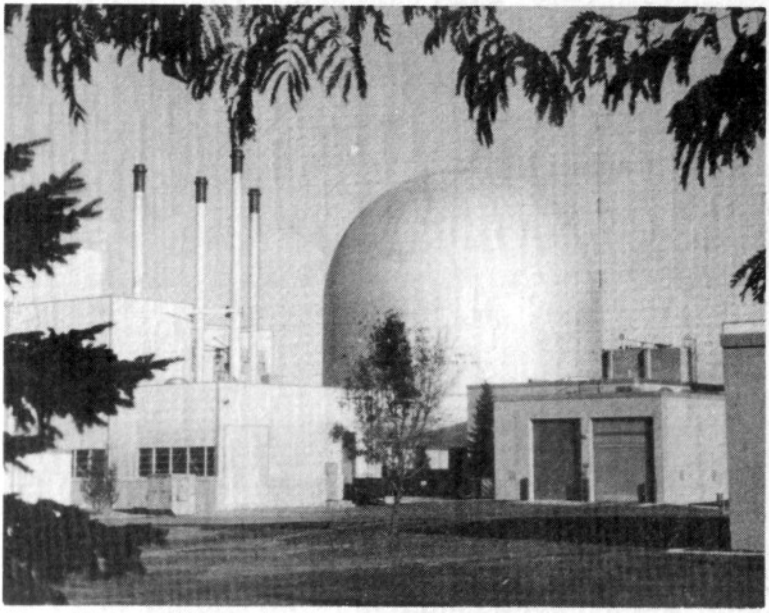
EBR-II

Experimental Breeder Reactor-II

EBR-II has been the backbone of the U.S. breeder reactor effort since 1964. The EBR-II plant consists of a sodium-cooled reactor with a thermal power rating of 62.5 megawatts (MW), an intermediate closed loop of secondary sodium, and a steam plant that produces 19 MW of electrical power through a conventional turbine generator. The original emphasis in the design and operation of EBR-II was to demonstrate a complete breeder-reactor power plant with on-site reprocessing of metallic fuel. The demonstration was successfully carried out from 1964 to 1969. The emphasis was then shifted to testing fuels and materials for future, larger, liquid metal reactors in the radiation environment of the EBR-II reactor core. It is now operating as the IFR prototype.



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The EBR-II core can accommodate as many as 65 experimental subassemblies for irradiation and operational reliability tests, fueled with a variety of metallic and ceramic fuels — the oxides, carbides, or nitrides of uranium and plutonium, and metallic fuel alloys such as uranium-plutonium-zirconium fuel for the IFR. Other subassembly positions may contain structural-material experiments.

Although steady-power irradiation tests of larger sized fuel specimens can presently be performed elsewhere, EBR-II remains in demand for steady-power tests — including tests for the fusion and space-reactor programs as well as IFR test program. In 1986, EBR-II completed a significant series of IFR safety tests. These tests simulated accidents involving loss of coolant flow. They demonstrated that the EBR-II pool-type design, like the IFR, using metallic fuel will safely shut itself down without automatic protection-system action or operator action when coolant flow is lost.

EBR-II is well suited for a broad range of research. Inherent safety and operational reliability research will continue in the future. Current programs include IFR key-feature testing, evaluation of power plant control strategies, and testing programs researching operation with flawed and breached fuel cladding. EBR-II also provides valuable experience in sodium chemistry, reactor safety analysis, and the development of components and instruments to operate in a sodium environment.

Throughout the entire experimental program, EBR-II has continued to generate electrical power and has produced nearly a billion kilowatt-hours for on-site use and for the power grid of the Idaho National Engineering Laboratory. Despite the fact that some experiments require the facility to operate at less than full power, the overall plant capacity factor has remained high and compares very favorably with commercial power generating stations.

Ongoing EBR-II tests of metallic IFR fuels are part of the IFR program that involves a demonstration of

advanced spent fuel processing. The reprocessing equipment has been installed in the former Fuel Cycle Facility to reprocess and refabricate the spent IFR fuel from EBR-II. A successful demonstration of the new fuel cycle process could lead to construction of a full-scale prototype of the IFR , which would produce several hundred megawatts of electricity.

The EBR-II has been continuously modified since 1964 to enhance safety and to provide new experimental capabilities. This has established a firm technical basis for its present role as the IFR prototype. Some of its new experimental capabilities are:

- A facility for instrumented subassemblies containing fuel or structural material, a thimble for incore tests of nuclear detectors, and breached-fuel test apparatus.
- A radioactive sodium chemistry loop to provide a side stream of primary sodium for on-line detection of sodium impurities.
- The data acquisition system, a computerized system for recording and manipulating data from experiments and plant instruments.
- A cover-gas cleanup system to measure and remove impurities from reactor cover gas in support of experiments of fuel with breached cladding.