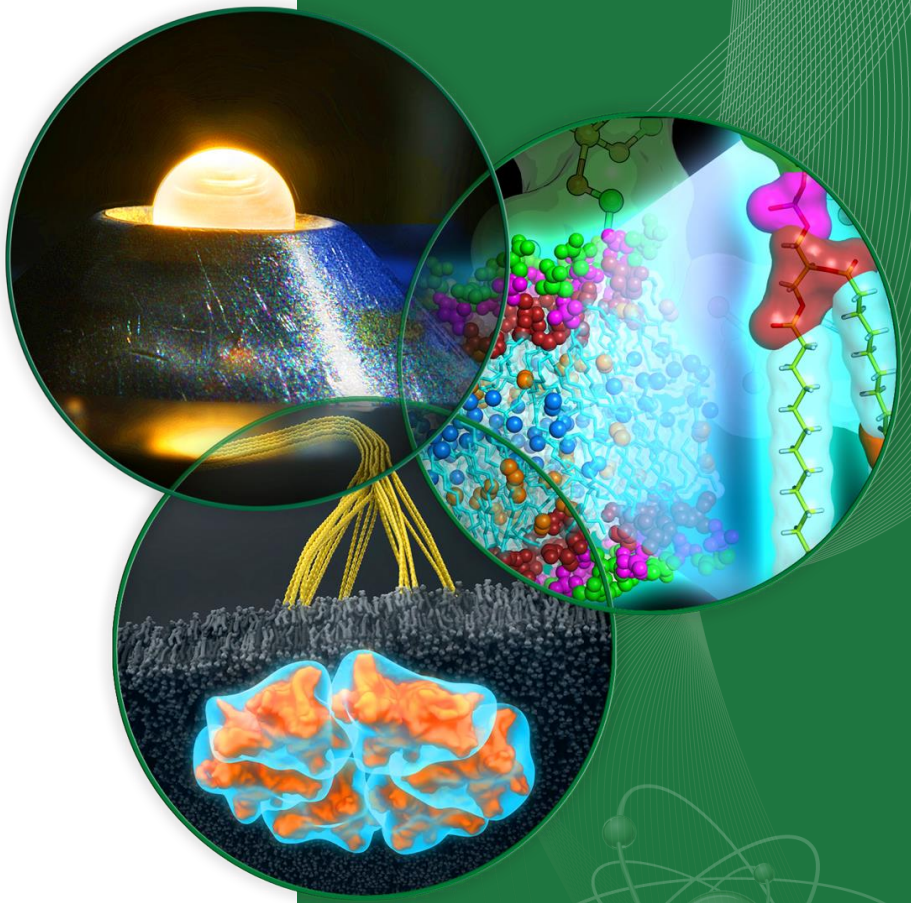
New Instruments and Beam Lines



Presented to
Neutron Advisory Board

Presented by
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Instrument and Source Division

June 30, 2016
Clinch River Cabin
Oak Ridge, Tennessee

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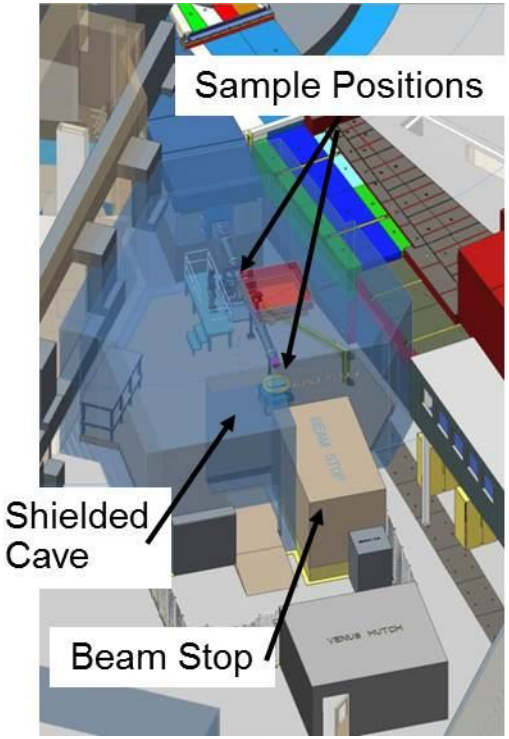
New instruments will increase SNS science productivity

