IT'S SCARY. IT'S EXPENSIVE. IT COULD SAVE THE EARTH.

NUCLEAR POWER RISKING A COMEBACK

Calvin Nolt, at left, gets more harmful radiation from a day in the sun than from a year near the Three Mile Island Generating Station, where steam rises from two cooling towers that serve the one reactor still in use there. In 1979 this was the site of the the worst nuclear accident in U.S. history. No U.S. nuclear plants have been commissioned since.

CHRIS HAMILTON

BY CHARLES PETIT

Nukes again? Maybe. The United States operates 103 nuclear power reactors—that's a quarter of the world's total—even if the most famous U.S. nuke isn't even real. That would be the Springfield plant, where doofus TV cartoon hero Homer Simpson is a safety inspector. "They're cash cows," says James Tulenko, a nuclear fuel specialist, University of Florida professor, and immediate past president of the American Nuclear Society. With hefty construction bills paid off at many plants, "you just deal with the operating costs. All those plants run flat out day and night," he says. And they deliver electricity more cheaply than gas or coal plants.

That's not the whole story, of course. The hopes of a burgeoning nuclear industry imploded 27 years ago after the partial meltdown at one of the Three Mile Island reactors in Pennsylvania, followed by the horror of Chernobyl seven years after that. Plus, decisions made by utility regulators in the 1970s and '80s left companies barely able to pay off billion-dollar nuclear construction bills. Now the U.S. produces half its electricity with cheaper coal-burning plants. The trouble with that is the two billion tons of climate-warming carbon dioxide spewing skyward every year. Industrializing nations, such as India and China, hungry for every megawatt of power they can produce, are also building new coal plants at a rapid clip.

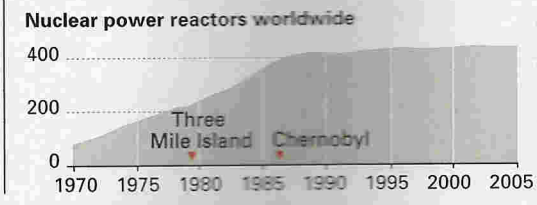
Still, for nearly a decade, with no new plants, nukes' 20 percent share of U.S. electricity production has held steady, keeping pace as overall electricity output has risen 15 percent. In the 1970s and 80s unscheduled shutdowns for repairs or other problems limited U.S. plants to less than 65 percent of their potential output. Today, with experience and improved operating practices, output exceeds 90 percent.

So is it time to embrace the atom again? There's a "nuclear renaissance" buzz emitting from engineers who design and operate reactors, think-tank academics who worry about long-range energy and environmental strategies, utility company executives, top members of the Bush Administration, and members of Congress. Proponents say atomic energy is a proven technology for a 21st-century civilization desperate to swear off fossil fuels and not to go broke doing it. Nuclear fission emits none of the greenhouse gases that are warming the climate. The Nuclear Energy Institute estimates that without nuclear power playing its current role in the generation of electricity, the U.S. would spew 29 percent—190 million metric tons—more carbon than it does now.

