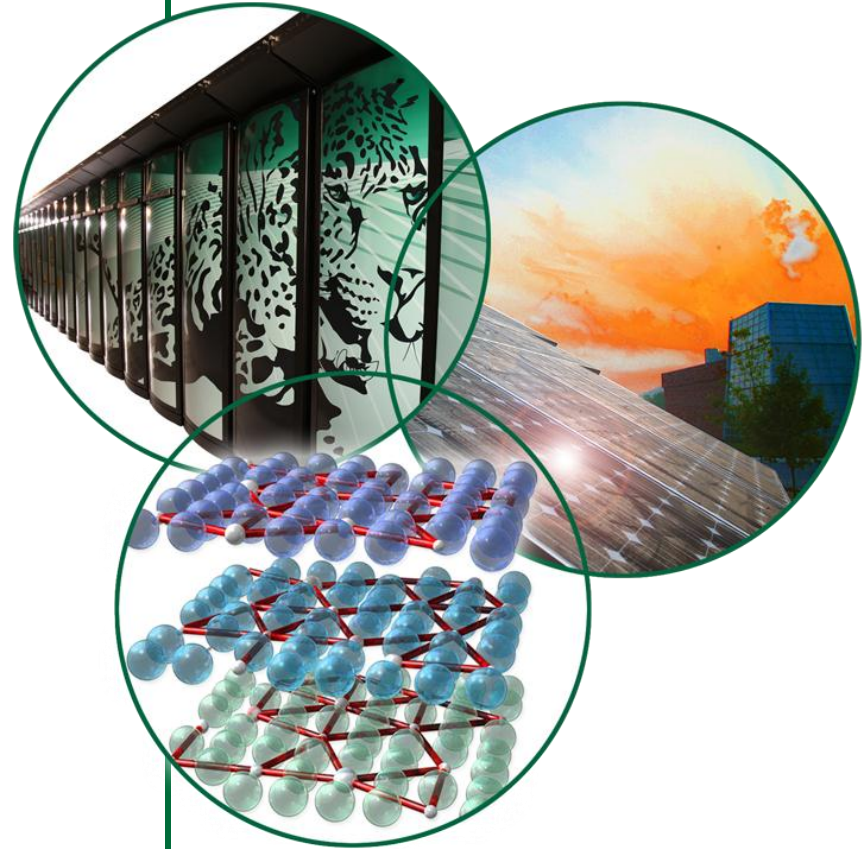


# ORNL's Neutron Sciences and Neutron Scattering Instrument Design

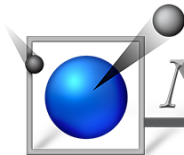
September 2012

David C. Anderson  
Melissa Harvey



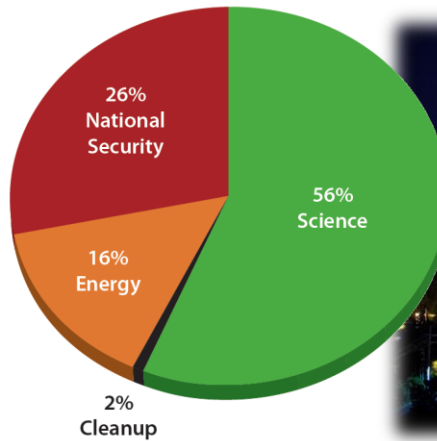


**and the**



*NEUTRON SCIENCES*

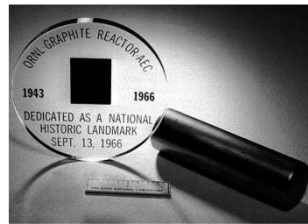
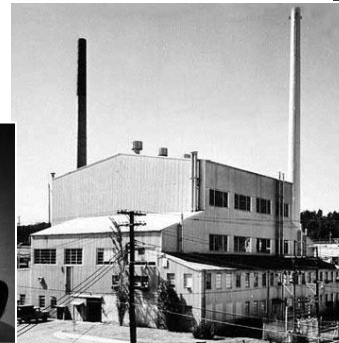
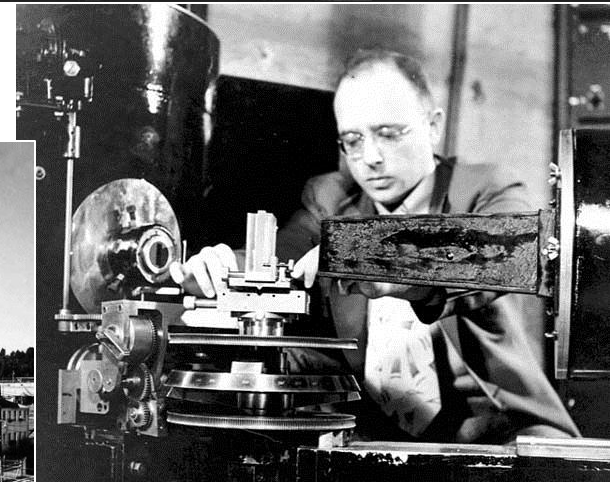
- **Director: Thomas E. Mason**
- **Staff: 4,400**
- **Research Staff: 1,600 scientists and engineers**
- **Users and visiting scientists, annually: 3,000**
- **Budget: \$1.65 billion**
- **Location: In eastern Tennessee's Anderson and Roane counties, part of DOE's Oak Ridge Reservation**
- **Established: 1943 as part of the World War II Manhattan Project**
- **US Patents since 2003: 292**
- **Active technology licenses: 115**





