Contract # DE-AC05-76ER04014

Report # ORO-4014-14

ANNUAL PROGRESS REPORT OF THE UNIVERSITY OF FLORIDA TRAINING REACTOR

September 1, 1983 - August 31, 1984

NUCLEAR FACILITIES DIVISION

DEPARTMENT OF NUCLEAR ENGINEERING SCIENCES

College of Engineering

University of Florida

Gainesville

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Submitted to the

Department of Energy
Nuclear Regulatory Commission

and

University of Florida

By

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Department of Nuclear Engineering Sciences
College of Engineering
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Gainesville, Florida
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I. INTRODUCTION

The University of Florida Training Reactor's overall utilization for the past reporting year has increased dramatically compared to previous years, even exceeding the levels of utilization characteristic of the early 1970's in some areas such as energy generation. Indeed, the total energy generation (Kw-Hr) for this reporting year is at the highest level ever and represents an increase of over 300% over the 1982-1983 reporting year which itself had an increase of 50% over the 1981-1982 reporting year.

An analysis of the facility utilization shows that the increased usage and energy generation over the previous several years is attributable to several supporting conditions. First, this reporting year is the first full year with complete installation of the new rabbit system and implementation of the associated Neutron Activation Analysis Laboratory (NAAL) giving the staff the capability to promote it among University of Florida users and among researchers at other universities and colleges around the State of Florida. Second, this reporting year was the first ever in which the University of Florida Training Reactor was supported as part of the Department of Energy's Reactor Sharing Program. This reactor sharing program is designed to increase the availability of University reactor facilities such as the UFTR to non-reactor owning colleges and universities (user institutions). Basically this grant provides funds against which reactor operating costs may be charged when the facilities are utilized by regionally affiliated user institutions for student instruction/training or for student or faculty research that is not supported by outside funding. In all, seven different academic institutions around the State of Florida made use of this program to utilize the UFTR for research, primarily via neutron activation analysis to determine trace element compositions and for reactor familiarization and training of students in various community college programs such as nuclear medicine technology and radiation protection technology programs. Reactor use by University of Florida courses and laboratories continues at the substantial level established in the previous two years. Finally, the acquisition of training programs conducted for two nuclear utilities during the current reporting year (a full program for Florida Power Corporation and a limited operations usage program for Georgia Power Company) has rounded out significant contributions to facility utilization and total energy generation.

With one training program already scheduled along with continued availability of the new remote sample-handling "rabbit" system (and NAA laboratory) plus renewal of the Reactor Sharing Program support, facility utilization and energy generation for the upcoming year should be maintained and possibly even considerably augmented. The latter augmentation is particularly possible because the UFTR utilizaton under the DOE Reactor Sharing Program has spread publicity on the availability of the UFTR so that a number of investigators on campus have indicated an interest in using the reactor facility and the functional "rabbit" system during the upcoming year.

As noted in the 1982-1983 report, the facility administration was considerably stabilized by appointment of a fully vested Reactor Manager during the year. In combination with the return of the Director of Facilities, these conditions were all contributing to the considerable broad-based increases in facility usage for education and training of university students and utility operators as well as research by faculty at the University of Florida and other schools. The decision of some staff personnel to go on part-time employment plus the facility director being on leave for this coming year may necessitate cutbacks in some usage programs until all replacement personnel are in place.

Several significant license-related administrative activities occurred during this reporting year. First, the UFTR Facility Emergency Plan was submitted to NRC in November, 1982 to meet NRC requirements for such a submittal by November 3, 1982. As a result of the NRC review of this Plan, a great deal of additional information and corrections to the Emergency Plan were requested by NRC by August 15, 1983. Because of the pervasive nature of the requested changes, corrections and additions to the Plan, two extensions to the August 15, 1983 deadline were obtained in order to produce a complete, rewritten UFTR Emergency Plan. This completely revised and rewritten UFTR Emergency Plan following the guidelines of ANSI/ANS 15.16-1982 was submitted to NRC for final approval on October 14, 1983. Final approval of this Emergency Plan was received from NRC in a letter dated June 4, 1984 with a requirement for notification of full implementation of the Plan within 120 days*.

