New American

Written by **Ed Hiserodt** on July 22, 2022

Published in the August 15, 2022 issue of the New American magazine. Vol. 38, No. 15

The Future of Nuclear Energy

As technology improves, it tends to shrink. Computers have gone from filling entire rooms to slipping into backpacks. Smartphones now replace cameras, alarm clocks, and dozens of other gadgets in one slim casing.

Likewise, data storage is migrating to cloud computing. Hard-drive afficionados can, for a few bucks, buy a flash drive that fits neatly in the palm of the hand, weighs less than one ounce, and stores two terabytes of information. That's 400,000 times the capacity of the first computer hard drive, which could store a mere five megabytes on 50 disks enclosed in a case larger than your refrigerator. According to IT management company Solarwind, IBM leased the colossus for $3,200 per month.

About the time that hulk lumbered onto the scene, the United States first began using nuclear power to generate electricity for commercial, non-military applications. On December 18, 1957, Pennsylvania's Shippingport Atomic Power Station went online. But nuclear did not seem to follow in the footsteps of shrinking technology.

Shippingport featured a pipsqueak reactor of antiquated design as compared to the capabilities and construct of later power plants. It generated 60 megawatts of electrical power (60 MWe), or as then-President Dwight Eisenhower described at its groundbreaking ceremony in 1954, "electricity for 100,000 people."

Most of the nuclear power plants built since the late 1960s produce at least 1,000 MWe. In your travels you may have seen one of these marvels. Drivers along Interstate 40 near Russellville, Arkansas, can't miss water vapor evaporating from the 450-foot hyperboloid cooling tower of Arkansas Nuclear One (ANO). (Incidentally, that pure, unpolluted mist is neither steam nor smoke. It is also not radioactive.)

ANO houses two of 93 commercial reactors operating today in the United States; the Nuclear Energy Institute says that together they power tens of millions of homes. Yet, unlike their shrinking technological cousins, nuclear plants have grown in size over time. Many consider them too big, with not-in-my-backyard attitudes predominating most communities. Construction costs are also crippling, amounting to billions of dollars once a utility jumps through the myriad legal and regulatory hoops in place. Most cannot afford to "bet the company" on new projects.

It's Not Easy Being Green

We can thank a well-financed cadre of leftist environmentalists for those progress-stifling measures. "Sue and settle" is a common tactic for eco-maniacs who obtain injunctions from friendly judges to

study the effects of proposed construction on the habitat of some snail or slug. Meanwhile, owners and contractors are crushed by liquidated damages for not meeting contractual deadlines.

For decades, project planners have also faced onerous regulations imposed by leftists working to promote so-called renewable energy. Industry professionals who object — because "renewables" such as wind and solar are completely unreliable — are demonized as greedy, shortsighted enemies of Mother Earth.

Germany is suffering the disastrous results of this green-tinted myopia. Major media blame the country's current energy rationing and record-setting utility bills on Russia's natural-gas cuts, which German Economy Minister Robert Habeck also holds responsible for his country's decision to fire up coal-burning power plants. *Deutsche Welle* quoted him describing the struggle for energy security as "sort of an arm-wrestling match" with Russian President Vladimir Putin.

Habeck apparently forgot that blackouts, shutdowns, and exorbitant energy rates have increasingly plagued his country for more than a decade, thanks to its own leftist policymakers and their green-energy goals. Former chancellor Angela Merkel ordered the 2011 *Atomausstieg* (nuclear phase-out), using as her excuse that year's earthquake and tsunami that damaged Japan's Fukushima Daiichi power plant. The *Daily Mail* tattled that Germany "survived this experiment only by importing nuclear-generated electricity" from its neighbors.

Tragically, not everyone has survived similar eco-crazed policies. In Texas, where the state's grid operator reports that wind power makes up more than 20 percent of the energy portfolio, the health department tallied dozens of deaths attributed to power outages during the devastating winter storm of 2021. Wind turbines froze, as did the state's natural-gas pipeline, long neglected in favor of massive government subsidies to wind mills.

