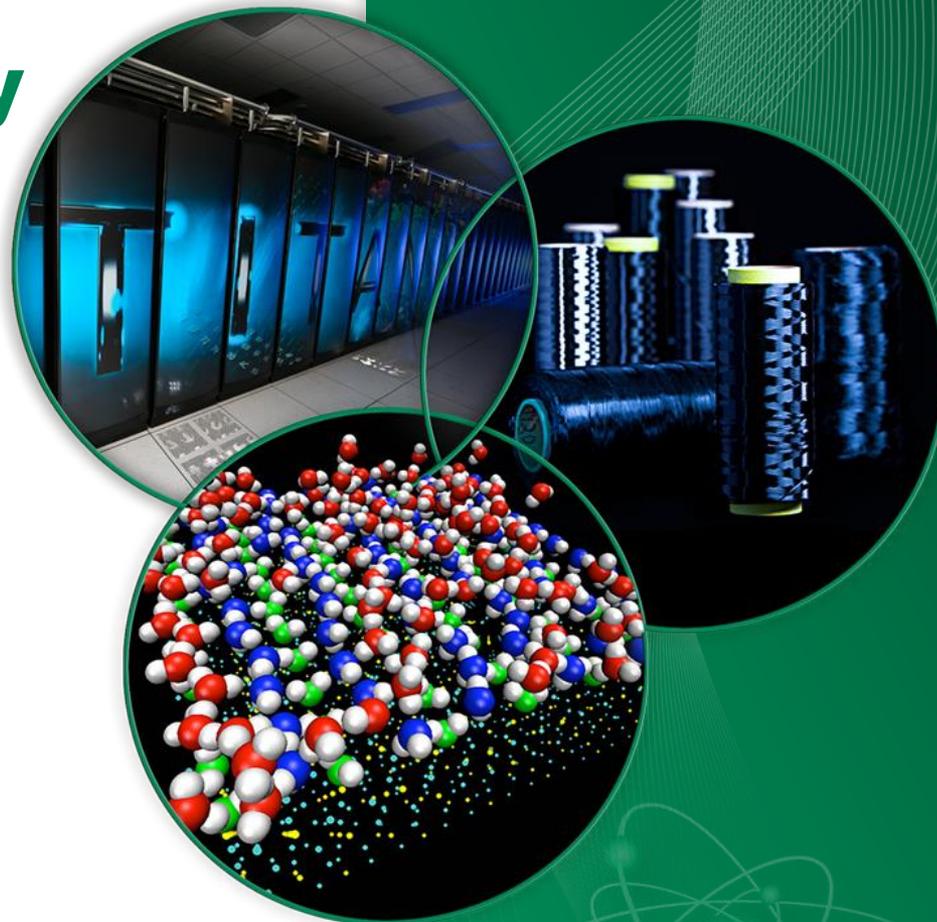


# Welcome to Oak Ridge National Laboratory

Presented at the  
**Global Sustainable Bioenergy  
Project meeting**

**James B. Roberto**  
Associate Laboratory Director  
Science and Technology Partnerships

Oak Ridge, Tennessee  
June 12, 2013



# Oak Ridge National Laboratory evolved from the Manhattan Project

The Clinton Pile was the world's first continuously operated nuclear reactor



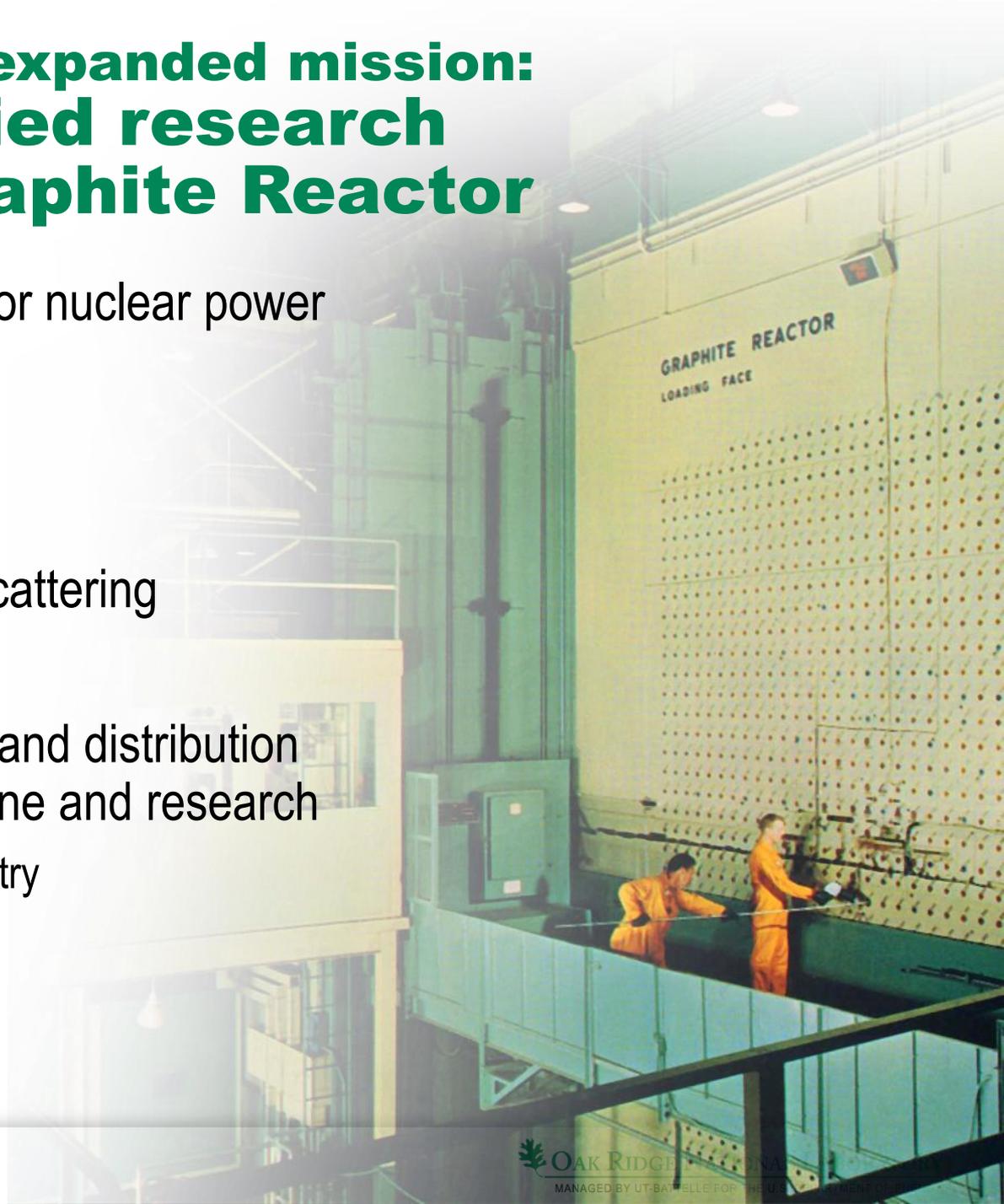
Chemical processing techniques were developed to separate plutonium from irradiated fuel



LIFE  
FILE

# Success led to an expanded mission: Basic and applied research utilizing the Graphite Reactor

- Science and engineering for nuclear power
  - Materials and fuels
  - Separations chemistry
  - Reactor technology
- Development of neutron scattering
  - Nobel Prize in Physics
- Development, production, and distribution of radioisotopes for medicine and research
  - Birth of a billion dollar industry



# Today, ORNL is DOE's largest science and energy laboratory

\$1.5B  
budget

4,500  
employees

3,000  
research  
guests  
annually

\$500M  
modernization  
investment

Nation's  
largest  
materials  
research  
portfolio

Most  
powerful open  
scientific  
computing  
facility

World's  
most intense  
neutron  
source

World-class  
research  
reactor

Nation's  
most diverse  
energy portfolio

Managing  
billion-dollar  
U.S. ITER  
project

# ORNL's mission

Deliver scientific discoveries and technical breakthroughs that will accelerate the development and deployment of solutions in clean energy and global security, and in doing so create economic opportunity for the nation



# ORNL innovations have had billion dollar impacts

Lab-on-a-chip: Caliper sold for \$600M in 2011

Cesium extraction: Basis for \$1.3B waste processing facility at Savannah River

Reactor life extension: \$20B cost avoidance

Advanced alloys: Chrome-moly steel in widespread use

Cryopreservation of mammalian embryos:  
Frozen embryo transfer for agricultural and human reproduction

Ion implantation: Technology for integrated circuits and medical implants

Centrifuge technology: Basis for vaccine purification and emerging U.S. enrichment industry