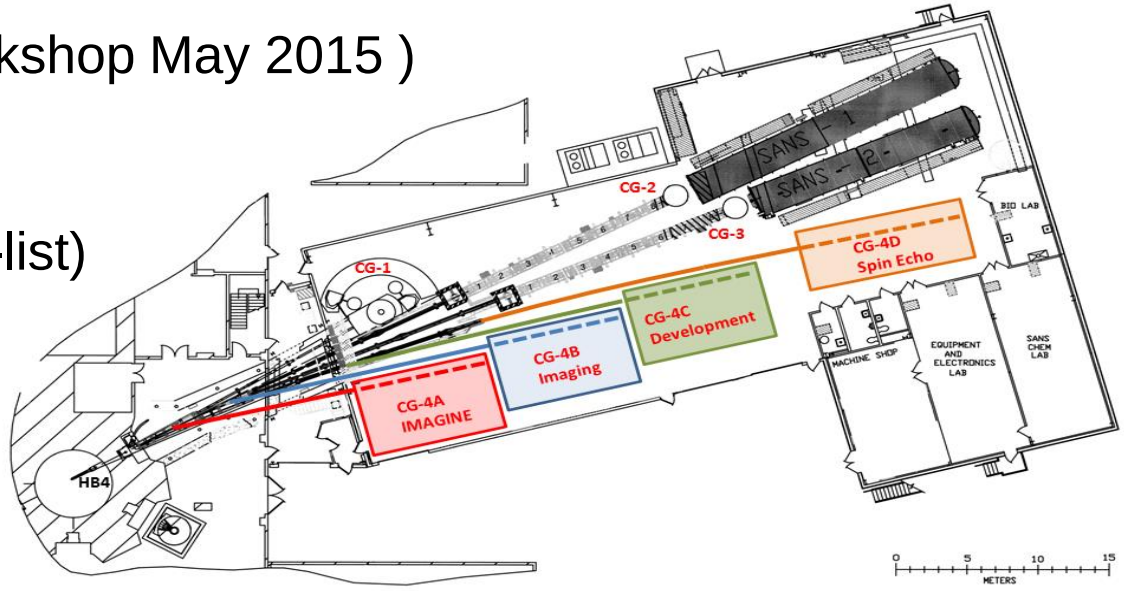
- 5 new experimental stations are being planned to fully build-out the suite of 24 beamlines at the SNS first target station.
- Design concepts are developed for two high-priority and high-throughput experimental stations:
  - VENUS – a time-of-flight neutron imaging station that will provide unique 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 ≈2023



