

Q&A: Nuclear Energy Development Threatens the Columbia River



COLUMBIA

RIVERKEEPER®

ABOUT THE AUTHOR

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ABOUT COLUMBIA RIVERKEEPER

Columbia Riverkeeper's mission is to protect and restore the water quality of the Columbia River and all life connected to it, from the headwaters to the Pacific Ocean. Representing over 16,000 members and supporters, Columbia Riverkeeper works to restore a Columbia River where people can safely eat the fish they catch and where children can swim without fear of toxic exposure. For more information, go to columbiariverkeeper.org.

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This Q&A explores small modular nuclear reactors, a technology that is commonly presented as a safe, affordable, and clean-energy solution to the climate crisis—and why the nuclear industry’s claims are unfounded. First, the Q&A describes X-energy’s Xe-100 high-temperature gas reactor and two other nuclear reactor projects. It begins with an outline of what is proposed, and addresses a preliminary timeline for siting the Xe-100 reactor along the Columbia River. Next, it answers questions about renewable energy sources, nuclear waste, accidents, and expected reactor project costs. Finally, the Q&A describes the state and federal regulatory process for this type of development. To stay informed on the latest SMR developments along the Columbia River, visit columbiariverkeeper.org.

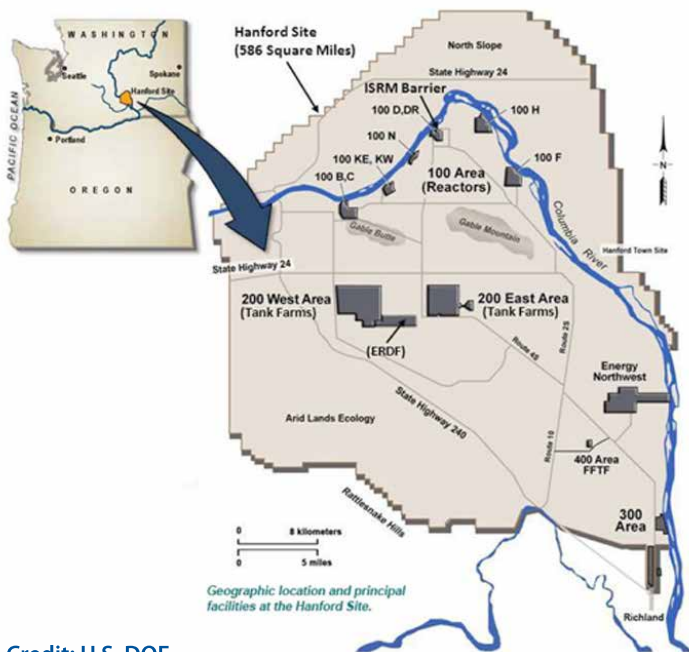
WHAT IS PROPOSED?

A company, X-energy, proposes to site a small modular nuclear reactor at Energy Northwest’s campus north of Richland, WA.¹ The Energy Northwest campus is surrounded by the Hanford Nuclear Site and the Columbia River.

Small modular nuclear reactors (SMRs) produce up to 300 MW-electric of power, are assembled in factories and transported for on-site installation.² Columbia Generating Station, a 1,200MW nuclear power plant, is already operating on the Energy Northwest campus.³



Columbia Generating Station. Credit: BPA

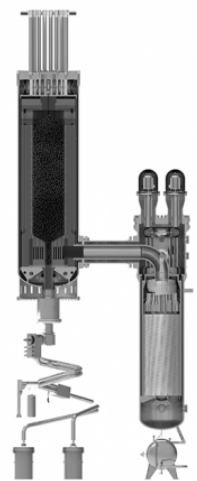


Credit: U.S. DOE

The proposed small modular nuclear reactor is X-energy’s high-temperature gas-cooled Xe-100 reactor.⁴ X-energy is based in Rockville, MD, and

the company’s CEO, Clay Sell, served as Deputy Secretary of Energy for the U.S. Department of Energy (DOE) from 2005 to 2008.^{5,6}

In 2020, the DOE awarded X-energy \$80 million in initial funding to build the Xe-100 reactor through the Advanced Reactor Demonstration Program.⁷ On April 1, 2021, X-energy, Energy Northwest, and Grant County Public Utility District (PUD) signed a memorandum of understanding to partner and support the development of the Xe-100 reactor.⁸



X-energy’s Xe-100 reactor. Credit: U.S. DOE

WHAT IS THE SIGNIFICANCE OF THE AREA NEAR X-ENERGY'S PROPOSAL?

