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From Discovery to Innovation...

Neutron Program for Materials Research Status Report 2004

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Annual General Meeting, Canadian Institute for Neutron Scattering
 Antigonish, Nova Scotia

September 25, 2004

 National Research Council Canada
 Conseil national de recherches Canada

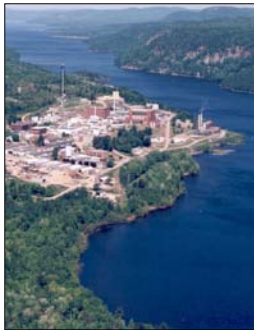
Canada

OUTLINE

- *Resources*
- *People*
- *Users and “production”*
- *Equipment*
- *Development Projects*
- *Motions*

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RESOURCES



NRU Reactor at Chalk River Laboratories

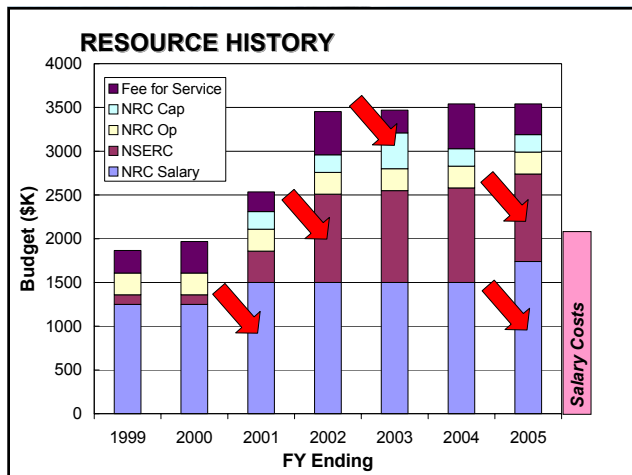
- CNSC informed of AECL intent to apply for license extension beyond 2005.
- Target horizon ~2012 or beyond.

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AECL's REASONS TO EXTEND NRU (Letter from AECL Pres. Van Adel to CNSC Pres. Keen)

- Develop and retain Canadian nuclear expertise
- Develop the Advanced CANDU Reactor, particularly demonstrating and qualifying ACR fuel and fuel channel components
- Enable commercial and public-policy applications of nuclear technology
- Ensure that AECL can meet its legacy obligations to support continued safe operation of existing CANDU nuclear power reactors
- Enable the production of isotopes for medical, industrial applications
- Ensure viability of the NRC and Canadian university advanced materials research using neutron scattering

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PEOPLE

Magnetism and Superconductivity	
Bill Buyers	Principal RO
Competition in Progress	Assistant / Associate RO
Zahra Yamani	Visiting Fellow (NSERC)
Materials Science and Engineering	
Ron Rogge	Senior RO
Michael Gharghoun	Associate RO as of July 2
Ron Donabarger	RCO
Jin Huang	Visiting Fellow (NSERC)
Structures & Dynamics of Molecular Materials	
Ian Swainson	Associate RO
Lachlan Cranswick	RCO
Lisheng Chi	Visiting Fellow (NSERC)
Surfaces and Interfaces	
Zin Tun	Senior RO
Helmut Fritzsche	Associate RO
Biophysics	
John Katsaras	Senior RO
Competition in Progress	Assistant / Associate RO
Jeremy Pencer	Visiting Fellow (NSERC)
Thad Harroun	Visiting Fellow (NSERC)

Ron Rogge introduces Prof. R.A. Holt (Queen's) and students to neutron diffraction for materials engineering

Supported by 8 technicians, 1 laboratory attendant, and 3 staff for admin, management, communication and strategic projects

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USERS AND PRODUCTION – Outreach Events

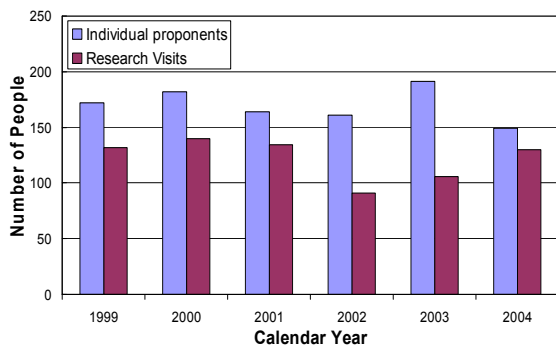
May - Powder Diffraction Workshop at U of Waterloo

June - International Summer School at Chalk River

SUMMER SCHOOL 2004 June 20-25

- Directed by Ron Rogge
- 44 attendees (biggest ever)
- 36 students, 9 Canadian universities
- Involved all NPMR staff and instruments

USERS AND PRODUCTION - Trends



USERS AND PRODUCTION - Statistics

In the last 12 months...

- 142 individual proponents (63 Canadian academics)
- 131 research visits (77 Canadian academics)

Canadian universities ...

