

PULSTAR ANNUAL REPORT TO
UNITED STATES NUCLEAR REGULATORY COMMISSION

for the

Period of 1 July 1983 - 30 June 1984

Submitted by

G. D. Miller, Associate Director

NCSU NUCLEAR REACTOR PROGRAM

Prepared by Thomas C. Bray
PULSTAR Reactor Operations Manager

Reference: PULSTAR Technical Specifications
Section 6.7.5

Docket No. 50-297

Department of Nuclear Engineering
North Carolina State University
Raleigh, North Carolina 27650

August 29, 1984

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DEPARTMENT OF NUCLEAR ENGINEERING

PULSTAR REACTOR ANNUAL REPORT

For the Period: 1 July 1983 - 30 June 1984

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	90.74 hours
b. Graduate Research	36.03 hours
c. Faculty Research	3.87 hours
d. Isotope Production	113.84 hours
e. Neutron Activation Analysis	1,469.95 hours
f. NPP Reactor Operator Training	924.32 hours
g. PULSTAR Reactor Operator Training	18.68 hours
h. Reactor Calibrations and Measurements	22.40 hours
i. Reactor Health Physics Surveillance	2.43 hours
j. Tours and Visitors*	26.72 hours

TOTAL 2,708.98 hours

Same reporting period 1982-83 2,867.88 hours

* Reactor Facility tours not utilizing the reactor. 57.00

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. Medical research isotope production; K-42, Na-24, P-32, etc.
- c. Reactor thermal power measurements.
- d. Axial neutron flux map in reactor fuel coolant channels.
- e. 1/M criticality experiment with fuel loading.
- f. Neutron diffusion length measurements in graphite.
- g. Beam tube neutron flux measurements for Prompt Gamma facility.

(2) Design Changes Accomplished:

None

(3) Changes in Performance Characteristics and Operator Procedures Related to Reactor Safety:

None

(4) 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:

1006.581 Megawatt-hours
41.941 Megawatt-days

: Pulse Operations:

0

: Reactor was critical:

1364.920 hours

: Cumulative Total Energy Output since Initial Criticality:

8712.477 Megawatt-hours
363.020 Megawatt-days

6.7.5.(c): Number of Emergency and Unscheduled Shutdowns:

0

: Number of Inadvertent Scrams:

28

Reasons: (1) Operator Error 26
(2) Low Flow Setpoint drift 1
(3) Safety Channel trip 1

Explanation of (1) above:

Nuclear Power Plant Reactor Operator Training and NRP Staff Reactor Operator Training.

Explanation of (2) above:

Primary Coolant flow rate trip switch (a P-E device designed to actuate when primary coolant flow rate = 475 gpm) functioned at 490 gpm. Small indicated fluctuations of brief duration, e.g., + 10 gpm for 100 msec, are normal in the primary cooling system. The trip setpoint of the P-E switch had shifted in the conservative direction from 475 gpm to 490 gpm.

Explanation for (3) above:

While operating routinely at 1 Megawatt, a scram trip was generated by the Safety Power Measuring Channel. This event had not occurred prior and has not occurred since. Every aspect of the occurrence was investigated to determine the cause and none could be found. Because the scram signal was generated only by the Safety Channel, while all other power measuring systems detected no power variations, our best diagnosis is a one-time electrical transient within the Safety instrumentation channel.

6.7.5.(d): Major Maintenance Operations:

None during this reporting period.

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

None during this report period.

6.7.5.(f): Radioactive Effluents

Liquid Wastes (summarized by quarters).

1. Radioactivity Released During the Reporting Period.

<u>Quarter</u>	<u>Period</u> <u>1983</u>	(a) <u>No. of</u> <u>Batches</u>	(b) <u>Total</u> <u>μCi</u>	(c) <u>Total Vol.</u> <u>Liters</u>	(d) <u>Diluent</u> <u>Liters</u>	(e) <u>Tritium</u> <u>μCi</u>
1st	1 July-30 Sept.	4	3.724	1.22 E4	9.30 E3	44.53
2nd	1 Oct.-31 Dec.	10	22.61	2.63 E4	3.02 E4	67.59
	1984					
3rd	1 Jan.-31 Mar.	6	19.65	1.92 E4	1.91 E4	< MDA
4th	1 Apr.-30 June	4	2.53	1.16 E4	0	< MDA

(f) 48.51 μCi were released during this reporting period.