# Graphite Reactor

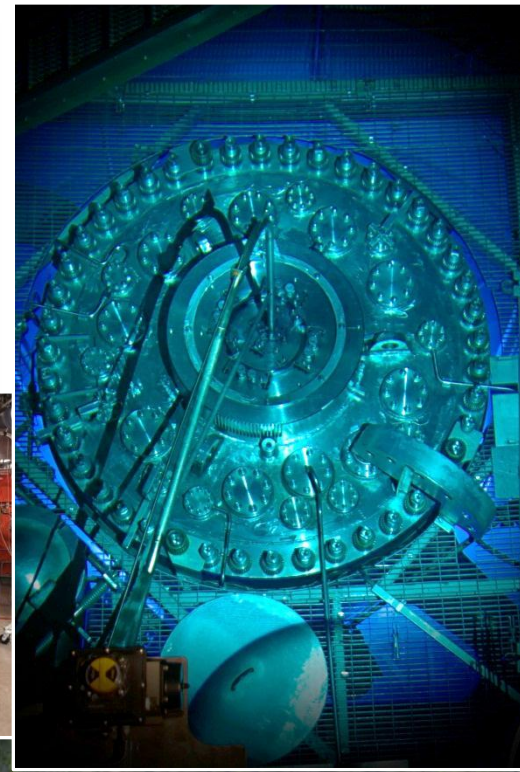
- Operated from 1943 – 1963
- First neutron scattering experiments at a reactor, by Clifford Shull and Ernie Wollan, 1945
- World's second artificial nuclear reactor (after Enrico Fermi's Chicago Pile)
- First reactor designed and built for continuous operation
- First facility in the world to produce radioactive isotopes for peacetime use
- Produced the first electricity from nuclear energy
- World's oldest reactor





# HFIR

- First went critical in 1965
- Beryllium-reflected, light-water-cooled and -moderated, flux-trap type reactor that uses highly enriched uranium-235 as the fuel
- Operates at 85 MW
- Western world's sole supplier of californium-252
- Cold neutron source installed in 2007
- 10 instruments in user program
- 1 development beamline
- 1 instrument in commissioning



FY2011 performance data

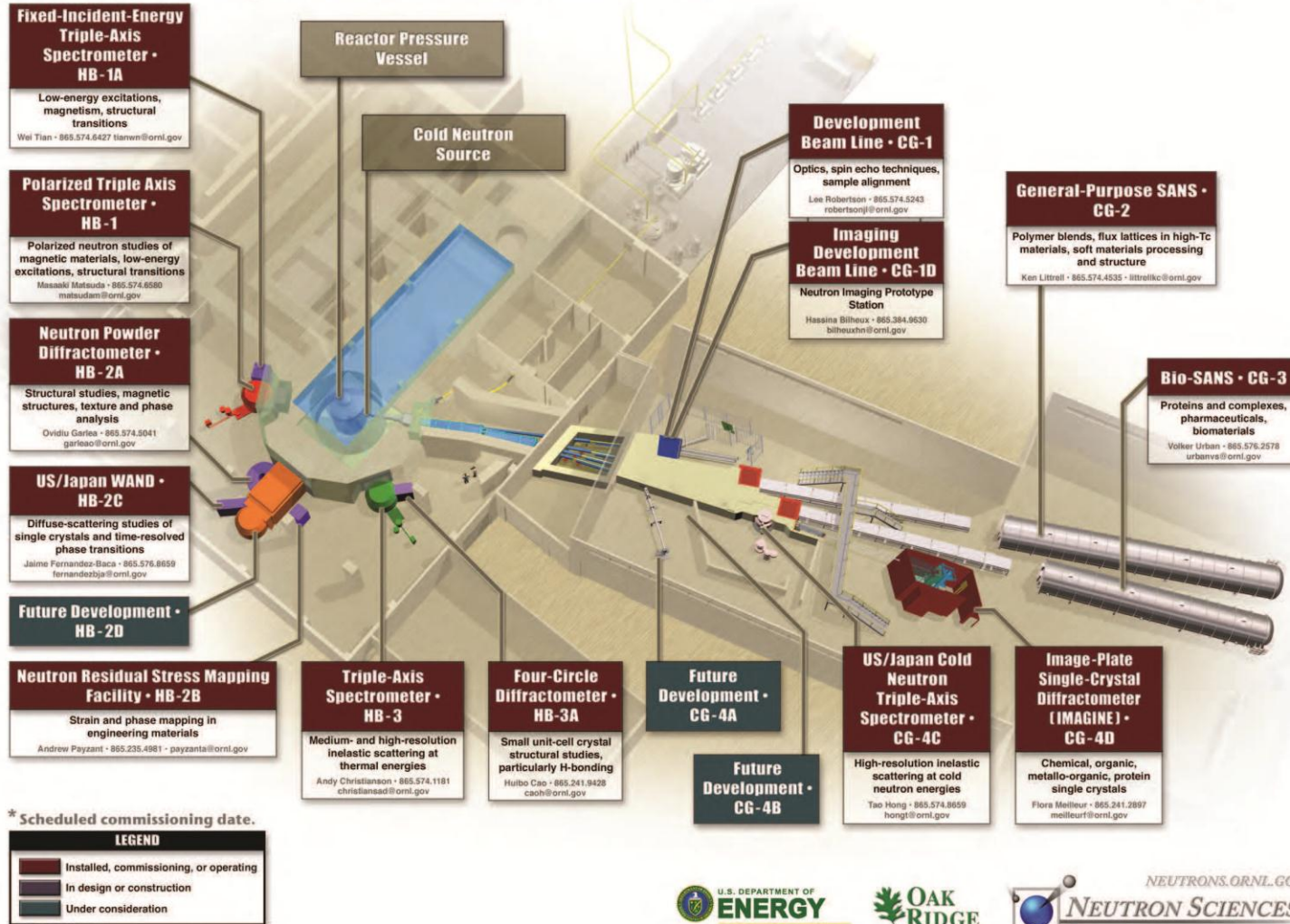
Operating hours Goal	Operating hours Delivered	Cycles Operated	Predictability
3900	4268	7	98.9%



# HFIR Facility Overview

## High Flux Isotope Reactor at Oak Ridge National Laboratory

The United States' highest flux reactor-based neutron source



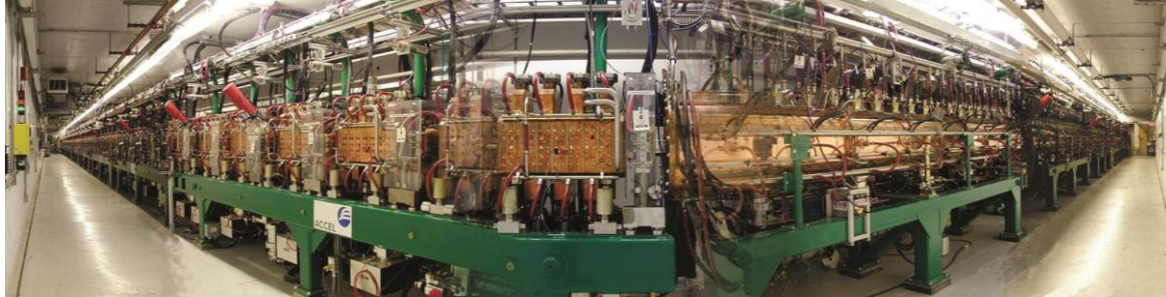
# A Sampling of HFIR Instrumentation





# SNS

- Completed in April 2006
- Most intense pulsed neutron beams in the world for scientific research and industrial development
- Built as a partnership of six DOE national laboratories: Argonne, Brookhaven, Lawrence Berkeley, Los Alamos, Oak Ridge, and Jefferson
- 13 instruments in user program
- 3 instruments in commissioning
- 3 instruments in construction
- 5 positions available for new beamlines



