of Tennessee, "to take advantage when the $1.4 billion Spallation Neutron Source comes along." The SNS at Oak Ridge National Laboratory is scheduled to become fully operational in 2008. The Combinatorial Sciences and Materials Informatics Collaboratory (CoSMIC) focuses on exploiting informatics to design materials.

Unlike the other IMIs, the International Center for Materials Research does not set itself a geographical, technique, or research focus. "Ambassadors" in many countries identify promising students and researchers for exchanges and collaborations, and anyone can apply for ICMR money to travel to or from the US to take part in a materials science collaboration, says director Anthony Cheetham of the University of California, Santa Barbara. "One of the motivations is to give young American scientists more of an international experience during their education, so we have set aside a lot of our funding for that."

Last November in Singapore the ICMR launched a program designed to give materials scientists from developing countries in Asia access to regional facilities—"characterization facilities, nuclear magnetic resonance, x-ray diffraction, fablabs, things like that," says Cheetham. "What I would like [the ICMR] to grow into in the fullness of time is a materials science equivalent to the ICTP [International Centre for Theoretical Physics in Trieste, Italy]."

A measure of success

The idea is for the IMIs to catalyze lasting collaborations that benefit both the US and partner countries. NSF won't mind if the IMIs create cracks in the insular attitude typical in the US. "People with diverse training and international experience have a better chance of getting a job," says Tom Weber, director of NSF's division of materials research. Hahn Choo, a codirector of the neutron institute, tells of one student who had never left eastern Tennessee before spending time at ISIS, the UK's pulsed neutron source: "It's eye opening. And if they have this eye-opening experience when they are young, it has greater impact," says Choo.

In an attempt to measure their impact, the IMIs keep tabs on such things as the numbers of exchanges they fund and workshops they hold and whether their techniques are catching on. "Informatics allows you to take massive amounts of seemingly unconnected information, seek and find relationships, and then make predictions," says CoSMIC director Krishna Rajan of Iowa State University. "If we can proselytize our approach so that others make it part of their day-to-day methods, that would be a measure of success." Adds I2CAM director Daniel Cox, "Are our workshops and exchanges generating collaborations, papers, proposals for new work? Are people using our website? Have we nucleated new science that wouldn't have happened otherwise?"

"The IMIs are not glamorous," says Cheetham. "There are no big events. It's small things—but small things can have quite a lot of impact."

Toni Feder

Stronger Future for Nuclear Power

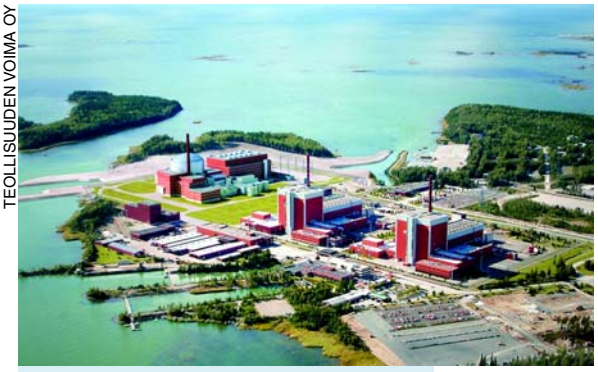
Nuclear reactor builders are jostling for business as energy utilities take another look at nuclear power.

Some two dozen power plants are scheduled to be built or refurbished during the next five years in Canada, China, several European Union countries, India, Iran, Pakistan, Russia, and South Africa. In the US and the UK, governmental preparations are under way that may lead to 15 new reactor orders by 2007.

About 16% of the world's electricity supply comes from nuclear power, and energy demand is increasing (see PHYSICS TODAY, April 2002, page 54). Worldwide, nearly 80% of the 441 commercial nuclear reactors currently in operation are more than 15 years old. To maintain nuclear power's position in the overall energy mix, new reactors will have to replace decommissioned ones, says a report from the Paris-based International Energy Agency.

The new interest in civilian nuclear energy results from some heavy lobbying by groups involved in building reactors, says Edwin Lyman of the Union of Concerned Scientists, and from attempts to reduce carbon-dioxide emissions. EU Energy Commissioner Andris Piebalgs adds that there are also increasing concerns about energy security, particularly in light of the recent disruption of Russian gas supplies in Europe.

Most of the new reactor designs are third-generation pressurized-water reactors (PWR), although companies in China, France, and South Africa are looking to build a fourth-generation



TEOLLISUUDEN VOIMA OY

Finland's new nuclear power plant at Olkiluoto will be home to Europe's first new reactor in 15 years.

design called a gas-pebble-bed reactor (PBMR). The new reactors are supposed to be inexpensive to build, more powerful, and safer; and they can be operated for up to 60 years, according to nuclear-power trade groups.