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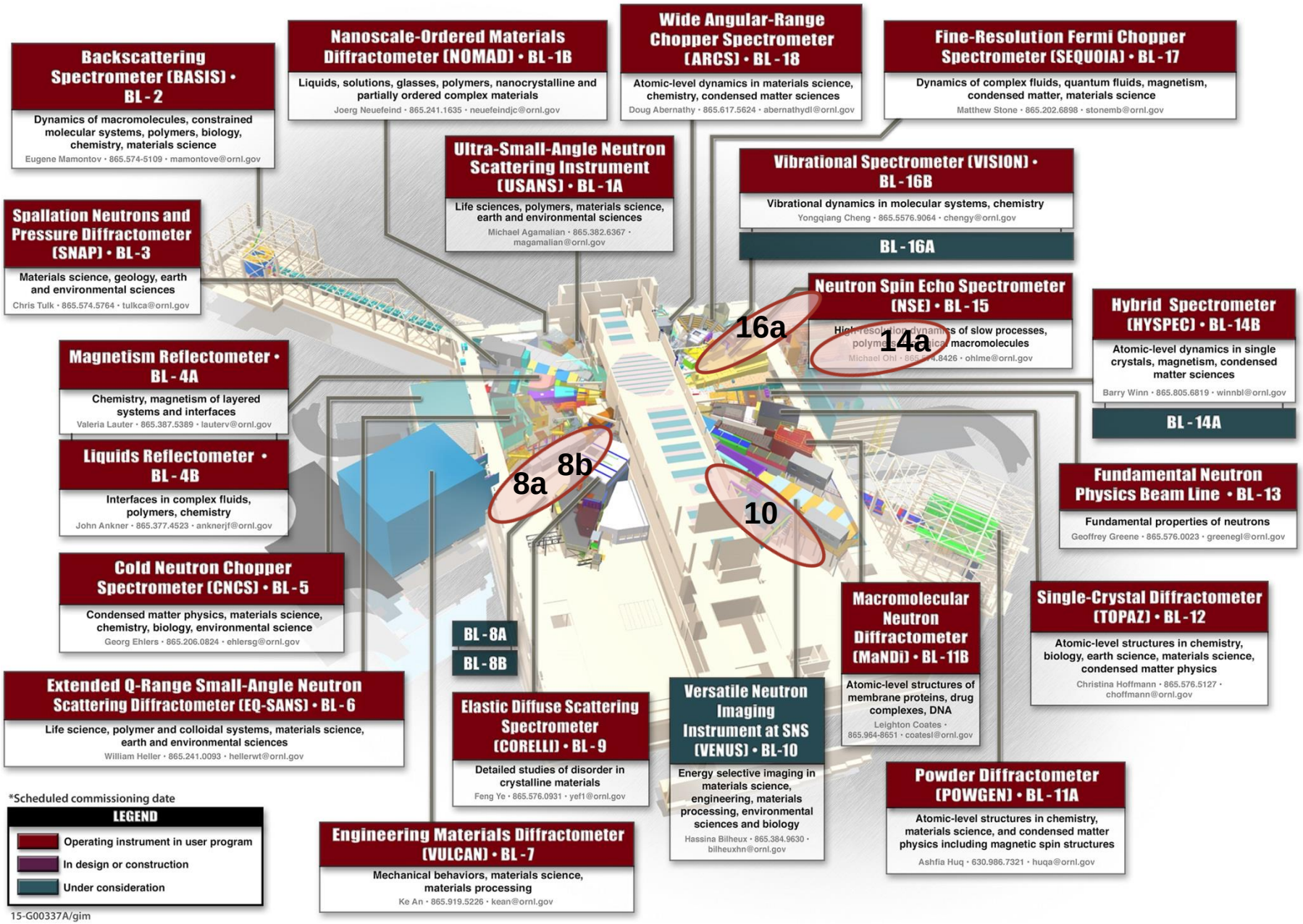
SNS – five unoccupied beam lines

