Facility and Instrument Development

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Neutron Facilities Development Division

ORNL User Week

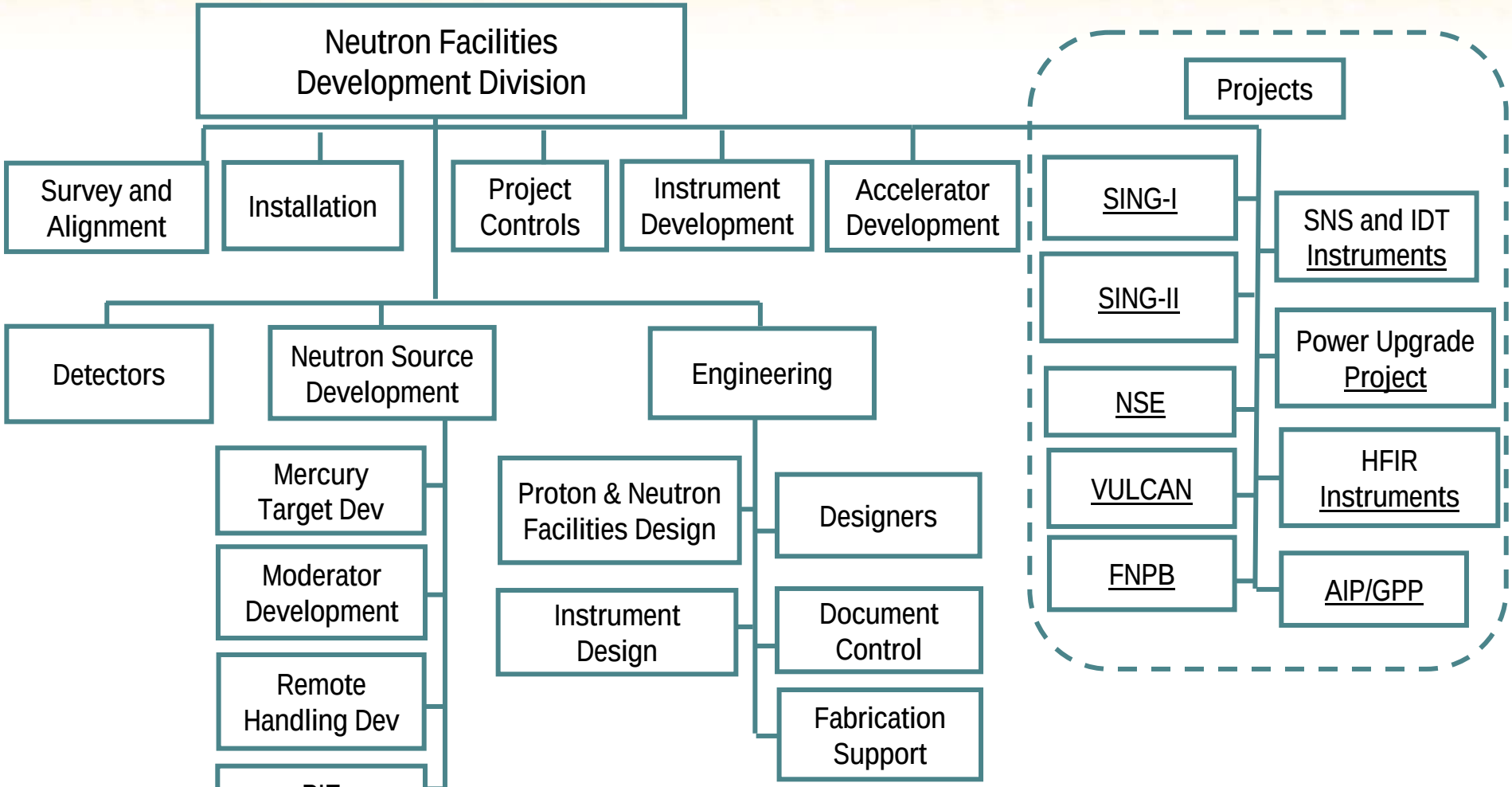
October 8, 2007

OAK RIDGE NATIONAL LABORATORY
U. S. DEPARTMENT OF ENERGY

Outline

- **Status of instrument projects**
  - **SNS and HFIR**
- **Science and Technology Development**
  - **Detectors**
  - **Instrument Development**
  - **Neutron Source Development**
- **Status of Accelerator and Target Facility Upgrades**
  - **SNS beam power upgrade**
  - **Second Target Station**

