EBR-I ATOMIC MUSEUM

A National Historic Landmark

EST. 1951

Self-Guided TOUR

On Dec. 20, 1951, EBR-I became the first power plant in the world to produce usable electricity using atomic energy. After that day until decommissioning in 1964, EBR-I generated enough electricity to supply all the power for its own building whenever the reactor operated.

INL Idaho National Laboratory

Welcome to the EBR-I Atomic Museum

This pamphlet will guide you through EBR-I and give you an idea of how atomic energy is used to make electricity. Along the tour route, many exhibits help tell the EBR-I story. If you have any questions during your visit, ask the tour guide on duty. We hope you'll enjoy your visit.

Climb the stairs to the first tour stop.

1. The universe is composed of tiny particles called atoms. Atoms of uranium-235 were used at EBR-I to generate electricity. As shown in the illustration in this exhibit, a uranium-235 atom splits or fissions when struck by a neutron. The splitting atom produces heat and waste products, and releases two or three neutrons. If those neutrons strike other uranium-235 atoms, they will also split, yielding heat and still more neutrons in a chain reaction.

At EBR-I, such a chain reaction was harnessed to generate electricity and also to demonstrate that more new fuel could be created than the reactor "burned." Creating nuclear fuel is possible because of a property of natural uranium. Less than 1 percent of natural uranium is the fissionable uranium-235. The rest is another kind of uranium called uranium-238, which does not readily split. Instead, a neutron is absorbed by a uranium-238 atom, which then changes into plutonium-239, a fissionable atom and a good reactor fuel. Thus, EBR-I was a breeder because it "bred" more plutonium-239 atoms than the uranium atoms it consumed.

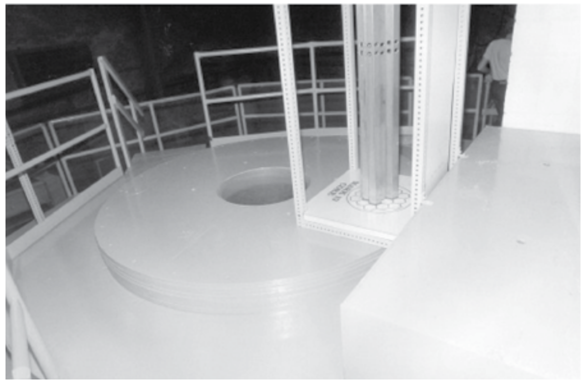
2. Compared to other power plants, EBR-I was unusual mainly in the kind of fuel it used. Coal- or oil-fired power plants burn their fuel to heat water to make steam. This steam drives a turbine that generates electricity. At EBR-I, the nuclear fuel created heat by means of a fission chain reaction. The heat was carried from the reactor core by liquid metal, which in turn heated a second system of liquid metal. This liquid metal was a combination of sodium (Na) and potassium (K) (called "NaK"). The second system containing NaK then heated water to make steam to drive the turbine/generator.

Go out the door on your left and turn right to the control room.

3. Like all power plants, EBR-I had a control room. From this room, operators started and stopped the chain reaction and controlled the equipment for making electricity.

When you're ready, go out the door on your left to stop #4.

4. You are now standing above the reactor – a nuclear heat source or furnace. When the reactor operated, the thick concrete walls surrounding it shielded workers from radiation. The uranium fuel was placed in long, thin, stainless steel rods like these on display. The fuel rods were lowered into the reactor core through the hole in front of you. Fission took place in the core, producing heat and breeding more fuel. There is no fuel in the reactor now. Notice the exhibit entitled "Breeding Blanket." Located in the basement – directly beneath the reactor core – this reflector cup served as the reactor's "on-off" control. When the cup was raised to surround the core, the reactor heated up. The reactor shut down when the cup was lowered



away from the core. Neutrons could escape easily from the small, basketball-sized core and be absorbed by the surrounding shielding.

The uranium-238 reflector around the core absorbed some of the neutrons to make new fuel and bounced enough other neutrons back into the core to maintain the fission chain reaction. Raising or lowering the reflector cup, by means of an elevator, controlled the rate of the reaction.

When you're ready, go back through the control room to the handrail and turn right to the next stop.

5. Steam created by the reactor's heat rotated this turbine. The turbine turned the generator to make electricity. The first electricity generated at EBR-I illuminated four light bulbs like the ones seen here. They are strung just as the original bulbs were in 1951. On that historic day, EBR-I staff members chalked their names on the wall opposite you to commemorate their achievement.

Watch your step going downstairs.

6. In this room, the heat from the second liquid metal system converted water into high-temperature steam. The steam was then piped to the turbine/generator where it produced electricity as you saw in stop #5.

Now follow the yellow lines to stop #7.

7. This plaque was installed by President Lyndon B. Johnson and Dr. Glenn T. Seaborg, chairman of the U.S. Atomic Energy Commission, during the dedication ceremony in 1966 designating EBR-I as a Registered National Historic Landmark - one of only ten in Idaho.

Continue to the fuel storage vault.

