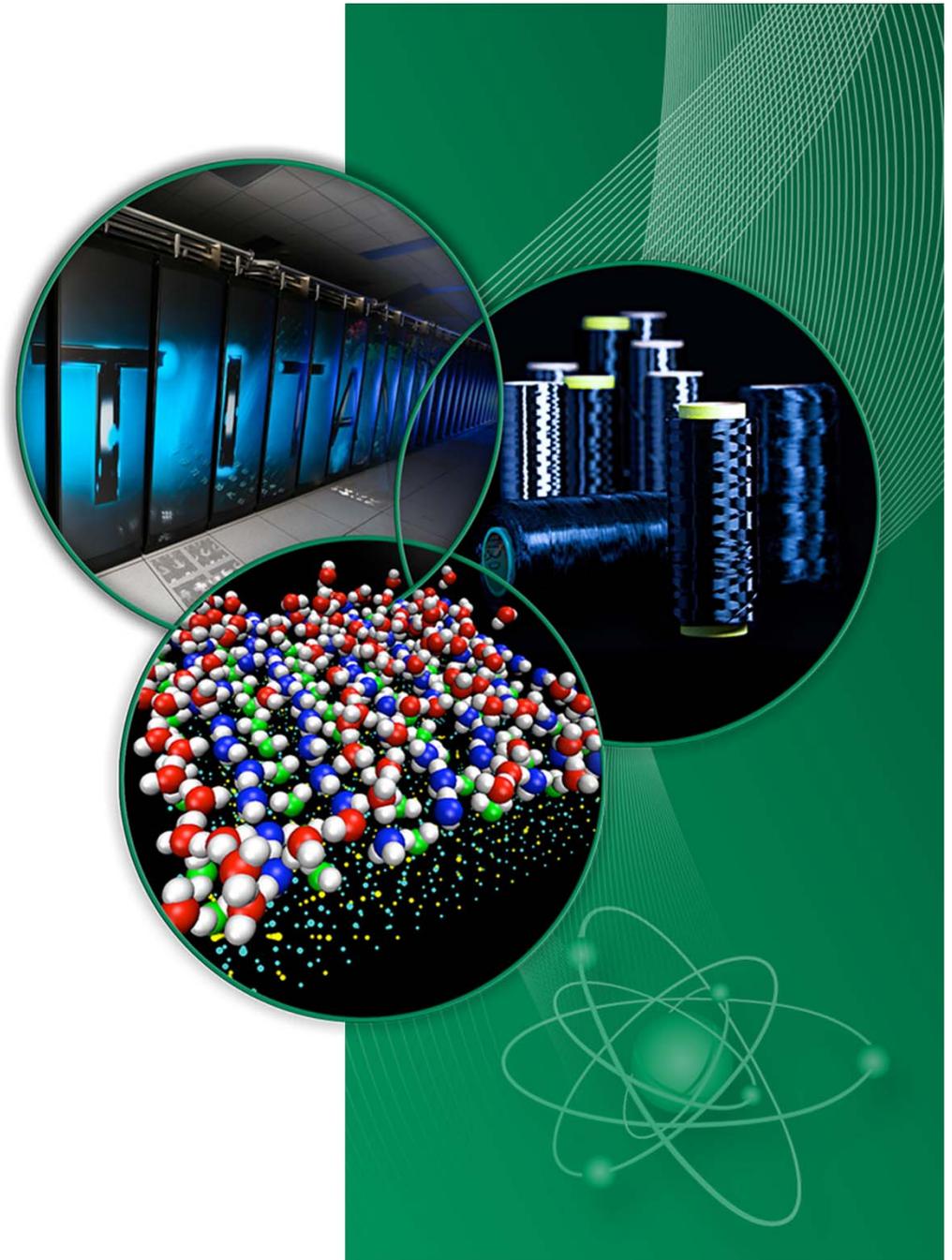


NSED Monthly Report

March 2014

Nuclear Science & Engineering Directorate

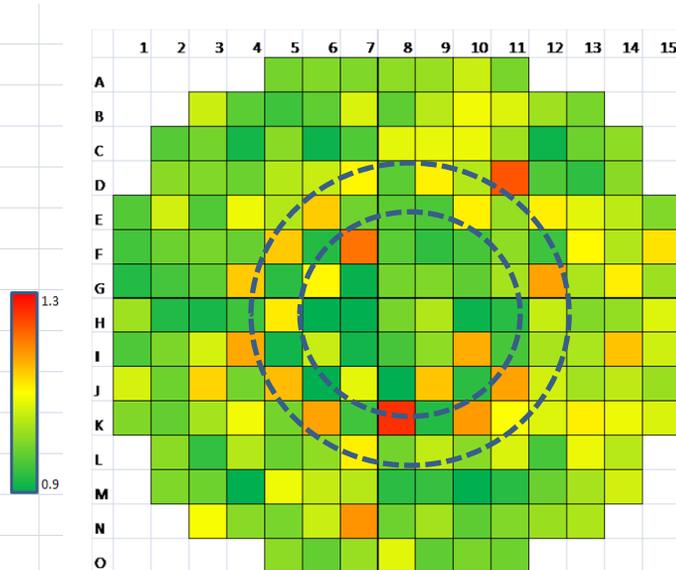
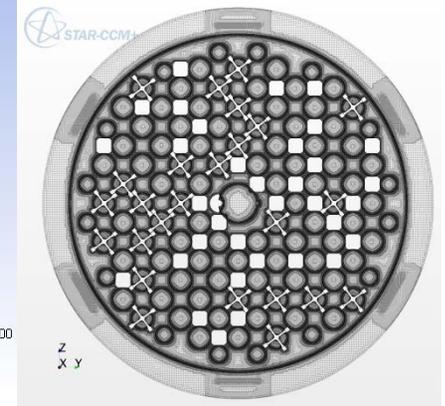
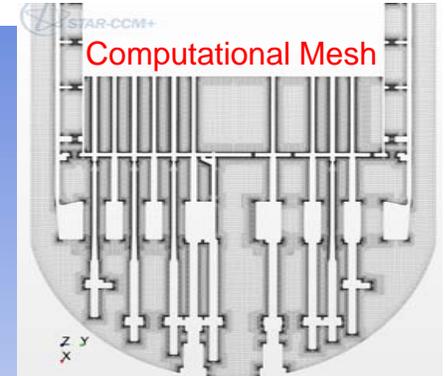
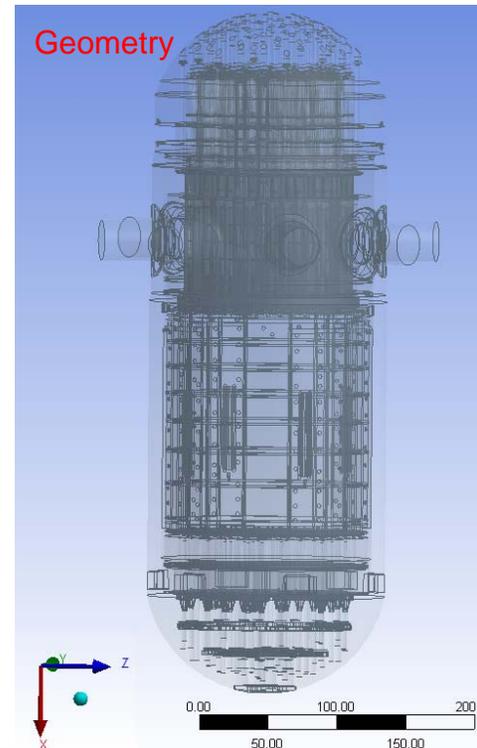


New Computational Fluid Dynamics (CFD) model developed for Watts Bar reactor vessel

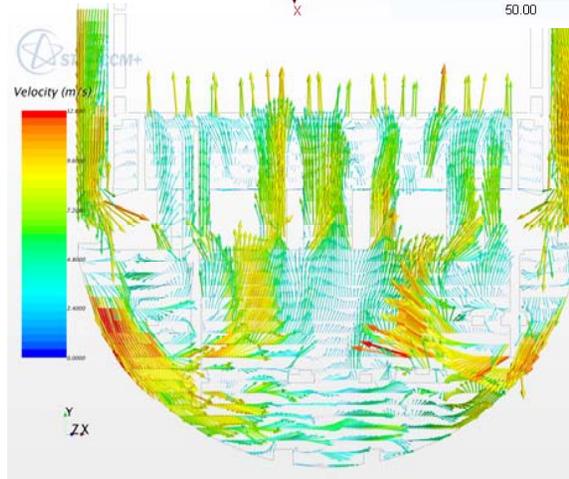
Science Highlight



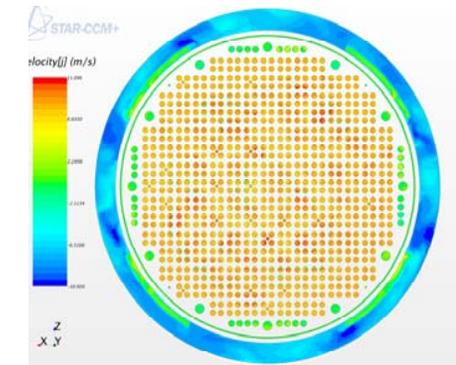
- A new CAD (solid) model for the TVA Watts Bar whole Reactor Pressure Vessel (RPV) with most of the features of the geometry faithfully captured.
 - CFD mesh generated consists of 299 M hexahedral cells.
- Preliminary CFD results have uncovered interesting flow dynamics at the inlets of the fuel assemblies
 - The adjacent fuel assemblies with large flow rate difference in the marked area represent area of potential susceptibility to Grid To Rod Fretting (GTRF), which has been observed in plant operations
- Further investigations will proceed as part of the TVA Test Stand on CFD analysis of lower plenum flow anomalies



2 Normalized Flow Rate at fuel assembly inlets



Flow Distribution in Lower Plenum



Flow Distribution at Core Plate

WNU Summer Institute alumni assembly

ORNL hosted the World Nuclear University (WNU) Summer Institute Alumni Assembly on March 31- April 4, 2014

The WNU Summer Institute is a six week program held at Oxford University's Christ Church College for selected early career nuclear professionals

The alumni assembly held at ORNL was the second of its kind, and featured specialized training sessions on research reactors, safeguards inspections, nuclear safety culture, and nuclear security

Invited speakers included distinguished leaders Pete Lyons (DOE Assistant Secretary of Nuclear Energy), Patricia Wieland (WNU President), William Magwood (Nuclear Regulatory Commissioner), and Thomas Countryman (Department of State Assistant Secretary for International Security and Nonproliferation)



Distinguished speakers at the World Nuclear University gathering toured ORNL facilities and engaged in discussions around ORNL capabilities



Thomas M. Countryman

Assistant Secretary,
Bureau of International Security and
Nonproliferation



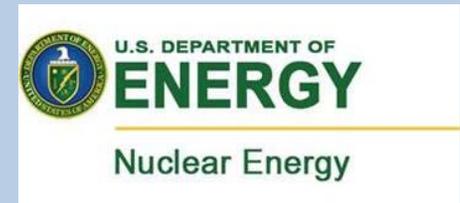
William D. Magwood, IV

Commissioner,
U.S. Nuclear Regulatory Commission



Dr. Peter B. Lyons

Assistant Secretary for Nuclear Energy



Farragut Press Article Highlights Wagner Brothers

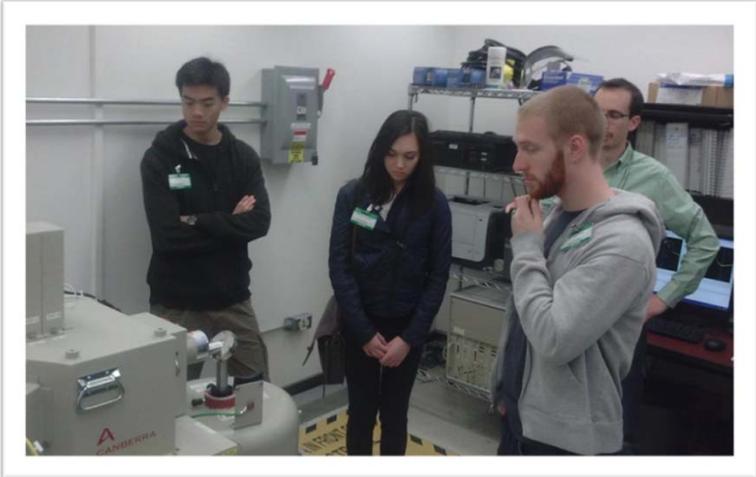


Along with his brother Robert, John Wagner (RNSD - pictured on left side of photo) was mentioned in a recent article appearing in the *Farragut Press* community newspaper. Both brothers began their journey at Oak Ridge National Laboratory as summer interns back in the early 1990s and have been very successful in their independent fields. The article highlights some of their accomplishments at ORNL.