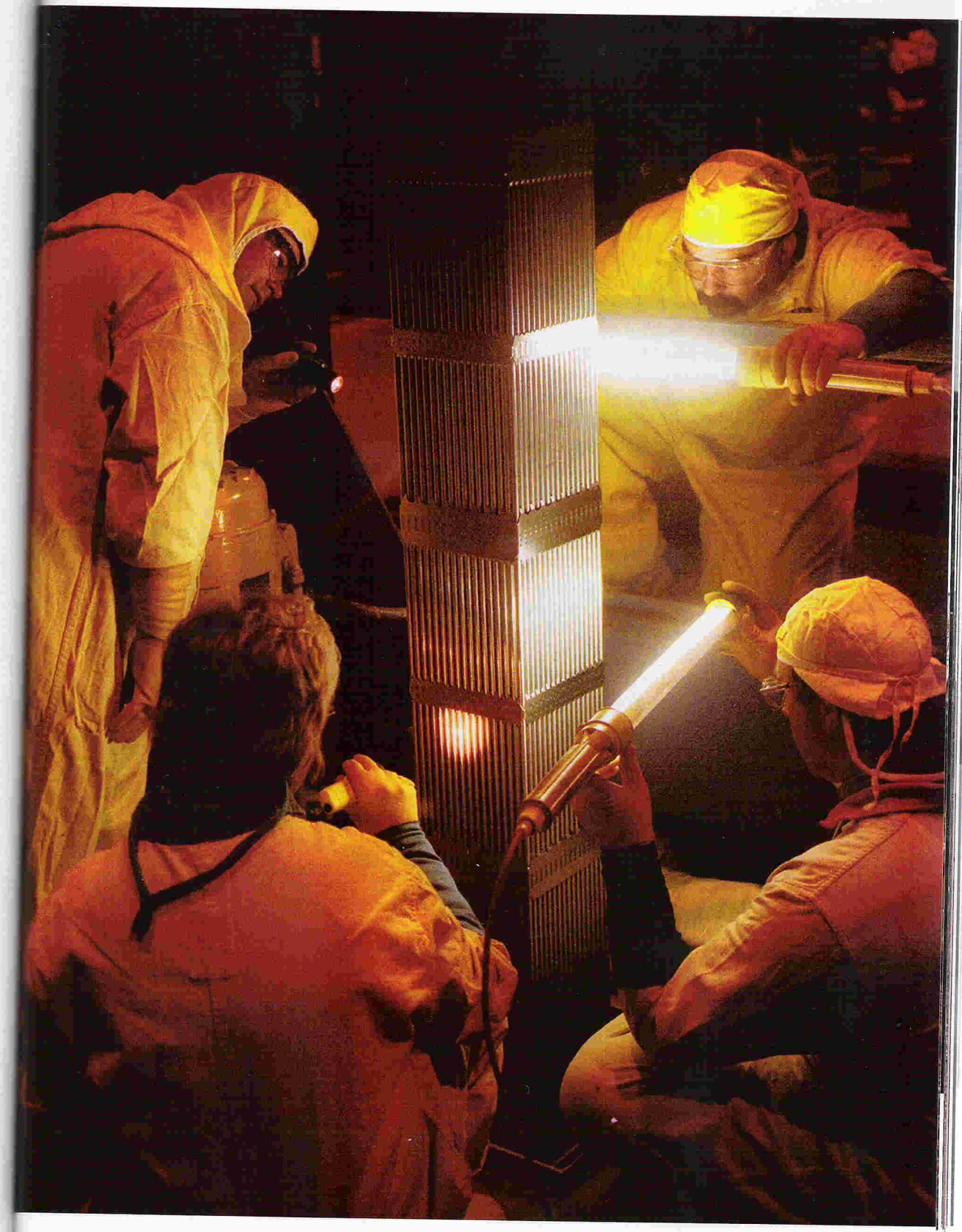
Scratch a nuclear engineer these days, and you'll likely find, under the buttoned-down exterior, a raving green activist. Even among the ranks of environmentalists who a decade ago

MISSILES TO MEGAWATTS

Technicians inspect a nuclear fuel assembly made of rods holding uranium pellets. In the U.S. half the uranium used in such assemblies comes from decommissioned Soviet weapons. The cost of new plants and memories of accidents have curbed demand for new reactors.



SOURCE: INTERNATIONAL ENERGY AGENCY (IEA); NGM ART



JAYSON MELLOM, THE TRIBUNE/ZUMA PRESS

could barely tolerate the mention of nukes, the possibility is getting an occasional thumbs-up. Climate change, for many, trumps any fear of nuclear energy. Its overwhelming advantage is that it's atmospherically clean, writes Stewart Brand, founder of the 1970s *Whole Earth Catalog*.