Second, as noted in Section II, the Director of Facilities has taken a leave of absence for the upcoming year. However, the reactor manager has been designated to act in his place while an SRO has been designated as the Acting Reactor Manager. This administrative arrangement meets all regulatory requirements and will enable the facility to meet all regulatory commitments.

Third, two sets of amendments to the Technical Specifications were approved during the reporting year. Amendment 14, originally submitted on August 19, 1984 was approved as Section 6.6.3 of the UFTR Technical Specifications. Amendment 14 makes the UFTR Technical Specifications conform with ANSI/ANS 15.18-1979 and the long standing UFTR practice requiring reporting significant changes in facility administration to the NRC. Amendment 15, originally submitted on October 27, 1982, essentially corrects a series of typographical and nomenclature errors to make the UFTR Tech Specs conform to desired and approved UFTR operational requirements and avoid unnecessary vagueness at sev-

* This notification has been subsequently transmitted to NRC in a letter dated September 25, 1984.

eral points.

The UFTR continues to operate with an outstanding safety record and in full compliance with regulatory requirements. An NRC inspection during the year resulted in only minor recommendation relative to security requirements. Similarly an inspection by a representative of American Nuclear Insurers also resulted in only minor recommendations relative to safety of the facility and associated personnel. The reactor and associated facilities continue to maintain a high in-state visibility and strong industry relationships. With the DOE reactor sharing program to support UFTR-related research by faculty at other academic institutions as well as training for various community college programs, the reactor facility is also maintaining high in-state visibility with these other institutions of higher learning. It is expected that more direct industry training will be accomplished in the upcoming year hopefully accompanied by further increases in research primarily through the use of the rabbit system and the associated NAAL facility both under the DOE Reactor Sharing Program and hopefully from research funded from other agencies, some of which has been developed from research begun under the reactor sharing program.

II. UNIVERSITY OF FLORIDA PERSONNEL ASSOCIATED WITH THE REACTOR

A. Personnel Employed by the UFTR

N.J. Diaz	- Professor and Director of Nuclear Facilities
W.G. Vernetson	- Assistant Engineer and Reactor Manager (September, 1983 - August 10, 1984) Assistant Engineer and Acting Director of Nuclear Facilities (August 10-31, 1984)
H. Gogun	- Senior Reactor Operator (full-time) (September, 1983 - May, 1984) Senior Reactor Operator (part-time) (June, 1984 - August, 1984)
G. Fogle	- Reactor Operator (full-time) (September, 1983 - February, 1984) Reactor Operator (part-time) (May, 1984 - August, 1984)
P.M. Whaley	- Student Reactor Operator (1/2 time) (September, 1983 - June, 1984) Senior Reactor Operator (3/4 time) (June - August, 1984) Acting Reactor Manager (3/4 time) (August 10-31, 1984)
C.J. Stiehl	- Student Reactor Operator Trainee (1/2 time) (July - August, 1984)
J. Ogles	- Student Reactor Operator Trainee (1/3 time) (May, 1984)

B. Radiation Control Office

D. Munroe	- Radiation Control Officer (September, 1983 - August, 1984)
H.G. Norton	- Assistant Radiation Control Officer (September, 1983 - August, 1984)
G.R. Renshaw	- Radiation Control Technician (September, 1983 - August, 1984)
H.J. Newman	- Nuclear Technician (1/2 time) (September, 1983 - March, 1984)
B.M. DesRoches	- Nuclear Technician (1/3 time) (March, 1984 - August, 1984)
R. Fayko	- Nuclear Technician (1/3 time) (October, 1983 - August, 1984)

C. Reactor Safety Review Subcommittee

M.J. Ohanian	- Chairman
W.G. Vernetson	- Member (Reactor Manager)
J.A. Wethington, Jr.[1]	- Member
W.E. Bolch	- Member
D. Munroe	- Member (Radiation Control Officer)

D. Line Responsibility for UFTR Administration

R.Q. Marston[2]	- President, University of Florida
W.H. Chen	- Dean, College of Engineering
J.A. Wethington, Jr.	- Acting Chairman, Department of Nuclear Engineering Sciences
N.J. Diaz[3]	- Director of Nuclear Facilities
W.G. Vernetson[4]	- Reactor Manager

E. Line Responsibility for the Radiation Control Office

R.Q. Marston	- President, University of Florida
W.E. Elmore	- Vice President, Administrative Affairs
T.R. Turk[5]	- Acting Director, Environmental Health and Safety
D. Munroe	- Radiation Control Officer

Note 1: J.A. Wethington, Jr. holds the position of Acting Chairman, Department of Nuclear Engineering Sciences.

