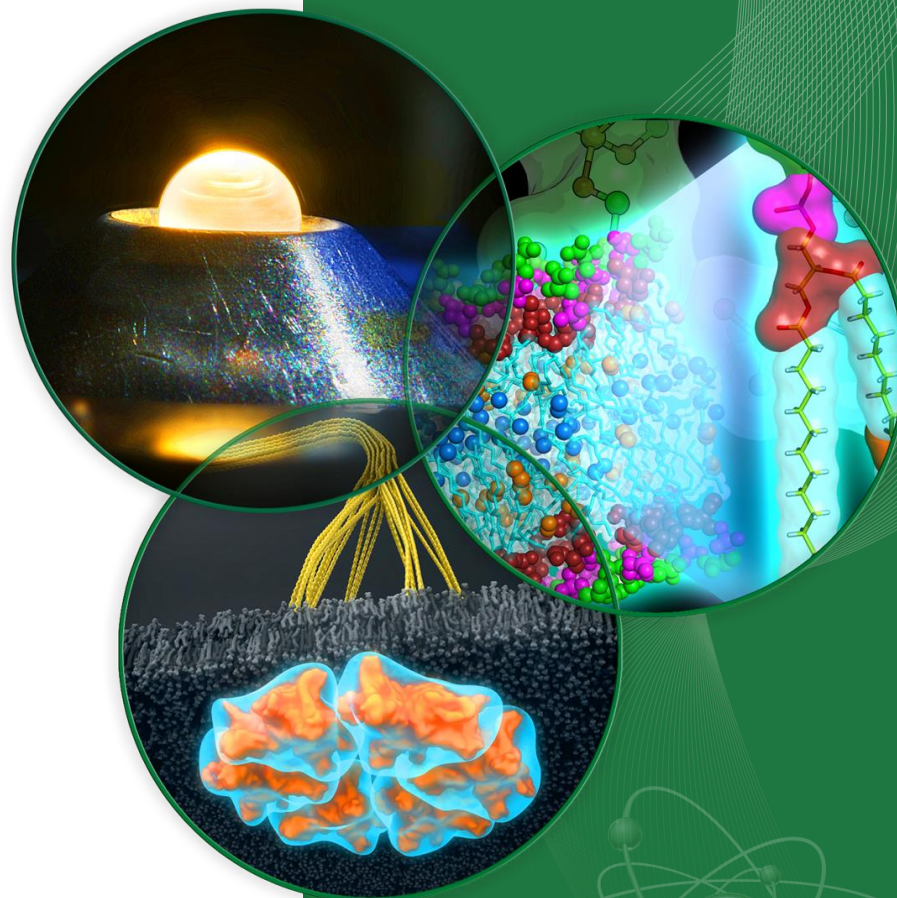


New Instruments and Beam Lines

Presented to
Neutron Advisory Board

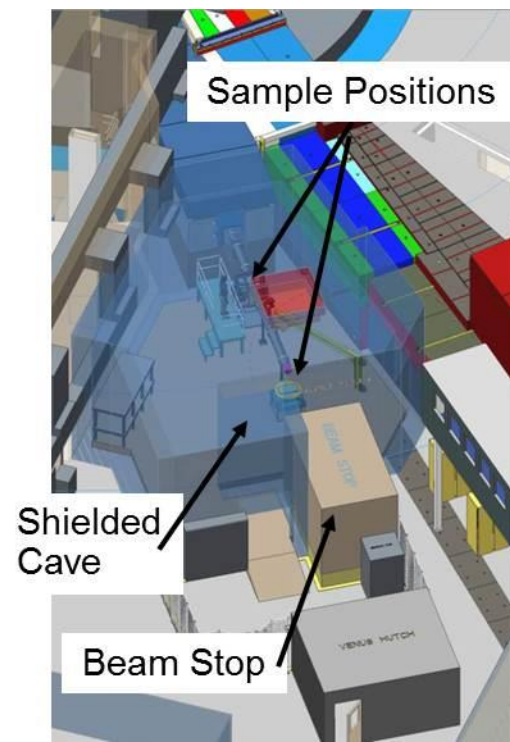
Presented by
Ken Herwig
Instrument and Source Division