(g) 112.12 μCi of Tritium were released during the reporting period.

2. Identification of Fission and Activation Products.

The gross beta-gamma activity of the batches in 1(a) above were less than 4 E-5 μCi/ml. An isotope 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 released

to the sewer resulted in activity considerably less than $4 \text{ E-}7 \text{ } \mu\text{Ci/ml}$. Therefore, all batches were released to the sanitary sewer system.

g. Gaseous Waste (summarized on a monthly basis)

1. Radioactivity Discharged During the Reporting Period (in curies) for:

(a) Gases

	<u>Period</u>	<u>Total Time Hours</u>	<u>Ci</u>
1983	29 June-29 July	744.83	.78
	29 July -29 Aug.	743.58	.38
	29 Aug.-28 Sept.	729.92	.47
	28 Sept.-27 Oct.	703.17	.53
	27 Oct.-28 Nov.	784.03	.98
	28 Nov.-5 Jan.	913.72	1.11
1984	5 Jan.-3 Feb.	702.5	.53
	3 Feb.-7 Mar.	760.67	.44
	7 Mar.-6 Apr.	692.50	.75
	6 Apr.-3 May	700.3	.66
	3 May-13 June	979.5	.73
	13 June-11 July	723.2	.77
	Totals	9167.93	8.13

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

Filters from the particulate monitoring channel were analyzed upon removal. 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 averaged concentration of Argon-41 released from the PUF-TAR Reactor facility exhaust stack during this period was $2.61 \text{ E-}6 \text{ } \mu\text{Ci/ml}$.

The MPC in an unrestricted area for Argon-41 is $4 \text{ E-}8 \text{ } \mu\text{Ci/ml}$.

Particulates:

See (g) 1(b) above.

Solid Waste from Reactor

1. Total volume of solid waste - 56.5 ft³
2. Total activity of solid waste - 0.365 mCi
3. Dates of shipments and disposal:

27 July 1983	Disposal by U. S. Ecology
16 September 1983	Disposal by U. S. Ecology
14 November 1983	Disposal by U. S. Ecology
21 December 1983	Disposal by U. S. Ecology
6 February 1984	Disposal by U. S. Ecology
16 May 1984	Disposal by U. S. Ecology
5 June 1984	Disposal by U. S. Ecology

6.7.5(g) Personnel Radiation Exposure Report (Reporting Period - 1 July 1983 - 30 June 1984)

<u>Name</u>	<u>Total Exposure (rem)</u>
(Faculty and Staff)	
Biddy, Jr., Oscar D.	0.0
Bilyj, Stephen J.	0.060
Brackin, Thomas L.	0.0
Bray, Thomas C.	0.0
Caccamo, David P. (Terminated 10/3/83)	0.0
Caves, John (Started 06/11/84)	0.0
Cockrell, Robert G. (Terminated 10/03/83)	0.0
Cornetti, Richard	0.030
Cross, Robert D. (Terminated 12/31/83)	0.0
Davis, Glenda	0.030
Doster, J. Michael	0.0
Douglas, William G. (Terminated 08/31/83)	0.0
Gardner, Robin P.	0.040
Gilligan, John (Start 08/10/83)	0.020
Grady, Stanley M.	0.100
Kimberley, Michael M.	0.0
Kohl, Jerome	0.0
Lewis, Luther (Terminated 01/31/84)	0.0
Mani, K.V. (Started 06/04/84)	0.0
Miller, Garry D. (Started 08/01/83)	0.110
Munn, Hugh	0.0
Murty, K. L.	0.020
Rayno, Donald (Started 08/18/83)	0.070
Saxe, Raymond F.	0.060
Stam, Ephraim	0.020
Turinsky, Paul	0.0
Verghese, K.	0.0
Weaver, Jack N.	0.0
Wehring, Bernard (Started 06/15/84)	0.0
<u>Radiation Protection Office Personnel</u>	
Anderson, Tommy L.	0.0
Bowman III, Worth B.	0.0
Caruthers, L. Thomas (Terminated 12/31/84)	0.0
Corbett, Marcelle	0.0
Emery, Robert J.	0.0
Harris, Ralton	0.0
House, Andrew	0.0
Mangum, Royelle O.	0.120
Morgan, D. William	0.270
<u>Custodians</u>	
Dunn, Johnnie J.	0.0
Lucas, Calvin	0.0
Saunders, Dorothy	0.0
Young, Charles	0.0

Other - 65 Film Badges were issued to graduate students and temporary staff, 97 film badges were issued for student laboratories, 176 film badges were issued to participants in short courses, 483 film badges were issued to visitors. No significant radiation exposures were reported; the majority of the radiation exposures were in the "no measurable exposure" range.

