# NUCLEAR ENERGY
## Frequently Asked Questions From Rural Utah

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1. **What is the permit and regulatory process for the test reactor?**
   The planned reactor is defined as a research and test reactor under U.S. law, which requires permitting and approval from federal regulators. As a research and test reactor, it will go through the 10 CFR Part 50 process just like a full sized nuclear power plant would. While tailored to the nature of its smaller design, the Class 104 standards it must meet are no less rigorous than the safety standards of larger reactors. The state and county will also negotiate details to ensure state and local laws are upheld.

   The operators will have to maintain a 10 CFR Part 55 operator license as well, just like the operators of a full sized power plant. This involves frequent testing by the NRC to ensure they maintain the required knowledge, skills and abilities to control the reactor during both routine operations and emergencies.

2. **Storage of the waste. Where is it going to go? How is it going to get there?**
   Valar Atomics will not produce spent reactor fuel with this reactor, the fuel will still have tremendous life left after testing. Typically any used reactor fuel will initially stay on-site. In the U.S., spent fuel is typically kept in water pools and then moved to dry-storage casks at the plant. If fuel ever needs to move (e.g. to a future repository or fuel factory), it would travel in purpose-built transport casks by truck or rail. The NRC points out that spent-fuel shipments have been made safely for decades: "over the last 40 years, thousands of shipments of spent nuclear fuel" have occurred "without causing any radiological releases or any harm to the public". Each cask is rigorously tested to survive accidents.

   In summary: any spent fuel would be secured on-site in robust containers, and if transported later it would be carried in specially certified casks under strict safeguards.

3. **More information about Thorium and Uranium U-235.**
   Uranium-235 (U-235) and thorium (Th-232) are both radioactive elements considered for use as nuclear fuel, but they function very differently. U-235 is a naturally occurring isotope of uranium that makes up about 0.7% of natural uranium. It is fissile, meaning it can sustain a nuclear chain reaction on its own. Because of this property, U-235 is the primary fuel used in most of today's commercial nuclear reactors and naval propulsion systems. However, it requires enrichment to increase its concentration before use. U-235 also produces radioactive waste and, if enriched to high levels, can be used in nuclear weapons, which raises proliferation concerns.

Thorium, by contrast, is a naturally occurring element—mainly found as thorium-232 —that is more abundant in the Earth's crust than uranium. Unlike U-235, Th-232 is not fissile but is fertile, meaning it can absorb a neutron to become uranium-233 (U-233), which is fissile and capable of sustaining a chain reaction. Thorium can be used as fuel in specially designed reactors, such as molten salt reactors, where it is converted into U-233 inside the reactor itself. Thorium-based reactors have the potential to generate less long-lived nuclear waste and present a lower risk of nuclear weapons proliferation, although U-233 still has security considerations.

In summary: U-235 is a proven and widely used nuclear fuel that is ready for commercial use today, while Th-232 represents a promising next-generation fuel option with potential benefits in safety, waste reduction, and resource availability. However, Th-232 requires further technological development and new reactor designs before it can be deployed at scale.

## 4. What security measures will be in place?

The NRC requires research and test reactors to maintain security plans or procedures that are designed to detect, deter, assess and respond to unauthorized activities (Regulated by 10 CFR Part 73). Large-scale nuclear sites have some of the strongest security in the country. Security plans use multiple layers: tall fences with motion detectors and cameras, armed guards on patrol, vehicle checkpoints, ID-controlled access, and even bullet-resistant shelters around critical systems.

Test reactors are held to different standards compared to power reactors due to their lower fuel amount on site. Research and test reactor security uses a graded approach with increasing requirements depending on the type of fuel or amount of radiological materials (i.e., higher licensed power level). Research and test reactor security follows a defense-in-depth philosophy similar to that employed at nuclear power plants. In practice, this means the project will maintain a secure, access controlled facility and coordinate security responses with local, state, and federal agencies.

