What's Wrong with Deep, Underground Reactors?

By Ace Hoffman, Carlsbad, California

Editor's note: Plans to place nuclear power reactors one mile underground are moving ahead in Parsons, Kansas. The company Deep Fission is conducting an experiment called Gravity Nuclear Reactor intending to sell electricity from a small, modular pressurized water reactor placed into a deep borehole. Ace Hoffman sees at least ten predictable problems:

1) It will have two cables, each one mile long, for placing and possibly retrieving the unit. Since reactors are extremely dense and heavy items, the possibility of a cable break should not be ignored. If one cable breaks or merely stretches a smidgen more than the other cable, the reactor will likely turn sideways and jam in the hole. This could happen near the surface or deep inside the hole. Furthermore, one dropped bolt, wrench, brick, rock, etc. could ruin everything. [A dropped wrench socket caused a nuclear-armed Titan II missile to explode inside its launch silo, Sept. 19, 1980 near Damascus, Ark., killing one and injuring 20 others.]

2) Multiple holes, if they are close together, could mean that a single reactor meltdown and steam explosion could affect nearby reactors. And the proper definition of "close" is very uncertain.

3) Mile-long drill holes can collapse at any point, making retrieval and operation impossible.

4) If a glitch blocks control rod insertion in the reactor, a meltdown could continue essentially forever.

5) It does not appear that the boreholes will be lined in any way. Natural fissures can cause large rocks to come loose, or the drilling process itself could loosen chunks of the walls. Perfect smoothness would require numerous drill bit changes, increasing the drilling cost significantly. Will dull drill bits be used to save money during construction (when no income is being made and costs mean everything)?

6) Earthquakes can destroy every borehole at once, causing as many meltdowns as there are reactors. Even a fraction of an inch misalignment could mean the reactor(s) could never be retrieved or serviced.

7) If water intrusion occurs from an unrealized already-existing deep fissure, everything goes boom and continues to spew radioactive steam essentially forever. Plugging up the hole would be extremely difficult, unlikely to be permanent, and only mean the underground area would continue becoming the most polluted place on Earth. Any warning signs above ground would not last nearly as long as the waste would be toxic, spreading, and unmanageable.

8) If either the down spout or the steam pipe breaks anywhere along the mile-deep tubing, it may be impossible to retrieve anything below the break point.

9) The only way for this to pay back the builders and operators is to run these reactors for a long, long time. Pulling any reactor up to inspect or repair it means pulling up the entire mile-long tubing, which means the whole length must be sectioned and separable. Each joint has to be 100% leak-proof. How many sections do they plan to have? (If each segment is 50 feet tall (about five stories), the full length would need over 100 segments for each reactor, with more than 100 leak-proof joints.

10) Operating reactors need electrical control cables as well as steam and water piping. These cables, dropping a mile straight down, will have to remain in perfect condition and be retrievable along with the reactor. Running right next to the hot steam and water is a very unsafe place for electrical cables.

There are undoubtedly many other problems with *any* deep-borehole reactor design, but these come to mind — without even requiring any deep-thought!

— The author has studied nuclear power as an independent researcher for more than 50 years.

Coalition Vows to Fight Restart of Mich. Reactor, Cites Unacceptable Risks to the Great Lakes Watershed

By Kevin Kamps

On July 24, the U.S. Nuclear Regulatory Commission (NRC) issued a final notice to support the restart of reactor operations at the Palisades Nuclear Plant in Michigan which was retired in May 2022.

The "zombie reactor" restart scheme is unneeded, insanely expensive for the public, and extremely high risk for health, safety, security, and the environment. NRC staff has determined there are "no significant hazards" to consider. How about the catastrophic accident risks foisted on the Great Lakes Basin — 21% of the entire planet's surface fresh water — and all who call it home?

A 1982 study commissioned by the NRC, and carried out by the Sandia National Lab — "Calculation of Reactor Accident Consequences" — estimated that a meltdown at Palisades would cause 1,000 acute radiation poisoning deaths, 7,000 radiation injuries, and 10,000 latent cancer fatalities, as well as (inflation adjusted) $168 billion in property damage.

The coalition challenging Holtec's Palisades restart scheme includes Beyond Nuclear, Don't Waste Michigan, Michigan Safe Energy Future, Nuclear Energy Information Service of Chicago, and Three Mile Island Alert of Pennsylvania. Terry Lodge of Toledo, Ohio, and Wally Taylor of Cedar Rapids, Iowa, serve as the coalition's co-counsel. Nuclear engineer Arnie Gundersen, as well as Stanford University professor and world-renowned climate mitigation researcher Dr. Mark Z. Jacobson, serve as the coalition's expert witnesses.

