

Nuclear Engineering and Oak Ridge National Laboratory



Fred Peretz

Nuclear Science and Technology Division

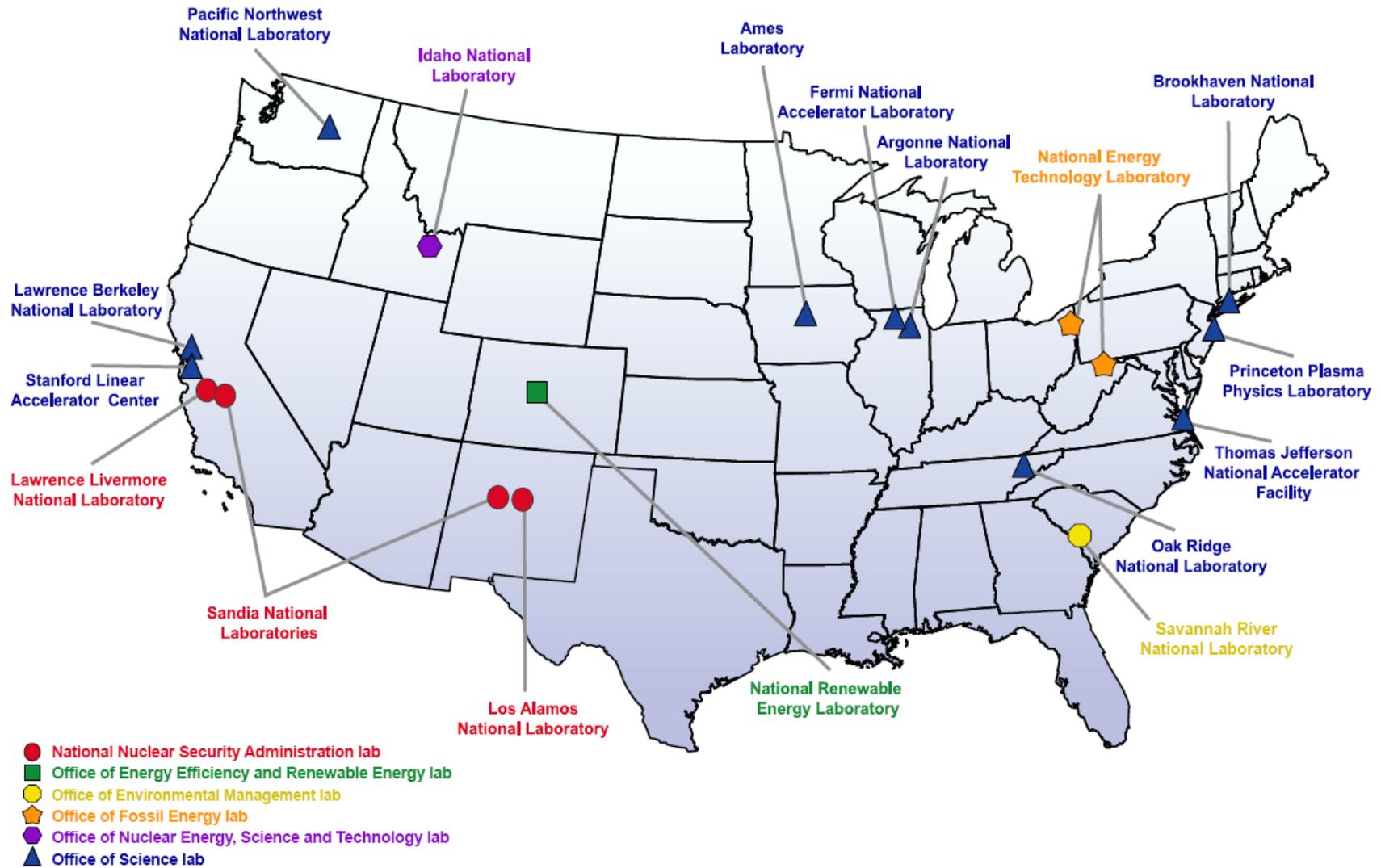
University of Wisconsin

**Student Chapters,
American Nuclear Society
Women in Nuclear**



April 17, 2008

Department of Energy Laboratories



Tennessee Valley Authority



Browns Ferry 1
May 2007 Startup
1160 MWe New Capacity
1st Nuclear Unit Since 1996



Watts Bar 2
Completion of Existing Plant
1167 MWe New Capacity

Bellefonte 3 and 4
NuStart Energy
Two AP1000 Reactors
New Design



Oak Ridge National Laboratory



Six Scientific Themes

*Born of necessity. Inspired by our quest to know.
We have always been called upon to address
America's greatest scientific challenges.*

NEUTRON SCIENCE

Leading the World

The Spallation Neutron Source and the High Flux Isotope Reactor together make Oak Ridge the world's foremost center for neutron science.

andersonian@ornl.gov

BIOLOGICAL SYSTEMS

Developing New Options

Whether converting biomass to fuel or understanding the impacts of climate change, biological research at ORNL is helping develop new options for energy, environmental protection, and human health. **mannre@ornl.gov**

ADVANCED MATERIALS

Strengthening American Industry

With DOE's first Nanoscience Center, the world's most powerful electron microscope, and the High Temperature Materials Laboratory, Oak Ridge plays a critical role in American industrial competitiveness.

buchananmv@ornl.gov

"Men love to wonder, and that is the seed of science."

... Ralph Waldo Emerson

NATIONAL SECURITY

Guarding the Gates

From biochemical sensors to stopping the proliferation of nuclear weapons, technologies that make America safer are among the laboratory's top research priorities.

akersfhjr@ornl.gov



HIGH PERFORMANCE COMPUTING

Tackling the Big Problems

With unmatched computational capacity for open scientific research, Oak Ridge is on a path by 2009 to reach a petaFlop, or 1 quadrillion mathematical calculations per second, making it possible to model the most complex scientific problems.

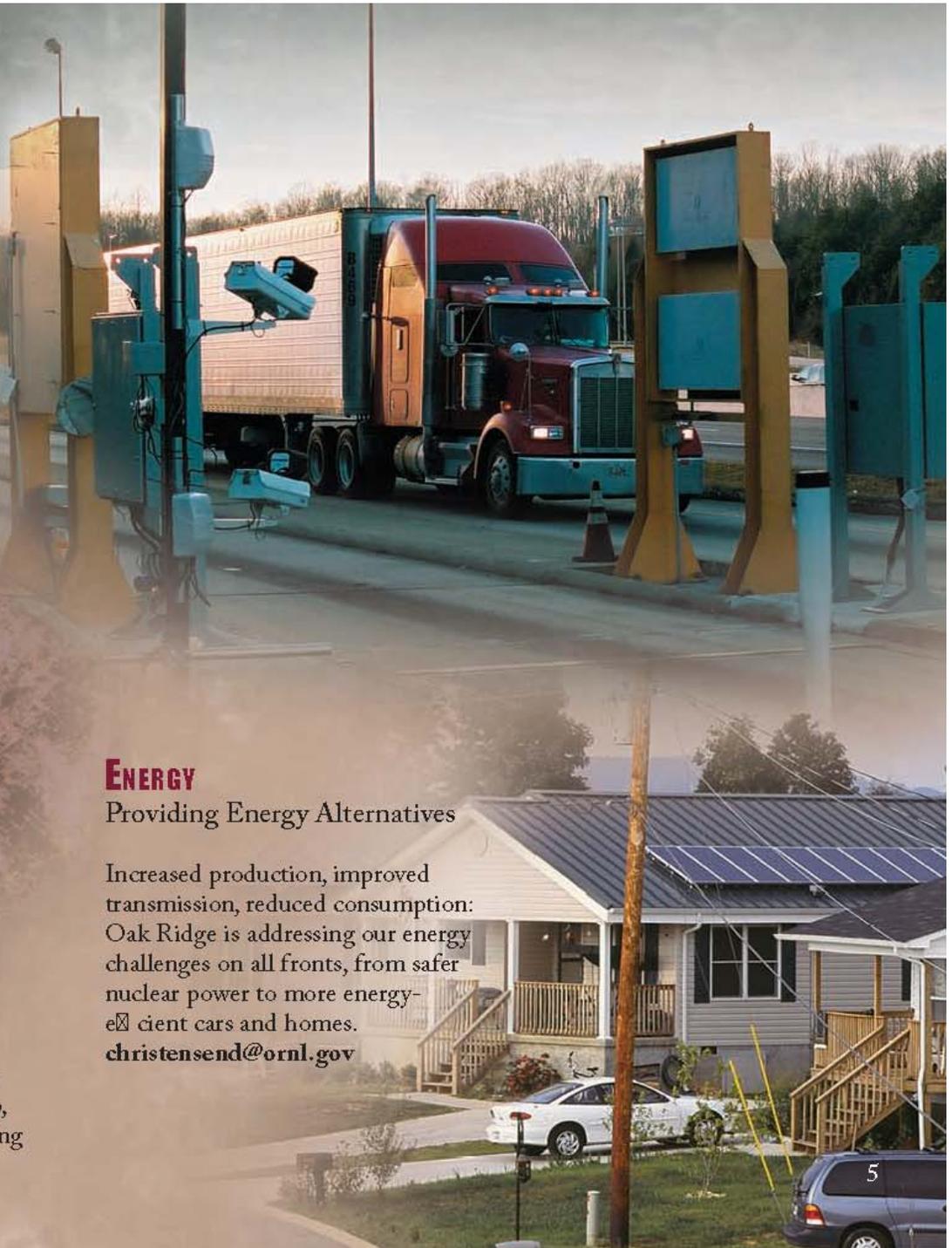
zachariat@ornl.gov

ENERGY

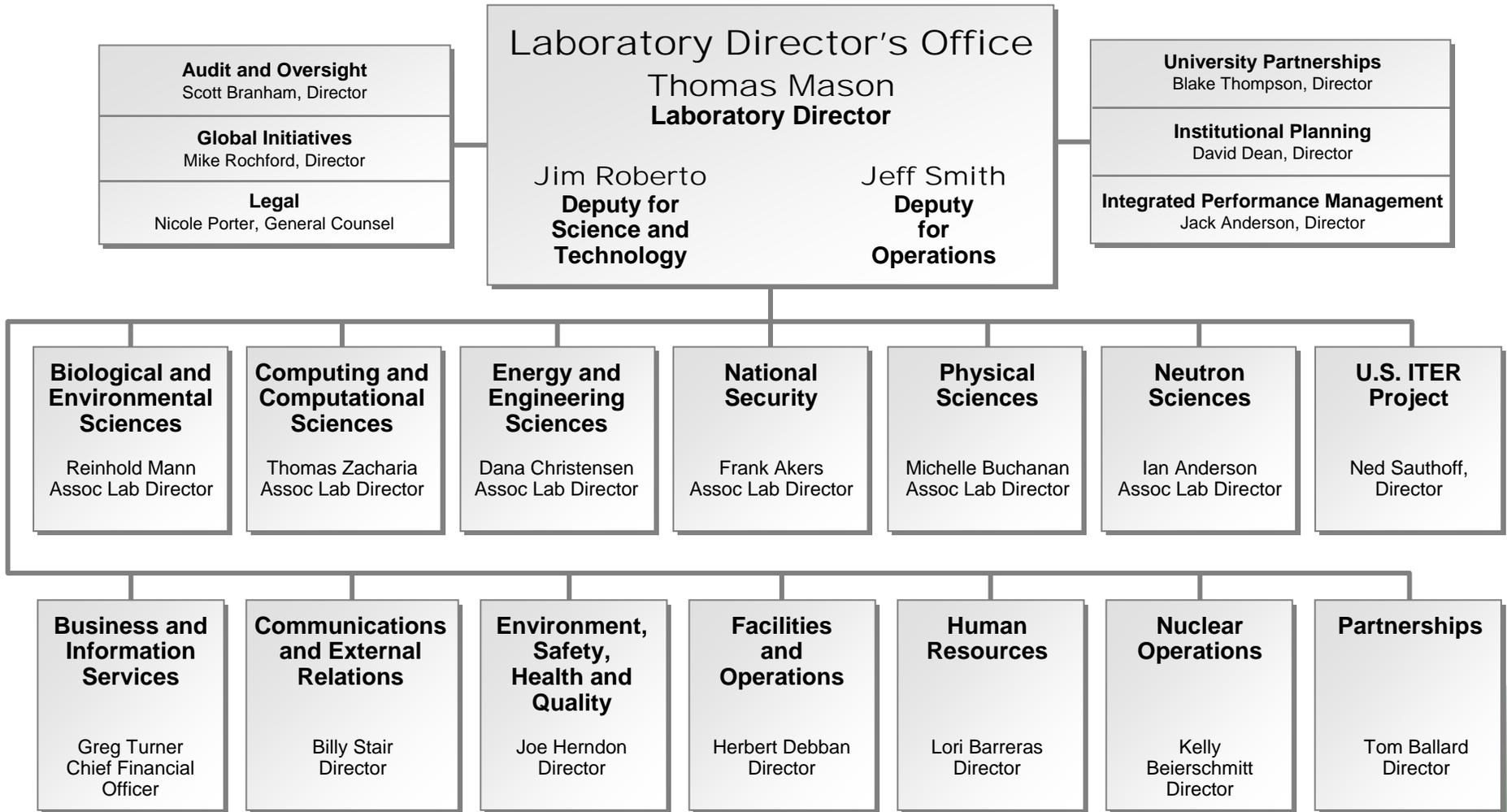
Providing Energy Alternatives

Increased production, improved transmission, reduced consumption: Oak Ridge is addressing our energy challenges on all fronts, from safer nuclear power to more energy-efficient cars and homes.