NFDD Organization Reflects Project & Development Mission



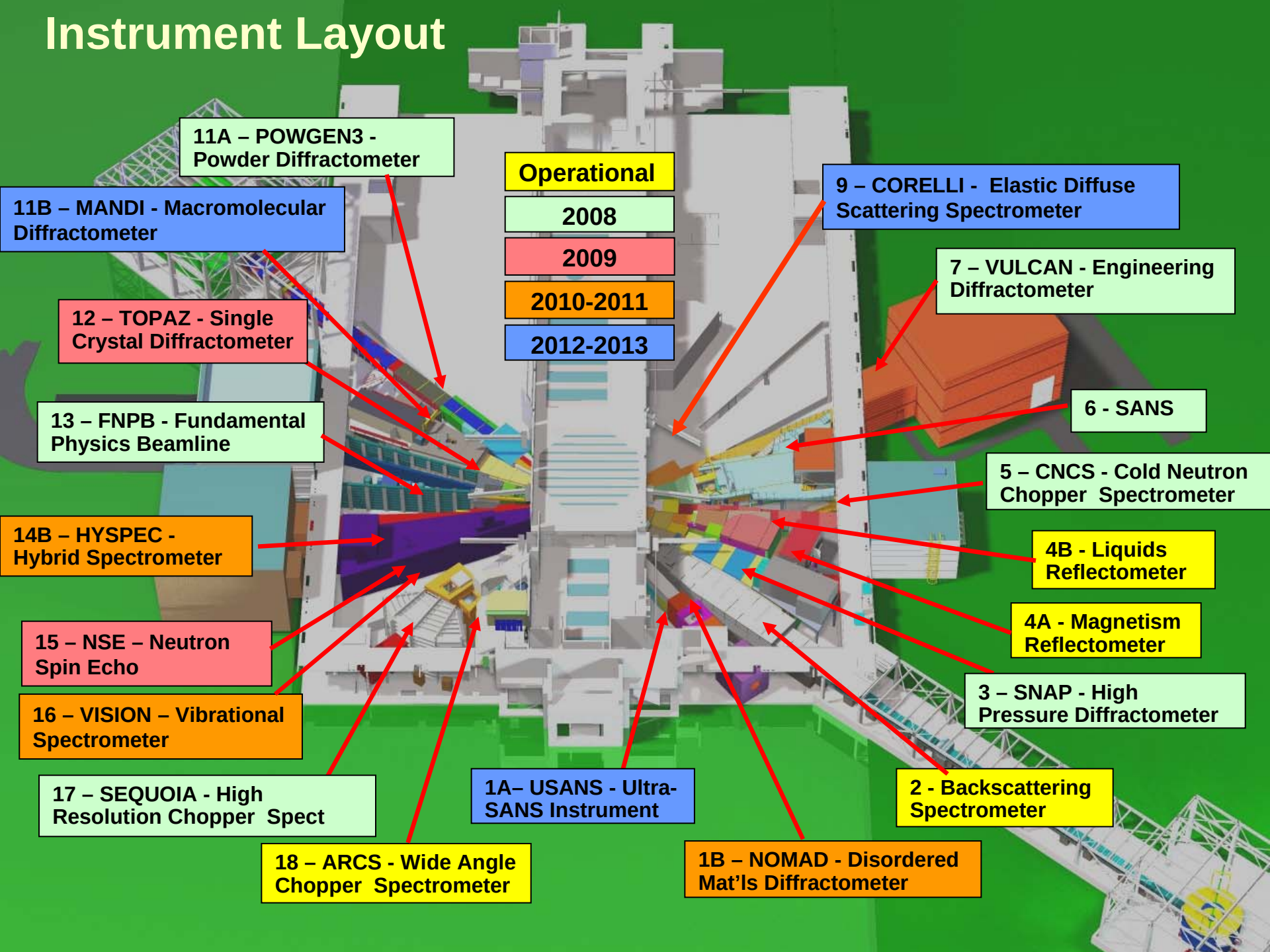
SNS Beam Line Status Summary

Beam line	Instrument name	Type of funding	Status	Planned start of commissioning
1A	TOF-USANS	SING-II[a]	Preliminary Design	Oct-12
1B	NOMAD	SING-I[a]	Under Construction	Oct-10
1C			————	
2	Backscattering Spectrometer	SNS[a]	Operating	Operating
3	SNAP	SING-I[a]	Under Construction	Apr-08
4A	Magnetism Reflectometer	SNS[a]	Operating	Operating
4B	Liquids Reflectometer	SNS[a]	Operating	Operating
5	CNCS	DOE-BES[a]	Under Construction	Apr-08
6	EQ-SANS	SNS[a]	Under Construction	Apr-08
7	VULCAN	CFI[b]	Under Construction	Oct-08
8A			————	
8B			————	
9	CORELLI	SING-II[a]	Preliminary Design	Oct-13
10			————	
11A	POWGEN3	SNS[a]	Under Construction	Apr-08
11B	MANDI	SING-II[a]	Preliminary Design	Oct-12
12	TOPAZ	SING-I[a]	Under Construction	Oct-09
13	FNPB	DOE-NP[c]	Under Construction	Oct-08
14A	40 T magnet		Preconceptual Design	
14B	HYSPEC	SING-I[a]	Under Construction	Oct-11
15	NSE	Jülich[d]	Under Construction	Apr-09
16A			————	
16B	VISION	SING-II[a]	Preliminary Design	Oct-11
17	SEQUOIA	SING-I[a]	Under Construction	Oct-08
18	ARCS	DOE-BES[a]	Operating	Operating