Unfortunately, Texans are now bracing for blackouts this summer. "Wind power is failing Texas during a record-setting heat wave with turbines producing only 8% of their potential energy output," laments the *Dallas Morning News*. "Thus the hottest days have by far the highest demand, but typically have little wind to produce wind power," Myron Ebell of the Competitive Enterprise Institute told the paper. Bloomberg reports that a severe wind deficit is causing a surge in German energy prices this summer, too.

Californians face blackouts for the third summer in a row as authorities call for rationing while blaming man-made global warming. Meanwhile, they lavishly subsidize wind and solar to meet a grid-crushing goal of 50-percent renewable generation by 2025, when hot days will continue to generate few breezes, and the sun will still not shine at night.

The terrible irony is that nuclear power is even cleaner than wind or solar in terms of greenhouse-gas emissions, according to official statistics compiled by OurWorldinData.org. Moreover, not only does it rank as the least expensive source, except for hydropower, it is also second only to solar in safety. The latter ranking even factors in "deaths from Chernobyl and Fukushima," data which are regularly contested by industry experts as grossly inflated.

In that case, why doesn't the environmentalist lobby embrace nuclear power? Leftist ideologues despise it because it works, and their aim is to destroy economic progress through stifling energy development. They are succeeding because of society's pervasive, irrational fear of radiation.

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Since the 1950s, U.S. regulators have stubbornly based nuclear policy on the disproven assumption that any dose of radiation, no matter how small, will cause cancer, birth defects, and other medical problems. With no evidence to support and much to contradict, this "linear no-threshold" (LNT) model was "the greatest scientific scandal of the 20th Century," according to Dr. Gunnar Walinder, former head of the Swedish Radiobiology Society, in his 1995 book *Has Radiation Protection Become a Health Hazard?* The scandal continues to plague us into the 21st century.

Nuclear Evolution

LNT also explains why nuclear power seems to have broken the rule that the newest, best innovations are the smallest. In fact, technology for small modular reactors (SMRs) has been evolving since the 1980s but has been stymied by LNT-based bureaucratic regulations.

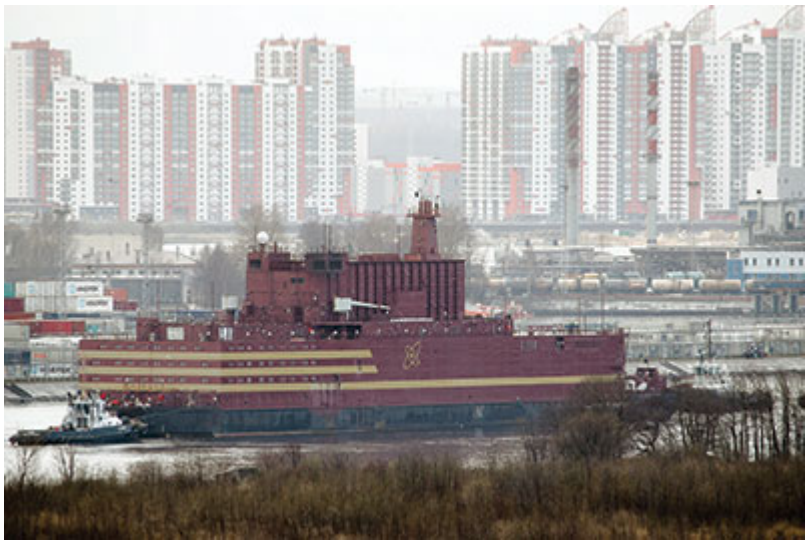
Rebecca Terrell described SMRs for *The New American* in 2016:

> Small modular reactors generate up to 300 megawatts of electricity.... These compact, factory-built units can power more limited areas — 20,000 homes for instance — and can be shipped to utilities in a truck. The time and cost of their construction amounts to a fraction of multi-billion-dollar commercial plants and further enhances safety features of the latter. Refueled every 10 to 30 years — some are even able to use spent fuel from large plants — "plug and play" SMRs need no large power grid. They offer obvious advantages to more isolated areas but could also render a vulnerable national electric grid obsolete.

