Nuclear power plants—to go

Concepts – this sounds good idea for small nations without regulatory controls.

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In a world of fast food and disposable cameras, now comes a "disposable" nuclear reactor.

Now under development, this nuclear reactor can meet the energy needs of developing countries without the risk that they will use the by-products to make weapons, said officials at the U.S. Department of Energy (DoE). The aim is to create a sealed reactor that can go to a site and generate power for up to 30 years, and then retrieve it when its fuel is spent.

The developers claim no one would be able to remove the fissile material from the reactor because its core would be inside a tamper-proof cask protected by a thicket of alarms. Known as the small, sealed, transportable, autonomous reactor (SSTAR), the machine will generate power without needing refueling or maintenance, said Craig Smith of the DoE's Lawrence Livermore National Laboratory in California.

Conventional reactors pose a threat of proliferation because operators have to periodically recharge them with fuel, which they have to remove later. Both steps offer operators the chance to divert fissile material to weapons programs.

Another reason to provide a small reactor is that conventional nuclear stations generate around a gigawatt of electricity, and that's overkill for plants in developing countries without an extensive electricity grid to distribute it. In an SSTAR, the nuclear fuel, liquid lead coolant, and a steam generator will be within the housing, along with steam pipes ready to hook up to an external generator turbine.

A version producing 100 megawatts would be 15 meters tall and 3 meters in diameter and weigh 500 metric tons. A 10-megawatt version is likely to weigh less than 200 metric tons. The U.S. will deliver the sealed unit by ship, and truck and install it. When the fuel runs out, the U.S. will collect the old reactor for recycling or disposal. The DoE hopes to have a prototype by 2015.

In conventional reactors, the nuclear chain reaction depletes the fissile isotopes in the fuel rods, which is why operators have to replace them every few years. To sustain power generation for 30 years, the sealed reactor will have to act as a breeder, using some of the neutrons to convert nonfissile isotopes such as uranium-238 into fissile plutonium-239.

To further extend the reactor's life, the cylindrical core will sustain fission only when surrounded by a metal cylinder that reflects neutrons back into the fuel. This mirror will start at one end of the core, and over the course of the reactor's lifetime move slowly along to the opposite end, consuming the fuel as it goes. Engineering long-term reliability into such a system will be a major task. Automated controls will monitor the sealed reactor, Smith said, adjusting its electrical output and shutting it down if it detects faults or tampering.