University	Beam Days
Toronto	165
McMaster	163
British Columbia	136
Queen's	112
Memorial	65
McGill	65
Lakehead	35
Dalhousie	26
Simon Fraser	20
Western Ontario	13
Manitoba	9
Alberta	7
Waterloo	7

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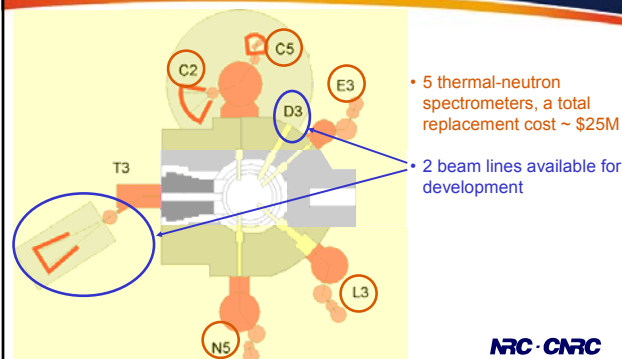
EQUIPMENT – Ancillary equipment

A basic suite of specimen environments is in place.

- 3 Closed-cycle refrigerators, one top-loading, base temps 4, 6.5 and 11K
- 2 Pumped He cryostats, one 1.8K <T <R.T., the other 2K <T <550K
- 1 Horizontal-field cryomagnet (**M2**): 1.8K <T <250K, Field 2.6T
- 1 Vertical-field cryomagnet (**M5**): 0.3K <T <300K, Field 9T (7.5T polarized)
- 1 High-temperature furnace 100C <T <2000C
- 1 Medium-range furnace R.T. <T <700C
- 1 Chiller -40C <T <R.T.
- Various others: pressure, tensile testing, radioactive specimen cell...

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EQUIPMENT – Beam Lines



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EQUIPMENT – Spectrometers

\$25M / 40 year lifetime → ~ \$625K / yr to maintain, refurbish

Beam	Opened	Required Maintenance	Upgrades
E3	1960's	Beam Stop	
L3	1970's	Beam Stop MB Monitor	White beam
N5	1970's	Yoke Gate! 20 _M Wedge Overhaul	
C2	1992	Yoke Shielding Oscillating Collimator	Sample changer Mezzanine
C5	1992	Beam Stop	Focused Heusler Multiwire det.



\$160K of Heusler crystals received from ILL

EQUIPMENT – Radiation Protection



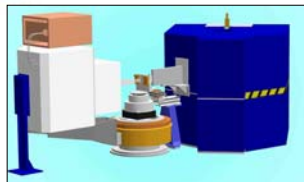
We are responsible for safety of our staff and visitors and must respond to unplanned events, inquiries from CNSC, and new requirements by AECL / NRU

- Motorize "Brookhaven" arcs
- Reposition lighted warnings
- Redesign beam stops
- Improve beam channel shielding
- Motorize beam-shaping jaws
- Use automation to align xtals
- ...

Redesign, fabrication and installation of beam stops to handle higher fields from focusing monochs and to reduce the probability of accidental exposure.

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DEVELOPMENTS – D3 Reflectometer



Led by UWO, supported by 13 universities – classified as a "national" project.

CFI conditional approval \$986 K
OIT contribution \$727 K
NRC contribution \$518 K
Other vendor discounts \$234 K

OIT granted 74% of its customary "full match" of CFI, because non-Ontario users will benefit from the facility.

The proposed NRC contribution was \$358 K. Discrepancy to be partially managed via in-kind contribution of central NRC fabrication services.

Conditions to be removed by end of calendar year.

DEVELOPMENTS – T3 Low-angle scattering

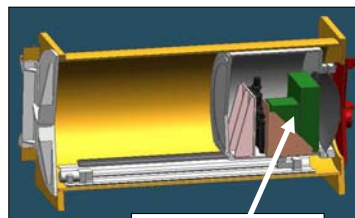


Image-plate Detector

Phase 1 design and pre-assembly complete

Preparing for review and approval by NRU for installation at T3 during fall, 2004.

Using NPMR minor capital budget for this project, ~\$450K to date

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DEVELOPMENTS – Neutron methods

- Heusler monoch / analyzer focusing pair → project transferred from CRL to NRC design and fabrication services
- Neutron Holography – step by step refinements. In the current year, the “inside detector” geometry increased signal by a factor of 400. Specimen can be analyzed in a single day.
- Neutron Microbeam → partnership with G. Ice (ORNL) whose synchrotron X-ray microbeam demonstration was published in Nature 2002.
- Inverse stress scanner, using white incident beam and wavelength analysis after diffraction from the specimen, highly preliminary
- “Super D2-B”? Other?



DEVELOPMENTS – Ancillary Equipment

- Equipment to provide sub 1K temperatures on the powder diffractometer → lash-up prototype adaptation of Heliox from M5
- Equipment to hold hydrogen-bearing materials at temperature and pressure, for in-situ neutron powder diffraction experiments → proposal received capital funding from NRC (\$250K)
- X-ray scattering facility slowly progressing to installation in Bldg. 459 (SAX and crystallography) → capital equipment donated by U Conn, setup funded by NRC minor capital



MOTIONS

1. CINS recognizes the value of a low-angle neutron scattering capability for the Canadian user community, and recommends that funds from the NSERC MFA grant can be applied for services and minor equipment needed to install the prototype instrument at the NRU T3 beam line.
2. CINS requests the Executive to establish a committee to identify a package of major ancillary equipment for which funding on the order \$500K will be sought from NSERC or CFI to modernize the national neutron beam laboratory, and ensure that Canadian academics have access to competitive equipment while visiting Chalk River.

