MASTER

ANNUAL PROGRESS REPORT of the University of Florida Training Reactor

September 1, 1979—August 31, 1980

Engineering & Industrial Experiment Station
Nuclear Facilities Division

DEPARTMENT OF NUCLEAR ENGINEERING SCIENCES
COLLEGE OF ENGINEERING
University of Florida
Gainesville

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ANNUAL PROGRESS REPORT OF THE
UNIVERSITY OF FLORIDA TRAINING REACTOR
SEPTEMBER 1, 1979 - AUGUST 31, 1980

Submitted to the
Department of Energy
Nuclear Regulatory Commission
and
University of Florida

By
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November, 1980

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I. INTRODUCTION

The University of Florida Training Reactor's overall utilization was increased from the previous year during this reporting period (September 1, 1979 - August 31, 1980). It remains, however, significantly below historical levels. The areas of teaching and training are just below average utilization but research activities have almost stopped.

Several factors have contributed to the relatively poor utilization.

1. The reactor has not increased its power level to satisfy the needs of experimenters. This has resulted in the transfer of experiments to the Georgia Tech reactor and restrictions in starting other research programs.

2. The reactor staff and administration has dedicated a large portion of its time to satisfying regulatory requirements, including re-licensing of the Facility, preparation of a Safety Analysis Report, new Safeguards and Physical Security Plan and associated modifications, emergency planning and others. No time has been available to develop research, educational or training programs which could not be handled with the present staff.

3. The lack of a full-time Reactor Manager at the Facility, totally dedicated to its administration and conduct of operations, hampers effective and consistent administration of the facility.

The facility has undergone modifications to increase its Physical Security and Safeguards according to Federal Regulations, as well as implement an Emergency Plan to deal with radiological events.

The new Safety Analysis Report for the UFTR is being printed, with submittal to the Nuclear Regulatory Commission expected by December 31, 1980.

New courses utilizing the UFTR are designed and training programs for the nuclear utilities are contracted for the upcoming year. These will significantly increase utilization, but a concerted effort must be made to increase

research utilization.

The increase in research utilization should be accomplished by a combined effort at College and Departmental level; it requires a commitment to provide analytical services to experimenters as well as "free" utilization or reduced-cost reactor time to initiate or develop research programs.

II. UNIVERSITY OF FLORIDA PERSONNEL ASSOCIATED WITH THE REACTOR

A. Personnel Employed by the UFTR

N.J. Diaz	- Professor and Director of Nuclear Facilities, Reactor Supervisor
H. Gogun	- Senior Reactor Operator (full-time)
G. Fogle	- Reactor Operator (full-time)
M. Constable*	- Student Reactor Operator (1/2 time)
S. Jaffe*	- Student Reactor Operator (1/3 time)

B. Other Licensed Operators

G.R. Dalton	- Professor and Senior Reactor Operator, Nuclear Engineering Sciences Department
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C. Radiation Control Office

T.J. Bauer	- Radiation Control Officer
H.G. Norton	- Radiation Control Technician
G.R. Renshaw	- Radiation Control Technician
G. McCrane	- Radiation Control Technician
W. Caughlin	- Nuclear Technician (1/2 time)
A. Williams	- Nuclear Technician (1/4 time)
Z. Berry	- Nuclear Technician (1/4 time)
M. Grote	- Nuclear Technician (1/4 time)
B. McCully	- Nuclear Technician (1/4 time)

D. Reactor Safety Review Subcommittee

G.R. Dalton	- Chairman
N.J. Diaz	- Member
A.M. Jacobs**	- Member
M.J. Ohanian	- Member

* NRC license to be granted by December 31st, 1980

** Appointed in November, 1980

D. Reactor Safety Review Subcommittee (continued)

T.J. Bauer - Member

W.E. Bolch - Member

E. Line Responsibility for the UFTR Administration

R.Q. Marston, President, University of Florida

W.H. Chen, Dean, College of Engineering

A.M. Jacobs, Chairman, Department of Nuclear Engineering Sciences

N.J. Diaz, Director of Nuclear Facilities and Reactor Supervisor

F. Line Responsibility for the Radiation Control Office

R.Q. Marston, President, University of Florida

W.E. Elmore, Vice-President, Administrative Affairs

B.G. Dunavant, Director, Environmental Health and Safety

T.J. Bauer, Radiation Control Officer

III. FACILITY OPERATION

The UFTR maintained the low level of energy generation and overall utilization experienced the last two years. Although the educational and commercial utilization (training) increased, the reduction in research activities offset the gains from the other areas of use. The UFTR lacked the manpower to actively search for and support research projects.