## 5. What kind of safety protocols and risk mitigation are planned?

Modern small reactors are designed with defense-in-depth and passive safety features. The reactor will have multiple redundant systems to control and cool the core. For instance, many designs rely on passive cooling: if power is lost, gravity, pressure differentials, natural circulation or heat pipes remove decay heat without any pumps or operator action. The fuel itself (TRISO particle fuel) is very robust at high temperatures and retains radioactive materials even if cooled later than planned. The Idaho-based NuCube design explicitly “minimizes moving parts” with heat pipes and TRISO fuel, which the company says “enhances safety and reliability”. The reactor core will sit inside a heavy steel vessel and containment building. In addition, standard emergency systems (control rods, backup generators, hardened vents, etc.) provide further protection.

Overall, regulators demand “multiple independent and redundant layers of protection” – the core premise of defence-in-depth. Both engineering (passive cooling, strong fuel, containment) and strict operating rules (continuous monitoring, drills, emergency plans) are used to keep the chance of any accident extremely low.

## 6. What about concerns of terrorism or sabotage?

The NRC requires operators to maintain security plans which explicitly address sabotage. Every nuclear power plant must plan for worst-case attacks. The NRC’s “design-basis threat” assumes armed saboteurs (with explosives, vehicles, etc.) trying to damage equipment or steal fuel. The required security upgrades mean nuclear facilities are built to survive even an airplane crash. The planned microreactor has a much smaller inventory of radioactive material than a large plant, so any potential release would be correspondingly smaller. In effect, a microreactor’s low power and sealed core make it harder to make a “dirty bomb” or cause a meltdown by sabotage. The plant will have armed security teams, 24/7 patrols, and coordination with local and federal forces. In short, while no location is 100% invulnerable, this reactor will have heavy security designed specifically to counter terrorism, making sabotage extremely difficult and unlikely to do more than local physical damage (with automatic shutdown procedures to prevent any release).

## 7. What are the potential outcomes of reactor accidents, and is there a risk of explosion or fallout? How big of an explosion could occur?

The premise that nuclear reactors can explode is simply false, reactors are built for a controlled release of energy over many years, with a proven safety track-record. Worst-case scenarios involve damage caused by pressurized steam, which is planned for with robust containment of the reactor and cooling loops. With the depth of safety designed into modern reactors and small-scale of the test reactor, the risk from accidents is minimal. Fallout would be unexpected, and public exposure would be negligible. Realistic worst-case accidents would lead to an on-site localized leak of radioactive material, for which emergency procedures are planned in advance with the NRC and would be enacted immediately.

## 8. What other technology is there beside wind, solar, coal, and nuclear?

Aside from the big four mentioned, other energy options include:
**Natural gas power:** Much of Utah’s energy comes from natural gas plants, both constant generation and power plants used to meet peak demand.
**Hydroelectric power:** Utah already uses dammed rivers (like the Colorado) to generate electricity; tidal or wave power are similar ideas (though Utah is landlocked).

**Geothermal energy:** Utah has significant geothermal resources. In fact, the state operates two geothermal power plants (Cove Fort and Roosevelt Hot Springs) and plans to expand them.
**Biomass and bioenergy:** Burning organic materials (wood, crop waste, landfill gas) can generate electricity or heat.
**Other/ emerging:** Fuel cells or hydrogen could store and deliver energy, as could large-scale batteries or pumped-storage hydro for grid balancing. Nuclear fusion is a long-term prospect still undergoing research. Each of these has trade-offs, and Utah is dedicated to an all of the above approach that evaluates every option.

### 9. Which energy sources minimize risk to human health and safety?

Studies consistently show that nuclear energy is among the safest and the cleanest source of energy available today. Per unit of energy produced, nuclear's safety record is on par with wind and solar energy while providing the lowest lifecycle emission of any source. Our World in Data summarizes that "nuclear and modern renewable sources are vastly safer and cleaner" than any other source. In practical terms, wind and solar have very few accidents, and the sparse historic nuclear accidents have led to far fewer fatalities overall than the mining accidents and pollution of all other sources. For radiation exposure, regulations limit any extra dose to the public to extremely low levels. In Utah, this means considering nuclear as part of our mix yields energy with much lower health impacts.