FY2011 performance data

Hours scheduled	Hours delivered	MWh delivered to target	Availability	Availability goal	Downtime
5436.5	5002.4	4132.0	92.0	88.0	497.7

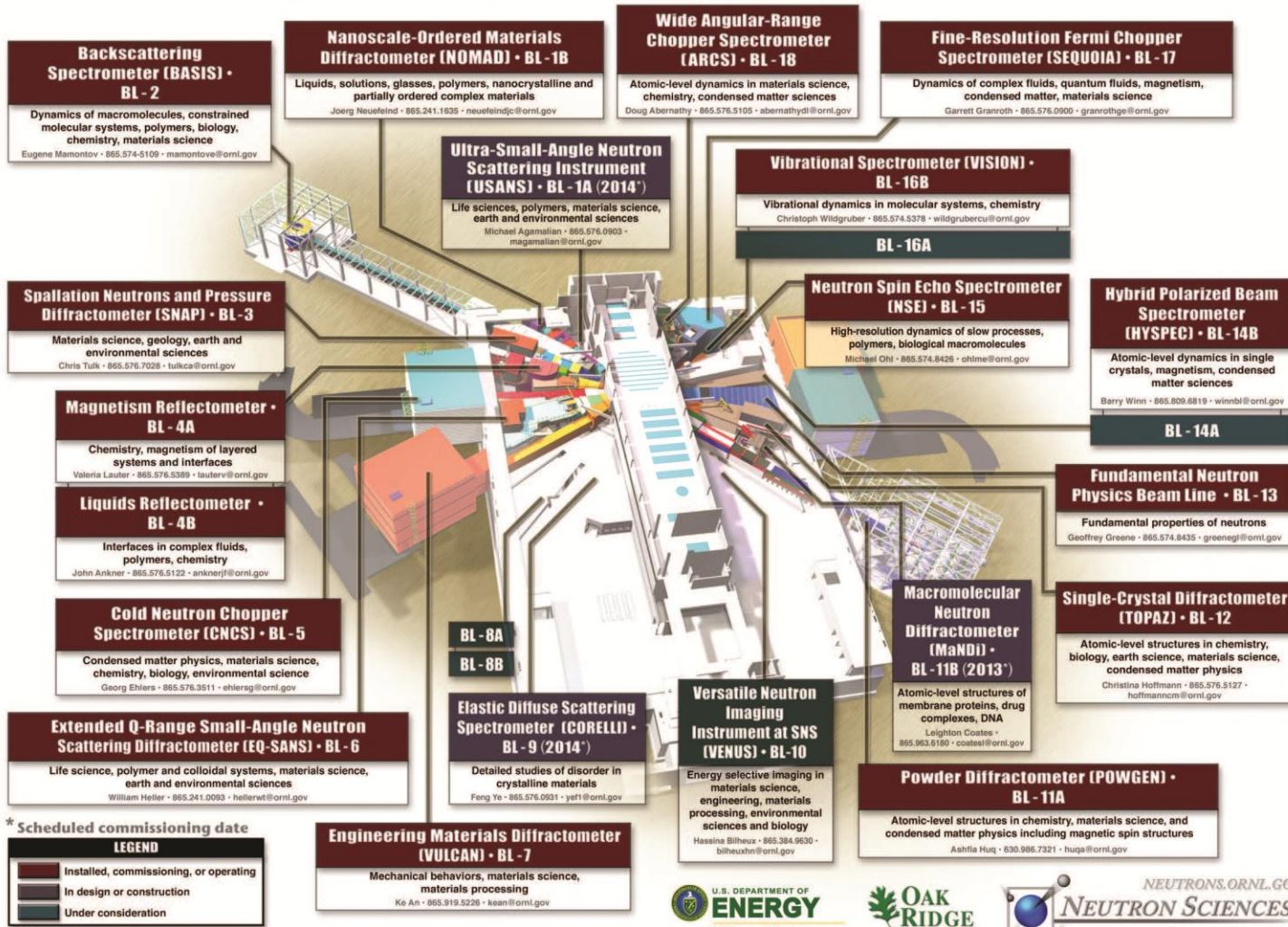


# SNS Facility Overview

## Spallation Neutron Source at Oak Ridge National Laboratory



The world's most intense pulsed, accelerator-based neutron source



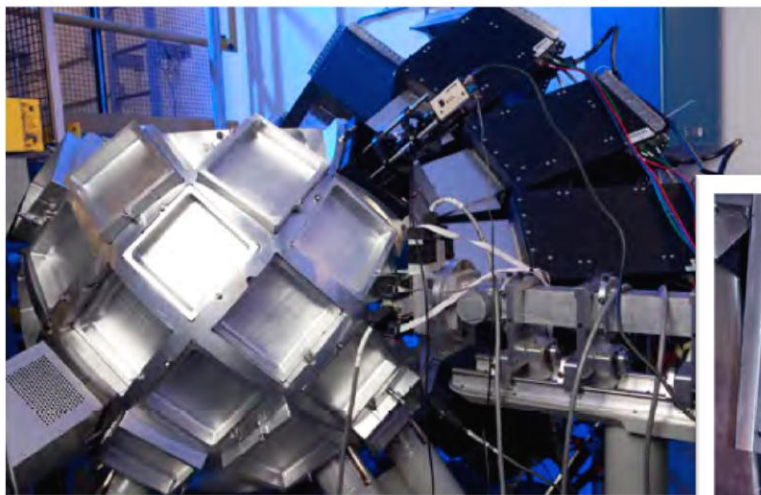
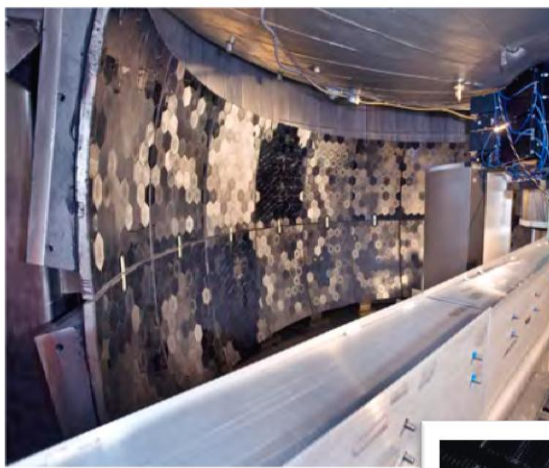


