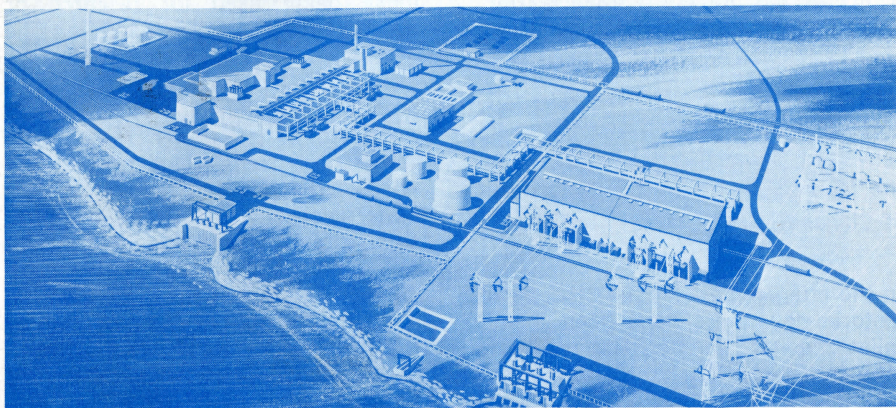


- NATION'S FIRST  
DUAL-PURPOSE REACTOR
- WORLD'S LARGEST  
POWER-PRODUCING  
REACTOR

# REACTOR



FROM CONCEPTION TO REALITY



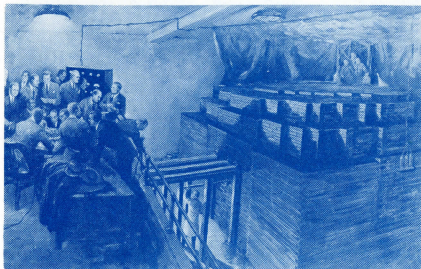
A PRIME CONTRACTOR FOR  
THE U. S. ATOMIC ENERGY COMMISSION

HANFORD ATOMIC PRODUCTS DEPARTMENT

**GENERAL**  **ELECTRIC**

RICHLAND, WASHINGTON 99352





Picture Courtesy Chicago Tribune

## 24 YEARS OF PROGRESS IN ATOMIC ENERGY

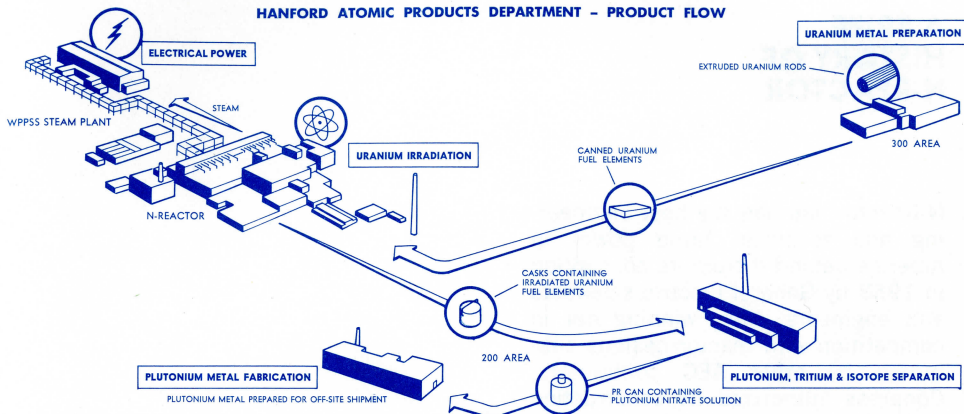
On December 2, 1942, a scientific team headed by Dr. Enrico Fermi successfully achieved the world's first controlled nuclear chain reaction. It was achieved in a hand-constructed, graphite pile erected in secrecy in a converted squash court underneath the football stands at the University of Chicago.

In the intervening 24 years since that historic day, there have been many milestones in the development of atomic energy and nuclear reactor technology. Today, you are looking at the latest and perhaps one of the most significant of these — Hanford's giant N-Reactor — the first dual-purpose reactor in the nation.

Nuclear reactors today, aside from those being used for research or training purposes, are used for one of two primary functions. They are used either as production reactors to produce plutonium and other nuclear materials or as power reactors to convert the tremendous heat of the nuclear reaction into steam to generate electricity or to drive a propulsion system. Up until the construction of "N", nuclear reactors were designed with only one of these purposes in mind for the design consideration of the two vary widely. N-Reactor, however, is unique. It has been designed so it can be operated as both a production reactor and as a power reactor — either separately or at the same time. No other reactor in the country has this flexibility.