Summary of Radiation and Contamination Surveys

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

h. Description of Environmental Surveys Outside of the Facility.

(See Attachment A)

RADIATION PROTECTION OFFICE
NORTH CAROLINA STATE UNIVERSITY

ENVIRONMENTAL RADIATION SURVEILLANCE REPORT

FOR THE PERIOD

04/01/83 - 07/31/84

1. INTRODUCTION

Environmental radioactivity levels in the vicinity of the North Carolina State University campus have been observed to remain at very low levels during the reporting period.

2. AIR MONITORING

Tables 2.2 and 2.3 give the gross beta activities and gamma activities of selected nuclides in units of fCi m^{-3} . Gross beta activities are determined by counting Millipore air filters. The gamma activities are reported as the composite of five Hi-Vol glass fiber filters representing each of the monitoring stations on campus.

3. MILK

Monthly analyses of milk from the Campus Creamery have consistently shown concentrations of Sr-90 that are well below the maximum permissible concentration (Table 3.1). Table 3.2 indicates that all samples indicate a level of I-131 that is below this laboratory's detection limit of 2.0 picoCurie liter⁻¹.

4. SURFACE WATER

Tables 4.1 and 4.2 give gross alpha, gross beta, and Sr-90 activities with the only two gamma emitters, K-40 and Cs-137, that were present in sufficient concentrations to identify. These samples were collected on Rocky Branch Creek at locations relative to the campus designated as ON and OFF.

5. SOIL

Soil samples were collected at four campus locations (North, South, East, and West of the reactor) and also at the Old Burial Ground on Reedy Creek Road and at the New Burial Ground near Carter Stadium. Most samples were taken within four inches of the surface, but some deep samples (4.5 feet) were obtained outside the two burial sites. All samples indicated very low levels of radioactivity.

6. VEGETATION

Samples of grass were taken at the same locations as the soil samples. Analysis for gross alpha, gross beta, and specific nuclides revealed no significant levels of radioactivity.

TABLE 2.1 LOCATION OF AIR MONITOR STATIONS

<u>Site</u>	<u>Direction</u> ¹	<u>Distance</u> ² (meters)	<u>Elevation</u> ³ (meters)
Broughton	Southwest	125	- 17
David Clark Labs	West	500	- 18
Library	Northwest	192	+ 11
Riddick	Southwest	99	- 14
Withers	Northeast	82	- 6

¹Direction - Direction from Reactor Stack

²Distance - Distance from Reactor Stack

³Elevation - Elevation Relative to the Top of the Reactor Stack

TABLE 2.2 SERIALLY TRANSPORTED GROSS BETA ACTIVITY ($\text{fCi m}^{-3} \pm 1 \sigma$)