[a]Funded by the U.S. Department of Energy Office of Science (DOE-SC).
[b]Funded by the Canada Fund for Innovation (CFI).
[c]Funded by the DOE Office of Nuclear Physics.
[d]Funded by the Research Centre Jülich.

- **Room for 25 instruments**
  - **4 Operating**
  - **11 under construction**
  - **5 in preliminary or conceptual design phase**
  - **5 open slots remaining**

Instrument Layout



Status of Beamline Construction Projects

SANS, POWGEN3, ARCS, and CNCS

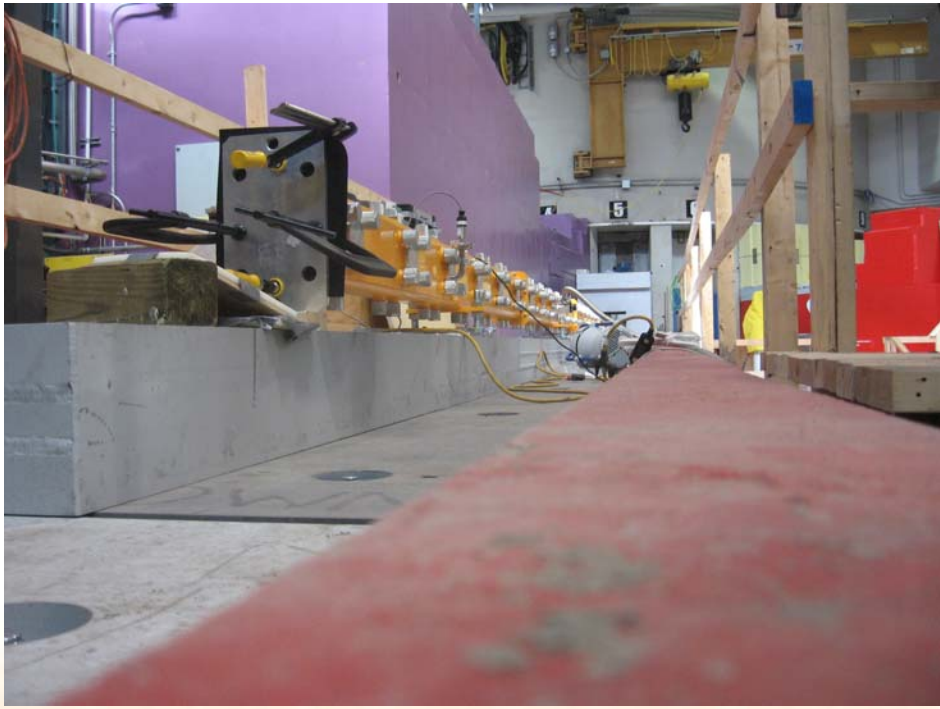
- **"SPACkle" Project - SANS, POWGEN3, ARCS, and CNCS**
  - **Grouped together internally within NFDD to:**
    - **Facilitate coordination**
    - **Allocate resources**
    - **Manage and track progress**
- **One instrument (ARCS) completed in 2007; three remaining in 2008**

ARCS (BL18)– Wide Angular-Range Chopper Spectrometer

- **Instrument completed and shutter opened on Sep 7, 2007**

CNCS (BL5) – Cold Neutron Chopper Spectrometer

- **External satellite building completed in July 2007**
- **Instrument Readiness Review scheduled for December 2007**
- **Will open shutter in January 2008**

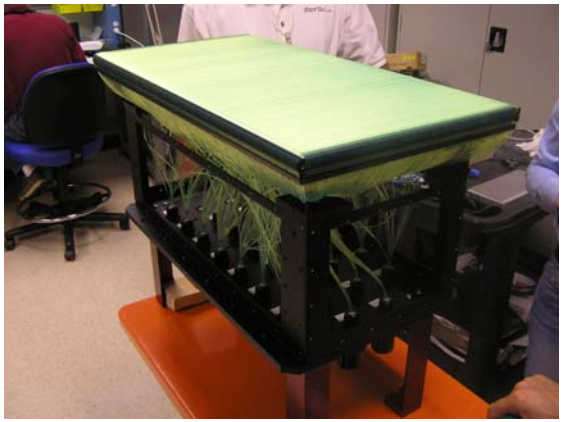


Non-BES Funded Instruments

- **Three instruments funded outside DOE-BES will be completed in 2008 and 2009**
  - **VULCAN (Canada)**
  - **FNPB (DOE-NP)**
  - **NSE (Jülich)**