Changes in regulations and standards affecting the UFTR continue to decrease the availability of the reactor as the staff continues to concentrate on making the necessary modifications, plans, reports, etc. It is expected that this level of regulatory activity will decrease to a more acceptable condition the coming year, especially after the new operating license is granted.

Shown in Table I is a summary of the reactor utilization for this reporting period. The list categorizes the twenty-three different research projects, teaching and training activities. The total reactor run-time was about 300 hours and the experiments used over 550 hours of facility time.

Table II summarizes the different categories of reactor utilization: teaching and research operator's training, commercial utilization (utility training program), testing and surveillance, and demonstrations. The research utilization was reduced to two projects using less than 60 hours of reactor run-time.

Detailed in Table III are the monthly and total energy generation, as well as the hours at full-power per month and total this year. The UFTR generated 9.8 Mw-hrs during this period.

Described in Table IV are the reasons and dates for unscheduled shutdowns and reportable incidents for the reporting period; however, an incident involving the PuBe startup source was reported to the NRC due to its radiological

significance. No radiation was released or significant radiation dose received by anyone due to this or any other reactor operation.

It is expected that, with the addition of a Reactor Manager, two part-time operators and support from the Analytical Facility of the Department, the research utilization can be significantly increased during the upcoming year.

TABLE I
SUMMARY OF FACILITY UTILIZATION
(September 1979 - August 1980)

NOTE: The projects marked with a + indicate irradiations or neutron activations. The projects marked with an * indicate training use. The projects marked with a ++ indicate demonstrations of reactor operations. "Utilization Time" is total time that the facility dedicates to a particular use, it includes "Run Time". "Run Time" is inclusive time from reactor startup to shutdown.

<u>PROJECT AND USER</u>	<u>TYPE OF ACTIVITY</u>	<u>UTILIZATION TIME</u> (hours)	<u>RUN TIME</u> (hours)
+ ENU 4505L, Dr. W. Ellis	NAA hair, insects and standards	3.67	2.68
+ ENU 4505L, Dr. W. Ellis	Neutron relaxation length by NAA of gold foil	2.83	1.05
++ENU 4505L, H. Gogun	α_T of moderator	3.42	2.48
++ENU 4505L, Dr. G. Dalton	Sub-critical multiplication	1.12	0.83
++ENU 4505L, Dr. G. Dalton	1/M and ρ determination by blade drop method	6.10	5.25
++ENU 4505L, H. Gogun	ρ worth of control blade by positive period method	2.33	1.78
++ENU 4505L, H. Gogun	High power and "cold slug"	1.83	1.52
++ENU 4505L, H. Gogun	Calometric heat balance	3.48	2.60
++ENU 4505L, H. Gogun	Low power, sub-critical operation	2.78	2.35
+ ENU 4304L, Dr. W. Ellis	NAA copper foil and discs for class demonstration	3.83	2.02
++ENU 5005, Dr. H. Campbell	High power operation	0.92	0.17
* ENU 5176, H. Gogun, G. Fogle	Reactor Operator Training Course	70.37	30.90
* ENV 6932, Dr. B. Dunavant, H. Norton	Radiation survey at power	2.25	1.87
* ENV 6932, H. Norton	Area monitor calibration exercise	0.73	0.44
* ENV 6932, H. Norton	Anti-C clothing exercise	1.00	0.00

