1967–2017

Idaho National Laboratory

Advanced Test Reactor

INL Idaho National Laboratory

The Advanced Test Reactor is the only U.S. research reactor capable of providing large-volume, high-flux neutron irradiation in a prototype environment. The reactor makes it possible, in weeks to months, to study the results of years of intense neutron and gamma radiation on reactor materials and fuels for the U.S. Navy, research and power reactors. ATR has many uses, supporting a variety of government and privately sponsored research.

The reactor was designed by Deslonde de Boisblanc in 1959. At its groundbreaking ceremony in 1961, Idaho Gov. Robert E. Smylie said the $40 million project was the largest construction project in the history of the state. It began operating in 1967. A celebration to honor the reactor's 50-year anniversary is being held June 29, 2017.

Past directors of the Advanced Test Reactor

F.R. Keller	1966-1970	B.H. Hamilton	1995-1996
F.L. McMillan	1970-1975	M.C. Patrick	1996-1999
F.C. Fogarty	1975-1978	D.M. Lucoff	1999-2001
M.S. Vargo	1978-1980	J.C. Midgett	2001-2003
D.B. Vanleuven	1980-1984	D.J. Richardson	2003-2005
A.L. Kologi	1984-1985	J.E. Dwight	2005-2007
D.B. Vanleuven	1985-1987	Doug Johnson	2007-2010
H.J. Zeile	1987-1989	Mike Love	2010-2015
F.C. Fogarty	1989-1993	Sean O'Kelly	2015-present
J.C. Okeson	1993-1994		

"The Advanced Test Reactor truly is one of the crown jewels of this laboratory. Capabilities at ATR and the Materials and Fuels Complex allow INL, working with industry and academia, to ensure the competitiveness of nuclear energy for decades to come."

–Dr. Mark Peters,
Idaho National Laboratory Director

It is an honor to be the associate laboratory director for the 50th anniversary of the Advanced Test Reactor's first day of operation. There have been many research, test and power reactors in the world, but there is only one ATR. We, the men and women who have worked here, both now and in the past, are very proud to operate, support and maintain this amazing, one-of-a-kind nuclear facility. Over the past five decades of operation, ATR has supported irradiation research programs in nuclear power and propulsion, and we expect to continue to operate ATR many decades into the future, so we may sustain these programs that are vital to our country.

Our reactor is supporting more nuclear materials research and development now than at any time in its history. There are more experiments, and more complicated experiments, to perform, which keep us busy preparing experimental safety and core design packages for the next operating cycle.

At the same time, the other half of ATR is preparing engineering designs and performing maintenance activities to systematically refurbish or replace equipment that will allow ATR to deliver its mission safely and reliably for years to come.

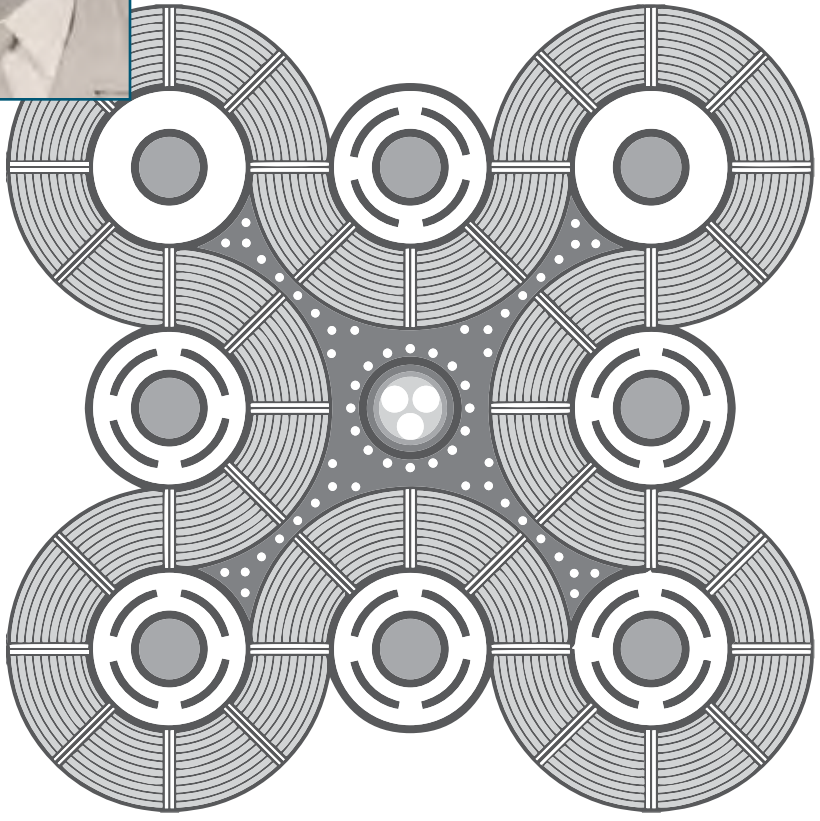
–Dr. Sean O'Kelly,
ATR Associate Laboratory Director

A winning design

Deslonde de Boisblanc and the ATR cloverleaf design

In the late 1950s, the Atomic Energy Commission and the Navy invited a number of companies to make proposals for an advanced test reactor that would serve not only the Navy but the AEC's other test needs for many years to come. Despite study periods of up to three years, none of several responses met the Navy's demanding requirements within a reasonable cost or time. It appeared that the aluminum-clad/enriched-uranium reactor concept might have reached its limit of performance.

