

NUCLEAR REGULATORY COMMISSION
PENNSYLVANIA STATE UNIVERSITY
DOCKET NO. 50-005
PENN STATE BREAZEALE REACTOR
ENVIRONMENTAL ASSESSMENT AND FINDING OF
NO SIGNIFICANT IMPACT
[NRC-2009-0495]

The U.S. Nuclear Regulatory Commission (NRC or the Commission) is considering issuance of a renewed Facility Operating License No. R-2, to be held by Pennsylvania State University (PSU or the licensee), which would authorize continued operation of the Penn State Breazeale Reactor (PSBR), located in University Park, Centre County, Pennsylvania. Therefore, as required by Title 10 of the *Code of Federal Regulations* (10 CFR) Section 51.21, the NRC is issuing this Environmental Assessment and Finding of No Significant Impact.

ENVIRONMENTAL ASSESSMENT

Identification of the Proposed Action:

The proposed action would renew Facility Operating License No. R-2 for a period of twenty years from the date of issuance of the renewed license. The proposed action is in accordance with the licensee's application dated December 6, 2005, as supplemented by letters dated October 31, 2008, and April 2, June 11, September 1, and October 21, 2009. In accordance with 10 CFR 2.109, the existing license remains in effect until the NRC takes final action on the renewal application.

Need for the Proposed Action:

The proposed action is needed to allow the continued operation of the PSBR to routinely provide teaching, research, and services to numerous institutions for a period of twenty years.

Environmental Impacts of the Proposed Action:

The NRC has completed its safety evaluation of the proposed action to issue a renewed Facility Operating License No. R-2 to allow continued operation of the PSBR for a period of twenty years and concludes there is reasonable assurance that the PSBR will continue to operate safely for the additional period of time. The details of the NRC staff's safety evaluation will be provided with the renewed license that will be issued as part of the letter to the licensee approving its license renewal application. This document contains the environmental assessment of the proposed action.

The PSBR is located on the main campus of PSU and is a part of the Radiation Science and Engineering Center. The reactor is housed in a multipurpose building constructed primarily of concrete, brick, steel, and aluminum which serves as a confinement. The reactor site comprises the reactor building and a small area immediately surrounding it, bounded by a chain-link fence. Adjacent to the site are athletic facilities to the north and west, fields and parking lots to the east, and academic and research buildings to the south. The nearest permanent residences are located approximately 360 meters (390 yards) from the site boundary. The nearest dormitories are located approximately 130 meters (120 yards) south of the reactor.

The PSBR is a pool-type, light water moderated and cooled research reactor licensed to operate at a steady-state power level of 1 megawatt thermal power (MW(t)). The reactor is also licensed to operate in a pulse mode. The fuel is located at the bottom of a polyurea-lined concrete pool with a volume of approximately 270,000 liters (71,000 gallons) and a depth of 7.3 meters (24 feet). The reactor is fueled with standard low-enriched uranium TRIGA fuel. A detailed description of the reactor can be found in the PSBR Safety Analysis Report (SAR). There have been no major modifications to the Facility Operating License since renewal of the license on January 27, 1986.

The licensee has not requested any changes to the facility design or operating conditions as part of the application for license renewal. No changes are being made in the types or quantities of effluents that may be released off site. The licensee has systems in place for controlling the release of radiological effluents and implements a radiation protection program to monitor personnel exposures and releases of radioactive effluents. As discussed in the NRC staff's safety evaluation, the systems and radiation protection program are appropriate for the types and quantities of effluents expected to be generated by continued operation of the reactor. Accordingly, there should be no increase in routine occupational or public radiation exposure as a result of license renewal. As discussed in the NRC staff's safety evaluation, the proposed action will not significantly increase the probability or consequences of accidents. Therefore, license renewal should not change the environmental impact of facility operation. The NRC staff evaluated information contained in the licensee's application and data reported to the NRC by the licensee for the last five years of operation to determine the projected radiological impact of the facility on the environment during the period of the renewed license. The NRC staff found that releases of radioactive material and personnel exposures were all well within applicable regulatory limits. Based on this evaluation, the NRC staff concluded that continued operation of the reactor should not have a significant environmental impact.

