Project Pele Overview

Mobile Nuclear Power For Future DoD Needs

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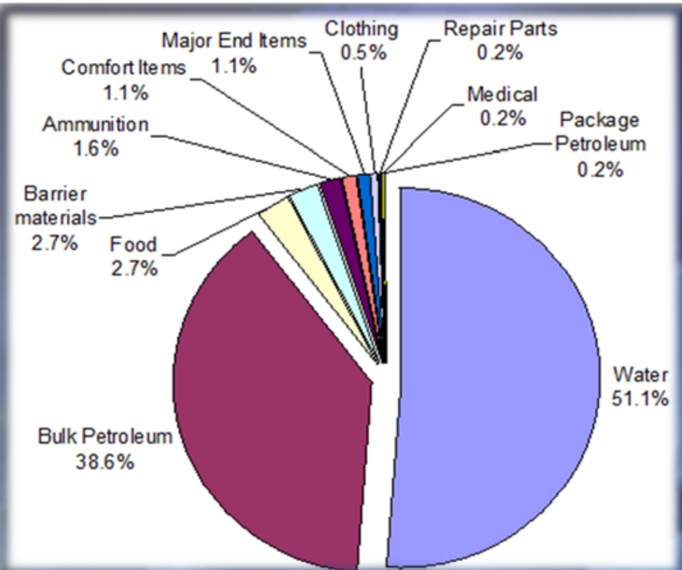
Project Pele

- **Project Pele is a prototype demonstration of an inherently safe mobile nuclear reactor**
  - Tristructural Isotropic (TRISO) fuel is a transformational technology which allows for inherently safe reactors which can withstand external attacks without creating a large evacuation zone
  - Pele reactor will produce 1-5 MW of electrical power for 3+ years, using high-assay low enriched uranium (HALEU), which will be transportable by truck, rail, ship, and C-17

- **Two-year design competition kicked off in March, 2020**

- **Full power testing of the Pele reactor is feasible by the end of 2023, with outdoor mobile testing at a DOE installation in 2024**

In A War Zone, Energy Logistics Are Critical



Between Oct 2001 and Dec 2010, 52% of Operation Enduring Freedom and Operation Iraqi Freedom casualties occurred from hostile attacks during land transport missions

Fuel & water account for 70% -90% of land transport missions

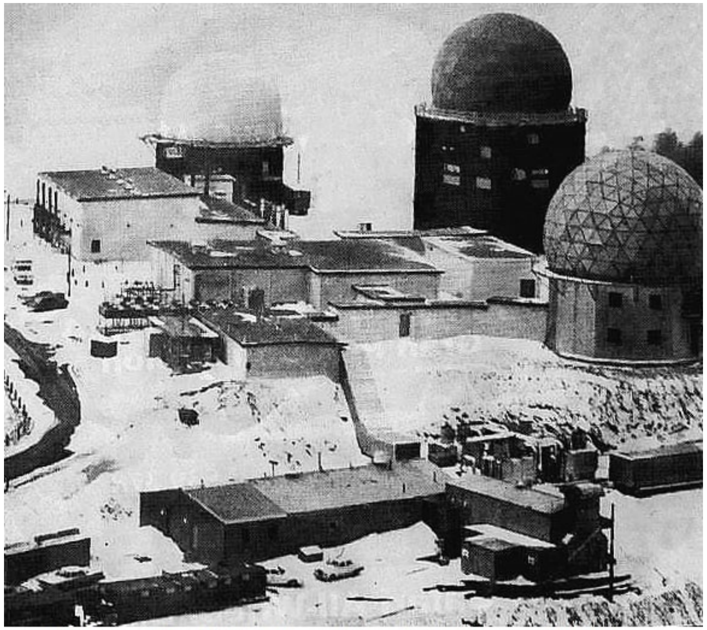
"Relieve the dependence of deployed forces on vulnerable fuel supply chains" ***Commanding General, 1st Marine Division in OIF***

Portable Nuclear Power: An Old Idea

- **The U.S. Army Nuclear Power Program ran from 1954 through 1977**
  - Eight reactors were constructed (five were portable), each between 1-10 MWe, of various designs and for various purposes

- **The first U.S. nuclear reactor to be connected to an electrical grid, in 1957, was an Army reactor (SM-1)**

- **As some of the earliest nuclear reactors ever built, they were technologically difficult to operate, unreliable, and too expensive relative to abundant fossil fuel alternatives**