The Navy asked Phillips (Petroleum Company) to take two months to review previous proposals and come up, if possible, with a conceptual design. This challenge handed National Reactor Testing Station people a chance to prove they could still produce brilliant ideas. One of them, Deslonde de Boisblanc, a scientist with no doctorate in physics but who nonetheless had a feel for the way neutrons behave, created an elegant design for the reactor core in 1959. The design, named Advanced Test Reactor (ATR), first of all solved the symmetry problem. De Boisblanc described the ATR's new way of controlling the power level.



I tried to avoid a common problem encountered in most other test reactors, where the control elements move up or down. In the ATR, the larger range of control is accomplished by rotating 16 beryllium cylinders with hafnium shells that cover 120° of the outer surface. (Hafnium is a strong neutron absorber.) The cylinders are situated around the core. When rotated singly or in groups, the hafnium moves closer or farther from the core, thereby controlling

reactivity without disturbing the vertical power profile.

The design also included small neutron-absorbing control rods. Unlike control rods in earlier reactors, these were not moved slowly up or down during reactor operations to effect their control, but either fully inserted or fully removed. Another groundbreaking—and aesthetically satisfying—innovation in the ATR was how it wrapped the reactor's fuel around the samples in serpentine fashion, more than doubling the neutron flux (available in the Engineering Test Reactor) to the sample. As de Boisblanc relates, it was during the long drive home from the Site that the "Aha!" moment occurred.

As was the custom, I was driving Byron Leonard, our consultant from Internuclear Company, to his hotel in Idaho Falls. It was one of those lingering twilight evenings, still quite light. On that straight stretch of Highway 20 across the desert, with its sagebrush and the frequent lava flow patches, there wasn't much to distract us.

I started to describe a novel way to look at the problem before us. I thought of breeder reactors, where the effort is to minimize the leakage of neutrons. I tried to think how we might make the neutrons leak in the direction of the sample, where we wanted to maximize the number of neutrons absorbed into the Navy's samples. If we placed water between the ATR fuel and the sample, the fast neutrons would "leak" into the water and collide with hydrogen. This would slow them down and they would pile up to create a high slow-neutron flux. This is the so-called "flux trap," which I didn't invent.

I reached over across the front seat of the car and with my finger drew four circles for test loops, and then a snakelike fuel line partially around each loop. Immediately, I saw that we could place another loop at the very center because the four arcs that surrounded the center loop were almost as effective as a circle. It soon became obvious that by placing a beryllium reflector properly we could gain four more attractive loop locations.

The more we looked at that strange arrangement, the better it looked. Possible new locations for control elements became apparent. Byron was so excited he volunteered to lay out the configuration. He didn't get much sleep that night, but what he produced was remarkable. His plan view showed that the entire serpentine fuel arrangement could be produced with only one type of fuel element. The number of test loops grew from the original four to nine.

The more we looked at that strange arrangement, the better it looked.

The next several days brought the usual questions from devil's advocates. As always with a "rich" design, each negative, when resolved, revealed new capability. They sensed they had a winner. Arranging the core into multiple different flux-trap regions—in which the power level could be different in each simultaneously—was something that de Boisblanc did invent. Satisfied, the AEC and the Navy selected the ATR cloverleaf design.

"Proving the Principle, a History of the Idaho National Engineering and Environmental Laboratory 1949-1999," by Susan M. Stacy Chapter 17

"The Advanced Test Reactor is a vital American asset. From serving as the primary testing station for the U.S. nuclear Navy to advancing clean nuclear energy, ATR and its talented staff have been achieving remarkable results for five decades. Here's to the next half-century of progress!"

–Gov. C.L. "Butch" Otter

The Early Years

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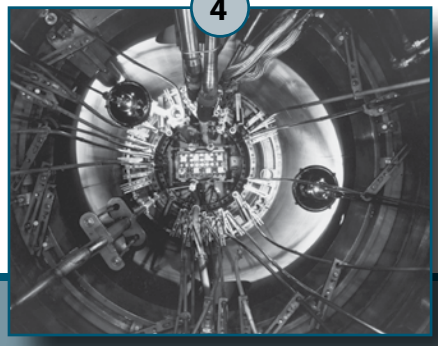
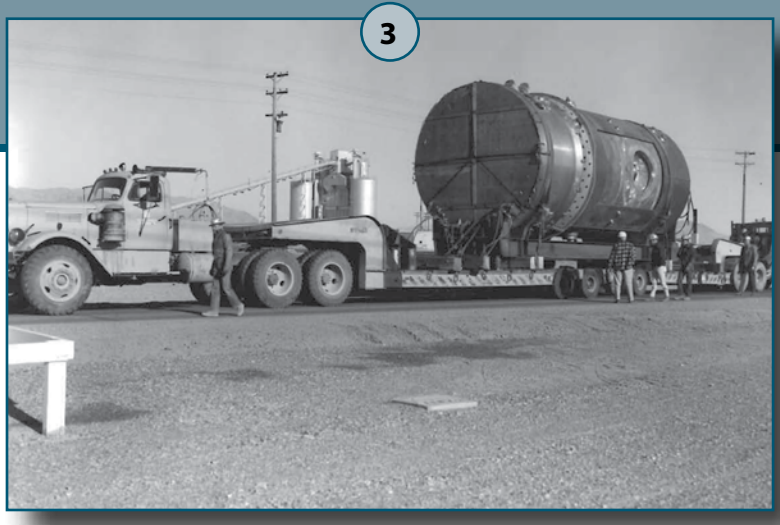
2