I. Radiological Impact

Environmental Effects of Reactor Operations:

Gaseous radioactive effluents are discharged by the facility exhaust system via vents located on the roof of the reactor building, at a volumetric flow rate of approximately 1.4 cubic meters per second (3000 cubic feet per second). Other release pathways do exist, however they are normally secured during reactor operation and have insignificant volumetric flow rates compared to the facility exhaust system. The only significant nuclide found in the gaseous effluent stream is Argon-41. The licensee performed measurements of Argon-41 production for

conditions of low-power and high-power reactor operation. Licensee calculations, based on those measurements, indicate that annual Argon-41 releases result in an offsite concentration of $3.2\text{E-}10$ microCuries per milliliter ($\mu\text{Ci/ml}$), which is below the limit of $1.0\text{E-}8$ $\mu\text{Ci/ml}$ specified in 10 CFR 20, Appendix B for air effluent releases. The NRC staff performed an independent calculation and found the licensee's calculation to be reasonable. The licensee also performed measurements and calculations to estimate the potential release of tritium resulting from evaporation of the reactor pool water. The NRC staff performed independent calculations and found the licensee's calculations to be reasonable and the potential airborne tritium concentration to be a small fraction of the air effluent concentration limit specified in 10 CFR 20, Appendix B. Total gaseous radioactive releases reported to the NRC in the licensee's annual reports were less than four percent of the air effluent concentration limits set by 10 CFR 20, Appendix B. The potential radiation dose to a member of the general public resulting from this concentration is approximately 0.02 milliSieverts (mSv) (2 millirems (mrem)) and this demonstrates compliance with the dose limit of 1 mSv (100 mrem) set by 10 CFR 20.1301. Additionally, this potential radiation dose demonstrates compliance with the air emissions dose constraint of 0.1 mSv (10 mrem) specified in 10 CFR 20.1101(d).

The licensee disposes of liquid radioactive wastes by evaporation, discharge to the sanitary sewer, or transfer to the Radiation Protection Office (RPO) which is a part of the PSU Department of Environmental Health and Safety. Disposal by evaporation removes the liquid from the liquid radioactive waste, creating demineralized water and traces of solid radioactive waste that remain in the evaporator tank for decay. Discharge of liquid waste to the sanitary sewer requires the use of procedures and RPO approval to ensure that discharges meet the requirements of 10 CFR 20.2003 for disposal by release into sanitary sewerage. The licensee also transfers small quantities of liquid radioactive waste to the RPO for proper disposal under the University's broad scope byproduct material license. During the past five years, the licensee

reported no routine releases of liquid radioactive waste by any of the disposal methods. One unplanned release occurred as a result of leakage of reactor pool water through the reactor pool liner to the earthen backfill surrounding the reactor pool. According to the licensee, the leakage resulted in the release of approximately 1.3 milliCuries of tritium, at a concentration of $2.8\text{E-}5 \mu\text{Ci/ml}$. This concentration is a fraction of the limit of $1\text{E-}3 \mu\text{Ci/ml}$ specified in 10 CFR Part 20, Appendix B for liquid effluents. Offsite groundwater sampling conducted by the licensee showed no detectable elevation in tritium levels. The NRC inspection report related to the reactor pool leakage identified no findings of significance.

The RPO oversees the handling of solid low-level radioactive waste generated at the PSBR. The bulk of the waste consists of gloves, paper, plastic, and small pieces of metal. Upon removal from the facility by the RPO, the waste enters the campus-wide radioactive waste stream covered by the University's broad scope byproduct material license. The RPO disposes of the waste by decay in storage or shipment to a low level waste broker in accordance with all applicable regulations for transportation of radioactive materials. According to the licensee, no spent nuclear fuel has been shipped from the site to date. To comply with the Nuclear Waste Policy Act of 1982, PSU has entered into a contract with the U.S. Department of Energy (DOE) that provides that DOE retains title to the fuel utilized at the PSBR and that DOE is obligated to take the fuel from the site for final disposition.

As described in Chapter 11 of the PSBR SAR, personnel exposures are well within the limits set by 10 CFR 20.1201, and as low as is reasonably achievable (ALARA). The RPO tracks personnel exposures, which are usually less than 0.5 mSv (50 mrem) per year. The PSU ALARA program requires the RPO to investigate any annual personnel exposures greater than 10 percent of the limit of 50 mSv (5000 mrem) specified in 10 CFR 20.1201. Personnel dosimeters mounted in the control room and reactor bay provide a quarterly measurement of total radiation exposures at those locations. These dosimeters typically measure annual doses

of less than 0.5 mSv (50 mrem) in the control room and less than 2 mSv (200 mrem) in the reactor bay. No changes in reactor operation that would lead to an increase in occupational dose are expected as a result of the proposed action.

The licensee conducts an environmental monitoring program to record and track the radiological impact of PSBR operation on the surrounding unrestricted area. The program consists of quarterly exposure measurements at four locations on the site boundary and at two control locations away from any direct influence from the reactor. The RPO administers the program and maintains the appropriate records. Over the past five years, the survey program indicated that radiation exposures at the monitoring locations were not significantly higher than those measured at the control locations. Year-to-year trends in exposures are consistent between monitoring locations. Also, no correlation exists between total annual reactor operation and annual exposures measured at the monitoring locations. Based on the NRC staff's review of the past five years of data, the NRC staff concludes that operation of the PSBR does not have any significant radiological impact on the surrounding environment. No changes in reactor operation that would affect off-site radiation levels are expected as a result of license renewal.

