Hanford's Historic B Reactor

United States Department of Energy
Richland Operations Office

Hanford's B Reactor

A need

The Hanford Site began as part of the United States Manhattan Project to research, test and build atomic weapons during World War II.

The original 670-square mile Hanford Site, then known as the Hanford Engineer Works, was the last of three top-secret sites constructed that produced enriched uranium and plutonium for the world's first nuclear weapons.

A past

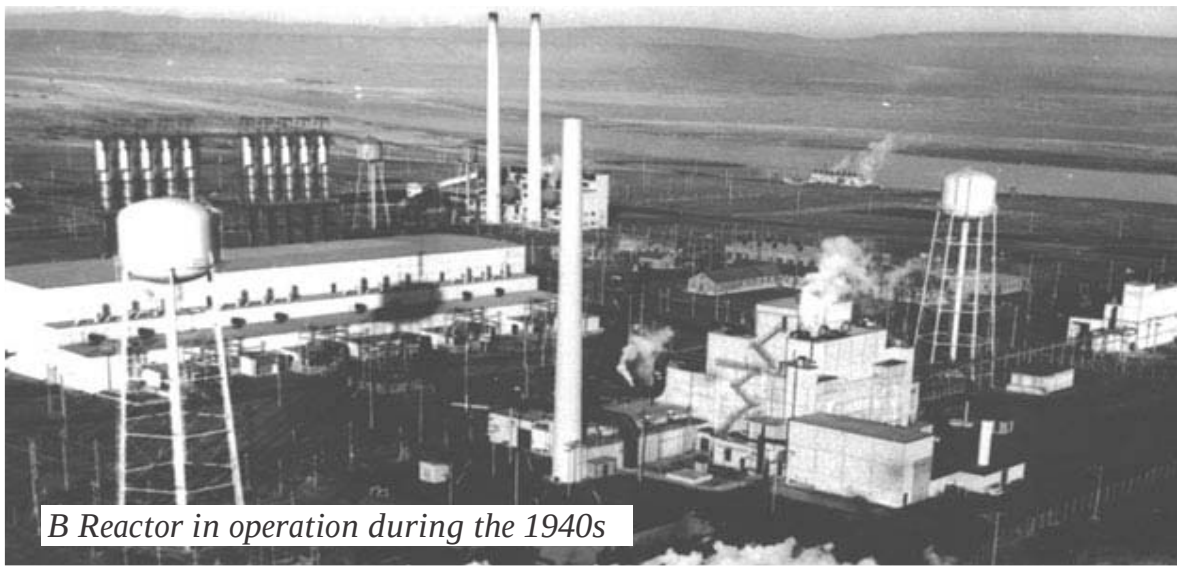
B Reactor, located about 45 miles northwest of Richland, Wash., is the world's first full-scale plutonium-production reactor. Not only was B Reactor a first-of-its-kind engineering structure, it was built and fully functional in just 13 months.

Eventually, the lands along the Columbia River in southeastern Washington state supported nine nuclear reactors at the height of Hanford's nuclear defense production during the Cold War era.