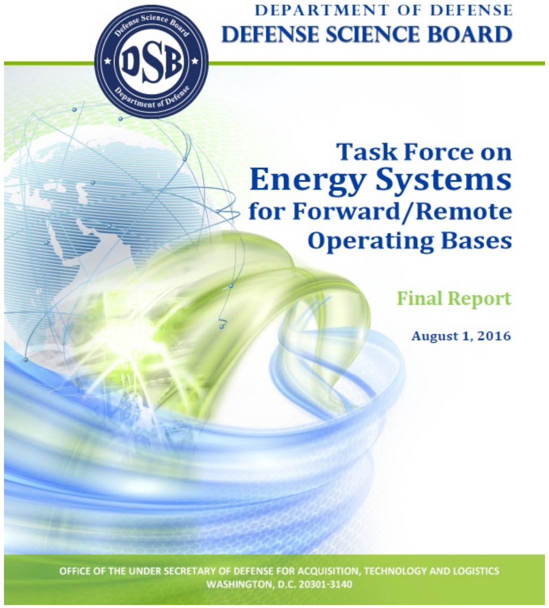


PM-1 Nuclear Plant (PWR), Sundance Air Force Station, Wyoming, 1962-1968

ML-1 US Army reactor, 1958, Arco, Idaho

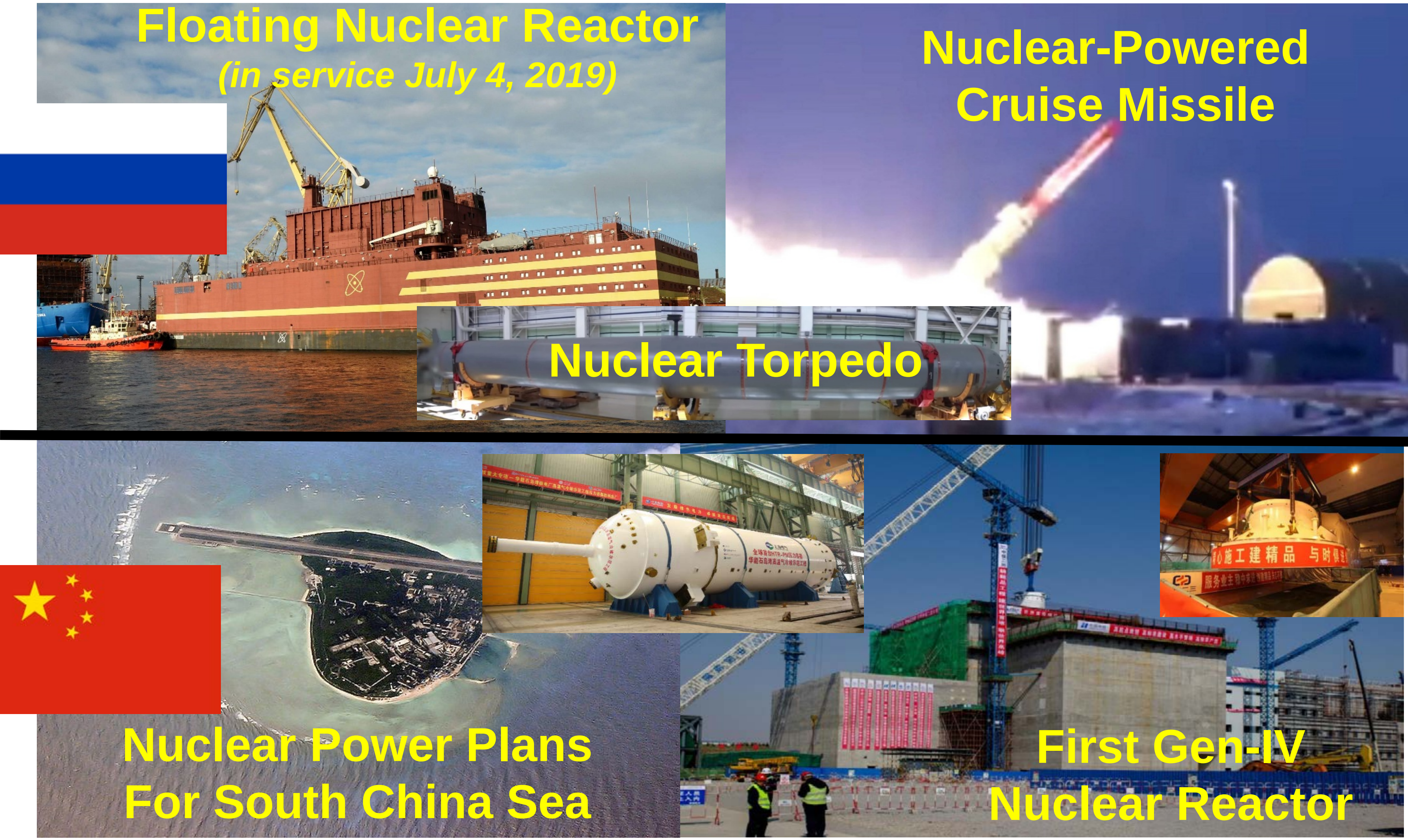
Portable Nuclear Power: Why Now?