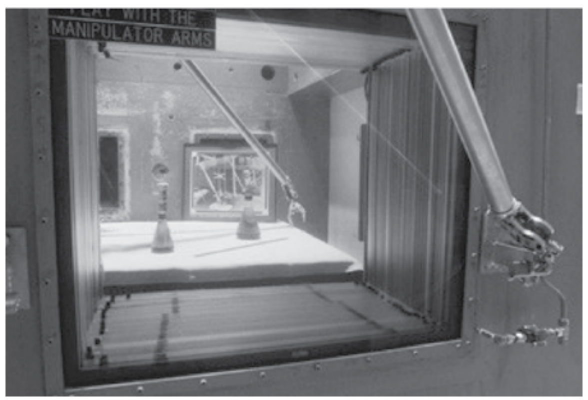
8. The nuclear fuel was inside stainless steel rods (actually only in the lower section of the rods). Extra fuel rods were stored as you see them in this vault. Before they were used in the reactor, the rods were not very radioactive and could be handled safely without shielding. After the fission process occurs in the reactor, the rods become highly radioactive. Behind you is a large cask, which, when lifted by the crane overhead, safely moved the highly radioactive spent fuel rods from place to place.

Go to your left to the rod farm.

9. Some radioactive liquid metal remained on the fuel rods when they were removed from the reactor core. Liquid metal was washed off in the hole covered by the bright metal plate in the floor to your left. Rods were then stored in the individually numbered holes, known collectively as the rod farm. The chalkboard was used to keep track of the spent rod inventory.

Walk along the yellow railing to the hot cell.

10. You are looking into the hot cell, used for inspection and repair of radioactive materials. The window's 34-layers (total thickness of 39 inches) and 39 inch-thick walls provided radiation protection. The manipulators are the first ever devised for remote handling of radioactive materials. Mechanical "hands" inside the hot cell duplicated every motion applied to the controls by an operator who stood outside the cell, where protection from penetrating radiation was provided by the thick concrete walls and the specially designed windows.



Turn back and walk to stop #11.

11. These three manipulators are of a later generation than the one just visited. Try your hand at stacking or positioning the blocks. Please take care when using the manipulators.

Turn to your right and go down the stairs to the next stop.

12. Neutrons could escape easily from the small, basketball-sized core. But the uranium-238 reflector around the core absorbed some of the neutrons to make new fuel and bounced enough other neutrons back into the core to maintain the fission chain reaction. Raising or lowering the cup-shaped reflector, by means of the elevator you see through the window, controlled the rate of the reaction.

Watch your head as you enter!

13. This is the reflector repair room. A reflector made of uranium-238 "bricks" surrounded the reactor core. When penetrated by neutrons, the atoms of uranium-238 converted to plutonium-239, the new fuel bred at EBR-I. Using the machinery around you, an operator looking through the window could remove and replace the bricks one by one.

Watch your head as you leave the room. Once outside, turn right and go around the corner to the window looking into the reflector repair room.

14. Look through the window into the reflector repair room. Notice how dim the room appears. The lead windows absorb not only radiation, but also light. The bank of bright lights above the window inside the room compensated for the light loss.

15. Through the window above, you can see the area where heat from the liquid metal in the reactor was transferred to the second system of liquid metal.

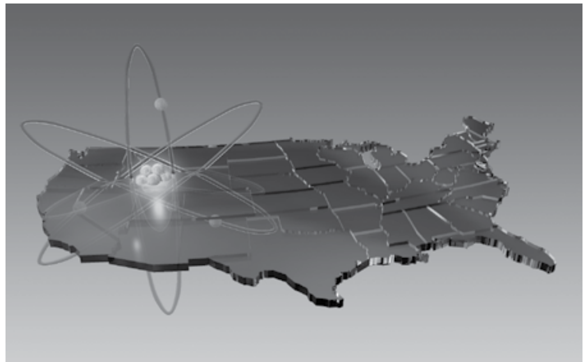
This ends your tour of EBR-I. We invite you to inspect the building further, including the exhibit area, which is to your left when your reach the top of the stairs. You may also seek out the tour guides for more detailed information. Help yourself to the handout material in the exhibit area, and please visit the two aircraft nuclear engine prototypes next to the parking lot. We hope you enjoyed your tour.

NEW TO EBR-I

A new exhibit suite opened in 2011, acknowledging the many achievements of EBR-I's successor, EBR-II. EBR-II began operations in 1964 and continued on until 1994. EBR-II was both larger and much more capable than its older sibling.

The new EBR-II suite is located in the Office Annex. The illustrious history of EBR-II is laid out for visitors, highlighted by replicas of the Control Room and the main floor of the reactor. There are even pieces of equipment that have been preserved from EBR-II and incorporated into the individual displays.

Visitors can also see and hear from those who followed in the EBR-I pioneers' footsteps, building on the success of EBR-I – designing an inherently safe reactor, improving efficiency and economics, and recycling used nuclear fuel. EBR-II was on the cutting edge of advanced nuclear research for over three decades, and the global nuclear science and engineering community still uses the knowledge gained from the reactor's operation.



INL Nuclear Energy Programs

Building upon its legacy responsibilities, infrastructure and expertise, INL's current nuclear energy mission is to lead and integrate development of advanced nuclear technologies that provide abundant, affordable and reliable energy to the United States and the world. This work directly supports the goal of the federal government to re-establish U.S. world leadership in nuclear science and engineering.

Current nuclear research programs focus on supporting the continued safe operation of the current fleet of nuclear power plants in the U.S. and the world, working toward improved fuel cycles, developing advanced nuclear energy systems, and encouraging the next generation of scientists and engineers through support of university research initiatives.

Additional information resources

- Speakers Bureau: Keith Arterburn (208) 526-4845 keith.arterburn@inl.gov
- INL Tours: Don Miley (208) 526-0050 donald.miley@inl.gov

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