June 30, 2016
Clinch River Cabin
Oak Ridge, Tennessee



New instruments will increase SNS science productivity

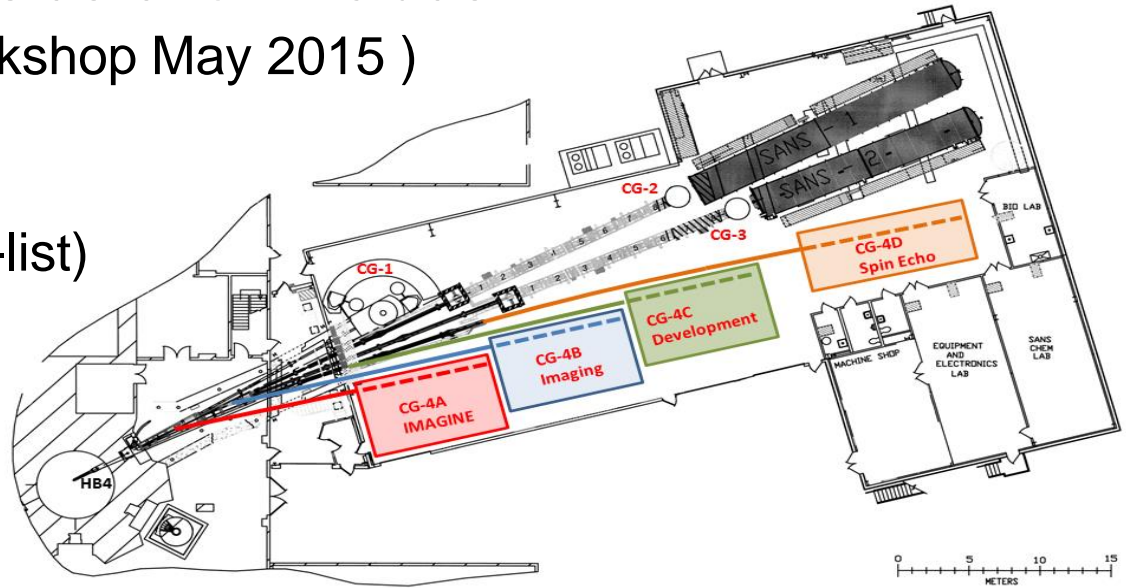
- 5 new experimental stations are being planned to fully build-out the suite of 24 beamlines at the SNS first target station.
- Design concepts are developed for two high-priority and high-throughput experimental stations:
 - VENUS – a time-of-flight neutron imaging station that will provide unique insight into advanced manufacturing techniques
 - RAPID – a small sample, powder diffractometer that will probe kinetic processes
- A funding model has been identified for VENUS
- A plan for construction of RAPID and three remaining beam lines involves
 - Engaging the research community to update competing existing instrument concepts
 - Selecting highest priority instruments for further development and construction



