Nuclear Plant Designs Ready To Be Built Now

by Marjorie Mazel Hecht

For an industrial nation that has a large demand now for electric power, 600- to 1,300-megawatt advanced standardized nuclear power plants are the most efficient way to go. Three standardized U.S. designs for advanced nuclear plants are approved by the U.S. Nuclear Regulatory Commission (NRC), and ready to be built: the Westinghouse AP-600 and AP-1,000 and the General Electric Advanced Boiling Water Reactor (ABWR). Another plant design, the ABB System 80+ (designed by a company now also owned by Westinghouse), is also certified.

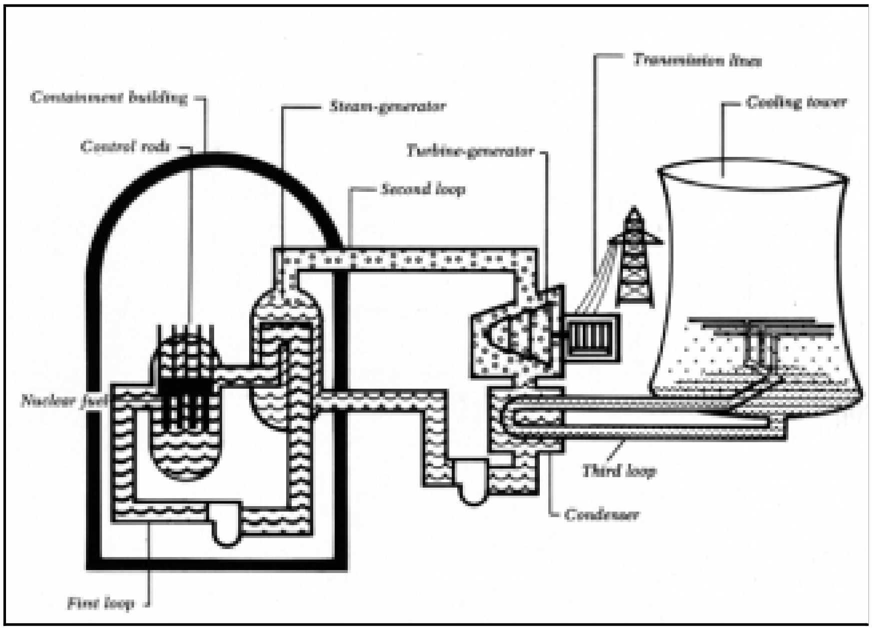
The certified design means that construction for the plants could start as soon as a company, or consortium, decides to build a plant, on an already approved site. Because the plant design is certified as meeting NRC safety requirements, there should not be the kind of delays that stalled construction of some plants in the 1970s, dragging out a 4-6 year process into 10 or more years.

The standardization of design is important. Many of the delays in building previous U.S. reactors came from individual adaptations, which made each reactor unique. The lesson of the French nuclear system (France is nearly 80% nuclear) is that turning out standardized reactors is faster, cheaper, and safer.

Note that the fourth-generation high-temperature modular reactor designs, General Atomics' GT-MHR and South Africa's PBMR, both of which use ceramic fuel and a direct-conversion gas turbine (no steam cycle required), are also design-ready, but they have not yet gone through the NRC certification process. (By law, the certification process, has to be paid for by the reactor designer, and costs millions of dollars.)

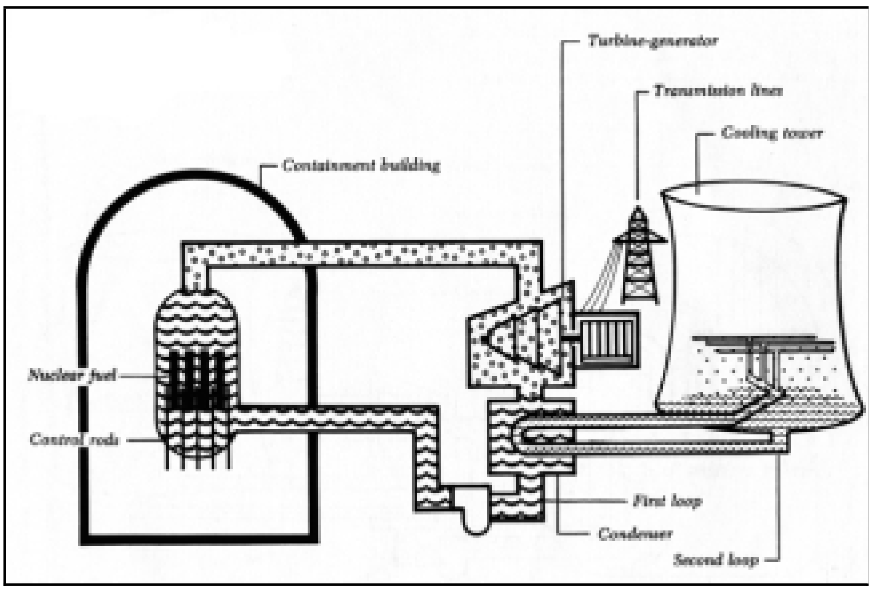
General Atomics is building its prototype of the gas-turbine modular

FIGURE 1
Pressurized Water Reactor



Source: DOE.

FIGURE 2
Boiling Water Reactor



Source: DOE.

helium reactor in Russia, and South Africa's PBMR is in the process of building its pebble-bed modular reactor for the nation's utility, Eskom; with adequate funding, both of these prototype plants could be on line by 2009-10.