### 10. What about concerns regarding land exchanges, AI development, smart cities, and citizen surveillance?

These issues are separate from the reactor project itself. The Valar test reactor and associated state policies focus purely on energy development. There is no proposal tying the nuclear site to AI centers, "smart city" planning, or surveillance systems. Land exchange concerns likely stem from general energy development (e.g., changing state-owned land to energy use), but any land swap or lease would go through public review. When sited for a nuclear facility, a robust environmental and safety review is required before any construction begins. The mention of AI and tech companies refers to the fact that data centers (which use lots of power) are interested in new power sources. That is about finding electricity, not building a surveillance network. In short, these concerns are not part of the Energy Lab's mission or intention.

### 11. How vulnerable is our energy infrastructure to attacks, like a single gunshot?

The regional electric grid is vulnerable to attacks, and attackers have in fact shot at power equipment before. For example, in 2022 gunmen disabled two substations in North Carolina, cutting power to about 36,000 homes. While not at the same level of these attacks, Utah's grid has also experienced vandalism as recently as 2016. So yes, a 'single gunshot' can potentially disable transmission lines or transformers, and security of the grid from both physical and cyber attacks is a constant national endeavor.

However, nuclear reactors are required to be hardened orders of magnitude more than ordinary grid infrastructure, the reactor core and safety systems sit behind yards of concrete and steel. Moreover, nuclear plants have robust backup power (diesel generators) on site if outside power is lost. In effect, losing grid power is a known and planned for scenario which does not reduce safety or security. Regulators have even tested nuclear power plants against airplane crashes. The best way to view it: an attack on a transmission tower or substation may be serious for the power grid, but a nuclear plant is built to withstand far larger threats.

### 12. Who will buy the energy generated by the reactor?

This unit is a research reactor – it won't sell any power onto the grid. In the future, commercial reactors could sell power like any other power plant. In Utah, the local utilities (Rocky Mountain Power/PacifiCorp) would likely be the buyers through power contracts or through private offtakers. For example, the new 400 MW solar project in Emery County has a 25-year power-purchase agreement with PacifiCorp. Similarly, a nuclear project would need such agreements. Valar Atomics has suggested placing reactors near large consumers (like data centers) to use power on-site. In any case, once operational, the electricity would go into the grid under contract to the utility or a private buyer, just as solar and wind projects do.

### 13. Will this project help local tax revenue?

Potentially. Any new facility adds to the tax base (property taxes on the plant and equipment, sales taxes on local purchases, income taxes from jobs). For concrete context, the nearby Green River solar project is explicitly expected to "increase local tax revenues" in Emery County. Likewise, a nuclear facility would generate new revenue. How much Emery County keeps will depend on the final tax agreements. In short: yes, the project should raise tax revenue.

### 14. What is the status of nearby developments like the Green River Nuclear project?

Blue Castle Holdings is a Utah-based company pursuing a nuclear project which is distinct from this test reactor. It plans to construct a commercial nuclear power plant near Green River (in Emery County). This "Blue Castle" project has state support (site permit, preliminary licensing) but has not finished its NRC approval process or begun construction; it is essentially on hold pending more funding and regulatory steps.

Blue Castle is **not** involved with the Valar/USREL micro-reactor project. It is a separate nuclear power venture: they want to build a full-scale commercial plant decades from now. By contrast, Valar's effort is small-scale and for research. The two share only a county and the general goal of nuclear energy, but they are independent initiatives.

### 15. What is the role of the county versus the state in oversight and decisions?

In Utah's framework, both levels have roles supporting the NRC in its primary regulatory duties. The state legislature recently established a Utah Energy Council, which, among other things, will facilitate projects and infrastructure improvements to promote baseload energy development.

For nuclear, the state has taken the lead on proactive siting with this research reactor, and will coordinate with the NRC and their requirements on all projects. Counties still retain traditional authority over local matters: building permits, land zoning, emergency services, etc. In summary: The NRC has overall jurisdiction on these issues, the state drives policy and the county regulates land use zoning, local permitting, and will have a say through consultation and negotiation.

