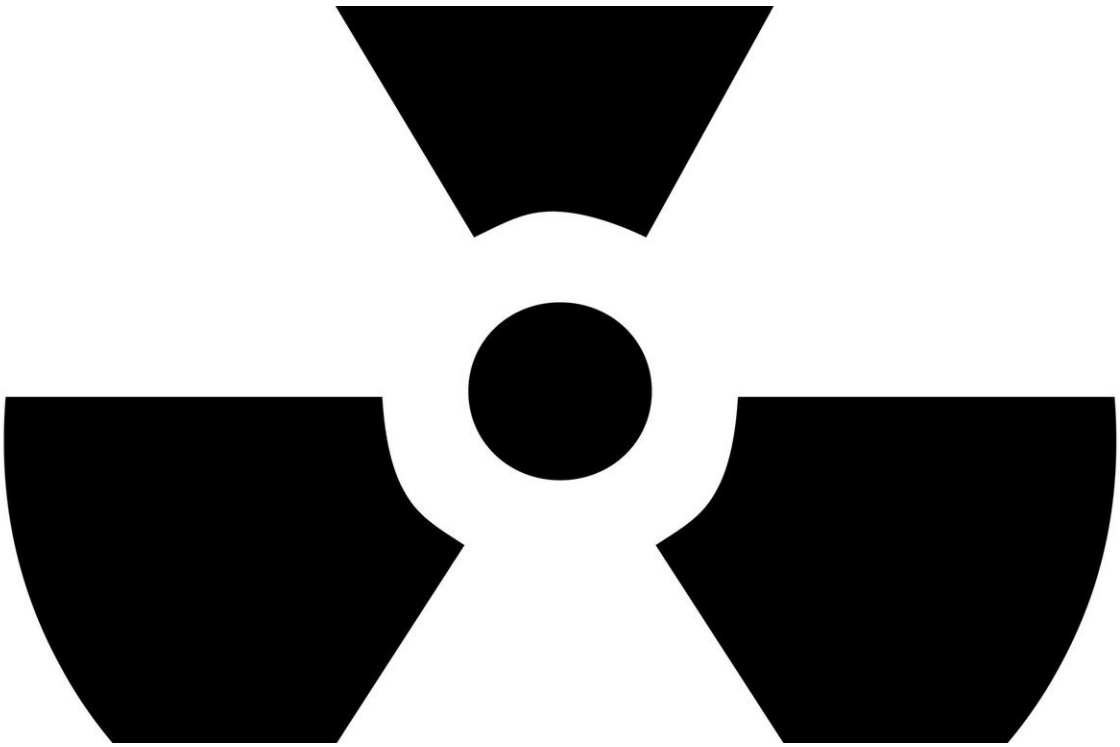
Experts voice safety concerns about new pebble-bed nuclear reactors

August 23 2018



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Researchers advise caution as a commercial-scale nuclear reactor known as HTR-PM prepares to become operational in China. The reactor is a pebble-bed, high-temperature gas-cooled reactor (HTGR), a new design that is ostensibly safer but that researchers in the U.S. and Germany warn does not eliminate the possibility of a serious accident. Their

commentary, publishing August 23 in the journal *Joule*, recommends continued research, additional safety measures, and an extended startup phase that would allow for better monitoring.

"There is no reason for any kind of panic, but nuclear technology has risk in any case," says first author Rainer Moormann, a nuclear safety researcher based in Germany. "A realistic understanding of those risks is essential, especially for operators, and so we urge caution and a spirit of scientific inquiry in the operation of HTR-PM."

In addition to generating electrical power more efficiently, pebble-bed HTGRs such as HTR-PM avoid some of the safety challenges that earlier reactor designs faced. They use graphite- and ceramic-coated grains of uranium fuel that can withstand the core's very high temperatures and passive cooling systems, which together should eliminate the possibility of a core meltdown. "Pebble-bed reactors have been described by their supporters as 'free from catastrophes' and 'walk away safe,'" he says.

What this means in practice, however, is that the soon-to-be-operational HTR-PM has been built without the safeguards that nuclear reactors in operation today are usually equipped with: it does not have a high-pressure, leak-tight containment structure to serve as a backup in case of an accidental release of radioactive material. It also does not have a redundant active cooling system.

"No reactor is immune to accidents. The absence of core meltdown accidents does not mean that a dangerous event is not possible," Moormann says. He and his coauthors, Scott Kemp and Ju Li of the Massachusetts Institute of Technology, argue that with new technology, there is always a higher chance of user error. And prototype HTGRs have surprised their operators in the past by forming localized hot spots in the core and unexpectedly high levels of radioactive dust. The pebble-

bed design also produces a larger volume of radioactive waste, which is challenging to store or treat.

Moormann acknowledges the potential of HTGRs and supports further research into them. "HTGR designs with what's known as a prismatic core seem to be less problematic than the pebble-bed one, so development work should concentrate on that," he says.

But to reduce risk, he and his colleagues advocate for several precautionary steps, including rigorous, continuous monitoring, the installation of containment and cooling systems, and an extended startup phase to allow the reactor to be observed and monitored as it comes to temperature. They also recommend investigating more secure long-term storage options for the fuel waste, which currently will be stored in aboveground canisters potentially vulnerable to environmental stresses and terrorism.

"There was already some controversy about pebble-bed HTGRs, but my impression was that many problems of them were not sufficiently published and thus not known to some of my colleagues," says Moormann. "I hope that the pros and cons will be broadly discussed."

More information: *Joule*, Moormann et al.: "Caution is Necessary in Operating and Managing the Waste of New Pebble-bed Nuclear Reactors" www.cell.com/joule/fulltext/S2542-4351(18)30335-0

Provided by Cell Press