Develop reactor design and support systems to demonstrate the application of small, modular reactors to fulfill DoD mission goals for energy security

The DoD 2010 Quadrennial Defense Review defines energy security as: "… having assured access to reliable supplies of energy and the ability to protect and deliver sufficient energy to meet operational needs." To address energy security while simultaneously enhancing mission assurance at domestic facilities, DoD will accelerate innovative energy and conservation technologies from laboratories to military end users.

SMRs have considerable DoD appeal—primarily for their matched power output and the possibility of location within DoD bases for grid independence and security. Using self-contained, long-term power generation sources will free the base from the logistical tail and vulnerability of trucked-in fuel supplies. DoD is actively soliciting solutions for energy security for all installations, both forward-based missions and continental U.S. bases.

The small, modular reactor concept places a sealed reactor underground wherever electricity is needed. It does not require the large infrastructure and water supply of a traditional reactor facility. After the fuel is expended (~20 years), the reactor core "cartridge" is returned to the manufacturer for fuel recycling/disposal.

SMRs have DOE interest for their commercial appeal primarily for their expected lower capital costs to first power, their size and modular scalability, and their benefits of carbon-free energy production. DOE is standing up programs to support the demonstration of a minimum of two SMRs. The U.S. Nuclear Regulatory Commission (NRC) is awaiting the application for design certification of up to four SMRs: three based on light water reactor technology and one based on sodium-coolant technology.

Military installations will be used to demonstrate and create a market for innovative energy efficiency and renewable energy technologies coming out of the private sector and DoD and DOE laboratories. The capabilities developed at Sandia, largely through our own investment, present an opportunity to provide the systems impact necessary for the demonstration of nuclear power as an effective solution at the right price for mutual DOE/DoD energy security goals. Sandia's assessments of military energy security, activities in DoD logistic support, SMR design and construction, and reactor safety assessment positions us to facilitate the DOE demonstration of an SMR at a DoD base.

The SMR system is built around a small uranium core, submerged in a tank of liquid sodium. The liquid sodium from the tank is piped through the core to carry the heat away to a heat exchanger also submerged in the tank of sodium. The sodium coolant does not capture/moderate the reactor's neutrons, so the reactor "burns" the transuranic fuel elements more completely—reducing waste-handling issues and producing much more electricity for the same amount of fuel. Passive reactor core cooling eliminates active pumping/valve systems and increases system safety.

In the Sandia system, the reactor heat is transferred to a very efficient supercritical CO_2 turbine to produce electricity. Both this and the sodium coolant system nearly eliminate the vast amounts of water a conventional nuclear plant requires to operate.

These smaller reactors would be factory built and mass-assembled, with the potential of producing 50 a year. Their identical design will allow rapid licensing and deployment. Mass production will keep the costs down, possibly to as low as $250 million per unit. Just as Henry Ford revolutionized the automobile industry with mass production of automobiles via an assembly line, the SMR concept would revolutionize the nuclear industry.

Fort Belvoir's SM-1 reactor was the first reactor connected to a commercial electricity grid.

The SMRs are designed to have an extended operational life—only needing refueling once every couple of decades, which helps alleviate proliferation concerns. The reactor core is replaced as a unit—essentially a cartridge core for which any intrusion attempt is easily monitored and detected.

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