BREAZEALE REACTOR

Penn State research reactor license is renewed

The Penn State reactor's license—the first one awarded by the Atomic Energy Commission—was recently renewed for an additional 20 years.

Pennsylvania State University's Breazeale Reactor is the longest operating licensed reactor in the United States. Its license—the first one ever awarded by the Atomic Energy Commission (AEC)—was issued on July 8, 1955, and the reactor was designated in 1991 as a Nuclear Historic Landmark by the American Nuclear Society. The reactor is still in service today, and on November 20, 2009, its license was renewed by the Nuclear Regulatory Commission for an additional 20 years.

The early days

Penn State was one of the first universities to take advantage of the Atoms for Peace program in the 1950s. Eric A. Walker, then the dean of engineering and architecture, proposed that the university construct a reactor for research and education purposes. The university's president, Milton Eisenhower (the brother of U.S. President Dwight D. Eisenhower) supported and encouraged this endeavor.

In early 1953, the university's board of trustees authorized $250 000 for the project, and two prominent nuclear engineers, William M. Breazeale and Robert G. Cochran, left Oak Ridge National Laboratory to design the reactor. Construction began in 1954 and was completed in time for the dedication on February 22, 1955. Fuel was not available until July because the AEC had not yet established procedures for its distribution and monitoring. The reactor went critical for the first time on August 15, 1955.

At that time, the reactor was known as the Pennsylvania State University Nuclear Reactor Facility. Its name was changed in March 1971 to honor Breazeale, the reactor's first director and its first licensed operator, who had died in 1970.

In 1960, the reactor's high-enriched uranium core—a materials testing reactor (MTR)–type—was upgraded in power from 100 kWt to 200 kWt. A license amendment in 1965 allowed for the conversion of the reactor to a TRIGA (Training, Research, Isotopes, General Atomics) design, which provided a higher steady-state power of 1 MWt and the capability to pulse the reactor up to 2000 MWt. Penn State was not the first university to install a TRIGA, but it was the first to convert an existing reactor from the high-enriched MTR core to the lower-enriched uranium TRIGA core.

President Dwight D. Eisenhower at the dedication ceremony for the Penn State research reactor on February 22, 1955. Shown here with Eisenhower (from left) are William Breazeale, Penn State President Milton Eisenhower, and Dean of Engineering Eric Walker. (Photo: Pennsylvania State University Archives)

The TRIGA license was renewed by the Nuclear Regulatory Commission in 1986 for a 20-year period, and another license renewal application was submitted to the NRC in December 2005. After the agency's initial review, the NRC made several requests for additional information. Once the additional information was supplied by the university and the NRC was satisfied with the responses to its questions, a 20-year license renewal was granted last November.

According to the NRC's license-renewal report on the reactor, the facility poses "no significant radiological risk to the health and safety of the public, facility personnel, or the environment." The report also concluded that the reactor has adequate funding and qualified personnel to continue operation for the next 20 years.

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Breazeale's research role

In the early days, the reactor's research targeted nuclear theory applications. Other research areas included materials testing and the production of radioactive isotopes for tracers. Neutron activation analysis was heavily utilized as a trace element analysis technique. Penn State faculty pioneered the use of activatable tracers for environmental investigation and biological systems research. The development of the neutron beam for nondestructive imaging began in the early 1980s with facility upgrades and continues today, with plans for expansion.

Penn State was one of only two universities where in 1956 an International School of Nuclear Science and Engineering was established to educate scientists and engineers from foreign countries. A total of 175 scientists and engineers from 39 countries participated in one of six programs that were conducted at Penn State from April 1956 to January 1959. The facility also conducted training programs for reactor operators in the United States until the early 1980s and developed special training and experiments for operators who would be conducting the defueling procedure at the post-accident Three Mile Island-2 reactor.

The Breazeale Reactor is housed in the Radiation Science and Engineering Center, which was established in 1990 as a university-wide facility to promote research, education, and varied applications of radiation science and nuclear engineering. In addition to the swimming pool–type reactor, the center currently includes gamma irradiation facilities (in-pool irradiator, dry irradiator, and hot cells), the Radionuclear Applications Laboratory, and various radiation detection and measurement labs. In the early 1990s, the center was one of the first facilities to install a digital control and monitoring system.

The reactor was originally attached to the middle of a bridge-like structure spanning the pool, with the bridge moving on rails along the length of the pool. In the mid-1990s, the bridge structure was redesigned to add lateral and rotational movement to the reactor core, which allows it to be positioned almost anywhere in the pool. To the best of the knowledge of the center's faculty, this capability makes the reactor unique in the world.

Plans for the expansion of the existing neutron beam lab and a new core-moderator and beam port arrangement are under way. The research envisioned for the center's new beam port/beam hall design will be primarily in cutting-edge nuclear science and materials science.

A view of the Breazeale Reactor core (Photo: Michael Black/Penn State University, Mechanical and Nuclear Engineering Department)

REACTOR OPERATORS

Grand Gulf puts reactor operators to the test

For reactor operators at Entergy Nuclear's Grand Gulf nuclear power plant, supporting the utility's commitment to safety constantly puts them to the test. Every five weeks, the operators are taken off shift for a week of requalification training and testing.

"Every five weeks my job is in jeopardy," said Bill Gordon, a control room supervisor at the Grand Gulf plant in Port Gibson, Miss. "That reality—along with a determination to ensure safety for employees and the community—motivates operators to always perform at peak levels."

Reactor operators are charged with generating power in a safe and responsible manner while protecting the safety and health of the public. Charles Roberts, training superintendent at Grand Gulf, said, "We train from the concept of nuclear safety, applying conservative bias and making sure that we don't get caught up in production demands versus the ultimate goal of safety."

In addition to understanding technical concepts, operators must demonstrate skills in communications, coaching, and teamwork. Exercises in the simulator are designed to duplicate actual plant events, and control room crews are required to follow procedures and work together to resolve problems.

The expectation is for crew members to identify areas in which they need to im-