If not for the U.S. Nuclear Regulatory Commission (NRC), this technology could already be the norm. In 2003, Toshiba Corporation offered to donate an SMR to Galena, Alaska, eager to prove the technology's worth in that remote off-grid town, which relies on diesel generators to meet electricity demand. But NRC held Toshiba to unrealistic and expensive licensing requirements of large-scale nuclear power plants, so the company backed out. Bureaucratic red tape caused a similar venture in Ester, Alaska, to suffer the same fate in 2009.

As a result, other countries have begun to outstrip the United States. Fatih Birol, executive director of the International Energy Agency, issued a statement in June naming Russia and China as dominating next-generation nuclear. "Advanced economies have lost market leadership," he warned.

For example, Russia's *Akademik Lomonosov*, "the world's first floating nuclear power plant," uses two 35 MWe SMRs, mounted on a barge. According to the International Atomic Energy Agency (IAEA), it began commercial operation in May 2020.



Nuclear cruiser: Two reactors aboard Russia's floating nuclear power plant, the Akademik Lomonosov, power the village of Pevek and mining projects north of the Arctic Circle. *(Photo credit: AP Images)*

World Nuclear News stated last year that two small reactors went online in China's Shandong province, powering "thousands of households." The China National Nuclear Corporation (CNNC) broke ground on another SMR in 2019, with a projected start-up by mid-2025. Bloomberg reports that there are 46 reactors planned or under construction in China.

The trend is catching on. South Korea and Saudi Arabia struck a 2019 agreement to develop SMRs based on a design approved by Korean regulators in 2012, according to *Global Construction Review*. Argentina also has an SMR under construction, while the Canadian Nuclear Laboratories are building several SMRs they hope to have operational by 2030. Denmark's Seaborg Technologies company is planning small reactors housed on floating barges; one barge can "power up to 1.6 million homes," says BBC. Even U.K.-based Rolls-Royce is jumping on the SMR bandwagon, landing a combined government grant/private investment of £405 million last November toward its development project.

IAEA identifies "more than 70 commercial SMR designs being developed around the world," and praises each for its affordability, efficiency, flexibility, and safety.

U.S. Criticality

"The hard truth for the U.S. nuclear sector is that bureaucratic inertia is preventing it from even approaching the starting line" in "the race to deploy next-generation nuclear reactors," wrote *Forbes* contributor Robert Bryce in January. He was incensed at NRC's recent rejection of an application by Oklo Power LLC, a Silicon Valley start-up that plans to build a version of SMRs known as mini-nuclear reactors. NRC claimed that the company had not provided complete information.

Instead, the agency offered a two-week window in April for public comments about the Kairos "Hermes" proposed SMR in Oak Ridge, Tennessee. The *OakRidger* reported widespread public support of the project, and if approved, it could be operational by 2026. However, that SMR is merely a test reactor not intended for generating power for the electrical grid.

NRC has so far given thumbs up to only one SMR light water reactor (LWR) design. In August 2020 the agency gave approval to NuScale Power, an Oregon-based manufacturer. Rated at 77 MWe, a single

NuScale unit is more powerful than its "pipsqueak" Shippingport ancestor, yet will "take up 1% of the space of a conventional reactor," describes Adrian Cho for *Science*. The units can be interconnected "like beer cans in a six-pack" to yield higher outputs.

NuScale landed more than $280 million in Department of Energy (DOE) grants between 2013 and 2018 to develop and license its products. (That's right: DOE grants to pay NRC fees.) The company received an additional $1.4 billion from the agency last year for its Carbon-Free Power Project. The venture will install six modular reactors producing 462 MWe at DOE's Idaho National Laboratory. Idaho's *Post Register* announced that it will be running by 2029.