VULCAN (BL7) – Engineering Materials Diffractometer

- **Funded primarily by the Canada Foundation for Innovation**
- **External building finished in July 2007**
- **To be commissioned in 2008**



NSE (BL15)

- **a.k.a. Ultra-high resolution Spin - Echo Spectrometer**
- **Being designed and built by Forschungszentrum Jülich**
- **Design is complete; all major components ordered**
- **Completion scheduled for 2009**

SING I

- **Five instruments grouped together in a single project and funded by DOE-BES**
- **All five instruments baselined (CD-2 approved) and in construction phase (CD-3 approved)**
- **On schedule and maintaining 25% cost contingency**
- **Overall project is 50% complete**
- **SNAP and SEQUOIA will be completed in 2008**
- **TOPAZ, NOMAD, and HYSPEC will be completed in 2009-2011**

SNAP (BL3) – Spallation Neutrons and Pressure

- **Incident beam line, cave, and hutch complete**
- **Anger camera detectors installed**
- **Completion planned for December 2007 – 3 months early**

SEQUOIA (BL17) – Fine-resolution Fermi chopper Spectrometer

- **Incident beam line completed in Jan 2007**
- **Large detector and sample tanks installed**
- **Completion planned for September 2008**

TOPAZ (BL12) – Single Crystal Diffractometer

- **Sub-project is 40 % complete**
- **Completion planned for September 2009**

NOMAD (BL 1b) – Nanoscale –Ordered Materials Diffractometer

- **Sub-project is 20 % complete**
- **Completion planned for September 2010**

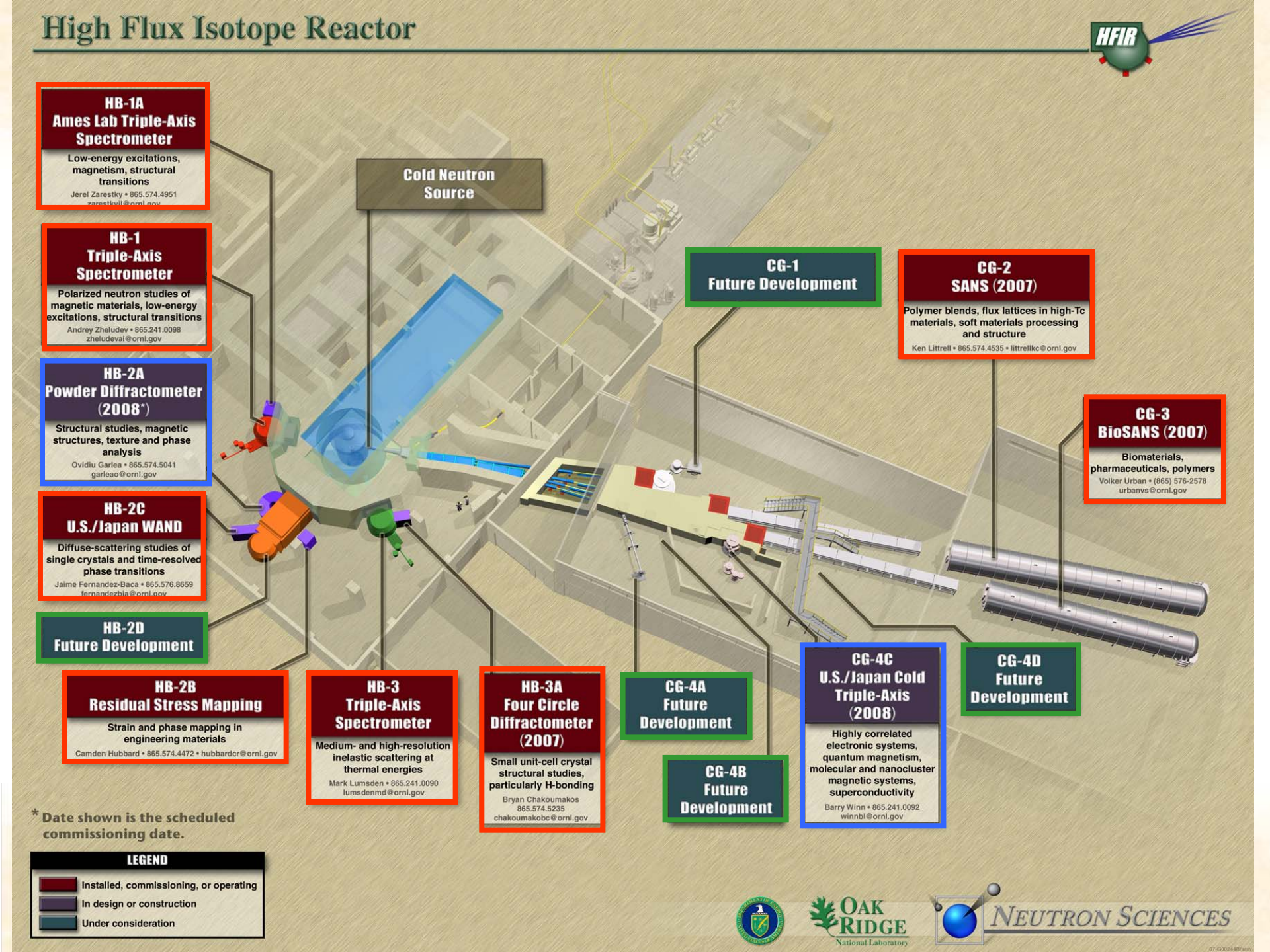
HYSPEC (BL14b) – Hybrid Chopper Spectrometer