The U.S. government chose the Hanford area for the Manhattan Project during World War II. For over forty years, the United States produced plutonium for nuclear weapons, and released hundreds of billions of gallons of liquid chemical and radioactive waste into the soil and groundwater. Today, the Hanford Nuclear Site is the most contaminated place in the Western Hemisphere. However, it is also a reservoir of biodiversity and a place of immeasurable significance to Columbia Plateau Tribes.

The Hanford Reach National Monument, adjacent to the Hanford Nuclear Site, is teeming with life and home to 43 species of fish, 42 mammal species, and 258 species of birds.⁹ The Hanford Reach is particularly significant because it is a fifty-mile free-flowing stretch of river, and

the largest remaining spawning grounds for fall Chinook salmon on the mainstem of the Columbia River.¹⁰ The region contains the largest remaining intact shrub-steppe ecosystem in the Pacific Northwest, providing habitat for a diverse range of native plants and animals.¹¹

The Hanford Nuclear Site encompasses a large area within culturally significant lands of the Confederated Tribes and Bands of the Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, Nez Perce Tribe, and the Wanapum people.¹² Native people have used the Hanford area since time immemorial to hunt, fish, gather food, trade, and live. This area has great traditional and religious significance to Columbia Plateau Tribes and is home to multiple traditional cultural properties, traditional use areas, as well as significant ceremonial sites.

Have any Columbia River Tribes weighed in on X-energy's proposal?

On August 6, 2021, the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) wrote a letter to the DOE opposing X-energy's SMR proposal. The letter states, "CTUIR does **NOT** support the deployment of Small Modular Reactors (SMR or SMNR) or any new/additive nuclear missions at the Hanford Site." The letter details CTUIR's Hanford Policy, which notes: "Hanford and Hanford-affected lands and resources should ***not be further developed and no new nuclear missions or expansion of nuclear energy, nor new or expanded nuclear fuel storage undertaken*** unless explicitly permitted by the CTUIR Board of Trustees through government-to-government consultation" (emphasis in original).

In 1855, the Yakama Nation, Warm Springs, CTUIR, and Nez Perce, signed treaties ceding millions of acres of their lands to the United States, in exchange for the preservation of important rights. The Hanford Nuclear Site is sited within the ceded territories of these Columbia River Tribal Nations. The Tribes approach Hanford cleanup through the frame of how Tribal people used and will use Hanford in the future: for hunting, fishing, gathering, sweat lodges, and other activities. These uses bring people in close contact with soils, water, air, plants, wildlife, and fish at Hanford. Therefore, new nuclear reactors and their toxic, long-lived waste are an affront to CTUIR's Treaty-honored rights.

ARE OTHER COMPANIES PROPOSING TO SITE NUCLEAR REACTORS IN WASHINGTON?

A second company, TerraPower, initially proposed operating a 345 MW-electric reactor at the Energy Northwest campus. TerraPower's Natrium is a sodium-cooled fast reactor.¹³ TerraPower is owned by Bill Gates and is based in Bellevue, WA.¹⁴ Similar to X-energy, TerraPower also received \$80 million in initial funding from the DOE through the Advanced Reactor Demonstration Program.¹⁵

In June 2021, Bill Gates abandoned the proposal to site the reactor in Washington and announced that a coal plant site in Wyoming was selected for the first Natrium reactor.¹⁶ The development of a nuclear reactor relies heavily on subsidies offered by the state and country where it is sited.¹⁷ If Wyoming does not offer adequate funding, TerraPower may decide to site the reactor in a different state. NuScale Power, based in Portland,

OR, is developing small modular light water nuclear reactors that will be grouped together in packs of one dozen.^{18,19} NuScale Power predicts their first reactors will be sited at the Idaho National Laboratory by 2030.²⁰ In May 2021, NuScale Power and Grant County PUD signed a memorandum of understanding to site an SMR in Central Washington.²¹ With TerraPower abandoning their proposed site at the Energy Northwest campus, there is speculation that NuScale may decide to fill the open spot.

