PENNSTATE

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RADIATION SCIENCE & ENGINEERING CENTER

Annual Operating Report, FY 09-10
PSBR Technical Specifications 6.6.1
License R-2, Docket No. 50-5

December 6, 2010

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

Dear Sir or Madame:

Enclosed please find the Annual Operating Report for the Penn State Breazeale Reactor (PSBR) at the Radiation Science and Engineering Center. This report covers the period from July 1, 2009 through June 30, 2010, as required by technical specifications requirement 6.6.1. Also included are any changes applicable to 10 CFR 50.59.

Sincerely yours,

Kenan Ünlü, Ph.D.
Director, Radiation Science
and Engineering Center

Enclosures:
Annual Operating Report, FY 09-10

cc: H. C. Foley
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PENN STATE BREAZEALE REACTOR

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Reactor Utilization

The Penn State Breazeale Reactor (PSBR) is a TRIGA Mark III facility capable of 1 MW steady state operation, and 2000 MW peak power pulsing operation. Utilization of the reactor and its associated facilities falls into three major categories:

EDUCATION use is primarily in the form of laboratory classes conducted for graduate and undergraduate students and numerous high school science groups. These classes vary from neutron activation analysis of an unknown sample to the calibration of a reactor control rod. In addition, an average of 2500 visitors tour the PSBR facility each year.

RESEARCH accounts for a significant portion of reactor usage which involves Radionuclear Applications, Neutron Imaging, Neutron Beam Techniques, Detector development and testing and multiple research programs by faculty and graduate students throughout the University.

SERVICE use provides vital techniques for industries in support of the national economy. Some examples include: radio-isotopes produced at the facility enable the critical petro-chemical industry to run at full capacity; the facility neutron beam laboratory serves an critical need in quality control of materials used to store the nation's spent nuclear fuel; and fast-neutron irradiation fixtures support the Nation's defense infrastructure and industry semiconductor production.

The PSBR facility operates on an 8 AM - 5 PM shift, five days a week, with early morning, evening, and weekend shifts to accommodate laboratory courses, public education and research or service projects as needed.

Summary of Reactor Operating Experience - Technical Specification 6.6.1.a.

Between July 1, 2009 and June 30, 2010, the PSBR was utilized while:

Mode of Operation	Time [hours]	Time / Shift [hours / shift]
Critical	767	2.5
Sub-Critical	228	0.8
Shutdown	618	2.0
Unavailable for Use	0	0
Total Usage	1614	5.3

The reactor was pulsed a total of 110 times with the following reactivities:

Reactivity	Number of Pulses
< $2.00	5
$2.00 to $2.50	94
> $2.50	11
Total	110

The square wave mode of operation was used 22 times to operate the reactor at power levels between 100 and 500 KW.

Total energy produced during this report period was 465 MWh with a consumption of 24 grams of U-235.

Unscheduled Shutdowns - Technical Specification 6.6.1.b.

During the reporting period, there was one unscheduled reactor shutdown and no SCRAMs.

On 8/10/09, the reactor was secured after an offsite water main line break caused a loss of University Water (one of two Technical Specifications recognized emergency fill supplies) to the facility. Water was restored later in the day and normal operations resumed the next day.

Major Corrective or Preventative Maintenance with Safety Significance - Technical Specification 6.6.1.c.

Routine preventative maintenance required by Technical Specifications (T.S.) was completed within the T. S. required time frames. No major corrective maintenance with safety significance was required. Some corrective maintenance items of interest or indirect impact on safety related systems included:

- In July 2009, the logic control board for the reactor instrumentation Uninterruptible Power Supply (UPS) was replaced after an unexplained momentary power interruption.

- Several occurrences of control rod position limit switches not actuating at desired positions were remediated with field adjustments. The switches serve no safety function but improper operation is an operator workaround. The problems seem to have been corrected during the biennial control rod overhaul in June of 2010.
- One air monitor failed low two times in this annual period (two available, one required by T.S.). The problem was corrected by additional bracing of the filter housing and cleaning and tightening of the detector friction electrical connections. The repairs were also applied to the redundant monitor.
- During the June 2010 biennial fuel inspection, two 8.5 wt% fuel elements were permanently removed from service due to visual indications. The indications (scratches with visual depth) were observed using a high quality underwater camera system that greatly facilitates inspection activities. The fuel elements passed the T.S. portion of the inspection but were removed for precautionary reasons.

Major Changes Reportable Under 10 CFR 50.59 - Technical Specification 6.6.1.d.

No facility or procedure changes were reportable under 10 CFR 50.59.

Facility Changes of Interest

Significant changes to the facilities security infrastructure were completed during this reporting period.

The following changes were completed during the May June 2010 maintenance outage:

- The primary pump impeller and electrical motor were upgraded in size to restore the primary coolant loop flow to the design value of 400 gpm. The change did not affect system piping and does not affect the LOCA analysis.
- The purification pump and motor skid was replaced with a modern pump skid. Portions of the isolable pipe were replaced to meet the ANSI pump configuration. The LOCA analysis was not affected.
- To address performance and obsolescence issues, the 3-ton overhead reactor gantry crane was upgraded and replaced with a modern unit.