<http://www.farragutpress.com/articles/2014/03/2586.html>

Next Generation Safeguards Program

- Hosted 6 universities for nonproliferation workshops:
 - University of Florida: March 3-7
 - North Carolina State University: March 10-13
 - University of Georgia and Mercyhurst University: March 18-21
 - Clemson University: March 25-27
 - University of Tennessee: March 24 and March 31
- Supported ORNL subject matter experts giving guest lectures and live Q&A sessions at the University of Tennessee, Knoxville (UTK) and through VTC for North Carolina State University (NCSU):
 - Lisa Loden and John Begovich, "Experiences in DPRK " for UTK (and the University of Florida joined)
 - Chris Pickett, "Containment and Surveillance" for NCSU
 - Michael Whitaker, "Enrichment Safeguards" for NCSU

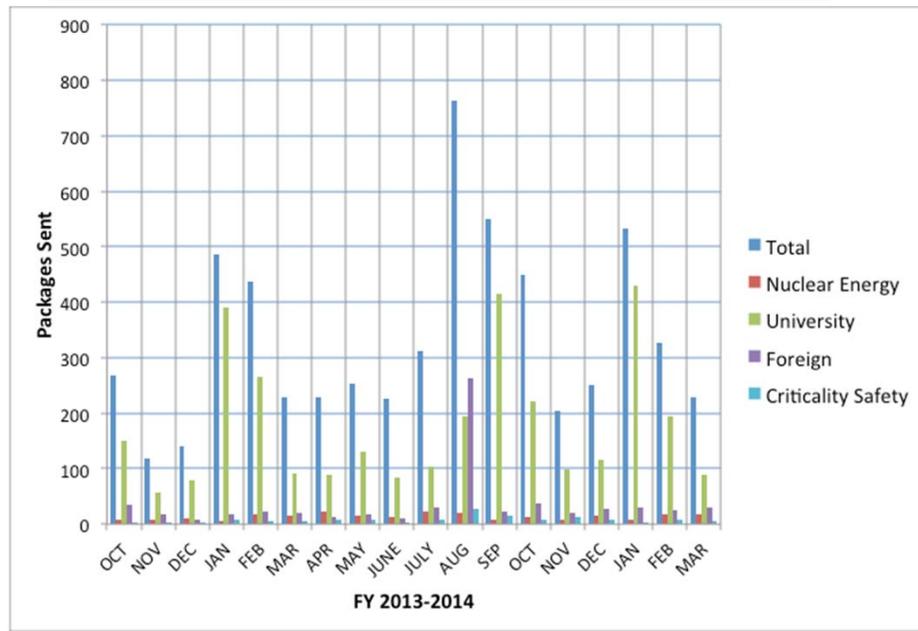
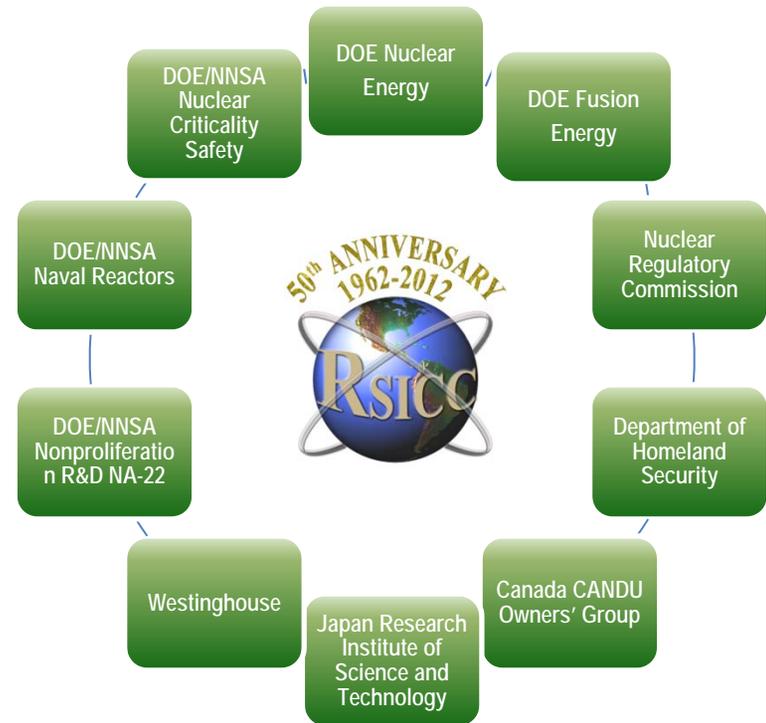
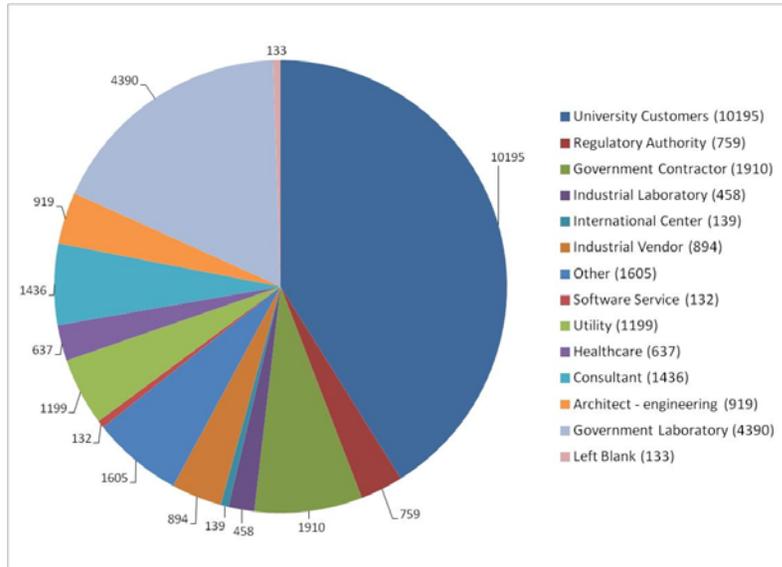


University of Georgia graduate student using a manipulator during a tour of REDC



NCSU Students learning about the Hybrid K-Edge Densitometer

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



- Software and data packages distributed FY2014: 1994
- 4 package updates and revisions March 2014

Radioisotope Production



Ac-225 purification glove box line at the Radiochemical Engineering Development Center

Ac-225 Program

Completed five shipments to three customers with a total activity of 27.6 mCi

Cm Target Refurbishment

A sufficient number of pellets have been pressed to meet production demands



Single curium oxide pellet

Pu-238 Production Program

- Fabrication of Np-237 pellets for target loading campaign 3 was completed
- Successful evaluation of spectrophotometric measurements of the Pu valences was conducted



Plutonium solution samples of valence states III, IV, and VI

Radioisotope Research & Development



Cf-251 Electrodeposition Studies

- Segments #3 and #4 have been successfully fabricated
- Video documenting the packaging and shielding of the segments for shipping has been completed and shared with staff at Dubna, Russia



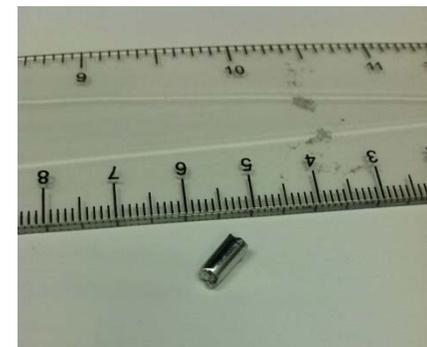
Mockup of loading shipping container with shielded sectors

Transcurium Optimization Study

Three targets have been fabricated; Am-243, Cm-245, and the mixed Cf



Drying block holding sample solutions



Finished target sample

Enriched stable isotope technical services and shipping

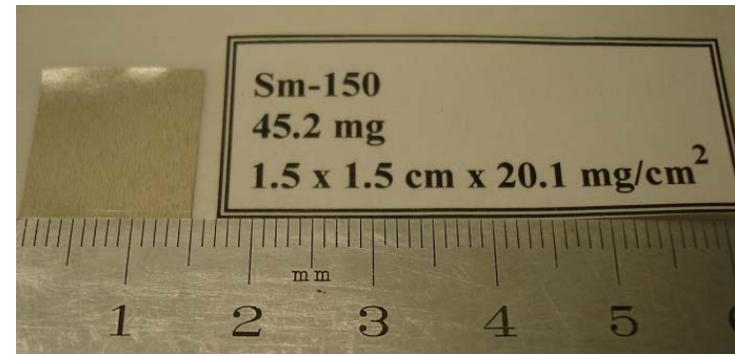


Eighteen shipments of 28 enriched stable isotopes were made in March

- 67 shipments of 216 enriched stable isotopes have been made in FY14 to date

Eleven custom technical services were completed in March

- Technical services included those below
 - 63 technical services have been completed in FY14 to date
- 200 liters of O-16 to a commercial customer
 - Metals of Mg-26, Sm-150, Sm-152, Pb-208, Pb-207, Zn-66, Zn-64, Cr-54 converted from oxides



Sm-150 target to be used in the study of K-isomers



Second Line of Defense activities



NSITD's Alex Enders and Michael Shannon at the IPPR meeting

Implementation Program and Project Review meeting – The NA-256 Second Line of Defense (SLD) program conducted the first annual SLD Implementation Program and Project Review (IPPR) meeting in Washington, DC, on March 25 and 26. ORNL participants included Mabelle Sumner, Alex Enders, Alan Krichinsky, Nathan Rowe, and Michael Shannon. The implementation program will be implementing fixed radiation detection systems in Jordan, Peru, and Belarus as well as preparing for regional implementation of large container seaports.

Multilateral Nuclear Environmental Programme in the Russian Federation Agreement – The SLD program met with their Russian counterpart – Federal Customs Service to discuss works plans under the Multilateral Nuclear Environmental Programme in the Russian Federation (MNEPR) agreement from March 11-14, 2014 in St Petersburg, Russia. Mabelle Sumner led this delegation and conducted discussions on the implementation memorandum, continued implementation of the communications system, and demonstration of the communications system in the Southern Customs Directorate (Sochi, Volgograd, and Ukrainian border).



Mabelle Sumner and members of the SLD program meet with Russian counterpart



Cambodian Customs Officers conduct a container inspection

Southeast Asia Activities – as part of a tripartite partnership between DTRA, the European Commission – Joint Research Centre, and SLD to install radiation detection equipment at the Phnom Penh Autonomous Port New Container Terminal (PPAP-NCT), Georgia Adams traveled to Cambodia to facilitate a final agreement on equipment placement and concept of operations with Cambodian officials. Adams also conducted an assurance visit at the Port of Sihanouk Ville to review the condition of equipment and operations at the site. Adams then traveled to Vietnam to meet with Vietnamese Customs to review agreements on the long-term sustainability of radiation detection operations at the Port of Vung Tau.



ORNL produced equipment featured on NNSA website

The NNSA Office of Proliferation Detection featured a measurement instrument developed and built by ORNL's Nuclear Material Detection and Characterization Group on its website

<http://nnsa.energy.gov/aboutus/ourprograms/dnn/rd/pd>

The Office of Proliferation Detection (PD) develops technologies to detect foreign nuclear weapons programs; supports nuclear arms control treaty verification and monitoring for compliance, and supports national nuclear security.