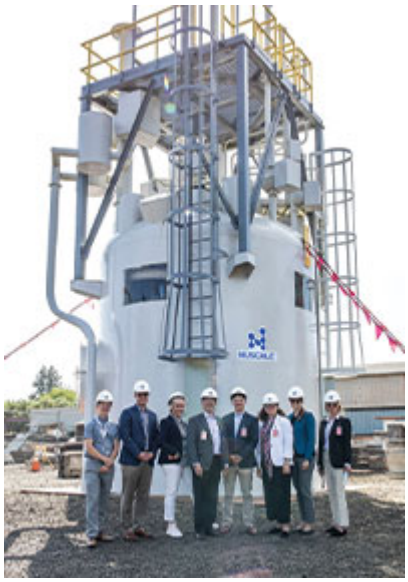
Even so, many call this too little, too late. "China is beating the pants off the United States" in next-generation nuclear, noted Bryce. And they're gloating about it. The *South China Morning Post* bragged last year about CNNC's ACP100 reactors, laughingly contrasting them with Nu-Scale's. "Power plants comprising two to six ACP100 reactors are envisaged, with 60-year design operating lifetime and 24-month refueling," it crowed. "Thus, electrical power output would range from 250 MWe for 2 units to 750 MWe for six of them. By comparison, a newly revised six-pack of NuScale's 77 MWe SMR would deliver 462 MWe."

Incidentally, NuScale nabbed its NRC approval in 2020, when the Trump administration was busy trying to play catch-up in small nuclear technology. During a trip to Japan in 2018 for a trade conference, then-Deputy Energy Secretary Dan Brouillette called SMRs "the future" of nuclear power, according to *The Mainichi*. As energy secretary, he told the National Space Council in 2020 that the administration was promoting SMRs "as part of a broader strategy to regain American global leadership in nuclear energy."

With Friends Like These...

Gone are those days. President Biden's interest in promoting nuclear is perhaps best illustrated by the fact that for most of his time in office, two of the five seats at NRC have been vacant. This May he finally nominated replacements. Only one of them is a nuclear engineer: Annie Caputo, who already served as an NRC commissioner from 2018 until 2021 and has experience in the nuclear industry. She and current Commissioner David A. Wright are both Trump appointees, and the latter has a nuclear-friendly track record. (Why did Biden appoint a Republican? The Atomic Energy Act of 1954 prohibits more than three commissioners from affiliation with one political party.)

Biden's other nominee is environmental activist Bradley R. Crowell, director of the Nevada Department of Conservation and Natural Resources and former legislative advocate for the vehemently anti-nuclear nonprofit Natural Resources Defense Council. (According to the Environmental Policy Alliance, NRDC is funded in part by the George Soros-backed Open Society Foundations and the Foundation to Promote Open Society, and other leftist organizations such as the SeaChange Foundation, the Schwab Charitable Fund, and the William and Flora Hewlett Foundation.) "A professional nuclear-industry wrecker like Bradley Crowell should not be placed in charge of the nuclear industry," spat *National Review*, which pointed out that NRDC wants to shut down all nuclear power plants.



Next-gen nuclear: The U.S. Nuclear Regulatory Commission approved the NuScale small modular reactor in August 2020, opening the door for the United States to benefit from the updated technology. *(Photo credit: facebook.com/NuScale)*

The rest of NRC's lineup does not instill greater hope. Chairman Christopher Hanson is a career civil servant with master's degrees in Divinity, and Forestry and Environmental Studies from Yale — not the sort of specialist to whom one would look for SMR expertise.

Likewise, Commissioner Jeff Baran is a Capitol Hill veteran who holds a master's in political science and a Harvard law degree. Only one Republican voted in favor of his original confirmation in December 2014, and U.S. Senator John Barrasso (R-Wy.) complained at his re-confirmation hearing that Senate Democrats were holding Trump's nominations of Caputo and Wright hostage unless Republicans agreed to also re-confirm Baran to a new five-year term. "I, along with many Republicans on [the Environment and Public Works] committee, have voted against his nomination on six separate occasions," complained Barrasso. "Since then, Commissioner Baran has given me little reason to reconsider my vote."

What can we expect from the current NRC squad? Recent history answers that question. In March, the agency's two Democrats overruled Wright's objections and rescinded current power plants' license renewals that a Republican-dominated NRC had previously granted. Hanson and Baran claimed that "more extensive environmental analysis" is needed, in obvious deference to the extremist groups that levied the appeal: Friends of the Earth, Miami Waterkeeper, and none other than the National Resources Defense Council. Wright's dissent accused his colleagues of undermining NRC's credibility in handing down an arbitrary decision based "on nothing other than the information and arguments previously considered and rejected" by a Republican majority.