Environmental Effects of Accidents:

Accident scenarios are discussed in Chapter 13 of the PSBR SAR. The maximum hypothetical accident (MHA) is the uncontrolled release of the gaseous fission products contained in the gap between the fuel and the fuel cladding in one fuel element to the reactor building and into the environment. The licensee conservatively calculated doses to facility personnel and the maximum potential dose to a member of the public. NRC staff performed independent calculations to verify that the doses represent conservative estimates for the MHA. Occupational doses resulting from this accident would be well below 10 CFR Part 20 limit of 50 mSv (5000 mrem). Maximum doses for members of the public resulting from this accident

would be well below 10 CFR Part 20 limit of 1 mSv (100 mrem). The proposed action will not increase the probability or consequences of accidents.

II. Non-Radiological Impacts

The PSBR core is cooled by a light water primary system consisting of the reactor pool, a heat removal system, and a processing system. Cooling occurs by natural convection, with the heated coolant rising out of the core and into the bulk pool water. The large heat sink provided by the volume of primary coolant allows several hours of full-power operation without any secondary cooling. The heat removal system transfers heat to the secondary system via a 1-MW heat exchanger. The secondary system uses water pumped from the nearby Thompson Pond. During operation, the secondary system is maintained at a higher pressure than the primary system to minimize the likelihood of primary system contamination entering the secondary system, and ultimately the environment. The licensee conducts periodic leak tests of the heat exchanger to further reduce the likelihood of secondary system contamination.

Release of thermal effluents from the PSBR will not have a significant effect on the environment. A storm sewer returns the heated secondary coolant to Thompson Pond. According to the licensee, the University maintains and complies with the appropriate Pennsylvania Department of Environmental Protection permit for secondary water discharge, and no violations of the permit have occurred. Given that the proposed action does not involve any change in the operation of the reactor and the heat load dissipated to the environment, the NRC staff concludes that the proposed action will not have a significant impact on the local water supply.

National Environmental Policy Act (NEPA) Considerations:

NRC has responsibilities that are derived from NEPA and from other environmental laws, which include the Endangered Species Act (ESA), Coastal Zone Management Act (CZMA), National Historic Preservation Act (NHPA), Fish and Wildlife Coordination Act (FWCA),

and Executive Order 12898 Environmental Justice. The following presents a brief discussion of impacts associated with these laws and other requirements.

I. Endangered Species Act

The site occupied by the PSBR does not contain any Federally- or State-protected fauna or flora, nor do the PSBR effluents impact the critical habitats of any such fauna or flora.

II. Coastal Zone Management Act

The site occupied by the PSBR is not located within any managed coastal zones, nor do the PSBR effluents impact any managed coastal zones.

III. National Historic Preservation Act

The NHPA requires Federal agencies to consider the effects of their undertakings on historic properties. The National Register of Historic Places (NRHP) lists one historical site located on the PSU campus, the Ag Hill Complex. The location of the Ag Hill Complex is approximately 1 km (0.6 Miles) East of the PSBR. Given the distance between the facility and the Ag Hill Complex, continued operation of the PSBR will not impact any historical sites. In 1991, the PSBR received the American Nuclear Society Nuclear (ANS) Historic Landmark Award, commemorated by a plaque located at the site. Continued operation of the PSBR will not affect this historic designation. During a telephone conversation between the NRC staff and the licensee on October 2, 2009, the licensee stated that PSU has no plans to apply to have the PSBR listed in the NRHP. Additionally, the licensee stated that any modifications to the facility exterior must go through Campus Planning and Design in the PSU Office of Physical Plant. This provides assurance that any modifications would be made only after an appropriate review by the University. Based on this information, the NRC finds that the potential impacts of license renewal would have no adverse effect on historic and archaeological resources at PSBR.

IV. Fish and Wildlife Coordination Act

The licensee is not planning any water resource development projects, including any of the modifications relating to impounding a body of water, damming, diverting a stream or river, deepening a channel, irrigation, or altering a body of water for navigation or drainage.

IV. Executive Order 12898 – Environmental Justice

The environmental justice impact analysis evaluates the potential for disproportionately high and adverse human health and environmental effects on minority and low-income populations that could result from the relicensing and the continued operation of the PSBR. Such effects may include ecological, cultural, human health, economic, or social impacts. Minority and low-income populations are subsets of the general public residing around the PSBR, and all are exposed to the same health and environmental effects generated from activities at the PSBR.