Our Mission About Us Media Room Federal Employment Blog

SEARCH

The Office of Proliferation Detection (PD)



Home > About Us > Our Programs > Nonproliferation > Research and Development > [The Office of Proliferation Detection \(PD\)](#)



Strategic Trade Control Enforcement Seminar, Saudi Arabia

- ORNL's Terry Donaldson was a co-facilitator for this regional NA-242 sponsored workshop in Riyadh, Saudi Arabia, March 3-5, 2014
- The seminar was sponsored by the World Customs Organization (WCO) for the North of Africa, Near, and Middle East region
- The seminar was held by WCO as one of several activities to increase assistance to member countries to enhance enforcement of strategic trade controls in support of nonproliferation of Weapons of Mass Destruction
- About 20 participants attended from seven countries in the region





Ukraine's Neutron Source Facility completed

- NNSA, GTRI, and representatives of the Kharkiv Institute of Physics and Technology (KIPT) have now completed the construction of the Neutron Source Facility
- In 2010, the United States committed to work with Ukraine to construct a Neutron Source Facility at the Kharkiv Institute for Physics
- This state of the art facility is equipped with the most up-to-date technology to operate at the highest safety standards
- The United States will continue to provide technical support for the Neutron Source Facility as Ukraine completes the necessary final equipment installation, testing, and start-up to make the facility fully operational



ORNL's Kris Gaines served as the Construction Manager on this project and also provided project oversight for the Argonne National Laboratory Project Lead and DOE Sponsor (NA-213)



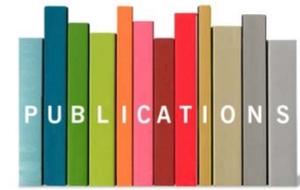
Cadre5, LLC was the winner of a 2014 ORNL Small Business Impact Award

- Cadre5, LLC was the winner of a 2014 ORNL Small Business Impact Award in the "Innovator" category at a recent East Tennessee Economic Council presentation
- The award honors a small business that has developed an outstanding idea, process, project management mechanism, or technology that is crucial to the success of an ORNL client's project
- Cadre5 has partnered with NSITD's Nonproliferation Systems group since 2007 on various software projects such as the NNSA Program Management Information System Generation 2 (G2)
- Cadre5 was submitted for the award by ORNL's Tim Wynn and Stacey Johnson



ORNL staff members Tim Wynn (right) and Stacey Johnson (left) shown with Cadre5's Steve Hicks and Chris O'Neal

Nuclear Security & Isotopes Division publications



- Journal Article – 1
 - Nicholson, Andrew, Hornback, Donald, and Hayward, Jason, "*Day to Day Variations in Neutron and Gamma Ray Background Radiation*," IEEE Transactions on Nuclear Science.
- Letter Report – 1
 - Stephanie Bruffey, Denise Lee, and Robert Jubin, *Milestone Report – M4FT-14OR03120224 – Submit Required Proposals to Conduct NDA of Legacy Kr-85 Samples*, ORNL/LTR-2014/72.
- ORNL/TM – 2
 - Paul Taylor, *Testing of Precipitation Processes and Calcination to Produce Uranium Dioxide from Uranyl Nitrate*, ORNL/TM-2014/66.
 - Ross Snow, James Garner, and Michael Whitaker, *Platform Scale Testing Center: Installation, Calibration, Commissioning, and Initial Testing*, ORNL/TM-2013/602.
- Paper in Conference Proceedings (Books, CD, etc.) – 1

Reactor Core Physics Benchmarking

Outstanding operational reactor results with the new and evolving CASL MPACT neutronics capability

Purpose

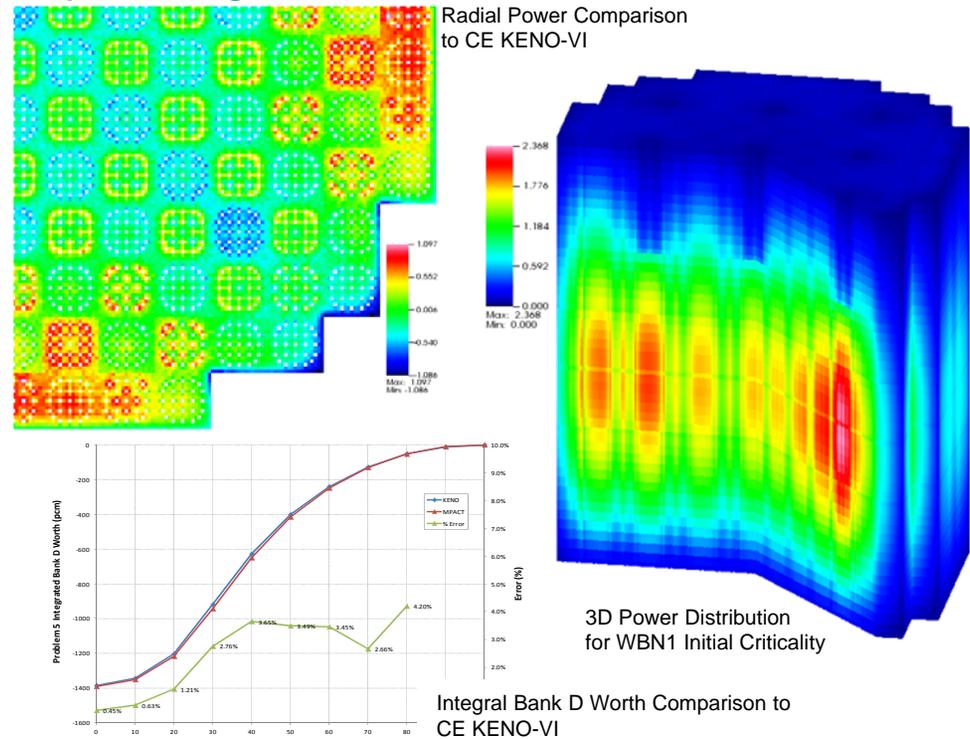
- Document MPACT performance for CASL Core Physics Progression Problems 1-5
- Benchmark MPACT results vs. measured Watts Bar Unit 1 Cycle 1 zero power physics testing data
- Document independent user experience and computational resources required

Summary Results

Prob. #	Typical Eigenvalue Difference (pcm)	Typical Pin Power RMS (%)	Number Compute Cores	Typical Runtime
1	-211	--	8	~3 secs
2	-126	0.12%	8	~1 min
3	-116	0.27%	464	~2 min
4	-113	0.95%	464	~33 min
5	-88	0.74%	2784	~75 min

Watts Bar Unit 1 Initial Startup Results

Item	Measured Difference	CE KENO-VI Difference
Criticality [†]	-225 ± 57 pcm	-96 ± 13 pcm
Control Rod Worths [†]	3.3 ± 1.5%	0.8 ± 0.3%
Differential Boron Worth	0.61 pcm/ppm	-0.05 pcm/ppm
Isothermal Temperature Coefficient	-1.55 pcm/F	-0.54 pcm/F



Conclusions and Feedback

- Good accuracy and stability with reasonable runtimes
- Small radial and axial power tilts for whole core models
- Needs IFBA treatment (5x slower)
- Needs control rod tip treatment (<80 pcm)
- Needs thermal expansion & rotational symmetry
- Needs faster runtime for T/H coupling

Reactor Core Physics Benchmarking

Initial transient results with the new and evolving CASL MPACT neutronics capability

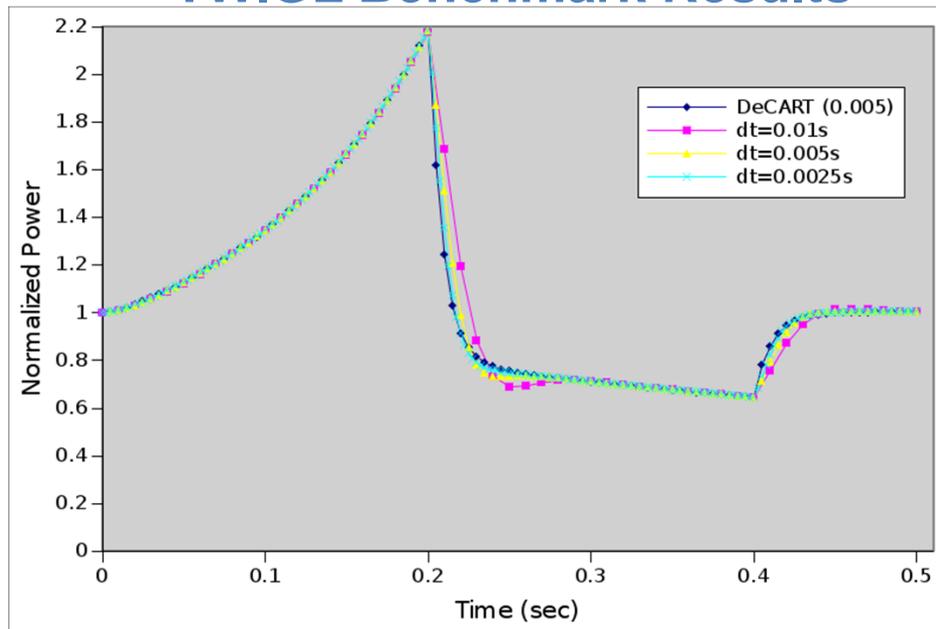
Purpose

- Provide capability to model time dependent neutron transport in support of RIA accident
- Compare accuracy of the transient to internationally accepted benchmarks and measured data

Execution

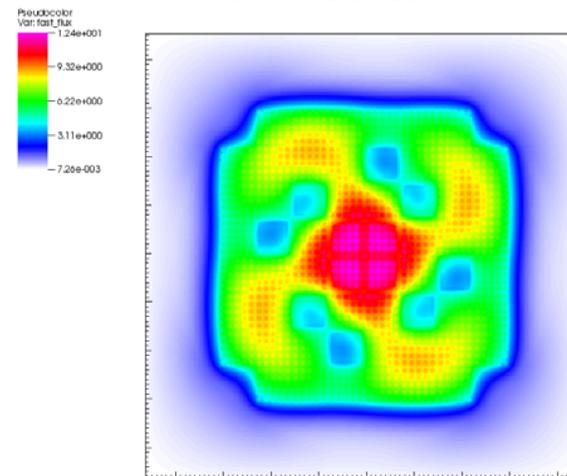
- Implement transient fixed source calculation to treat prompt and delayed neutron generation
- Perform comparisons of power during transient for TWIGL benchmark case
- Develop steady state model of SPERT-III Reactor for comparison to measured data

TWIGL Benchmark Results

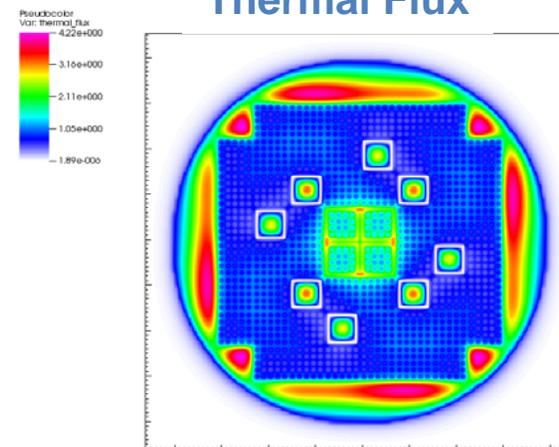


SPERT S.S. Results

Fast Flux



Thermal Flux



	sec	sec	sec	DeCART
Peak Power	2.1754	2.1806	2.1838	2.1826
Asymptotic Power	1.0038	1.0028	1.0027	1.0019
Integral Power	0.5401	0.5373	0.5360	0.5353

Best practices and user guidelines defined for CASL validation and uncertainty (VUQ) analyses

- DAKOTA (<http://dakota.sandia.gov/>) is the delivery software for CASL VUQ tools
- The manual defines best practices and user guidelines
- The manual is designed for use by CASL engineers
- CASL relevant applications and simplified examples are employed to demonstrate DAKOTA best practices
- The manual describes user guidelines for sensitivity analysis, surrogate construction, calibration, and uncertainty quantification
- The manual includes verification of VUQ tools to insure accuracy
- CASL benefits from extensive DAKOTA development paid for by NNSA customers

DAKOTA VUQ tools select 5 important CTF parameters from 35 based on multiple sensitivity analysis

parameter	partial correlation	simple correlation	morris main	morris interaction	CPS variation
k_tmasl	0.11	0.00	6.48E-05	2.28E-05	medium
k_tmoml	0.02	-0.02	2.23E-04	1.30E-04	medium
k_tnrgl	-0.01	0.03	9.00E-06	9.49E-06	low
k_xkwlx	1.00	0.88	1.80E-01	7.07E-03	high
k_cd	1.00	0.46	9.59E-02	7.88E-03	high

CASL status briefings with NRC Commissioners

Commissioner George Apostolakis



- March 25, 2014
- Met with CASL staff at North Carolina State University (NCSU)
- Briefed on CASL Status and future plans

Commissioner Kristine Svinicki



- March 19, 2014
- Met with CASL staff and toured the VOCC laboratory at ORNL
- Briefed on CASL Status and future plans

Commissioner William Magwood



- April 2, 2014
- Met with CASL staff and toured the VOCC laboratory at ORNL
- Briefed on CASL Status and future plans

DOE budget proposal includes \$24.3M for CASL renewal

- DOE/NE has developed a rigorous renewal review plan
 - CASL renewal proposal due July 1st, 2014
 - Site visit, August 2014
 - Decision by September 30, 2014
- Proposal development is underway



“...and funding the continuation of the very first DOE Hub, the one at Oak Ridge on modeling and simulation of nuclear systems, one that we feel has been, obviously since we are proposing to continue it, has been extremely successful.”

-- Secretary Ernest Moniz

March 4, 2014

Briefing on President Obama's 2015 Budget Proposal

“...CASL has performed, in my estimation, extremely well. They have been very effective in their primary focus in bringing high-performance computational tools to industry. The industry involvement is superb. And their ability to transfer tools to industry has been excellent.”