That doesn't bode well for the near future of SMRs in the U.S. Also standing in the way of success is NRC's cripplingly expensive and time-consuming permitting process. The Nuclear Innovation Alliance published a 2021 report explaining that getting NRC approval for a new reactor design can cost "tens of millions of dollars." In fact, to receive its certification, NuScale had to spend "more than a half a billion dollars in total." Much of its DOE funding went toward that bill, and it still "took more than ten years" for NuScale to navigate NRC's "licensing pathways."

Perhaps these headaches help explain why NRC lists only two other LWR license applicants currently in the queue for SMR approval. General Electric and Hitachi (GEH) teamed up to develop the BWRX-300 (an acronym for boiling water reactor, 300 MWe), which the company describes as tenth-evolution technology. Canada has already chosen the BWRX-300 for planned construction at the Darlington nuclear station. Ontario Power Generation announced in December that the project will be completed "as early as 2028." Other plans using the BWRX-300 are underway in Saskatchewan, as well as in Poland and Sweden.

A foot-dragging NRC describes itself as "currently engaged in pre-application activities" with GEH. The same status applies to Holtec International and its SMR-160, a small pressurized water reactor that generates 160 MWe. Last November, *World Nuclear News* reported that Holtec had finalized "an agreement with Hyundai Engineering & Construction of South Korea for the turnkey supply" of its SMR worldwide. Stateside, Holtec is still waiting for NRC approval, which it hopes to gain in 2025 so it can proceed with construction at the sites of several decommissioned nuclear power plants around the country.

Power Packs

We can attribute the international popularity of SMRs to a plethora of benefits they present. DOE praises their increased safety features "that passively cool reactor cores without the need for operator action." Their smaller size means quicker construction and fewer components. Most are designed for in-ground or underground construction, making them less vulnerable to extreme weather or physical attacks. They provide reliable baseload and backup power with infrequent refueling requirements. Most significantly, they can operate independently of a vulnerable electric grid.

The SMR is ideal for working in a variety of residential and industrial situations as it can be configured for both heating and electrical generation — one-stop shopping for all energy needs. The reason for this is a process known as "cogeneration," whereby wasted heat in the nuclear electrical generation process is circulated through heating systems. The IAEA lists 43 conventional nuclear reactors worldwide that already employ cogeneration, in countries such as China, Russia, Ukraine, Finland, and Switzerland. SMRs can do the same on a smaller scale.

According to Energy Department data, a single SMR could provide electrical service and heating to thousands of homes, freeing them from the vagaries in price and supply of other energy sources and from dependence on the nationwide electric grids. The Energy Information Administration (EIA) says that one 200 MWe SMR could serve all the heating and electric needs of a typical manufacturing facility in the United States. Another SMR application in high demand is desalination, i.e., economically removing salts and other compounds from seawater for the purposes of farming and irrigation.

The most crucial reason to promote SMR development is the fact that the average age of operating U.S. conventional nuclear reactors is 40 years, and we've already seen the bias of the current NRC against renewing their licenses. Moreover, the Global Energy Monitor says the average age of U.S. coal-fired power plants is 53 years, while their average "useful life" is considered to be 40 to 45 years.

The environmental lobby has made it just as difficult to build new coal plants as it is to build nuclear, yet something is going to have to replace both as they approach their end of life. Based on generation potential, if we look to wind power to replace coal, we would have to install more than 522,000 2-MW

turbines — each with a generous capacity factor of 0.35 — on nearly 44.4 million acres of treeless ground. Even then they would do us no good when the wind isn't blowing, and EIA says that turbines are likely to last only 20 to 25 years.

With an expected lifespan of 25 to 30 years, solar yields a similar scenario, and what would back that up at night?

However, it would take a small number of SMRs to replace both coal and conventional nuclear, and they would do so without emitting a single molecule of carbon dioxide.

If we are to make up for imminent power-generation losses as government shutters reliable energy sources, and if we are to keep pace internationally and ensure energy independence, it is incumbent on the United States to adopt and spread SMR technology as rapidly as possible.

Ed Hiserodt is an aerospace engineer and president of Controls & Power, Inc. He authored the 2005 book Under-Exposed: What if Radiation Is Actually Good for You? *and has been a contributor to* The New American *magazine since 2007.*

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