

US Coast Guard personnel to power plants.

University reactors, despite being about 600 times smaller than commercial reactors, also operate under NRC guidelines. They, too, have tightened security, stationing armed guards at reactor sites.

At the same time, the heightened security is increasing the number of false alarms. For example, in October a threat against the Three Mile Island nuclear power plant in Pennsylvania led to the closure of two nearby airports for four hours. As resources become stretched, government authorities worry they won't be able to meet the demand for increased security. Some state officials, such as Governor George Ryan of Illinois, are trying to get emergency spending bills passed to help pay for protecting their state's nuclear power plants. Meserve agrees that money could soon be a problem, "In the longer term, it's a serious question for power plant operators and other critical infrastructure assets over who will pay."

Another worry for commercial reactor operators is whether a hostile and fearful public climate will dash plans to extend the lifetime of existing nuclear power plants. "We feel that nuclear still has a future, and we believe that we have proved ourselves to the NRC... that we can meet their security and operating standards," says Tom Shiel from Duke Energy.

PAUL GUINNESSY

IAEA Calls for Tighter Security Worldwide

Mohamed ElBaradei, director general of the International Atomic Energy Agency, is calling on the world to tighten security at civilian nuclear plants to avoid their being targeted by terrorists. The September attacks on the US were a "wake-up call," he told the United Nations General Assembly in New York. Some nuclear regulatory bodies are already tightening security—for example, by putting fighter aircraft on patrol near reactors. France has installed missiles at its Cap de la Hague nuclear reprocessing plant. And Germany's Environment Minister Jürgen Trittin may close his country's nuclear reactors if the risks from attack are deemed too high by a security review panel.

But theft of nuclear material, not terrorist attacks on reactors, still poses the greatest danger, the IAEA warns (see PHYSICS TODAY, July 2001, page 29). Twice earlier this year, terrorists were caught spying on a Russian nuclear storage site, Russia's military nuclear security head Igor Volynkin said on television, according to the IAEA Web site. And in April, 600 grams of highly enriched uranium with a black-market value of \$1.5 million was recovered in Colombia. Instead of creating an atomic bomb, a terrorist group might simply attach radioactive material to a conventional weapon to make a "dirty bomb." The effects of the resulting radioactive contamination could be devastating. Even relatively small amounts of radioactive material can cause serious problems. In 1987, Brazilian scavengers stole a 20-gram capsule of cesium-137 and sold it to a scrap yard in the city of Goiânia. Nearly 250 people became sick and another 110 000 will have to be monitored for the rest of their lives. "The deadliness of handling intensely radioactive material can no longer be seen as an effective deterrent," says Abel Gonzalez, the IAEA's director of radiation and waste safety. IAEA officials have initiated a thorough review of the organization's activities and are considering creating a fund to help countries protect against nuclear terrorism. "There have been two nuclear shocks to the world already—the Chernobyl accident and the IAEA's discovery of Iraq's clandestine nuclear weapons program," says ElBaradei. "It will be vital that we do all in our power to prevent a third."

In some cases, employees of nuclear facilities are suspect. In Pakistan this October, physicists Bashiruddin Mahmood and Chaudry Abdul Majeed, past members of the Pakistan Atomic Energy Commission, were taken into "protective custody" by the government amid fears about their close links with the Taliban. Says ElBaradei, "These are unconventional threats that require unconventional responses."

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CERN Grapples with LHC Cost Hike

Nobody doubts that the Large Hadron Collider (LHC) being built at CERN is technically robust or that it will produce spectacular science once it starts smashing protons together. But the project is in trouble financially: Managers at CERN, which straddles the border of France and Switzerland, revealed in September that costs have crept 850 million Swiss francs (roughly \$514 million) above the allotted 2.6 billion Swiss francs. Now they are scrambling to come up with a plan to pay the extra price.

CERN faults the original budget for not having any contingency. "When the LHC was approved in 1996," says Roger Cashmore, the lab's director of research for collider programs, "[the governing] council gave us, as an extra present, a 900 million Swiss franc budget cut, so it was a very tough deal that we struck—to build a new high-tech accelerator with a cut to personnel and money." (See PHYSICS TODAY, February 1997, page 58.)

▶ Cutbacks, loans, project slowdown, and new money could all contribute to paying the extra costs of the Large Hadron Collider and to restoring CERN's reputation.

The size and suddenness of the price hike came as a shock, say CERN scientists and council members, who represent the lab's 20 member states. CERN management "didn't take the tight budget seriously enough. This is

proved because they started new programs. They don't have the mentality of doing things at cost," says council vice president Hermann Schunck, from Germany's research ministry. "How did they get into this without warning us earlier?" asks British delegate Ian Halliday, head of the UK's Particle Physics and Astronomy Research Council.