-- Assistant Secretary Lyons

March 25, 2014

DOE-NE FY15 Budget Hearing of the House Appropriations Subcommittee on Energy and Water Development and Related Agencies



CASL Industry Council Meeting

March 11-12, 2014 Charlotte, NC



Participants:

ANSYS
AREVA
Bettis
CD-adapco
Core Physics
Dassault Systems
Dominion
Duke
EDF
EPRI
Exelon
GNF
GSE Systems
mPower
NuScale
Rolls Royce
WEC

• Topics

- CASL status and recent results
- VERA Core Simulator updates
- Update on fuel performance modeling efforts within MPO (CRUD, PCI, GTRF)
- Test Stand update (WEC, EPRI, TVA)
- Zero Power Physics Test simulations for the AP1000 PWR startup
- CASL value proposition (ROI) analysis
- Phase 2 scope and technology deployment

• Summary of Round Robin suggestions, concerns, comments:

- Deliberate emphasis is needed to make CASL tools used and useful by the industry especially when CASL is no longer a hub
- Phase 2 Scope: need to extend into new areas
- Test Stands: important to get technology out to end users; impressed with the WEC results
- Value: demonstrate the impact of VERA by solving an industry issue - codes must have VUQ

CASL Activities

CASL

- Future Potential Development Paths for Insilico
- Verification and Validation
- COBRA-TF Working Group Meeting
- Phase 2 Scope Meeting
- TVA Test Stand Review



VOCC Tours

7 Tours for
March 2014

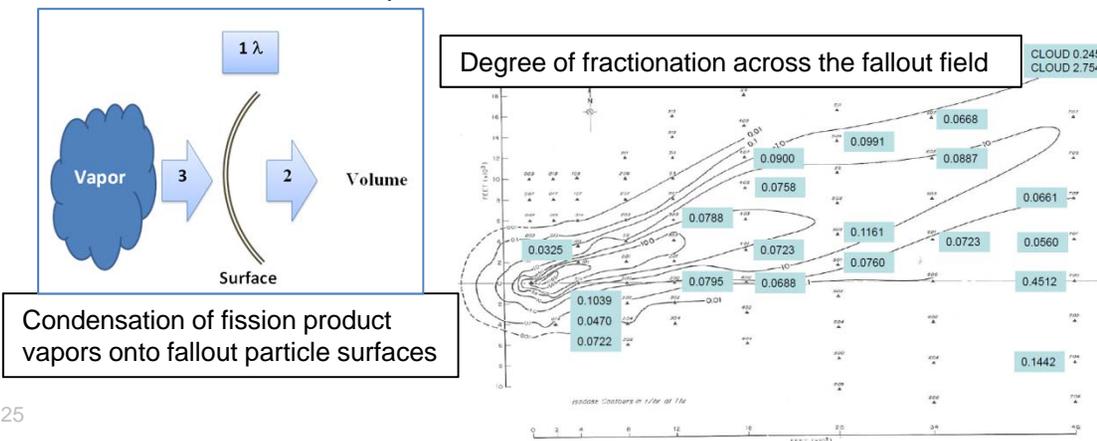
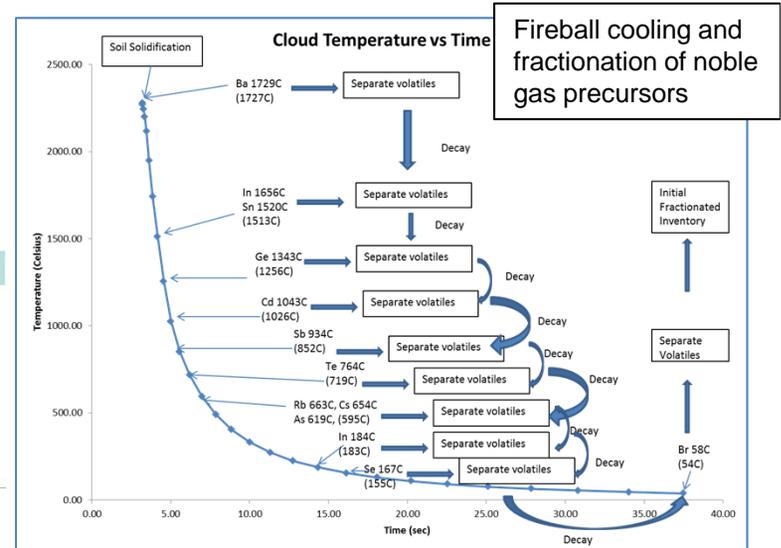
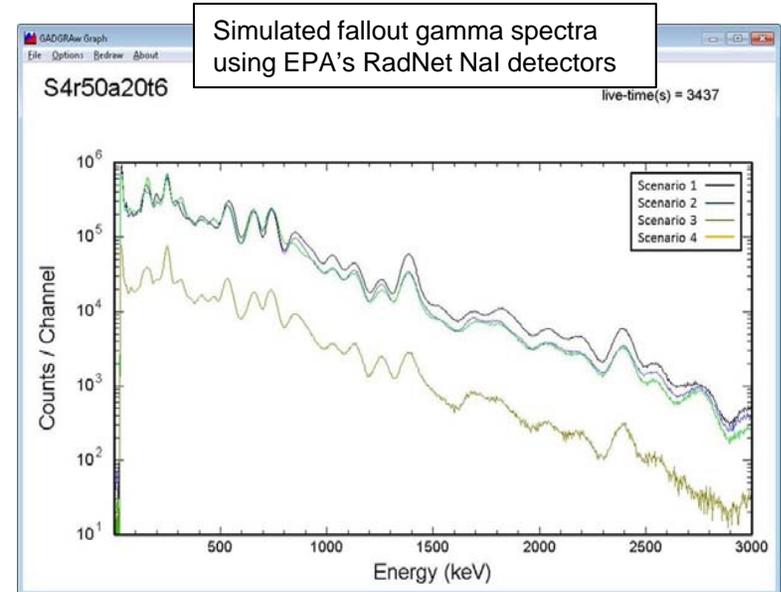
- Bill Kinsella, NCSU Nuclear Communications
- Douglas Clapp, US Senate Appropriations Energy and Water Development Subcommittee
- Kristine Svinicki, NRC Commissioner
- Temitope Taiwo, ANL
- Lockheed Martin Corporation
- Legal Interns
- ORNL and INL Business Services

Meetings

Industry Council, Charlotte, NC, March 11-12

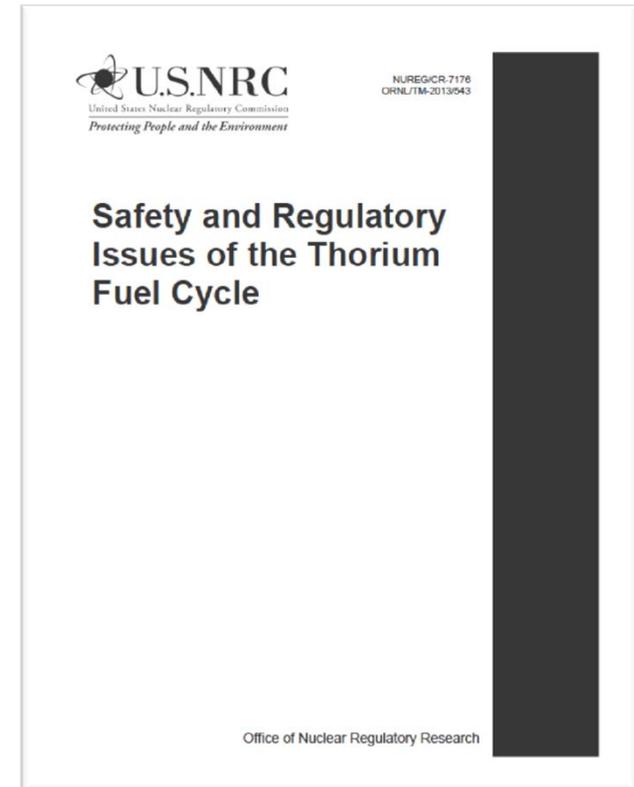
DTRA Nuclear Forensics Program review

- Materials Collection, Analysis, & Debris Diagnostics
 - Conducted March 11-13 at TASC just outside Ft. Belvoir, VA
 - Attended by V. Jodoin, B. Grogan, and D. Hooper along with J. Roback and other ORNL staff
 - Presentations highlighted 5 separate ORNL collaboration projects with PNNL, LANL, SRNL, SNL, & other labs
 - Workshops were held on 3 emerging topics:
 - Surrogate Debris Production
 - Verification & Validation Strategy for DTRA/NTFC/A
 - Pre-detonation Persistent Signatures
 - ORNL funding has increased from \$201K in FY12, \$457K in FY13, to \$665K in FY14



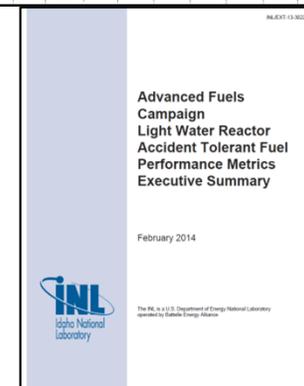
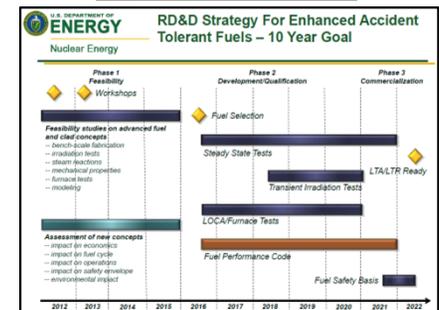
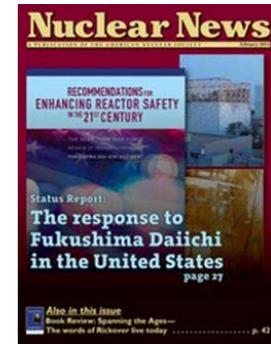
Publication of Thorium NRC NUREG Report

- *Safety and Regulatory Issues of the Thorium Fuel Cycle*, NUREG/CR-7176 (ORNL/TM-2013/543), prepared for the U.S. Nuclear Regulatory Commission by Oak Ridge National Laboratory (February 2014).
 - Focus on potential near-term application of thorium fuels
 - Brief background on use of thorium in the US and abroad, addressing both historical and current interests
 - Possible issues associated with addition of thorium to LWR fuel
 - Reactor operating parameters (reactivity coefficients, pin powers, etc.) and out-of-reactor issues (decay heat, source terms, gamma spectra, etc.) for thorium fuels are compared to UOX and MOX fuels



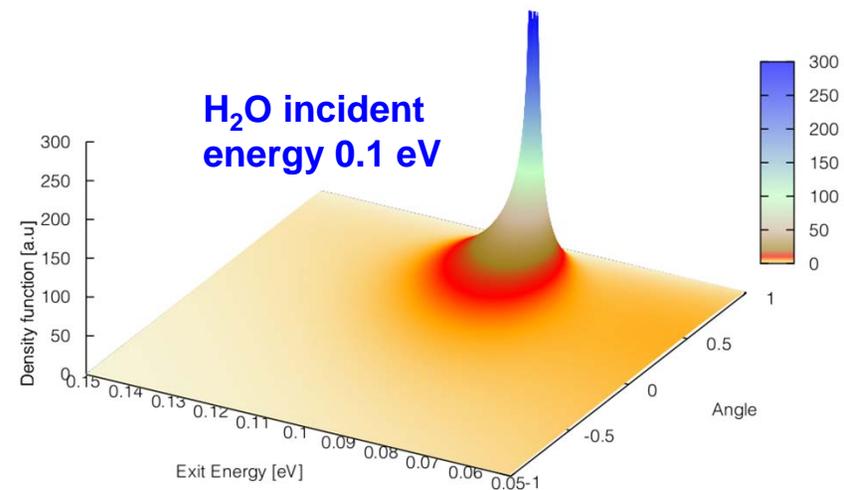
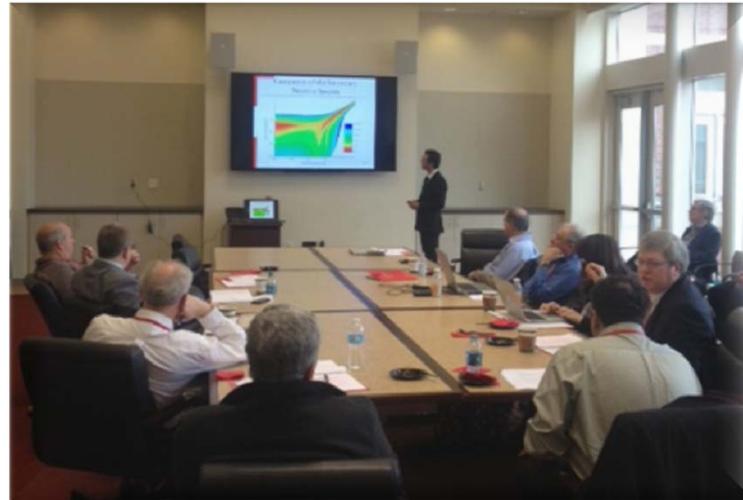
ORNL actively engaged in DOE-NE Accident Tolerant Fuel (ATF) metrics development and concept analysis