Yet, Brand points out: "Nuclear certainly has problems—accidents, waste storage, high construction costs, and the possible use of nuclear fuel for weapons." Most experts agree that such problems are no small drawback to forging ahead with new nukes. So despite shifting attitudes, atomic allergy has eased only slightly if at all among the bulk of prominent environmental leaders. Analysts also point to other problems, such as unresolved waste questions and limited public input on the whole issue of nuclear power. The current strategy, predicts Gus Speth, co-founder of the Natural Resources Defense Council and Dean of Forestry and Environmental Studies at Yale University, will just replay the battles of the 1970s.

Other nations are watching the U.S., but not waiting. France gets 78 percent of its electricity from nuclear power and is considering replacing its older plants with new ones. And the industry is expected to burgeon in Asia in the next quarter century. China, on top of its headlong rush to build coal-burning plants, also has ambitious plans for new reactors: It can get 6,600 megawatts of power now from nine reactors. It's aiming for 40,000 megawatts.

India, a nation of 1.1 billion people—and one beset both by crushing poverty and a tumultuously expanding economy—has 15 nuclear power reactors already at work. Eight more are under construction, more than in any other nation. The Department of Atomic Energy lauds the greenhouse benefits of nukes, but the main impetus is sheer gigawatt lust. "Our energy policy is simple," says Baldev Raj, director of the Indira Gandhi Centre for Atomic Research near the Bay of Bengal city of Chennai. "If you have a way to make electricity, then we say, make as much as you can."

That would include building reactors such as those at Kaiga Generating Station in a clearing in the jungled Western Ghats mountains about 20 miles inland from southwest India's seacoast. Coming upon the two 220-megawatt, pressurized heavy-water reactors is like stumbling into a thumping big factory in the middle of Yellowstone National Park. The region gets more than 15 feet of rain yearly, and its forest is home to increasingly threatened species. "Tigers? Yes, they are near. Panthers and king cobra too," says Anwar Siddiqui, senior manager for the Nuclear Power Corporation of India.

A country with reactors in such places must really like them. Amid a jumble of construction cranes and heavy concrete walls, two similar reactors are rising next to the first two, and another pair, more than twice as powerful, will likely join them in coming years.

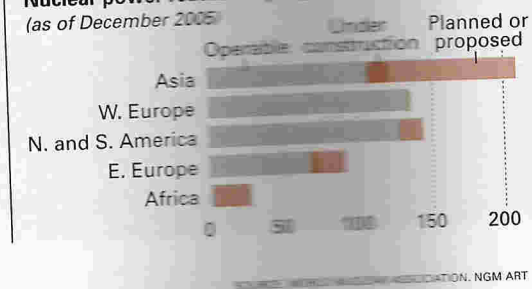
Back near the Indira Gandhi center a 500-megawatt breeder reactor is under construction and set to start up in 2010. Four more are to follow by 2020. They are very efficient at manufacturing plutonium fuel from their original uranium fuel load, which greatly increases the amount of energy they produce. But critics worry that the plutonium could possibly get in the wrong hands.

In part because of proliferation concerns, the U.S. has sworn off such breeder reactors for the time being. But outside powers have little leverage over India's nukes. With few exceptions they are entirely homegrown. India gave itself little choice about going it alone. In 1974, it set off an underground nuclear explosion using plutonium surreptitiously diverted from a test reactor that Canada helped it build in the 1950s.

India became a nuclear pariah. Other countries suspended technical assistance, and Canadian engineers walked off a job in Rajasthan.

POWER HUNGRY

The reactor under construction will make electricity for three million people in Chennai, India. Asia's expanding populations and industries are leading nations to seek energy from nuclear power along with coal and natural gas.



The Indians finished the plant themselves.

They are now enthusiastic masters of all things nuclear. The uranium fuel in Kaiga's reactors comes from mines west of Calcutta; workshops in the south provide the plant with gleaming, 65-foot-high, 110-ton steam generators that drive electric dynamos. Control systems, zircaloy fuel tubes, and 22-ton reactor components arrive from Hyderabad.