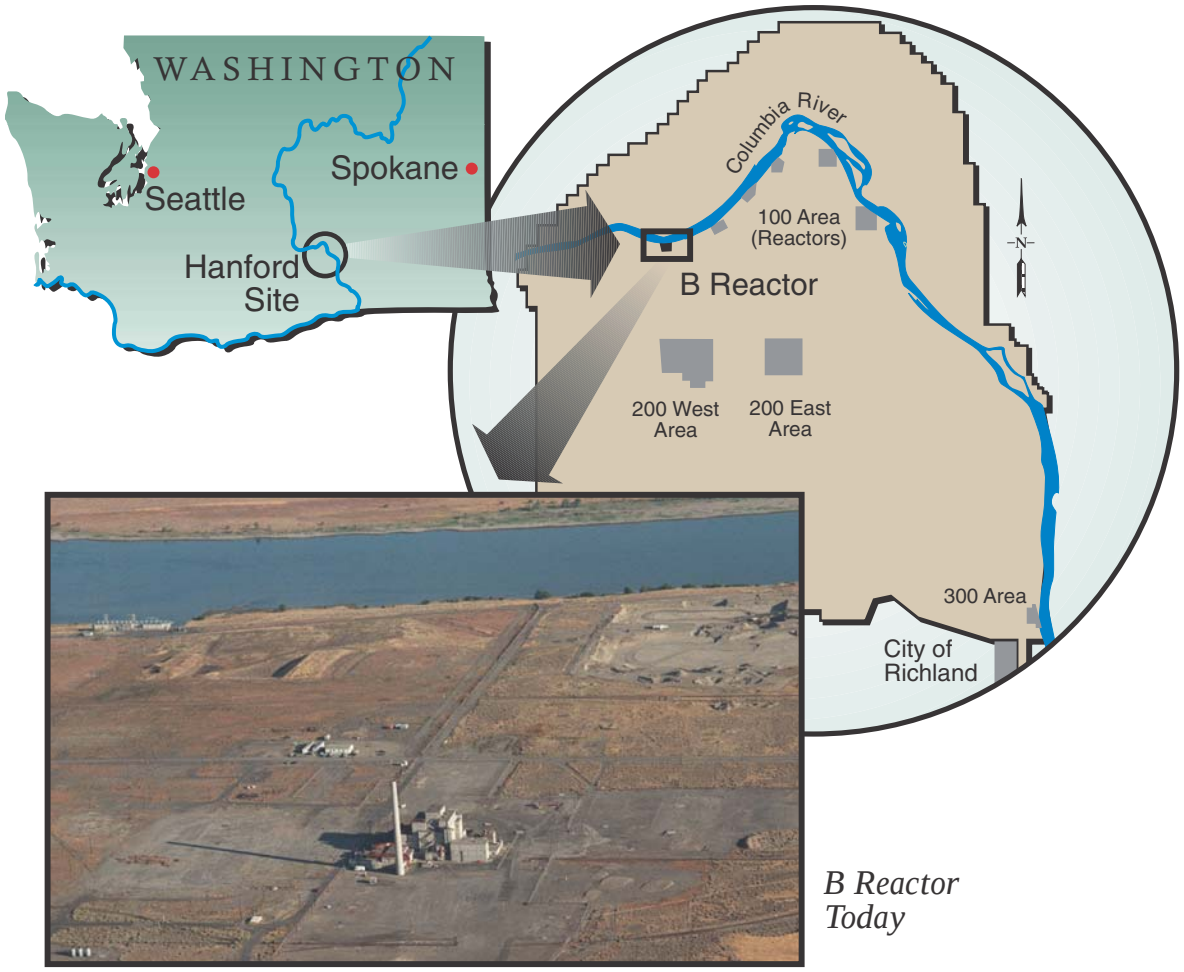
The B Reactor was shut down in 1968. In 1980, the U.S. Department of Energy began removing all B Reactor support facilities. The reactor building is all that remains.

A future

Currently, workers are removing hazards from the building and expanding the area available for public access. A planning process during the 2002 fiscal year will evaluate long-term uses for B Reactor.



B Reactor in operation during the 1940s



B Reactor Today

B Reactor Project

Environmental Restoration & Historic Preservation

In August 2000, DOE-RL and Bechtel Hanford Inc., the Environmental Restoration Contractor, partnered in a project to protect and maintain Hanford's B Reactor while providing limited public access.

Potential hazards still exist within the building, but the approved tour route is safe for visitors and workers.

Additional areas may be opened as hazards are mitigated and public safety can be assured.

Ensuring A Safe Visit

- **Follow the directions of your escort**
- **Stay with your escort on the designated tour route.**
- **Do not reach across any posted radiological signs or barriers**

Putting It All Together

B Reactor control room

This control room is where B Reactor operators manipulated control rods to monitor temperature levels and guard against potential malfunctions. Many of the control room instruments originated at the Hanford Site.