WHAT IS X-ENERGY'S TIMELINE FOR SITING AN SMR NEAR THE COLUMBIA RIVER?

To receive \$80 million in funding from the DOE, X-energy had to show they could meet a seven-year time frame from testing, to licensing, and building the reactor.²² They claim the Xe-100 reactor will be fully operational by 2028.²³



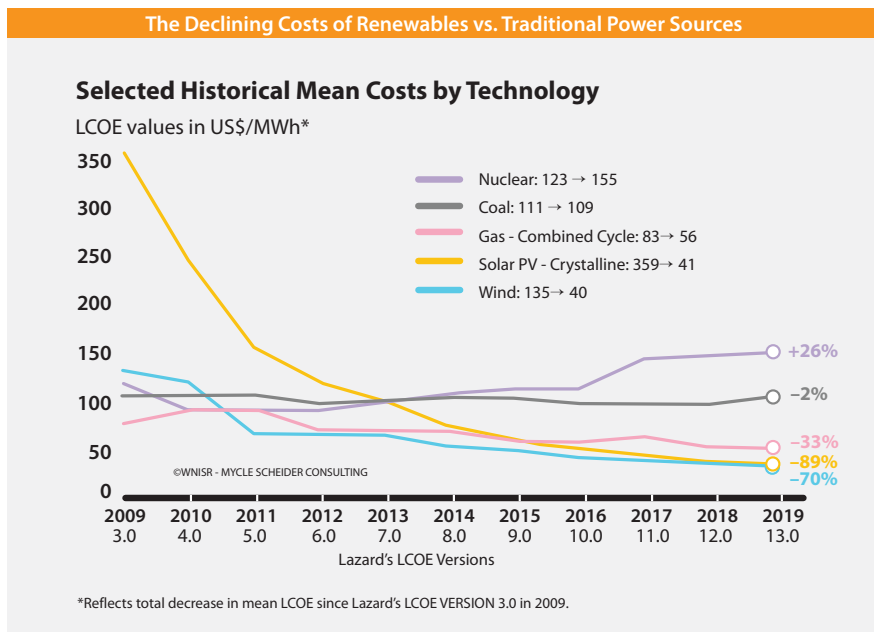
The majestic White Bluffs along the Columbia River's Hanford Reach. Credit: Columbia Riverkeeper

CAN NUCLEAR ENERGY COMPETE WITH RENEWABLES?

Renewable energy sources are promising competitors to nuclear energy. The cost of solar and wind energy has decreased, making the technologies more accessible. Between 2009 and 2019, U.S. utility-scale solar energy costs saw an 89% reduction and wind energy saw a 70% reduction.²⁴ In contrast, nuclear energy costs increased by 26%.²⁵ Electricity generation from wind and solar has quadrupled over the past decade, while nuclear energy production has not changed.²⁶

Climate Change: There is Not Enough Time for Nuclear Innovation to Save the Planet.”³¹ The title speaks for itself, and Macfarlane’s argument supports the idea that renewable energy resources such as wind and solar will outstrip nuclear energy in their ability to rapidly decarbonize the economy. Macfarlane identifies SMRs as a false climate solution.

Aside from solar and wind, geothermal energy will create fierce competition for nuclear power. Geothermal provides constant baseload energy, but it is also able to produce flexible, dispatchable power



Credit: 2020 World Nuclear Report

Credit: Thomas Reaubourg

Nuclear energy is typically considered a baseload source, producing a constant amount of energy to meet demand all of the time.²⁷ Solar and wind are variable energy sources because they rely on when the sun shines and the wind blows. Battery storage enables solar and wind energy to extend their output capabilities. A 2021 study conducted by MIT researchers found that the costs of lithium-ion batteries fell by 97% since 1991.²⁸ The average capacity cost of a lithium-ion battery pack in 2020 was \$137/kWh.²⁹ While lithium-ion batteries currently provide short term storage, long-duration energy storage options are rapidly being developed and in the future will compete with baseload sources of energy, such as nuclear.³⁰