Note 2: Effective September 1, 1984, Mr. Marshall Criser is the new President of the University of Florida.

Note 3,4: Dr. N.J. Diaz is on leave for a year beginning August 10, 1984. In his absence, Dr. W.G. Vernetson has been appointed to the position of Acting Director of Nuclear Facilities with Mr. P.M. Whaley appointed as Acting Reactor Manager.

Note 5: The search for a new Director is complete with the new director (Dr. William S. Properzio) in position as of October 8, 1984.

III. FACILITY OPERATION

The UFTR experienced a dramatic and substantial increase in its overall utilization in most areas when compared to the last reporting year, with utilization approaching the highest levels recorded in the early 1970's. This increase has been supported by a variety of usages ranging from industry educational and training programs to research and educational utilization by University of Florida as well as other researchers and educators around the State of Florida through the support of the DOE Reactor Sharing Program.

As expected, the decision to develop the Neutron Activation Analysis program has improved research irradiation utilization. With successful implementation of the new remote sample-handling "rabbit" facility, efforts to advertise availability and encourage usage of the UFTR (especially for research) are proceeding favorably. Under the Reactor Sharing Program there has been significant usage by users from other schools; in addition, there have been a number of usages among researchers at the University of Florida. Hopefully some commercial irradiations will be forthcoming during this next year to further complement UFTR operating activities.

The level of administrative work dedicated to regulatory activities should be reduced to a more manageable effort this upcoming year following acceptance of the updated and revised UFTR Emergency Plan.

Shown in Table I is a summary breakdown of the reactor utilization for this reporting period. The list categorizes the 43 different research projects, various tests, teaching and training activities. The total reactor runtime was about 737 hours while the various experiments and other projects used over 1140 hours of facility time.

Table II summarizes the different categories of reactor utilization: college and university teaching, research projects and UFTR operator's training and requalification, testing and surveillance, and various reactor operations demonstrations. The research utilization consisted of 10 projects using about 414 hours of reactor run-time. With increases in most areas from the last reporting year, the research and training supported under the DOE Reactor Sharing Program plus two commercial utility training programs are primarily responsible for the total facility utilization being one of the highest in UFTR history. With utility training and outside research activities already scheduled for the upcoming year, this next year promises to produce facility utilization at a similar or even higher level.

Table III contains a breakdown delineating the 7 schools and their 32 usages of the UFTR facilities which were sponsored under a Department of Energy Reactor Sharing Program grant. These sponsored usages account for about 20 hours of run time in Category I in Table II and over 80 hours of run time in Category II and have resulted in much improved visibility for the UFTR around the State of Florida and also among researchers and other users at the University of Florida.

Detailed in Table IV are the monthly and total energy generation, as well as the hours at full-power per month and totals for this past year. The UFTR generated 47.29 Mw-hrs during this twelve month reporting period. Both the total Mw-hrs energy generation and the hours at full power represent over 325% increase from the previous year. The 47.29 Mw-hrs represents nearly 415% increase over the previous five-year average. The 47.29 Mw-hrs energy generation is the highest for any reporting year since the UFTR first went critical in May, 1959. Having such a record in this 25th anniversary year is a fitting way to commemorate these 25 years of operation.

Described in Table V are the reasons and dates for four unscheduled shutdowns for the reporting period. No reportable incidents occurred during this reporting year. However, Table VI contains a descriptive log of nine (9) unusual occurrences with brief evaluations of each. No uncontrolled releases of radioactivity have occurred from the facility and controlled releases are well within established limits. The personnel radiation doses were minimal and averaged well under 10% of the allowable dose. Environmental radioactivity surveillance continues to show no detectable off-site dose attributable to the UFTR facility.

TABLE I

SUMMARY OF FACILITY UTILIZATION
(September , 1983 - August, 1984)

NOTE: The projects marked with a * indicate irradiations or neutron activations. The projects marked with an ** indicate training/educational use. The projects marked with an *** indicate demonstrations of reactor operations. "Experiment Time" is total time that the facility dedicates to a particular use, it includes "Run Time." "Run Time" is inclusive time commencing with reactor startup and ending with shutdown and securing the reactor.