### 16. Will the state consider local government input?

Local input is written into the process. As the primary regulator, the NRC considers local involvement in, and information about, their activities to be a cornerstone of strong, fair regulation of the nuclear industry. They recognize local interest in the proper regulation of nuclear activities and provide opportunities for citizens to be heard, encouraging public comments. The state regularly consults with local governments on taxes and developments, and nuclear power will follow similar processes as a large driver of local economic value.

### 17. Can coal plant workers really transition to nuclear jobs (70% transfer claim)?

There is significant overlap in skills, but not all jobs are identical. A DOE analysis notes that many coal-plant roles have analogous nuclear roles: both plants need electrical and mechanical engineers, electricians, and mechanics. For example, both use large steam turbines and generators. The "70%" figure often cited refers to this overlap of identical/near-identical jobs, where the primary tasks and job requirements are the same. In practice, many coal workers could move to a nuclear plant after retraining to learn nuclear-specific procedures and pass federal certifications.

Nuclear plants also have new positions (e.g. reactor operators, nuclear engineers) that require extra training and licenses. According to the same DOE guide, a new nuclear plant would have dozens of nuclear-certified jobs that a coal plant doesn't (like the 20 nuclear engineers for a 500 MWe plant).

### 18. Are turbine operation skills transferable between coal and nuclear?

Yes. The basic task of running and maintaining a steam turbine and generator is very similar in both types of plants. Both coal and nuclear units boil water to drive turbine generators. Therefore, coal plant turbine operators, mechanics, and boiler technicians would find much of their knowledge applicable at a nuclear plant. The aforementioned DOE analysis confirms that both plant types require "a similar number of power plant employees" for the turbine/engine room. The main difference is that nuclear plants typically have stricter safety procedures and separate reactor controls that coal plants do not. But in terms of the mechanical and electrical work on the turbine/generator itself, the skills transfer directly. Workers would still need training on the new systems, but their turbine expertise remains valid.

### 19. How many workers will be needed to launch and operate the facility? How many people will it take to maintain?

It depends on the size of the plant. For the small 0.1 MW (100 kW) test reactor, only a very small technical team is needed (likely just a few engineers and technicians during initial operations). For a commercial-scale deployment, numbers are higher: DOE examples suggest a multi-module SMR site (around 924 MW) might have roughly 270 permanent operations staff. For comparison, TerraPower's 345 MW Natrium plant is projected to have about 200 full-time employees. So on that order of magnitude: a few hundred permanent jobs once built, with construction phases involving many more temporarily.

### 20. What about workforce housing and affordability?

Rapid influx of workers can strain local housing, and is a valid concern with utility-scale nuclear power facilities. Utah leaders are aware of this issue: the governor created the BUILD Council to plan housing, infrastructure and utilities for projected growth. State and county agencies will work together to support new housing demand spikes and promote general housing development. Given the much larger workforce required during construction, companies sometimes provide worker camps or partner on apartment construction for short-term needs.  Far in the future, new housing or renovation of nearby towns might be needed with large projects, but is not a concern with this planned test reactor.

### 21. What strategies will be used to keep costs down?

Proponents cite several cost-reduction strategies. Valar Atomics' founder argues that mass manufacturing of identical small reactors can greatly cut costs. They envision "gigasites" where all complexity is engineered into the first few units, making subsequent reactors much cheaper. In his words, putting the first few reactors on site "allows you to produce very cheap energy" afterward. Non-specific to Valar, this generally means standardizing components, factory production of reactor modules, and economies of scale. Other strategies are being developed, including using passive-safety designs with lower maintenance and factory-loading fuel.

The state and federal government is also pursuing regulatory streamlining. All these aims to reduce the permitting and construction costs. Finally, choosing an existing research site (the Utah San Rafael Energy Lab) means Utah can offer the space at minimal additional cost. While nuclear projects have historically been expensive, these combined approaches (standard design, mass production, simpler safety systems, and regulatory reform) are intended to control costs.