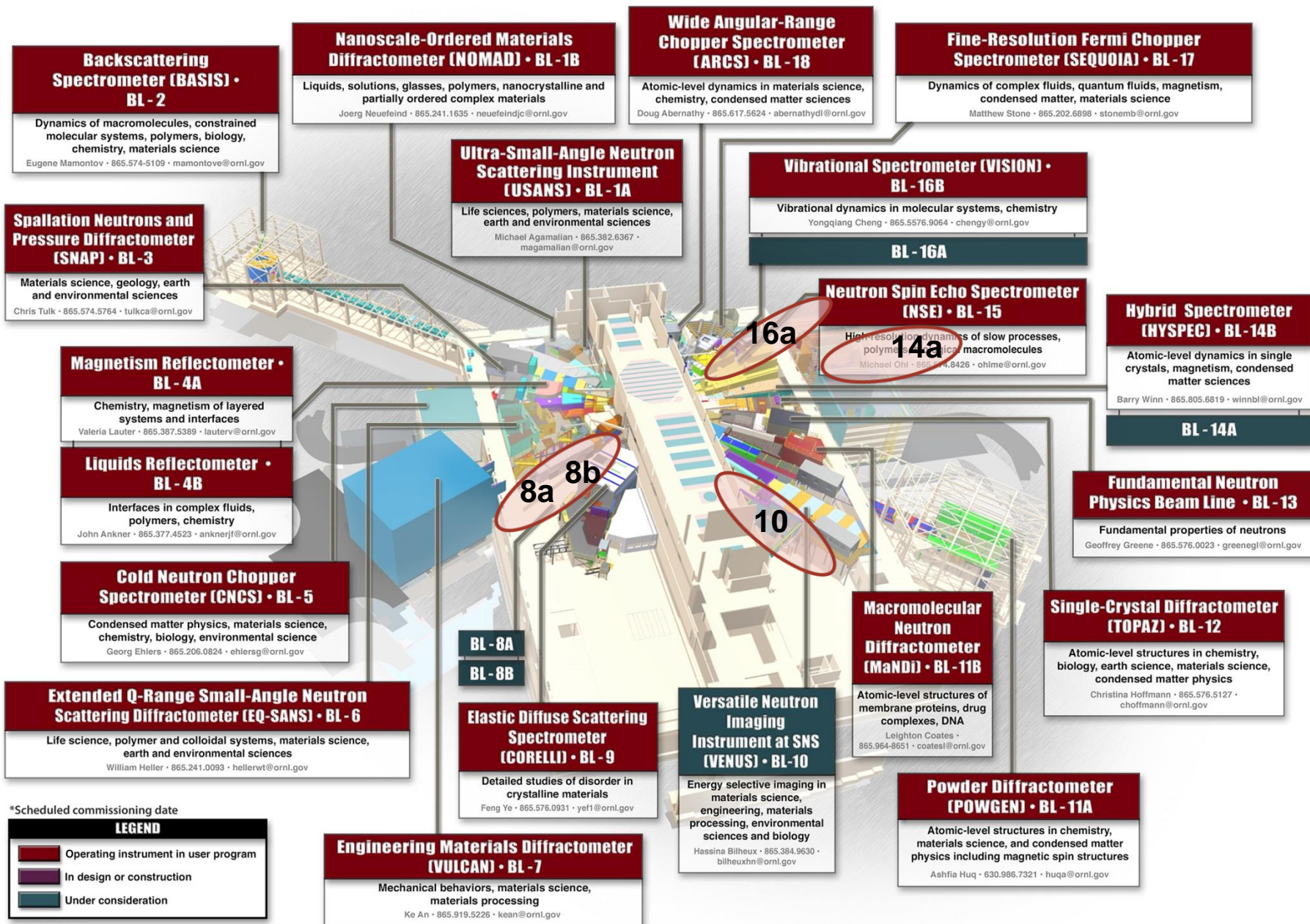
VENUS at BL10

New end guide positions at HFIR cold source will expand science capabilities

- Modern guide design adds three new end-guide positions
- Instruments under consideration include
 - MANTA , cold TAS (workshop May 2015)
 - Neutron Spin Echo (workshop May 2015)
 - Larmor station (FY16 A-list)
 - Optimized cold neutron imaging
 - High flux SANS
- Plan forward involves
 - Iteration of guide concept and instrument requirements
 - Engaging the science community to develop science case
 - Prioritize between competing scenarios
- Timing – replacement of the cold source and HFIR beryllium replacement \approx 2023



SNS – five unoccupied beam lines

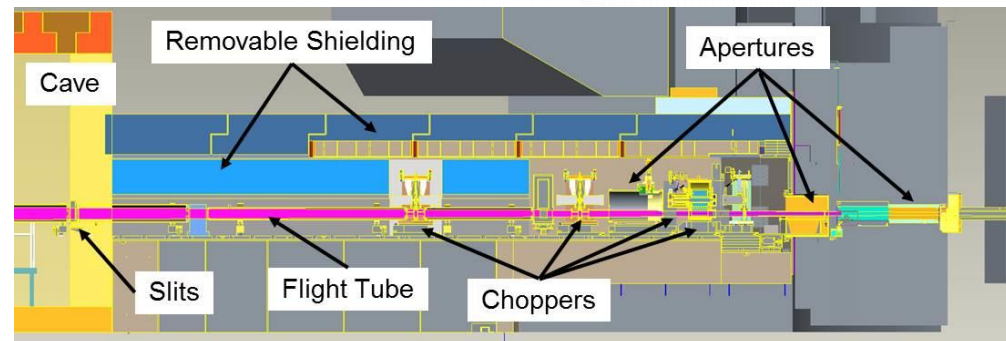
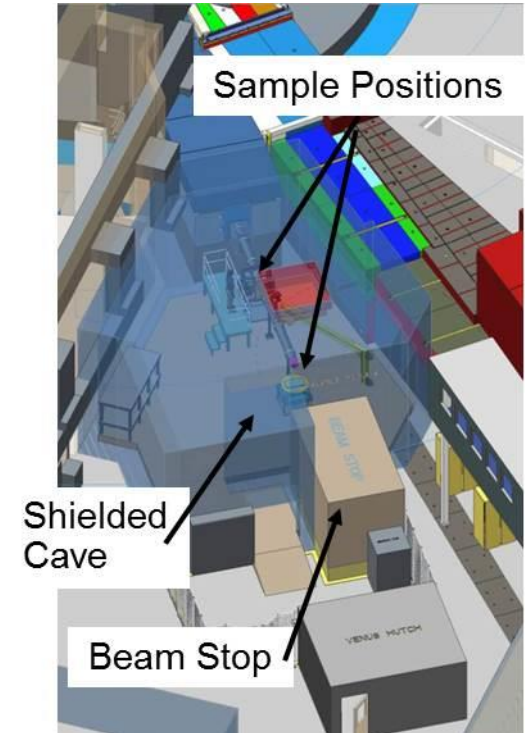