PROJECT AND USER	TYPE OF ACTIVITY	RUN TIME (hours)	EXPERIMENT TIME (hours)
*NAA Research - Dr. G.S. Roessler	Bone Marrow and Blood Serum Trace Element Analysis - Cancer Research	274.06	286.46
**ENU 4505L - Dr. W.H. Ellis	Senior Level Nuclear Engineering Laboratory Exercises and Experiments	12.74 (1.75)	26.33
**ENU 6516L - Dr. E.E. Carroll, Jr.	Graduate Level Nuclear Engineering Laboratory Exercises and Experiments	3.77	6.20
*NAA Research - Dr. G.S. Roessler and N.B. Comerford	Pine Needle and Soil Sample Trace Element Analysis	13.15	14.40
*NAA Research - Dr. G.S. Roessler	NAA of Thorium Bearing Soil Samples	12.30	12.63
**ENU 4134 - Dr. W.G. Vernetson	Class Demonstration Run for Heat Transport Considerations	0.60	1.42
*Preliminary Research on Cerenkov Detector Development - Dr. E.E. Carroll, Jr.	Lithiated Paraffin Irradiation and Evaluation Plus Spectral Analysis of Thermal Column	1.16	15.78
*NAA Research - Dr. S. Anghaie/Dr. R. Abbasschian	NAA Evaluation of Metal Processing by Rapid Cooling for Fusion Machinery Application	2.36 (0.53)	3.30
**ENU 4905/6937 - Dr. W.G. Vernetson/ Reactor Staff	Independent Reactor Operations Laboratory Course for Undergraduate and Graduate Nuclear Engineering Students	42.32 (2.74)	96.54

TABLE I (CONTINUED)

PROJECT AND USER	TYPE OF ACTIVITY	RUN TIME (hours)	EXPERIMENT TIME (hours)
**ENU 3002 - Dr. G.S. Roessler	Reactor Operations Demonstration	0.83	2.22
*NAA Research - Dr. Grace Chiu/Ranga Rao - University of West Florida - Reactor Sharing	Evaluation of Uptake of Heavy Metals in a Seagrass Community	57.07	61.93
*NAA Research - Dr. J. Trefry, Florida Institute of Technology - Reactor Sharing	NAA of Trace Elements in Marine Sediments	23.85	26.13
***Gainesville High School Students - E. Baumgartner	Tour, Lecture and Demonstration of Reactor Facility Operations	0.40	1.50
***Presentation for Prospective Staff Member - K.M. Harvey (Ex-Navy)	Tour and Demonstration of Reactor Facility Operations	0.47	5.75
***1984 Engineers' Fair Reactor Staff	Tours and Demonstrations of Reactor Operations	0.73	5.42
**St. Augustine High School Science Class - Ms. E. Doyle Reactor Sharing	Lecture, Tour and Demonstration of Reactor Facility Operations	0.35	1.92
**Santa Fe Community College Nuclear Medicine Technology Program - S. Marchionno - Reactor Sharing	Demonstration of UFTR Operations with Radiation Surveys and NAA Exercises	1.98	3.08
***UF Freshman Honors Program - Bert Hickman	Lecture, Tour and Demonstration of Reactor Operations	1.16 (1.16)	2.08
**Central Florida Community College Radiation Protection Technology Program - G. Stephenson - Reactor Sharing	Demonstration of UFTR Operations with Radiation Surveys and NAA Training Exercises	2.07	6.96

TABLE I (CONTINUED)