In July 2021, Allison Macfarlane, former Chair of the Nuclear Regulatory Commission, wrote an article titled, “Nuclear Energy Will Not Be the Solution to

that complements renewable energy.³² According to industry experts, geothermal is a carbon-free source that requires financial backing to scale up and become a prominent clean-energy source. The U.S. Energy Information Administration (EIA) estimates the average cost of geothermal energy entering the market in 2026 is \$36 per megawatt-hour, whereas the average cost of nuclear energy is \$69 per megawatt-hour.³³ Geothermal has the potential to price nuclear energy out of the market and prevail as a reliable baseload source of energy.

The EIA predicts that decreasing prices for renewable energy and natural gas will cause nuclear power to decrease and generate just 11% of the nation’s electricity by 2050.³⁴ These gains in renewable energy and other energy sources mean there is no market for new nuclear reactors.

DO SMRS PRODUCE NUCLEAR WASTE?

SMRs, just like nuclear reactors currently in operation, produce nuclear waste. With no national geologic repository, this toxic and radioactive waste is stored on-site in dry



Dry cask storage for nuclear waste. Credit: U.S. NRC

casks licensed by the Nuclear Regulatory Commission.^{35,36} The waste stays radioactive for hundreds of thousands of years, which creates a substantial burden on future generations.³⁷ The Xe-100 reactor in particular produces large volumes of spent fuel—more than ten times that of light water reactors per unit of electricity generated—due to its unique fuel technology.³⁸

The Hanford Nuclear Site is no stranger to nuclear waste. Hanford, home to the first plutonium-production facility in the world, now contains over 500 contaminated facilities and structures.³⁹ The legacy of Hanford's radioactive waste caused extensive pollution and impacted the health of workers at Hanford and surrounding communities. Still today, the U.S. government is trying and failing to prevent more radioactive releases into the soil and groundwater at Hanford.⁴⁰ The Xe-100 and its unavoidable nuclear waste would add a significant burden to the land, the Columbia River, and surrounding communities for generations.



Workers remove a box of transuranic waste during current Hanford cleanup efforts. Credit: U.S. DOE



Historic Hanford Nuclear Site. Credit: U.S. DOE

WHAT NATURAL DISASTERS COULD TRIGGER A NUCLEAR REACTOR ACCIDENT?

High-temperature gas reactors, such as the Xe-100 design, are susceptible to minor failures that may trigger an accident.⁴¹ Typical problems that occur with this technology are: graphite dust accumulation, water or oil intrusion, and fuel failures.⁴² These failures, coupled with human error, can lead to large-scale disasters. In addition to technology-specific accidents, the site itself is vulnerable to earthquakes and flooding that are capable of triggering a reactor accident.



Kayakers paddle the Hanford Reach. Credit: Sara Quinn



Great horned owls reside in the area surrounding where the SMR projects are proposed. Credit: U.S. Fish and Wildlife Service

A 2013 seismic study of the area found that twelve major earthquake faults cross the Hanford Nuclear Site.⁴³ The researcher found the faults were longer than originally recorded. Longer faults usually generate larger magnitude earthquakes—with

the potential to produce earthquakes greater than magnitude 7.⁴⁴ While it is uncertain how an earthquake would affect the two proposed SMRs, earthquakes are a real threat to this region and should not be overlooked or underestimated.



Chinook salmon use the nearby Hanford Reach as an essential spawning ground. Credit: U.S. Fish and Wildlife Service



Porcupine are native to the area surrounding the Hanford Nuclear Site. Credit: U.S. Fish and Wildlife Service

A recent study found that flooding will increase in the Columbia River over the next 50 years.⁴⁵ While the study considered natural river conditions and left out the role of dams in flood mitigation, the results are worrisome.⁴⁶ There is an expected 30 to 40% increase in flood risk.⁴⁷ The Energy Northwest campus is located three miles inland from the Columbia River and sits 90 feet above the river.^{48,49} It is difficult to predict how the Xe-100 reactor will be affected under these circumstances. If the SMR is sited underground, which is a possibility, it would have an increased risk of flooding.⁵⁰

Climate change is already having an extraordinary effect on the planet.⁵¹ The Xe-100 reactor is designed to operate for 60 years.⁵² Climate change and associated impacts call into question the overall safety of the reactor proposal at Hanford.