Minority Populations in the Vicinity of the PSBR—According to 2000 census data, 4.3 percent of the population (approximately 634,000 individuals) residing within a 50-mile radius of PSBR identified themselves as minority individuals. The largest minority group was Black or African American (12,000 persons or 1.9 percent), followed by Asian (7,700 or 1.2 percent). According to the U.S. Census Bureau, about 9.4 percent of Centre County population identified themselves as minorities, with persons of Asian origin comprising the largest minority group (4.4 percent). According to census data 3-year average estimates for 2005-2007, the minority population of Centre County, as a percent of total population, had increased to 11.4 percent.

Low-Income Populations in the Vicinity of the PSBR—According to 2000 census data, approximately 13,000 families and 78,000 individuals (approximately 7.9 and 12.4 percent, respectively) residing within a 50-mile radius of the PSBR were identified as living below the

Federal poverty threshold in 1999. The 1999 Federal poverty threshold was \$17,029 for a family of four.

According to Census data in the 2005–2007 American Community Survey 3–Year Estimates, the median household income for Pennsylvania was \$47,913, while 11.9 percent of the state population was determined to be living below the Federal poverty threshold. Centre County had a lower median household income average (\$42,976) and higher percentages (18.5 percent) of individuals living below the poverty level, respectively.

Impact Analysis—Potential impacts to minority and low-income populations would mostly consist of radiological effects, however radiation doses from continued operations associated with the license renewal are expected to continue at current levels, and would be well below regulatory limits.

Based on this information and the analysis of human health and environmental impacts presented in this environmental assessment, the NRC staff concludes that the proposed action would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations residing in the vicinity of the PSBR.

Environmental Impacts of the Alternatives to the Proposed Action:

As an alternative to license renewal, the NRC staff considered denial of the proposed action. If the Commission denied the application for license renewal, facility operations would end and decommissioning would be required. The NRC staff notes that, even with a renewed license, the PSBR will eventually require decommissioning, at which time the environmental effects of decommissioning will occur. Decommissioning will be conducted in accordance with an NRC-approved decommissioning plan which will require a separate environmental review under 10 CFR 51.21. Cessation of facility operations would reduce radioactive effluents. However, as previously discussed in this environmental assessment, radioactive effluents

resulting from facility operations constitute only a small fraction of the applicable regulatory limits. Therefore, the environmental impacts of license renewal and denial of the application for license renewal are similar. In addition, denial of the application for license renewal would cause the benefits of teaching, research, and services provided by facility operation to be lost.

Alternative Use of Resources:

The proposed action does not involve the use of any different resources or significant quantities of resources beyond those previously considered in the issuance of Amendment No. 23 to Facility Operating License No. R-2 for the Penn State Breazeale Reactor dated January 27, 1986, which renewed the Facility Operating License for a period of 20 years.

Agencies and Persons Consulted:

In accordance with the agency's stated policy, on September 28, 2009, the staff consulted with the State Liaison Officer regarding the environmental impact of the proposed action. The consultation involved a thorough explanation of the environmental review, the details of this environmental assessment, and the NRC staff's findings. The State official stated that he understood the NRC review and had no comments regarding the proposed action. The State official did comment on the designation of the PSBR as an ANS Nuclear Historic Landmark. The comment was informational in nature and the NRC staff responded by including this information in this environmental assessment and noting that continued operation of the facility will not adversely impact the ANS Nuclear Historic Landmark designation.

Finding of No Significant Impact:

On the basis of the environmental assessment, the NRC concludes that the proposed action will not have a significant effect on the quality of the human environment. Accordingly, the NRC has determined not to prepare an environmental impact statement for the proposed action.

For further details with respect to the proposed action, see the licensee's letter dated

December 6, 2005 (ML091250487), as supplemented by letters dated October 31, 2008 (ML092650603); and April 2 (ML093030395), June 11 (ML092030312), September 1 (ML092580215), and October 21, 2009 (ML092990409). Documents may be examined, and/or copied for a fee, at the NRC's Public Document Room (PDR), located at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland. Publicly available records will be accessible electronically from the Agencywide Documents Access and Management System (ADAMS) Public Electronic Reading Room on the NRC Web site <http://www.nrc.gov/reading-rm/adams.html>. Persons who do not have access to ADAMS or who encounter problems in accessing the documents located in ADAMS should contact the NRC PDR Reference staff at 1-800-397-4209, or 301-415-4737, or send an e-mail to pdr@nrc.gov.

Dated at Rockville, Maryland, this 4th day of November, 2009.

FOR THE NUCLEAR REGULATORY COMMISSION

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