PROJECT AND USER	TYPE OF ACTIVITY	RUN TIME (hours)	EXPERIMENT TIME (hours)
**Hillsborough Community College Nuclear Medicine Technology Program - Dr. M. Lombardi - Reactor Sharing	Demonstration of UFTR Operations with Radiation Surveys and NAA Training Exercises	1.45	3.05
**CFCC Radiation Protection Technology Program - Ms. R. Rawls - Reactor Sharing	Radiological Control and Protection Training Program of Cooperative Work Exercises	13.70 (0.68)	43.05
**EEL 4280 - Dr. R. Westphal	Reactor Operations Demonstration	1.30	6.44
**ENU 4612/5615L - Dr. E.E. Carroll, Jr.	Nuclear Instrumentation Course: Instrumentation Demonstration With Reactor Operations	10.32	13.00
**ENV 4201/5206 - Dr. C.E. Roessler	Reactor Facility Instrumentation and Operations Demonstration	2.37 (1.50)	3.05
**ENV 4241 - Dr. C. Roessler	Familiarization Review of Reactor and Radiation Monitoring Instrumentation - Operations Demonstration	2.0	2.15
**ENU 5176L - Dr. E.T. Dugan/ Reactor Staff	Reactor Operations Laboratory Course Exercises	90.52 (1.75)	151.51
**ENU 4104 - Dr. A.M. Jacobs/ P.M. Whaley	Reactor Operations Demonstration for Junior Level Nuclear Engineering Students	0.95	1.75
**CHS 5110 - Dr. K. Williams	Reactor and NAA Lab Demonstration/Utilization for Radiochemistry Research Laboratory Course	3.89	4.87
**ENV 6211 - D.L. Munroe	Radiation Monitor Calibration and General Area Survey Techniques	1.72	1.93
*Fla. Foundation for Future Scientists (NAA Research) - Dr. W.G. Vernetson/ John Carswell	Summer Student Research Program: NAA of Potential Hogtown Creek Contaminants	22.32	27.85

TABLE I (CONTINUED)

PROJECT AND USER	TYPE OF ACTIVITY	RUN TIME (hours)	EXPERIMENT TIME (hours)
**Operator Training - Dr. W.G. Vernetson/ Reactor Staff	NRC Requalification Training Requirements	62.25 (48.98)	122.13 (33.22)
**Operator Exams	NRC Administered Operator Examinations	0.00	3.75
**Radiation Surveys/ RadCon Training - Radiation Control	Radiation Surveys of UFTR Cell and Environment at Steady-State Full Power	13.57 (5.17)	13.57 (5.17)
Argon-41 Effluent Determinations - Dr. W.G. Vernetson/ Reactor Staff	Argon-41 Stack Concentration Measurements and Evaluation	14.53	19.10
Tech Spec Requirements - Reactor Staff	Reactor Testing, Calibration and Related Measurement Activities (Including Verification of Cold Critical Positions and other Verifying Operations)	18.90	35.13
***Florida Regional Junior Science, Engineering and Humanities Symposium - Dr. W.G. Vernetson/ Reactor Staff	Reactor Demonstration and Tours of Facilities	0.97 (0.50)	2.67
***Florida Foundation of Future Scientists - L. Jimison, D. Pierce and C. Calwell	Lectures, Tours and Demonstrations of Reactor Facility Operations	1.63 (0.58)	4.33
*Florida Foundation of Future Scientists (NAA Research) - Dr. W.G. Vernetson/ David Goldstein	Summer Student Research Program: Evaluation of Titanium Depositions on Soda Lime Silicate Glass Slides	10.40 (1.92)	11.50 (2.33)
Heat Exchanger Maintenance - Dr. W.G. Vernetson	Removal, Cleaning, Replacement and Checkout of UFTR Heat Exchanger	1.73	11.50

TABLE I (CONTINUED)

PROJECT AND USER	TYPE OF ACTIVITY	RUN TIME (hours)	EXPERIMENT TIME (hours)
**Reactor Operator Hot License Candidate Training - Dr. N.J. Diaz/Dr. W.G. Vernetson	Training Course for Florida Power Corporation Crystal River 3 Hot License Operator Candidates	61.71 (0.42)	92.04
**Reactor Usage Operator Training - Dr. W.G. Vernetson	Reactor Operations Training for Georgia Power Company Shift Supervisor SRO Candidates	15.85	40.73 (15.25)
*University of South Florida (St. Petersburg) Marine Science Department - Dr. R. Byrne/Dr. G. Smith - Reactor Sharing	Tour and Demonstration of Reactor Facility Operations	0.50 (0.50)	1.00
*University of South Florida (St. Petersburg) Marine Science Department - Dr. R. Byrne/Dr. G. Smith - Reactor Sharing	Azimuthal Flux Map of Vertical Ports	1.02	1.83
	TOTAL[1,2]	804.97 (68.18)	1197.68 (55.97)
	TOTAL ACTUAL	736.79	1141.71

NOTE 1: Values in parentheses represent multiple or concurrent facility utilization (Run or Experiment time); that is, the reactor was already being utilized in a primary run for a project so a reactor training or demonstration utilization could be conducted concurrently with a scheduled NAA irradiation, course experiment, or other reactor run. Thus, the actual reactor run time for the 1983-1984 reporting year is 736.79 hours.