# A Sampling of SNS Instrumentation

NOMAD Vessel Installation



Inside the BASIS tank



TOPAZ Detector Array Tank



Inside Sequoia Vessel



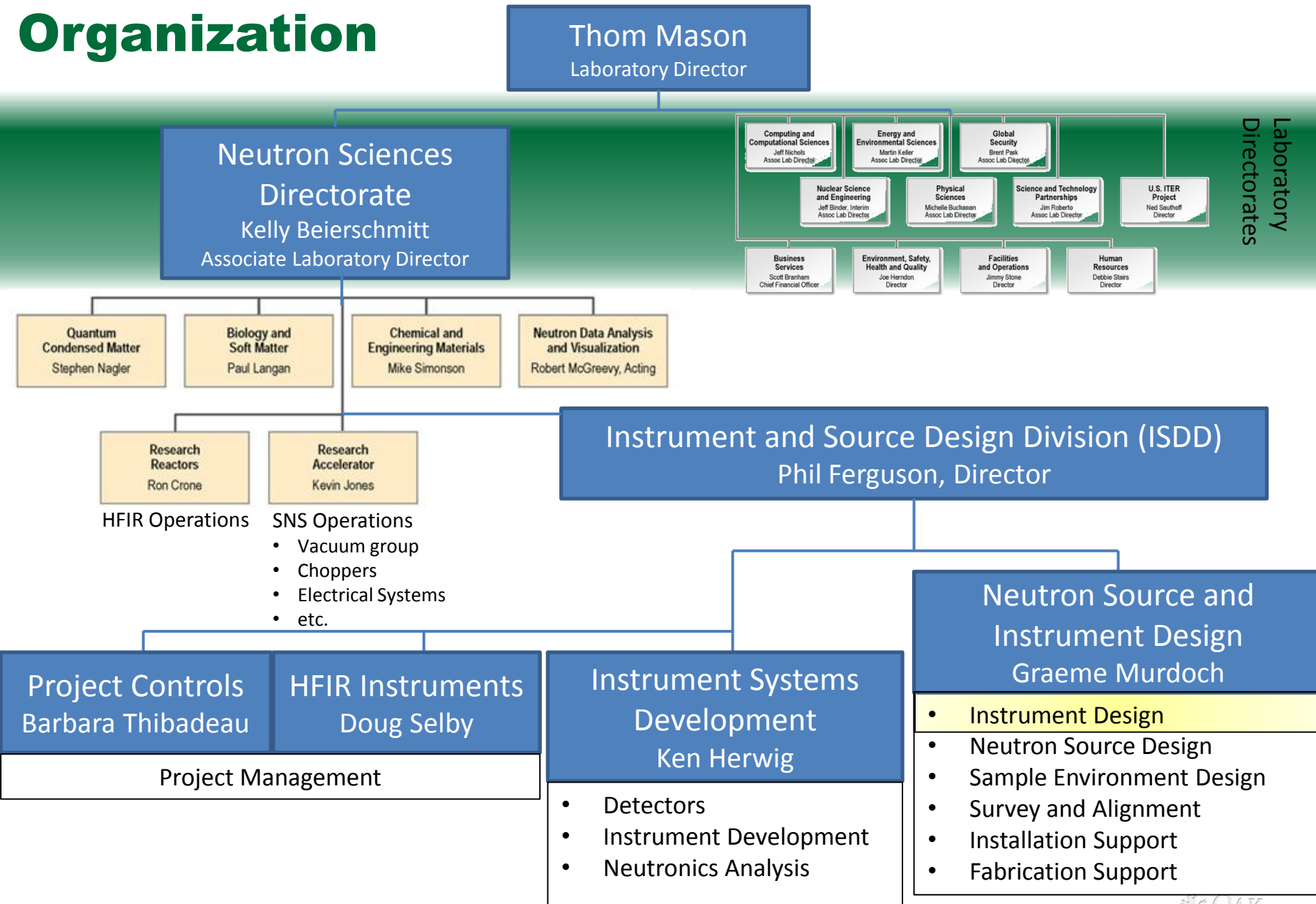
Magnetism Reflectometer



# Neutron Scattering Instrument Design

# Organization

Laboratory Directorates





# Instrument Design – D. Williams

## SNS South Side (BL 1-9) / HFIR Instruments

D. Anderson	Team Lead/System Engineer
B. Bailey	Design Engineer
R. Dearstone	Design Engineer
R. Hicks	Design Engineer
A. Jones	HFIR Task Manager
G. Rennich	Design Engineer
R. Summers	Design Engineer
S. Howard	Designer
W. Turner	Designer

## Design Office

K. Potter	Team Lead
M. Costa	Designer
L. Davis	Designer
S. Hamblen	Designer
M. Hammons	Designer
G. Jones	Designer
S. Roy	Designer
W. Sharp	Designer
R. Taylor	Designer

## SNS North Side Instruments (BL 10-18)

S. Keener	Team Lead/System Engineer
R. Allen	Design Engineer
D. Conner	Design Engineer
M. Harvey	SNS Task Manager
M. Hoffmann	Design Engineer
M. Overbay	Design Engineer

# Facility Capabilities – Engineering

- Instrument Design Engineers
- Neutron Chopper Engineers
- Survey & Alignment
- Vacuum Systems
- Piping Engineers
- Electrical Engineers
- Structural Engineers

# Facility Capabilities – Manufacture

- Lab machine shops, including one located at the SNS
- ORNL Facilities and Operations Directorate
  - Laborers: carpenters, iron workers, etc.