### 22. How many megawatts will the mobile reactors generate?

It varies by design. The initial test reactor in Emery County is only 0.1 MW, purely for research and development, and will not connect to the grid. However, other microreactors under discussion are larger. For example, the NuCube microreactor to be tested in Utah can generate up to about 15 MW. By contrast, the larger AP1000-type reactors (like the newly built reactors in Georgia) are ~1,100 MWe each – microreactors are a fraction of that. In summary: the first unit is 0.1 MW; the NuCube design slated for Utah is up to ~15 MW; future "small" modular reactors could range from a few MW up to a few tens of MW depending on design and number of modules on-site

### 23. How much water will the test reactor use?

Very little. Unlike conventional reactors, many modern microreactor designs use air, inert gas (like helium), or heat pipes for cooling instead of large water systems. For example, Westinghouse's 5 MW eVinci microreactor explicitly requires "no water for cooling or operation." The planned Utah test reactor is helium-cooled, so it will not draw cooling water from rivers or aquifers. The only water used will be for normal plant operations (e.g. drinking water, sanitation, etc.). In short, water consumption will be negligible compared to a traditional power plant.

### 24. How will officials communicate with residents who don't use the internet?

Public outreach must be multi-channel. Officials and developers can and do use local newspapers, radio and mail. In Emery County, that might mean community bulletins at town halls, flyers distributed by mail or public notice boards, and announcements on local radio (e.g. Castle Country Radio) or in the Emery County newspaper. Town meetings can be held in community centers. Emergency alerts (sirens, radio/TV messages) are standard for safety communications. County offices often coordinate rural outreach, so residents should watch for announcements and feel free to contact commissioners or the Office of Energy Development by phone or mail for updates.

### 25. What research is being done to ensure safety and security?

It must be stated that nuclear power is already safe and continuously getting safer. DOE notes that current U.S. reactors already have "the highest standard for operational safety and security" globally, and new designs are adding new passive safety systems.

Many federal and academic programs are focused on safety across the entire nuclear lifecycle, not just reactors. National labs study new fuels like TRISO (which holds fission products even at high heat) and test natural-circulation cooling designs. The NRC also has research programs on reactor safeguards and trains security forces with realistic scenarios. Universities are working on related nuclear engineering and security projects. Both government and industry are conducting extensive research and development – from computer simulations to full-scale tests – to validate that new reactors meet strict safety and security goals. The planned testing at the Utah San Rafael Energy Lab is itself part of that research effort: it will gather real-world data on reactor behavior and help prove the safety systems work as designed.

### 26. How will nuclear fuel be stored, contained, and possibly reprocessed?

Fresh fuel for microreactors will be in robust, NRC certified containers and be installed into the reactor vessel. Typically any used reactor fuel will initially stay on-site. In the U.S., spent fuel is typically kept in water pools and then moved to dry-storage casks at the plant. If fuel ever needs to move (e.g. to a future repository or fuel factory), it would travel in purpose-built transport casks by truck or rail. The NRC points out that spent-fuel shipments have been made safely for decades: "over the last 40 years, thousands of shipments of spent nuclear fuel" have occurred "without causing any radiological releases or any harm to the public". Each cask is rigorously tested to survive accidents.

Reprocessing (chemically separating usable isotopes) is not currently done for commercial power fuel in the U.S., and fuel is likely to remain in containment either on-site or in a designated federal repository. Were commercial reprocessing to become available, spent fuel could be transported to that location in specialized casks. No matter the eventual case, fuel is never simply left in the environment. It is always enclosed in solid ceramic forms and stored under layers of concrete and steel.

### 27. What is the risk of radioactive fallout and how would we be warned of a leak?

Modern reactor accidents are locally contained events, so fallout in the classic sense is very unlikely. Nonetheless, NRC safety rules and regulations require planning for off-site releases.

Regulations call for public emergency plans in case a serious accident would send radiation beyond the plant fenceline. In this scenario, local emergency officials would use sirens, radio and TV alerts, and even automated phone or cell broadcasts to warn residents. People would be directed to evacuation or sheltering. The U.S. also has radiation monitoring (EPA's RadNet) and public alert channels. Essentially, if any significant leak occurred, authorities would alert nearby communities immediately via sirens and media. In normal operation, releases (if any) are so small they don't trigger public warnings.