1. Construction of ATR facilities. Jan. 4, 1962.
2. Construction of ATR facilities, looking northeast at excavation operations for reactor building foundations. Dragline at left is mucking out rock from heat exchanger pit. Backhoe is stripping overburden in rod access and waste pit area.
3. Reactor vessel and core internals assembly being transported by truck from Central Facilities Area to ATR Complex after arriving by rail.
4. ATR predecessor, the Materials Test Reactor (MTR), was the first reactor at the ATR Complex. A view of the MTR core and reflector.
5. ATR reactor vessel and core internals assembly ready to be lowered into position.

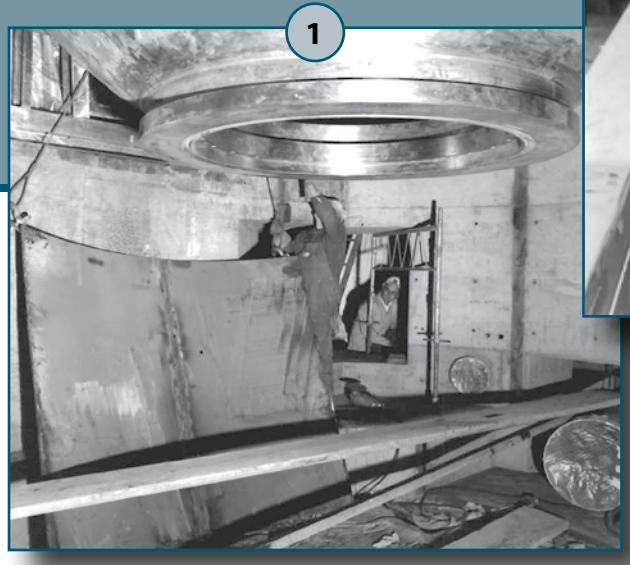


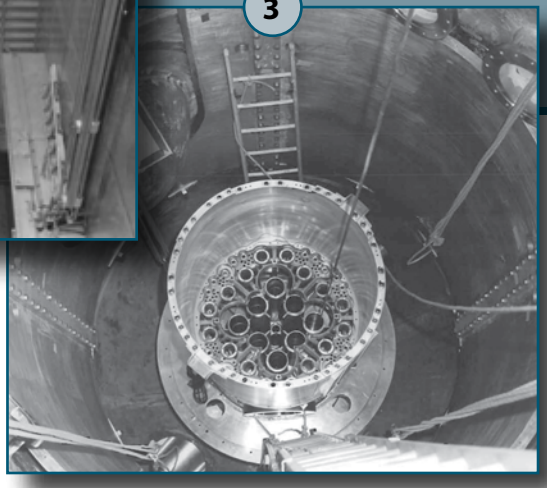


"For 50 years, the Advanced Test Reactor has served the American taxpayer, enhancing national security by keeping nuclear-powered submarines at sea for their lifetimes, and driving an evolution of nuclear energy into a power source that provides 19 percent of this nation's electricity. The good news? With regular maintenance and upgrades, ATR will continue to be the test reactor of choice for decades to come."