# Facility Capabilities – Installation

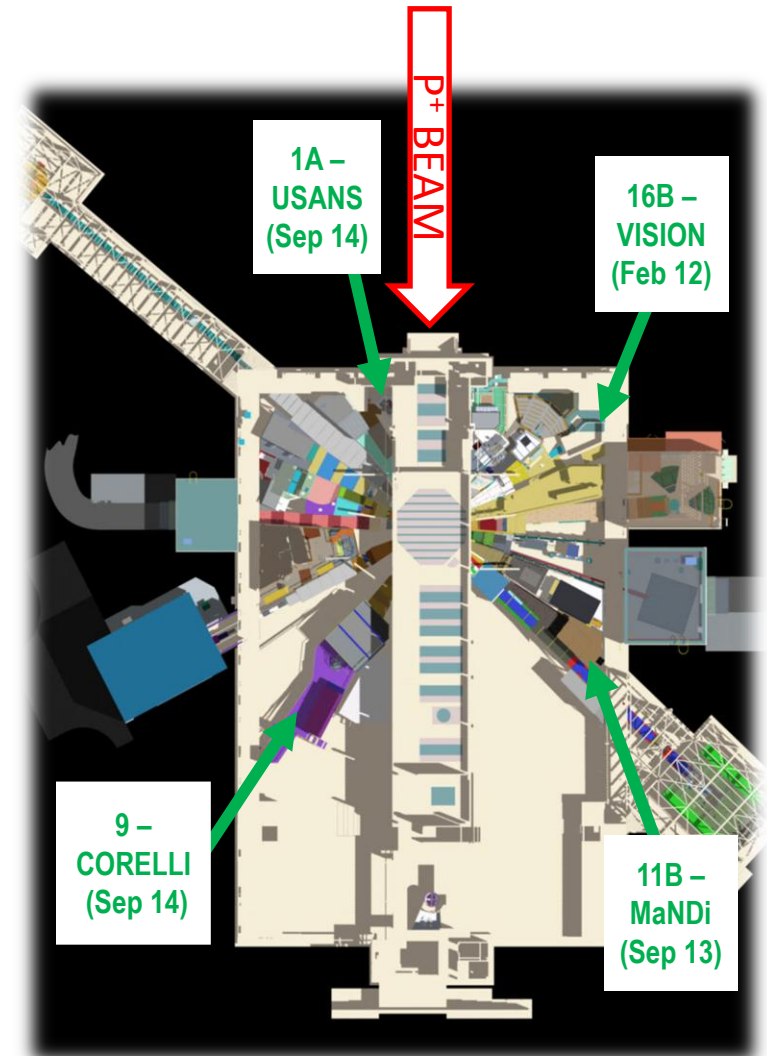
- **Installation Group**
- **Instrument Support Group**
- **ORNL Facilities and Operations Directorate**
  - Laborers: carpenters, iron workers, etc.

## Project Management Structure

- **U.S. Dept. of Energy requirements**
  - DOE Order 413.3B, Program and Project Management for the Acquisition of Capital Assets
  - Earned Value Management System
- **Project Teams comprised of Project Manager, Lead Engineer, Lead Scientist, Lead Designer, and expanded as necessary**

