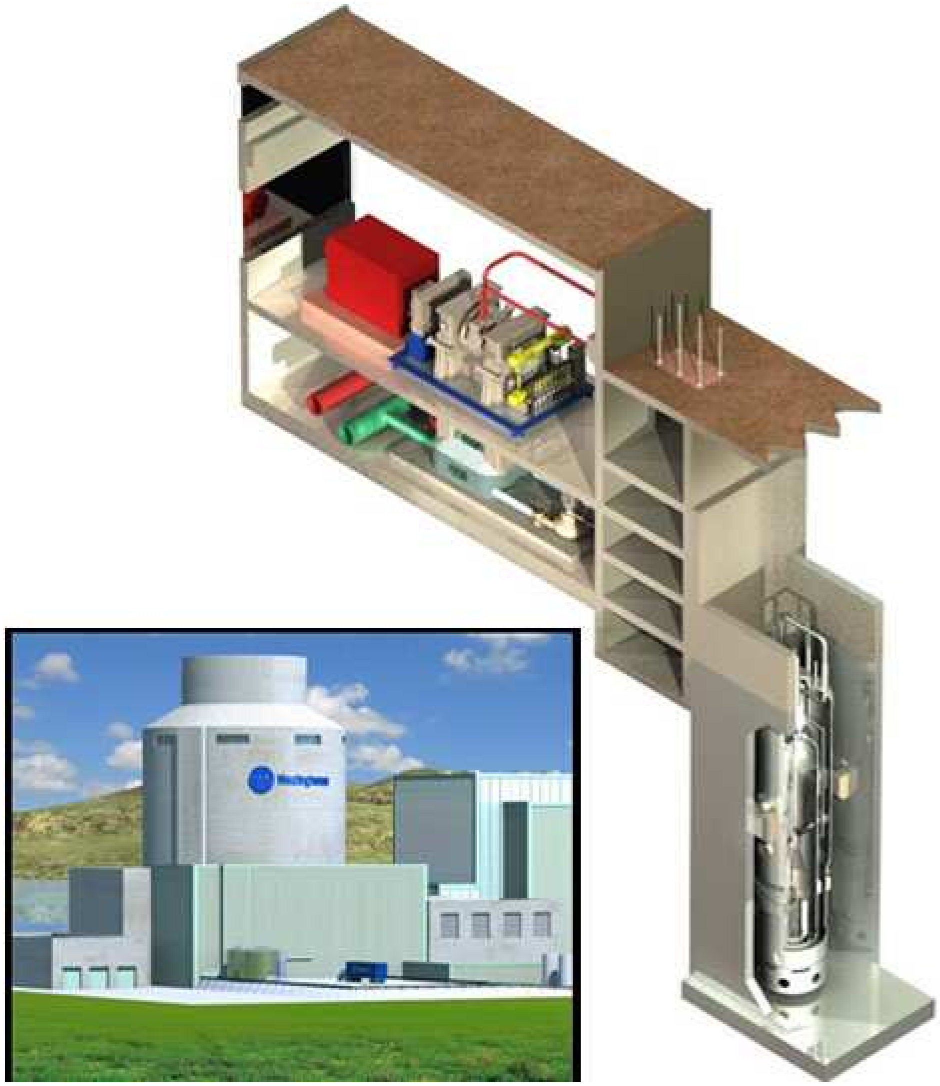
Mini Reactors Show Promise for Clean Nuclear Power's Future

If new portable reactors get the green light this month, nuclear energy could be rolled out in the furthest reaches of the United States.

By Phaedra Hise
Published on: July 15, 2008



NuScale's reactor and module containment unit (bottom right) is nearly 10 times smaller than the Westinghouse AP1000 standard design (bottom left) and sits below ground, while standard steam turbines, generators and condensers (top left) make for cheaper manufacturing.

Higher fuel prices and increased carbon emissions have been giving nuclear energy a boost. So far this year, the Nuclear Regulatory Commission has received licensing requests for 19 new nuclear power plants. That number could increase exponentially, along with the number of suitable sites for a plant, if the NRC approves a brand-new design for portable modular units developed at Oregon State University.

Interest in minireactors has grown over the past few years, according to Felix Killar at the Nuclear Energy Institute. “They're simple and robust, with safety features to allow a country without nuclear expertise to gradually put in small plants, and get people trained and familiar with them before moving into more complex plants.” But small-scale plants could prove useful in the United States, too, particularly in areas where residents must now rely on diesel generators for electricity. Toshiba is reportedly working on a small-scale design for Galena, Alaska. But NuScale Power, the startup spun from Oregon State, is the first American company to submit plans to the NRC, which regulates all domestic nuclear power plants.

The plant's design is similar to that of a Generation III+ “light water” reactor, but the size is unusual. “The whole thing is 65 ft. long,” explains Jose Reyes, head of the nuclear engineering department at Oregon State and a co-founder of NuScale Power. The reactor unit of NuScale's containment unit is 14 ft., compared to a Westinghouse AP1000, a standard current design, which is about 120 ft. in diameter. It has to be built and serviced on-site, but NuScale's units could be manufactured at the factory, then shipped on a rail car or heavy truck to any location and returned for refueling.

As in modern reactors, the containment shell acts as a heat exchanger, Reyes explains. The water closest to the core is vented into the outer shell as steam, where it condenses and drips into the cooling pool, which is recirculated to cool the core. The whole unit sits below grade, without telltale cooling towers. The reactor doesn't use pumps to circulate the water if the unit overheats, which means it needs no external power to cool down. That's a “passive safety” feature that protects the unit from electrical sabotage.

The new unit can be manufactured cheaply, with standard turbines from General Electric, for example, rather than custom-made parts. Because the steel reactor vessel is only 9 ft. in diameter, it can be made entirely in the U.S., rather than relying on Japan Steel Works, the only manufacturer who can cast today's one-piece, 25-ft.-plus reactor vessels.

Each 45-megawatt electrical unit would generate enough power for about 45,000 homes. By comparison, plants operated today generate 1000 to 1700 megawatts, according to NRC spokesman Scott Burnell. “You can't take an AP1000, a large base-load reactor, and put it down where there's no grid to support it. A smaller design could be useful in a remote setting.”

Large utilities could also use smaller units to their advantage, according to Reyes. Instead of shutting down an entire plant to replace fuel, as happens today, the utility could build a modular plant and then shut down only the unit affected.

NuScale has built and tested a one-third-scale unit that uses electrical heat to simulate a nuclear core. After the design is presented to the NRC on July 24, NuScale will spend the next year and a half testing it. They will then submit a final report to the Nuclear Regulatory Commission, which can spend two or three years reviewing documentation before approval. If all goes according to schedule, Reyes estimates, the minireactors could start to go on line in 2015.

RELATED STORIES
- **TECH WATCH: New Plants Pave Clean Road for Nuke Power**
- **HOW IT WORKS: Efficient Centrifuge Enriches Nuclear Energy**
- **SPECIAL REPORT: Can Safe Nuclear Power Work for America?**
- **EXPERTS: Advantages and Disadvantages of Nuclear Energy**