Canadian Scientists and Nuclear Industry Plan Joint Research Reactor

If it's approved, a new reactor would provide Canada with its first cold-neutron source. It would also be the first research reactor built in North America in decades.

Materials scientists and Atomic Energy of Canada Ltd have teamed up to ask the Canadian government to finance a new research reactor that would be used both for neutron scattering experiments and as a testing site for AECL's power reactor business.

The proposed Canadian Neutron Facility for Materials Sciences (CNF) is intended to replace AECL's workhorse research reactor at Chalk River, Ontario, which has been running since 1957 and is scheduled to shut down in 2005. But approval for the Can$388 million (US$260 million) CNF will have to come swiftly if construction is to start this year and a lapse in neutron production is to be avoided.

William Buyers, a senior scientist in the neutron scattering materials research program at Chalk River, says, "There is more momentum for the new research facility than there has been for a decade." The CNF would be Canada's first source of cold neutrons (energies below 10 meV and wavelengths greater than 3 angstroms), and also would provide thermal neutrons (energies around 25 meV). Arthur Carty, president of the National Research Council of Canada (NRC), the body representing the materials science community in the CNF proposal, adds that "there is an urgency to getting it going," but he notes that the CNF must first win support from Natural Resources Canada, the ministry responsible for the government-owned AECL, and then from Industry Canada, which oversees the NRC, and from other ministries. Says Carty, "I'm not overly optimistic, but I'm certainly not pessimistic."

The CNF design was ready as PHYSICS TODAY went to press, "but we're waiting for a full business plan," explained a government spokesman. Says the reactor company's Ian Hastings, "The best we could hope for would be inclusion in the next federal budget [which is scheduled to be announced in February], but that is by no means assured."

A dual-purpose reactor

"Neutron scattering has three killer applications," says Bruce Gaulin, a McMaster University physicist and president of the Canadian Institute for Neutron Scattering, a nationwide organization and advocacy group for neutron users. "Measuring magnetism in solids and depth profiling materials to measure strain are two areas that Canada is doing well at. The area we have almost no presence in is studying hydrogenous materials with neutrons." But with the sensitivity of neutron scattering to distinguish hydrogen and deuterium, Gaulin continues, the CNF's large fluxes of cold neutrons would make it possible to systematically study a wide range of materials that have a high proportion of hydrogen atoms, especially those based on large biological molecules and polymers. Adds John Root, the group leader for Chalk River's neutron scattering materials research program, "A lot of advanced materials are based on soft condensed matter," which can be studied only with cold neutrons. "With a cold source, we would suddenly be able to do a lot of science that we couldn't do before. Most neutron beam research facilities have a cold source. We're just trying to catch up."

The CNF is designed to provide neutrons with an average flux of 4×10^{14} n/cm^{2}s. Among the more than 20 instruments planned for the facility are reflectometers, a cold-neutron triple-axis spectrometer for high-resolution measurements of spin excitations and a disc chopper spectrometer for molecular vibration spectroscopy, with some instruments for use with thermal neutrons being transferred from the existing reactor. Construction costs for the CNF's neutron scattering user facility would come to about Can$90 million of the total, and its annual operating cost is estimated at Can$8 million.

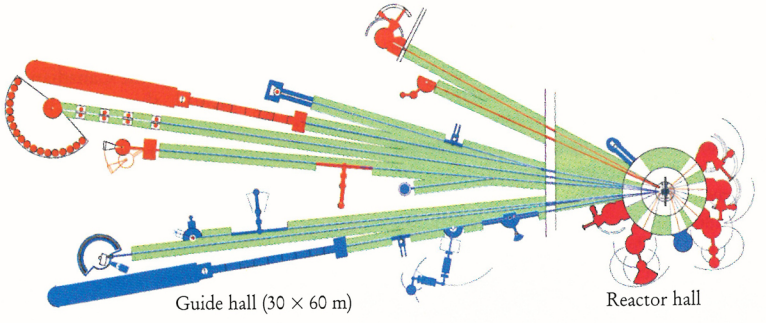
At the core of the medium flux reactor, where the hottest neutrons and other fission products of the low-enriched uranium fuel will be found, AECL plans to test and develop fuel components by irradiating materials and subjecting them to pressures and temperatures that simulate conditions in a power reactor.

AECL maintains it needs a new research reactor to remain competitive in the commercial reactor business. And, says Buyers, although the government "could choose to cherry pick" and skimp on the materials science part of the new facility, the proposal by AECL and NRC argues it would be cost-effective to build one dual-purpose neutron facility. "We are aiming to get this project approved as a whole."

The NRC is pitching the CNF as part of a three-pronged approach to keep Canada at the leading edge in materials science research in the 21st century. The two other prongs are magnetic resonance techniques using beams of muons and polarized nuclei at TRIUMF, in Vancouver, and a proposed x-ray synchrotron light source in Saskatoon, for which a decision is expected this spring.

