

PULSTAR ANNUAL REPORT TO
UNITED STATE NUCLEAR REGULATORY COMMISSION

for the

Period 1 July 1989 - 30 June 1990

Submitted by

G. D. Miller, Associate Director

NCSU NUCLEAR REACTOR PROGRAM

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PULSTAR Reactor Operations Manager

Reference: PULSTAR Technical Specifications
Section 6.7.5

Docket No. 50-297

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DEPARTMENT OF NUCLEAR ENGINEERING

PULSTAR REACTOR ANNUAL REPORT

For the Period: 1 July 1989 - 30 June 1990

The following report is submitted in accordance with Section 6.7.5 of the PULSTAR Technical Specifications:

6.7.5.a Reactor Operating Experience:

(1) The NCSU PULSTAR Reactor has been utilized for the following:

a.	Teaching and Short Courses	115.80	hours
b.	Graduate Research	19.55	hours
c.	Isotope Production	41.67	hours
d.	Neutron Activation Analysis	2088.52	hours
e.	NPP Reactor Operator Training	287.02	hours
f.	PULSTAR Reactor Operator Training (PTO)	46.17	hours
g.	Reactor Calibrations/Measurements & Surv.	23.43	hours
h.	Reactor Health Physics Surveillance	<u>3.02</u>	<u>hours</u>

TOTAL 2625.18 hours

Same reporting period 1988-1989 3347.19 hours

A cross section of experiments performed in the reactor relate to these areas:

- a. Neutron Activation Analysis of animal tissue, fly ash, sediments, rain/river water, filters, resins, coal, milk, graphite, textile fiber, etc.
- b. Reactor thermal power measurements for teaching laboratories.
- c. Isotope Production
- d. Thermal neutron depth profiling of Boron-implanted silicon.
- e. Neutron diffusion length measurements in graphite.
- f. Neutron Radiography.
- g. Thermal neutron diffusion in oils

(2) Changes in Performance Characteristics Related to Reactor Safety:

None

(3) Results of Surveillance, Tests, and Inspections:

The reactor surveillance program has revealed no significant nor unexpected trends in reactor systems performance during this report period.

6.7.5.b Total Energy Output:

990.597 Megawatt-hours
41.275 Megawatt-days

Pulse Operations:

0

Reactor was Critical:

1232.30 hours

Cumulative Total Energy Output since Initial Criticality:

15829.076 Megawatt-hours
659.545 Megawatt-days

6.7.5.c Number of Emergency and Unscheduled Shutdowns:

Unscheduled shutdowns - 2 total

- (1) Response to building fire alarm
- (2) Pneumatic Shuttle could not be moved from irradiation position.

Inadvertent scrams - 7 total

- (3) Operator error - - - - - 7

Explanation of (1) above:

Operating Procedures require reactor shutdown by manual scram (followed by building evacuation) when fire alarm sounds. Fire was of chemical origin in a laboratory not related to the reactor facility.

Explanation of (2) above:

Pneumatic irradiation facility ("rabbit" or PN) shuttle had been sent to the PN irradiation position in the south reflector peak adjacent to the reactor core for a 30-second exposure. Upon actuating the PN return switch, the radiochem station control panel blew a fuse for an undetermined reason and the rabbit could not be withdrawn from the core irradiation position. Rather than over expose the target the operator shutdown the reactor by manual scram; the correct action under the circumstances.

Explanation of (3) above:

Improper operation of the linear level power channel range switch by NPP and NRP Operator trainees.

6.7.5d. Major Maintenance Operations:

Repaired pool liner w/epoxy seal: see NP 1-90 on file at facility.

6.7.5e. Changes in Facility, Procedures, Tests, and Experiments:

- (1) Design Change 90-1, Replacement instrumentation power supplies for PULSTAR Reactor control console
The seven power supplies being replaced are original equipment in the reactor control and are of vacuum tube design. This change authorizes removal of the original power supplies and replacement with modern solid state technology supplies having identical electrical performance characteristics. Original electrical wiring and connections to other components in the affected power measuring channels will remain intact.

Safety Evaluation: "Functional Design (Performance) of reactor nuclear instrumentation will not be changed. Replacement power supplies will be adjusted to provide same electrical potentials as present vacuum tube-type equipment."