- **Sub-project is 19 % complete**
- **Completion planned for September 2011**

SING-II

- **Four instruments to be completed between 2011-2013**
- **Critical Decision-0 (Mission Need) approved in Oct 2005; Critical Decision-1 (Alternative Selection and Cost Range) approved in Sep 2007**
- **Instruments**
  - **USANS – Ultra-Small Angle Neutron Scattering Instrument**
  - **VISION – Chemical Spectrometer**
  - **MANDI – Large Molecule Diffractometer**
  - **CORELLI – Single Crystal Diffuse Scattering Spectrometer**
- **VISION CD-2 (Performance Baseline) planned for Dec 2007**

High Flux Isotope Reactor



* Date shown is the scheduled commissioning date.

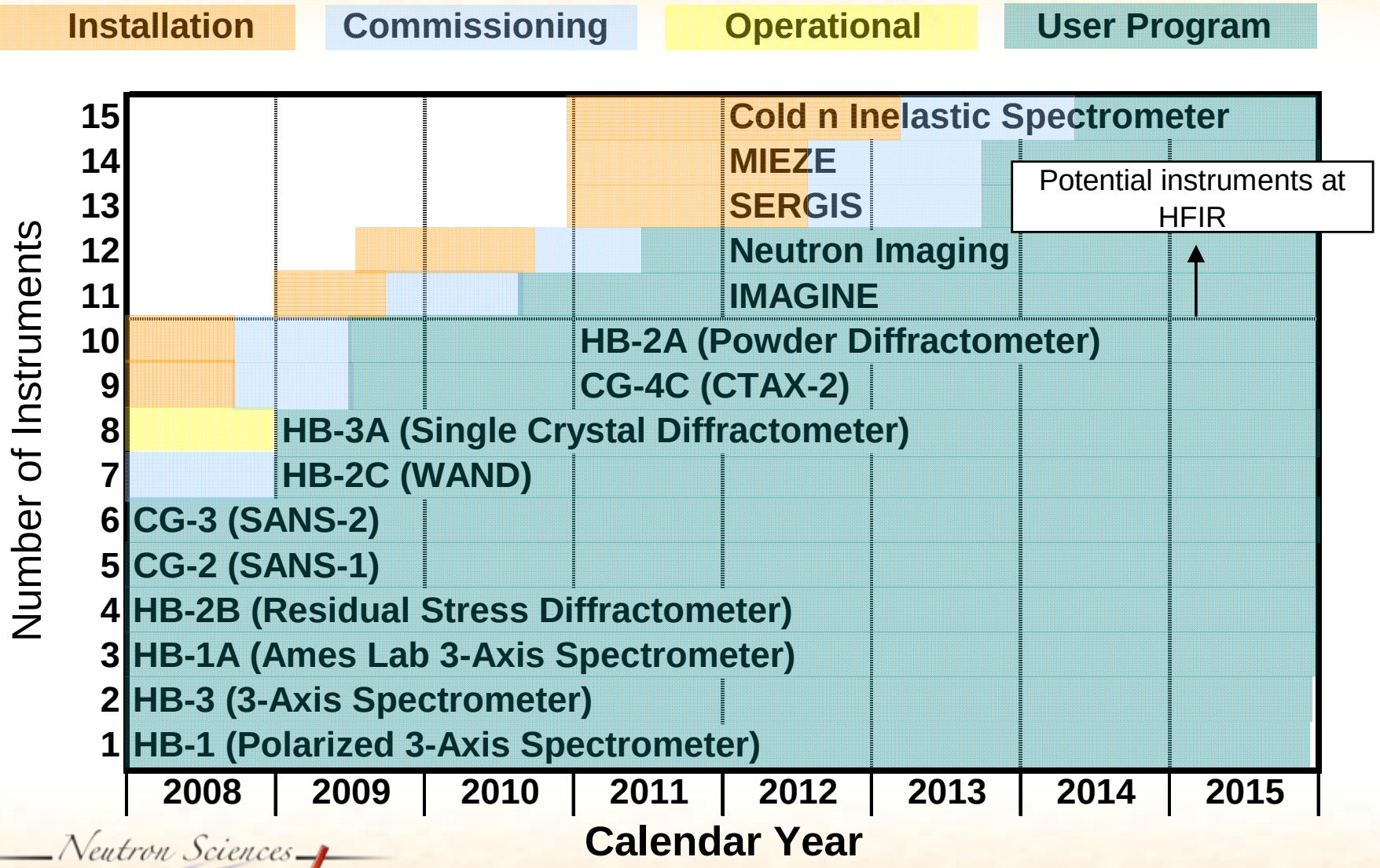
LEGEND

- Installed, commissioning, or operating
- In design or construction
- Under consideration

OAK RIDGE National Laboratory

NEUTRON SCIENCES

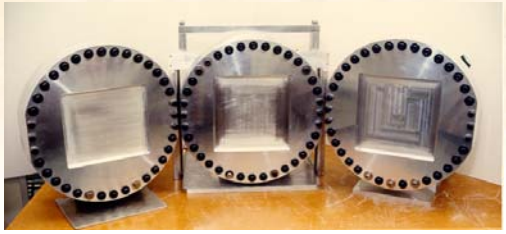
HFIR Beamline Status Summary



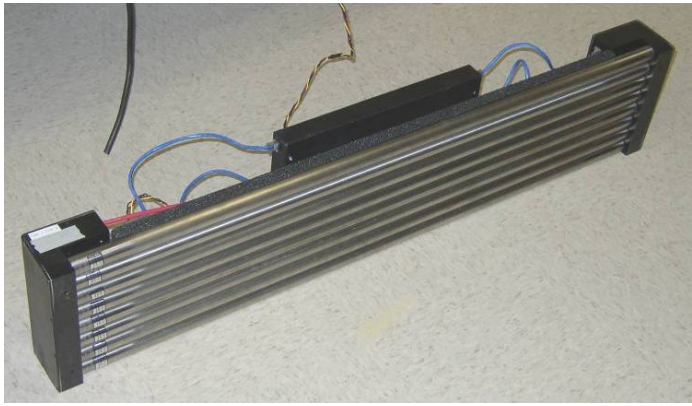