New instruments will provide new science capabilities and maximize use of FTS

- June 2016: BESAC prioritization sub-committee recommendation
 - *The Oak Ridge National Laboratory should make the build-out of the experimental stations for the first target station a priority.*
- 5 unoccupied beam lines
 - **BL8a** and **BL8b** – shallow poisoned, de-coupled 300K water moderator – thermal neutrons, high-resolution pulse shapes (well matched for diffraction)
 - **BL10** – poisoned, de-coupled para-H₂ – cold neutrons, high-resolution pulse shapes (time-of-flight neutron imaging)
 - **BL14a** – coupled para-H₂ – cold neutrons, broad pulse shapes (originally proposed for Zeemans), must be longer than 60 m
 - **BL16a** - deep poisoned, de-coupled 300K water moderator – thermal neutrons, moderate-resolution pulse shapes (spectroscopy)

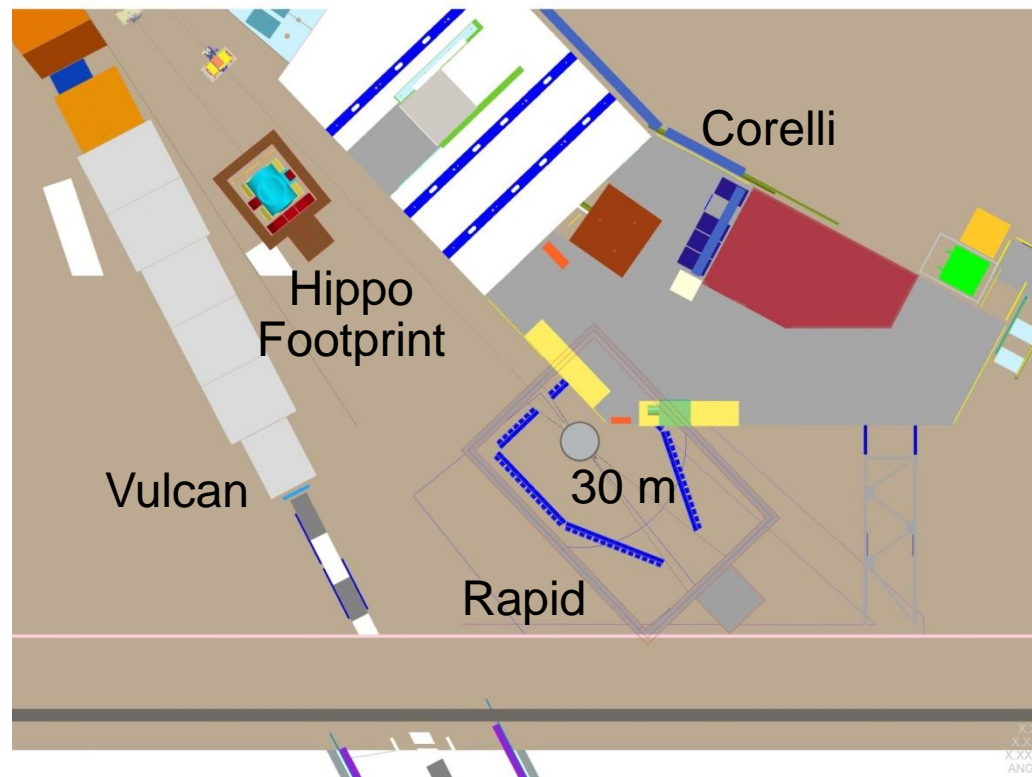
VENUS – a partnership funded beam line

- VENUS – a time-of-flight, wavelength-resolved neutron imaging station at SNS BL10
 - Additive manufacturing, energy, transportation, geoscience, plant physiology
 - 28 x 28 cm² field-of-view
 - 20 and 25 m sample stations
 - $\delta\lambda/\lambda \leq 0.15\%$; $400 \leq L/D \leq 2000$
- Conceptual design supports an aggressive completion schedule – 41 months including 10 months float
- \$18.5M (includes 18% contingency on design, procurement, installation)
- March 15, 2016 – VENUS workshop with Advanced Manufacturing Office of DOE-EERE
 - Mission need statement (CD-0) signed by EERE April 23, 2016
 - Design/Construction start pending final funding agreements



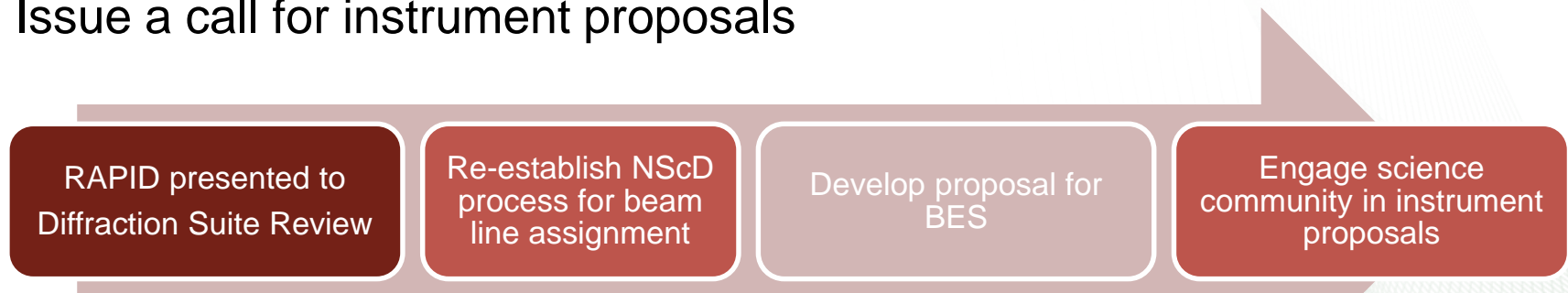
BL8b RAPID - Rapid Acquisition Parametric and In-situ Diffraction