(2) Procedure Changes

- (a) Twenty-nine (29) Health Physics Procedures were reviewed and approved by the Radiation Protection Council. Some of these procedures are revisions and some are new methodology. All subject procedures are noted on the index sheet attached to this report.
- (b) Revision 5 to the PULSTAR Operations Manual was made to improve some reactor system descriptions; document minor procedural changes; remove typographical and figure errors; and standardize operations manual format.
- (c) PC 50-89 was a change to the Technical Specifications that increased membership on the Reactor Safeguards Advisory Group from three (3) to five (5) individuals and extended appointment term from three (3) years to five (5) years.
- (d) NP 1-90 documented the procedural steps to accomplish permanent repair to the reactor primary pool liner leak. First described in our 1987-1988 Annual Report (Paragraph 6.7.5.d), the leak repair culminated almost two years of rigorous leak causal analyses and proposed repair techniques.

HEALTH PHYSICS PROCEDURES INDEX

<u>NO.</u>	<u>REV</u>	<u>TITLE</u>
→ 1-1	0	Training Requirements for Selected Emergency Team Members Who Wear Self-Contained Breathing Apparatus (SCBA)
→ 1-2	0	Maintenance of Self-Contained Breathing Apparatus (SCBA)
→ 1-3	0	Physical Examinations & Bioassay Requirements for SCBA Users
→ 10-1	2	Inventory and Location of Special Nuclear Material
→ 10-2	2	Special Nuclear Material (SNM) Accountability
→ 10-3	2	Radiation Work Permit
→ 10-5	2	Transfer and Shipment of Radioactive Material
→ 20-1	2	Servicing Continuous Filter Air Sampler PULSTAR Off-line Air Sampler
→ 20-2	2	Release of Radioactive Wastes to the Sanitary Sewer System
→ 20-3	2	Sampling Waste Water Tanks
→ 20-4	2	Water Samples From PULSTAR Pool Surface
→ 20-5	2	Water Samples From Piping Valves
→ 20-6	2	PULSTAR Deep Pool Water Samples
→ 20-7	2	Water Sample Preparation for Neutron Activation Analysis
→ 20-8	2	Water Sample Preparation for Gross Beta/Gamma Counting
→ 20-9	2	pH Determination Using Corning 125 Digital Meter
→ 20-10	2	Resistivity Measurements Using YSI Model 31 Meter
→ 20-11	2	Preparation of Air Sample Filters for Laboratory Proportional Counting
→ 20-12	2	Changing Continuous Air Monitors (CAM) Filters
→ 20-13	2	Calibration of Eberline Continuous Air Monitor (CAM)
→ 20-14	2	Radiation and Contamination Surveys of PULSTAR Bay
→ 20-15	2	Determine Efficiency and Operating Plateau Gas Flow Proportional Counters
→ 20-16	1	Calibration (Electronic) and Efficiency checks for RM-14 Monitors
→ 20-17	0	Drift and Response Checks for Direct Read-Out Dosimeters
→ 20-18	0	Decontamination
→ 20-19	0	Lower Limit of Detection (LLD) and Minimum Detectable Concentration (MDC)
→ 20-20	0	Sample Analysis Using The Nuclear Services Gamma Spectroscopy System
→ 20-21	1	Radiochemical Determination of Tritium in Waste Water, Urine and other Biological Samples
→ 20-22	0	GM Detector Sensitivity to Argon-41 (Channel #5)
→ 30-1	2	Access to Restricted Areas
→ 30-2	0	Radiation Safety Training
→ 40-1	3	Utilization of Reactor Irradiation Facilities
→ 40-2	0	Encapsulation
→ 50-1	0	Pressure Testing Sump Discharge Line

6.7.5(F) Radioactive Effluents:

Liquid Waste (summarized by quarters)

1. Radioactivity released during the reporting period.

<u>Quarter</u>	<u>Period</u>	(a) no. of <u>batches</u>	(b) total <u>μCi</u>	(c) tot. vol. <u>an ltrs</u>	(d) Diluent <u>ltrs</u>	(e) Tritium <u>μCi</u>
1st	1 Jul - 30 Sep 89	6	68.93	2.04 E4	1.52 E5	64.69
2nd	1 Oct - 31 Dec 89	6	23.34	2.05 E4	3.78 E4	20.28
3rd	1 Jan - 31 Mar 90	6	34.65	2.05 E4	6.61 E4	14.84
4th	1 Apr - 30 Jun 90	6	511.50	2.05 E4	1.25 E6	481.39

(f) 581.20 μCi were released during this reporting period.