<u>PROJECT AND USER</u>	<u>TYPE OF ACTIVITY</u>	<u>UTILIZATION TIME</u> (hours)	<u>RUN TIME</u> (hours)
+ ENU 6517, Dr. W. Ellis	Time delay coincidence spectrometry by NAA of copper foils	3.48	2.78
++NES 600, Dr. E. Carroll	Danger coefficient and statistical weight	3.72	3.23
+ NES 600, Dr.W. Vernetson	Absolute β counting and ϕ determination by NAA of gold foil	0.83	0.48
+ ENU 6515L, Dr. W. Vernetson	Effective resonance integral by NAA of metal foils	1.00	0.33
* Central Fla. Community College HP Lab, H. Norton	Radiation surveys at power	1.53	0.98
+ Dr. G.S. Roessler and J. Swanson	NAA of trace elements in cancer metastasis	55.70	51.10
+ Dr. E.E. Carroll and M. McCoy	Feasibility study of GCR ϕ determination	5.58	4.18
+ Summer Science Training Program, Dr.W.Vernetson, J. Houck	ϕ determination by NAA of gold foil	2.00	0.87
* Louisiana Power & Light H. Gogun, G. Fogle	Operator training	166.05	123.93
* Reactor Operator Training, H. Gogun, G. Fogle	Training operators for NRC license	39.90	10.85
++ Reactor tours and demonstrations, H. Gogun, G. Fogle	Orientation, lectures and operation demonstrations	46.08	8.49
* Reactor Operator Requalification Training, H. Gogun	Compliance with NRC requalification training requirements	7.68	3.30
+ Determination of Ar ⁴¹ Concentration, G.Fogle, J. Swanson	Counting activity of stack effluent sample	8.00	6.20
* UFTR Testing and Calibration Runs, H. Gogun	Instrument calibrations and verifications	34.83	28.77
TOTALS		<u>483.04</u>	<u>301.43</u>

TABLE II
UFTR UTILIZATION SUMMARY

	<u>Utilization Time</u> (hours)	<u>Run Time</u> (hours)
UF Courses and Laboratories	119.22	64.61
Research Activities	61.28	55.28
UFTR Operator Training and Requalification	47.58	14.15
UFTR Testing and Surveillance*	42.83	34.97
Commercial Utilization (Louisiana Power & Light Reactor Operator Training)	166.05	123.93
Reactor Tours and Demonstration Runs**	<u>46.08</u>	<u>8.49</u>
TOTALS	<u>483.04</u>	<u>301.43</u>

*Console checkouts are excluded

**Note: 33 tours were conducted for 313 persons. These include high school, junior college and UF students, emergency response team units and interested members of the general public.

TABLE III
MONTHLY REACTOR ENERGY GENERATION

<u>Monthly Totals</u>	<u>Kw-Hrs</u>	<u>Hours at Full Power</u>
September 1979	1.33	0.0
October 1979	141.43	1.4
November 1979	0.1	0.0
December 1979	17.1	0.17
January 1980	725.95	7.25
February 1980	682.72	6.73
March 1980	1,163.61	8.67
April 1980	1,855.0	18.5
June 1980	222.16	1.60
July 1980	1,554.03	13.03
August 1980	<u>140.51</u>	<u>1.35</u>
TOTALS	<u><u>9,800.14</u></u>	<u><u>90.97</u></u>

TABLE IV
UNSCHEDULED SCRAMS

<u>Date</u>	<u>Occurrence</u>
May 6, 1980	Electrical Failure
July 14, 1980	Electrical Transient
July 24, 1980	Manual Scram*
July 25, 1980	Electrical Failure

*Senior Operator initiated manual scram on realizing PuBe source was still in reactor at 10 kw power level. Full report submitted to NRC on incident on August 5, 1980.

IV. MODIFICATIONS TO THE OPERATING CHARACTERISTICS OR CAPABILITIES OF THE UFTR

No significant modifications to the operating characteristics of the UFTR were done during the period September 1, 1979 through August 31, 1980.

A series of significant improvements in the area of Physical Protection* and Emergency Response have been implemented.

