

The New York Times Reprints

This copy is for your personal, noncommercial use only. You can order presentation-ready copies for distribution to your colleagues, clients or customers [here](#) or use the "Reprints" tool that appears next to any article. Visit www.nytreprints.com for samples and additional information. [Order a reprint of this article now.](#)



March 24, 2011

A Radical Kind of Reactor

By **KEITH BRADSHER**

SHIDAO, China — While engineers at Japan's stricken nuclear power plant struggle to keep its uranium fuel rods from melting down, engineers in China are building a radically different type of reactor that some experts say offers a safer nuclear alternative.

The technology will be used in two reactors here on a peninsula jutting into the Yellow Sea, where the Chinese government is expected to let construction proceed even as the world debates the wisdom of nuclear power.

Rather than using conventional fuel rod assemblies of the sort leaking radiation in Japan, each packed with nearly 400 pounds of uranium, the Chinese reactors will use hundreds of thousands of billiard-ball-size fuel elements, each cloaked in its own protective layer of graphite.

The coating moderates the pace of nuclear reactions and is meant to ensure that if the plant had to be shut down in an emergency, the reaction would slowly stop on its own and not lead to a meltdown.

The reactors will also be cooled by nonexplosive helium gas instead of depending on a steady source of water — a critical problem with the damaged reactors at Japan's Fukushima Daiichi power plant. And unlike those reactors, the Chinese reactors are designed to gradually dissipate heat on their own, even if coolant is lost.

If the new plants here prove viable, China plans to build dozens more of them in coming years.

The technology under construction here, known as a pebble-bed reactor, is not new. Germany, South Africa and the United States have all experimented with it, before abandoning it over technical problems or a lack of financing.

But as in many other areas of alternative energy, including solar panels and [wind turbines](#), China is now taking the lead in actually building the next-generation technology. The

government has paid for all of the research and development costs for the two pebble-bed reactors being built here, and will cover 30 percent of the construction costs.

Despite Japan's crisis, China still plans to build as many as 50 nuclear reactors over the next five years — more than the rest of the world combined. Most of this next wave will be of more conventional designs.

But if the pebble-bed approach works as advertised, and proves cost effective, China hopes it can eventually adopt the technology on a broad scale to make nuclear power safer and more feasible as it deals with the world's fastest growing economy and the material expectations of its 1.3 billion people.

Western environmentalists are divided on the safety of pebble-bed nuclear technology.

Thomas B. Cochran, the senior scientist on nuclear power for the [Natural Resources Defense Council](#), an American group, said that such reactors would probably be less dangerous than current nuclear plants, and might be better for the environment than coal-fired plants.

“Over all, in terms of design,” he said, “it would appear to be safer, with the following caveat: the safety of any nuclear plant is not just a function of the design but also of the safety culture of the plant.”

The executives overseeing construction of the new Chinese reactors say that engineers are already being trained to oversee the extensively computerized controls for the plant, using a simulator at a test reactor that has been operating for a decade near Beijing, apparently without mishap.

But [Greenpeace](#), the international environmentalist group, opposes pebble-bed nuclear reactors, questioning whether any nuclear technology can be truly safe. Wrapping the uranium fuel in graphite greatly increases the volume of radioactive waste eventually requiring disposal, said Heinz Smital, a Greenpeace nuclear technology specialist in Germany.

But he said the waste is far less radioactive per ton than spent uranium fuel rods — one of the big sources of trouble at the Fukushima Daiichi plant.

China is building a repository for high-level nuclear waste, like conventional fuel rods, in the country's arid west. But the far less radioactive spheres, or pebbles, like those from the Shidao reactors will not require such specialized storage; China plans to store the used pebbles initially at the power plants, and later at lower-level radioactive waste disposal sites near the reactors.

Whatever fears the rest of the world may have about China's nuclear ambitions, the environmental cost-benefit analysis contains at least one potential positive: More nukes would let China reduce the heavy reliance on coal and other fossil fuels that now make it the world's biggest emitter of global-warming gases.

"China epitomizes the stark choices that we face globally in moving away from current forms of coal-based electricity," said Jonathan Sinton, the top China specialist at the International Energy Agency in Paris. "Nuclear is an essential alternative" to coal, he said. "It's the only one that can provide the same quality of electricity at a similar scale in the medium and long term."

Chinese leaders have been largely unwilling to engage in the global debate on [climate change](#). But they have made a priority of reducing urban air pollution — which kills thousands of people every year and is largely caused by burning coal — and of improving mine safety. Coal mining accidents killed more than 2,400 people in China last year alone.

China's biggest electric company, the state-owned Huaneng Group, now aims to prove that the technology can work on a commercial scale by building the two pebble-bed reactors — each capable of meeting the residential power needs of an American city of 75,000 to 100,000 people. The reactors are expected to go into operation in about four years.

The plants' foundations have already been laid, their steel reinforcing bars pointing skyward, on a desolate landscape dominated by thatch-roofed huts and last season's cornfields. Chinese safety regulations require that all nuclear plants be located at least 30 miles from the nearest city, in this case Rongcheng, which has a population of one million.

It was only three days after a tsunami swamped Japan's Fukushima Daiichi plant that China's legislature approved its five-year plan calling for dozens of new nuclear reactors. As the severity of that crisis became evident, Beijing said it would "temporarily suspend" the approval of new nuclear reactors, but would allow construction to proceed at more than two dozen other nuclear projects already under way.

By coincidence, China's cabinet and its national energy bureau had both given final approval for the pebble-bed reactors here in Shidao in the two weeks before the earthquake, said Xu Yuanhui, the father of China's pebble-bed nuclear program.

China's nuclear safety agency has met since the Japanese earthquake and reviewed the Shidao's project plans and site preparation, and has indicated it will be the next project to receive safety clearance.

“The conclusion is clear that it is all ready to start to pour concrete,” said Dr. Xu, a former Tsinghua University professor who is now the vice general manager of Chinergy, the contractor building the reactors here.

Germany led the initial research into pebble-bed nuclear reactors and built its own research version in the 1960s. That reactor closed after an accident, caused by a jammed fuel pebble that released traces of radiation — coincidentally nine days after the Chernobyl accident in 1986, at a time of greatly increased worry about nuclear safety. Dr. Xu said that China, learning from the German mishap, had designed its reactors to keep the pebbles from jamming.

South Africa tried hard until last summer to build a pebble-bed reactor but ran into serious cost overruns.

In the United States, the federal government and companies have spent heavily on pebble-bed research. But there has been little appetite for actually building new nuclear reactors — of any sort — since the Three Mile Island accident in 1979.

“The Chinese had a determination to build, to show the technology to work, and a commitment to get it done,” said Andrew Kadak, a [Massachusetts Institute of Technology](#) nuclear engineer specializing in pebble-bed reactors. “In the U.S. we didn’t have, and still don’t have, the commitment.”