christensend@ornl.gov



ORNL Organizational Structure



ORNL Organizations Involved in Nuclear

Energy and Engineering Sciences

Physical Sciences

Neutron Sciences

Nuclear Operations

US ITER Office

National Security

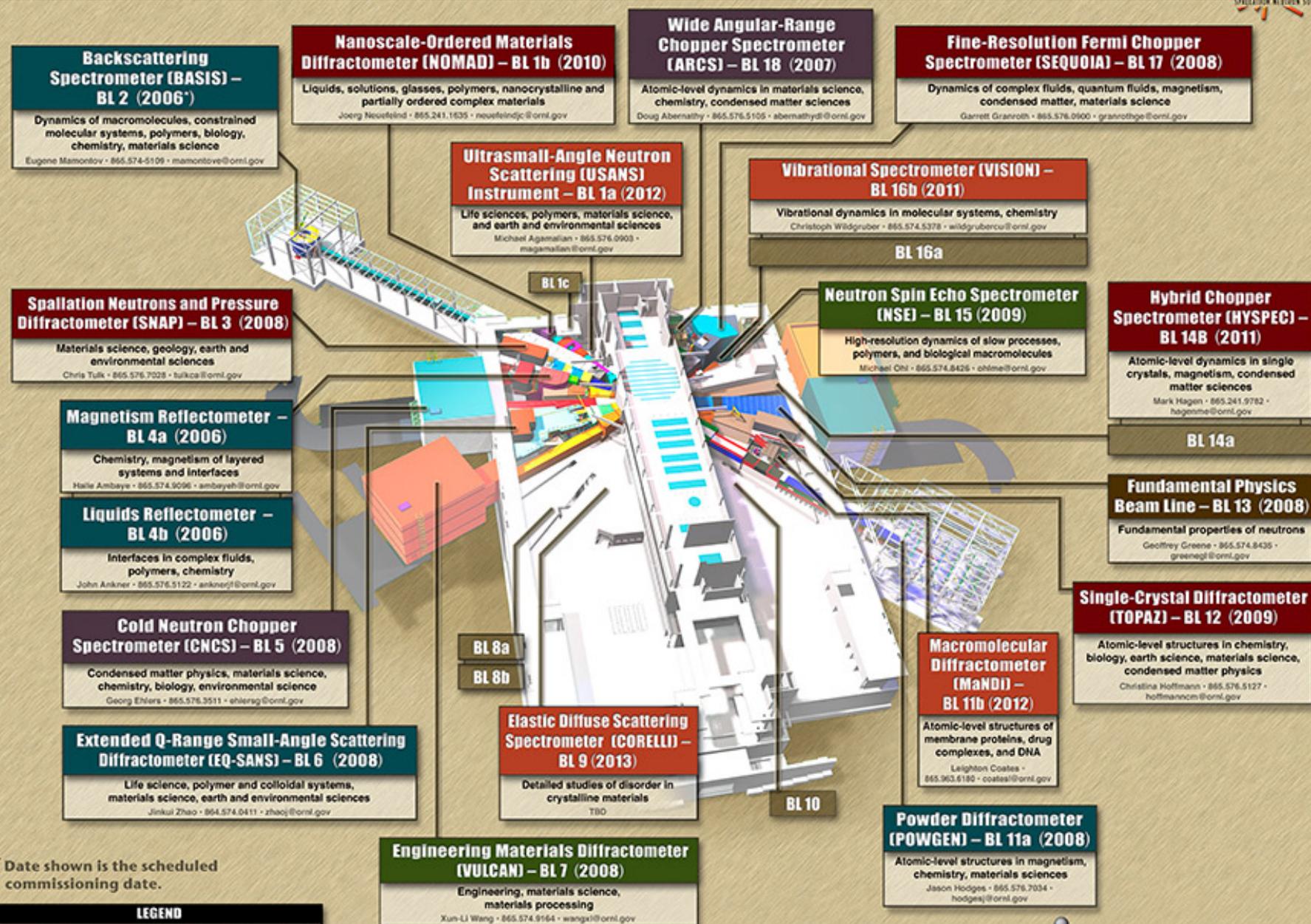
Facility Operations

Computing and Computational Sciences

Spallation Neutron Source



Spallation Neutron Source



* Date shown is the scheduled commissioning date.

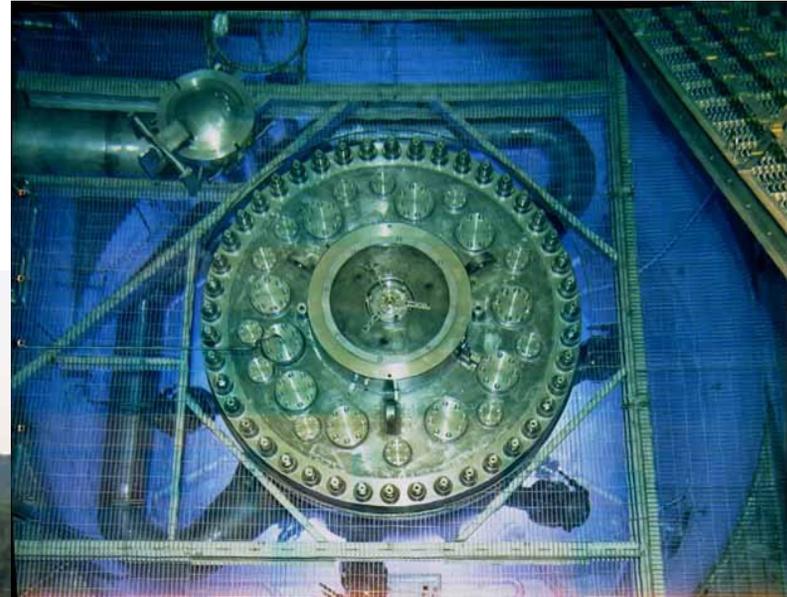
LEGEND		
SNS TPC	SING I	SING II
DOE Grant	DOE NP	Non U.S.