*Withheld from public disclosure pursuant to 10 CFR 2.790

V. SIGNIFICANT MAINTENANCE AND TEST OF REACTOR SYSTEMS

<u>Date</u>	<u>Description</u>
6 September, 1979	Replaced Dry Cells Security System Control Unit
18 September, 1979	Replaced Motor Drive Safety Blade #2
28 September, 1979	S-1 Control Blade Drop Times Completed
16 October, 1979	Q-1 Completed Quarterly SCRAM Checks
25 October, 1979	S-2 Completed Blade Worth Measurements
5 November, 1979	Repaired Recorder Air Particulate Detector
4 December, 1979	Q-2 Calibration Check of Area Monitors
7 December, 1979	Q-3 Conducted Radiological Emergency Drill
11 December, 1979	Repaired 2 Pen Recorder
20 December, 1979	Repaired 2 Pen Recorder
15 January, 1980	Q-1 Completed Quarterly Scram Checks
15 January, 1980	Replaced the 2 Pen Recorder Amplifier
16 January, 1980	Repaired Digital Blade Position Indicator
4 February, 1980	Leak Checked Antimony-Beryllium Source
11 February, 1980	Reactivity Worth Measurements Safety #1
12 February, 1980	Reactivity Worth Measurements Safety #1
13 February, 1980	Reactivity Worth Measurements Safety #1
15 February, 1980	Repaired Leak Shield Tank Purification Loop
18 February, 1980	Repaired North Area Monitor Recorder
27 February, 1980	Q-3 Radiological Emergency Drill With Disaster Team and Hospital
5 March, 1980	Q-2 Completed Calibration Checks Area Monitor

<u>Date</u>	<u>Description</u>
12 March 1980	Repaired Stack Monitor Preamplifier
13 March 1980	Completed Power Installation for Relocating Partial Monitor
31 March, 1980	Repaired Solo Bridge Conductivity Probe
1 April, 1980	S-1 Blade Drop Timing Checks
10 April, 1980	Repaired Connection to Security System
10 April, 1980	Repaired Batteries in Security System
16 April, 1980	A-2 Annual Calibration Test of Nuclear Instruments
22 April, 1980	Replaced Rupture Disc in Coolant System
2 May, 1980	Q-1 Quarterly Check Scram Functions
20 May, 1980	Q-2 Calibration Check of Area Monitors
27 May, 1980	S-2 Reactivity Check of Blade Worth
2 June, 1980	Changed Secondary Cooling to City Water
3 June, 1980	Changed Secondary Cooling to City Water
24 June, 1980	Q-3 Completed Radiological Emergency Drill
3 July, 1980	Q-1 Quarterly Check Scram Functions
24 July, 1980	Changed Secondary Cooling to City Water
24 July, 1980	Changed Secondary Cooling to Well Water
7 August, 1980	Cleaned and Decontaminated East West Thru Port
15 August, 1980	Oiled Diluting Fan Bearing
26 August, 1980	Q-1 Quarterly Check Scram Functions
27 August, 1980	Replaced Overhead Crane Support Cable
29 August, 1980	Q-3 Completed Radiological Emergency Drill

VI. CHANGES TO TECHNICAL SPECIFICATIONS AND STANDARD OPERATING PROCEDURES

- A. There were no changes to the Technical Specifications during this reporting period.
- B. Revisions to Standard Operating Procedures
 - 1. UFTR-SOP-A.1 - Pre-operational Checks
 - a. PART II Rev. 10, 5/80
 - 2. UFTR-SOP-A.2 - Startup
 - a. Page 4 Rev. 6, 10/80
 - b. Page 5 Rev. 6, 10/80
 - c. Page 6 Rev. 6, 10/80
 - 3. UFTR-SOP-A.3 - Operation at Power
 - a. Page 1 Rev. 6, 10/80
 - 4. UFTR-SOP-D.2 - Radiation Work Permit
 - a. Page 1 Rev. 7, 8/80
 - 5. UFTR-SOP-E.4A - Reactor Shielding and Graphite
 - a. Coversheet Orig., 1/80
 - b. Page 1 Orig., 1/80
 - c. Page 2 Orig., 1/80
 - 6. UFTR-SOP-E.4B - Auxiliary Systems Maintenance Shield Tank & Shield Tank Recirculating System
 - a. Coversheet Orig., 1/80
 - b. Page 1 Orig., 1/80
 - c. Page 2 Orig., 1/80
 - d. Page 3 Orig., 1/80
 - e. Page 4 Orig., 1/80