Instrumentation: >\$1B in products and spinoffs from ORTEC and TENNELEC

Reactor technology: Concept and technology development for light water, high temperature, and molten salt reactors

PUREX: Basis for nuclear fuel reprocessing techniques used worldwide

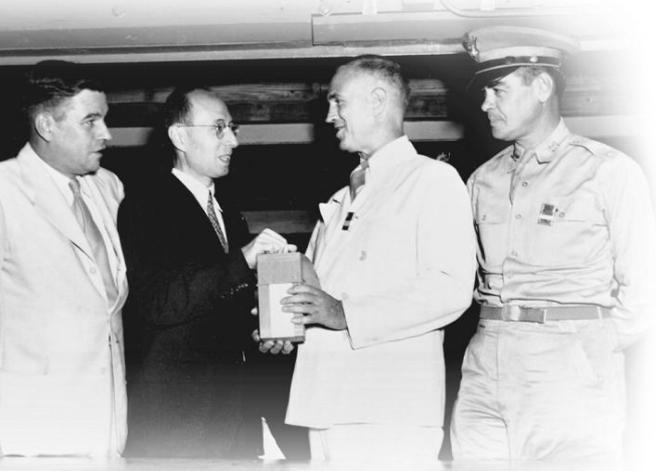
Radioisotopes: Now a multibillion dollar industry (>100 million procedures per year)

1940s

1960s

1980s

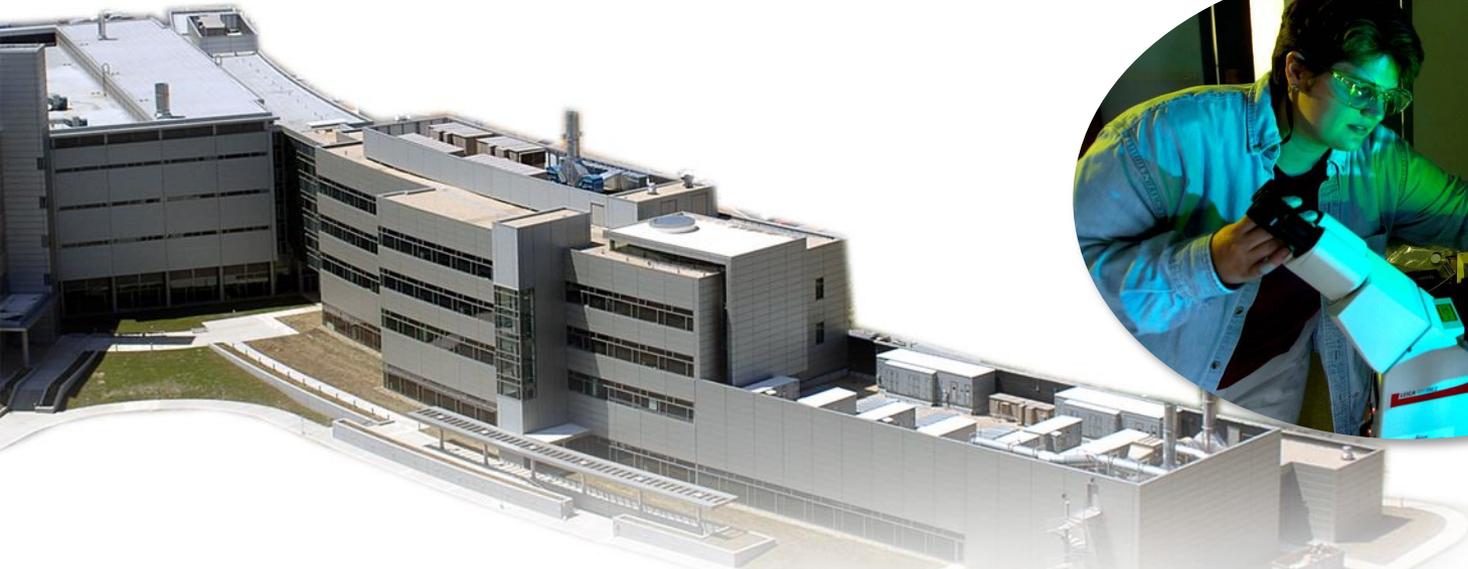
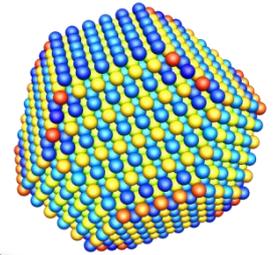
2000s