### 28. How likely is a mini-reactor leak, and what would happen if it occurred?

The likelihood is very low, the reactor design and fuel are chosen to avoid leaks even in accidents. If a leak somehow did occur,  the limited fuel used by microreactors and robust fuel forms (TRISO) make even the theoretical maximum release tiny. Even if a leak did happen (for example, a crack in the containment), the expected exposure to the public would be low enough that long-term health effects would be extremely unlikely.

Industry data emphasizes that the overall risk of any serious nuclear accident is "low and declining". Emergency plans exist to dose-model the release and protect the public. In practice, the worst-case studies for modern reactor exposures show very low off-site doses (comparable to a chest CT scan or less). So while any leak is taken very seriously, a "mini-reactor" leak would be little cause for panic.

### 29. What is the cancer risk from living near the facility?

Studies show no measurable increase in cancer rates for communities near nuclear power plants. The NRC points out that routine plant emissions are kept well below regulatory dose limits and have not harmed public health. In fact, a National Cancer Institute report found that cancer death rates were essentially the same "whether a reactor was nearby or not". In the U.S., living next to a nuclear plant typically adds a tiny fraction of normal background radiation, far less than everyday natural variations or other sources. In short, according to decades of data the additional cancer risk from living near this kind of reactor would be essentially zero.

### 30. What safety measures are in place now to protect public health?

Even before this reactor is built, stringent safety standards apply. A nuclear facility would be required to continuously monitor radiation (in air, water, and the plant itself). Workers must use personal dosimeters and protective gear to keep exposures "As Low As Reasonably Achievable". Public dose limits are very low, far less than the average dose received simply existing on Earth. The plant's air and water discharge would be filtered and monitored; any release above trivial levels would trigger an alarm. In addition, detailed emergency plans (jointly with county and state agencies) would be in place to protect health. These combined measures – from constant radiation monitoring to evacuation drills – are part of current regulatory requirements, which research shows keep public radiation doses effectively at background levels.

### 31. How is this project different from historic atomic weapons testing?

They are very different. Atomic testing (like the 1950s Nevada tests) involved deliberate nuclear explosions with massive, uncontrolled releases of radiation and fallout. In contrast, a power reactor's fission is slow and contained. As DoE explains: a bomb is engineered for instant, maximal energy release, whereas a reactor is engineered for steady, long-term power generation. Reactor fuel is low-enriched uranium (3–5% U-235), not the near-100% used in bombs, and the core is surrounded by thick containment. In the extremely unlikely event of a reactor accident, any release would be limited in scale and spread, unlike the broad fallout of a bomb test. In short, what people call "atomic testing" was a weapons program causing widespread contamination; this reactor project is civilian energy research with multiple engineered safeguards. The history of downwind health effects comes from those historic weapon tests, which this project is fundamentally not.

## 32. How could Emery County benefit from this project?

Hosting test reactors could bring jobs, investment, and economic diversification. The Utah San Rafael Energy Lab is already in Emery County to attract exactly these kinds of projects. Emery County "aims to improve and revitalize [its] economy with advanced energy research". The project would create real construction and technical jobs for the local community. Workers spend money locally, creating jobs outside of the nuclear industry as well, and future nuclear power plants will pay property and sales taxes.

The lab also offers opportunities for local universities and schools to partner on research and training, boosting education and innovation in the county. In summary: similar projects elsewhere have brought new income and jobs, and the lab's mission statement envisions exactly that economic revitalization for Emery.

## 33. If Emery County gets no benefit, why is the project here?

Emery County stands to greatly benefit from this and similar projects. Utah has already invested in the Utah San Rafael Energy Lab for energy research and development, making Emery an enticing location for innovative investment. Governor Cox noted that the lab was already state-owned and "providing space" for companies to test reactors at minimal extra cost. Emery County has actively participated in developing this energy strategy, and the state has identified it as the logical site to advance nuclear innovation.