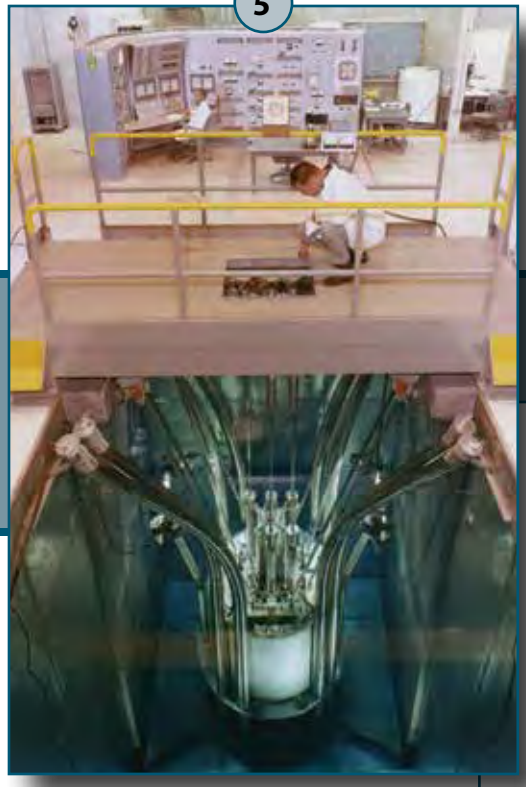
–Lt. Gov. Brad Little

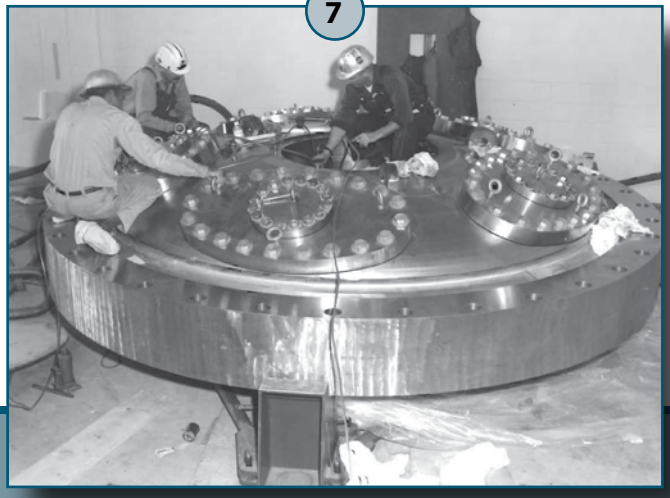
1960s

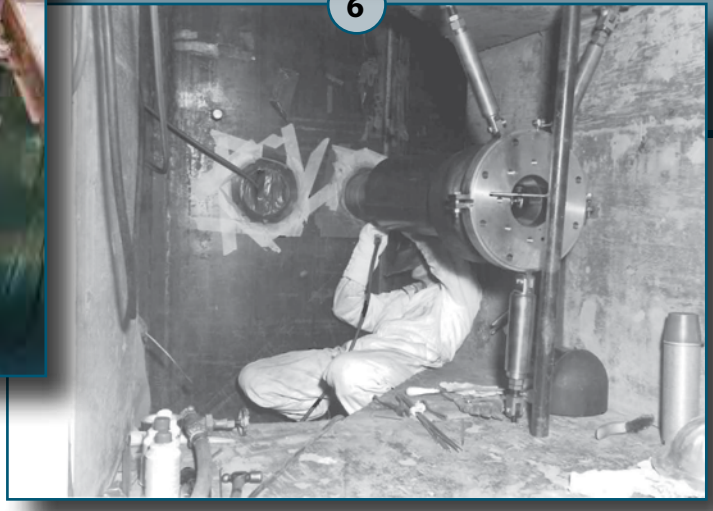




1. Lowering reactor vessel in the ATR reactor building.
2. ATR Canal under construction.
3. View looking northeast through refueling port showing interior of reactor vessel.
4. ATR predecessor, the Engineering Test Reactor (ETR), was the second reactor at the ATR Complex. A view of ETR core.
5. ATR Critical Facility.
6. ATR safety rod drive flange tube being welded to vessel nozzle in the safety rod drive area.
7. Hydrostatically testing loop penetration plugs in reactor vessel top head closure plate.







"Idaho is home to world-class nuclear reactor research, a proud history of 50 years dating back to the Advanced Test Reactor's first day of operation. Its unique qualities as the only reactor capable of providing large-volume, high-flux neutron irradiation help pave the way for safe advancements in nuclear technology. Research surrounding the ATR is crucial to decreasing nuclear proliferation threats and promoting American energy independence. Congratulations to ATR's dedicated workforce, both past and present. We look forward to the legacy you will continue to build over the next 50 years."

–Sen. Mike Crapo

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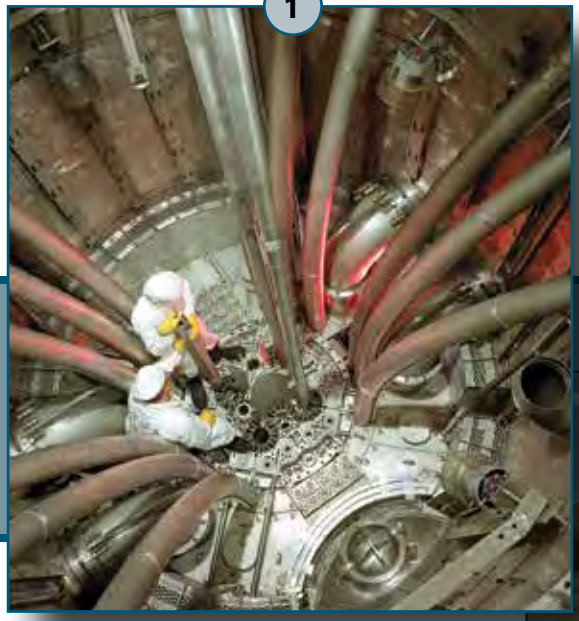

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1 Inside ATR before July 2, 1967, making sure fuel elements fit properly.