NEUTRON SCIENCES

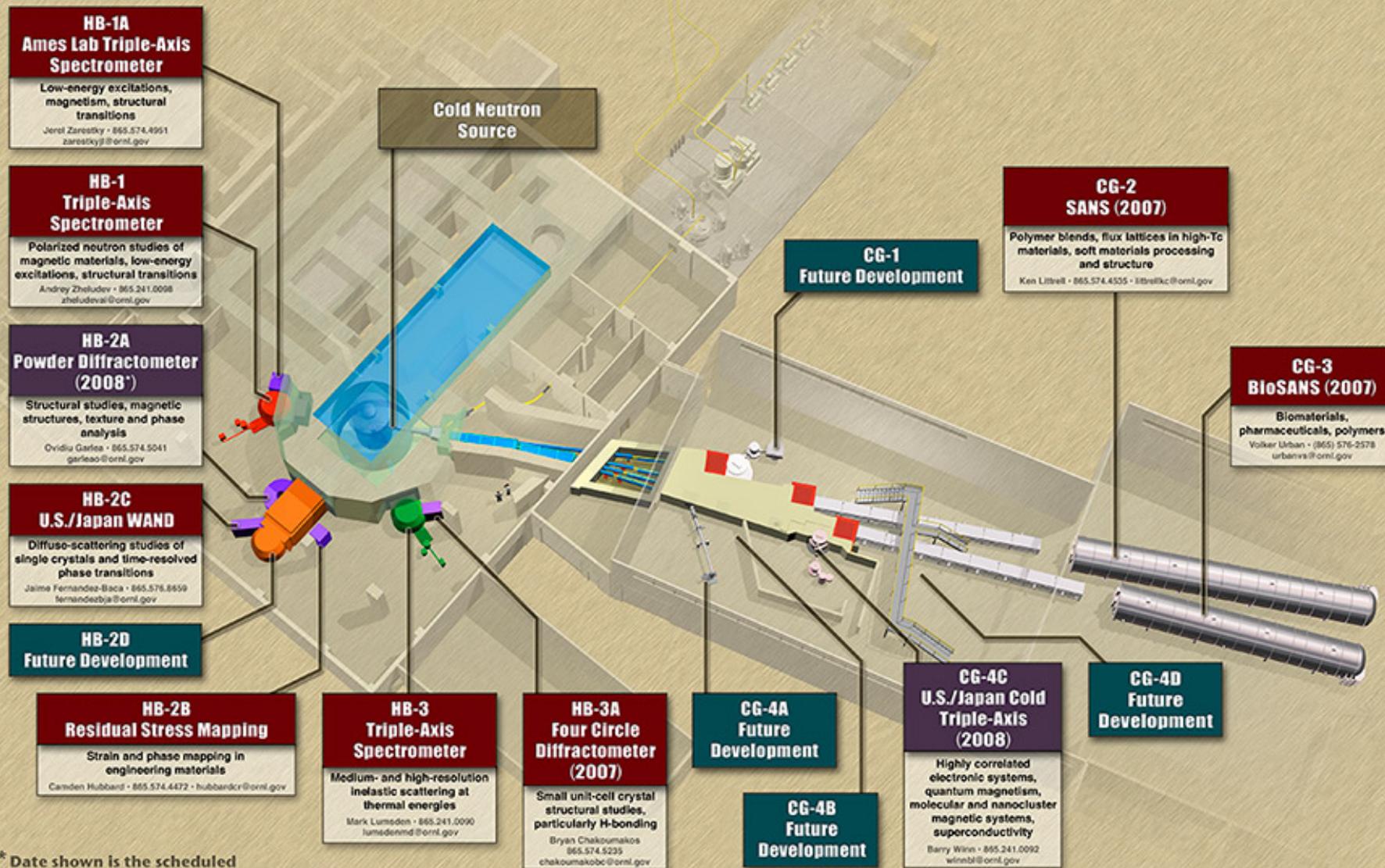
High Flux Isotope Reactor

- 85 MW
- Californium production
- New cold source and cold guides



High Flux Isotope Reactor

HFIR



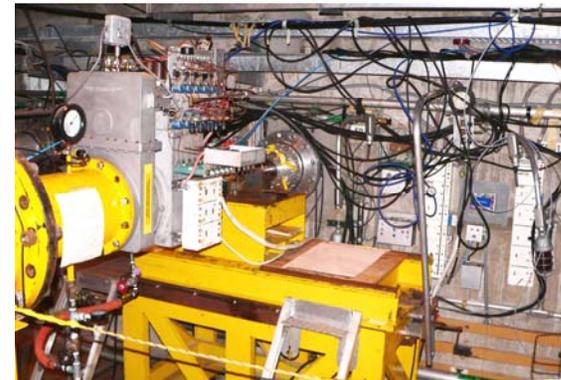
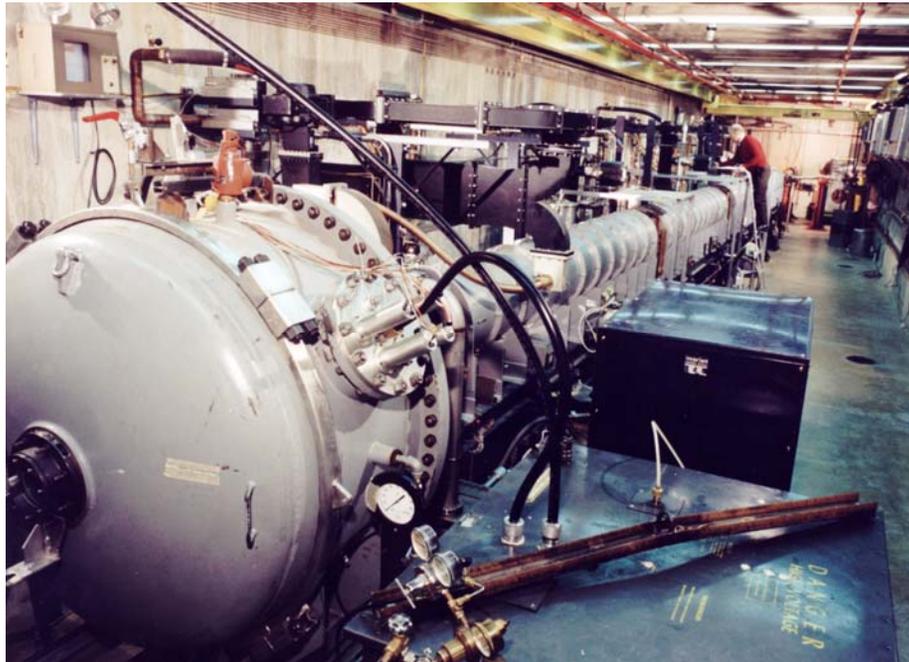
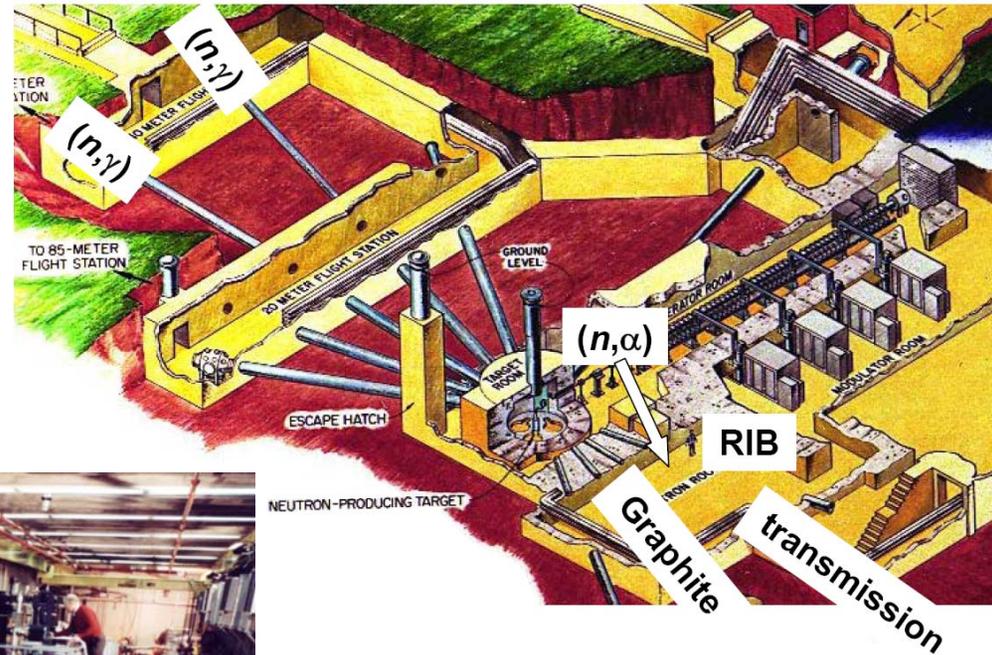
* Date shown is the scheduled commissioning date.

LEGEND	
■	Installed, commissioning, or operating
■	In design or construction
■	Under consideration



NEUTRON SCIENCES

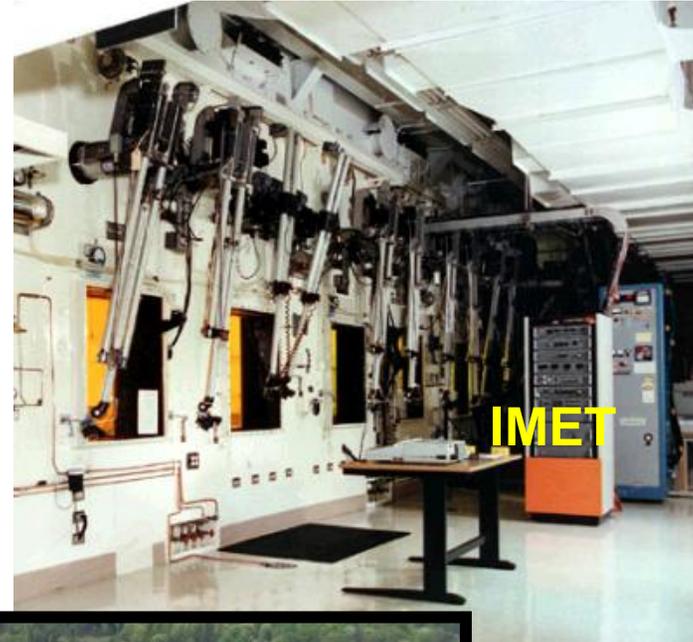
Oak Ridge Linear Electron Accelerator



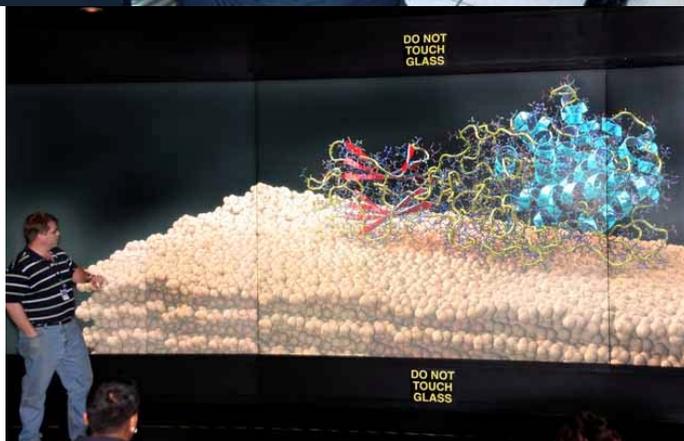
Non-Reactor Nuclear Facilities



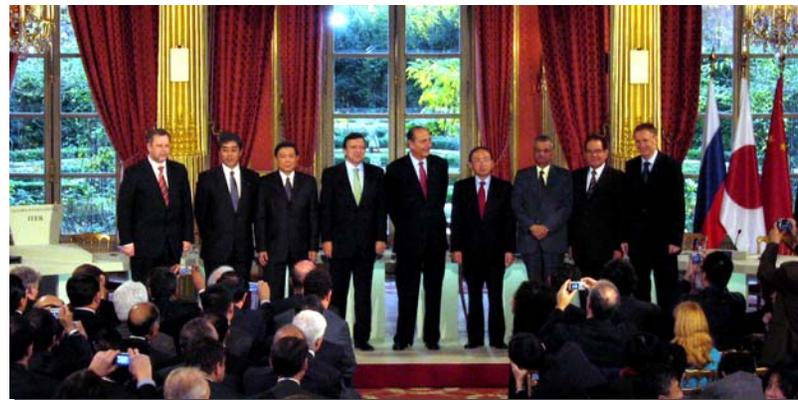
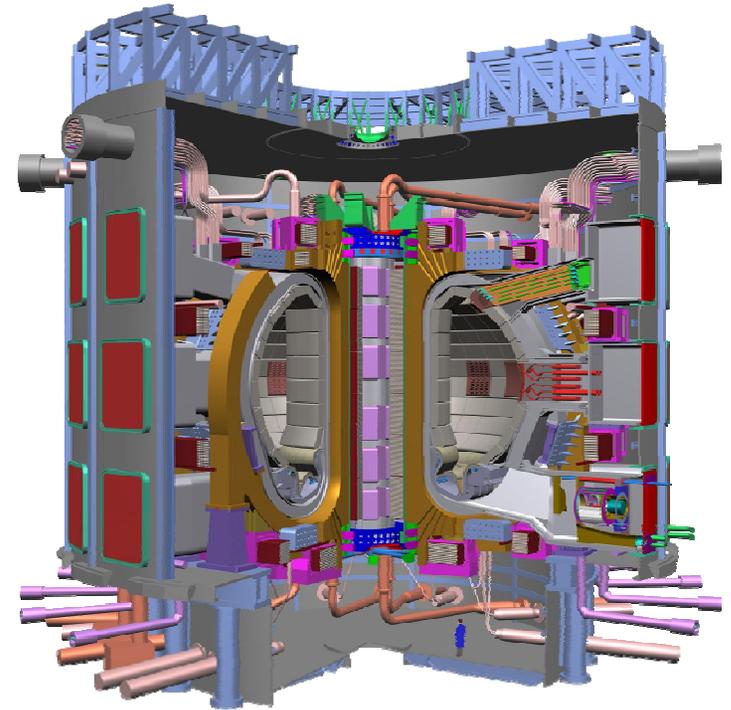
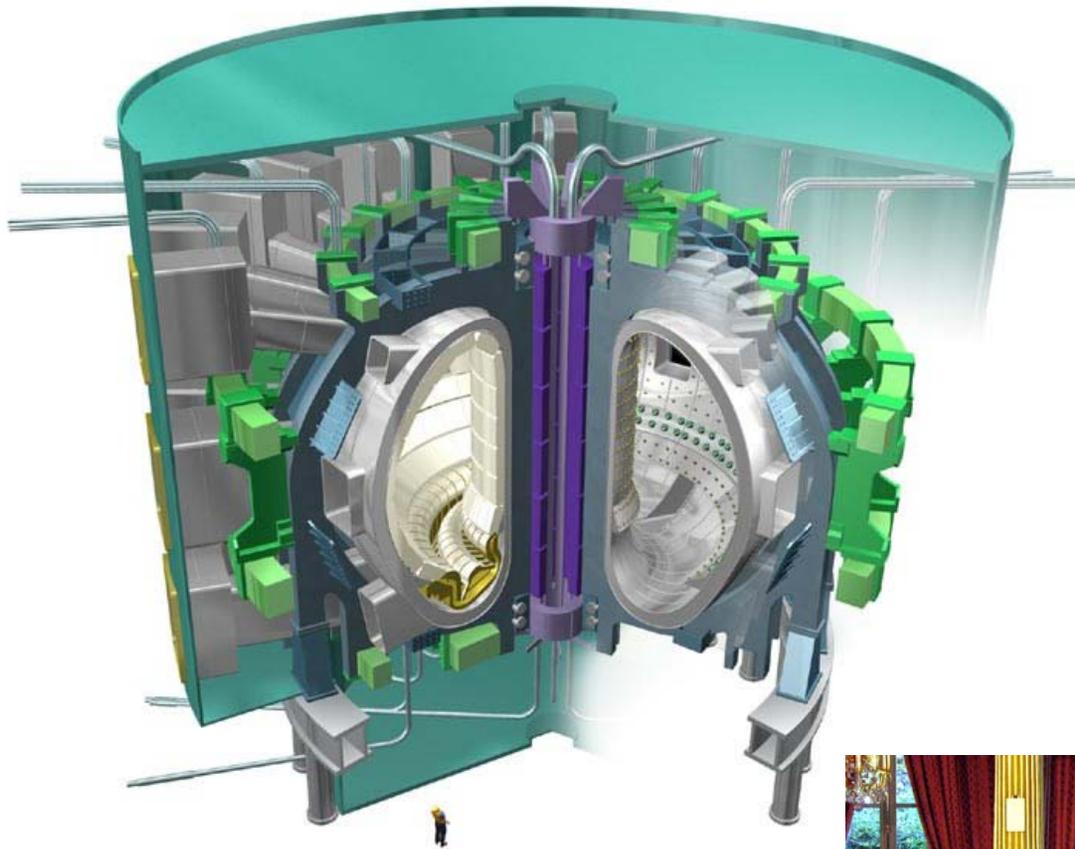
Building 3525 at ORNL