Indeed, many high-energy physicists and policy-makers worry that the LHC overruns reflect badly on the

field and could have ripple effects on other current and future high-energy projects. "What CERN has blown over the past few months is

CERN STAFF ASSOCIATION



WHEN THE BUDGET for the Large Hadron Collider was being set a few years ago, CERN staff members warned that it was draconian.



EXCAVATION for the Compact Muon Solenoid experiment contributed to the Large Hadron Collider's cost overrun.

its reputation for delivering on time and on budget," says Halliday.

Coping with overspending

The LHC tab swelled in part due to the added costs of the superconducting dipole magnets—CERN spent 150 million Swiss francs on unplanned prototypes, and magnet assembly climbed some 180 million Swiss francs higher than expected. (Sources close to the issue say the magnet makers inflated the prices.) Then there were computing costs for developing a vast data grid (120 million Swiss francs); civil engineering problems encountered in digging a cavern for the Compact Muon Solenoid (CMS), one of the two main LHC experiments (70 million Swiss francs); outside contractors (150 million Swiss francs); a shortfall in money from non-member states (50 million Swiss francs); a rise in CERN's contribution to the LHC detectors (50 million Swiss francs); and assorted smaller items.

Of the new bill, only 480 million Swiss francs is for things specified in the original LHC budget, says Director General Luciano Maiani. That's an overrun of about 18%. The rest of the roughly 30% in extra costs was supposed to be absorbed by CERN's general budget. "Though in absolute terms it is a large amount of money, it's not such an unusual or unforeseen thing," says Maiani. "I think that in the end, when we have a new plan, people will realize that this is part of the normal fight of a new big project."

With a combination of loans, austerity measures, and more money from member states, says Maiani, "we should be able to cope." But it will be tough: Loans would put CERN's future in hock. As for economies within CERN, belt-tightening has already

left the lab lean. "There's not much to be had there," says Cashmore, "and a lot of damage could be done to good programs." CERN is nonetheless considering slowing or stopping its non-LHC programs, which include the fixed-target and heavy-ion experiments at the Super Proton Synchrotron, the Antiproton Decelerator, and a neutrino beam to Italy's Gran Sasso National Laboratory.

While austerity measures are not likely to save much, they're necessary to regain the trust of the CERN council. "It is important that [CERN management is] seen to be making strenuous efforts to get back on budget," says Halliday.

More money from member states would be the simplest solution for CERN. An initial appeal for a 4% hike was not well received, but council members seem open to a smaller increase.

High-energy physicists worldwide worry that the budget crisis will postpone the LHC from starting in 2006. But Maiani says time will not be used as a contingency to draw out payment. "We would like to insist on that. A delay to ease the financial situation would not be acceptable," he says.

But many CERN scientists oppose sacrificing other experiments to the LHC, especially given that they suspect its schedule will slip in any case. "Building the LHC is the first priority, even to me," says Friedrich Dydak, who is involved in planning a neutrino factory at CERN. "But only half of the particle physics community wants to do LHC physics. Therefore a world laboratory like CERN should retain attraction also to the other half of the community." The LHC is the highest-energy accelerator in the world, so it has no competition, he adds. "A delay would be acceptable if

there is a non-LHC physics program that can ease the terrible prospect of not producing physics results for many years to come."

The CERN staff is more split now than it was five years ago, when members voluntarily accepted pay cuts and other belt-tightening measures to accommodate the LHC's squeezed budget (see *PHYSICS TODAY*, August 1997, page 51). This time, says one physicist, "there seems to be little will on the side of the personnel to make more sacrifices in order to bail out bad managers."

Diabolical timing

For the UK, says Halliday, "CERN's timing is diabolical, because we have just presented our budget request, which fixes funding through 2006. If we have to pay more for the LHC, that reduces our chances of getting funding for the e^+e^- linear collider."

"It's not a good time to ask for more money," admits Maiani. Among other demands on budgets, many European countries are beefing up security in the wake of the terrorist attacks in the US.

Despite the problems, the CERN management and council are intent on finding a solution. "I am certain that everybody involved will do everything not to endanger the LHC," says Schunck of Germany, the country that clamped down hardest on the CERN budget in 1996. Referring to the US cancellation of the Superconducting Super Collider in 1993, he adds, "We are not in an SSC situation."

TONI FEDER

Goldin Era Ends at NASA, Canada Picks New Space Chief

Dan Goldin, NASA's longest-serving chief administrator, announced his resignation in mid-October, just days before the results of an investigation into cost overruns of the International Space Station (ISS) were made public. In November, he joined the Council on Competitiveness, a group based in Washington, DC, that promotes American economic and business leadership.

Goldin is widely credited with revitalizing enthusiasm for space science exploration both within NASA and among the public (see *PHYSICS TODAY*, April 2001, page 25). He was instrumental in getting NASA to consider innovative technological solutions in an agency that was still reeling from the aftereffects of the 1986 Challenger