- Rapid proposed *Delivering on the Promise of Powder Diffraction* – user workshop June 2013
- Science Mission will be complementary to POWGEN and NOMAD (refine requirements with community input)
 - Refined structures from small samples
 - High speed and parametric refinements
 - Stroboscopic measurements
 - 200 mg sample with simple structure in ≈ 10 minutes (6 hours on current POWGEN)
 - Pair Distribution Functions
- CEMD instrument
 - Prepare for August review of diffraction suite instruments



SNS next steps

- Initiate engineering design/construction of VENUS when funding available
- Mature RAPID conceptual design
 - Simple McStas guide design
 - Analyze position relative to diffraction instrument suite
- Present RAPID concept at August 3, 2016 external diffraction suite review
- Re-establish NScD process for reviewing and recommending assignment of beam lines
- Develop proposal for BES
 - Include RAPID concept
 - Options for remaining 3 beam lines (INVENT, low-Q spectrometer, special purpose diffraction...)
- Issue a call for instrument proposals



HFIR – new guide configuration supports additional instruments

Fixed-Incident-Energy Triple-Axis Spectrometer • HB-1A

Low-energy excitations, magnetism, structural transitions

Wei Tian • 865.574.6427 • tianwn@ornl.gov

Polarized Triple Axis Spectrometer • HB-1

Polarized neutron studies of magnetic materials, low-energy excitations, structural transitions

Masaaki Matsuda • 865.574.6590
matsudam@ornl.gov

Neutron Powder Diffractometer • HB-2A

Structural studies, magnetic structures, texture and phase analysis

Clarina Dela Cruz • 865.241.2431
delacruzcr@ornl.gov

WAND • HB-2C

Diffuse-scattering studies of single crystals and time-resolved phase transitions