VII. RADIOACTIVE RELEASES AND ENVIRONMENTAL SURVEILLANCE

A. Gaseous (Argon-41)

<u>Month</u>	<u>μCi Released</u>	<u>μCi/ml*</u>
September 1979	5.93×10^3	2.06×10^{-12}
October 1979	6.3×10^5	2.19×10^{-10}
November 1979	4.01×10^2	1.39×10^{-13}
December 1979	7.62×10^4	2.65×10^{-11}
January 1980	3.24×10^6	1.12×10^{-9}
February 1980	3.04×10^6	1.05×10^{-9}
March 1980	5.19×10^6	1.8×10^{-9}
April 1980	8.27×10^6	2.01×10^{-9}
May 1980	1.4×10^7	3.5×10^{-9}
June 1980	9.9×10^5	2.41×10^{-10}
July 1980	6.9×10^6	1.7×10^{-9}
August 1980	6.2×10^5	1.52×10^{-10}

TOTAL ARGON-41 RELEASED = 42.39 Ci

B. Liquid Waste From The UFTR/Nuclear Sciences Complex*

There were 618,000 liters discharged to the campus sanitary sewage system during this reporting period.

<u>Month</u>	<u>μCi/mlβ</u>
September 1979	2×10^{-9}
November 1979	NDA
December 1979	NDA

<u>Month</u>	<u>$\mu\text{Ci/ml}$</u>
January 1980	1.7×10^{-8}
February 1980	NDA
April 1980	NDA
July 1980	NDA
August 1980	NDA

*The effluent discharged into the holding tanks comes from twenty laboratories within the Nuclear Sciences Center as well as the UFTR complex.

NDA - No Detectable Activity, minimum detectable activity = $2.4 \times 10^{-9} \mu\text{Ci/ml}$

The UFTR normally released to the holding tanks approximately 1.5 liters of primary coolant per week due to waste from primary sampling. The average activity for this coolant was $1.34 \times 10^{-7} \mu\text{Ci/ml}$ for the reporting period.

On April 22, 1980, approximately 176 liters of water were released to the holding tanks at $1.08 \times 10^{-7} \mu\text{Ci/ml}$. This represents the total primary coolant release for this reporting period. There was no detectable alpha activity released. Allowing for the decay in the holding tanks and using a characteristic half-life of 15 hours, the activity was reduced to less than $5.4 \times 10^{-8} \mu\text{Ci/ml}$. This activity was diluted to a level of NDA before tanks were released to the environment.

C.

The UFTR maintains film badge monitoring in areas adjacent to the UFTR complex. The seven monthly monitored film badges usually read less than 10 milliroentgens. The following is the total for this reporting period September 1979 through August 1980:

A-1	50 millirens
A-2	40 millirens
A-3	20 millirens
A-4	20 millirens
A-5	50 millirens
A-6	30 millirens
A-7	20 millirens

No personnel associated with the UFTR received more than 10 mr/month.

Dosimeter exposure measurements for visitors to the UFTR were all less than 5 milliroentgen for this reporting period.

VIII. EDUCATION, RESEARCH, AND TRAINING UTILIZATION

Note: The participating students are indicated with an *. Other participants are faculty or staff members of the University of Florida, unless specifically designated otherwise. A ** indicates those students working on theses or dissertations.

1. Nuclear Engineering Laboratory II (ENU 6516) - Dr. E.E. Carroll, Dr. W.H. Ellis, Dr. W.G. Vernetson (Nuclear Engineering Sciences)

This Nuclear Engineering Laboratory for graduate students used the UFTR for a series of experiments, including irradiation of materials and reactor measurements.