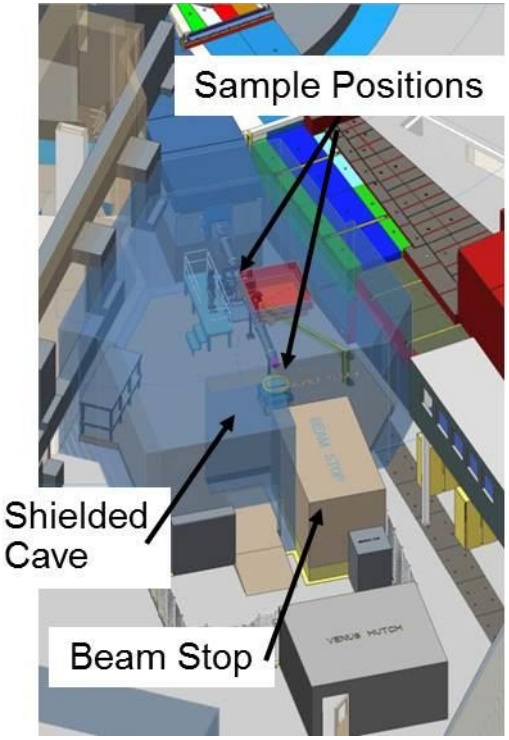


New instruments will provide new science capabilities and maximize use of FTS

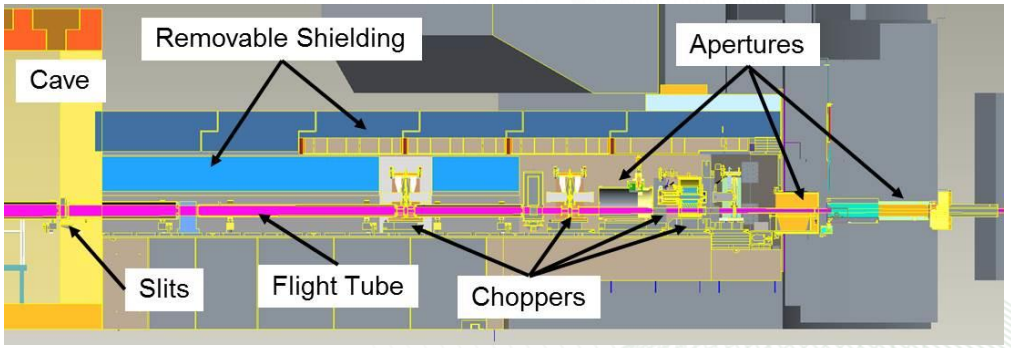
- June 2016: BESAC prioritization sub-committee recommendation
  - *The Oak Ridge National Laboratory should make the build-out of the experimental stations for the first target station a priority.*
- 5 unoccupied beam lines
  - **BL8a** and **BL8b** – shallow poisoned, de-coupled 300K water moderator – thermal neutrons, high-resolution pulse shapes (well matched for diffraction)
  - **BL10** – poisoned, de-coupled para-H_2 – 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 cm^2 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

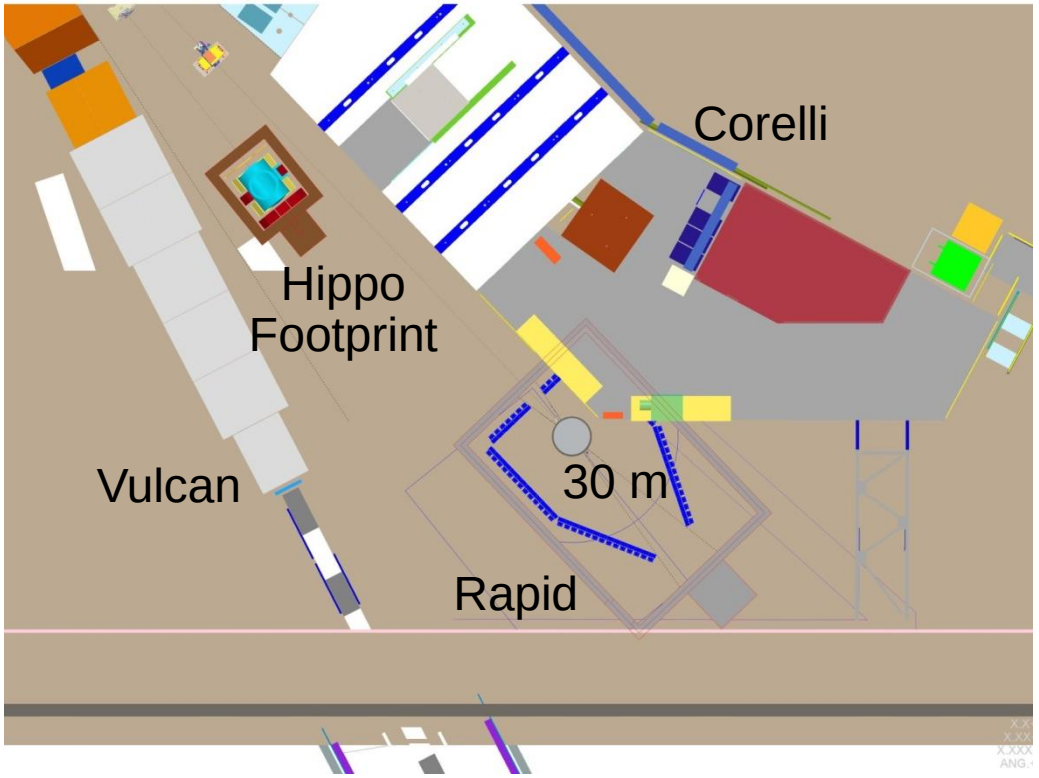


- $18.5M (includes 18% contingency on design, procurement, installation)
- March 15, 2016 – VENUS workshop with Advanced Manufacturing Office of DOE-EERE
  - Mission need statement (CD-0) signed by EERE April 23, 2016
  - Design/Construction start pending final funding agreements