Retired B Reactor instrument supervisor, Dee McCullough, tells a visitor how the control panel worked.

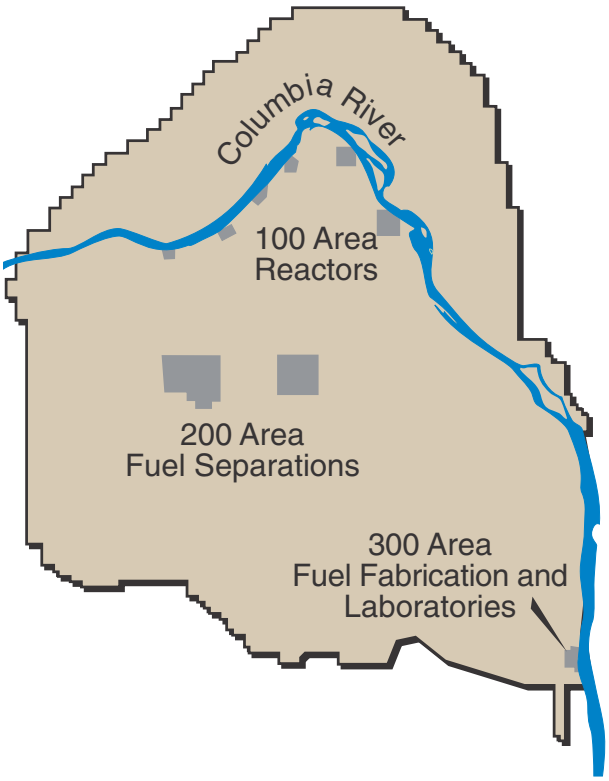
B Reactor core facts

- 36-feet long, 28-feet wide, 36-feet high
- Core sits on a 23-foot thick concrete foundation
- Core and work area encased by 5-foot thick concrete walls
- 2,004 process tubes
- 32 fuel slugs per process tube
- 200 tons of uranium fuel slugs filled reactor
- 2,200 tons graphite for core
- Originally operated at 250 megawatts thermal
- Productivity: 1,000 kilowatts per hour for 1 month = 1 ounce plutonium
- Original cooling system: Treated river water entered core at 30,000 gpm; exited at 149 degrees Fahrenheit

Hanford Site nuclear defense production areas

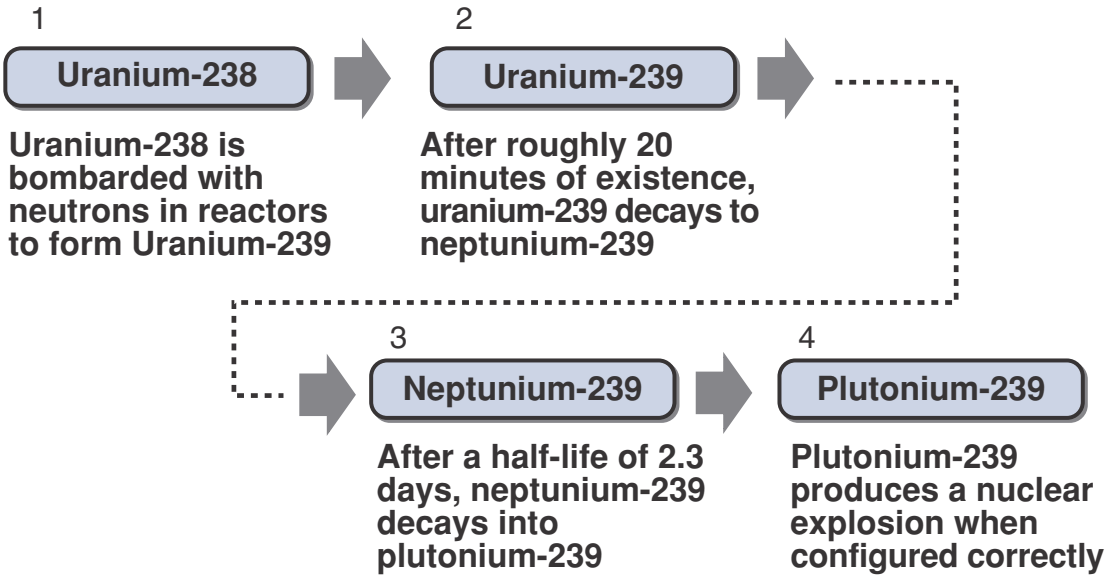
During World War II and the Cold War era the Hanford Site comprised three main areas dedicated to the production of plutonium.