## HANFORD ATOMIC PRODUCTS DEPARTMENT - PRODUCT FLOW



## N MEANS NEW

The N-Reactor is a gigantic atomic energy endeavor introducing many of the latest advancements in nuclear technology.

A brief review of some of its firsts and significant features reveals that it is or will be incorporating:

- One:** First United States dual-purpose reactor (production of plutonium, tritium, isotopes and by-product electrical energy).
- Two:** Largest power reactor in the world (800-860 thousand kilowatts) nearly one-half of the output of Coulee Dam, more than the capacity of Bonneville Dam, about the capacity of McNary.
- Three:** First large scale use of carbon steel piping for high pressure recirculating reactor cooling system.
- Four:** First use of zirconium, an exotic metal of the future, for large heavy-wall process tubes in a production facility.
- Five:** First production use of zirconium clad coextruded metallic uranium fuel in high temperature, pressurized water.
- Six:** First use of "Controlled release" confinement system, a significant advancement in reactor safety.

## IT'S IN N

### Concrete

110 thousand cubic yards, enough to build a sidewalk 3 feet wide, 4 inches thick from Richland, Washington to San Francisco.

### Reinforcing Steel

11 thousand tons, enough steel to make 1/2" in diameter rod reaching from New York City to Tokyo.

### Multi-Wire Electrical Cable

6 1/2 million linear feet, equivalent to 1 wire from New York City to New Orleans.

### Steam Generator Tubing

250 miles, enough tubing to reach from Richland to Seattle.

### River Pumping Capacity

500 thousand gallons per minute—enough water could be pumped in one day to supply the city of Richland (approx. population 25,000) for 2.5 years.

### Primary Pipe

2,500 tons, or equivalent to a 10-inch column of pipe 15 miles high.

### Man Power

45 thousand man months, or the equivalent of one man for 3,700 years.

### Generating Plant

Electrical generating capacity 800 thousand kilowatts, enough electricity each hour to supply the average American home for 50 years.





## INSIDE THE REACTOR

Basically, a nuclear reactor is an atomic furnace in which the fissioning, or splitting of atoms of nuclear fuels can be controlled and put to useful work.

While the design of a nuclear reactor is actually exceedingly complex, there are certain basic elements that are needed in the construction of any reactor.

**Fissionable Uranium**—To keep the chain reaction going and to produce heat; this is the fuel supply.

**Moderator**—To slow down the neutrons freed by fission to manageable speeds so that they will split an atom rather than glance off its surface. Water or graphite is commonly used.

**Control Rods**—To absorb some of the free neutrons given off by the chain reaction process. These rods, made of neutron-absorbing material, are inserted in the reactor or withdrawn to keep the chain reaction going at the desired rate.

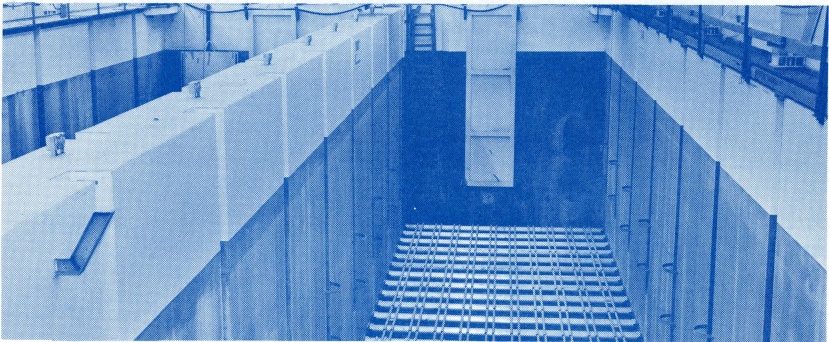
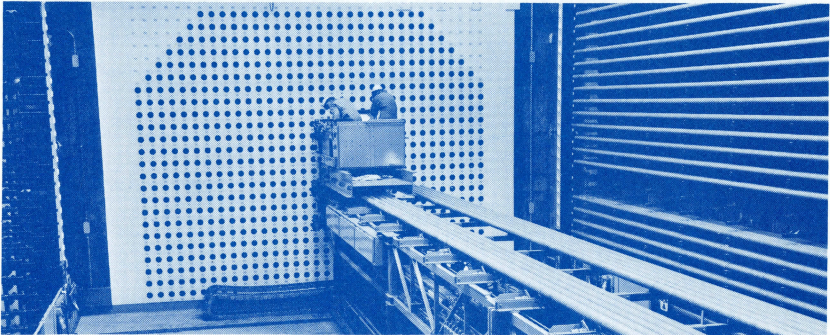
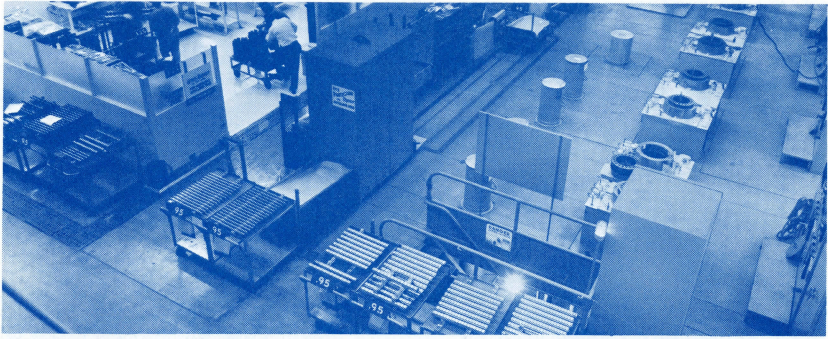
**Coolant**—To carry off the tremendous heat produced by the fissioning atoms and to use it to change water into steam. Water, compressed gases, or liquid metals can be used.