DATE	SAMPLING LOCATIONS				
	DCL	BROUGHTON	LIBRARY	RIDDICK	WITHERS
1983					
04/04-04/08	35.0 \pm 4.4	34.6 \pm 4.2	41.7 \pm 4.8	38.7 \pm 4.5	31.8 \pm 4.2
04/11-04/15	43.9 \pm 4.8	32.8 \pm 4.4	32.9 \pm 4.4	32.9 \pm 4.4	39.3 \pm 4.6
04/18-04/22	37.3 \pm 4.4	34.9 \pm 4.3	34.2 \pm 4.5	36.0 \pm 4.5	38.6 \pm 4.6
04/25-04/29	30.6 \pm 4.2	43.8 \pm 5.0	38.9 \pm 4.5	35.7 \pm 4.4	36.3 \pm 4.5
05/02-05/06	41.1 \pm 4.8	42.9 \pm 4.9	40.0 \pm 4.7	37.4 \pm 4.4	35.1 \pm 4.6
05/09-05/13	44.2 \pm 4.8	45.3 \pm 4.9	46.3 \pm 5.0	42.3 \pm 4.8	No Data
05/16-05/20	33.1 \pm 4.4	33.5 \pm 4.6	39.5 \pm 4.8	31.0 \pm 4.2	34.2 \pm 4.5
05/23-05/27	31.8 \pm 4.4	32.4 \pm 4.5	33.8 \pm 4.6	34.2 \pm 4.3	24.2 \pm 4.0
05/30-06/03	27.0 \pm 4.1	36.0 \pm 4.8	38.1 \pm 4.5	42.0 \pm 5.0	33.2 \pm 4.4
06/06-06/10	47.1 \pm 5.7	44.6 \pm 5.1	50.2 \pm 5.2	46.4 \pm 5.1	55.1 \pm 5.6
06/13-06/17	49.3 \pm 5.2	42.0 \pm 4.8	54.7 \pm 5.3	41.1 \pm 4.8	43.4 \pm 4.8
06/20-06/24	39.4 \pm 4.8	31.9 \pm 4.2	44.7 \pm 5.1	52.3 \pm 5.3	47.8 \pm 5.1
06/27-07/01	45.0 \pm 5.0	49.0 \pm 5.1	34.3 \pm 4.3	38.6 \pm 4.5	35.8 \pm 4.7
07/04-07/08	37.1 \pm 4.9	34.3 \pm 4.4	35.0 \pm 4.6	30.0 \pm 8.1	24.8 \pm 3.8
07/11-07/15	43.0 \pm 5.3	51.2 \pm 5.8	51.0 \pm 5.8	41.0 \pm 5.3	43.3 \pm 5.5
07/18-07/22	52.1 \pm 5.8	43.4 \pm 5.4	46.5 \pm 5.6	51.8 \pm 5.9	40.1 \pm 5.4
07/25-07/29	37.1 \pm 5.1	39.2 \pm 5.2	31.5 \pm 5.0	37.1 \pm 4.6	42.4 \pm 4.7
08/01-08/05	41.1 \pm 4.7	45.6 \pm 5.0	34.2 \pm 5.3	45.3 \pm 5.5	51.4 \pm 5.8
08/08-08/12	47.5 \pm 5.8	29.8 \pm 5.0	28.5 \pm 4.8	44.5 \pm 5.4	46.4 \pm 5.6
08/15-08/19	50.1 \pm 5.4	40.3 \pm 5.0	64.9 \pm 6.4	63.6 \pm 6.3	67.0 \pm 6.5
08/22-08/26	41.7 \pm 4.5	45.6 \pm 4.9	44.3 \pm 4.8	35.7 \pm 5.1	40.0 \pm 5.4
08/29-09/02	32.7 \pm 4.4	33.4 \pm 4.6	36.1 \pm 4.5	47.3 \pm 4.8	41.2 \pm 4.7
09/05-09/09	46.4 \pm 5.1	46.2 \pm 5.0	38.5 \pm 4.6	44.8 \pm 5.7	50.4 \pm 5.1
09/12-09/16	52.1 \pm 6.1	41.2 \pm 5.5	40.8 \pm 5.3	63.6 \pm 6.4	41.2 \pm 5.4
09/19-09/23	46.1 \pm 5.1	41.8 \pm 5.5	50.1 \pm 5.1	40.0 \pm 5.4	47.4 \pm 5.8
09/26-09/30	19.9 \pm 5.0	28.0 \pm 5.0	34.3 \pm 5.1	29.9 \pm 5.0	23.8 \pm 4.8
10/03-10/07	33.1 \pm 5.3	46.0 \pm 5.6	41.8 \pm 5.5	51.0 \pm 5.8	28.9 \pm 5.0
10/10-10/14	46.3 \pm 5.1	28.0 \pm 4.2	37.2 \pm 4.3	37.0 \pm 4.6	35.0 \pm 4.5
10/17-10/21	29.9 \pm 4.1	43.1 \pm 4.9	41.0 \pm 4.7	45.6 \pm 4.9	34.1 \pm 4.5
10/24-10/28	30.3 \pm 5.1	35.7 \pm 5.1	32.4 \pm 5.0	44.5 \pm 5.4	43.3 \pm 5.5
10/31-11/04	51.1 \pm 5.9	42.4 \pm 5.6	44.6 \pm 5.5	41.4 \pm 5.3	42.8 \pm 5.3
11/07-11/11	20.2 \pm 4.7	34.7 \pm 5.2	27.8 \pm 4.9	40.1 \pm 5.4	40.7 \pm 5.2
11/14-11/18	25.4 \pm 4.9	19.2 \pm 4.4	23.0 \pm 4.6	28.3 \pm 4.8	34.5 \pm 5.3
11/21-11/25	53.2 \pm 6.1	27.1 \pm 4.9	21.6 \pm 4.6	40.0 \pm 5.4	53.3 \pm 5.2
11/28-12/02	45.8 \pm 5.7	44.3 \pm 5.6	42.7 \pm 5.4	30.8 \pm 5.0	46.0 \pm 5.6
12/05-12/09	48.6 \pm 5.3	49.4 \pm 5.1	44.6 \pm 4.9	42.2 \pm 4.8	43.3 \pm 4.9
12/12-12/16	36.2 \pm 4.7	45.3 \pm 5.2	59.7 \pm 5.7	48.7 \pm 5.2	57.5 \pm 5.6
12/19-12/23	49.3 \pm 5.1	35.3 \pm 4.5	43.0 \pm 4.8	44.8 \pm 5.0	43.1 \pm 4.8
12/26-12/30	38.1 \pm 4.8	40.9 \pm 5.0	35.8 \pm 4.7	33.9 \pm 4.6	47.5 \pm 5.2

