THE CASE FOR

# Army Nuclear Power

*By CPT David Oh*

## Introduction

With the transition from counterinsurgency operations to Large-scale Combat operations (LSCO), the United States Army is emphasizing modernization. Air Defense Artillery plays a crucial role in this transformation as emerging threats, including hypersonic weapons and UAV proliferation, grow increasingly sophisticated. While modernization efforts often focus on sensors, AI, directed energy, and autonomous systems, they frequently overlook a fundamental issue: the energy demands of these technologies. Nuclear power presents a viable solution to this challenge. The Army and Air Defense Artillery should prioritize developing nuclear power to meet future energy requirements and maintain a technological edge over adversaries.

## Understanding Current Nuclear Power Capabilities

Nuclear power generation relies on nuclear fission, in which the nucleus of heavy elements, primarily uranium-235, splits, releasing energy in the form of heat. This heat sustains a chain reaction that powers reactors. Modern nuclear reactors employ enriched uranium fuel assemblies encased in ceramic pellets, which provide an exceptionally efficient energy source.

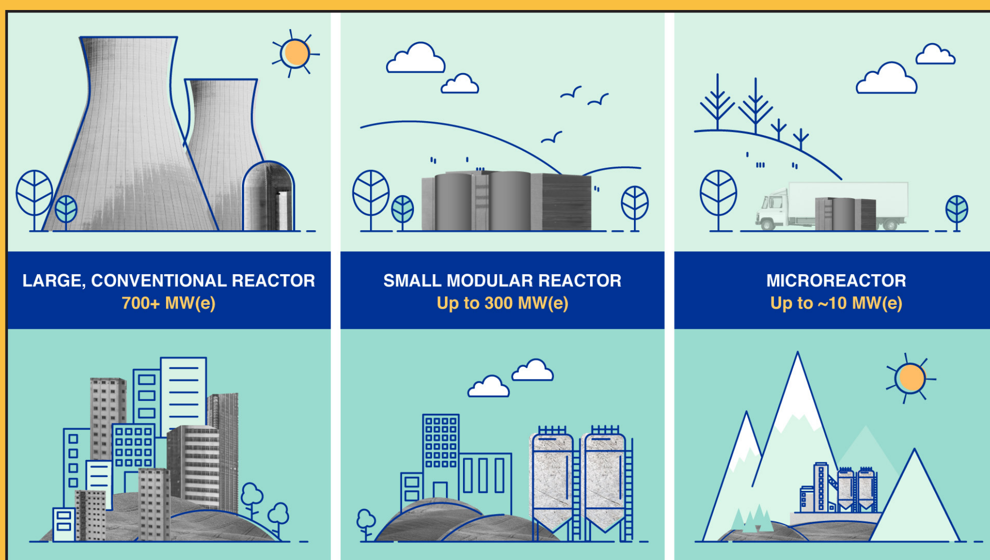
Current reactors utilize water as a coolant, ensuring efficient heat transfer while maintaining multiple safety barriers. Modern nuclear plants achieve approximately 34-36% thermal efficiency, constrained by reactor core temperature limitations. Safety features include numerous containment layers to prevent radioactive release and passive cooling systems that function without external power.

## The Future of Nuclear Power

Innovations in nuclear technology promise to enhance safety, efficiency, and sustainability. One key advancement is Small Modular Reactors (SMRs), which offer scalable power solutions. According to the International Atomic Energy Agency (IAEA), "SMRs can be prefabricated and transported to installation sites, reducing costs and construction time."[1] Their smaller footprint makes them deployable in areas unsuitable for larger reactors.

Another promising technology is Molten Salt Reactors (MSRs). These reactors operate at higher temperatures and lower pressures, increasing safety and efficiency while generating less waste. Additionally, thorium-based MSRs provide a safer, more abundant alternative to uranium fuel, mitigating nuclear proliferation concerns.

Fusion power, though still in development, represents a long-term energy solution. Unlike fission, fusion combines light atoms, such as hydrogen isotopes, to generate power. Fusion produces minimal radioactive waste, eliminates meltdown risks, and utilizes abundant fuel sources. Although practical fusion power remains decades away, its potential impact on military energy needs is significant.




## Uses for Nuclear Power

Nuclear power offers several advantages in LSCO

1 Efstathios Michaelides, Alternative Energy Sources (Berlin: Springer, 2012), 99-129.

environments, primarily by reducing logistical vulnerabilities. Traditional fossil fuel-based generators require constant resupply, creating supply chain risks. High-energy systems, such as the KuRFS radar and THAAD, demand continuous power, which limits their mobility. Nuclear power provides sustained energy without frequent refueling, enabling remote deployment. Technology such as SMRs can operate for extended periods before requiring refueling. "SMRs may require refueling only every 3 to 7 years,"[2] Reducing logistical burdens and increasing operational security.[3] Furthermore, forward operating bases currently rely on civilian power grids, which can be exploited. Having SMRs would reduce or eliminate this dependency.