(g) 638.42 μCi were released during this reporting period.

2. Identification of Fission and Activation Products.

The gross alpha-beta-gamma activity of the batches in (a) above were less than 4×10^{-5} μCi/ml. An isotopic analysis of these batches indicated only background activity.

3. Disposition of liquid effluents not releasable to Sanitary Sewer System. All batches of 1(a) above when diluted by campus water resulted in activity considerably less than 4×10^{-7} μCi/ml. Therefore all batches were released to the sanitary sewer system.

Gaseous Waste (summarized monthly)

1. Radioactivity discharged during the reporting period (in Curies) for:

a. Gases

<u>Year</u>	<u>Period</u>	<u>Total Time In Hours</u>	<u>Curies</u>
1989	04 Jul - 1 Aug	704.42	0.17
	02 Aug - 31 Aug	736.17	0.23
	01 Sep - 01 Oct	767.30	0.37
	02 Oct - 31 Oct	744.50	0.63
	01 Nov - 30 Nov	744.75	0.43
	01 Dec - 31 Dec	768.25	0.50
1990	01 Jan - 31 Jan	718.25	0.25
	01 Feb - 01 Mar	720.00	0.73
	02 Mar - 30 Mar	680.75	0.32
	01 Apr - 30 Apr	703.75	0.50
	01 May - 20 May	706.25	0.60
	30 May - 28 Jun	<u>712.20</u>	<u>0.48</u>
		8706.59	5.21

(b) Particulates whose half-life is greater than (8) days.

Filters from the particulate monitoring channel were analyzed upon removal and again the following week. There was no particulate activity ((b) above.) indicated on any filter during this reporting period.

2. Gases and particulates discharged during this reporting period.

Gases:

The yearly average concentration of Argon-41 released from the PULSTAR reactor facility exhaust stack during this period was 1.7×10^{-8} $\mu\text{Ci/ml}$.

Particulates:

See gaseous waste 1(b) above.

SOLID WASTE FROM REACTOR

1. total volume of solid waste - 38 ft³
2. total activity of solid waste - 0.13312 mCi
3. Dates of shipments and disposal:

11 Aug 1989	CNSI
19 Apr 1989	CNSI
12 Apr 1989	CNSI
6 Jun 1990	CNSI

6.7.5.G: Personnel Radiation Exposure Report (Reporting Period 07/01/89-06/30/90)

<u>Faculty and Staff</u>	<u>Total Exposure (rem)</u>
BIDDY, Oscar D.	0.010
BILYJ, Stephen J.	0.060
BRACKIN, Thomas L.	0.0
BRAY, Thomas C.	0.020
BULLEN, Daniel B.	0.0
CAVES, John R.	0.020
DAVIS, Glenda	0.010
DOSTER, J. Michael	0.010
ELLEMAN, Thomas S.	0.010
GARDNER, Robin P.	0.010
GILLIGAN, John	0.010
GRADY, Stanley M.	0.080
HANKINS, Orlando H.	0.0
JOHNSON, Jr., Charles M.	0.0
KOHL, Jerome	0.0
LAMBERT, Joseph P. F.	0.010
LODGE, Phillip S.	0.030
MANI, Kolam V.	0.020
MILLER, Garry D.	0.020
MUNN, R. Hugh	0.040
MURTY, K. L.	0.030
RAYNO, DONALD R.	0.020
STAM, E.	0.030
STRICKLAND, David D.	0.020
TITTLE, Charles	0.0
TURINSKY, Paul J.	0.110
VERGHESE, Kuruvilla	0.010
WEAVER, Jack N.	0.010
WILSHIRE, Frank W.	0.030

OTHER:

Approx. 25 film badges were issued monthly to graduate students and temporary staff;
 Approx. 130 film badges were issued for short courses;
 Approx. 380 film badges were issued for visitors.

No significant radiation exposures were reported; the majority of these radiation exposures were in the "no measurable exposure" range.

6.7.5.h Summary of Radiation and Contamination Surveys Within the Facility

Neither the radiation nor the contamination surveys indicated any trend or shift of data from past experience/surveys.

6.7.5.i Description of Environmental Surveys Outside of the Facility

(See Attachment A)