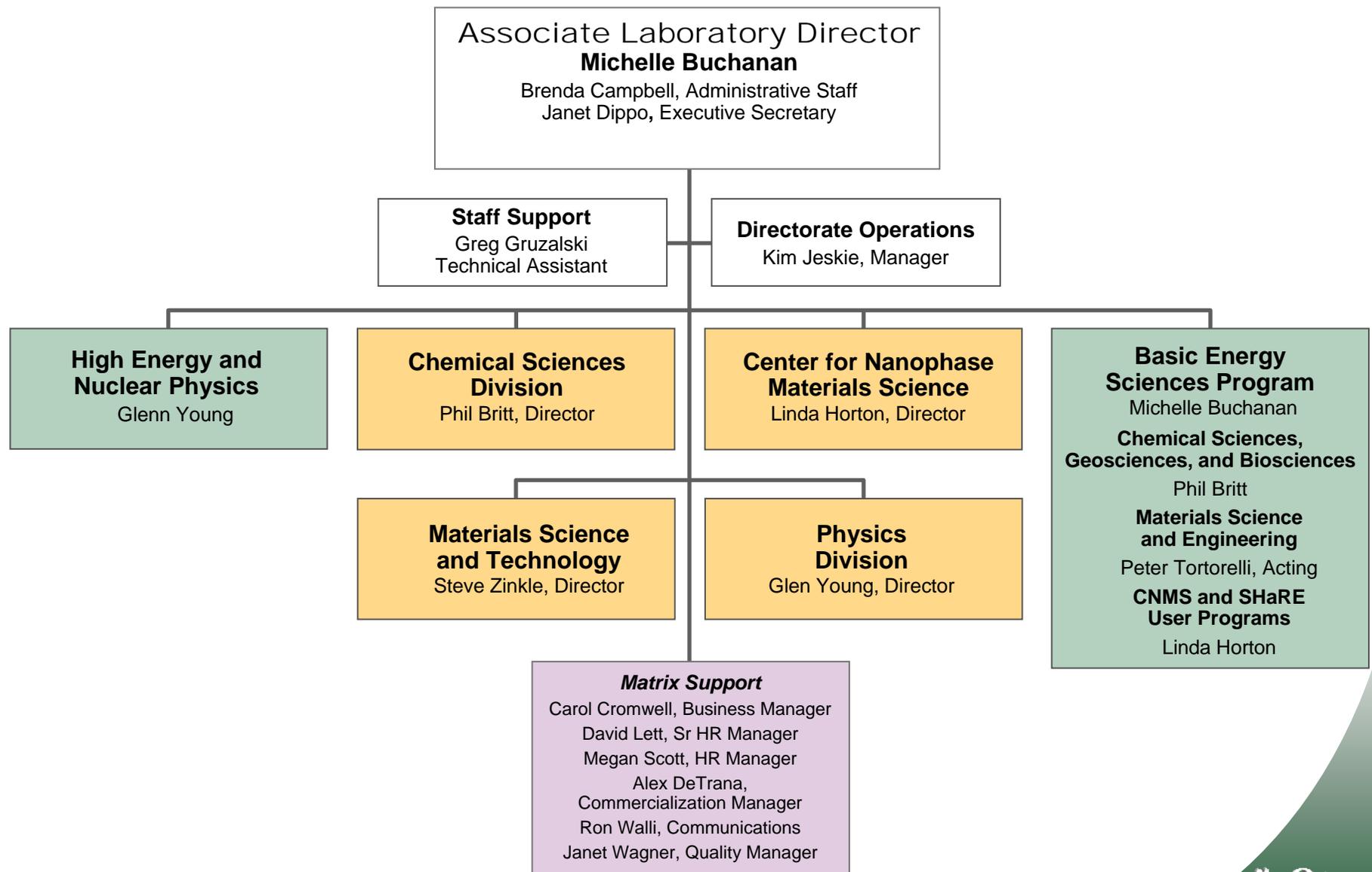
High Performance Computing



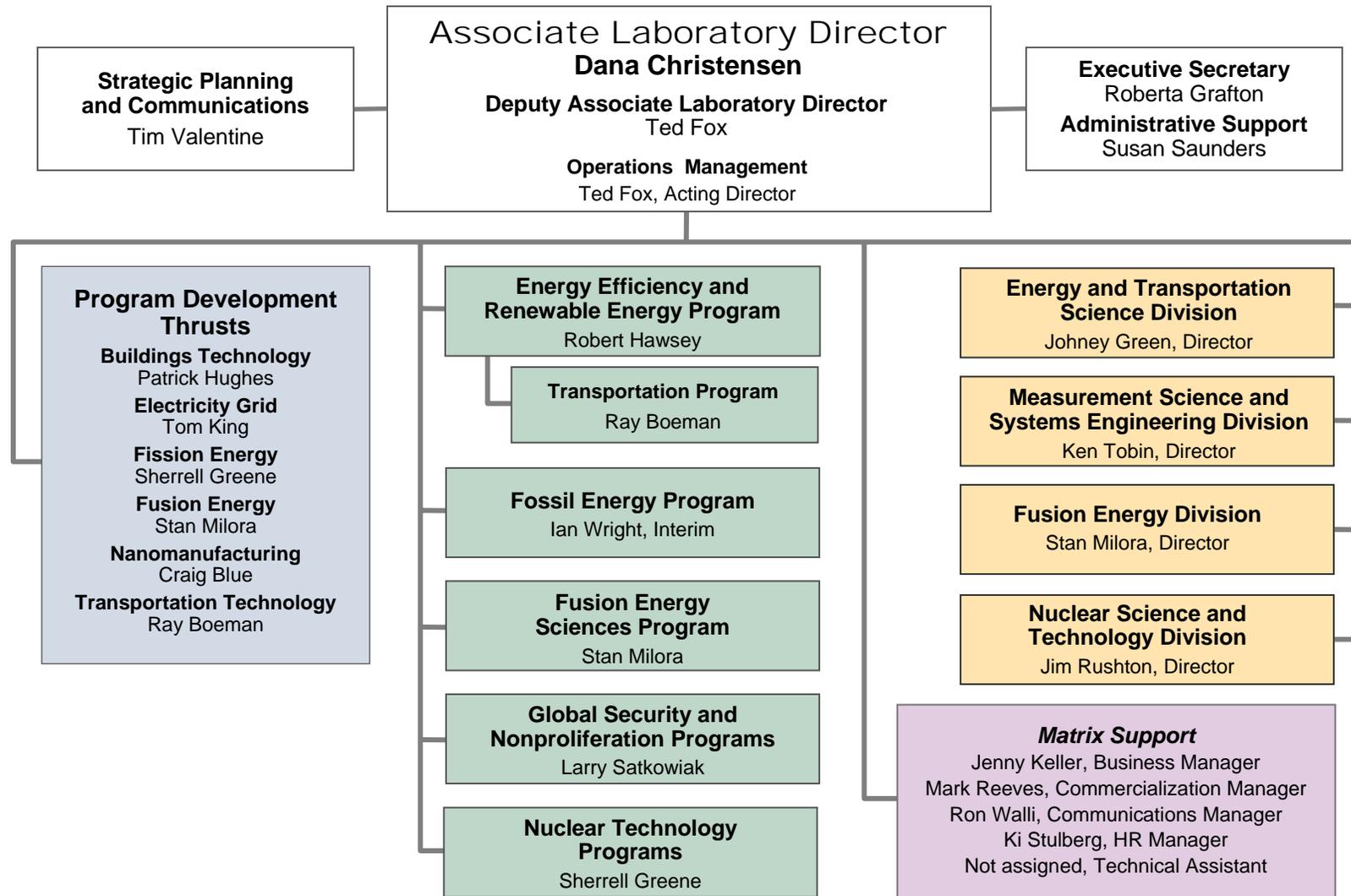
U.S. ITER Project Office



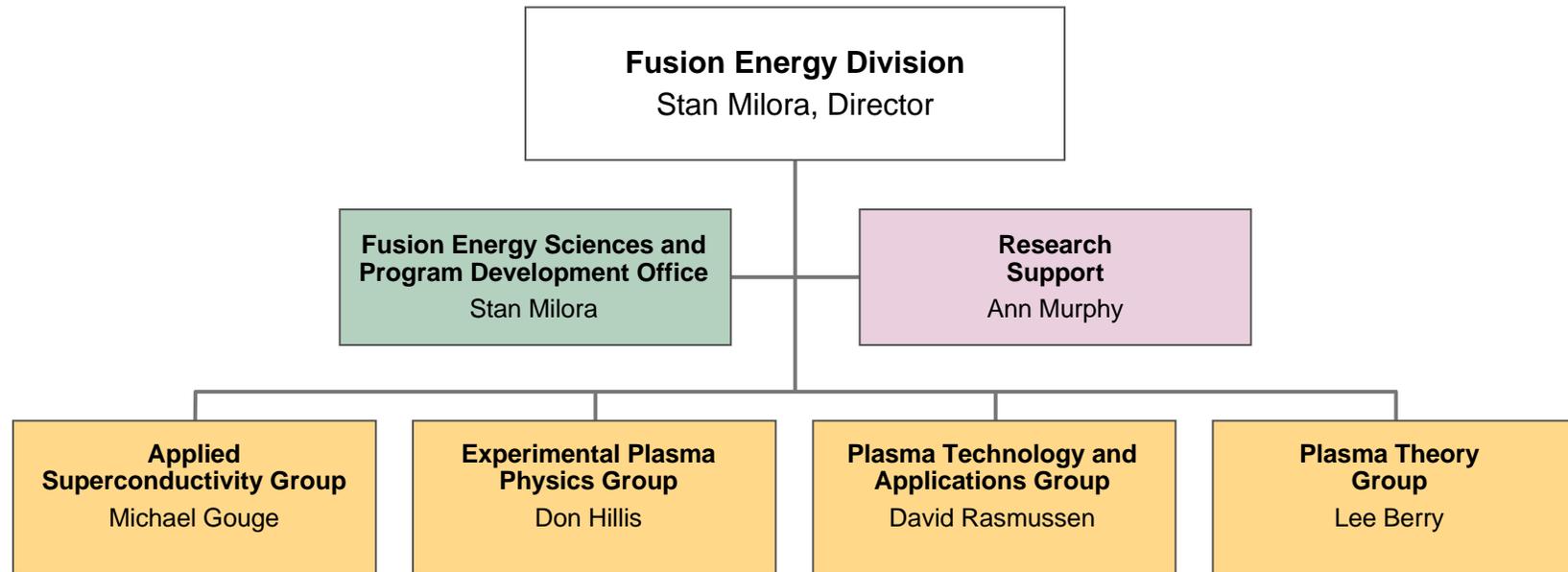
Physical Sciences



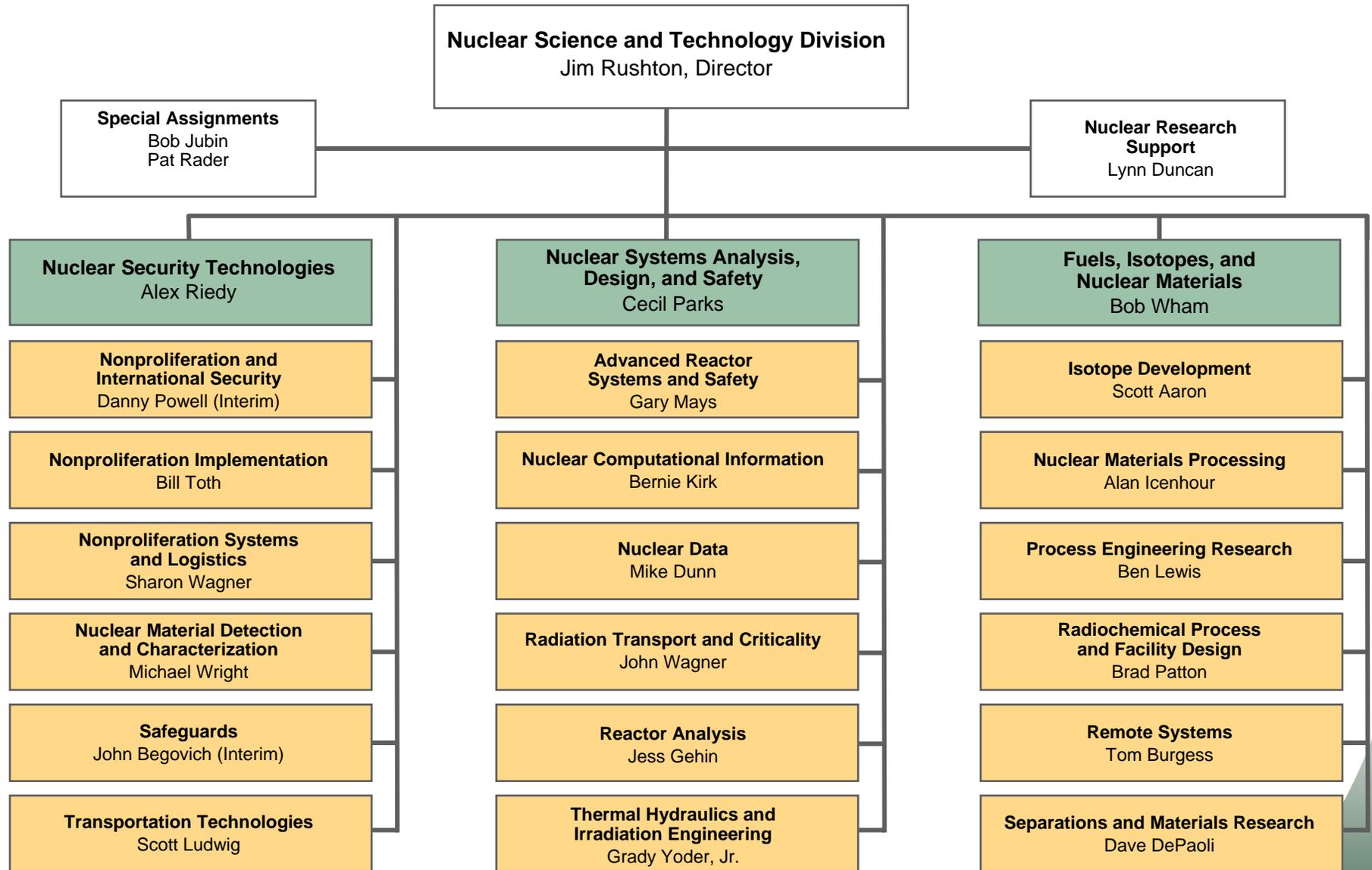
Energy and Engineering Sciences



Fusion Energy Division



Nuclear Science and Technology Division



Energy-related Research at ORNL

Biological and Environmental Sciences	Computing and Computational Sciences	Energy and Engineering Sciences	National Security	Physical Sciences	Neutron Sciences	ITER
<ul style="list-style-type: none"> • Bioenergy Science Center • Bioconversion Science and Technology • Hydropower Technology 	<ul style="list-style-type: none"> • Fusion Simulation Support • Grid Visualization • Nuclear Simulation • Enrichment Simulation • Transportation 	<ul style="list-style-type: none"> • Energy Efficiency and Renewable Energy Program <ul style="list-style-type: none"> – Energy Delivery and Electric Reliability • Fusion Energy Sciences • Fossil Energy Program • Nuclear Technology <ul style="list-style-type: none"> – NE – NR – OCRWM – NRC • Nuclear Non-proliferation Program • DOT 	<ul style="list-style-type: none"> • Portable Power • Defense Logistics • Critical Infrastructure 	<ul style="list-style-type: none"> • Basic Energy Sciences • High Temperature Materials Laboratory • Advanced Materials for Applied Energy Programs • Center for Nanophase Materials Sciences 	<ul style="list-style-type: none"> • Neutron Sciences Applications to Energy R&D • Fuel and Materials Irradiations 	<ul style="list-style-type: none"> • Fusion Engineering

From ORNL Today...