NOTE 2: Exp. Time is run time (total key on time minus checkout time) plus set-up time for experiments or other reactor usage including checkouts, tests and maintenance involving reactor running.

TABLE II

UFTR UTILIZATION SUMMARY*

		Run Time (hours)	Experiment Time (hours)
1.	College Courses and Laboratories	285.36 (14.01)	523.81 (20.42)
2.	Research Activities	416.34 (2.45)	459.51 (2.33)
3.	UFTR Operator Training and Requalification	62.25 (48.98)	125.88 (33.22)
4.	UFTR Testing and Surveillance	35.16	65.73
5.	Reactor Tours and Demonstrations	5.86 (2.74)	22.75
	TOTAL	804.97 (68.18)	1197.68 (55.97)

*Console checkouts excluded.

NOTE 1: The same meaning is attached to values in parentheses as in Table I.

NOTE 2: The first two categories of College Courses and Laboratories as well as Research Activities include significant usages sponsored under the Department of Energy UFTR Reactor Sharing Program which allowed seven (7) schools to have 32 usages of the UFTR facilities as delineated in Table III.

TABLE III

1983-1984

REACTOR SHARING PROGRAM

SUMMARY USAGE OF UFTR FACILITIES

School	Usages*	Users	
		Faculty	Students
University of South Florida, St. Petersburg (USF-SP)	2	2	1
Santa Fe Community College (SFCC)	1	1	10
Central Florida Community College (CFCC)	11	2	21
Hillsborough Community College (HCC)	1	1	8
University of West Florida (UWF)	6	2	1
Florida Institute of Technology (FIT)	4	3	0
St. Augustine High School (SAHS)	1	1	14
TOTAL	26	12	55

* Usage is defined as utilization of the University of Florida Training Reactor for all or any part of a day. In many cases a school can have multiple usages but all related to the same research project or training program.

TABLE IV

MONTHLY REACTOR ENERGY GENERATION[1]
(September, 1983 - August, 1984)

Monthly Totals	Kw-Hrs	Hours at Full Power
September, 1983	816.7	6.92
October, 1983	2674.5	26.51
November, 1983	1620.8	16.20
December, 1983	11,238.4	112.38
January, 1984	6388.2	63.00
February, 1984	3340.7	29.93
March, 1984	4578.7	42.33
April, 1984	1684.5	16.07
May, 1984	5575.0	55.75
June, 1984	4453.0	44.14
July, 1984	4324.1	40.01
August, 1984	592.8	4.93
YEARLY TOTAL	47,287.4[2]	458.17

Note 1: Kw-Hrs yearly total for the 1983-1984 reporting year represents a 326% increase over the previous reporting year while the hours at full power represent a similar 336% increase over the previous year.

Note 2: The 47,287.4 Kw-Hrs of energy generation is the highest one year total energy generation for the 25-year history of the UFTR.

TABLE V

UNSCHEDULED TRIPS*

Date	Occurrence
January 4, 1984	Power Failure (Momentary Electrical Power Transient)
February 28, 1984	Power Failure (Momentary Electrical Power Transient)
May 31, 1984	Reactor Operations Course trainee error involving pressing console power-on switch during process of bringing reactor to shutdown condition
June 14, 1984	Electrical Power Transient caused blown fuses on deep well pump and resulted in trip from loss of secondary cooling at power

* All safety systems responded as intended for the trips listed in this Table.

TABLE VI

LOG OF UNUSUAL OCCURRENCES

During this reporting period there were no events which compromised the health and safety of the public. Several events, classified as unusual occurrences, are described below as they deviated from the normal functioning of the facility and are included here as the most important such deviations for the reporting year.