# World-class capabilities for materials R&D

- DOE's first Nanoscale Science Research Center
  - Nanofabrication
  - Nanoscale characterization
  - Materials synthesis and chemistry at the nanoscale
- World leading facilities (neutron scattering, electron microscopy, high-performance computing)
- Synthesis and processing (alloys, ceramics, semiconductors, thin films, nanofabrication, laser and infrared processing)
- Hundreds of industrial partners; thousands of university users

Understanding materials and chemistry at the length scale where properties are determined



# Developing and applying the world's best tools for neutron scattering

High Flux Isotope Reactor:  
Intense steady-state neutron flux  
and a high-brightness cold neutron source

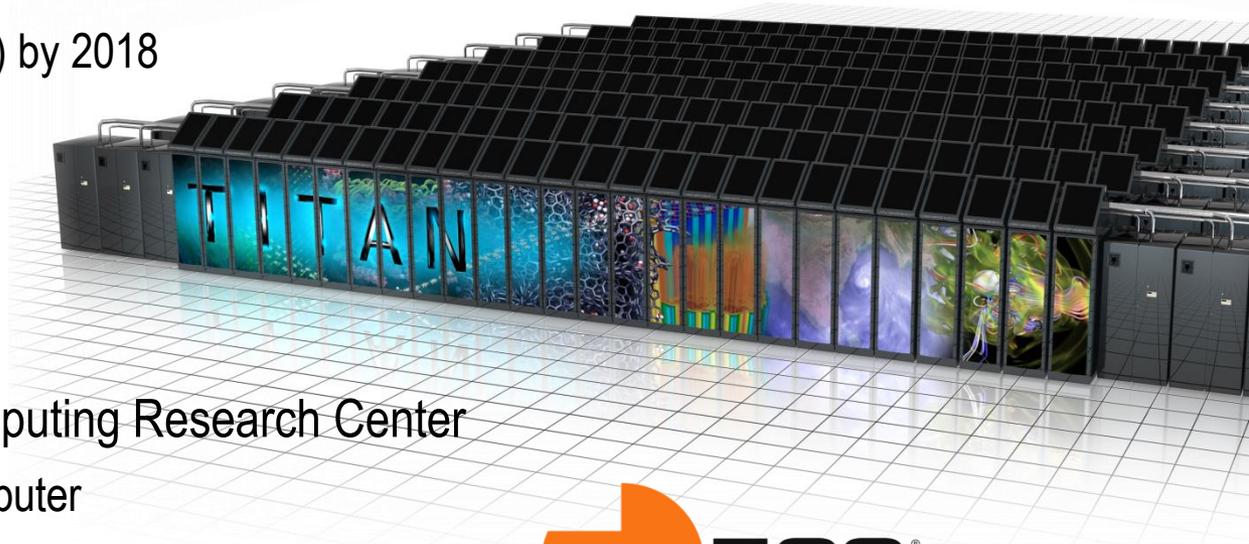
Spallation Neutron Source:  
World's most powerful  
accelerator-based neutron source

SNS and HFIR serve more than a  
thousand researchers each year

Determining the nanoscale structure and dynamics of materials and biological systems

# Leading the development of ultrascale scientific computing

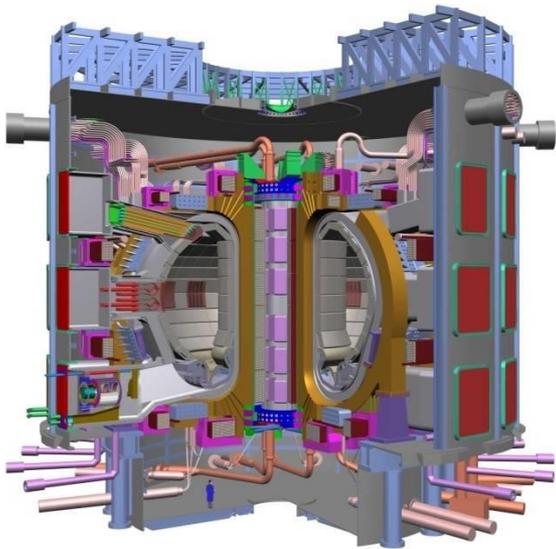
- DOE Leadership Computing Facility
  - Cray XT7 Titan operating at ~27 petaflops
  - World's fastest computer
  - Exascale system (1,000 PF) by 2018
- NSF National Institute for Computational Sciences
  - Fifth fastest university computer (1.1 petaflops)
- NOAA National Climate Computing Research Center
  - NOAA's most powerful computer
- Exascale systems will transform science
  - Predictive simulation of materials and complex systems
  - Integrated climate modeling at the kilometer scale