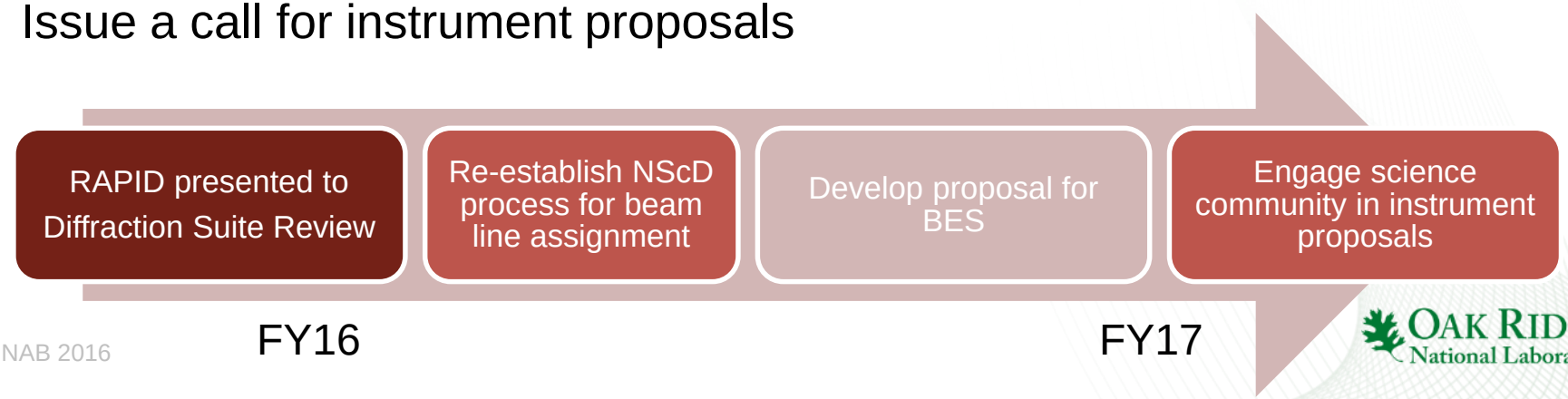
BL8b RAPID - Rapid Acquisition Parametric and In-situ Diffraction