Rushton honored by University of Wisconsin



Nuclear S&T Division Director Jim Rushton has been selected to receive the University of Wisconsin College of Engineering Distinguished Achievement Award from his alma mater. Jim and wife, Becky, will pick up the award in October. "My experience at the University of Wisconsin Engineering Physics Department under the leadership of Max Carbon was outstanding in every respect and has been the foundation for my entire career," Jim says.

Nuclear Security Technologies

- **Material protection, control, and accounting**
- **Safeguards**
- **Arms control assessments**
- **Export control**
- **Nuclear threat reduction**
- **Radiation detection**
- **Radiation transport**
- **Transportation technologies**
- **Fissile material detection**
- **Fissile material disposition**
- **Instrumentation**



Radiation Detector System Testing



Russian Nuclear Material Security

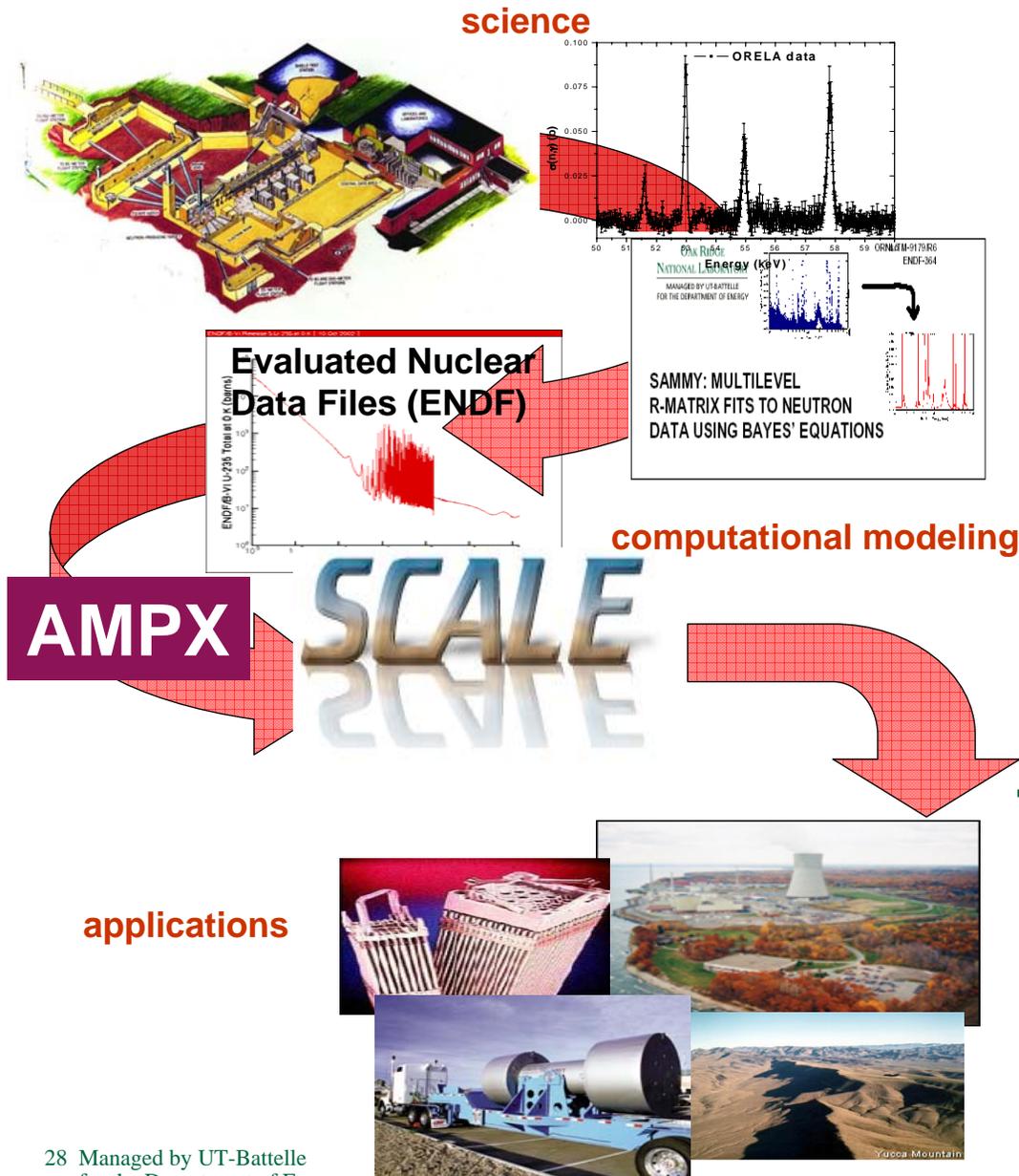


Nuclear Systems Analysis, Design, and Safety

- Nuclear data and codes
- Criticality safety
- Reactor physics
- Radiation shielding
- Advanced/Space reactors
- Thermal hydraulics
- Material and fuel irradiation
- Information/Systems analysis
- Facility safety
- Risk assessment
- Regulatory support
- System instrumentation and controls
- Enrichment technology



SCALE



Interface **science** (the basic physics of cross-section measurements), **computational modeling** (SCALE), and **applications** expertise to support evaluation and resolution of nuclear engineering and safety issues.

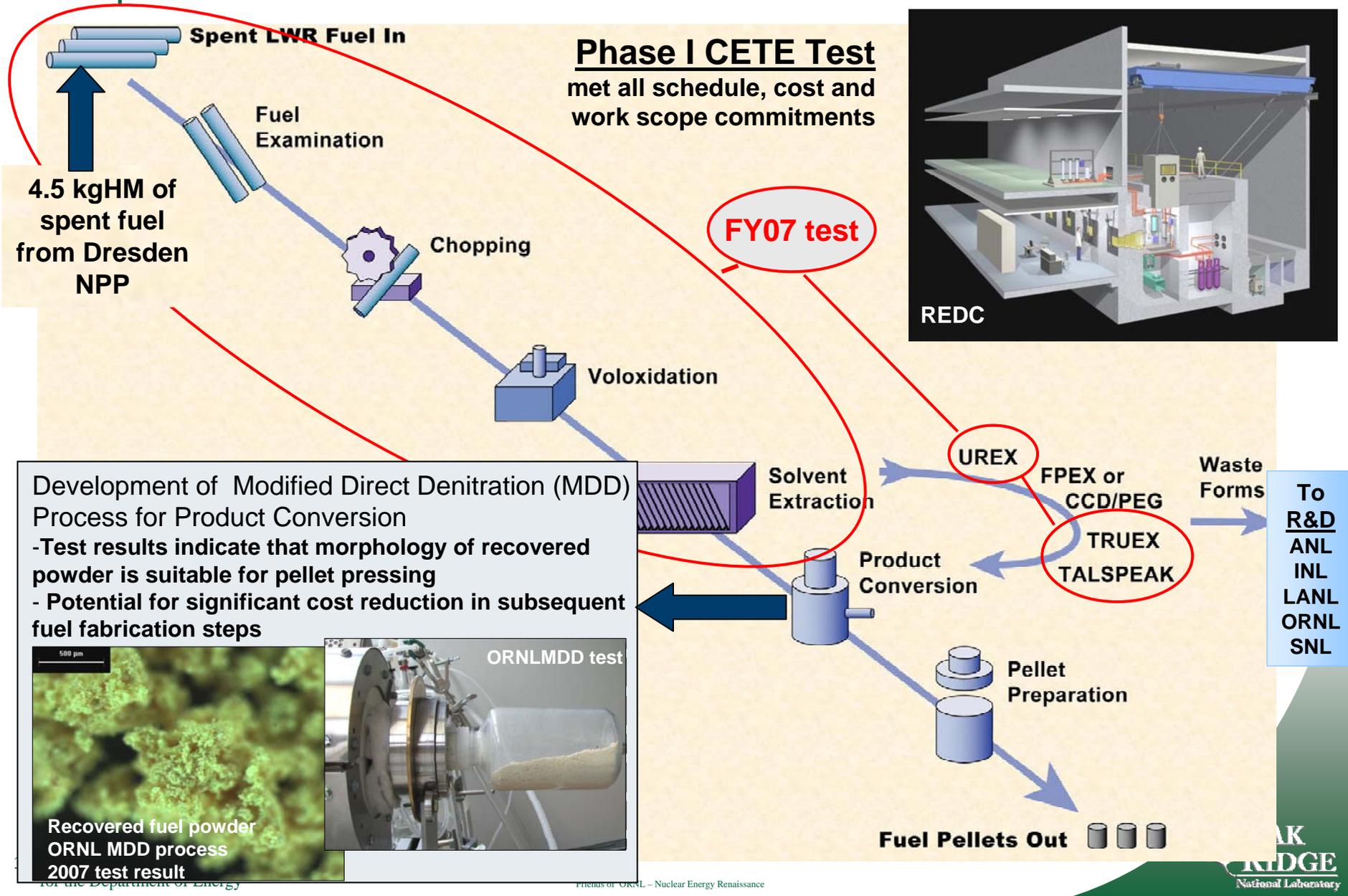
- Cross-section processing
- Criticality safety
- Radiation protection and shielding
- Reactor physics
- SNF/waste characterization (e.g., inventory, decay heat, radiation source and spectra)

Fuels, Isotopes and Nuclear Materials

- **Nuclear fuels**
- **Heavy element production**
- **Stable/radioactive isotopes**
- **Medical isotope development**
- **Separations science and technology**
- **Nuclear process and equipment design**
- **Robotics**
- **Remote handling**
- **Chemical engineering**



Global Nuclear Energy Partnership Coupled End-To-End Demonstration



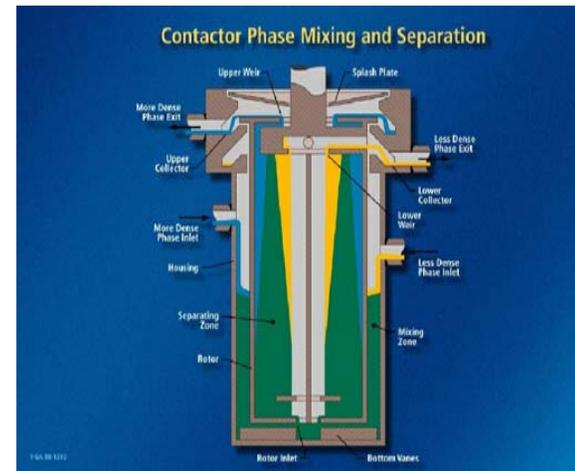
Centrifugal Solvent Extraction Contactors

- ORNL specialty (24 years)
- ORNL has designed contactors of various sizes for use in remote operating environments
- New contactor test station being installed in Bldg. 4501