The 300 Area was where workers manufactured and fabricated fuel slugs to place inside reactor cores. Fuel was irradiated in reactors at the 100 Areas. In the 200 Areas, plutonium was chemically extracted from irradiated fuel.



Required plutonium production steps

Plutonium is an element created in reactors from uranium and rarely occurs in nature outside of nuclear reactor production.



The B Reactor Tour Route

A Work Area

The work area faces the reactor core and provided the space needed to add fresh uranium fuel. Here, workers loaded 8.5-inch long by 1.5-inch diameter aluminum clad uranium cylinders called slugs. The loading, or charging, elevator ran across the reactor face providing access to each row of process tubes for operation and maintenance. Fuel slugs were pushed out of the reactor rear face into a spent fuel storage basin as new fuel was added in front.

B Reactor Front Face

The front face pipes held cooling water furnished from an original pair of 20-inch risers that were replaced by 36-inch risers in 1957. Water from the risers ran through 39 horizontal cross-headers into flexible process tubes and through couplings called pigtails. Nine horizontal control rods on the left side of the reactor block were pulled out to increase the chain reaction, or inserted to slow down or shutdown the chain reaction. Twenty-nine vertical safety rods were suspended above the reactor from electromagnetic clutches. In the event of a malfunction, the rods would drop into the core and shutdown the chain reaction.