- 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

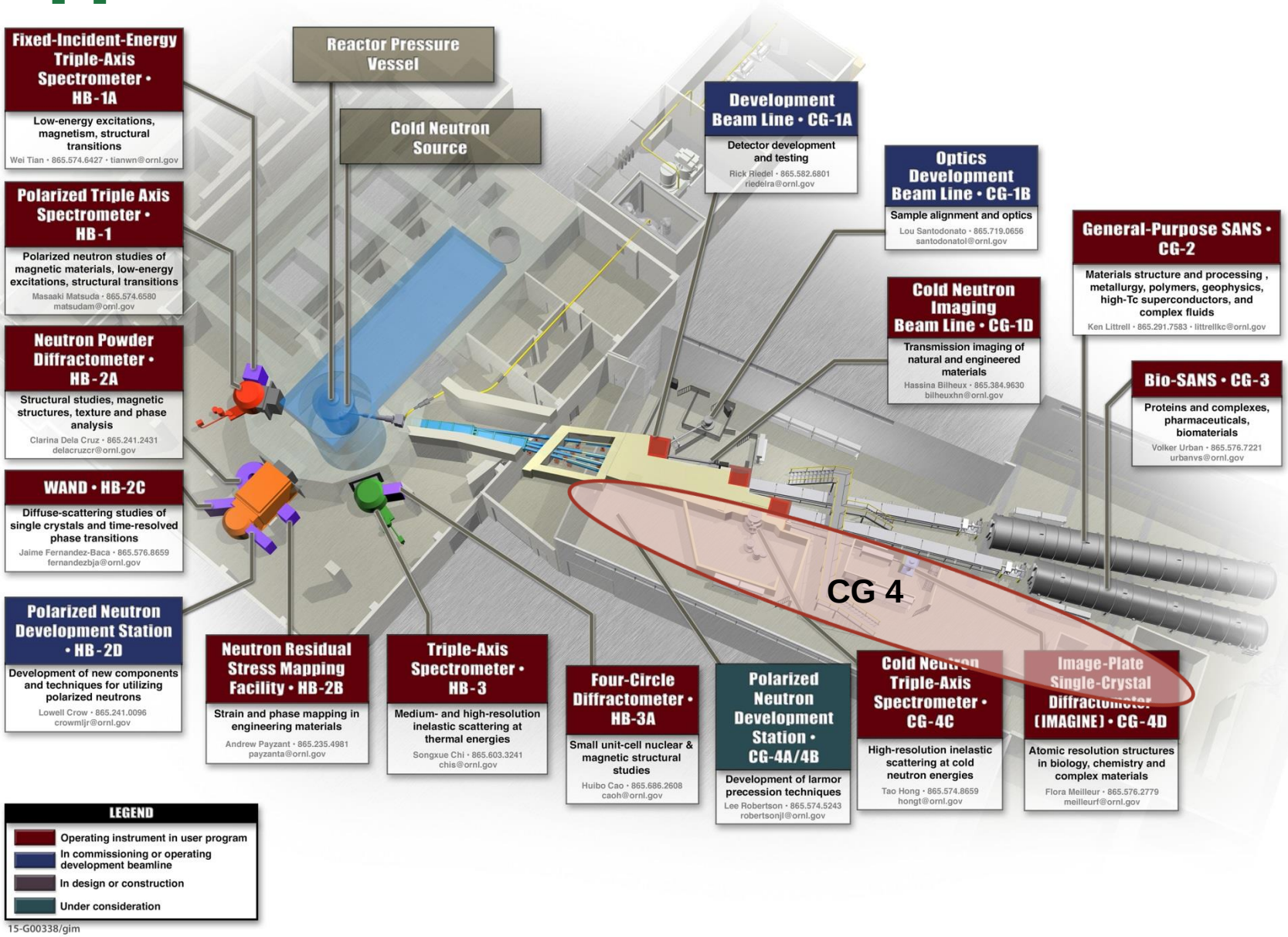


SNS next steps

- 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

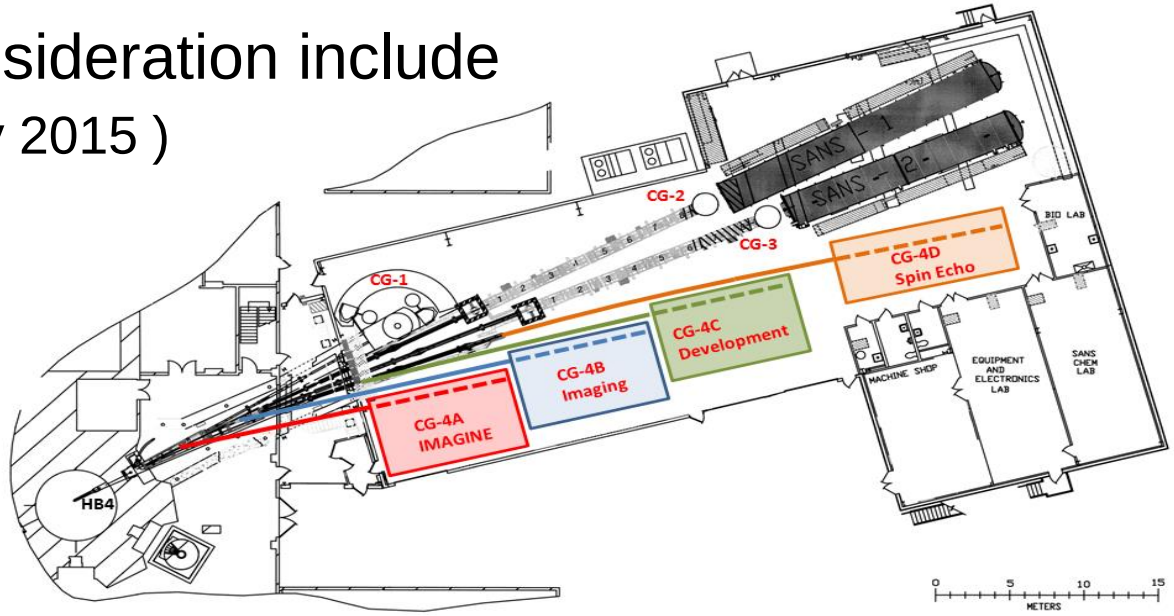


HFIR – new guide configuration supports additional instruments



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

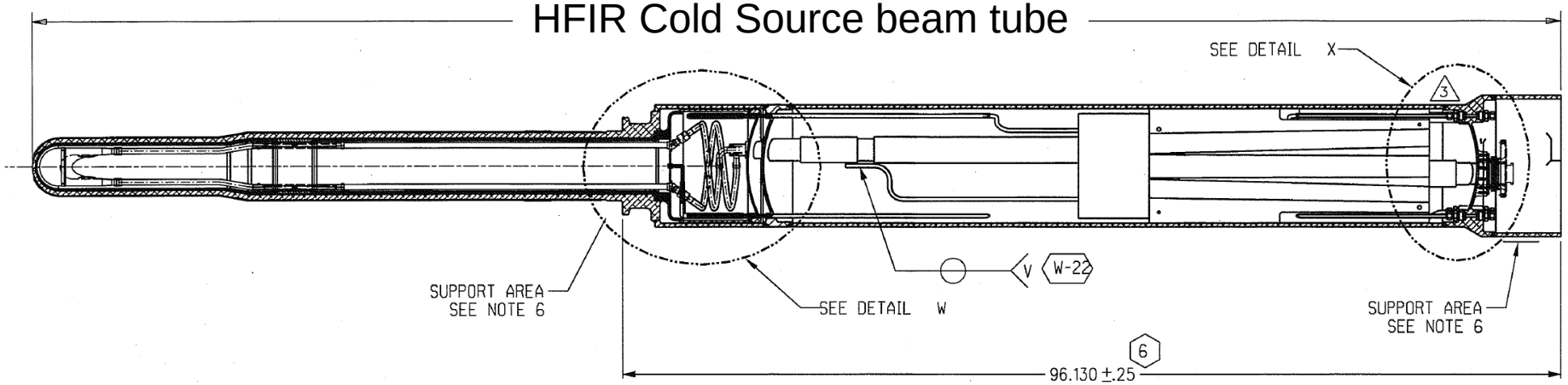
- FY16 “C”-list – Lee Robertson assigned as lead
  - Kick-off meeting June 28, 2016 (≈25 instrument scientists, neutronics, neutron optics, engineering)
  - Identified team members
- Instruments under consideration include
  - MANTA (workshop May 2015)
  - Neutron Spin Echo (workshop May 2015)
  - Larmor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



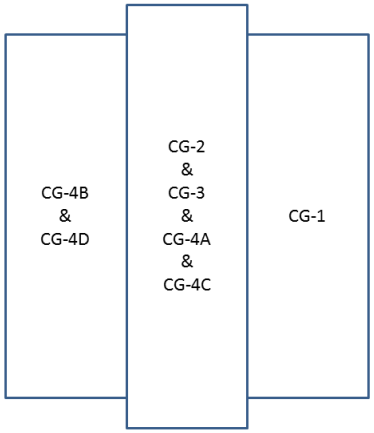
- Timing – replacement of the cold source and HFIR beryllium replacement ≈2023