Jaime Fernandez-Baca • 865.576.8659
fernandezbja@ornl.gov

Polarized Neutron Development Station • HB-2D

Development of new components and techniques for utilizing polarized neutrons

Lowell Crow • 865.241.0096
crowmjljr@ornl.gov

Neutron Residual Stress Mapping Facility • HB-2B

Strain and phase mapping in engineering materials

Andrew Payzant • 865.235.4981
payzanta@ornl.gov

Triple-Axis Spectrometer • HB-3

Medium- and high-resolution inelastic scattering at thermal energies

Songxue Chi • 865.603.3241
chis@ornl.gov

Four-Circle Diffractometer • HB-3A

Small unit-cell nuclear & magnetic structural studies

Huilbo Cao • 865.686.2608
caoh@ornl.gov

Polarized Neutron Development Station • CG-4A/4B

Development of larmor precession techniques

Lee Robertson • 865.574.5243
robertsonjl@ornl.gov

Cold Neutron Triple-Axis Spectrometer • CG-4C

High-resolution inelastic scattering at cold neutron energies

Tao Hong • 865.574.8659
hongt@ornl.gov

Image-Plate Single-Crystal Diffractometer (IMAGINE) • CG-4D

Atomic resolution structures in biology, chemistry and complex materials

Flora Meilleur • 865.576.2779
meilleurf@ornl.gov

Development Beam Line • CG-1A

Detector development and testing

Rick Riedel • 865.582.6801
riedelra@ornl.gov

Optics Development Beam Line • CG-1B

Sample alignment and optics

Lou Santodonato • 865.719.0656
santodonatol@ornl.gov

Cold Neutron Imaging Beam Line • CG-1D

Transmission imaging of natural and engineered materials

Hassina Bilheux • 865.384.9630
bilheuxhn@ornl.gov

General-Purpose SANS • CG-2

Materials structure and processing, metallurgy, polymers, geophysics, high-Tc superconductors, and complex fluids

Ken Littrell • 865.291.7583 • littrellkc@ornl.gov

Bio-SANS • CG-3

Proteins and complexes, pharmaceuticals, biomaterials

Volker Urban • 865.576.7221
urbanvs@ornl.gov

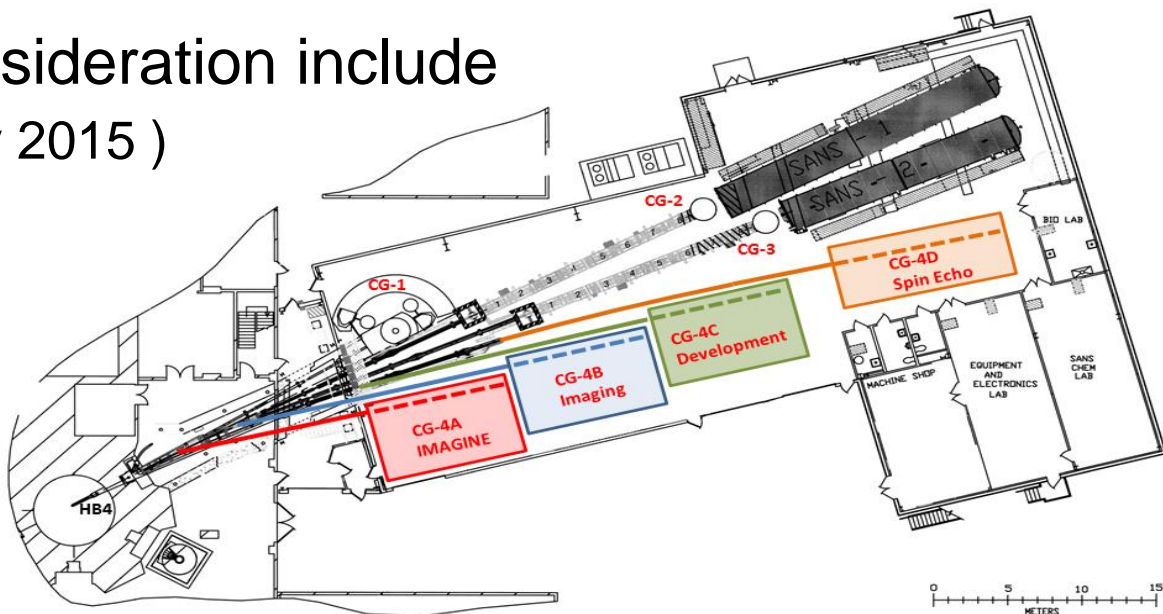
CG 4

LEGEND

- Operating instrument in user program
- In commissioning or operating development beamline
- In design or construction
- Under consideration