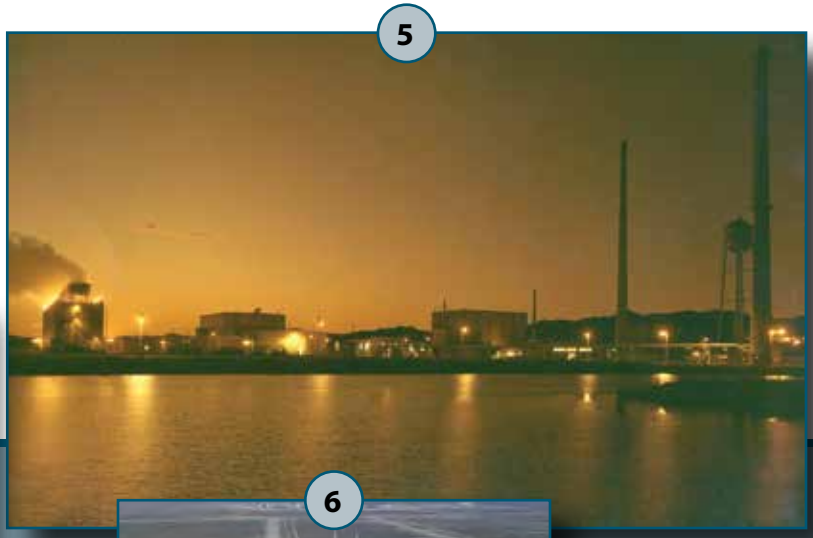
2. Core of the ATR at power, exhibiting the blue Cherenkov Effect.

3. Looking west at ATR Complex; ETR (left), MTR (middle) and ATR (right).

4. ATR reactor top.

5. ATR Complex at night with evaporation ponds in the foreground.

6. ATR Complex aerial view from the NW to SE.



"As our nation's leading nuclear energy research laboratory, Idaho National Lab is home to the Advanced Test Reactor—a true national treasure. For the last fifty years, the Advanced Test Reactor has ensured that nuclear power is a safe and effective source of energy, and has helped power the U.S. Navy. The dedicated research and operations personnel have been key to Advanced Test Reactor's successes and they will continue to sustain its mission well into the future."

–Sen. James E. Risch

1970s

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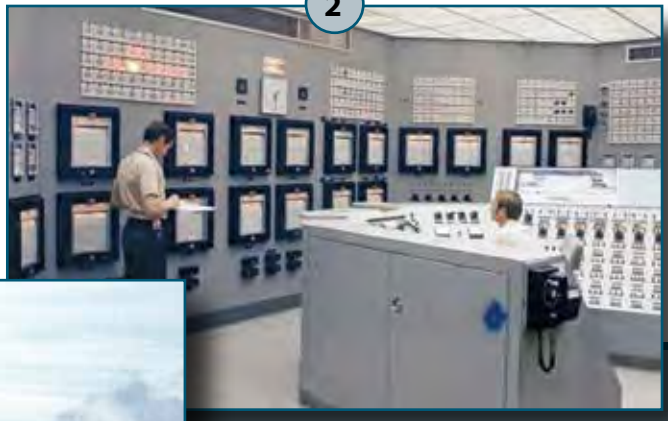

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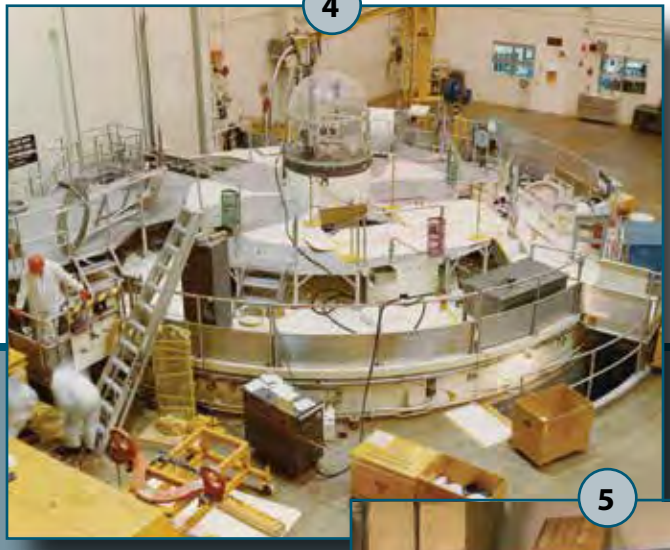
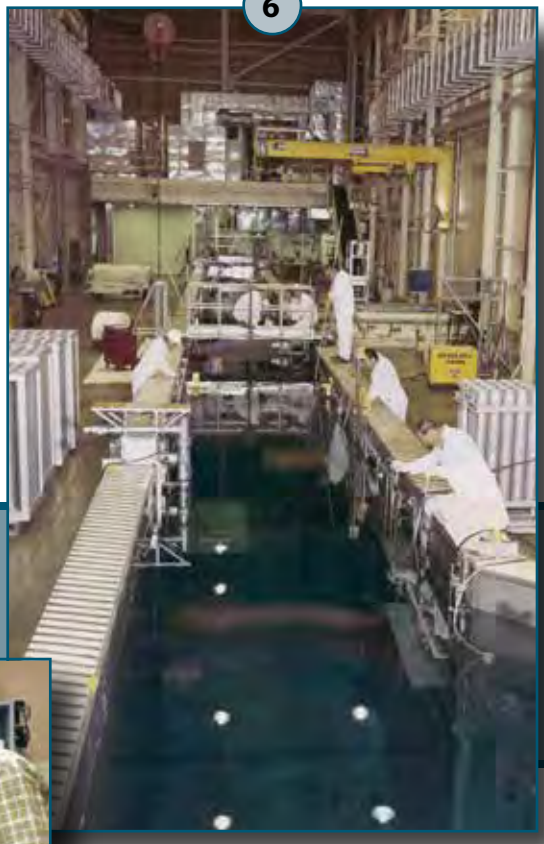
1. Water vapor rises from the MTR (middle), ETR (left) and ATR (right), all at power providing neutrons for customers.
2. ATR Control Room, 1971.
3. ATR Canal, 1971.
4. ATR reactor top.
5. ATR Health Physics office.
6. Work being performed in the ATR Canal area.