TABLE 2.2 AERIALY TRANSPORTED GROSS BETA ACTIVITY ($\text{fCi m}^{-3} \pm 1 \sigma$), continued

DATE 1984	SAMPLING LOCATIONS				
	DCL	BROUGHTON	LIBRARY	RIDDICK	WITHERS
01/02-01/06	37.1 \pm 5.3	36.0 \pm 4.5	31.6 \pm 4.3	32.0 \pm 4.2	35.0 \pm 4.5
01/09-01/13	30.5 \pm 4.9	41.1 \pm 4.5	40.0 \pm 4.7	37.9 \pm 5.2	39.5 \pm 4.5
01/16-01/20	35.2 \pm 4.6	32.6 \pm 4.3	33.0 \pm 4.4	38.6 \pm 4.5	40.2 \pm 4.8
01/23-01/24	31.1 \pm 4.4	39.4 \pm 4.4	43.6 \pm 5.0	37.0 \pm 4.9	31.0 \pm 4.3
01/27-02/03	34.0 \pm 5.2	31.0 \pm 4.3	37.0 \pm 4.9	33.1 \pm 5.0	25.5 \pm 4.6
02/06-02/10	20.1 \pm 4.5	32.2 \pm 5.0	31.2 \pm 4.5	29.8 \pm 4.2	37.2 \pm 4.9
02/13-02/17	27.2 \pm 4.6	38.4 \pm 5.0	32.7 \pm 4.4	45.3 \pm 4.8	22.9 \pm 4.5
02/20-02/24	28.8 \pm 4.6	26.4 \pm 4.6	33.1 \pm 5.0	23.1 \pm 4.4	40.2 \pm 4.8
02/27-03/02	33.4 \pm 5.1	27.1 \pm 4.6	27.5 \pm 5.7	28.8 \pm 4.6	39.7 \pm 4.7
03/05-03/09	31.3 \pm 5.0	41.2 \pm 5.3	35.6 \pm 5.2	36.5 \pm 5.3	34.9 \pm 5.2
03/12-03/16	37.2 \pm 5.4	44.8 \pm 5.5	32.9 \pm 4.4	38.6 \pm 4.5	41.1 \pm 4.5
03/19-03/23	53.0 \pm 6.0	44.8 \pm 5.5	40.2 \pm 5.4	46.1 \pm 5.0	55.0 \pm 5.4
03/26-03/30	48.8 \pm 5.0	51.2 \pm 5.1	49.1 \pm 5.0	36.1 \pm 4.5	35.0 \pm 4.5
04/02-04/06	44.9 \pm 5.9	26.1 \pm 4.0	49.2 \pm 5.1	44.7 \pm 4.9	35.4 \pm 4.5
04/09-04/13	44.5 \pm 4.9	46.7 \pm 5.2	52.7 \pm 5.3	49.5 \pm 5.2	27.3 \pm 4.2
04/16-04/20	60.1 \pm 5.7	54.6 \pm 5.4	48.1 \pm 5.1	54.3 \pm 5.4	35.4 \pm 4.5
04/23-04/27	30.5 \pm 4.2	43.8 \pm 4.8	50.3 \pm 5.2	41.4 \pm 4.7	46.1 \pm 5.0
04/30-05/04	31.2 \pm 4.4	35.0 \pm 4.6	37.1 \pm 4.7	46.4 \pm 5.1	38.9 \pm 4.5
05/07-05/11	42.1 \pm 4.8	42.3 \pm 4.9	39.9 \pm 4.9	43.6 \pm 5.0	33.0 \pm 4.5
05/14-05/18	35.0 \pm 4.4	29.4 \pm 4.1	30.8 \pm 4.2	34.0 \pm 4.4	37.3 \pm 4.4
05/21-05/25	34.2 \pm 4.3	43.3 \pm 4.8	38.7 \pm 4.5	41.4 \pm 4.6	32.0 \pm 4.3
05/28-06/01	50.3 \pm 5.2	51.3 \pm 5.3	46.5 \pm 5.1	33.6 \pm 4.6	39.4 \pm 4.8