- **Defense Science Board (DSB) in 2016 identified critical growing energy challenges**
  - Energy usage on the battlefield is likely to increase significantly over the next few decades making energy delivery and management a continuing challenge.
  - Exponential growth in energy demand is forcing a serious re-evaluation of DoD energy logistics
  - The study found that longer term energy solutions should support sustainment of technical superiority.
  - New modern warfighting systems (e.g. directed-energy lasers, railguns, and UAVs) have ever-increasing demands for reliable, high-density energy.
- **Significant technological advances in nuclear power since the 1960s**
  - Generation III reactors have been operating safely since 1996, and significant development and risk-reduction on Generation IV reactors is already complete.
  - Fully inherently safe reactors have been built and tested, allowing autonomous operation and eliminating meltdown risks.



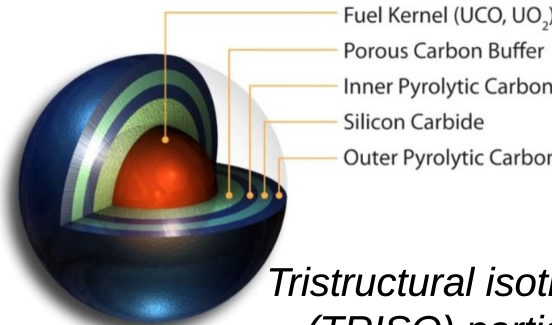
DSB Conclusion: "There is opportunity to invert the paradigm of military energy. The U.S. military could become the beneficiaries of reliable, abundant, and continuous energy through the deployment of nuclear energy power systems."

Advanced Nuclear Reactors Are Already Here

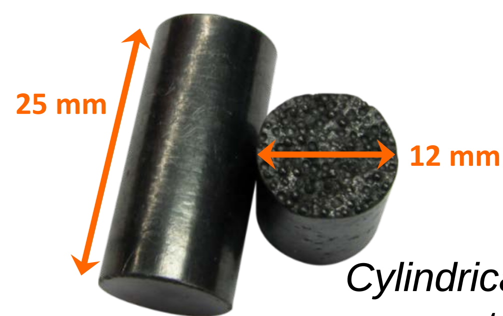


TRISO Fuel: A Paradigm Shift For Nuclear Power

- **The Advanced Gas Reactor (AGR) Fuel Development Program was initiated in 2002**
  - TRISO fuel has already been subjected to rigorous testing by DoE, eliminating the need for DOD/SCO to develop or qualify a new fuel
- **Silicon carbide keeps fission products sealed inside, meaning that a containment vessel failure is no longer catastrophic**
  - Design reduces diversion and proliferation risks due to low (< 20% U235) enrichment and individually coated particles
  - Rugged, robust fuel structure deters use as an improvised weapon such as a dirty bomb
- **Innovative pellet design as first line of containment is a paradigm shift in safety for nuclear power**
  - Standard industrial regulations could apply, significantly reducing manufacturing/safety/O&M/regulatory costs
  - Pellets minimize consequences to the environment and population from events affecting structural integrity of reactor or causing release of contamination