- Ongoing ORNL/RNSD work supports ORNL/MSTD and the broader ATF program via reactor physics assessments and severe accident (SA) analysis of light water reactor (LWR) ATF concepts
- ORNL hosted DOE-NE Fuel Cycle Research & Development (FCRD) Advanced Fuels Campaign (AFC) meeting March 12-13
 - Jeff Powers and Kevin Robb attended and represented ORNL
 - ORNL contributions to ATF metrics development and SA modeling were presented by Shannon Bragg-Sitton of INL
 - Follow up actions by ORNL included providing HFIR power history data to AFC DOE-NE Program Manager and National Technical Director, and working with LANL to verify agreement between reactor physics calculations performed at both labs



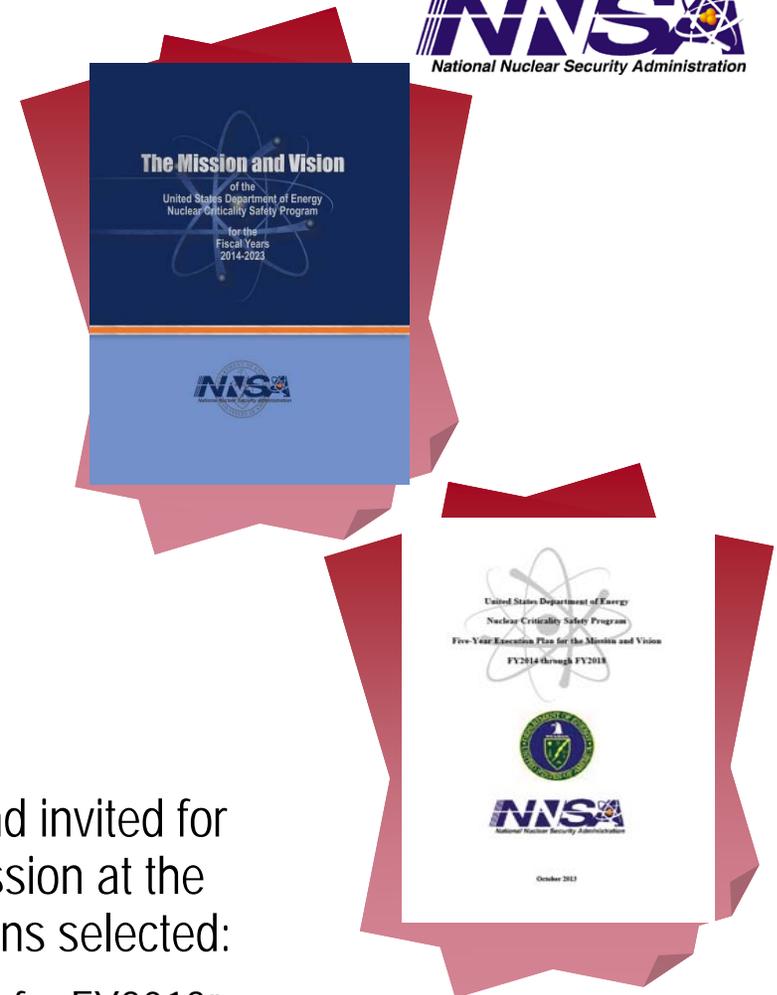
ORNL and NCSU host Neutron Thermal Scattering Workshop

- Workshop held at NCSU March 11-12, 2014
- Participants from ANL, BNL, KAPL, BAPL, RPI, LLNL, NCSU, ORNL SNS, and ORNL NDCS Group
- Goran Arbanas gave presentation covering ORNL efforts to develop methods to produce thermal neutron scattering kernel evaluations
- Mike Dunn served as co-organizer and co-host for the workshop and gave an overview of the US NCSP Nuclear Data Program Element work efforts



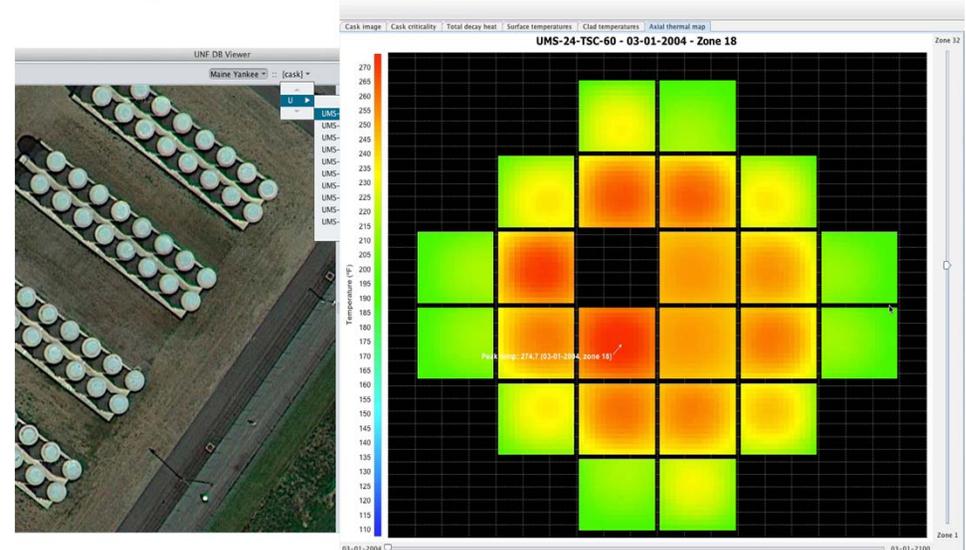
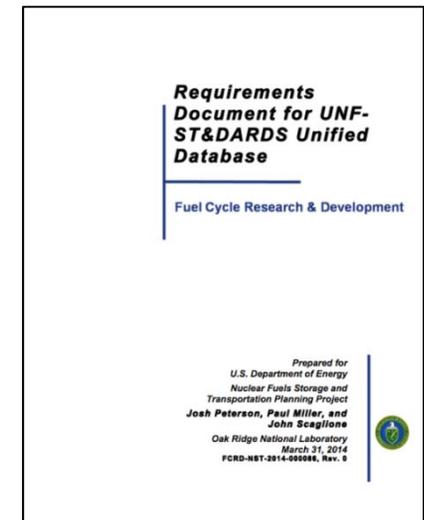
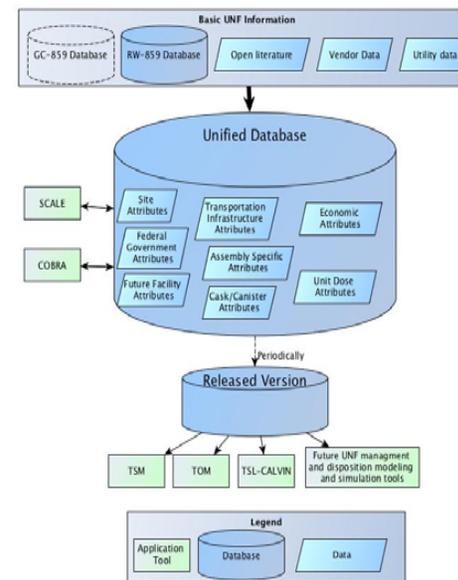
US Nuclear Criticality Safety Program (NCSP) review

- The annual NCSP Review Meeting was held at Los Alamos National Laboratory (LANL) March 25-28, 2014
- Participants included federal and contractor staff from NCSP sites throughout the DOE Complex
- NCSP task managers and research staff provided detailed technical presentations covering work accomplishments at their respective sites
- Luiz Leal, Brad Rearden, and Mike Dunn gave presentations summarizing ORNL NCSP work accomplishments in FY2013
- 6 out of 29 presentations selected as “Best Papers” and invited for development into summaries for the special NCSP session at the November 2014 ANS Meeting—two ORNL presentations selected:
 - Leal: “ORNL Nuclear Data Evaluation Accomplishments for FY2013”
 - Dunn: “NCSP Nuclear Data Advisory Group (NDAG) Report”



Requirements Document for the UNF-ST&NDARD's Unified Database completed

- This satisfies a Level 2 milestone for the DOE-NE Nuclear Fuels Storage & Transportation project led by ORNL
- The Unified Database is being developed to provide a controlled source of technical data for various waste management system analysis/evaluation tools, access to key technical data, and analysis capabilities to characterize the used nuclear fuel (UNF) inventory
- Briefing on UNF-ST&DARDS was provided to Monica Regalbuto, Deputy Assistant Secretary for Fuel Cycle Technologies (NE-5), in the DOE Office of Nuclear Energy, and several of her senior staff, including John Herzceg, Andy Griffith (NE-52), and Patricia Paviet (NE-51)
- Follow-up briefings were recommended to further "advertise" the UNF-ST&DARDS capabilities within DOE

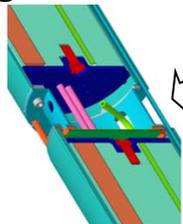


Materials irradiation – March 2014

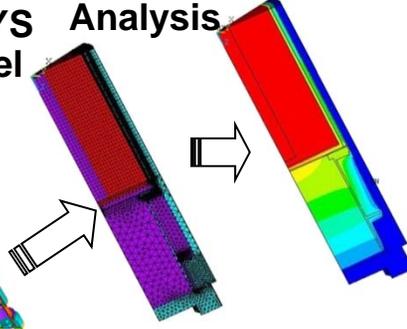
Project	Format	Sponsor	Stage					Notes
			Newly proposed	In Design	In Fabrication	In Reactor	Removed	
Steel Screening	Rabbit					5		Cycle 451
Titan Metal	Rabbit	DOE, FE US-Japan				1	29	Tungsten and steel
Composite Flexure	Rabbit	DOE, FE				8		SiC
Mini-Composite	Rabbit	DOE, FE				3	1	SiC
Round-bar Tensile	Rabbit	DOE, FE		4+		TBD 2013		Steel
Hydrided Clad	Target	DOE, NE					4	Zircaloy
Ibiden	Rabbit	WFO, Ibiden				19	19	Graphite
Nippon	Rabbit	WFO, Nippon				30, Cycle 452		Graphite
Toyo Creep	Target	Toyo Tanso			1	2, Cycle 449		Graphite
Inconel springs	Rabbit	AECL		11		8, Cycle 452	2	
Graphite Creep	Rabbit	EDF			4		3	Irr. Graphite
SHINE	Rabbit	DOE				3 Cycle 452		Mo-99
Exotic Ceramic	Rabbit	DOE, FE				3	6	
SiC Joining tests	Rabbit	DOE, FE		21	5	Cycle 453		SiC
HTV Capsule	Target	DOE NE		1		2014		Graphite
FCR&D Rabbits	Rabbit	DOE NE		1	5	Cycle 454		DU fuel samples
FeCrAlY	Rabbit	Fusion				2, Cycle 450	3	FeCrAlY
EPRI Rabbits	Rabbit	EPRI			7	Cycle 453		
TOYO Rabbits	Rabbit	TOYO TANSO				17	23	Graphite
EPRI VXF	VXF Target	EPRI				3		Steel Weld Coupons
Superconducting Tapes	Rabbit	Fusion		2		Cycle 454		
Bulk Metallic Glass	Rabbit	Fusion		4				

Experiment Design

Design Detail



ANSYS Model

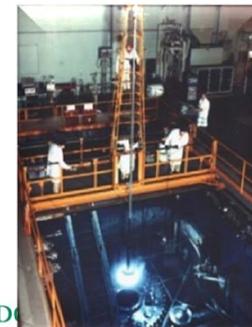


Thermal Analysis

Experiment Fabrication



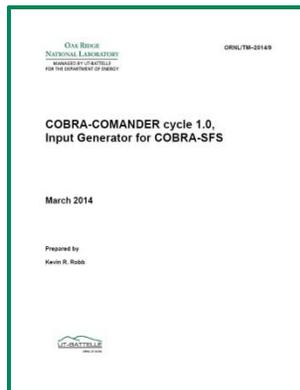
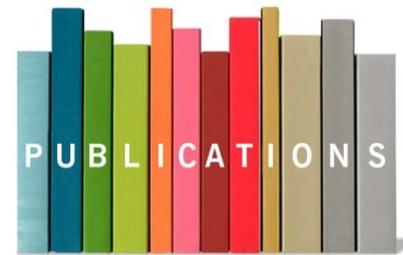
Irradiation



Reactor & Nuclear Systems Division publications



- Conference Paper - 1
- Letter Reports – 3
- ORNL TM Reports - 6

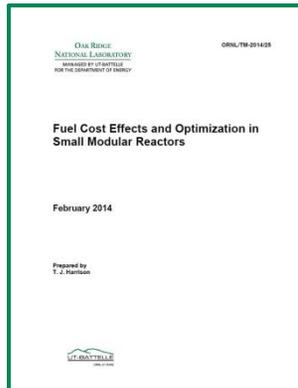


Kevin R. Robb, *COBRA-COMANDER cycle 1.0, Input Generator for COBRA-SFS*, ORNL/TM-2014/9, UT-Battelle, LLC, Oak Ridge National Laboratory, March 2014.