The international view

Late last year, officials from Bruce Power, one of Canada's largest power companies, announced a Can$4.25 billion (US$3.6 billion) investment to rebuild two reactors that have stood idle for nearly 10 years on the eastern shore of Lake Huron, north of Kincardine, Ontario. Last December, the Ontario Power Authority proposed plans to build 12 new nuclear plants to help phase out Ontario's coal-fired power stations.

New 1600-MW European PWRs are being built, one in Finland and one in France, with respective power-up dates of 2008 and 2012. On 5 January, France's president, Jacques Chirac, announced plans for an expansion of renewable and nuclear energy sources for France, including a PBMR by 2020. UK Prime Minister Tony Blair is expected to announce this spring six to eight new reactors in the UK.

Russia is currently constructing several reactors, including an 800-MW fast neutron reactor, but financial difficulties may delay four of them, says the London-based World Nuclear Association. Iran is building two Russian-designed reactors, the first of which should go on line later this year. The first South African PBMR is set to be completed in 2012.

Nuclear-industry officials have long said that the majority of growth would come in Asia. Japan is building five new power plants by 2010, and China plans to build 30 nuclear reactors, based on domestic designs, by 2020. China also sees nuclear technology as a major export opportunity, say industry analysts, and is building its second of four power plants for Pakistan, which may lead to a larger order. India has nine power plants under construction, including a fast-breeder reactor that generates its own fuel.

Six countries—Argentina, Brazil, Bulgaria, Chile, the Czech Republic, and Turkey—may build two to five PWRs each, while Germany, Sweden, and Switzerland are now reevaluating plans to phase-out nuclear power.

US moves

The US nuclear power industry has been virtually frozen since the Three Mile Island accident in 1979, but in the US Congress 2005 energy bill, tax credits worth $3.1 billion, along with liability protection and compensation for legislative delays, were added for the industry. On 30 December 2005, for the first time in years, the Nuclear Regulatory Commission (NRC) certified the design of a new reactor—the 1000-MW Westinghouse advanced passive (AP) reactor.

Six US power-plant operators are preparing combined construction and operating license (COL) requests to the NRC that could restart construction in the next five years. NuStart Energy, a consortium of nine nuclear energy companies, submitted plans for a General Electric simplified boiling water reactor at the Grand Gulf nuclear station near Port Gibson, Mississippi, and an AP-1000 reactor at the Bellefonte nuclear plant near Scottsboro, Alabama.

Two AP-1000 reactors may be built in the Carolinas by Duke Energy, along with another reactor by Progress Energy. "Preparing this application provides us the option to continue using a diverse fuel mix in the future," says Brew Barron, Duke Energy's chief nuclear officer.

Constellation Energy of Baltimore, Maryland, is in partnership with AREVA, a large French–German engineering firm, to submit COL requests for a European PWR at the Calvert Cliffs Nuclear Power Plant site in southern Maryland and the Nine Mile Point nuclear plant in Oswego, New York. Entergy, another NuStart member, announced it was preparing its own COL request for a new reactor at its River Bend Station power plant in St. Francisville, Louisiana. On 6 December, two electric utilities, Scana Corp and Santee Cooper, filed a letter of intent with the Nuclear Regulatory Commission to build two new reactors north of Columbia, South Carolina, to meet growing regional power demands.

According to representatives of the electric utilities involved, the US government and the reactor technology suppliers are paying for most of the $150 million the certification process costs. "The utilities are waiting to see if they can get any more subsidies out of the government," says Lyman, "so it's still premature to say if any of them will go ahead." A satisfactory means for disposal of their radioactive waste products has not yet been announced.

But the nuclear power industry believes the first new US order is only two years away. Says NuStart Energy president Marilyn Kray, "Our country needs these advanced nuclear plants."

Paul Guinnessy

NSF Centers to Study Societal Impact of Nanotechnology

To better understand and anticipate what one researcher calls the "risk, hope, hype, and fear" of nanotechnology, NSF is funding two new centers and two related projects to create a four-university network that will study the "societal implications" of the rapidly expanding field of science. The five-year grants, which total $14.3 million, will fund the sixth major NSF nanotechnology research network and add yet another piece to the $1 billion-per-year US National Nanotechnology Initiative.

The University of California, Santa Barbara, will receive $5 million, and Arizona State University in Tempe will get $6.2 million to establish the centers, which will research the implications of nanotechnology on everything from the equitable distribution of benefits to the convergence of biology and nanomachines. "Nanotechnology promises insights and innovations that could revolutionize whole sectors like manufacturing, energy, and health care," said David Guston, a political scientist and the principal investigator at the ASU center. But nanotechnology also raises profound questions about "identity, security, economic equity, bioconvergence of human and nanomaterials, and environmental and health risks," he said.

In addition to funding the centers, NSF is allocating $1.4 million to a research group at the University of South Carolina to study the role of images in communicating about nanotechnology. The group will also look at