A scarce commodity

Does the world really need another nuclear reactor? Yes it does, according to the Organisation of Economic Cooperation and Development (OECD). Neutron scattering facilities are overbooked worldwide. And the neutron shortage will worsen, according to a 1998 OECD report (see http://www.oecd.org/dsti/sti), which predicts that between 2010 and 2020 the available neutrons will drop to one-third the present production as reactors are closed down, while demand by scientists will increase. Says Buyers, "Existing reactors are old. The CNF will be the first steady-state reactor source built on the North American continent



THE CANADIAN NEUTRON FACILITY would start out with about ten instruments (positions shown in red), and include provisions for more than a dozen follow-on ones (blue). (Courtesy of NRC and AECL.)

in decades. It will fill a key need in neutron beam research." Adds the University of Minnesota's Frank Bates, who is president of the Neutron Scattering Society of America, "It's hard to imagine building another reactor in the US in the foreseeable future—we would have difficulty for political reasons, if nothing else. If the CNF is approved, it will be completed around the same time the spallation source [at Oak Ridge National Laboratory] comes on line, which will be good for collaboration. But if the Canadian government says, 'No, we will not do this,' who in the way of students and postdocs will go into neutron scattering? They'll have no prospects. It would create not only a neutron gap, but a gap in people and expertise." **TONI FEDER**

Howes Will Lead AAPT in 2001

Ruth H. Howes takes office this month as vice president of the American Association of Physics Teachers. Howes, who succeeds Robert F. Sears Jr, will become president-elect next year and president in 2001. AAPT's current president is Larry D. Kirkpatrick of Montana State University.

Howes is the George and Frances Ball Distinguished Professor of Physics and Astronomy at Ball State University. She holds a BA in physics from Mount Holyoke College and an MA and PhD in physics from Columbia University. After earning her doctorate in 1971, Howes worked at several institutions in Oklahoma before joining Ball State in 1976. An experimental nuclear physicist, Howes is also known for her involvement in science policy and science education. She recently completed a term as chair of the American Physical Society's Panel on Public Affairs, and she also has held fellowships with the US Arms Control and Disarmament Agency and the American Association for the Advancement of Science (the latter with the Senate Labor and Human Resources Committee).

RUTH H. HOWES

Also taking office this month are Richard W. Peterson of Bethel College, as AAPT secretary, and Lila M. Adair, a physics teacher and head of the science department at Central Gwinnett High School in Lawrenceville, Georgia, as the AAPT executive board's high school representative.

IN BRIEF

Germany's Gottfried Wilhelm Leibniz Society has joined the ranks of the country's scientific elite. Formally established in 1995, the society's 78 centers—known collectively until 1997 as the "Blaue Liste" (because they were first listed on blue paper)—include a hodgepodge of former West and East German science and humanities institutions (as well as libraries and museums) that were lumped together after German reunification and now aim to straddle basic and applied research. The society's centers employ a total of about 11 000 people (including 4200 scientists) and have a budget of $750 million (1997). This past November, the society was invited to participate in the informal but politically influential meetings of the presidents of the country's science and science funding organizations. Representatives from many of these organizations, as well as from the state and federal governments, also serve on a new council that is to direct the Leibniz Society in scientific, budgetary and policy matters. And Frank Pobell, who heads the Rossendorf Research Center near Dresden, was elected to a two-year term as the society's president.

The National Science Foundation is investing in a batch of new Engineering Research Centers. The five ERCs will focus on the engineering of living tissues (based at the Georgia Institute of Technology); development of computer-aided surgical methods (Johns Hopkins University); marine biotechnology (University of Hawaii at Manoa); conversion of electrical energy to other energy forms (Virginia Polytechnic Institute); and fiber and film development for computer technology (Clemson University). NSF will provide $2 million a year per center for five years, and each center will have to obtain additional support from its academic and industrial partners. NSF selects new ERCs every other year; these 5 bring to 34 the total number established since the program began in 1985.

Physics education research results will soon be published in an annual supplementary issue of the American Association of Physics Teachers' *American Journal of Physics*. AAPT is pro-

Student-Run Physics Conference Enters Its 35th Year

Each year since 1965, physics students from across Canada have made a trek to the Canadian Undergraduate Physics Conference (CUPC), a student-organized, student-run event where the participants meet, mingle and discuss their research.

The most recent gathering, held on 11–14 November at Queen's University in Kingston, Ontario, drew about 200 students from more than 20 schools. A majority of the attendees also gave presentations of their work, in either short formal talks or poster form. "It was a good opportunity for them to stand up and present what they've been working on, just as they will be expected to do in the future," says Art McDonald, a professor at Queen's and director of the Sudbury Neutrino Observatory. "All of the presenters were nervous, and everyone else was enthusiastic and supportive."

A highlight of the conference was the invited lectures by, among others, Bill Phillips of the National Institute of Standards and Technology, who spoke on his Nobel Prize–winning work on atom cooling and trapping, and Jim Peebles of Princeton University, who discussed current theories of the evolution of the universe. Students also toured National Research Council labs in Ottawa and attended a graduate school and career fair. Rounding out the program was the annual CUPC pub crawl. "I hear a number of local establishments were well-studied by the students," notes McDonald.

The first CUPC was put together by undergraduates at McGill University and the University of Toronto, and students from various institutions have carried on the tradition since then. It's worth noting that no central body oversees the conference (although the Canadian Association of Physicists provides some financial support). Instead, the organizing baton is passed each year from institution to institution, explains Michael Levi, a senior at Queen's who was the 1998 conference coordinator. Students vie for the honor of playing host, and the conference is more popular than ever, with nearly every physics department in Canada represented. During the November meeting, the organizers tapped the University of Alberta to host the 1999 conference.

Melissa Franklin, a particle physicist at Harvard University, says one of the main benefits for students is getting to meet their peers from other schools. She knows that firsthand. In the 1970s, she attended twice while studying at the University of Toronto; last year, she returned as an invited speaker. "I have many colleagues now whom I met at those conferences and still keep in contact with, 25 years later," Franklin says. **JEAN KUMAGAI**