Project Pele Update

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Project Pele

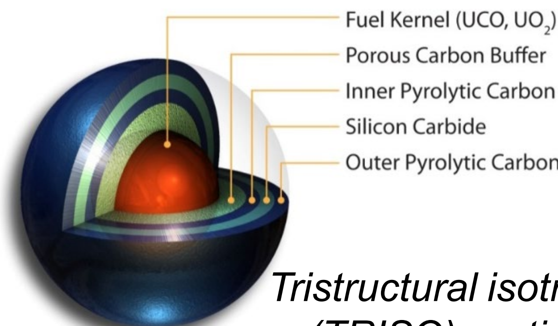
- **A 2016 Defense Science Board (DSB) study[1] found the Department of Defense (DoD) has a need for a mobile, reliable, sustainable, and resilient power source which does not require a long logistics tail**
  - Nuclear power is uniquely suited to meet DoD needs (2M x energy density of diesel)
  - Advances in technology have made feasible highly autonomous, inherently safe, reactors
  - Funded as a Climate program (can offset >1 million gallons of diesel/year)
- **Incorporates Advanced Tristructural Isotropic (TRISO) encapsulated nuclear fuel for safe operations**
  - Robust particle coatings are extremely resistant to meltdown or kinetic destruction
  - SCO/DOE/NASA have re-established a national TRISO production capability
- **Two-year reactor design competition kicked off in March 2020**
  - BWXT selected as winning vendor in Spring 2022
  - Engineering design is being finalized in 2024
- **Pele hardware purchases have begun**
  - Long lead item hardware purchases began in 2023
  - Fuel fabrication is due to be completed by end of 2024
- **Fabrication will begin once design is complete and long-lead hardware is on-site**
  - Assembly of reactor core will begin 1QCY2025
  - Targeting complete assembly by end of 2025
  - Electricity generation at Idaho National Laboratory in 2026

[1] Defense Science Board, Final Report, Task Force on Energy Systems for Forward/Remote Operating Bases (August 1, 2016)

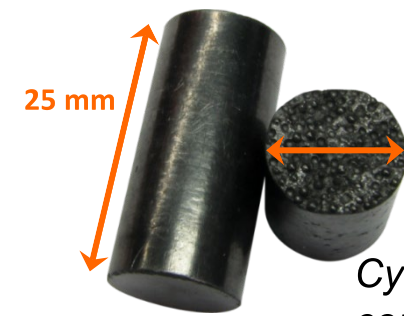
TRISO Fuel: A Paradigm Shift For Nuclear Power

- **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 design as first line of containment is a paradigm shift in safety for nuclear power**
  - TRISO fuel and compacts could significantly lower safety/O&M/regulatory costs
  - Pellets minimize consequences to the environment and population from events affecting integrity of reactor or threatening release of contamination

Kinetic impact testing of TRISO simulants is an element of Project Pele



Tristructural isotropic (TRISO) particle



Cylindrical fuel compacts

Nuclear Power Is Hard

"An academic reactor or reactor plant almost always has the following characteristics: (1) It is simple. (2) It is small. (3) It is cheap. (4) It is light. (5) It can be built very quickly. (6) It is very flexible in purpose ("omnibus reactor"). (7) Very little development is required. It will use mostly "off-the-shelf" components. (8) The reactor is in the study phase. It is not being built now.

On the other hand, a practical reactor plant can be distinguished by the following characteristics: (1) It is being built now. (2) It is behind schedule. (3) It is requiring an immense amount of development on apparently trivial items. Corrosion, in particular, is a problem. (4) It is very expensive. (5) It takes a long time to build because of the engineering development problems. (6) It is large. (7) It is heavy. (8) It is complicated."

--Hyman Rickover, 1953
"The Father of the Nuclear Navy"

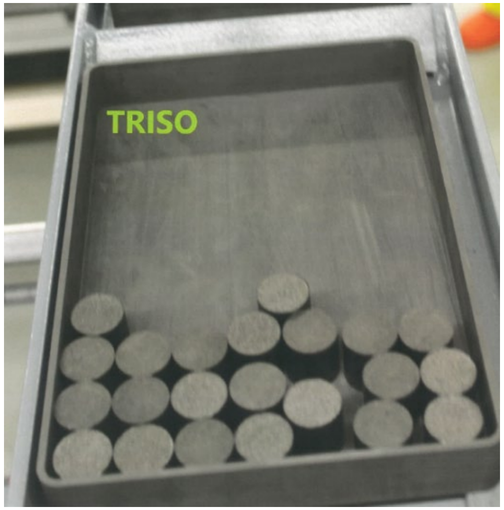
Number of non-Naval power reactors currently under construction, by nation*:

25: China
6: India
4: Egypt, Russia, Turkey
2: Bangladesh, Japan, South Korea, Ukraine, United Kingdom
1: Argentina, Brazil, France, Iran, Slovakia
0: USA

Only two U.S. commercial nuclear reactors have been built and connected to the electric grid whose construction broke ground after 1978 (Vogtle-3 and Vogtle-4).**

*As of April 2024, per https://pris.iaea.org/PRIS/WorldStatistics/UnderConstructionReactorsByCountry.aspx
**Shearon Harris Nuclear Power Plant

Project Pele Hardware



TRISO

Shell Forging

Images used with permission of BWX Technologies

Vessel Head

Etched tubes for shipping fuel to Idaho

Picture courtesy of NAC International

Concrete pad work will begin in Idaho later this year

Path Toward Successful Transition

- **Enforce quality of entire supply chain**
  - Rigorous process to approve all technical specifications before ordering components
  - Audits to ensure quality from both sub-contractors and other suppliers
- **Develop training program**
  - U.S. Army Office of the Chief of Engineers is collaborating with INL and USMA West Point on development of a training program, simulator work, and an operational manual
  - National Guard Bureau personnel will participate in reactor transport/assembly
- **DOTmLPF-P analysis**
  - Doctrine, Organization, Training, materiel, Leadership, Personnel, Facilities, Policy
    - Work has begun to update Service regulations to support a potential transition decision
- **Transition must be cost-efficient**
  - Microreactors must be ordered in sufficient quantities and at sufficient speed for assembly efficiencies of scale to drive costs down to current prices in remote/austere locations
  - The DoD must tie nuclear decision to larger policy question of carbon-free energy and energy resiliency, and how much it is willing to spend to achieve those goals

Whole-of-government decision on future of nuclear power must consider both military and commercial uses of microreactors and SMRs