Neutron Detectors – Group Leader Ron Cooper

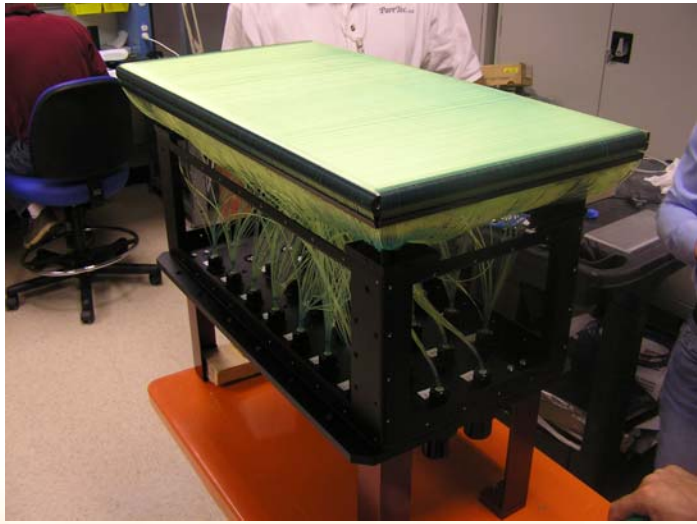
- **Develop detector systems as necessary to meet requirements for new instruments or instrument upgrades**
- **Provide detector systems for instruments being constructed**
  - **Procurement**
  - **Fabrication/assembly**
  - **Testing/calibration**
  - **Installation**
- **Provide support for detector systems in operating instruments**
- **3 Scientists (Ron Cooper, Lowell Crow, and John Richards); 1 Technical Staff; 8 Technicians**

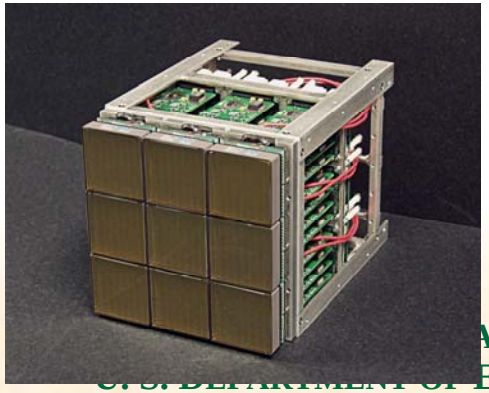
Neutron Detectors



- **We are using four detector types:**
  - **Multiwire proportional chambers**
  - **Position sensitive proportional tubes**
    - **Commercially available tubes**
    - **Electronics and packaging done in house**
  - **Scintillation detectors with wavelength shifting fiber readout**
    - **New development**
  - **Anger cameras with position sensitive PMTs**
    - **New development**