IS THE PROJECT FINANCIALLY VIABLE?

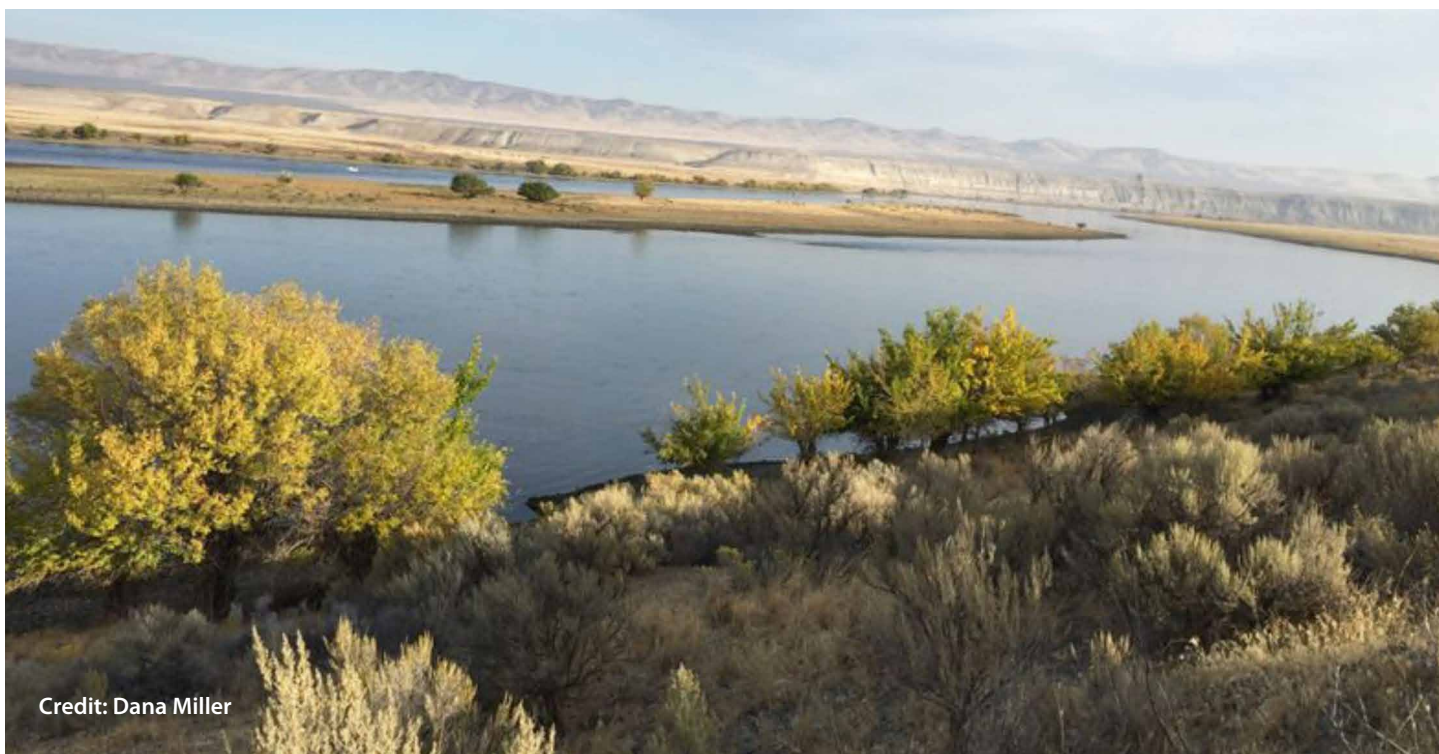
Nuclear power is extremely expensive.⁵³ SMR construction costs may be lower than larger nuclear reactors, but they fail to yield competitive electricity costs due to their smaller size and lower generating capacity.⁵⁴ Costs increase if these reactors attempt to vary their output to complement renewable sources of energy that have variable outputs.