Emerging military technologies will further increase energy demands. Directed Energy (DE) weapons stand to benefit. DE weapons face power limitations that hinder their effectiveness against high-speed threats such as hypersonic missiles. "Future advancements in DE will require more efficient energy sources to enable deployment across all domains."[4] Though SMRs would be unfeasible for smaller weapon systems, future microreactor advancements could make DE self-sufficient.

AI plays a growing role in Air Defense decision-making. AI-enabled systems require vast computational power, and in a near-peer conflict, the ability to process and react faster than adversaries is crucial. Training AI models such as ChatGPT-3 consumes approximately 1,300 megawatt hours, underscoring the need for robust energy infrastructure.[5]

Quantum computing and cryptology also offer significant advantages in secure communications and navigation. However, these systems require stable, high-energy inputs. "Quantum computers must be cooled to near absolute zero to function, necessitating significant energy expenditures."[6] Nuclear power can provide the reliability needed to sustain these advanced systems.

## Addressing Nuclear Power Concerns

Nuclear power faces challenges despite its advantages, including safety concerns, cost, and public perception. Modern SMRs incorporate passive safety systems that prevent meltdowns. Even in total power loss scenarios, passive cooling ensures core stability, significantly reducing risks compared to earlier designs.[7]

While the high initial cost of nuclear installations presents a hurdle, economies of scale and increased

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2 "What Are Small Modular Reactors (Smrs)?," IAEA, September 13, 2023, https://www.iaea.org/newscenter/news/what-are-small-modular-reactors-smrs#:~:text=Many%20of%20the%20benefits%20of,for%20industry%20and%20the%20population.

3 Steven B. Krivit, Jay H. Lehr, and Thomas B. Kingery, Nuclear Energy Encyclopedia: Science, Technology, and Applications (Hoboken, NJ: Wiley, 2011), 30.

4 "Molten Salt Reactors," IAEA, April 13, 2016, https://www.iaea.org/topics/molten-salt-reactors.

5 James Vincent, "How Much Electricity Does AI Consume?" The Verge, February 16, 2024, https://www.theverge.com/24066646/ai-electricity-energy-watts-generative-consumption.

6 News Center and Lindsey Valich, "A Quantum Leap in Cooling Atoms for Better Computers," News Center, September 22, 2023, https://www.rochester.edu/newscenter/quantum-mechanics-thermoelectricity-superposition-entanglement-565852/#:~:text=Quantum%20computers%20require%20cold%20environments,information%20contained%20in%20the%20qubits.

7 "What Are Small Modular Reactors (Smrs)?"

production could lower costs over time. Historically, The U.S. military pioneered costly technologies that later benefited civilian industries, such as the internet, radar, and GPS. Expanding military nuclear power could yield similar economic benefits. Reduced logistics requirements and maintenance costs make nuclear power systems more cost-effective over their operational lifespan.

Legal and ethical concerns also warrant consideration. The 1961 Army SL-1 accident is often cited in discussions of military nuclear safety, but its impact was comparable to other industrial accidents. Additionally, modern thorium-based reactors reduce nuclear proliferation risks, making them more viable for military applications.[8]

Technical expertise remains a challenge, but solutions exist. The Navy has successfully maintained a corps of nuclear-trained personnel, and similar programs could be implemented within the Army. Additionally, private-sector partnerships could support developing and maintaining military nuclear power infrastructure.

## Conclusion

Nuclear power represents a strategic opportunity for the Army, particularly in supporting energy-intensive systems such as AI, quantum computing, and DE weapons. Its advantages—including logistical efficiency, operational resilience, and economic feasibility—make it a compelling solution for future military energy needs.

The ability to out-compute and out-power adversaries could prove decisive in future conflicts. Early investment in military nuclear power will allow the Army to refine technologies, build expertise, and reduce long-term costs. Overcoming societal and legal stigmas surrounding nuclear power is essential to maintaining technological superiority.

As adversaries expand their energy capabilities, the United States cannot afford to fall behind. Nuclear power offers a solution to current energy challenges and investment in future military effectiveness. Air Defense Artillery should be charged with integrating nuclear power to ensure continued dominance in an evolving battlefield.

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IAEA, RAND, Rochester University News Center, The Verge.

8 "3 Die in Reactor Blast," Spokane Daily Chronicle, January 4, 1961, https://news.google.com/newspapers?id=EaASAAAAIBAJ&pg=4433%2C513325, 1.