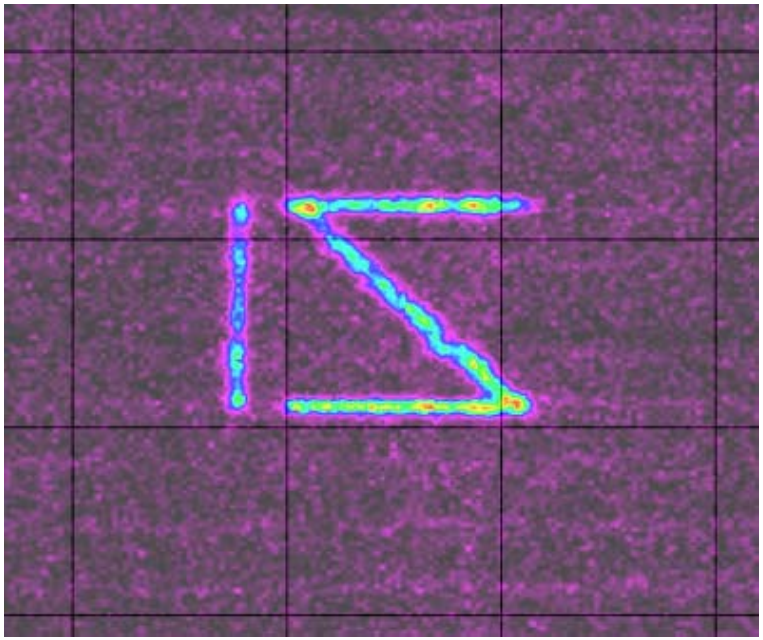






Developed and implemented the world's best resolution (< 1.3 mm) neutron Anger Camera Detector

- **These detectors will be used on the SNAP, TOPAZ, and MANDI instruments**



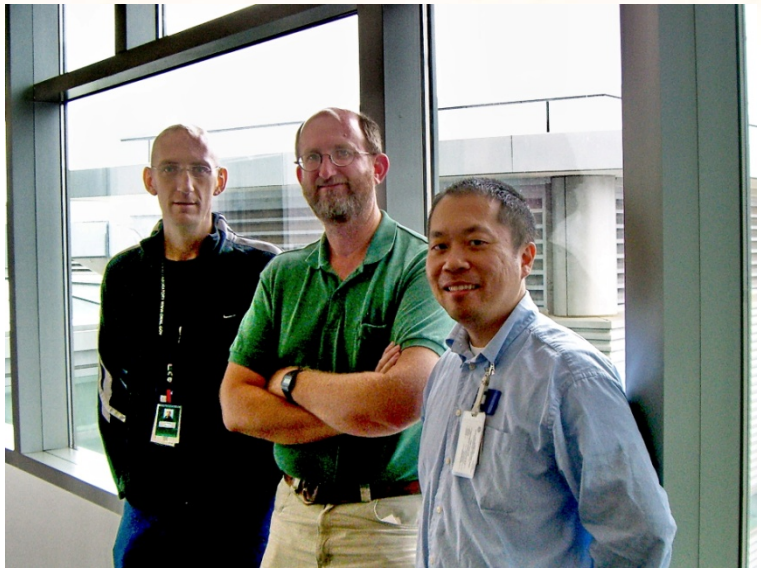
Neutron image of mask showing 1.3mm resolution in gaps, a new world record

Installation of this array of detectors on SNAP was a SING Project major milestone

NFDD Instrument Development Group

Lee Robertson **Group Leader**
Hal Lee **Research Scientist**
Dennis Rich **Research Scientist**

This group focuses on the development of new and novel neutron scattering instrument components and techniques

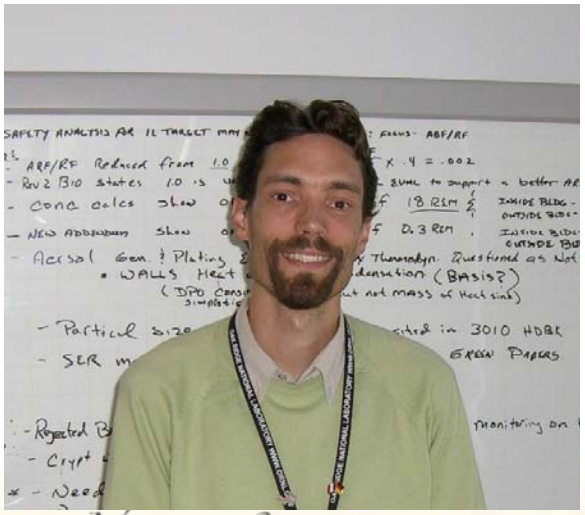


- **The primary goal of the group for 2008 is to produce a working prototype wide angle He3 polarizer and have a design suitable for use on the instruments by 2009**