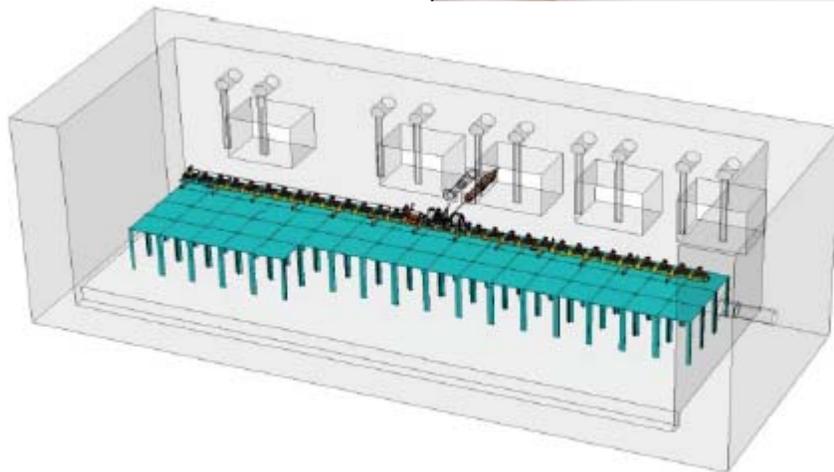
Contactor installation at the Oak Ridge Y-12 Plant



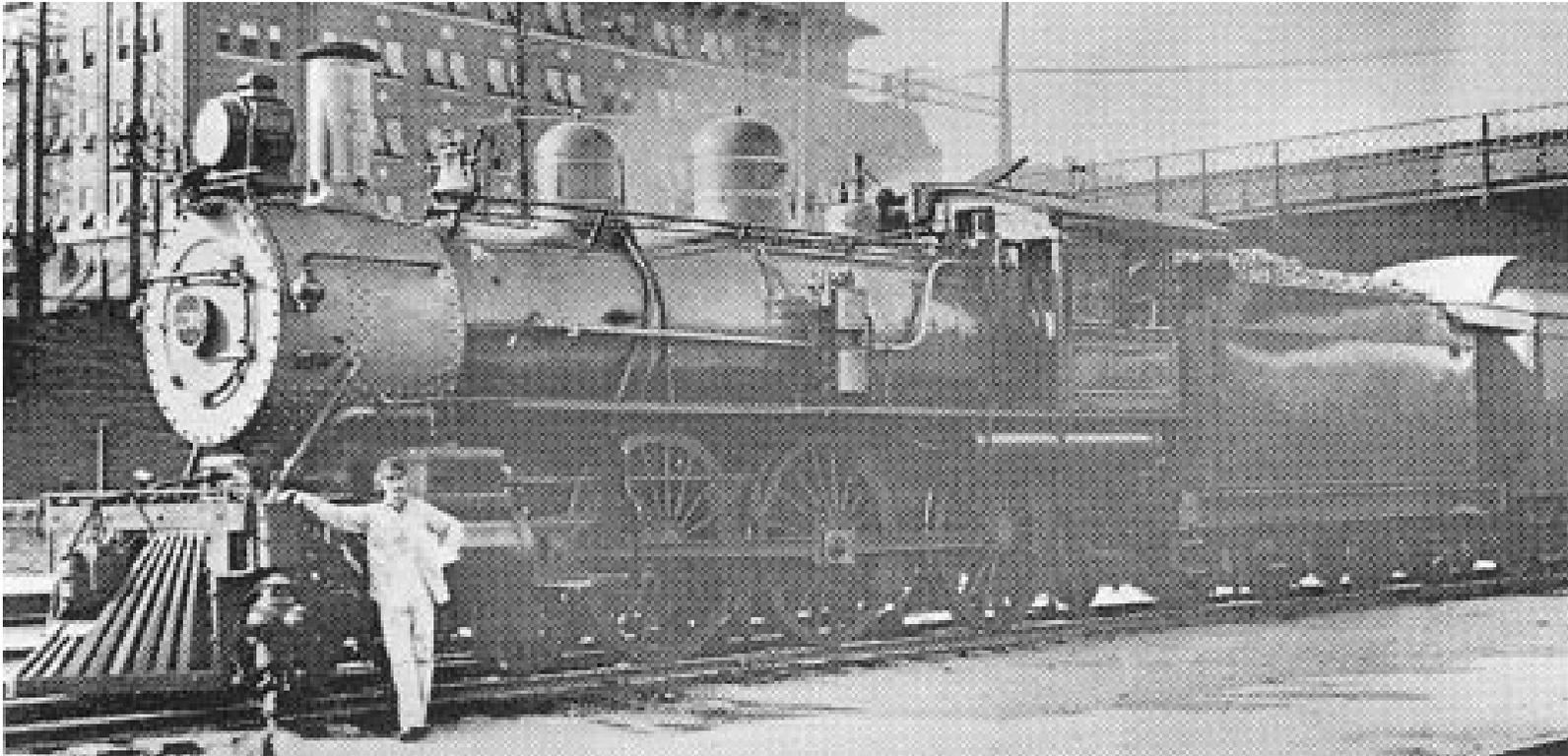
Remotely maintainable Chemical Systems Test Contactor Cascade at ORNL



Nuclear Fuels Examination



What's It Like to Be an Engineer in Tennessee?



Great Smoky Mountains



Mountains, Forests and Lakes



Knoxville



Oak Ridge



Springtime in East Tennessee



Four Seasons



College Football is Big...



So is Women's Basketball (Men's, too)



My Version – Nuclear Engineer at Oak Ridge

Hired in 1977, Central Engineering Services

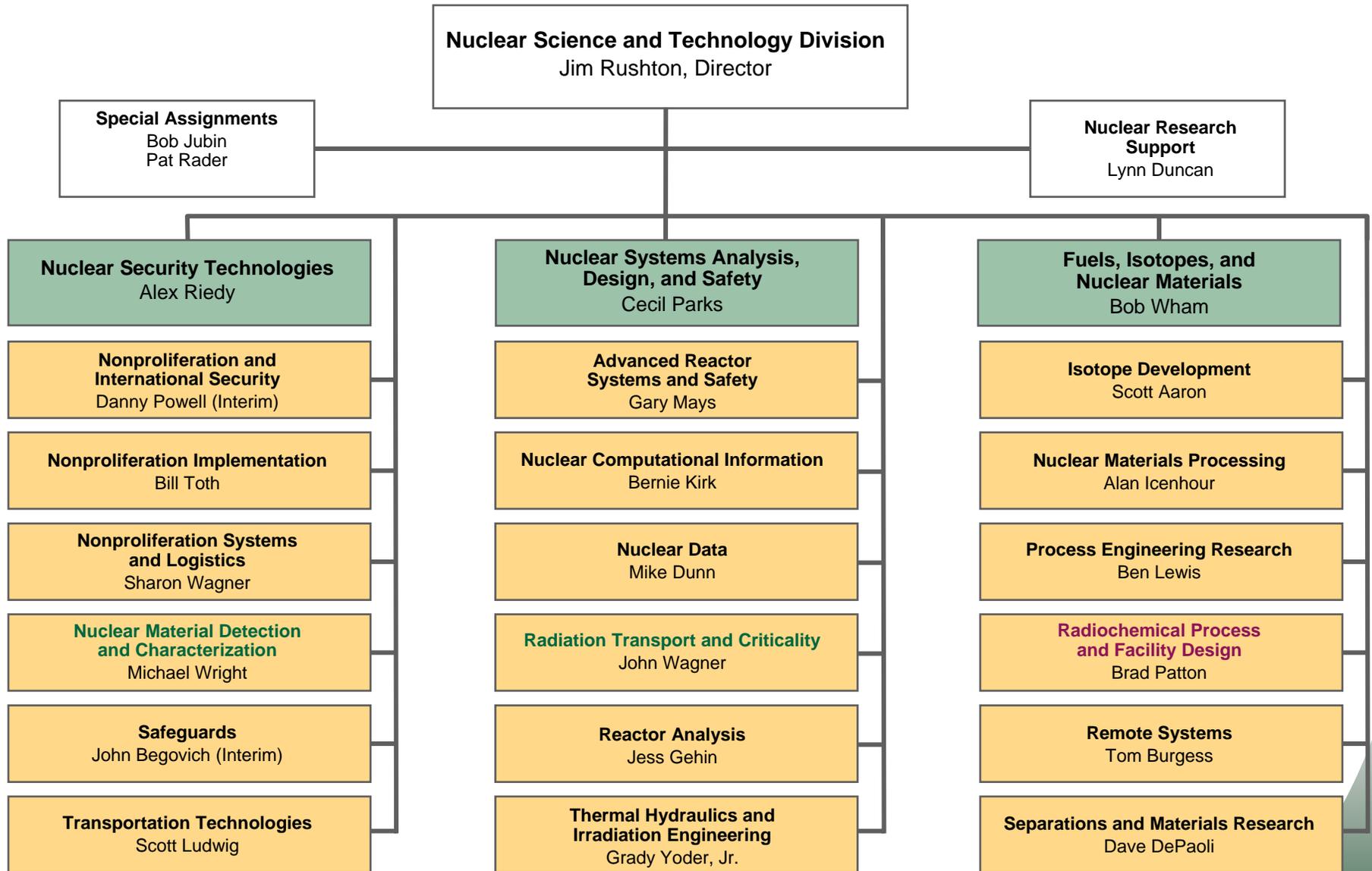


- **Union Carbide Corporation – Nuclear Division**

Project Execution

- **Project planning and tracking**
- **Concept development**
- **Hardware design and fabrication**
- **Operations checkout and completion**

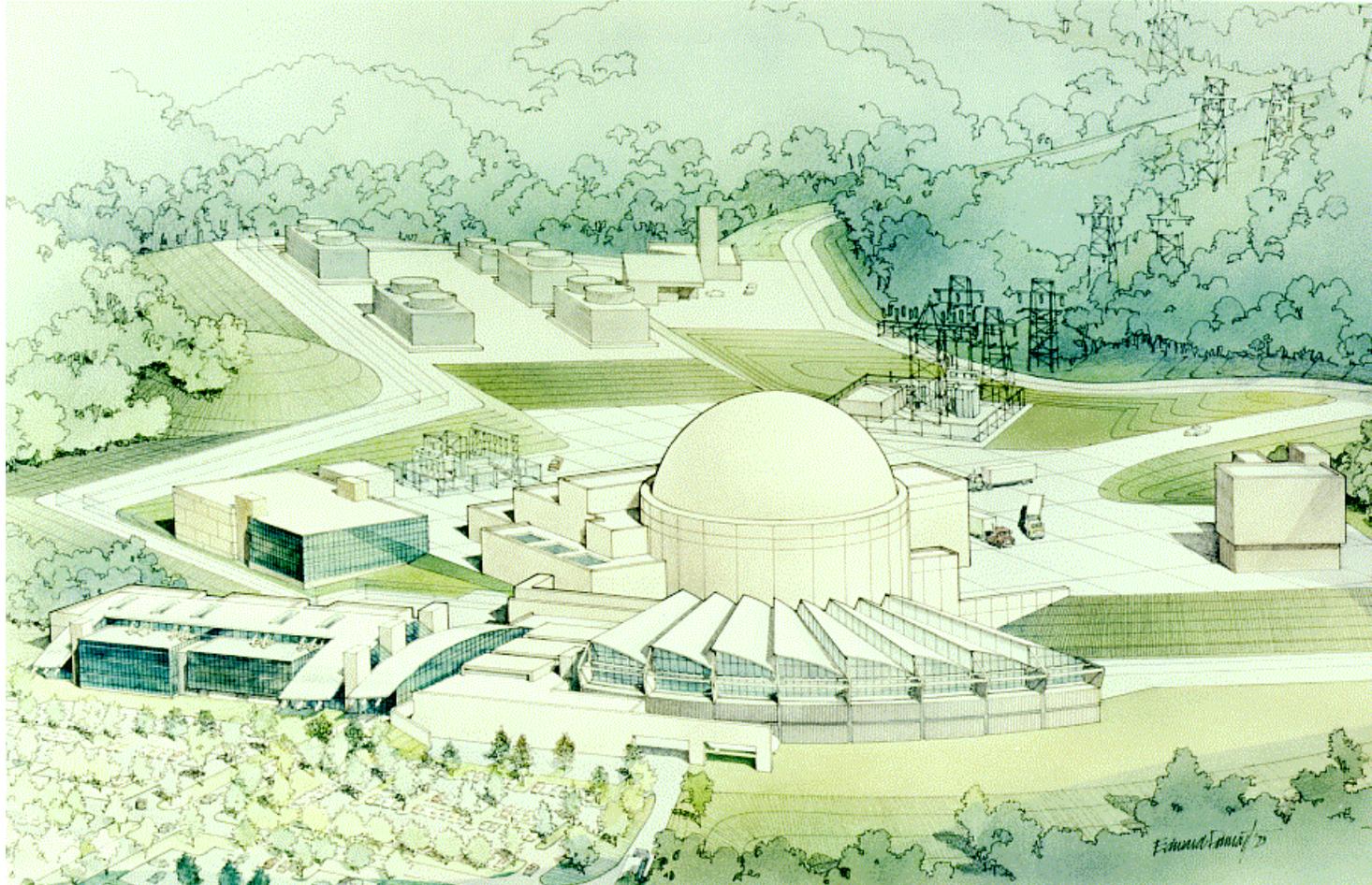
Where Do I Work?