Because of the high capital costs, nuclear plant operators opt to run SMRs constantly as a baseload source to distribute the costs over as many units of electricity as possible.⁵⁵ If operators vary operations, the result: a higher cost per unit of electricity generated.

The “Eyes Wide Shut” report, developed by Oregon Physicians for Social Responsibility and M.V. Ramana, an internationally recognized authority on nuclear power, details the impact of varied operations on SMR costs for NuScale Power’s SMR. A hypothetical nuclear power plant operating at a capacity factor of 95% indicates the reactor is running almost constantly, thus effectively distributing the costs. The report found that for NuScale Power’s SMR, the cost of generating electricity increases by about 20% if the capacity factor is reduced from 95% to 75%.⁵⁶

Investors are wary of backing these projects, because of an absence of commercial SMRs in the U.S. and the regulatory, technological, and financial risks that face new reactors.⁵⁷ The market for SMRs is in part driven by expansive, expensive government subsidies and assistance to companies proposing new SMR designs.⁵⁸

The nuclear power industry has a long history of underestimating the time it will take to complete a nuclear plant.⁵⁹ SMRs may face the same cost overruns and construction delays as larger reactors. NuScale Power’s SMR costs have doubled from \$3 billion to \$6.1 billion.⁶⁰ Furthermore, the completion date has changed from 2015 to 2030.⁶¹ The technology of NuScale’s reactor is a condensed size of the light water reactors, the most common type of reactor in the world.⁶² New designs, such as the Xe-100, are expected to have a more demanding federal safety approval process. It will likely be more expensive and time consuming to get newer designs licensed.⁶³ In addition, lack of experience with new reactor designs suggests that estimates of construction cost and time are even more unpredictable than for light water reactors.⁶⁴



Credit: Dana Miller

WHAT IS THE REGULATORY PROCESS TO DEVELOP AN SMR?

If a company wants to site their nuclear reactor in Washington, they must follow the federal regulatory process administered by the Nuclear Regulatory Commission (NRC) and the state regulatory process administered by Washington State's Energy Facility Site Evaluation Council (EFSEC). For a deep dive into the regulatory process, check out this [2016 EFSEC-commissioned report](#).

X-energy has a few options for obtaining federal licenses. They can pursue the two-step licensing process, in which the NRC reviews the safety of the preliminary plant design and the proposed site and then issues a construction permit.⁶⁵ While the plant is being constructed, the Commission then evaluates safety and environmental impacts to ultimately issue an operating license.⁶⁶ Another avenue for obtaining the necessary licenses

is through the combined licensing process. A combined license may include an early site permit, a standard design certification, both or neither.⁶⁷ If the combined license does not include an early site permit or a standard design certification, the combined license application must provide an equivalent level of information that would have been submitted for the permit and certification.⁶⁸ The combined license integrates the construction and operating licenses into one application.

X-energy must also begin a certification process with EFSEC to fulfill the state regulatory process.⁶⁹ Through this process an Environmental Impact Statement and air and water discharge permits are developed.⁷⁰

To date, X-energy has only engaged in pre-application interactions with the NRC. These interactions began between X-energy and the NRC in September 2018.⁷¹



A herd of elk ambles through the Hanford Nuclear Site with a cocooned reactor in the background.
Credit: U.S. EPA

CONCLUSION

The nuclear industry's claims of SMRs providing a safe, affordable, and clean-energy solution to the climate crisis are misleading. The arguments presented in this Q&A raise serious concerns about nuclear waste, accidents, construction delays, and cost overruns—demonstrating that SMRs are an unacceptable solution to combat climate change. Investment should shift away from SMRs to radically accelerate a transition to renewable energy.

Furthermore, the place chosen to site these reactors is significant. The DOE is struggling to clean up the extensive radioactive waste and contamination currently at the Hanford Nuclear Site. These SMR proposals and their inevitable waste would further perpetuate the burden of cleanup. The Hanford Nuclear Site was once treated as a nuclear waste dumping ground. Nevertheless, the immense importance of the site to Tribes, fish, plants, animals, and the surrounding communities means thorough cleanup at Hanford matters. SMRs have no place in Hanford's vibrant future.



Credit: Kiliii Yüyan

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