Inside the Reactors

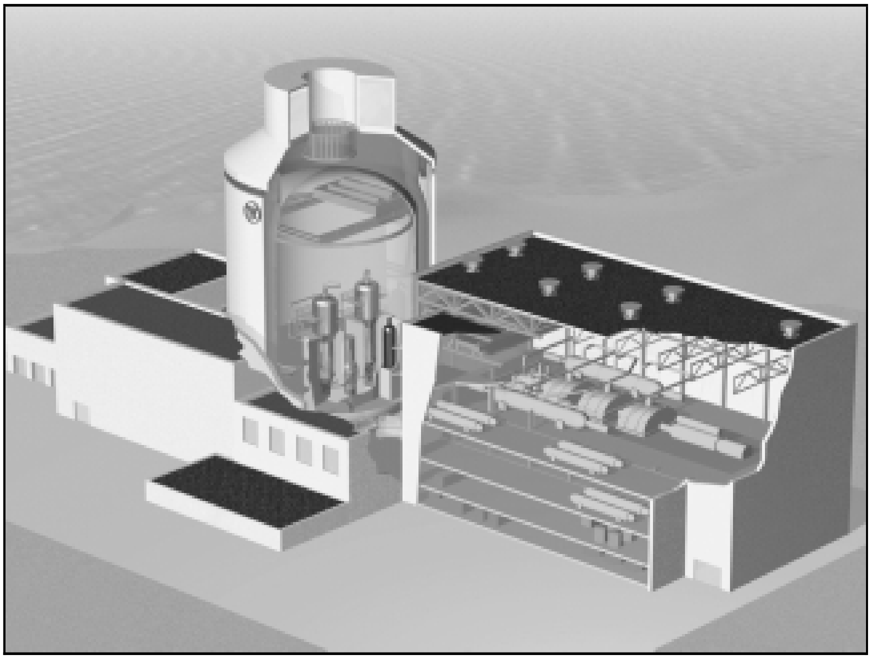
Most of the world's 440 operational nuclear plants are light water reactors. The two basic types in operation are shown here schematically in **Figures 1** and **2:** pressurized water reactors and boiling water reactors. Like other types of power plants, a source of heat is used to boil water into steam, which then turns a turbine to create electricity. The heat source in these plants is a sustained nuclear fission reaction, which results from the splitting apart of uranium atoms.

The main difference between the two plants is that the pressurized water reactor has an additional "loop," which goes from the steam generator to the turbine, while the water in the boiling water reactor boils inside the pressure vessel itself, producing steam that directly turns the turbine generator.

Other types of nuclear plants include the breeder or fast reactor, which can create more fuel than it consumes, and the high-temperature gas-cooled reactor, whose higher heat output enables it to be coupled with industrial processing that requires a high temperature. There are many other reactor designs that could be developed, and some of these designs are in the process of NRC certification.

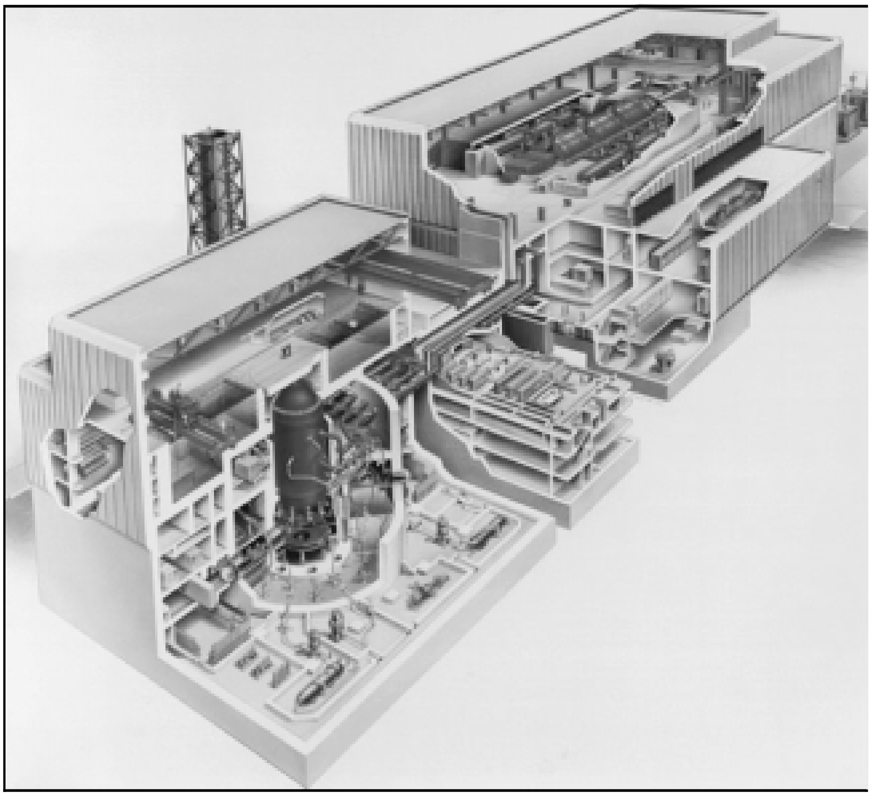
The two standardized designs shown in cutaway views (**Figures 3** and **4**) are more compact than previous reactor designs, with passive and improved safety systems, more modular prefabricated (and thus less costly) components, and simplified operational systems. The Westinghouse AP-1,000 can be put on line in 36 months; the General Electric ABWR can be put on line 42 months. Two of these ABWR models (at 1,356 megawatts each) went on line in Japan in 1996 and 1997, built in partnership with Toshiba and Hitachi.

FIGURE 3
Westinghouse AP1000



Source: Courtesy of Westinghouse Electric Corp.

FIGURE 4
General Electric's ABWR



Source: Courtesy of General Electric Co.