"We can't go back, we can only go forward," said Swapnesh Malhotra, a spokesman for India's atomic energy department. "Life depends on energy, and I ask, where do we get it? We will get it somewhere."

Meanwhile, the U.S. tiptoes ahead. In the nation that gave it birth, nuclear power may get its second wind in a mowed field outside the quiet town of Port Gibson, Mississippi. The field, close by a reactor that has been operating since 1985, is part of the Grand Gulf Nuclear Station, owned by a subsidiary of Entergy Corporation, the fourth largest electricity producer in the U.S.

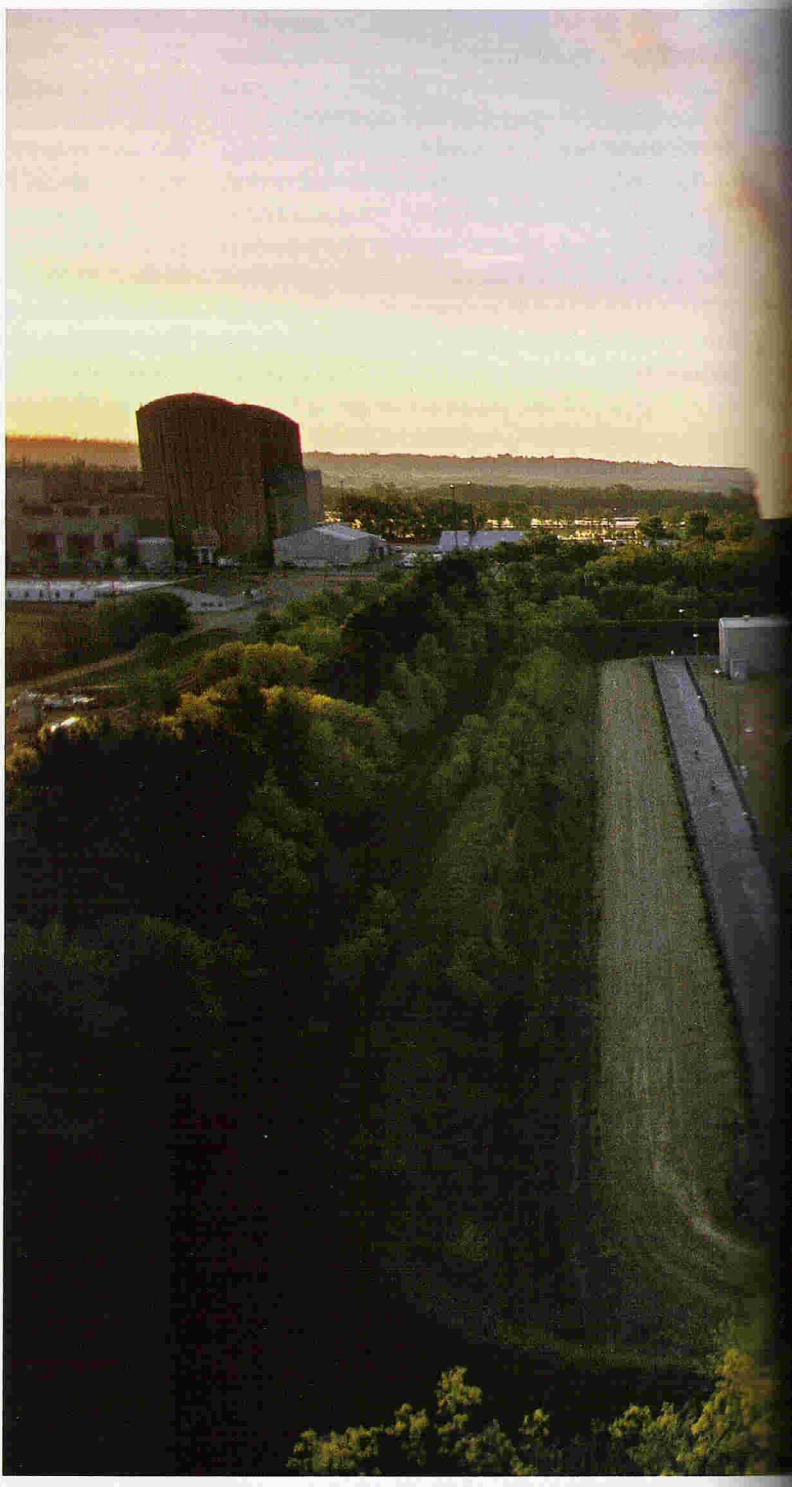
Entergy hopes to fire up a new nuke here by 2015. First, General Electric (GE) and Westinghouse, the nation's only reactor makers, must finish detailed designs for machines they've been promoting as more foolproof and easier to operate than those they built decades ago. Formal license applications could be filed by 2008. Federal regulators might chew on them until 2010.