TABLE 2.3 AERIALY TRANSPORTED GAMMA ACTIVITY ($\text{fCi m}^{-3} \pm 1 \sigma$)

Sampling Period	NUCLIDES					
	Ce^{144}	Ce^{141}	Ru^{103}	Ru^{106}	Zr^{95}	Nb^{95}
1983						
04/04-04/08	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
04/11-04/15	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
04/18-04/22	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
04/25-04/29	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
05/02-05/06	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
05/09-05/13	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	No Data
05/16-05/20	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
05/23-05/27	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
05/30-06/03	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
06/06-06/10	6.8 ± 2.3	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
06/13-06/17	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
06/20-06/24	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
06/27-07/01	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
07/04-07/08	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
07/11-07/15	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
07/18-07/22	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
07/25-07/29	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
08/01-08/05	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
08/08-08/12	11.0 ± 1.2	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
08/15-08/19	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
08/15-08/19	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
08/22-08/26	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
08/29-09/02	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
09/05-09/09	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
09/12-09/16	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
09/19-09/23	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
09/26-09/30	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
10/03-10/07	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
10/10-10/14	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
10/17-10/21	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
10/24-10/28	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
10/31-11/04	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
11/07-11/11	11.3 ± 1.7	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
11/14-11/18	8.7 ± 1.8	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
11/21-11/25	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
11/28-12/02	11.7 ± 1.7	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
12/05-12/09	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
12/12-12/16	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
12/19-12/23	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
12/26-12/30	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5

TABLE 2.3 AERIALY TRANSPORTED GAMMA ACTIVITY (fCi m^{-3} 1σ), continued

Sampling Period	NUCLIDES					
	<u>Ce</u> ¹⁴⁴	<u>Ce</u> ¹⁴¹	<u>Ru</u> ¹⁰³	<u>Ru</u> ¹⁰⁶	<u>Zr</u> ⁹⁵	<u>Nb</u> ⁹⁵
1984						
01/02-01/06	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
01/09-01/13	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
01/16-01/20	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
01/23-01/24	9.6 + 2.8	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
01/27-02/03	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
02/06-02/10	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
02/13-02/17	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
02/20-02/24	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
02/27-03/02	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
03/05-03/09	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
03/13-03/16	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
03/19-03/23	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
03/26-03/30	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
04/02-04/06	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
04/09-04/13	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
04/16-04/20	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
04/23-04/27	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
04/30-05/04	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
05/07-05/11	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
05/14-05/18	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
05/21-05/25	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5
05/28-06/01	< 5.0	< 1.0	< 0.5	< 5.0	< 1.0	< 0.5

TABLE 3.1 Sr⁹⁰ IN COW'S MILK (pCi ℓ⁻¹ ± 1 σ)

<u>Date</u>	<u>Activity</u> (pCi ℓ ⁻¹ ± 1 σ)
April 1983	4.8 ± 0.8
May	4.7 ± 0.8
June	5.2 ± 0.8
July	6.3 ± 0.7
August	5.7 ± 1.1
September	4.9 ± 0.8
October	3.5 ± 0.6
November	5.8 ± 1.0
December	4.7 ± 0.8
January 1984	5.4 ± 1.5
February	6.2 ± 1.5
March	6.3 ± 1.4
April	4.1 ± 0.7
May	4.9 ± 1.2

TABLE 3.2 I-131 IN COW'S MILK (pCi ℓ⁻¹ ± 1 σ)