Our environmental coalition first petitioned to intervene and request a hearing, in opposition to the Exemption Request in early December 2023. We did so again on October 7, 2024.

The NRC ruled against our coalition's intervention petition and request for hearings, but we have appealed the adverse rulings and are awaiting a response. We also have challenged the adequacy of NRC staff's "Environmental Assessment" and "Finding of No Significant Impact." Sixty-six organizations and 145 individuals submitted extensive comments on the draft assessment, and our coalition filed related contentions.

In addition, we have challenged the Holtec company's proposed band-aid fixes to the reactor's severely degraded steam generator tubes, a self-inflicted wound. Holtec — which has no reactor operating nor construction experience — neglected critical safety maintenance from 2022 to 2024, a "rookie error," as our expert witness, nuclear engineer Arnie Gundersen, has called it, with potentially dire consequences. Holtec's neglect allowed corrosive chemical attacks on both the inside and outside of the exceedingly thin-walled steam generator tubes.

As Gundersen has testified in these proceedings, the failure of a single tube would result in a release of radioactivity to the environment. But a cascading failure of multiple tubes could cause a reactor core meltdown, and catastrophic release of hazardous radioactivity onto the winds and waves. He warned about the potential consequences more than a decade ago, when he first served as our expert witness at Palisades, concerning yet another still-unaddressed pathway to reactor core meltdown: the worst case of neutron-embrittlement of a reactor pressure vessel in the country, and likely in the world.

Holtec recently submitted yet another request to postpone implementing fire protections that have also been neglected at Palisades for decades, despite related scandals, and the fact that fully half of all reactor core meltdown scenarios can be initiated by fire, according to retired Union of Concerned Scientists Nuclear Safety Project Director David Lochbaum, a nuclear engineer.

For these reasons, we will continue to resist at every opportunity Holtec's Palisades "zombie reactor" restart scheme, enabled by a complicit and colluding NRC. There is too much at stake to do otherwise.

— Kevin Kamps, the long-time nuclear waste specialist at Beyond Nuclear, is now the Executive Director of Don't Waste Michigan, in Kalamazoo.



Idaho National Lab, the site of recent tests of small modular nuclear reactors, supported by the U.S. Department of Energy. Photo: inl.gov

Test Reactors go Critical

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The test reactor demonstration was conducted in partnership with DOE, INL, and BWX Technologies, Inc. — supplier of the TRISO fuel used to power the reactor — and with support from the U.S. Army, which is seen as a future end user of the reactor.

The Antares TRISO fuel comes from scrap materials provided by the DOE's nuclear weapons program, the National Nuclear Security Administration.

The criticality demonstration represents a key step toward deploying electricity-producing micro-reactors for U.S. military installations "by the end of September 2028," Antares said.

Other Criticalities and Milestones this Summer

Valar Atomics' "Ward 250" reactor — the size of a minivan — is the first of the DOE-approved reactors that was not constructed at a national lab. Under the DOE pilot program, it reached criticality on June 18, 2026, and powered up to 10 kilowatts as of June 22.

Deployable Energy, Inc's reactor, a helium-cooled high-temperature gas, 1-megawatt micro-reactor called the "Unity Nuclear Battery," also at INL, was the third to reach criticality.

The fourth reactor in the program, Aalo Atomic's reactor "Aalo-X" reached zero-power criticality on July 4, again at INL.

The "Groves Isotope Test Reactor," developed by Oklo, and Atomic Alchemy, became the first reactor on private land using fully commercially available fuel, to reach criticality.

Where do we go from here?

What all these new criticalities mean, beyond validating the fanfare of Trump's Executive Order 14301, remains to be seen. The road from criticality to producing electricity — and from there to being commercial viability and utility scale — is long. It does, however, mean that this administration and the Big Tech firms that have so vehemently wooed it, are pushing hard — with their collective trillions — toward realizing new reactor ambitions, largely in hopes of powering AI data centers, surveillance, and imperial military outposts. It is no coincidence that most of these reactor designs are being tested at national labs and military sites, skirting Nuclear Regulatory Commission rules for civilian licensing and safety regulation.

Antares CEO Jordan Bramble put it this way: "We said criticality in 2026, electricity production in 2027, and power to the war fighter in 2028 ... That doesn't happen by accident. … It also doesn't happen without decades of DOE investment …. Idaho National Laboratory and DOE-Idaho provided the design, regulatory, and facilities support that enabled this schedule."

As an all-star cast of Big Tech heavyweights appeared before Congress for a hearing this September — imploring the federal government to finally regulate rollout of new artificial intelligence technology — it is worth remembering that the same lineup of suits has spent ten years privately funding development of small modular "advanced" nuclear reactors and lobbying Congress to repeal federal regulation of commercial reactor licensing, construction, and operation.