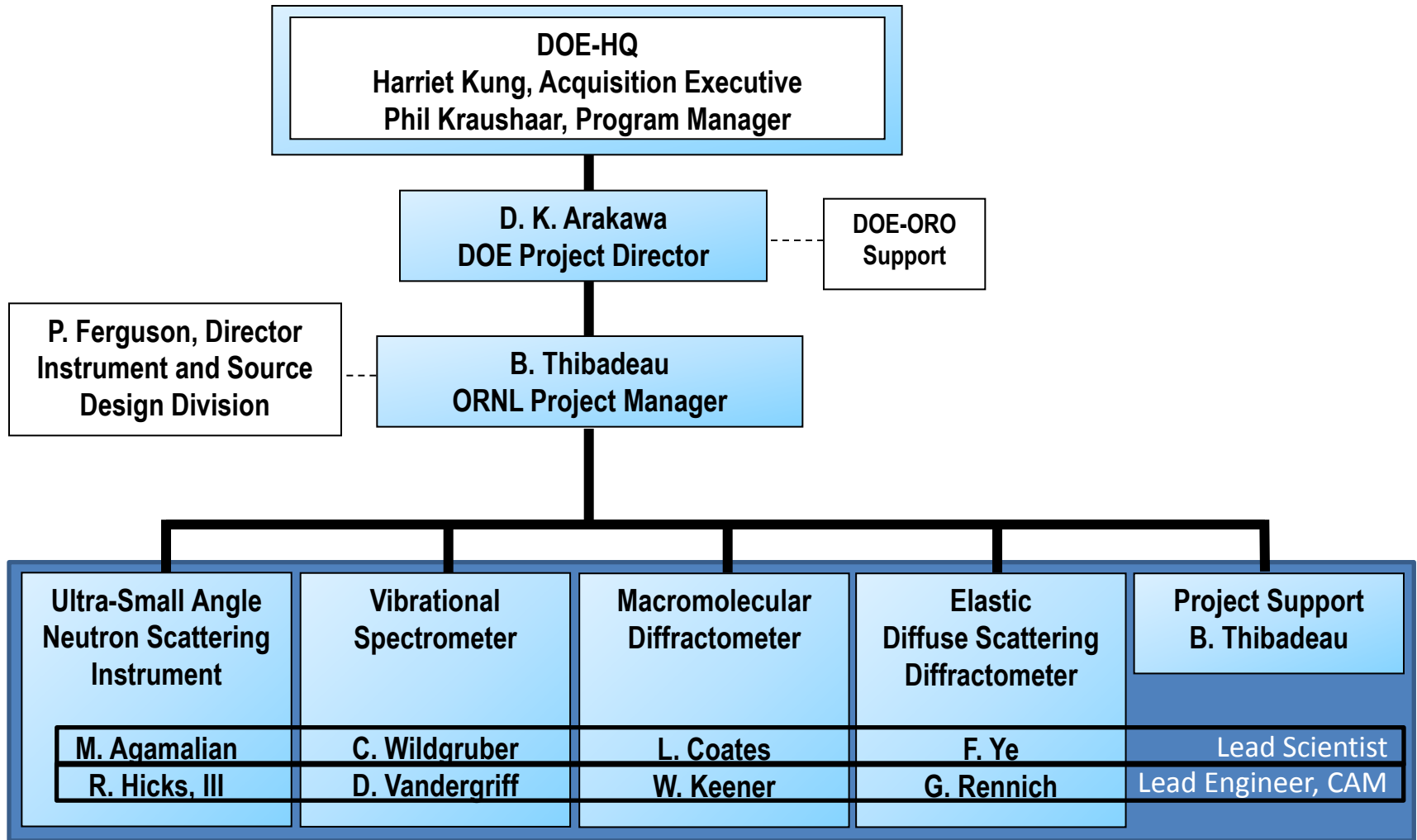
# SING II

- Four instruments, managed as one project
  - VISION, MaNDi, Corelli and USANS
- “Mission Need” approved in October 2005
- 72% Complete
- VISION is complete (in commissioning)
- MaNDi complete 2012
- Corelli and USANS complete in 2014





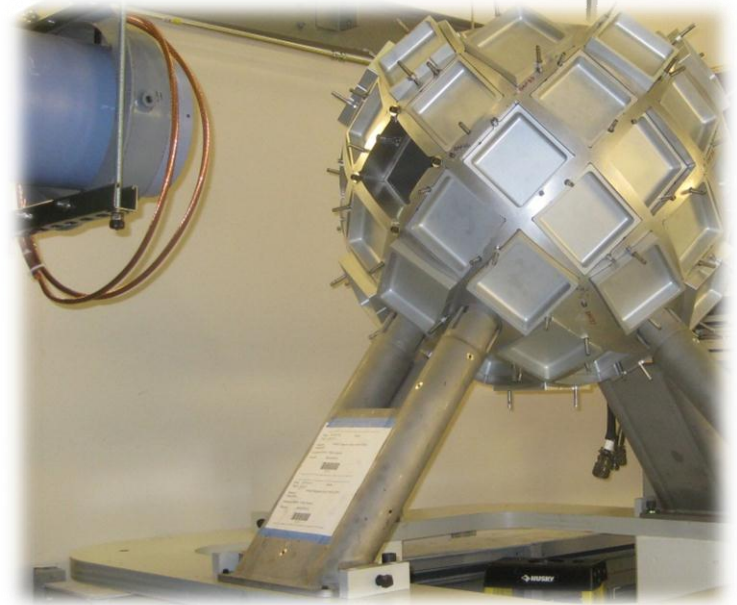
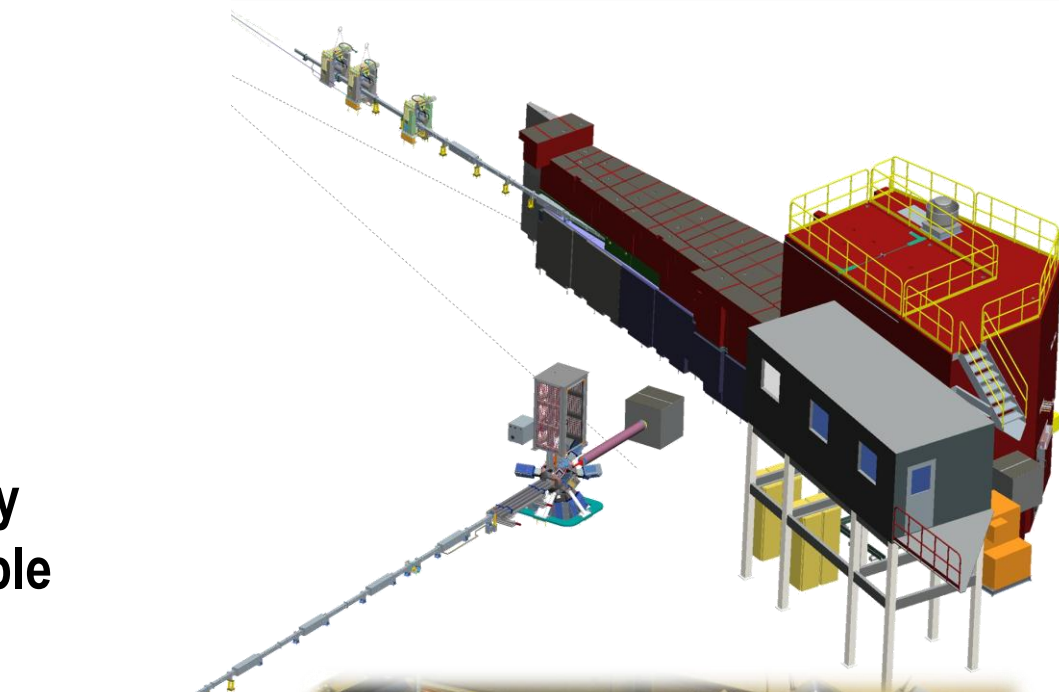
# SING II Project Organization



# MaNDi

- 94% complete
- Detector Array Frame (DAF) has capacity for 48 Anger Camera modules, project will install 20+
- 3 bandwidth choppers, secondary shutter, optics table with selectable guide configuration

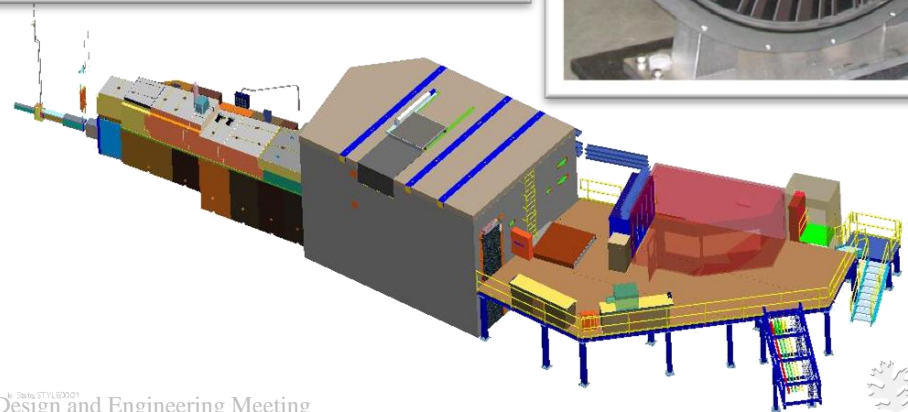
- Leighton Coates – Lead Scientist
- Scott Keener – Lead Engineer & Control Account Manager
- Jack Thomison – Engineer
- Larry Davis – Lead Designer