Procedures

Several single use procedures were developed as needed to support the core change, maintenance, and system modifications. Additionally, procedures are normally reviewed biennially, and on an as needed basis. Numerous minor changes and updates were made to maintain procedures during the year and they will not be listed.

New Tests and Experiments - None

Radioactive Effluents Released - Technical Specification 6.6.1.e.

Liquid There were no planned or unplanned liquid effluent releases under the reactor license for the report period.

Liquid radioactive waste from the radioisotope laboratories at the PSBR is under the University byproduct materials license and is transferred to the Radiation Protection Office for disposal with the waste from other campus laboratories. Liquid waste disposal techniques include storage for decay, release to the sanitary sewer per 10 CFR 20, and solidification for shipment to licensed disposal sites.

Gaseous All releases were less than 20% of the allowed or recommended concentrations.

Argon-41 (Ar-41)

Gaseous effluent Ar-41 is generated from dissolved air in the reactor pool water, air in dry irradiation tubes, air in neutron beam ports, and air leakage to and from the carbon-dioxide purged pneumatic sample transfer system.

The amount of Ar-41 released from the reactor pool is very dependent upon the operating power level and the length of time at power. The release per MWH is highest for extended high power runs and lowest for intermittent low power runs. The concentration of Ar-41 in the reactor bay and the bay exhaust was measured by the Radiation Protection staff during the summer of 1986. Measurements were made for conditions of low and high power runs simulating typical operating cycles.

In order to ease the burden of collecting and reporting release data while maintaining a conservative reporting philosophy, the RSEC altered the calculation of Ar-41 release for the 2009-2010 reporting period. For calculation of the Ar-41 release, all power operations are assumed to take place at the location of greatest Ar-41 generation and release (Fast Neutron Irradiator (FNI) tube). This raises the estimated release above the previous method of reporting. In 2008-2009, the RSEC calculated an Ar-41 release from open tubes as 319 mCi for 570 MWh of operation. The new method calculates a release of 820 mCi for 465 MWh of operation in 2009-2010. The method includes direct release from the pool as well as release from the FNI fixture. This methodology results in higher calculated release rates and is therefore more conservative for reporting. The calculated releases are still far below any limit or constraint on the operations at the RSEC. The revision to the release method was reviewed under 10CFR50.59.

Using this new method, the calculated annual production was 820 mCi. Some of this Ar-41 would be trapped and decay in place. However, even if all of the 820 mCi were treated as a separate release, the percent of the 10CFR20 Appendix B limit would be no more than 3.0 %.

The use of the pneumatic transfer system (rabbit) was minimal during this period and any additional Ar-41 release would be insignificant since the system operates with CO_2 as the fill gas. A small amount of Ar-41 is released from each rabbit capsule. A two minute irradiation @900 kW will produce .0026 mCi. In the 2009-2010 reporting period 62 rabbit capsules were irradiated at a variety of power/time combinations (typically less than 900 kW). The resulting 0.16 mCi of Ar-41 are not a significant contributor to the total release.

Tritium (H-3)

Tritium is released by evaporation of reactor pool water as a gaseous release. The total makeup to the reactor pool in 2009-2010 was aproximently 11,000 gallons or 1.25 gallons per hour. For conservatism, 1.5 gallons per hour was used in the calculation. The evaporative loss rate is dependent on relative humidity, temperature of air and water, air movement, etc.

For a pool Tritium concentration of 23,322 pCi/l (average for January 1, 2010 to June 30, 2010) the tritium activity released from the ventilation system would be ~1,160 μCi. A dilution factor of 2 x 10E8 ml /sec was used to calculate the unrestricted area concentration. This is from 200 m2 (cross-section of the building) times 1 m/sec (wind velocity). These are the values used in the safety analysis in the reactor license. A sample of air conditioner condensate a previous year showed no detectable Tritium. Thus, there is probably very little Tritium being collected and released in liquid form to the sanitary sewer system.

Parameter	*Value*	*Units*
Tritium released	1160	micro curies
Average concentration, unrestricted area	<2x10-13	μCi/ml
Permissible concentration, unrestricted area	1x10-7	μCi/ml
Percentage of permissible concentration	<0.0002	%
Calculated effective dose, unrestricted area	<1x10-4	mRem

Environmental Surveys - Technical Specification 6.6.1.f.

The only environmental surveys performed were the routine TLD gamma-ray dose measurements at the facility fence line and at control points in one residential area several miles away. The net measurements (in millirems) tabulated below represent the July 1, 2009 to June 30, 2010 reporting period.

Location	*3rd Qtr '09*	*4th Qtr '09*	*1st Qtr '10*	*2nd Qtr '10*	*Total*
Fence North	6	6	1	3	16
Fence South	4	4	3	5	16
Fence East	5	6	3	5	19
Fence West	6	4	2	4	16
Pleasant Gap	9	8	5	8	30

There is no meaningful increase in exposure at the facility fence-line due to licensed operations for the current fiscal year.