To expedite the process, Entergy organized a consortium in 2004 of nine utility companies plus GE and Westinghouse. The consortium, named NuStart, hopes to test new Nuclear Regulatory Commission procedures that will grant a combined construction and operating license to avoid the interminable hearings of the 1960s and '70s.

Only then, if GE, Westinghouse, or both, get approval, will Entergy and other NuStart members decide on actual orders. Construction would take four to five years.

That's if there's money. Congress last year passed an energy bill that guarantees loans made by investors and includes a subsidy of up to six

BABU, REUTERS/CORBIS



WHAT ABOUT THE WASTE?

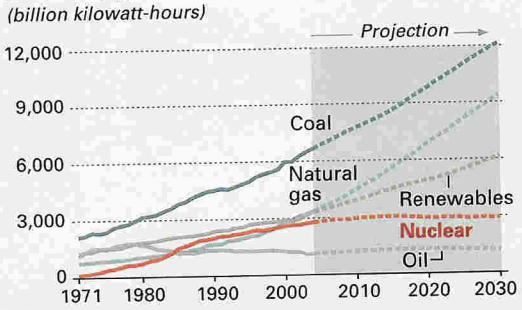
White steel casks hold spent fuel from Minnesota's Prairie Island nuclear reactors. Each of the nation's 103 power-generating reactors annually produces tons of radioactive debris that must be stored—and secured from terrorists. Future reactors may recycle spent fuel and reduce waste.

PETER ESSICK

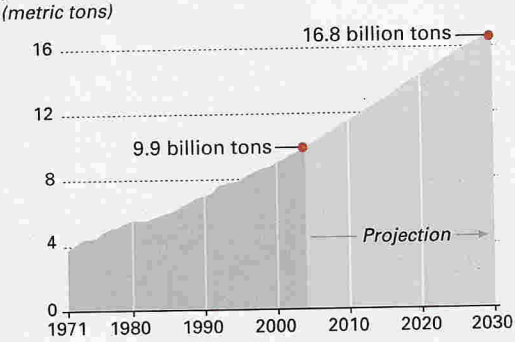
MAKING THE CASE

Earth's electricity consumption is expected to double in the next 25 years. Natural gas and coal, the biggest CO_2 producer, will meet most of the demand. For nuclear power to replace them, nations would have to build thousands of expensive reactors. Even industry advocates like Adrian Heymer of the Nuclear Energy Institute concede that won't happen: "Meeting future energy needs will require many types of fuels. Nuclear needs to be part of the mix."