# Addressing the energy challenges of today . . . and tomorrow

## Fusion and fission

- Managing the billion-dollar U.S. contribution to ITER
- Advanced nuclear fuel cycle R&D



## Renewables

- \$135M center for cellulosic ethanol research
- Materials for energy storage and photovoltaics



## Energy efficiency

- DOE's leading lab in transportation and industrial technologies



# Transforming the new biology into bioenergy

- Developing bio-based solutions for energy, the environment, and carbon sequestration
- Managing the \$135M DOE BioEnergy Science Center to advance cellulosic ethanol research
- Partnered with UT in the \$73M Tennessee Biofuels Initiative
  - Joint venture with DuPont
  - Includes bioenergy research, a 50,000 gal/year pilot plant, and agricultural incentives for switchgrass



# Advanced manufacturing

## Manufacturing Demonstration Facility

- Leveraging ORNL expertise and facilities for advanced manufacturing and materials R&D
- Working with companies to reestablish U.S. leadership in advanced manufacturing
- 3-year \$2.4M grant awarded to the *AMP!* Team (Tech2020, Pellissippi State, ORNL and UTCIS)
- Key thrust: Additive manufacturing

## Carbon fiber technology

- \$35M Carbon Fiber Test Facility
- \$2.9M workforce development partnership with Roane State Community College
- Oak Ridge Carbon Fiber Composites Consortium: 50 companies
- Partnerships with key industries: \$13.5M Dow-Ford-ORNL project

## Lignin-based carbon fiber

- Integrated R&D
  - Lignin screening
  - Fiber spinning
  - Composite development
- Pilot scale demonstration at CFTF



# Our unique facilities provide distinctive capabilities and bring thousands of researchers to ORNL each year



Spallation  
Neutron Source

Center for  
Nanophase  
Materials Sciences



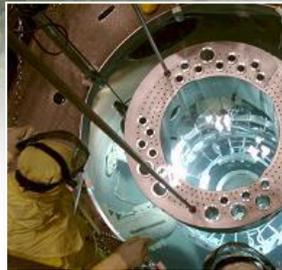
Manufacturing  
Demonstration Facility



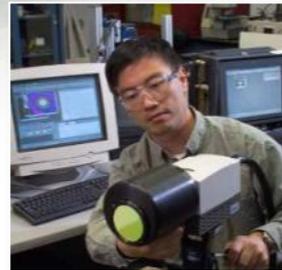
Building  
Technologies  
Research and  
Integration  
Center



Oak Ridge  
Leadership  
Computing  
Facility



High Flux  
Isotope  
Reactor



High  
Temperature  
Materials  
Laboratory



National  
Transportation  
Research  
Center



BioEnergy  
Science  
Center

# Partnerships are critical to our success

Major projects	Research collaborations	Guest researchers	Joint institutes	Industry and technology transfer
<ul style="list-style-type: none"><li>• SNS built by a consortium of 6 national labs</li><li>• Center for Advanced Simulation of Light Water Reactors (CASL)</li><li>• BioEnergy Science Center</li><li>• NSF petascale computing facility</li><li>• Carbon Fiber Pilot Facility</li></ul>	<ul style="list-style-type: none"><li>• Projects with 200+ universities</li><li>• Hundreds of joint research activities (70% of ORNL publications have a university coauthor)</li></ul>	<ul style="list-style-type: none"><li>• Hundreds of faculty and students</li><li>• Thousands of guest researchers at 10 national user facilities</li></ul>	<ul style="list-style-type: none"><li>• Advanced materials</li><li>• Neutron sciences</li><li>• Biological sciences</li><li>• Computational sciences</li></ul>	<ul style="list-style-type: none"><li>• 90 new companies since 2000</li><li>• 300 industries</li><li>• 100 active technology licenses</li><li>• 174 R&amp;D 100 Awards</li></ul>

ORNL's BioEnergy Science Center:  
A \$135M industry-lab-university  
partnership



# Oak Ridge National Laboratory:

Science and technology for innovation