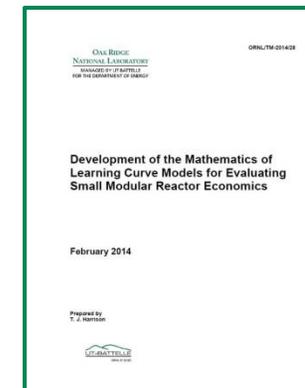
Kevin R. Robb, Matthew W. Francis, and Mitchell T. Farmer (ANL) *Ex-Vessel Core melt Modeling Comparison between MELTSPREAD-CORQUENCH and MELCOR 2.1*, ORNL/TM-2014/1, UT-Battelle, LLC, Oak Ridge National Laboratory, March 2014.

Reactor & Nuclear Systems Division publications



T. J. Harrison, *Fuel Cost Effects and Optimization in Small Modular Reactors*, ORNL/TM-2014/25, UT-Battelle, LLC, Oak Ridge National Laboratory, February 2014.

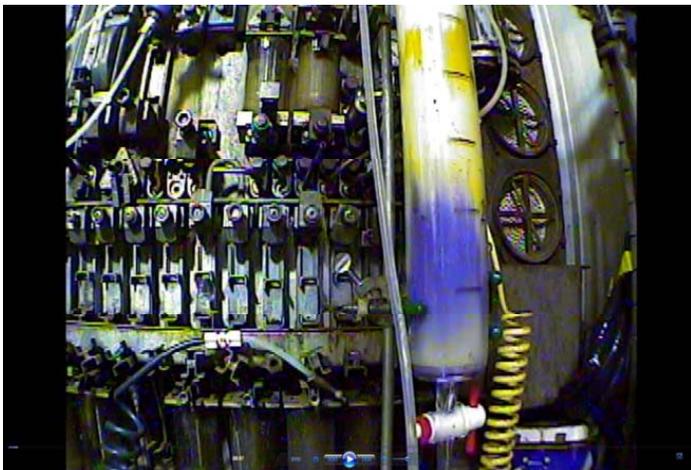
T. J. Harrison, *Development of the Mathematics of Learning Curve Models for Evaluating Small Modular Reactor Economics*, ORNL/TM-2014/28, UT-Battelle, LLC, Oak Ridge National Laboratory, February 2014.



Jianwei Hu, Ian Gauld, James E. Banfield (GE), and Steven E. Skutnik (UT), *Developing Spent Fuel Assembly Standards for Advanced NDA Instrument Calibration - NGS/ Spent Fuel Project*, ORNL/TM-2013/576, UT-Battelle, LLC, Oak Ridge National Laboratory, February 2014.

A major milestone completed – disposition for a problematic U.S. legacy

- Requirement: Priority disposition of DOE's highest-intensity PuBe neutron sources
- No alternative disposition option within DOE complex before cask expiration
- Completed unloading of 8 incoming shipments and cask retirement
- Separation of plutonium and beryllium ongoing in REDC hot cells, and possible recovery of plutonium for re-use



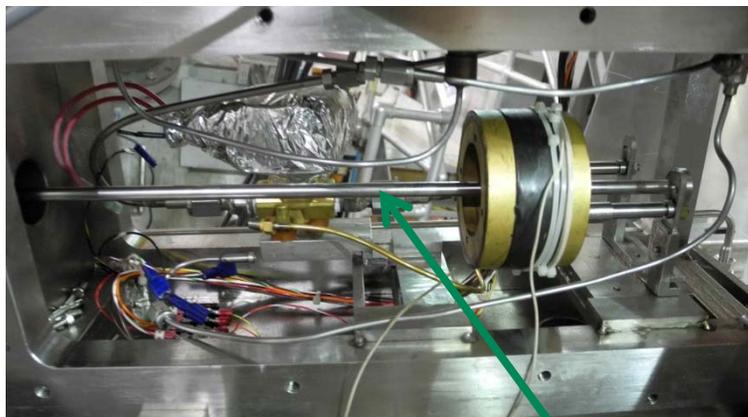
Ion exchange separation of Pu (blue) from Be and decay products



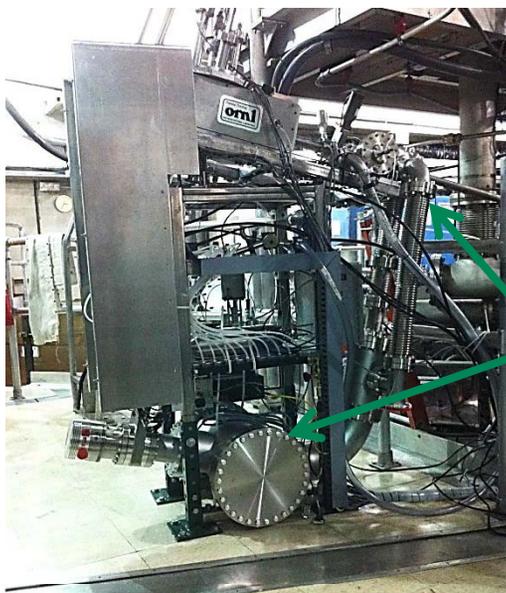
Loaded incoming cask, and empty outgoing casks

New, smaller size pellet capability installed on DIII-D shattered pellet injector

Advancing fusion reactor plasma disruption mitigation experiments



7 mm Barrel Inside
Injector Box



SPI Injection
Line Pumping

SPI Installation on DIII-D

- Shattered Pellet Injector (SPI) at DIII-D was updated with new 7mm barrel (vs previous 16mm)
- Experiments on thermal mitigation of disruptions with ITER relevant sized neon pellets are planned
- Pumping of the injection line was added to pump neon vapor and propellant gas needed for these experiments

*S.J. Meitner, C.R. Foust, S.K. Combs,
N. Commaux, B.Daniels, A.R. Horton,
L.R. Baylor*

Prototype Materials Plasma Exposure eXperiment (Proto-MPEX) milestone

- Vacuum pump-down of Proto-MPEX performed on March 26
- Next milestone: first plasma with 1T magnetic field in May 2014



Assembling Proto-MPEX



Multi-Program High Bay Facility (7625/ 7627)

- Completed installation of new 13.8-kV vacuum switchgear in 7627 required for high magnetic field operation of Proto-MPEX
- Relocated High Power Prototype (HPP) antenna assembly from 7625 to storage in 7041
- Replaced deionized water system ion exchange and carbon filter cartridges
- Completed installation and start-up of new compressor for facility instrument air supply
- Supported conceptual design of new ITER Ion Cyclotron Heating radiofrequency transmission line mezzanine structure
- Completed campaign of weekly facility access tours for unescorted access into Building 7625



New Instrument Air Compressor

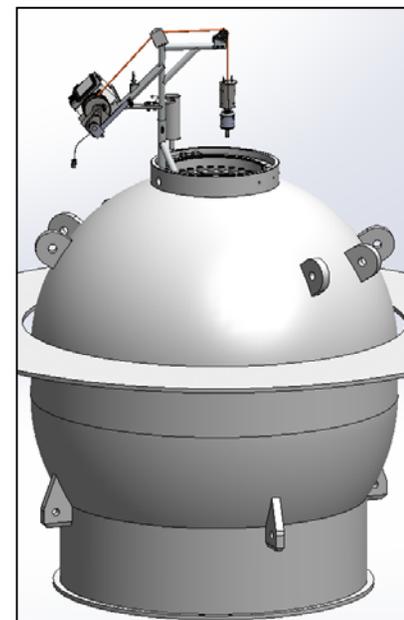


Removing HPP Antenna from facility

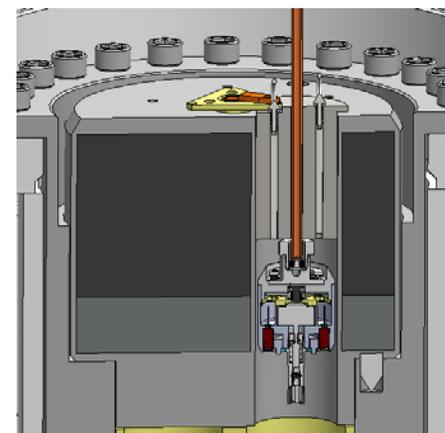
REDC "Q-Ball Cask" upgraded target lifter design complete and fabrication started

The LRL Model 25T Cask (Q-Ball Cask) is used to transfer isotope targets between THE Radiochemical Engineering Development Center (REDC) and High Flux Isotope Reactor (HFIR)

- ORNL Remote Systems (RS) personnel are assisting with the design of an upgraded lifting tool for the 7920 Q-Ball cask target baskets
- The current target lifter has several disadvantages:
 - Engages and disengages automatically based on the weight of the targets, applied to the tool
 - Does not positively grip and release the target basket
 - Has a history of inadvertently releasing the target basket
 - Has no method to verify whether the tool is attached to the basket
- The new target lifter design includes:
 - Electrical-solenoid actuated target basket gripper
 - Remote manual-backup, basket grip & release actuator
 - Weight sensor verification of gripper attachment
 - Two closed circuit television cameras for visual verification
- Detail design is complete and fabrication has started



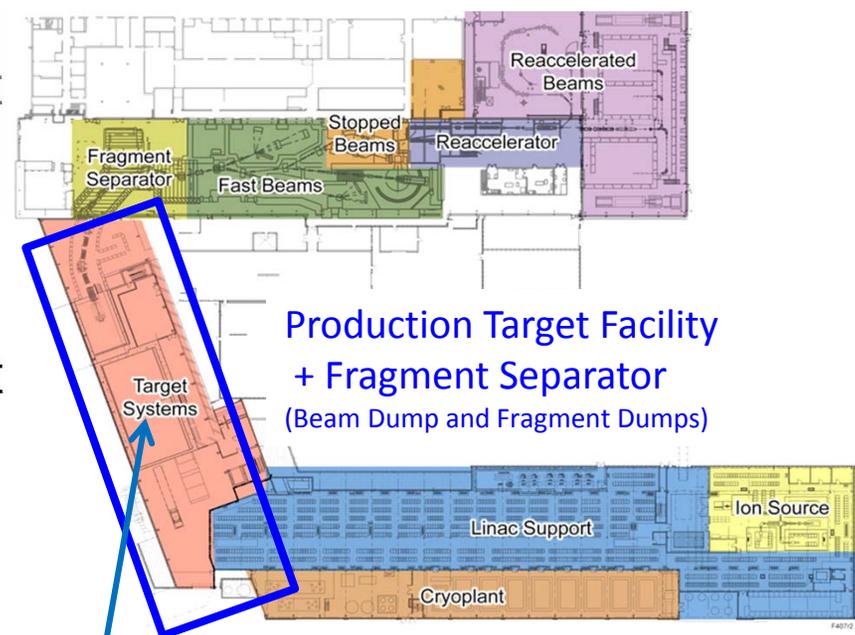
Q-ball target lifter overall design



Section view of lifter in cask

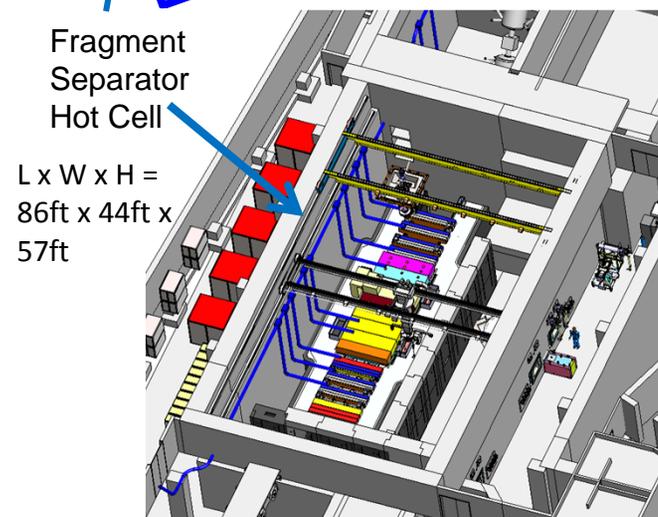
FRIB official groundbreaking ceremony held at MSU on March 17

- Additional ORNL FY14 funding was received in March for continued FRIB detailed design support
- Facility for Rare Isotope Beams (FRIB) received full FY14 DOE funding in January 2014 and approval for civil construction start
- ORNL provides detailed design and R&D support in fragment separator components, remote handling systems, rad analysis and waste handling, non-conventional utilities, and facility design



The Facility for Rare Isotope Beams (FRIB) is a DOE-SC National User Facility in design

FRIB will produce rare isotopes with primary beams up to 400 kW, 200 MeV/u uranium



Fusion & Materials for Nuclear Systems Division public



- Nuclear Fusion

- A. Loarte. . . L. R. Baylor, A. Wingen, et al., "*Progress on the application of ELM control schemes to ITER scenarios from the non-active phase to DT Operation.*" Vol 54(3). DOI: 10.1088/0029-5515/54/3/033007
- M. L. Mayoral. . . C. C. Klepper, et al., "*On the Challenge of Plasma Heating with the JET Metallic Wall.*" Vol 54(3). DOI: 10.1088/0029-5515/54/3/033002
- D. Shiraki, et al., "*Error Field detection in DIII-D by magnetic steering of locked modes.*" Vol 54(3). DOI: 10.1088/0029-5515/54/3/033006

- Computer Physics Communications

- D. L. Green, L. A. Berry, "*Iterative addition of parallel temperature effects to finite-difference simulation of radio-frequency wave propagation in plasmas.*" Vol 185(3), pp. 736-743. DOI: 10.1016/j.cpc.2013.10.032

- IEEE Trans. on Plasma Science

- J. D. Lore, J. H. Harris, A. Lumsdaine, D. McGinnis, et al., "*Design and Analysis of Divertor Scraper Elements for the W7-X Stellarator,*" pp. 539-544.
- J. M. Canik, T. K. Gray, R. Maingi, J. E. Menard, "*Feasibility of Power and Particle Handling in an ST-FNSF and the effects of Divertor Geometry*" pp. 573-579.