2. Principles of Nuclear Reactor Operations (ENU 5176) - Dr. N.J. Diaz, UFTR Staff (Nuclear Engineering Sciences)

For this course, participating students are assigned in pairs to spend two hours weekly in the UFTR cell performing reactor startups, shutdowns, operations at power, as well as tests and calibrations of reactor systems and nuclear instruments normally done as routine checkouts. This course is recommended for senior undergraduates and graduate students in Nuclear Engineering. All student activities in the UFTR are performed under the direction of a licensed Reactor Operator or Senior Reactor Operator.

3. Principles of Nuclear Reactors (ENU 4101) - Dr. H.D. Campbell (Nuclear Engineering Sciences)

Fundamental aspects of reactor operations are demonstrated to engineering students majoring in areas other than nuclear engineering.

4. Fundamentals of Reactor Engineering (ENU 5005) - Dr. H.D. Campbell (Nuclear Engineering Sciences)

Fundamental aspects of reactor operations are demonstrated to engineering students majoring in areas other than nuclear engineering.

5. Nuclear Engineering Laboratory I (ENU 4505L) - Dr. W.H. Ellis (Nuclear Engineering Sciences)

This Nuclear Engineering Laboratory for undergraduate students used the UFTR for a series of experiments and exercises that included: radiation field

surveys and radiation protection, measurement of the diffusion length of neutrons in graphite, low and high power reactor operations, 1/m approach to critical by control blade, temperature coefficient measurements, and blade reactivity measurements by blade drop and positive period techniques.

6. Application of Nuclear Radiation and Energy 1 (ENU 4304) - Dr. W.H. Ellis (Nuclear Engineering Sciences)

The use of radioisotopes in nuclear analysis, engineering and special research problems are demonstrated by the activation of materials in the UFTR and the corresponding studies.

7. Special Problems in Environmental Engineering (ENV-6932) - Dr. B.G. Dunavant, H. Norton, (Environmental Engineering Sciences)

The reactor is used for demonstration of reactor operations, for reactor-related health physics activities and radiation protection exercises and for isotope technique laboratories.

8. LPL Reactor Operations Training Program - N.J. Diaz, G.W. Fogle, H. Gogun, W.G. Vernetson (Nuclear Engineering Sciences)

The cold-license candidates for the Waterford 3 SES nuclear power plant of the Louisiana Power and Light Co. spent three weeks performing hands-on operations at the UFTR. This is a federal requirement established for candidates for Reactor Operator licenses.

9. UFTR Operator Training and Requalification - N.J. Diaz, G.W. Fogle, H. Gogun and Reactor Staff (Nuclear Engineering Sciences)

The training or requalification programs establish a required number of startups, weekly checks, daily check, drills and lectures for each operator to participate in in order to develop or maintain proficiency.

10. NAA Research - Trace Elements and Cancer - Dr. G.S. Roessler, John Swanson**, M. Soucie* (Nuclear Engineering Sciences)

This research project studied the relationship between trace elements in tissue, cancer and cancer metastasis. Activation analysis of murine melanoma tissue is used to compare elemental composition of mouse normal tissue, primary tumor and metastasis. The research also used various biological standards to

establish base composition levels.

11. Gaseous Core Reactor Research, funded by National Science Foundation - E.E. Carroll, N.J. Diaz, M. McCoy** (Nuclear Engineering Sciences)

Foils are activated in the UFTR to calibrate foils strings and test the computational system that will be used in the Gaseous Core Reactor Experiments at Los Alamos Scientific Laboratory.

12. UFTR Calibration and Test Runs - H. Gogun, G.W. Fogle (Nuclear Engineering Sciences)

The required testing and surveillance of reactor protection, control and radiation monitoring systems is conducted according to the established requirements of the Technical Specifications.

IX. THESES, PUBLICATIONS, REPORTS AND ORAL PRESENTATIONS
OF WORK RELATED TO THE USE AND OPERATION OF THE UFTR

1. "Trace Elements and Cancer," Ph.D. dissertation, John Swanson, August 4, 1980.
2. "Generation, Measurement and Utilization of Xenon Excimer Radiation Produced by Nuclear Reactor Products," R.A. Walters, et al., ANS Transactions, Volume 34, June, 1980.