<u>Date</u>	<u>Activity</u> (pCi ℓ ⁻¹ ± 1 σ)
April 1983	< 2.0
May	< 2.0
June	< 2.0
July	< 2.0
August	< 2.0
September	< 2.0
October	< 2.0
November	< 2.0
December	< 2.0
January 1984	< 2.0
February	< 2.0
March	< 2.0
April	< 2.0
May	< 2.0

TABLE 4.1 SURFACE WATER SPECIFIC ACTIVITY (pCi ℓ^{-1} $\pm 1 \sigma$)

<u>Date</u>	<u>Location</u>	<u>Gross Alpha</u>	<u>Gross Beta</u>
April 1983	ON	0.3 \pm 0.1	5.0 \pm 0.4
	OFF	0.3 \pm 0.1	5.2 \pm 0.4
May	ON	0.2 \pm 0.1	3.0 \pm 0.4
	OFF	0.3 \pm 0.1	4.7 \pm 0.4
June	ON	0.3 \pm 0.1	4.0 \pm 0.4
	OFF	0.4 \pm 0.1	8.0 \pm 0.6
July	ON	0.2 \pm 0.1	4.5 \pm 0.4
	OFF	0.3 \pm 0.1	4.7 \pm 0.4
August	ON	0.4 \pm 0.2	6.1 \pm 0.5
	OFF	0.2 \pm 0.1	5.3 \pm 0.4
September	ON	0.4 \pm 0.1	11.0 \pm 0.5
	OFF	0.4 \pm 0.1	6.1 \pm 0.4
October	ON	1.0 \pm 0.1	9.0 \pm 0.5
	OFF	0.4 \pm 0.1	5.5 \pm 0.4
November	ON	0.4 \pm 0.1	6.0 \pm 0.5
	OFF	0.3 \pm 0.1	3.3 \pm 0.4
December	ON	0.3 \pm 0.1	4.4 \pm 0.4
	OFF	0.3 \pm 0.1	4.0 \pm 0.4
January 1984	ON	0.3 \pm 0.1	6.0 \pm 0.5
	OFF	0.3 \pm 0.1	8.2 \pm 0.7
February	ON	0.3 \pm 0.1	3.3 \pm 0.4
	OFF	0.2 \pm 0.1	6.2 \pm 0.5
March	ON	0.3 \pm 0.1	5.4 \pm 0.5
	OFF	0.2 \pm 0.1	5.9 \pm 0.5
April	ON	0.3 \pm 0.1	4.0 \pm 0.4
	OFF	0.1 \pm 0.1	4.0 \pm 0.4
May	ON	0.1 \pm 0.1	3.7 \pm 0.4
	OFF	0.1 \pm 0.1	3.6 \pm 0.4

TABLE 4.2 SURFACE WATER SPECIFIC ACTIVITY (pCi ℓ^{-1} $\pm 1 \sigma$)

<u>Date</u>	<u>Location</u>	<u>⁴⁰K</u>	<u>¹³⁷Cs</u>	<u>⁹⁰Sr</u>
April 1983	ON	< 3.0	< 0.1	< 0.3
	OFF	< 3.0	< 0.1	< 0.3
May	ON	< 3.0	< 0.1	< 0.4
	OFF	< 3.0	< 0.1	< 0.5
June	ON	< 3.0	< 0.2	< 0.4
	OFF	< 3.0	< 0.3	< 0.4
July	ON	< 3.0	< 0.2	< 0.2
	OFF	< 3.0	< 0.3	< 0.3
August	ON	< 3.0	< 0.3	< 0.3
	OFF	< 3.0	< 0.3	< 0.2
September	ON	< 3.0	< 0.1	< 0.3
	OFF	< 3.0	< 0.3	< 0.4
October	ON	< 3.0	< 0.2	< 0.5
	OFF	< 3.0	< 0.1	< 0.4
November	ON	< 3.0	< 0.3	< 0.2
	OFF	< 3.0	< 0.1	< 0.2
December	ON	< 3.0	< 0.2	< 0.2
	OFF	< 3.0	< 0.3	< 0.2
January 1984	ON	< 3.0	< 0.1	< 0.3
	OFF	< 3.0	< 0.4	< 0.4
February	ON	< 3.0	< 0.3	< 0.4
	OFF	< 3.0	< 0.5	< 0.4
March	ON	< 3.0	< 0.2	< 0.5
	OFF	< 3.0	< 0.5	< 0.5
April	ON	< 3.0	< 0.2	< 0.2
	OFF	< 3.0	< 0.1	< 0.3
May	ON	< 3.0	< 0.3	< 0.4
	OFF	< 3.0	< 0.3	< 0.2