As the coolant passes around and through the reactor core, it picks up the heat given off by the fissioning uranium atoms. The heated coolant is piped off to a heat exchanger where it turns the water in a secondary system of pipes into steam. The steam, in turn, can then be piped to a turbine generator for the production of electricity or simply “dumped” as a waste product.

**Shielding**—To stop radiation—stray neutrons, particles of matter, and waves of energy given off by the radioactive uranium.

Put these elements together and you have a simple nuclear reactor.



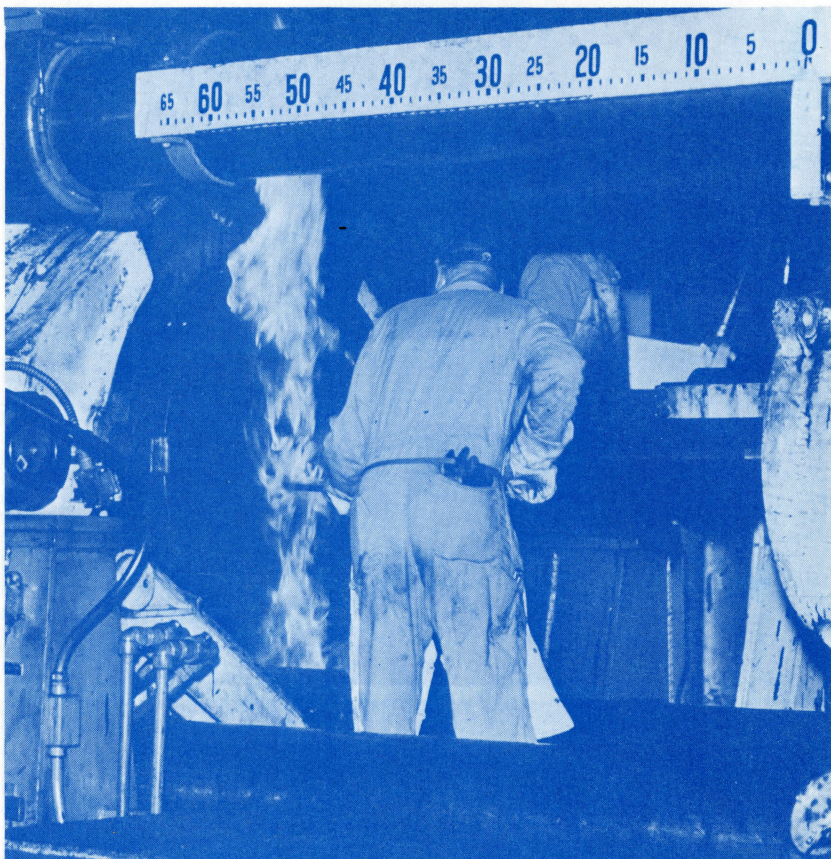


TOP—These are the fuel elements used in N-Reactor. They vary from one to three feet in length and are about  $2\frac{1}{2}$  inches in diameter. They contain enriched uranium.

CENTER—Fuel is charged in the reactor in the long process tubes shown on the charging machine and on the wall at right. The graphite stack is behind heavy concrete and steel-plate shielding.