Fuel Cycle Technology Development



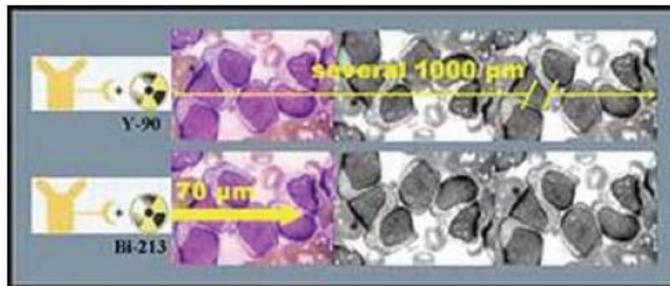
Advanced Neutron Source (A really big research reactor)



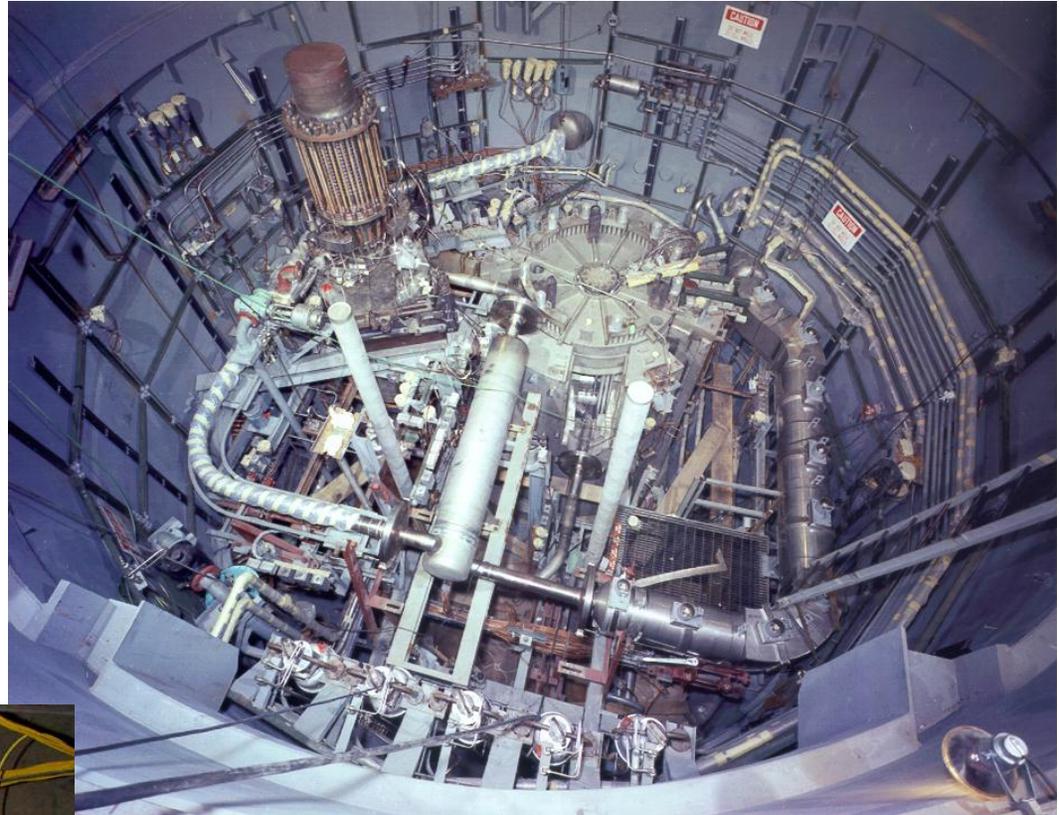
Radioimmunotherapy – Separation of ^{229}Th



Radioimmunotherapy – ^{229}Th to ^{213}Bi



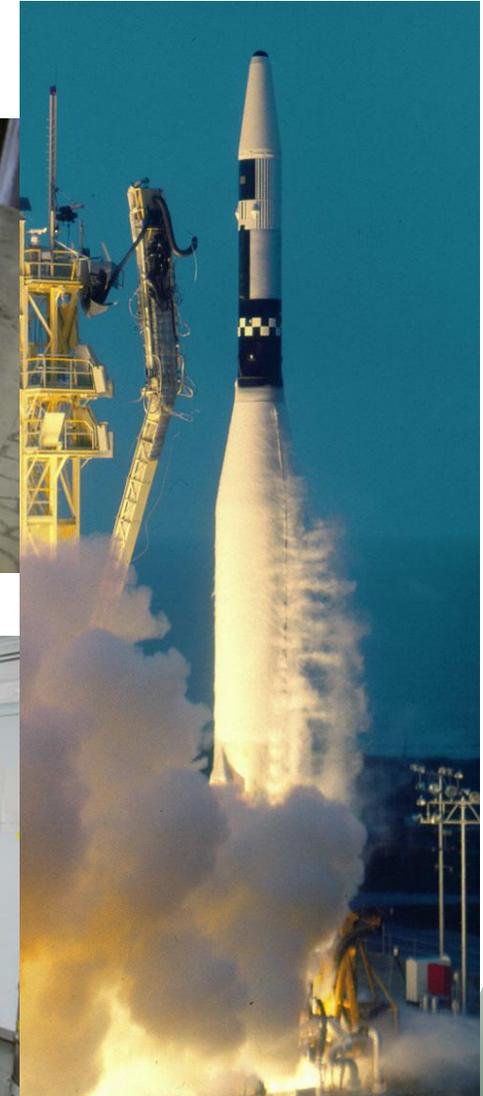
Molten Salt Reactor Experiment



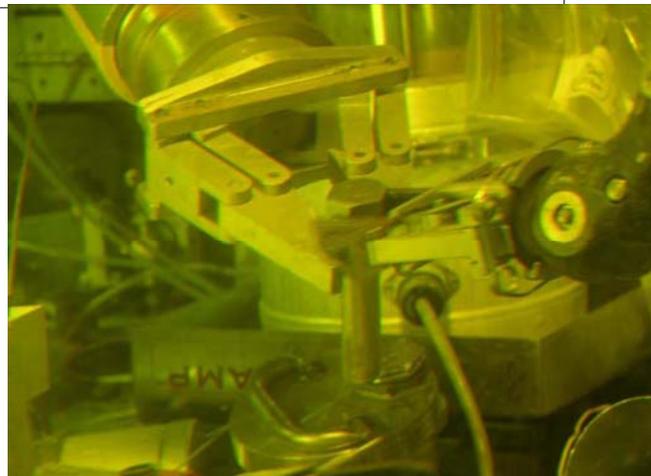
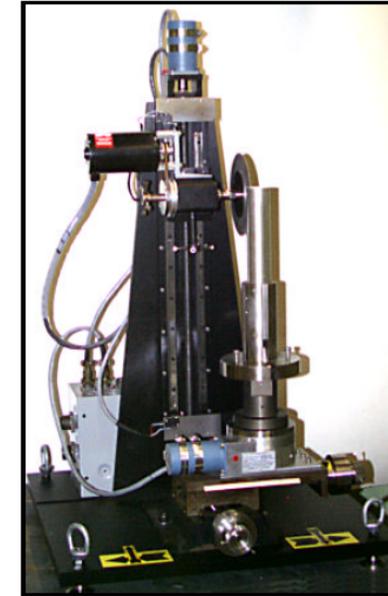
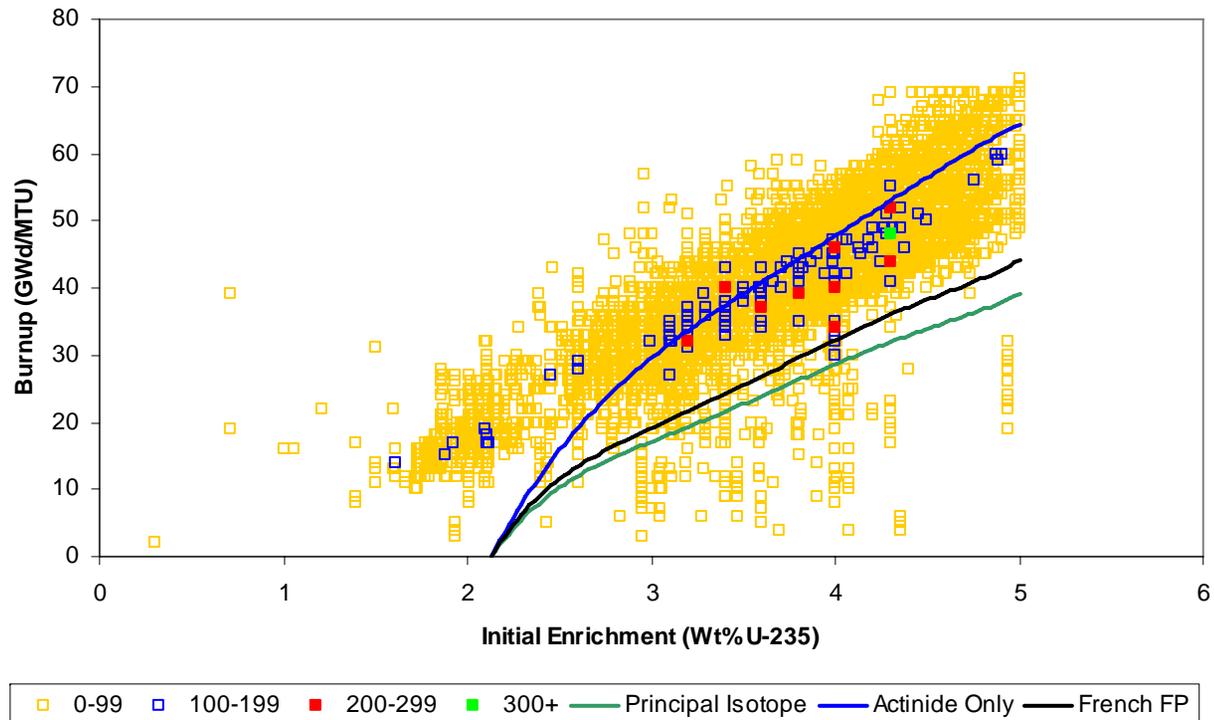
Radiation Detector System Testing