ORNL Instrument Development Fellowships

Novel Concepts for Neutron Instrumentation

- **Fellowship is for 1-3 years**
- **Development of novel neutron instrumentation and instrument components to be used for neutron science**
- **Directed to scientists within 10 years of their PhD**
- **Proposals are now being accepted for 2008 – contact Lee Robertson (robertsonjl@ornl.gov) for details**



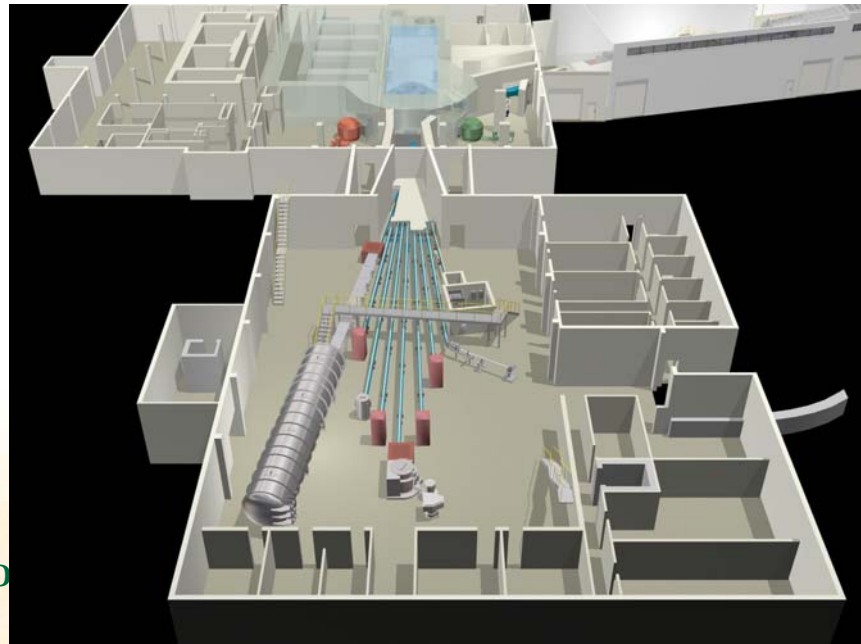
Dr. Thorwald van Vuure is the first Instrument Development Fellow. He is working on a new detector concept combining gas detectors using inclined layers of solid thermal-neutron converters with gas electron multipliers for thermal-neutron detection.

Key Elements of the Overall Plan for Neutron Source Upgrade and Development

- **Conceptual design for Power Upgrade Project (PUP) completed**
  - **Project complete in 2013**
  - **Increase beam energy from 1.0 GeV to 1.3 GeV**
  - **30% increase in beam power**
- **Beam current increase (60%) will be accomplished through a series of R&D activities and Accelerator Improvement Projects (AIPs)**
- **Net result of PUP + AIPs will be a doubling of the SNS beam power by 2013**
- **Meanwhile work on targets and moderators/reflectors continues**
  - **He refrigerator repair to extend run period for cryogenic moderator system**
  - **Procure and load heavy water in the reflector**
  - **Cavitation damage mitigation to extend the lifetime/power level for Hg targets**
  - **Rotating target concepts for the Second Target Station**

Longer-Term Plans

- **SNS Second Target Station**
  - **Pre-conceptual design and planning**
  - **Series of workshops held to optimize performance parameters and build science case**
  - **White paper to be issued soon in preparation for Critical Decision–0 (Mission Need) approval**
  - **22 Instruments**
  - **440 – 880 kW?**
  - **20 Hz?**
- **HFIR Second Cold Source (HB-2)**
  - **Pre-conceptual layout and cold source evaluations**
  - **Remains on DOEs twenty year plan**



Summary

- **Beamline and accelerator/target upgrade projects plus development of instrument-related science and technologies are focused on supporting our neutron science mission**
  - **Twenty beamlines in some stage of design (5), construction (11), or operation (4) at SNS**
    - **Seven will be finished in 2008!**
  - **Fifteen instrument slots at HFIR; eight operating, two under construction (finish in 2008), five proposed**
  - **Emphasis on development of detectors and instrument science and technology as well as accelerator and target systems is built into the organization**
  - **SNS (2x) power upgrade will be completed in 2013**
  - **Second Target Station concept is approaching Mission Need approval stage**