BOTTOM—This is the basin in which the irradiated fuel is cooled under 20 feet of water prior to shipment for processing.



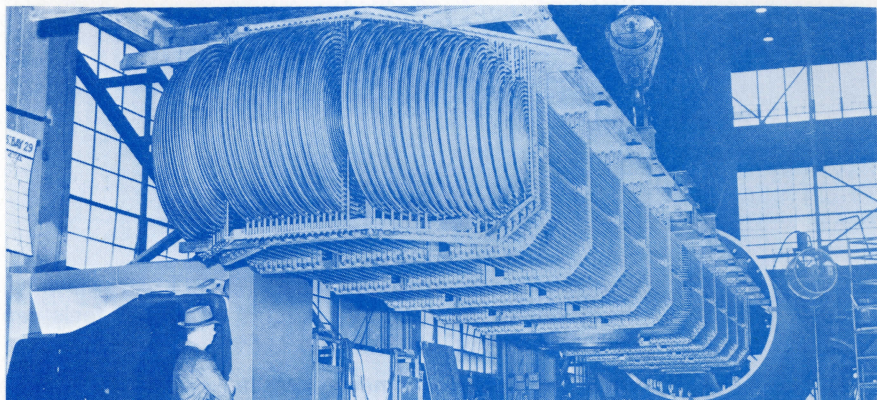


A 2750 ton co-extrusion press, largest in the Northwest, is used in co-extruding unique N-Reactor fuel elements.

## FUEL

The basic fuel ingredient for N-Reactor is slightly enriched metallic uranium. There the similarity with fuel of other production reactors at Hanford ends. N-Reactor fuel elements are longer and comprise an assembly of two tubular fuel elements, one inside the other. They are clad with zirconium alloy, highly resistant to corrosion in high temperature water. A huge press forces a massive assembly of heated uranium and zirconium through a die to create long bars of precise dimensions, requiring a minimum of operations for further conversion to finished fuel elements.





Top—Hot water from the reactor is carried through 20 miles of 5/8-inch stainless steel or inconel tubing in each of the 12 steam generators. Around the tubing is water from the steam plant. It is turned into steam by the reactor's heat.

Center—Eight 38-inch diameter pipes carry about 13 million pounds per hour of steam from the reactor to the steam plant shown in the background.

Left—The late President John F. Kennedy visited N-Reactor site to dedicate the steam plant on Sept. 26, 1963.



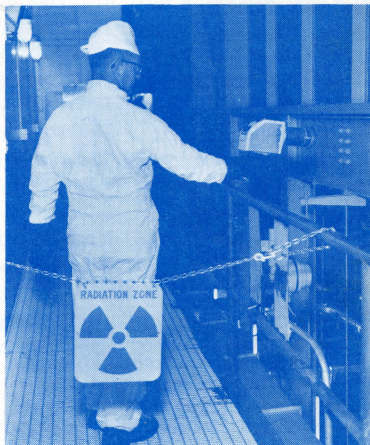
## A BRIEF HISTORY OF N-REACTOR

N-Reactor has had the best engineering and technical brain power in America behind it from its conception in 1953 by General Electric scientists and engineers. After winning out in competition with reactor designs submitted by other AEC contractors, Congress authorized its construction in 1958. It was to be designed primarily to produce plutonium but was also to be convertible to produce plutonium and electrical power.

As construction began, the question of whether N-Reactor would ever be converted was left unanswered. It was not until 1962, when Congress passed the enabling legislation that authorized the dual-purpose role, that this question was finally answered. The Washington Public Power Supply System constructed and operates the adjacent power-generating facilities that not only makes "N" the nation's first dual-purpose reactor, but makes it the largest power producing reactor in the world.

N-Reactor is an asset to national prestige, to the country's defense, to the furtherance of peaceful applications of atomic energy, and to the economy of the Northwest and the nation. Aside from producing plutonium and electrical power, the reactor is producing tritium and valuable isotopes for space, research and industry.

Tritium can be used to make a "clean" explosive for digging canals and harbors and mountain passes for roads and railroads. It is used also for a self-generating light source for buoys and other signals and may some day be used to directly produce electricity.



Radiation monitor Hank DeHaven uses a "cutie pie" instrument in a high radiation zone to determine how long it is safe for men to work in that area. The protective clothing, which includes rubber gloves and galoshes, must be shed before leaving the contaminated area. Because of safety precautions such as these, N-Reactor boasts a much better safety record than non-nuclear industries.

**OPERATION TIPTOP**  
Toward Improved Plant Total Operating Performance