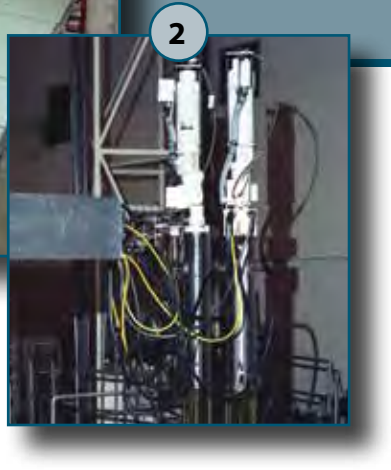




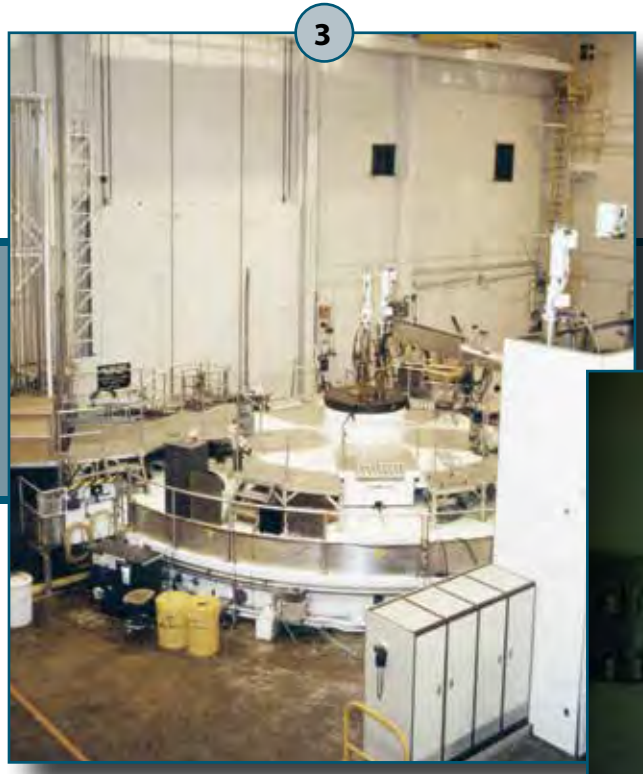
"From the very beginning, the Advanced Test Reactor and its dedicated employees have established Idaho as the nation's premier research, development, and demonstration facility for assessing and measuring neutron behavior in complex environments. I'm proud to celebrate ATR's 50th anniversary, and I look forward to many more years of successful operation."

–Rep. Mike Simpson

1980s



1. Control system to operate 1C West Loop in the ATR 2nd Basement. Individual control systems were replaced by the Loop Operating Control Station.
2. Powered Axial Locator Mechanism (PALM) for moving experiments into and out of ATR during operation.
3. ATR top with PALM equipment in place.
4. Looking through the window from ATR Control Room to the main floor.
5. Safely handling Cobalt 60 targets in the ATR Canal.



"The incredible advances in nuclear technology—whether for generating power or powering our military— can trace their roots to the Advanced Test Reactor. This is a legacy for which the people of Idaho should be incredibly proud. The Advanced Test Reactor has made Idaho and the United States a world leader in nuclear advancements for the past 50 years, and I'm looking forward to another 50 years of strong leadership."