Modern guide designs provide more instrument end stations

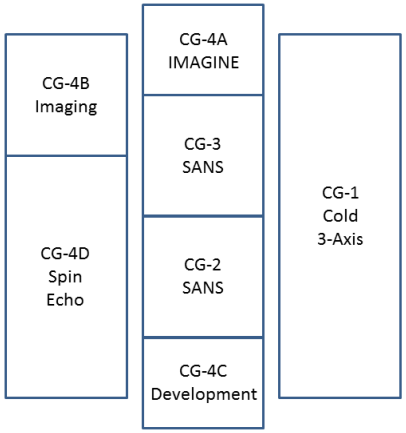
- Open view of cold source by eliminating/modifying steel collimator
- Bring guide elements much closer to cold source

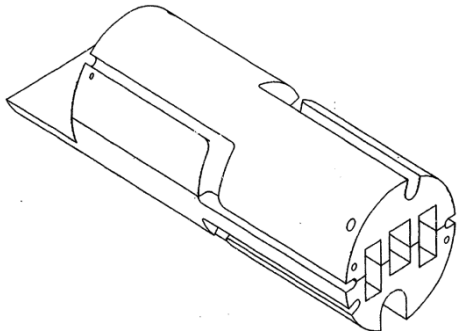


3.8m from Cold Source



5.2m from Cold Source

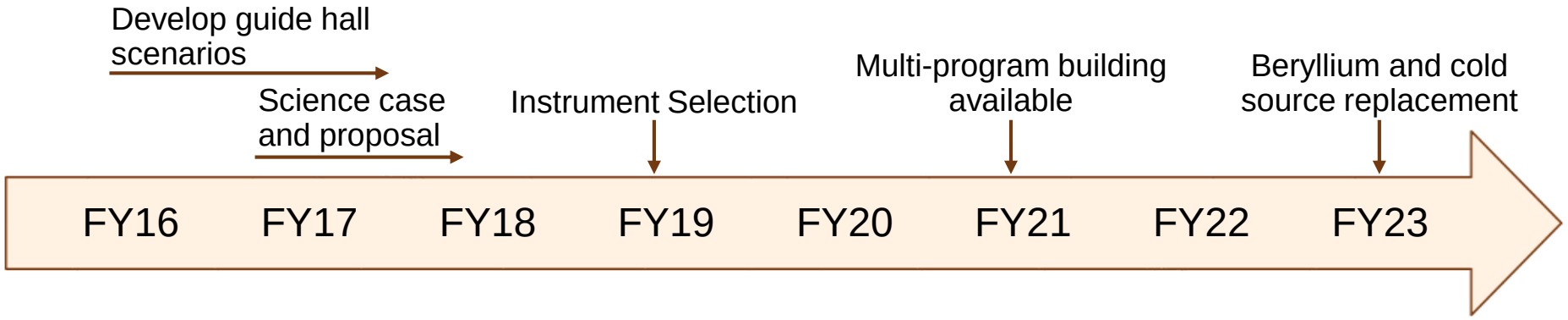




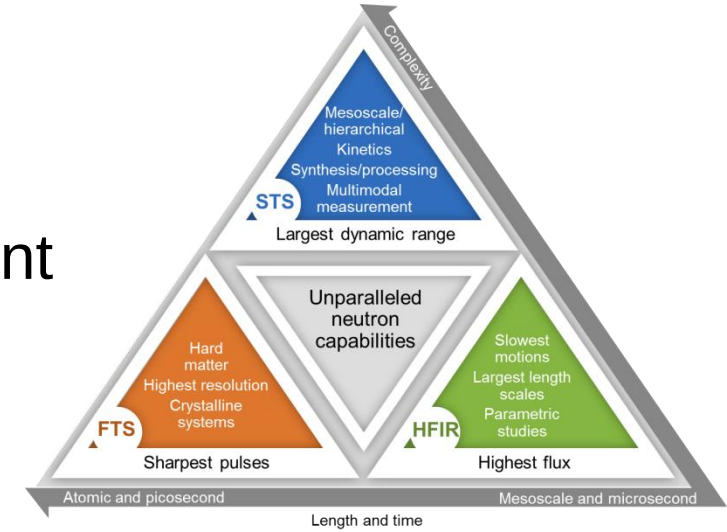
Steel collimator

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 exampled by
  - High-resolution neutron spin-echo
  - MANTA – cold TAS (100x ORNL current performance)

Questions?

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