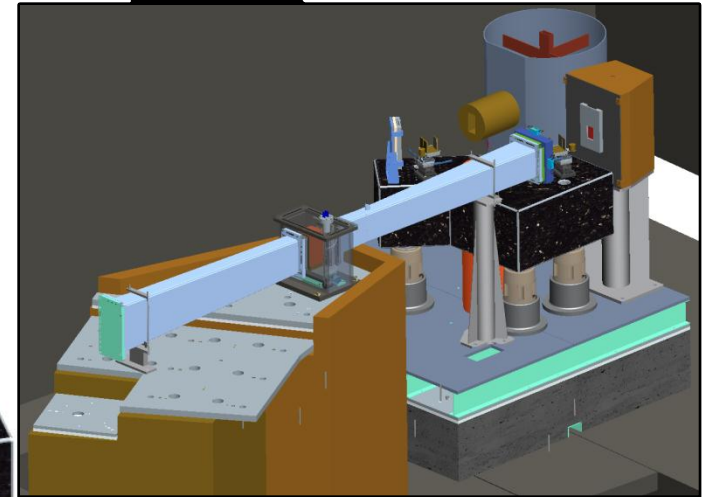
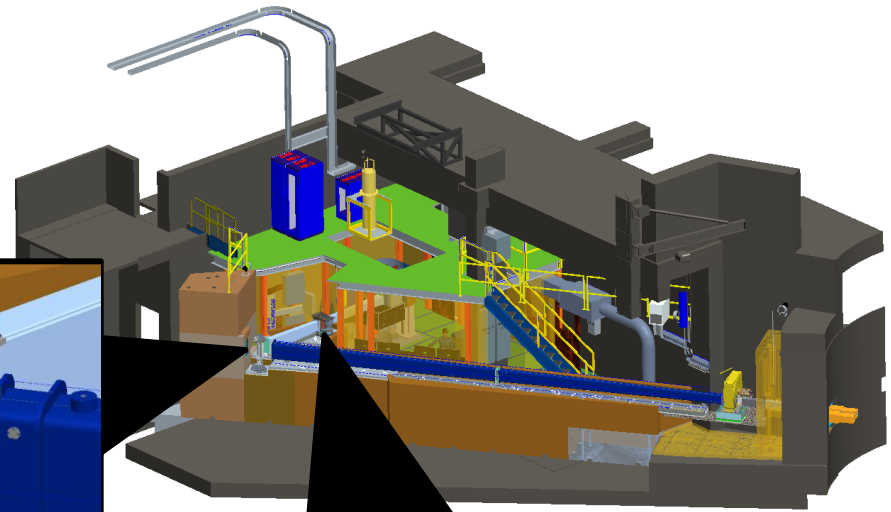
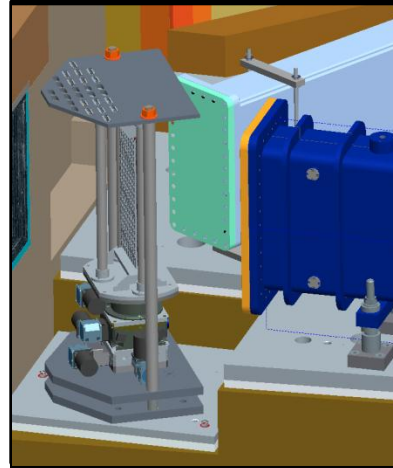
# Correlli

- 55% Complete
- 90 x  $^3\text{He}$  LPSD capacity, project will install 38
- T0 Chopper, 3 Disk Choppers, secondary shutter
- Sample Scattering Vessel
  - 49m<sup>3</sup> vacuum vessel
  - 3m radius, 3m tall
  - Weighs 30 tons
- Feng Ye – Instrument Scientist
- George Rennich – Lead Engineer & Control Account Manager
- Bill Turner – Lead Designer
- Ed Hardin – Designer
- Kevin Berry – Detector Lead



# USANS

- 59% complete
- T0 chopper
- 2 x channel cut, perfect Silicon crystals
- Double focusing Copper 111 crystal array



- Michael Agamalian – Instrument Scientist
- W. Robby Hicks – Lead Engineer & Control Account Manager
- Bob Dearstone – Engineer
- Steve Howard – Lead Designer
- Ron Taylor – Designer
- Kevin Berry – Detector Lead