NNFD FY 2014 cumulative facility metrics

Hot Cell Availability

Bldg. 7920 March	96.4%
Cumulative	95.3%
Bldg. 7930 March	94.7%
Cumulative	98.1%
Bldg. 3525 March	100%
Cumulative	99.7%
Bldg. 3025E March	100%
Cumulative	96.7%

Facility Upgrades and Maintenance Activities

7920

- Programmed maintenance operations
 - Continued with Glove Box Installations and Removal Operations / Installation of Glove Box Shields.
 - Installation of new 208VAC electrical service for and pre-installation testing of Cub 3 Furnace Controller in support of Target Fabrication Refurbishment activities.
- 

7930

- Programmed maintenance operations
 - Continued Par Phase I facility electrical modifications
 - Completed installation of new gas rack storage area and shed on North side of 7930.
- 
- Performed Functional Test of E-1 Fan Motor Control System and Backdraft Dampers.
 - Performed IPLT of E-1 HEPA Filters.

3525

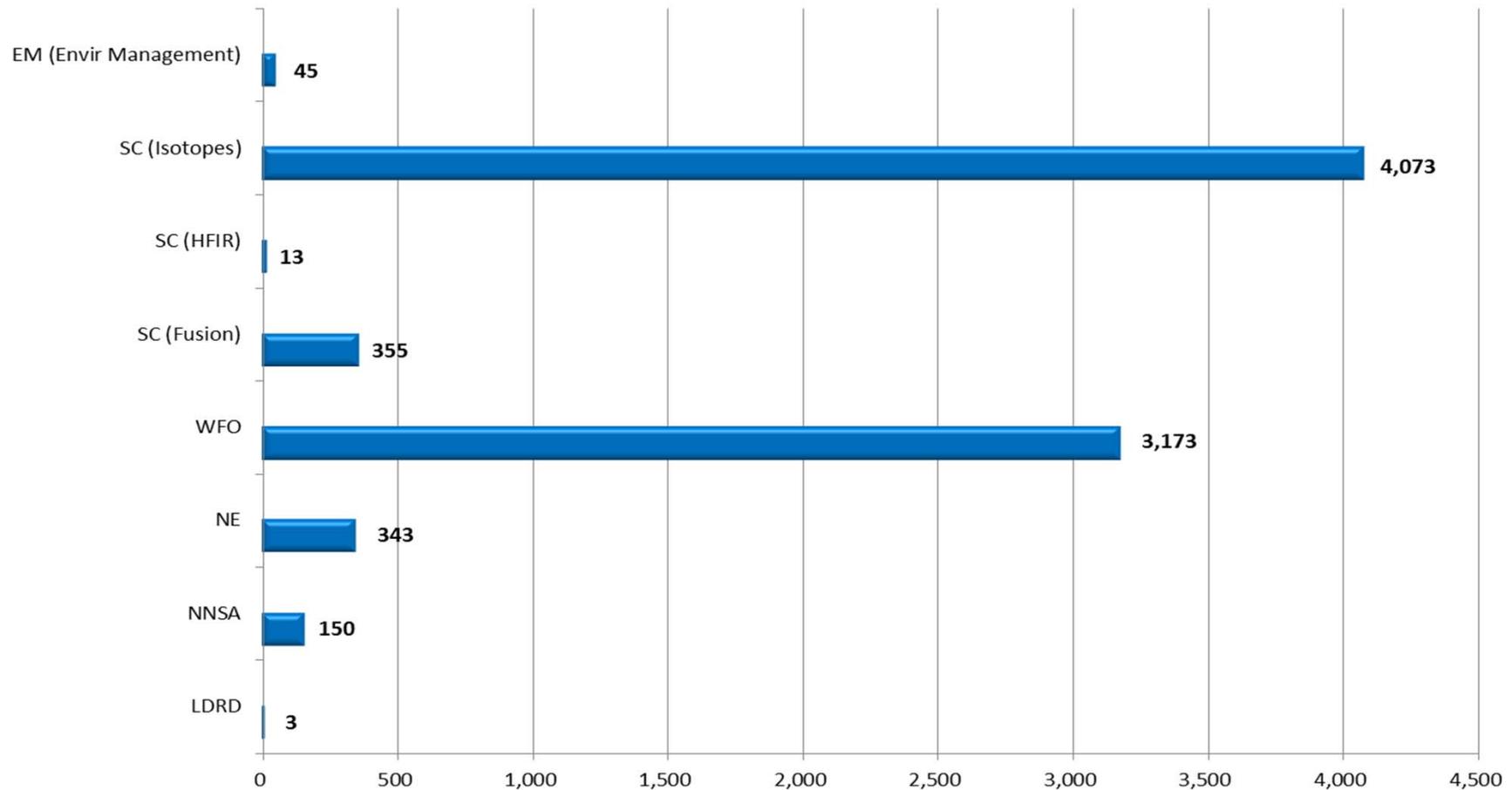
- Programmed maintenance operations

3025E

- Programmed maintenance operations

NNFD FY 2014 business volume by customer metrics

ORNL Hot Cell Usage by Sponsor (12-month period ending March 31, 2014)



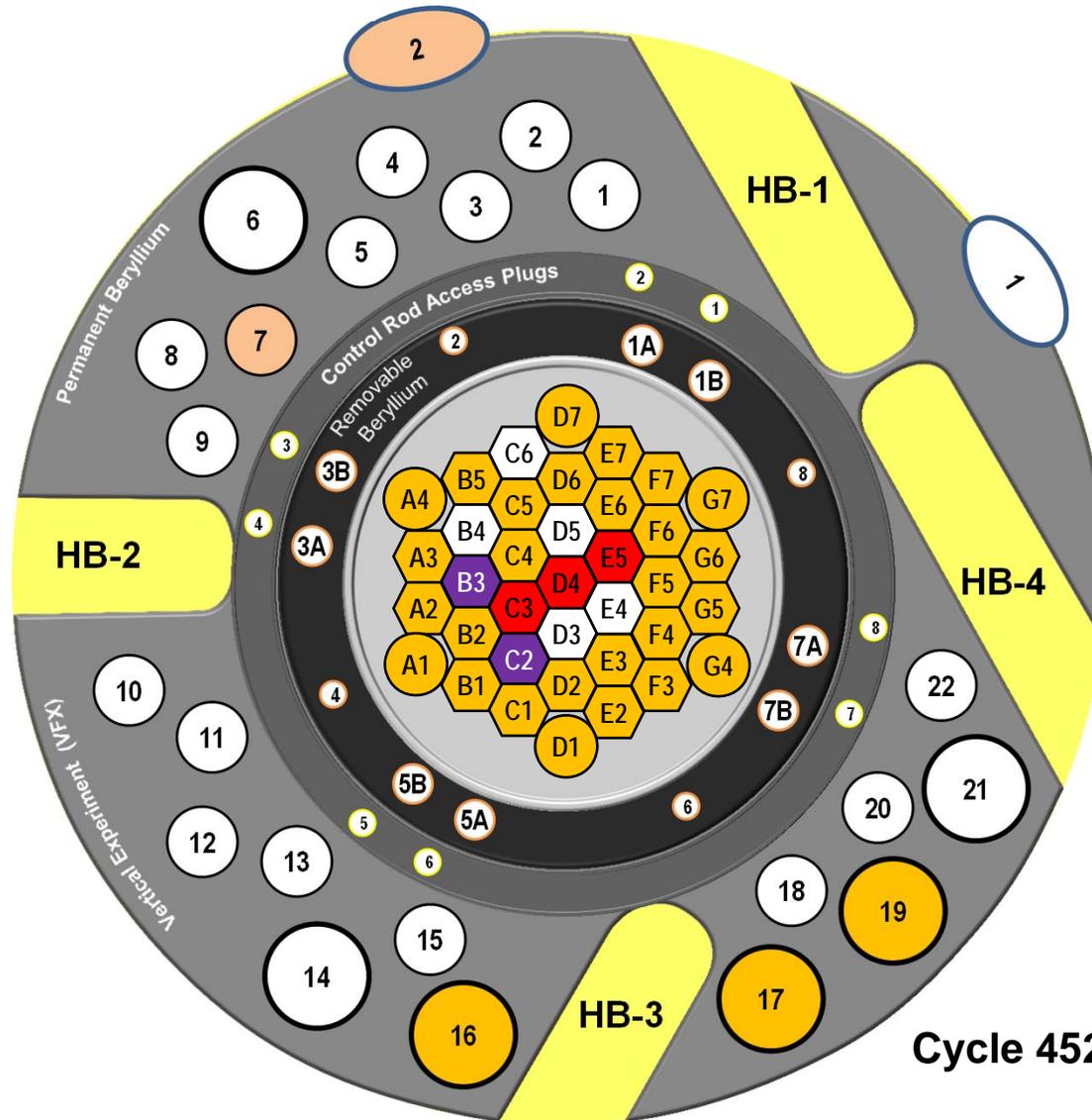
HFIR cycle 452 concluded on March 23



March 2014						
SU	M	T	W	TH	F	SA
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

Reactor OFF

Reactor ON



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

Cycle 452 graphical summary



The number of irradiation capsules slightly lower because of preparation for Cf-252 production in Cycle 453

Materials Experiments

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

Commercial Isotope Production

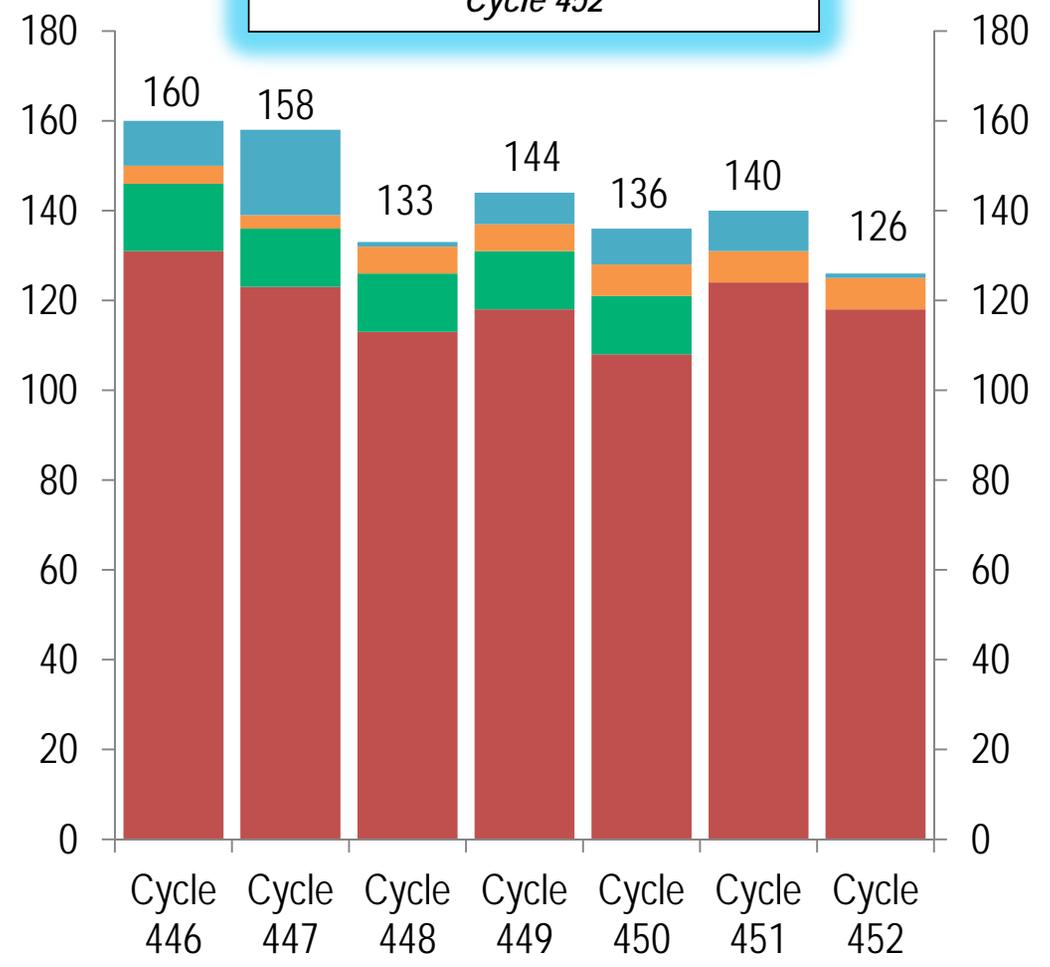
- Selenium (Se-75) – production
- Ni-63 production