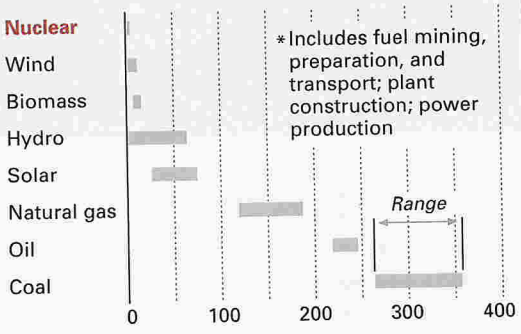
Electricity generation by fuel worldwide
(billion kilowatt-hours)



CO_2 emissions from electricity production worldwide
(metric tons)



Greenhouse gas emissions by fuel type*
(grams of carbon equivalent per kilowatt-hour)



billion dollars for running the first new plants. But the industry insists that it can't get private financing for construction of the plants without government loan guarantees. Environmentalists like Speth consider the nuclear industry mature enough to sink or swim without federal assistance—and with vigilant regulation.

Everyone in the business knows financial woes helped torpedo the first wave of atomic ambition four decades ago. Next to the vacant, waiting Grand Gulf field is an unfinished concrete silo that stares at the sky like an empty eye socket. It was to be the containment structure for a twin to the reactor there today. But just before Christmas 1979, staggered by construction costs, Entergy (then called Middle South Utilities) pulled the plug on the second silo.

Even so, the one reactor that was completed drained the company coffers. In 1984 it feared it wouldn't be able to make payroll. "We had the bankruptcy lawyers all lined up," says Randy Hutchinson, an Entergy senior vice president. American banks turned their backs. Only a high-interest loan from a consortium of European banks kept the company afloat.

In the long run, even nuclear advocates agree that the best hope for the future lies in new designs for reactors. In two or three decades the industry could see generation IV machines that run more efficiently at much higher temperatures, thus getting far more energy from their starting load of uranium. The intense nuclear reactions at such temperatures would leave waste that, compared to today's, is less toxic and lasts for a shorter period of time. Advanced reactors would have simpler safety features and require less sophisticated backup systems. They could cool themselves down in the event of an accident with little human intervention, making them less tempting targets for terrorists.

Last year's energy bill authorized 1.25 billion dollars for the Department of Energy's Idaho National Laboratory to build an experimental, high-temperature, helium-gas-cooled reactor specifically to learn how efficiently such a thing can produce both electricity and—no small

Future Power Do the benefits of nuclear energy outweigh the risks? Vote in our poll. Then find out how energy efficient your house is in an interactive game at **ngm.com/0604.**