Table 5.1 SOIL SPECIFIC ACTIVITY ($\text{pCi g}^{-1} \pm 1 \sigma$)

Location	Gross Alpha	Gross Beta ⁻	⁴⁰ K	¹³⁷ Co	²²⁶ Ra
Inside OBG (Surface)	3.4 \pm 0.9	34.0 \pm 3.1	5.0 \pm 10.1	< 0.1	0.3 \pm 0.04
Inside NBG (Surface)	3.2 \pm 0.8	21.0 \pm 2.7	2.7 \pm 0.5	< 0.1	0.8 \pm 2.5
North Campus	3.4 \pm 0.9	12.5 \pm 2.4	18.0 \pm 10.0	< 0.1	< 0.4
South Campus	1.8 \pm 0.7	12.0 \pm 2.2	5.1 \pm 10.1	< 0.4	< 0.4
East Campus	6.0 \pm 1.0	15.1 \pm 2.5	8.9 \pm 0.6	< 0.1	2.1 \pm 0.2
West Campus	2.7 \pm 0.8	34.1 \pm 3.2	4.6 \pm 0.5	< 0.1	6.0 \pm 5.5
West (4.5 ft)	9.2 \pm 6.7	18.3 \pm 2.5	9.9 \pm 10.0	< 0.1	< 0.4
Outside OBG (4.5 ft)	2.9 \pm 0.3	42.5 \pm 3.5	13.7 \pm 10.1	< 0.1	2.2 \pm 9.1
Outside NBG (4.5 ft)	4.9 \pm 1.0	28.1 \pm 3.0	9.0 \pm 8.2	< 0.4	4.1 \pm 0.6

OBG = Old Burial Ground

NBG = New Burial Ground

TABLE 6.1 VEGETATION SPECIFIC ACTIVITY ($\text{pCi g}^{-1} \pm 1 \sigma$)

<u>Location</u>	<u>Gross Alpha</u>	<u>Gross Beta⁻</u>	<u>K⁴⁰</u>	<u>Cs¹³⁷</u>	<u>I¹³¹</u>	<u>Co⁶⁰</u>
North Campus	0.05 \pm 0.03	3.2 \pm 0.6	< 5.0	< 1.0	< 2.0	< 1.0
South Campus	0.09 \pm 0.03	5.6 \pm 3.0	< 5.0	< 1.0	< 2.0	< 1.0
East Campus	0.02 \pm 0.04	4.2 \pm 11.5	< 5.0	< 1.0	< 2.0	< 1.0
West Campus	0.08 \pm 0.03	8.2 \pm 3.0	6.7 \pm 0.4	< 1.0	< 2.0	< 1.0
Inside OBG	0.10 \pm 0.03	5.9 \pm 1.1	< 5.0	< 1.0	< 2.0	< 1.0
Outside OBG	0.01 \pm 0.03	11.2 \pm 1.9	< 5.0	< 1.0	< 2.0	< 1.0
Inside NBG	0.04 \pm 0.03	30.0 \pm 3.8	< 5.0	< 1.0	< 2.0	< 1.0
Outside NBG	0.05 \pm 0.03	6.2 \pm 1.4	10.2 \pm 1.0	< 1.0	< 2.0	< 1.0



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August 29, 1984

Cecil O. Thomas, Chief
Standardization and Special Projects Branch
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Docket No. 50-297
ANNUAL REPORT

Dear Sir:

In compliance with Section 6.7.5 of the North Carolina State University PULSTAR Technical Specifications, our Nuclear Reactor Program staff has prepared the attached Annual Report for the period 1 July 1983 through 30 June 1984.

Very truly yours,

Garry D. Miller
Associate Director

TCB:
GDM:lpe

Attachment:
PULSTAR Annual Report (3 copies)

cc: All with attachment:

- (1) USNRC Director of Regulatory Operations, Region II
- (2) Dr. James R. Mulholland, Chairman
Radiation Protection Council
- (3) Dr. Jimmie J. Wortman, Chairman
Reactor Safeguards Advisory Committee
- (4) Mr. D. W. Morgan
Radiation Protection Officer
- (5) Dr. L. K. Monteith, Dean
School of Engineering
- (6) Dr. Paul J. Turinsky, Head
Department of Nuclear Engineering

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