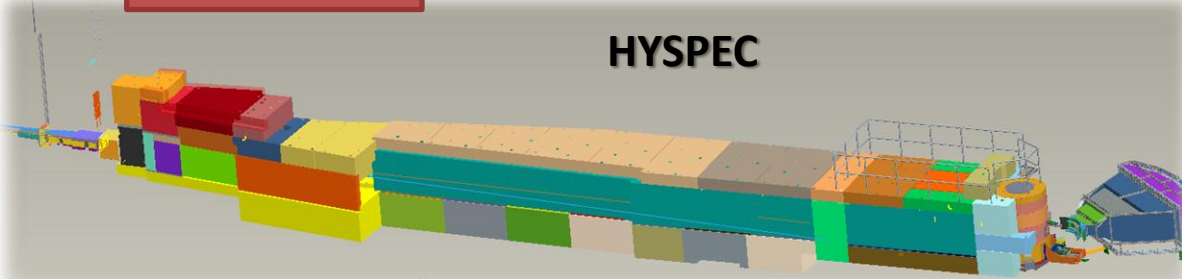




# Recently Completed Instruments

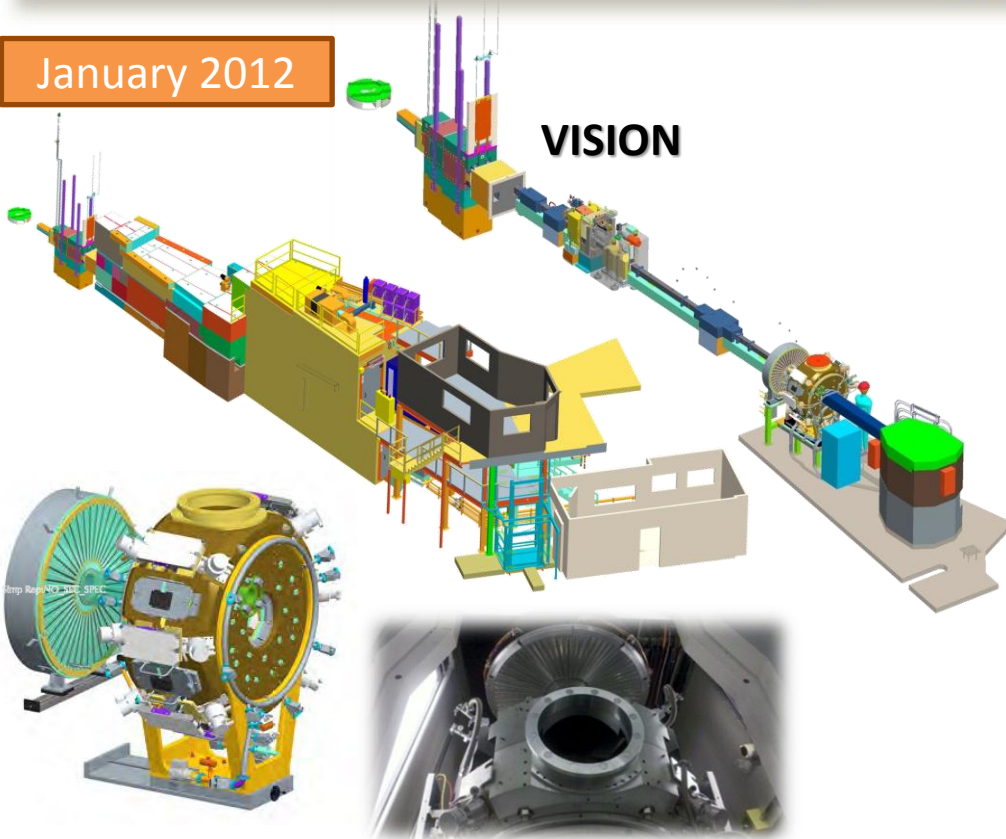
August 2011

**HYSPEC**



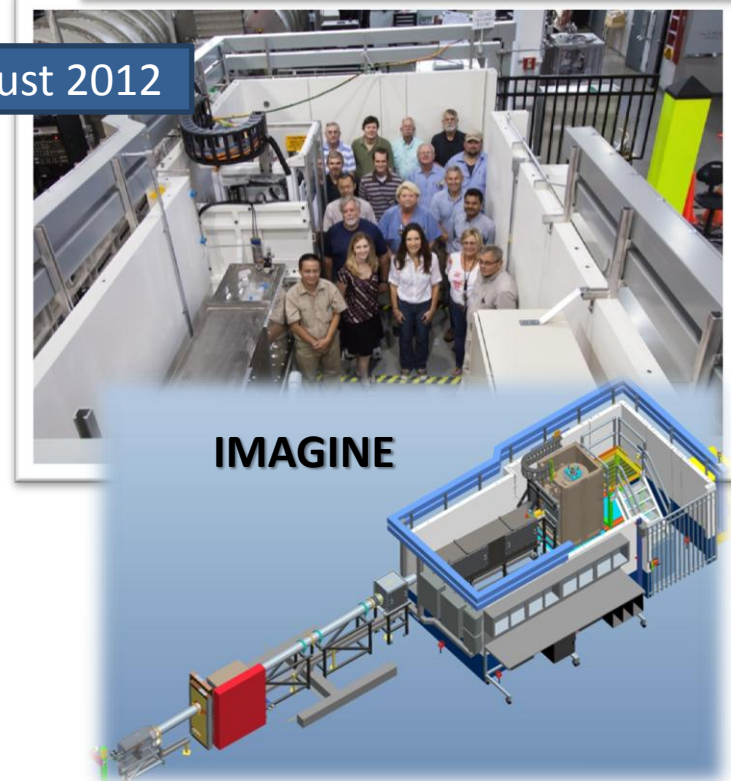
January 2012

**VISION**



August 2012

**IMAGINE**



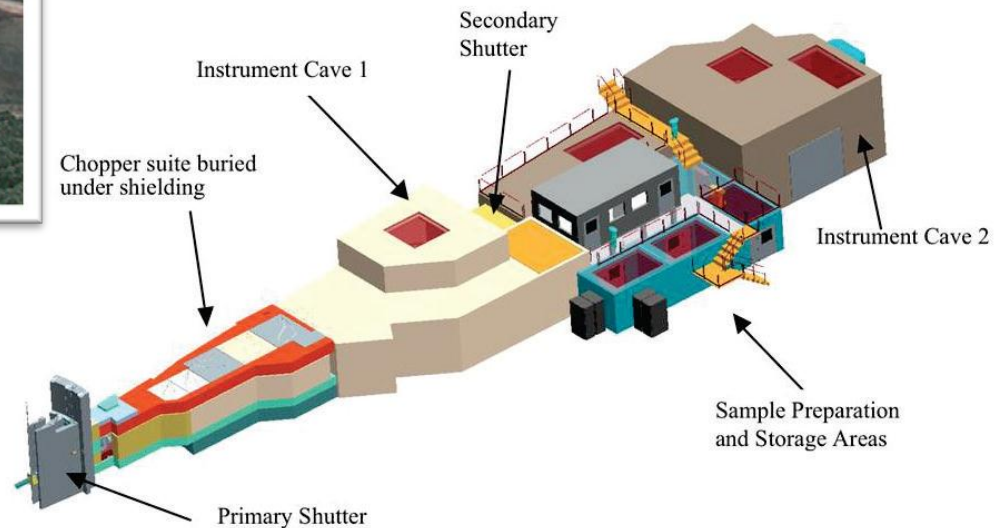


# Future Developments Under Consideration

- SNS: VENUS, 2<sup>nd</sup> Target Station (includes Power Upgrade Project)
- HFIR: 2<sup>nd</sup> cold source



## VENUS – the Versatile Neutron Imaging Instrument at SNS



# Questions