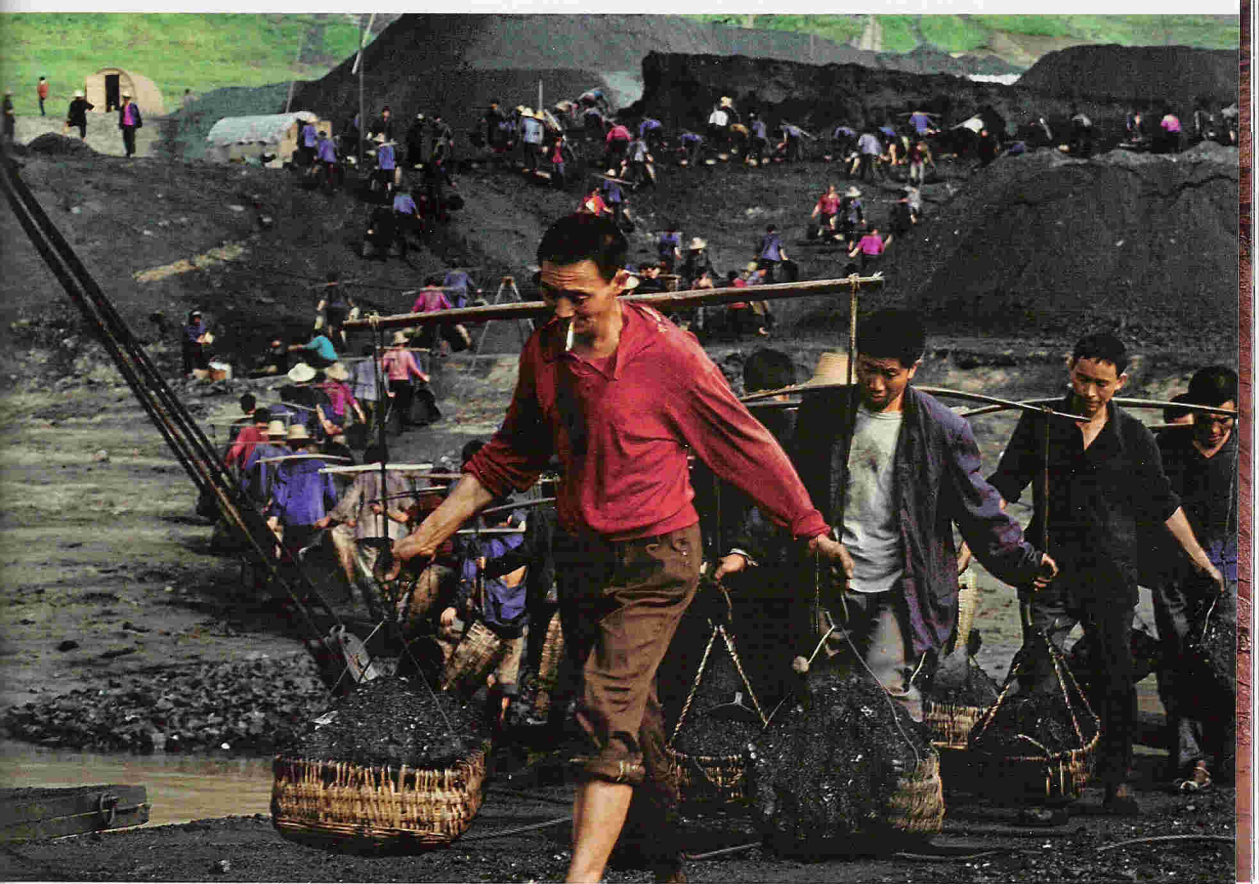
SOURCES: IEA (TOP AND CENTER); INTERNATIONAL ATOMIC ENERGY AGENCY (BOTTOM). NGM ART

extra—hydrogen gas, which could be used as vehicle fuel.

For now, however, the most ardent pro-nuke advocates can't argue with a worst-case scenario. A major release of radiation such as from Chernobyl in 1986; a terrorist attack that somehow penetrated elaborate security and steel-reinforced walls to purloin fuel or release a cloud of radiation; diversion of weapons-grade uranium or plutonium to rogue nations or criminal groups—all have visceral impact far beyond the pollution, coal-mine accidents, and climate-altering emissions of fossil fuel plants. In a speech at Grand Gulf, Gary Taylor, head of Entergy's nuclear division, stressed the hazard to both the public and the industry if a reactor should go seriously wrong. "We have 40 years in an industry that has proved itself to be safe—and I mean safe. Nukes haven't made news lately, but with just one major accident . . ." he snapped his fingers. "Everything we have worked for could die, just like that."

In the meantime, fields like the one at Grand Gulf lie untouched. Can a new nuclear era even get started? Nearby residents are eager to see action. National polls show a rising acceptance of nuclear energy, with some showing as high as 59 percent in favor. Port Gibson's mayor and board of aldermen endorse a new reactor for the boost its taxes would give local schools and other institutions.

Does anyone in town consider Grand Gulf's lone operating nuke a menace? Michael Herrin, pastor of Port Gibson's First Presbyterian Church, its tall spire topped by a golden hand pointing skyward, answers: "People from the plant speak at local meetings. We know the cloud of steam that comes from the cooling tower isn't radioactive. In this town, the dragon is unemployment. Entergy is the hero." □



Laborers carry the fuel that keeps China's economy booming: Coal provides 80 percent of China's electricity. Even with plans for dozens of new nuclear reactors, China, like much of the world, will rely on CO_2-generating coal well into the future.