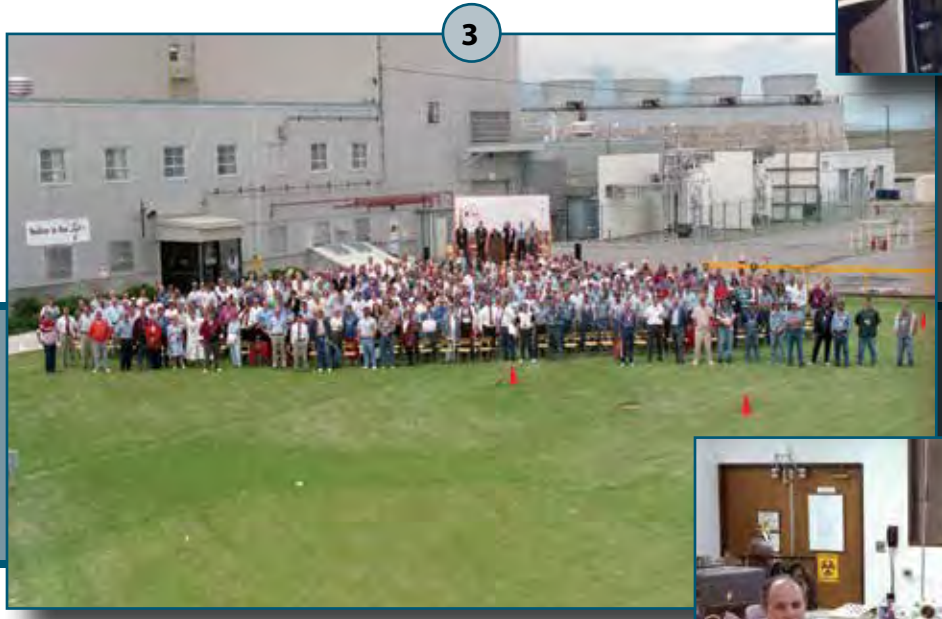
–Rep. Raúl Labrador

1990s

1

2

1. Technicians working in the (TRA) Hot Cells.
2. Working with an In-Pile Tube Strongback on the main floor of ATR.
3. Attendees of the 30th anniversary celebration.
4. Laboratory in the basement of MTR.
5. Installation of the Loop Operating Control Station.



"The Advanced Test Reactor is a national treasure and is key to our security. For over 50 years, the Advanced Test Reactor has provided the Navy with crucial services that support today's nuclear fleet and enable our future nuclear navy."

–Adm. James F. Caldwell Jr.,
Naval Nuclear Propulsion Program Director

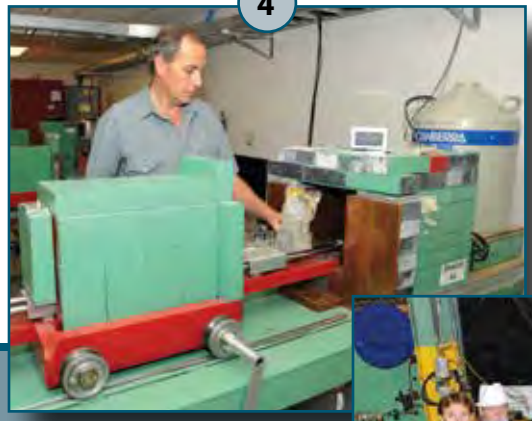
2000s


1


3

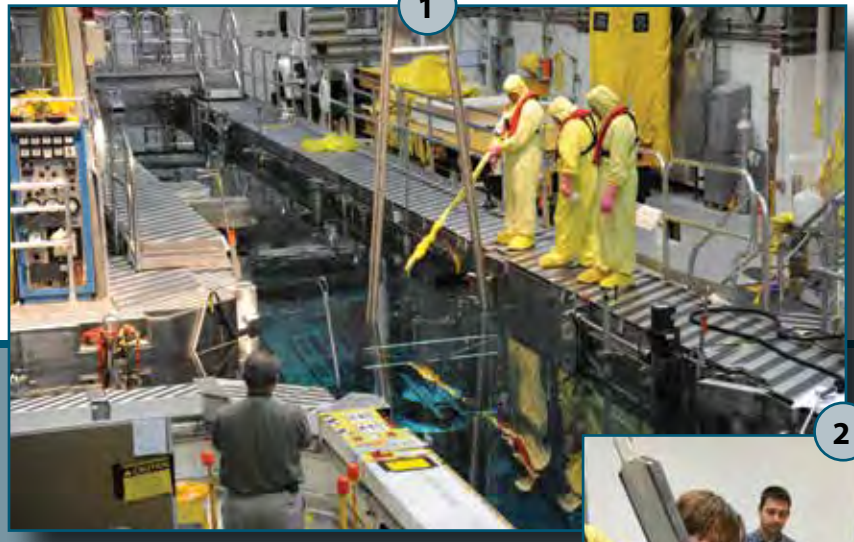

2

1. Backup diesel generator in case of loss of commercial power.
2. ATR Simulator.
3. Operators accessing a refueling port during an outage.
4. Radiation Measurements Laboratory (RML) at ATR Complex.
5. ATR Complex maintenance organization employees fabricate an ATR work platform.
6. An Electric Power Research Institute (EPRI) experiment being assembled at the Test Train Assembly Facility (TTAF).



"The Department of Energy's Office of Nuclear Energy has world-class facilities across the nation, and the Advanced Test Reactor is the crown jewel of our nuclear research infrastructure. Its ingenious design and its dedicated personnel have made it an invaluable asset for the nation across five decades. Going forward, we remain committed to operating, maintaining and upgrading ATR to continue its role as the best research reactor in the world."

–Ray Furstenau, U.S. Department of Energy Office of Nuclear Energy, Associate Principal Deputy Assistant Secretary



1. ATR operators and radiation control technicians preparing to lift a loaded used fuel cask out of the storage canal.
2. Workers load an experiment into ATR.
3. Refueling port platform used for maintenance or repair work inside the reactor vessel without removing the reactor head.
4. On May 8, 2017, Energy Secretary Rick Perry, Rep. Mike Simpson and Adm. James Caldwell toured the ATR.
5. Aerial view of ATR Complex, 2015.

"The Advanced Test Reactor has operated safely for many years and through its research continues to improve the safety of the nation's and the world's nuclear facilities and capabilities. Its unique design and dedicated cadre of operations and research personnel will ensure its continued contributions for many years to come."