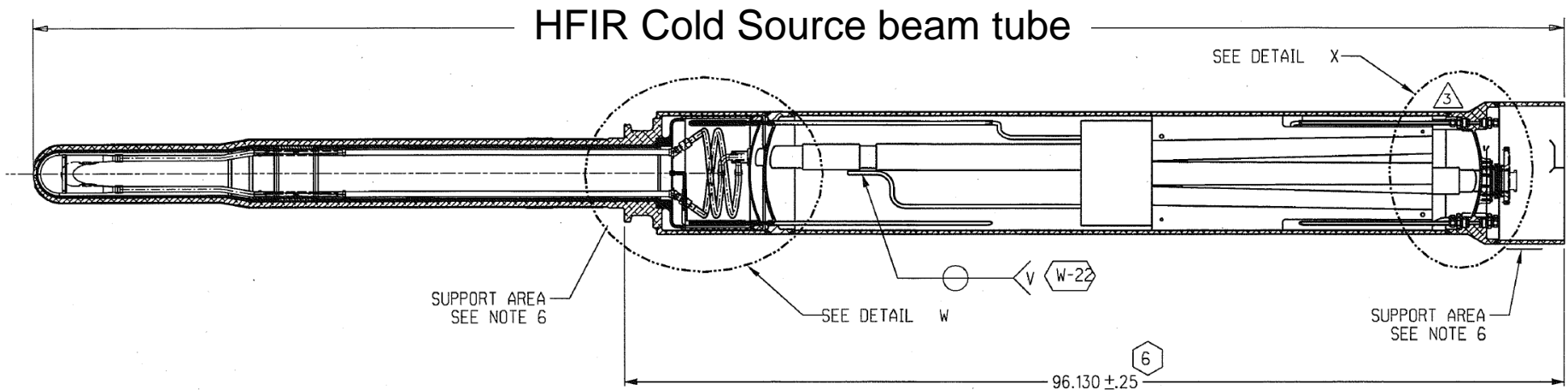
New end guide positions will expand science capabilities at HFIR cold source

- FY16 “C”-list – Lee Robertson assigned as lead
 - Kick-off meeting June 28, 2016 (≈25 instrument scientists, neutronics, neutron optics, engineering)
 - Identified team members
- Instruments under consideration include
 - MANTA (workshop May 2015)
 - Neutron Spin Echo (workshop May 2015)
 - Larmor station (FY16 A-list)
 - Optimized cold neutron imaging
 - High flux SANS
- Timing – replacement of the cold source and HFIR beryllium replacement ≈2023

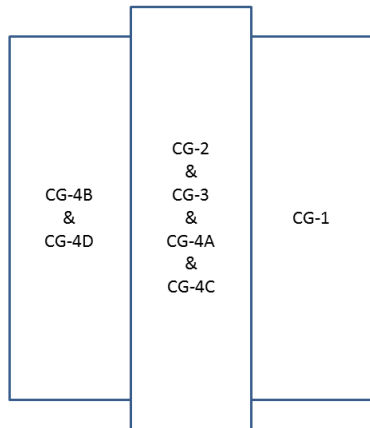


Modern guide designs provide more instrument end stations

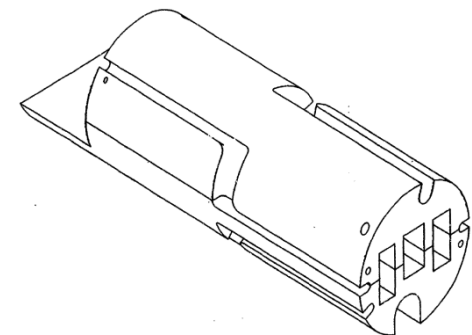
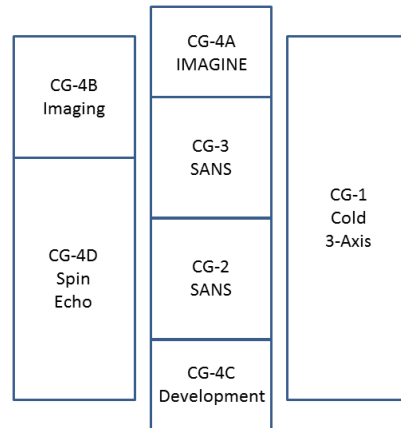
- Open view of cold source by eliminating/modifying steel collimator
- Bring guide elements much closer to cold source



