Replacing ATR core components requires removal of the 31-ton stainless steel lid of the reactor vessel, last done in 2004. ATR's distinctive cloverleaf core is shown at right.

Renewing INL's Advanced Test Reactor

The Advanced Test Reactor, or ATR, is a centerpiece for the world-leading nuclear energy research capabilities at Idaho National Laboratory. ATR is the world's most powerful and versatile test reactor.

A DISTINCTIVE NATIONAL RESOURCE

ATR's one-of-a-kind capabilities support a wide range of vital missions for the U.S. Navy and the Department of Energy's Office of Nuclear Energy. The reactor also supports university research and both U.S. and international nuclear industries. Plus, it produces valuable isotopes for medical treatments and to power NASA space exploration.

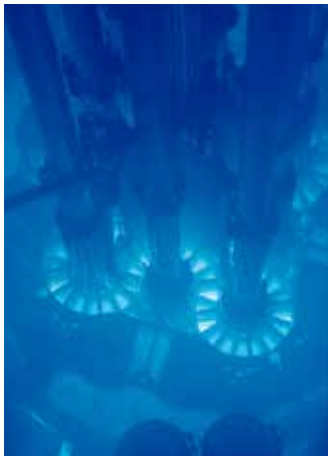
ATR began operating in 1967 and was the third-generation design for flagship test reactors operating on the INL Site. ATR's distinctive cloverleaf design was far ahead of its time, enabling capacity and a range of capabilities no other test reactor can match even today.

OVERHAULING THE REACTOR

ATR is an intricate machine, and the entire core overhaul process can be compared to rebuilding the engine of a high-performance car. It is a highly complex task that requires careful planning and coordination, resulting in as-new performance.

As a test reactor, ATR operates at low temperatures and pressures compared to commercial power reactors, which are designed to produce heat. In contrast, ATR's main job is to produce neutrons. It does so at very high levels, aided by reflectors made of beryllium metal surrounding the reactor core. By exposing fuel and material samples to this environment, researchers gain valuable data about how new materials and designs will respond to long-term operations in high-radiation environments.

Designers knew the high level of neutrons would eventually take its toll on the reactor's reflector blocks and other internal core components. So they tailored ATR's unique design to enable key internal components to be periodically replaced through a process known as the Core Internals Changeout.



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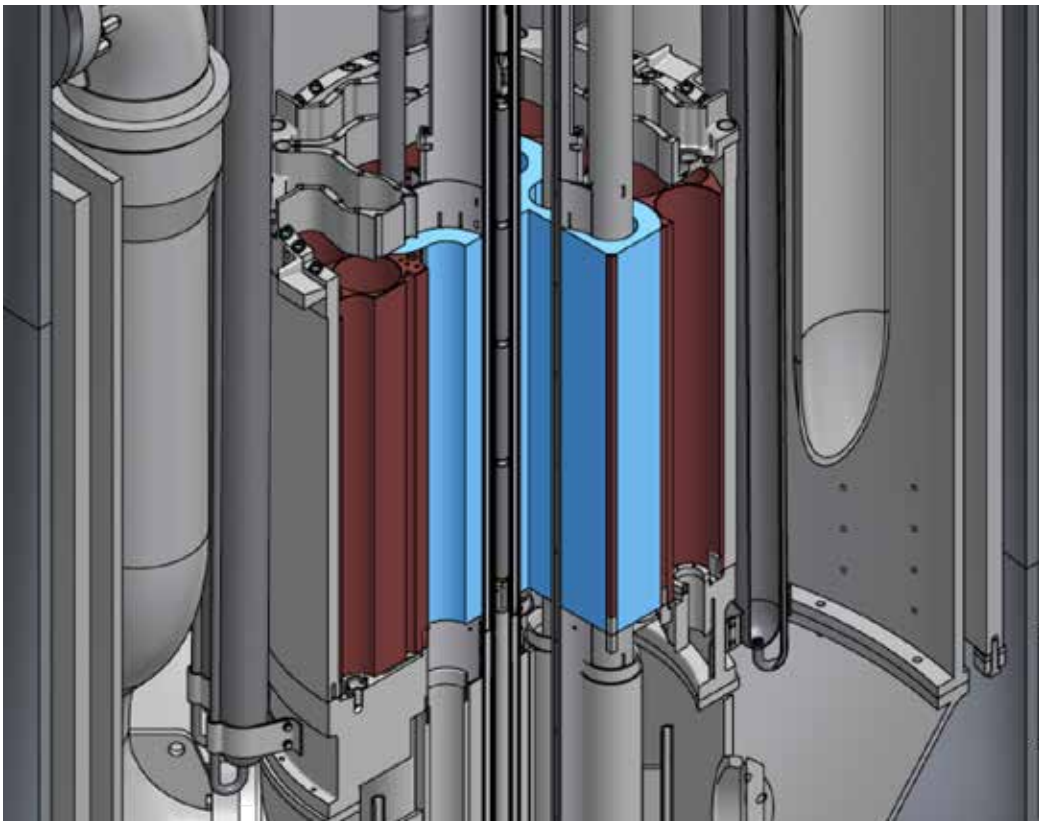

ATR's core overhaul process renews the reactor by replacing components nearest to the core (shown in blue). Those components experience the heaviest long-term wear, particularly the reflector blocks (shown in red).

Initially, overhauls of ATR occurred every five years, but the interval became longer as the ATR team gained operational experience and improved the design of the beryllium reflector blocks.

ATR has been through five core overhauls since it first achieved full power, with the last beginning in 2004. ATR's sixth overhaul, lasting about nine months, began in April 2021.

ACCESSING THE CORE

Gaining access to the key components inside the vessel is a daunting task in itself, involving the removal and replacement of much of ATR's experiment support infrastructure, including the in-pile tubes that are used to expose experiments to the core environment.

Next, 23 interlocking concrete and steel shield blocks are removed, totaling more than 150,000 pounds. The shield blocks rest over the reactor vessel during normal operations. Then the 62,000-pound stainless steel lid of the reactor vessel is removed and placed on a stand for inspection and upgrades.

At this point, ATR's team can replace the reactor's reflector blocks and other key components, before beginning the careful reassembly and reinstallation of the experiment infrastructure.

RESTART PREPARATIONS

Before operations can resume, INL and DOE verify readiness by assessing all existing procedures and training, paying special attention to modifications made during the outage.

The reactor fuel and a new round of experiments can then be inserted. Cooling and experiment loop flow systems are gradually brought up to pressure. Then a newly overhauled Advanced Test Reactor can continue its mission as the nation's leading test reactor, helping to enable a new generation of advanced reactors that will provide the world with clean energy well into the future.

Watch a video overview of ATR here: https://youtu.be/kAI4bbf8xfU

And an animated overview of the core changeout process here: https://youtu.be/XxAAlMMF24w

FOR MORE INFORMATION

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