Tristructural isotropic (TRISO) particle

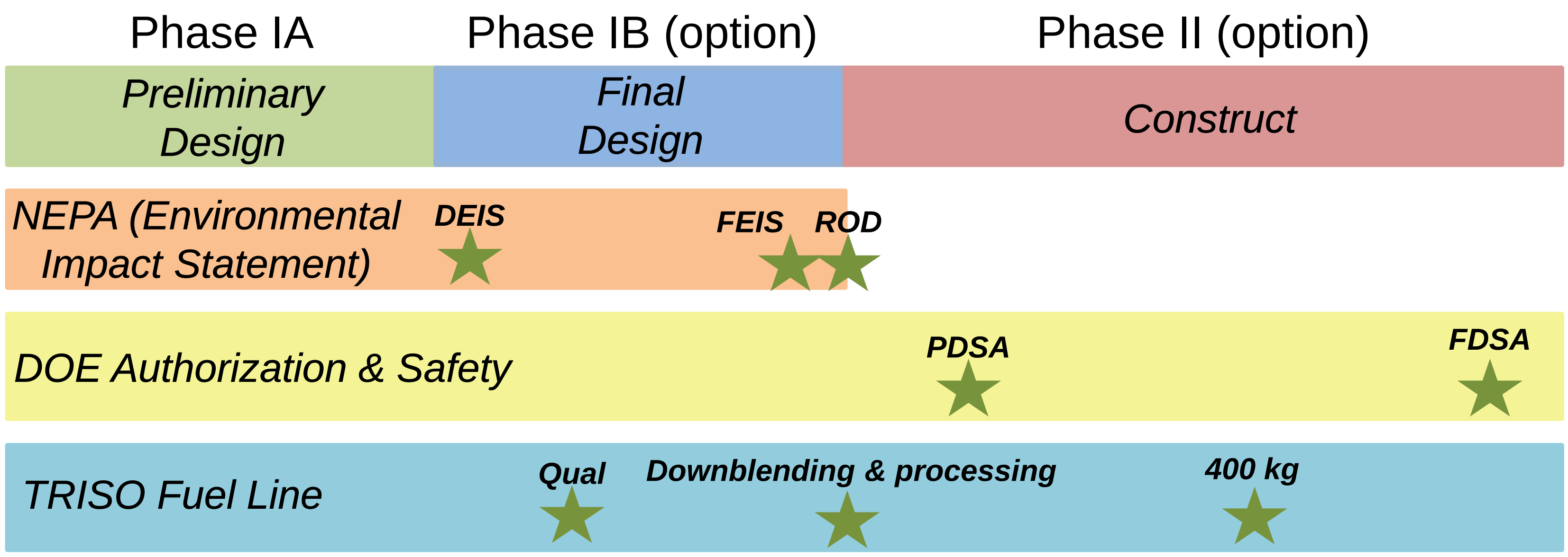


Cylindrical fuel compacts

Kinetic impact testing of TRISO simulants will be an element of Project Pele

Project PELE: Program Plan

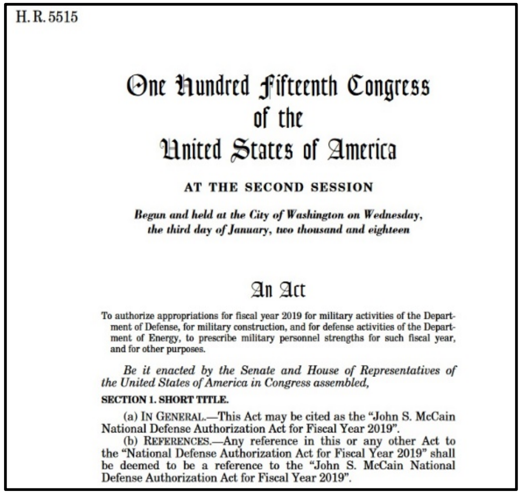
- **SCO has initiated a mobile nuclear reactor design competition, with an option to construct and test the reactor by the end of 2023:**
  - 1-5 MWe, 3+ years lifetime, HALEU fuel, inherently safe, <40 tons, transportable in a C-17 and by truck, assembled in <3 days, dissembled/transportable in <7 days, minimally operated, black-start capable, minimal proliferation/safety risks



Whole of Government Approach

- **2019 NDAA: DOE and DOD should develop a plan to design, build, and test a microreactor at a DOD installation no later than 2027**

- **Interagency collaboration is crucial in order to achieve Project Pele. This includes:**
  - Signed MOU between SCO, DOE, and NRC to provide technical support, advise on design and safety, and reduce future licensing risk
  - Signed IAA between SCO and DOE to provide DOE safety oversight and authorization for Pele, and an extension of Price-Anderson nuclear indemnification
  - Army Corps of Engineers is technical lead on NEPA Environmental Impact Statement
  - NNSA has agreed to provide Pele with highly enriched uranium for downblend to HALEU
  - Signed MOA between SCO, DOE, and NASA to jointly develop a commercial-scale TRISO facility to provide fuel for both terrestrial and space-based advanced reactors


H.R. 5515

One Hundred Fifteenth Congress
of the
United States of America

AT THE SECOND SESSION

Begun and held at the City of Washington on Wednesday, the third day of January, two thousand and eighteen

An Act

To authorize appropriations for fiscal year 2019 for military activities of the Department of Defense, for military construction, and for defense activities of the Department of Energy, to prescribe military personnel strengths for such fiscal year, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

(a) IN GENERAL.—This Act may be cited as the "John S. McCain National Defense Authorization Act for Fiscal Year 2019".

(b) REFERENCES.—Any reference in this or any other Act to the "National Defense Authorization Act for Fiscal Year 2019" shall be deemed to be a reference to the "John S. McCain National Defense Authorization Act for Fiscal Year 2019".

US Army Corps of Engineers

National Nuclear Security Administration

Strategic Game-Changer

- **Nuclear power has the opportunity to offer resilient, reliable energy for remote, strategically important, and key mission assurance installations within the United States**

- **Mobile nuclear power will allow a transformation in capabilities for the future warfighter**

- **Nuclear power has significant technical and regulatory challenges which must be addressed**
  - e.g. regulatory regime, safety/environmental procedures, industrial supply chain, levelized cost of electricity, CONEMPs, technical requirements, and training

- **It is necessary to demonstrate a full prototype reactor to determine the feasibility of future technology transition**