–Rick Provencher, U.S. Department of Energy Idaho Operations Office Manager

Recognizing the 50th Anniversary of the Advanced Test Reactor at Idaho National Laboratory

Hon. Michael K. Simpson of Idaho in the House of Representatives, Tuesday, April 25, 2017

Mr. SIMPSON. Mr. Speaker, I rise today to call your attention to an extraordinary facility located on the Department of Energy's 890-square-mile Site in Idaho, and the many people who have been employed there over the last 50 years.

Idaho National Laboratory is this nation's lead nuclear research, development and deployment laboratory. It also has emerged as a world leader in cybersecurity, keeping our critical infrastructure safe from those who would do us harm, and broader clean energy research and development.

One of INL's crown jewels is the Advanced Test Reactor. This summer, we are celebrating the 50th anniversary of ATR, and recognizing that experiments conducted there have helped ensure our national security and advance knowledge about clean nuclear energy.

Just as importantly, we also recognize that, with regular maintenance and upgrades, ATR will continue to be this nation's test reactor of choice at least through 2050.

What makes ATR so unique—and valuable—is its ingenious cloverleaf design, envisioned by an engineer named Deslonde de Boisblanc on a lonely stretch of Highway 20 in the Idaho desert more than a half century ago.

de Boisblanc's design resulted in a one-of-a kind reactor that can house simultaneous experiments under distinct temperatures, pressures and irradiation conditions. That means, at the ATR complex, we can test materials for academia, industry and the U.S. Navy—all at the same time. The knowledge that our talented scientists, engineers and technicians pull out of this reactor is incredibly valuable.

For example, when the Navy began sending fuel samples from its nuclear submarines to the INL Site, that science was in its infancy. Eventually, nuclear fuel became more complex. The Navy needed to test larger fuel elements, not just samples, and with the Cold War accelerating, it needed those test results more quickly.

So, ATR was built, started up in 1967, and two years later brought to full power of 250 megawatts. The impact on America's Nuclear Navy has been remarkable. Early submarines had to be pulled out of duty every two years or so for expensive and time-consuming refueling. Because of what we have learned from experiments at ATR, the reactor cores for the Navy's newest submarines last for their entire lifetimes, more than 30 years.

Idaho National Laboratory's Advanced Test Reactor has saved taxpayers millions of dollars and made our country safer and more secure. That's a testament not only to the facility—and de Boisblanc's unique design—but also to generations of world-class scientists, engineers, technicians and mechanics who have kept the reactor functioning at the highest possible level these five decades.

ATR has also played a central role in helping sustain this nation's current light-water nuclear reactor fleet, which produces 19 percent of America's electricity and 63 percent of its carbon-free electricity.

In 2007, ATR became a National Scientific User Facility. That allows our colleges and universities to run experiments at ATR, with the Department of Energy footing the bill. As a result, we have expanded knowledge about clean nuclear energy throughout the nation and built a foundation for the next generation of reactors, including small modular reactors, such as one that could begin producing power in the Idaho desert as soon as 2024.

It is a great honor to congratulate INL on ATR's 50th anniversary, acknowledge its dedicated, talented and determined workforce, from past and present, and look ahead to many more years of valuable service to our nation.

Executive Department
State of Idaho

The Office of the Governor
Proclamation

State Capitol
Boise

WHEREAS, Idaho National Laboratory (INL) is the nation's leader in nuclear research, development and deployment; and

WHEREAS, INL's Advanced Test Reactor is celebrating 50 years of service to the nation; and

WHEREAS, the Advanced Test Reactor modernized America's nuclear Navy and helped ensure our national security by keeping nuclear-powered submarines at sea instead of in ports for regular refueling; and

WHEREAS, the ability to test nuclear fuel and materials at different power levels has helped extend the lives of the nation's commercial nuclear reactors, which provide 19 percent of America's electricity and 63 percent of our carbon-free electricity; and

WHEREAS, the Advanced Test Reactor contains the greatest volume of experimental space in the world, is in demand from academia and industry, and with regular updates will continue to be the test reactor of choice for years to come;

NOW, THEREFORE, I, C.L. "BUTCH" OTTER, Governor of the State of Idaho, do hereby proclaim the June 29, 2017 to be

ADVANCED TEST REACTOR DAY

in Idaho.

IN WITNESS WHEREOF, I have hereunto set my hand and caused to be affixed the Great Seal of the State of Idaho at the Capitol in Boise on this 29th day of June, in the year of our Lord two thousand and seventeen and of the Independence of the United States of America the two hundred forty-first and of the Statehood of Idaho the one hundred twenty-seventh.

C.L. "BUTCH" OTTER
GOVERNOR

LAWERENCE DENNEY
SECRETARY OF STATE

"The Advanced Test Reactor is a tribute to American ingenuity and ability, and has allowed the U.S. to lead the world in nuclear reactor technology for 50 years. It has supported the U.S. Nuclear Navy to become the best, most safe and reliable nuclear fleet in the world. The Department of Energy is looking forward to many more years of cutting-edge nuclear science to come from the Advanced Test Reactor and the dedicated employees at the ATR Complex."

–Secretary Rick Perry
U.S. Department of Energy

17-50148