C Accumulators

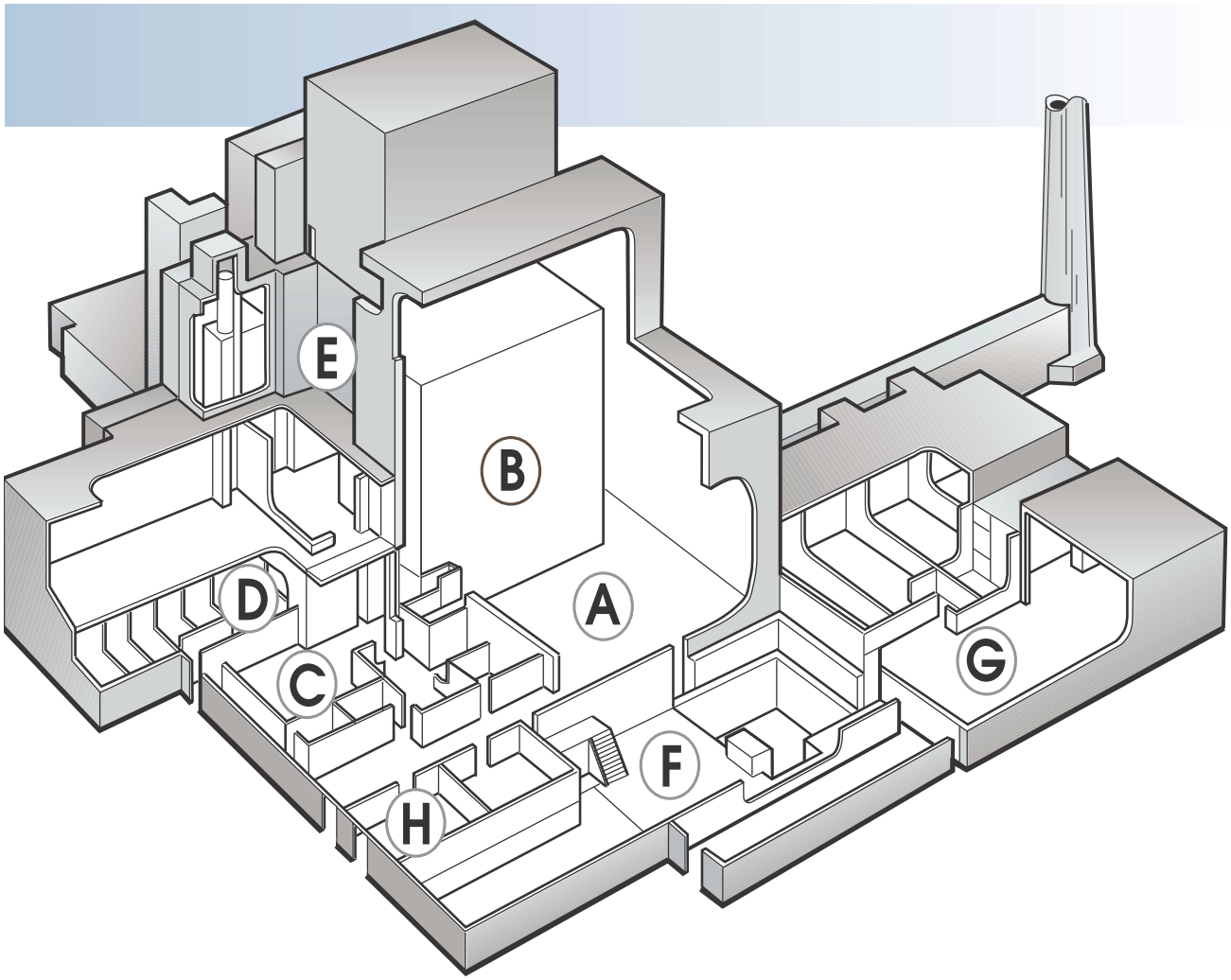
Three hydraulically-elevated tanks containing river rocks were suspended as a fail-safe backup in case of an electrical failure. The accumulators were locked into place when the reactor started. The tanks descended in a power failure while their hydraulic-pressure pushed seven control rods into the reactor shutting down the chain reaction.

D Control Room

An operator monitored and controlled the reactor from the main control panel. The operator regulated the chain reaction by inserting or retracting one or more of the nine control rods and monitored various gauges used to measure water pressure in each of the 2,004 process tubes.

E Fuel Basin Viewing Window

The fuel basin viewing window shows the wooden deck that suspended workers above a basin where irradiated fuel was stored in 20 feet of water. Spent fuel was stored in the basin for up to two months. The water shielded workers from radiation while the fuel cooled off. Irradiated fuel slugs were then moved to the fuel transfer bay and shipped by rail car to the 200 Areas where plutonium was extracted from the fuel.



F Valve Pit

The walkway looks down at the plumbing that supplied water to the reactor from the now demolished pumphouse. By 1957, more than 70,000 gpm could be pumped through the reactor cooling system compared to the initial intake of 30,000 gpm. Several backup systems were available to ensure cooling water would reach the reactor in an emergency.

G Fan Rooms

The intake fan room supplied ventilation into B Reactor and allowed for pressurized zones. Air was exhausted through a 200-foot stack at the building's south end.

H Instrument Shop

The room was originally used as a shop where B Reactor workers calibrated, fixed and maintained instruments. Currently, the room is used as a lunchroom for B Reactor staff and the only area used for food and beverage consumption. The room also serves as a place for visitors to rest during tours.

Historical Recognition for B Reactor

Since the United States BiCentennial in 1976, Hanford's B Reactor has been recognized for its historical significance as one of the 20th Century's most important technological inventions.

