

ZPPR

Zero Power Physics Reactor



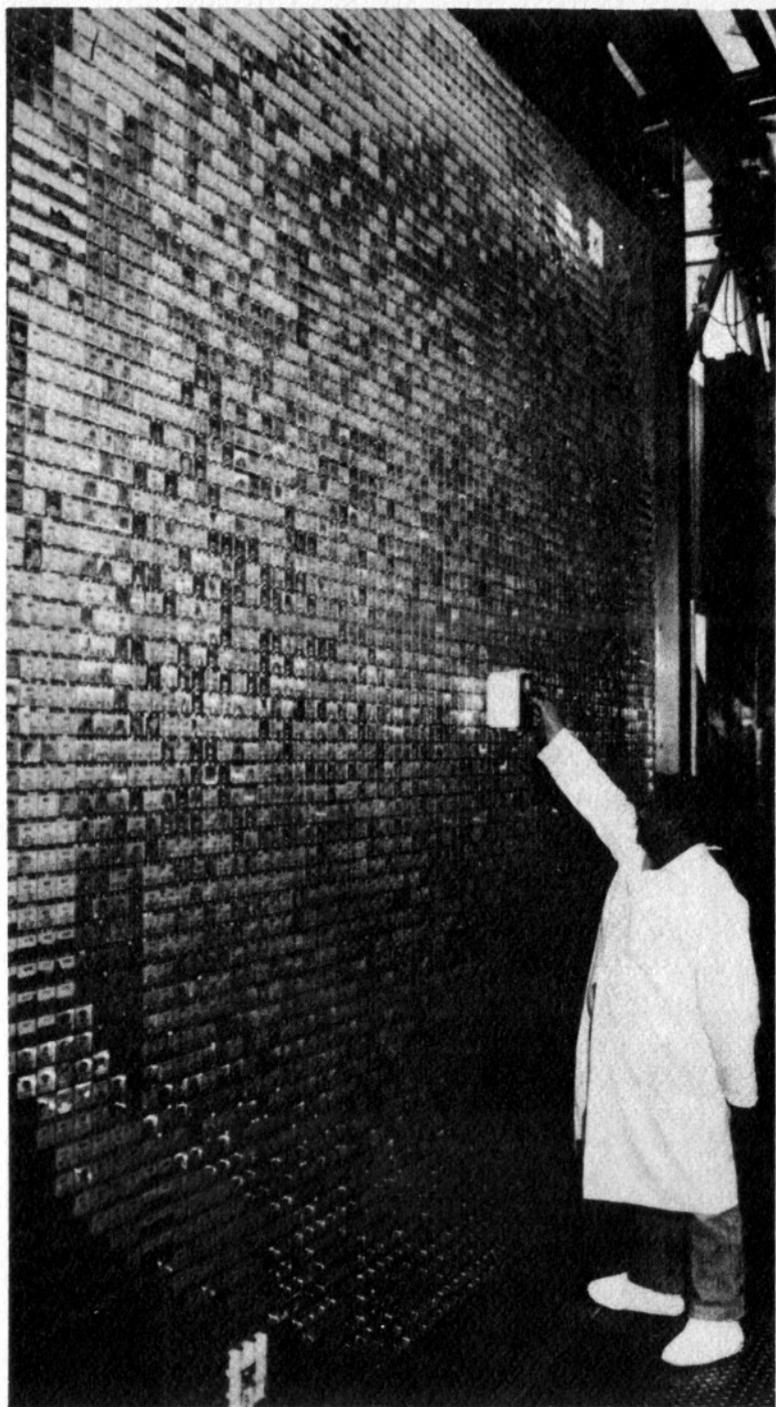
Zero Power Physics Reactor

The Zero Power Physics Reactor (ZPPR) is the national facility for testing the physics properties of advanced fast-spectrum reactors such as Argonne's Integral Fast Reactor, large breeder reactors, space reactors or gas-cooled fast reactors. Testing is done by assembling and operating a reactor that closely resembles the particular design that is under consideration.

Any reactor built in ZPPR is called a critical assembly. It is the same size, as and has all the gross physical characteristics of the reactor being designed. The masses of all the materials are close to the design quantities. Only on a scale finer than two inches, about the typical distance that a neutron travels between collisions, are there significant physical differences.

It is an interesting and fortuitous feature of reactors that their physics properties are essentially the same at all power levels. Thus, even though ZPPR may operate at only one-millionth of the reactor design power level, such properties as the critical mass of the fuel, the effectiveness of the control rods, and the point-to-point variation in the power density are almost exactly the same as they would be in the power plant being designed. Nevertheless, the physics quantities measured in ZPPR are not used directly to "correct" the design. Rather, the computer codes used in the reactor design are also used to calculate predictions of the measured quantities. By comparing the predicted values against the measured values, the design codes themselves can be calibrated for a particular type of reactor. Thus, new measurements are not required every time a small change is made during the design evolution.

There are other fast critical facilities operating in France, Japan and the Soviet Union, but they do not rival ZPPR in size, flexibility or capability. ZPPR's versatility was demonstrated during a three-year period in the mid-1980's when four diverse reactor cores were tested; a 10 MWe uranium-fuelled military emergency power reactor, a 330 MWe uranium and plutonium version of an Integral Fast



ZPPR Core

Reactor (IFR) design, a 0.3 MWe uranium-fuelled space reactor, and a 700-1100 MWe plutonium-fuelled breeder reactor.

The ZPPR critical assembly is put together from rectangular building blocks of fuel, coolant and structural materials. The facility has a very large inventory of these materials that can be assembled in various combinations to construct any reactor within just a few weeks. Because ZPPR is operated at very low power, the materials do not become very radioactive, and can be used over and over again. This feature, combined with the short time required to assemble a core, means that reactors can be built and tested in ZPPR for about 0.1% of the capital cost of the power plant.

The facility's unique construction characteristics provide an ultrastable environment for precise measurements as well as the capability to meet stringent safeguards requirements. The reactors are assembled in a 14' x 14' x 10' stainless-steel honeycomb matrix that is split into two halves except during operation. The matrix sits at the center of a 50'-diameter concrete cylinder that is buried 20' under a large mound of earth, sand and gravel. This "Gravel Gertie" type of construction was originally used in the nuclear weapons test program in Nevada and is capable of safely containing any type of accident. 