3.8m from Cold Source



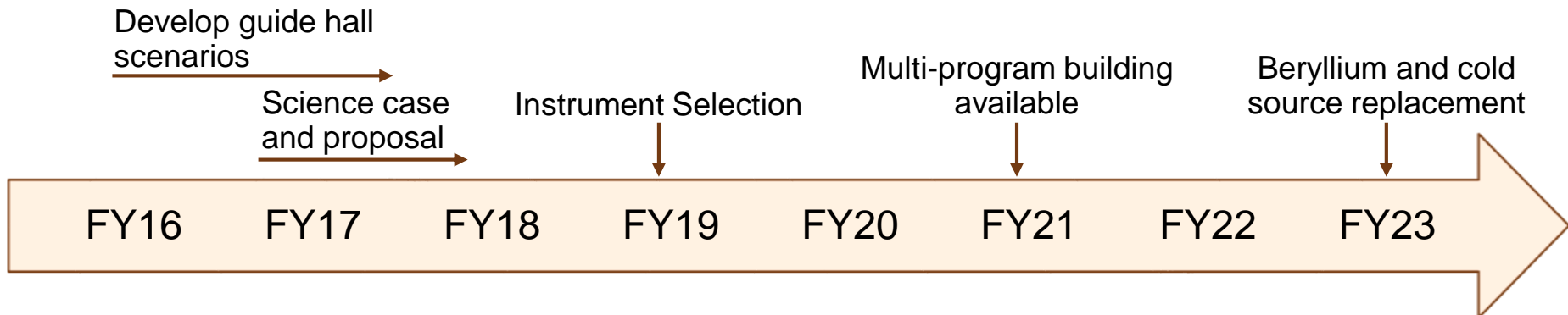
5.2m from Cold Source



Steel collimator

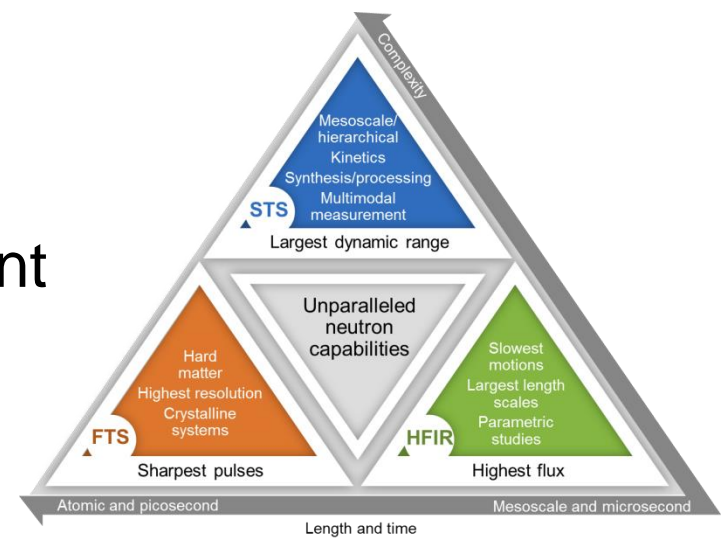
HFIR next steps

- Develop guide-hall scenarios
 - Initial instrument requirements
 - Guide requirements developed to support specific instrument needs
 - Monte Carlo models of instruments
- Instrument/science specific workshops
 - Engage the user community
- Develop proposal
 - Science Case developed
 - Guide and instrument concepts
 - Early experiments modeled
- 2021 – Need multi-program support building to provide space to assemble and stage new instruments and guide sections
- 2023 – beryllium change out, replace cold source, install new guide configuration



Summary

- Maximizing the science impact of current two ORNL neutron sources is an essential element of our 3-source strategy
- Building out five unoccupied beam lines at STS first target station will deliver core capabilities for hard-condensed matter and engineering materials
 - Filling out the diffraction suite with medium resolution diffractometer
 - Neutron imaging applied to range of science and engineering challenges including additive manufacturing
- Reconfiguring the HFIR cold guide hall will deliver world-leading capabilities for soft-matter science and spectroscopy as exemplified by
 - High-resolution neutron spin-echo
 - MANTA – cold TAS (100x ORNL current performance)



Questions?