Research Isotopes

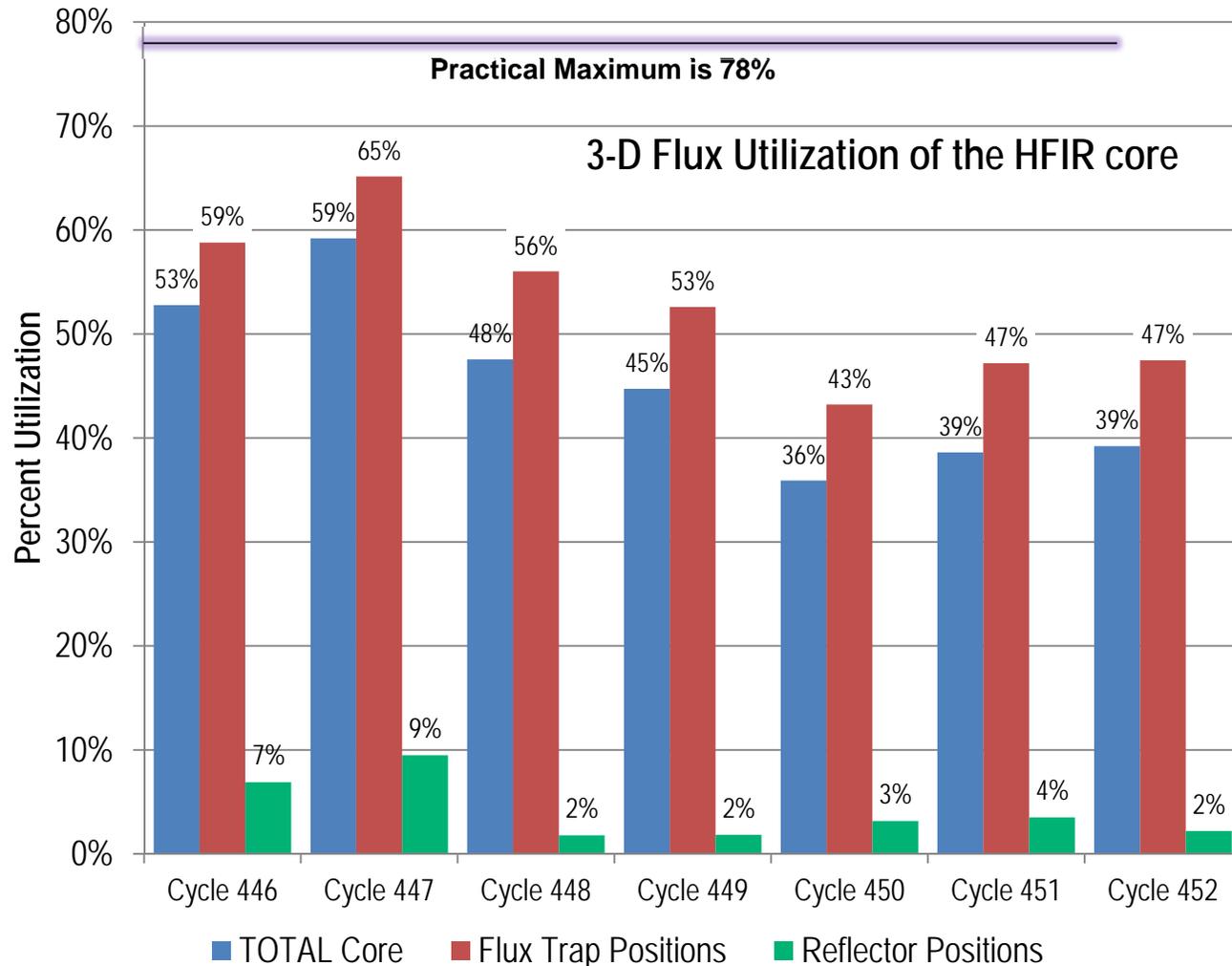
- Silver-107 irradiation for research

- No Pu-238 target in the core during Cycle 452
- Additional Pu-238 test targets expected in Cycle 453

126 total irradiation capsules for Cycle 452



3-D Flux utilization remains steady, with preparations continuing for increased utilization due to Cf-252 production and Pu-238 demonstration irradiations



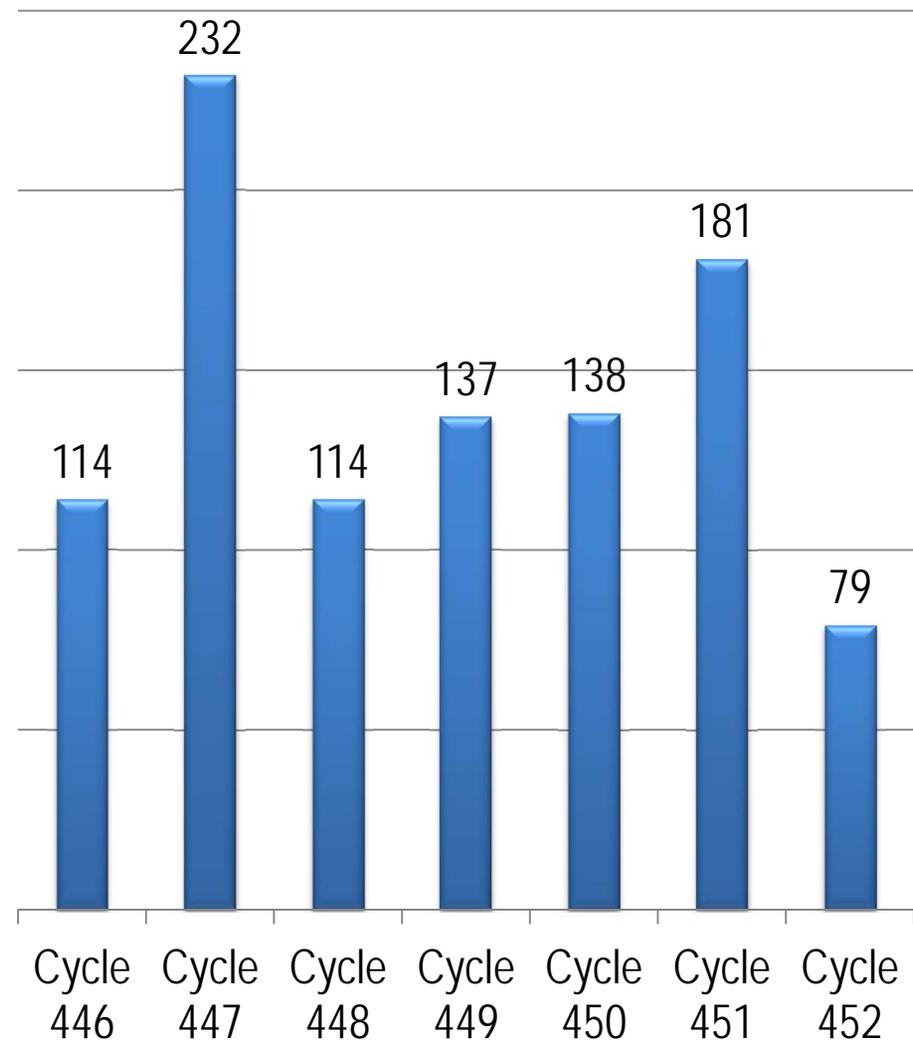
- Flux Utilization remains down slightly as we make room for upcoming Cf-252 production targets
- Flux utilization also lower due to removal of Pu-238 targets until new ones arrive in Cycle 453
- The **practical maximum** 3D utilization is less than 100% due to heat-load and flow limitations in the flux trap. The practical maximum is approximately 78%

HFIR pneumatic tube irradiations and NAA work continue during Cycle 452

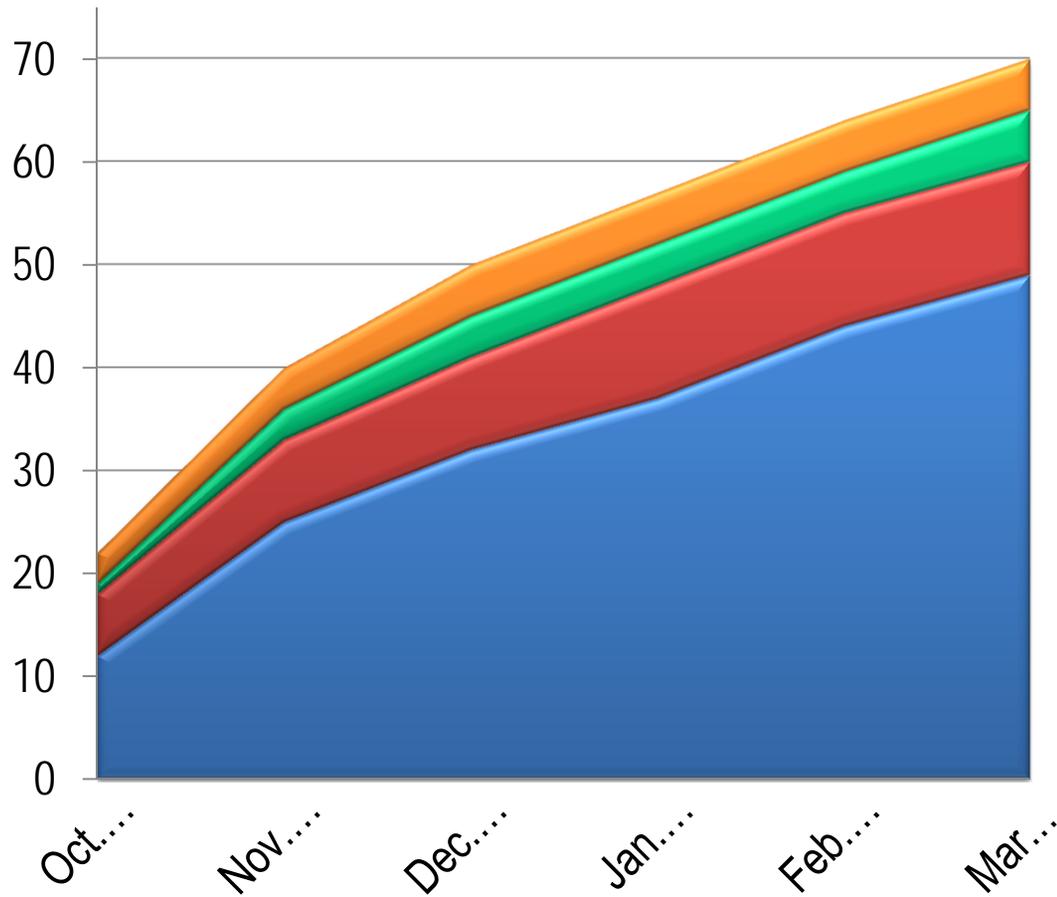
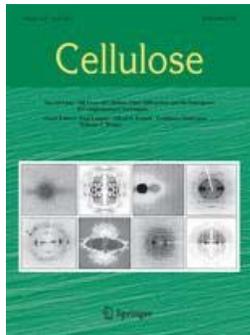


Pneumatic Tube Summary

- 54 Rabbits for IAEA
- 14 Silver zeolites for iodine sequestration research
- 1 Sm-153 metal for isotope production
- 2 Yb-169 for research
- 1 U-235 oxide for LLBL nuclear forensics
- 2 Fe-59 production for separations research
- 5 Flux monitors
- 79 TOTAL**



5 new publications in March that cite HFIR in neutron scattering



- Modeling, Simulation and Reactor Operations (Cumulative)
- Isotope Production and Research (Cumulative)
- Materials Science (Cumulative)