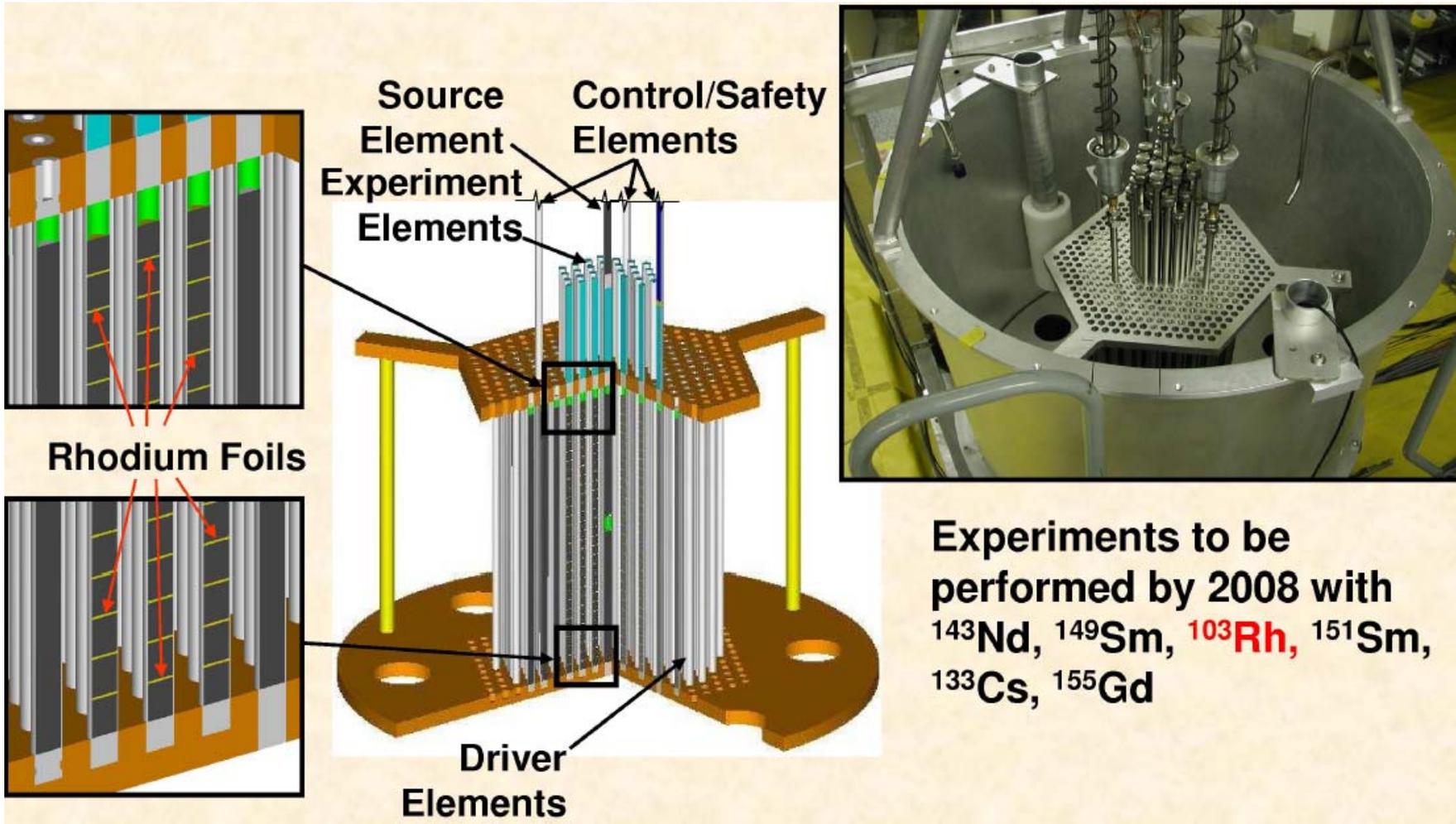
Tower Shielding SNAP 10A Reactor



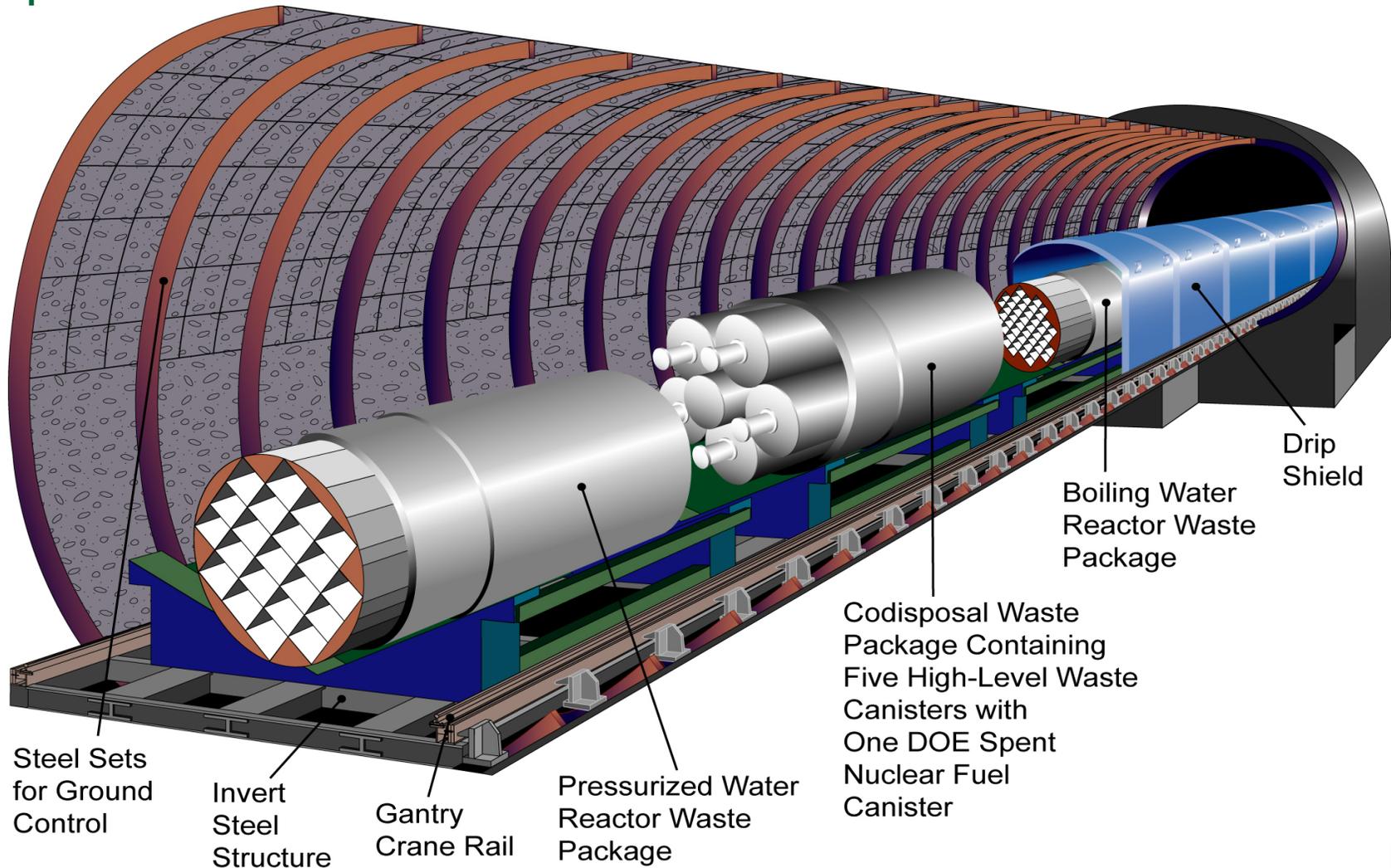
Burnup Credit for Yucca Mountain Radiochemistry



Burnup Credit for Yucca Mountain Critical Experiment

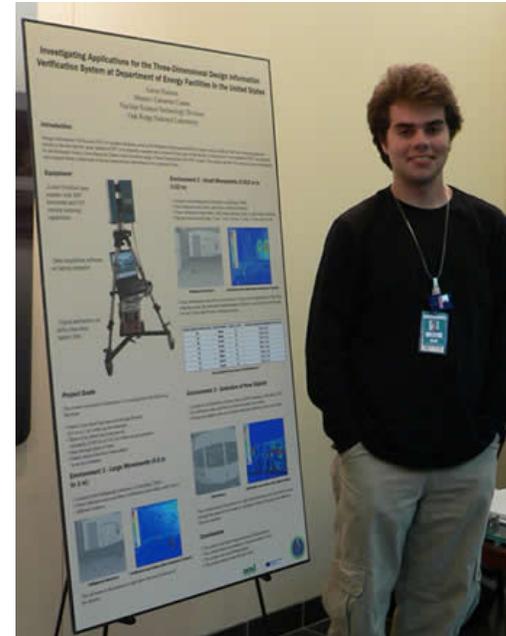


Waste Types in Yucca Mountain Emplacement Drift



Drawing Not to Scale
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Summer Students and ORNL



Undergraduate Student Programs

Academic Fellowships and Scholarships, Research Experiences, Sabbaticals, and Internships
Available through ORISE and ORAU

Undergraduate Students

Select List of Programs by:

Program Name

Program Sponsor

Application Deadline

Geographic Location

or make selections for one or more of the following:

Fields of interest:

[pick one] ▼

Types of program:

[pick one] ▼

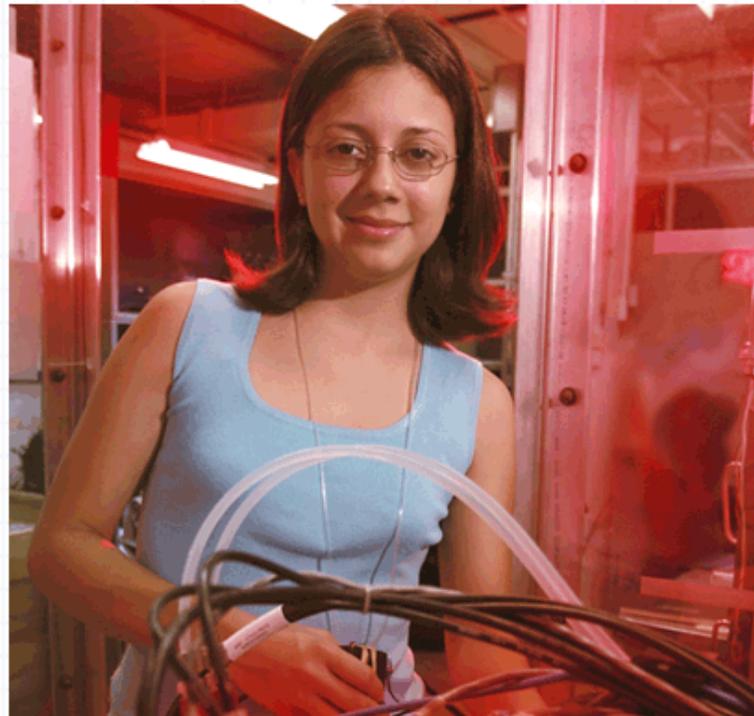
When appointments start:

[pick one] ▼

U.S. Citizenship requirements:

[pick one] ▼

SUBMIT



■ List of Immediate Needs

■ Participant Experiences

■ Our commitment to diversity

■ Special events

■ Contact us

Education Opportunities Home | ORISE | ORAU

Post-Doc Programs

Academic Fellowships and Scholarships, Research Experiences, Sabbaticals, and Internships
Available through ORISE and ORAU

Post Doctoral Fellows

Select List of Programs by:

Program Name

Program Sponsor

Application Deadline

Geographic Location

or make selections for one or more of the following:

Fields of interest:

[pick one] ▼

Types of program:

[pick one] ▼

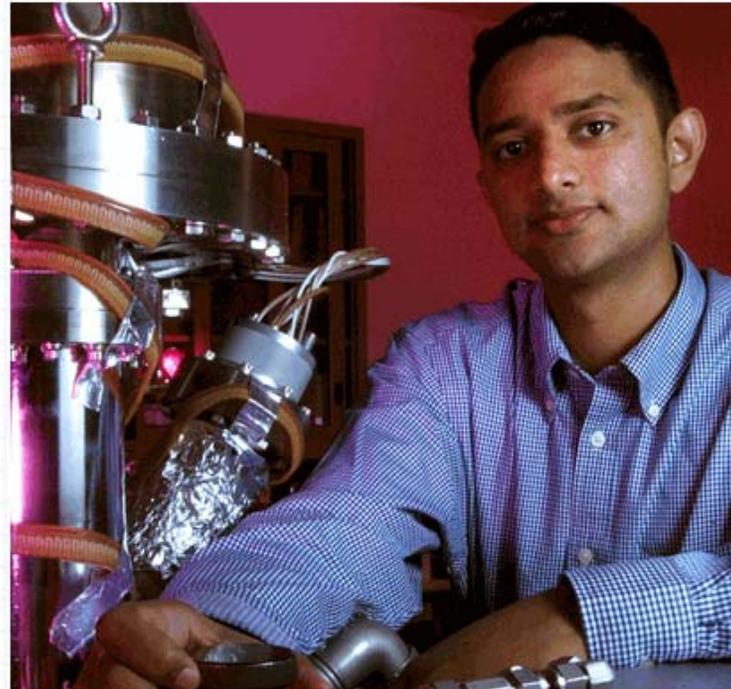
When appointments start:

[pick one] ▼

U.S. Citizenship requirements:

[pick one] ▼

SUBMIT



- Our commitment to diversity
- Special events
- Contact us

List of Immediate Needs

Participant Experiences

[Education Opportunities Home](#) | [ORISE](#) | [ORAU](#)

American Nuclear Society



- **National Organization**
- **Practice Sections**
- **Local Sections**
- **Student Chapters**

American Nuclear Society Oak Ridge/Knoxville Local Section



Dominated by ORNL, but diverse

- **Oak Ridge National Laboratory**
- **University of Tennessee Nuclear Engineering**
- **Y-12 National Security Complex (criticality safety)**
- **Various small local firms**
- **Bechtel (subcontract to TVA)**

Monthly dinner meetings, with speaker

- **Attendance ranging from 40 to 75**

Women in Nuclear

- **Oak Ridge Chapter**
 - Very active
 - Tightly integrated with ANS local section



American Nuclear Society Oak Ridge/Knoxville Local Section

Active in the community

- **Teachers' workshops**
- **Science clubs**
- **SHADES (with WIN)**
- **Support to science fairs and local schools**

Scholarships to University of Tennessee undergrads

American Nuclear Society University of Tennessee Student Section Vanderbilt University Student Section

- **University of Tennessee**
 - Nuclear Engineering department
 - Mix of undergraduate and graduate students
 - Immediate vicinity
 - Traditional close ties to Oak Ridge/Knoxville section
- **Vanderbilt University**
 - Relatively new student section
 - Loosely connected to nuclear activities
 - Mostly graduate students
 - Three-hour drive