BOB SACHA

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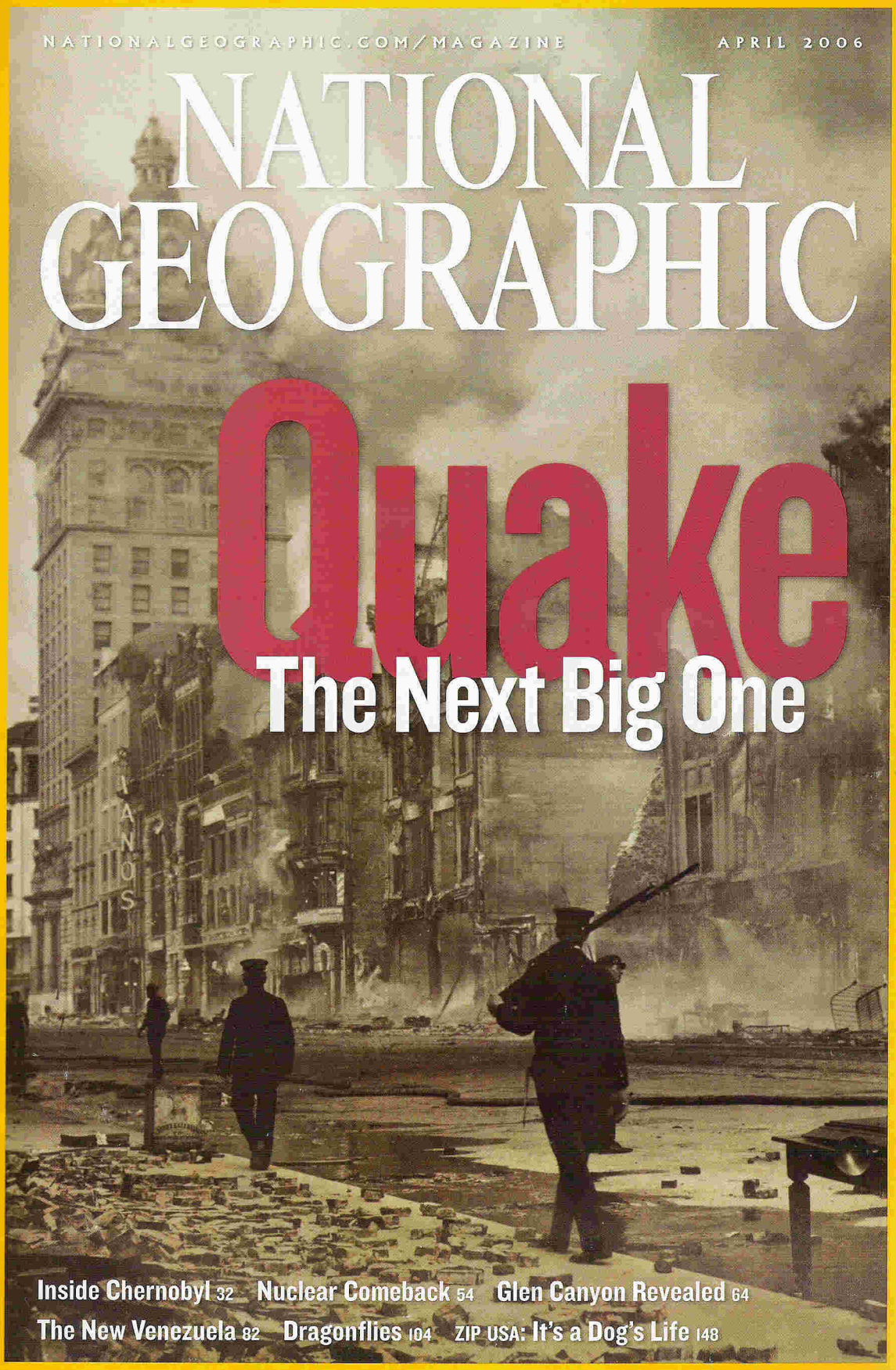

Quake
The Next Big One