1976 National Historic Mechanical Engineering Landmark
American Society of Mechanical Engineers

1992 National Register of Historic Places
National Park Service

1993 Nuclear Historic Landmark
American Nuclear Society

1994 National Civil Engineering Landmark
American Society of Civil Engineers

2002 National Historic Landmark (in process)
National Park Service

B Reactor History

1942	December 28, President Franklin D. Roosevelt approved the Manhattan Project
1943	January, the Hanford Engineer Works (Hanford Site), the Manhattan Project's third top-secret location, is selected October, U.S. Army Corps of Engineers break ground to build B Reactor
1944	September 13, first uranium fuel slugs are loaded into B Reactor September 26, B Reactor goes critical
1945	February 3, B Reactor plutonium delivered to Los Alamos, New Mexico July 16, B Reactor plutonium used in world's first nuclear explosion at the Trinity Test in Alamogordo, New Mexico August 9, B Reactor plutonium used in Fat Man bomb dropped on Nagasaki, Japan September 2, Japan officially surrenders and W.W.II comes to an end
1946	March 1946 - June 1948, B Reactor temporarily shutdown
1949	March, B Reactor begins irradiating lithium-fluoride slugs for tritium production
1952	November 1, B Reactor tritium used in world's first test detonation of a hydrogen bomb on Bikini Atoll in the South Pacific B Reactor continues lithium-fluoride irradiation
1968	January 29, Atomic Energy Commission issues shutdown of B Reactor February 12, B Reactor permanently shutdown
1980	B Reactor declared excess property by U.S. Government
1999	September, final Hanford land use plan for the next 50 years allows visits to B Reactor
2000	August, B Reactor Project formed by DOE-Richland Operations Office and managed by Bechtel Hanford Inc., the Environmental Restoration Contractor
2001	August, Engineering Evaluation / Cost Analysis report released by DOE and the U.S. Environmental Protection Agency determines 10-year hazard mitigation and public access as interim uses for B Reactor

Before B Reactor

First settlers

Native Americans occupied the Hanford area for several thousand years before settlement of southeastern Washington state by Europeans. The local tribes, particularly the Wanapums, thrived until the early 1800s, before the arrival of explorers, fur trappers and Euro-American ranchers and farmers.

Agriculture

The Euro-American resettlement of the Hanford area transformed the region into farmland dependent upon irrigation. While Native Americans intensively used the Columbia River's fish resources as a mainstay of their economy, the small communities of Hanford, White Bluffs and Richland used the lands for grazing, farming and mining until the creation of the Hanford Site in 1943.

Environmental Restoration at Hanford

Scope of project

The U.S. DOE awarded the Environmental Restoration Contract in 1994 to plan, manage, integrate and execute a full range of activities to clean up contaminated soils, inactive nuclear facilities and groundwater at the 586-square mile Hanford Site.

The Environmental Restoration Contractor team, led by Bechtel Hanford, Inc., and its pre-selected subcontractors CH2M Hill Hanford, Inc. and Eberline Services Hanford, Inc., are focused on cleanup along the Columbia River corridor and on Hanford's Central Plateau.

Remedial Action and Waste Disposal of Contaminated Material

Decontamination and Decommissioning of Retired Production Reactors and Supporting Facilities

Groundwater/Vadose Zone Integration and Groundwater Management

Surveillance/Maintenance and Transition of Inactive Facilities

For more information access these internet locations

DOE Richland Operations Office
www.hanford.gov

Hanford Site Historic District
www.hanford.gov/docs/rl-97-1047

Bechtel Hanford, Inc.
www.bhi-erc.com

B Reactor Project
www.bhi-erc.com/Projects/s_m/b_reactor.htm

B Reactor Museum Association
www.b-reactor.org

Columbia River Exhibition of History
Science & Technology
www.crehst.org

To Arrange a B Reactor tour, visit:
www.hanford.gov/tours/index.cfm

Partners in Progress

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