4 January 1984	- Electrical power transient caused the dump valve power fuse to fail and trip the reactor. All safety systems responded properly as intended.
24 January 1984	- The secondary system sample valve was not fully closed and as a result, actuated the primary coolant pit water level alarm. About 2 cups of water were involved with no detectable radioactivity; the reactor was secured at the time.
25 January 1984	- Safety Blade #3 clutch current indicator lamp (50,000 hour lamp) burned out causing Safety Blade #3 to drop while at power. Replacement of this lamp, as part of the reactor control system, constitutes major maintenance. However, this lamp was replaced without shutdown and without required approval in violation of UFTR Standard Operating Procedures and, as discussed in the next day notification to NRC on 26 January 1984, was potentially a violation of the UFTR Technical Specifications. The Reactor Safety Review Subcommittee reviewed this occurrence on January 26, 1984 and agreed with this evaluation and the need that it be communicated to the NRC. A complete letter of evaluation along with corrective action commitments to prevent recurrence of this potential violation of Tech Specs was sent to the NRC in a letter dated February 7, 1984. At this time evaluation of the occurrence is considered closed.
28 February 1984	- An electrical transient resulting in a momentary loss of AC power caused a trip during a reactor startup for the Florida Power Corporation Training Program. All safety systems responded properly as intended.
5 April 1984	- The primary coolant rupture disc was broken due to operator error; rupture disc replacement, pit cleanup and replacement of demineralized water were routine at shutdown.
31 May 1984	- Reactor trip was caused by student error by pressing console power-on switch during process of bringing reactor to shutdown condition during reactor operations laboratory course; all safety systems responded properly as intended.

TABLE VI

LOG OF UNUSUAL OCCURRENCES (CONTINUED)

31 May 1984	- The reactor was shutdown under normal conditions and then restarted about one hour beyond the 6 hour window within which a new daily checkout would not be required. This action was discovered on July 1 as the June Monthly Report was being compiled. This matter was reported to the NRC in a letter dated the next day, July 2, 1984. Instructions on the requirements for performing daily checkouts were reviewed with the UFTR Staff as corrective action as discussed in a summary letter to the NRC dated July 12, 1984. In addition, after hours operation will contain a reminder on this point in the future. The occurrence of a potential violation of the technical specifications was described along with UFTR administrative and Reactor Safety Subcommittee review and evaluation of the event and the corrective actions taken to prevent reoccurrence of this type event. At this time evaluation of the occurrence is considered closed.
12 June 1984	- The reactor was shutdown when a rabbit capsule with solid, bagged sample did not return from a 30 second irradiation at full power. The cause was a failure of the capsule leaving the capsule in two pieces, which inhibited movement. After repeated efforts to bring the capsule back, it was recovered broken but the sample bag was still intact and not hotter than expected. A new capsule was made and tried successfully on 13 June 1984; a limit of 300 uses has been placed on rabbit capsules to assure the combination of fluence and repeated shock of entry and return has a reduced likelihood to result in future capsule failures.
14 June 1984	- Reactor tripped at full power due to loss of secondary flow caused when blown fuses resulted in shutdown of the deep well pump. Upon examination the fuses were found to be failed, probably due to one or more lightning-related surges associated with violent weather prevalent during the week of 11 June 1984. This type of trip or pump failure has occurred on a number of previous occasions especially during the hot weather electrical storm season.

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

No significant modifications to the operating characteristics or capabilities of the UFTR were made during the reporting period.

V. SIGNIFICANT MAINTENANCE AND TESTS OF UFTR REACTOR SYSTEMS

Date	Description
12 September 1983	Replaced electrolytic capacitors in 2-pen recorder.
16 September 1983	Performed leakage swipe smear of Sb-Be source.
19 September 1983	Replaced shield tank demineralizer cartridge.
20 September 1983	Q-4/Q-5 Radiation survey of unrestricted and restricted areas.
21 September 1983	Performed leak smear of Sb-Be source.
30 September 1983	Q-3 Quarterly Radiological Emergency Drill.
17 October 1983	Q-1 Quarterly check of scram functions.
18 October 1983	Q-2 Quarterly calibration check of area and stack radiation monitors.
24 October 1983	Replaced area radiation monitor emergency batteries.
7 November 1983	Replaced ceramic filter of shield tank recirculating system.
10 November 1983	A-3 Determination of Moderator Temperature Coefficient.
15 November 1983	S-2 Measurement of control blade integral worths by blade drop method.
22 November 1983	S-2 Measurement of regulating blade integral worth by blade drop method.
1 December 1983	Leak smear of PuBe source.
2 December 1983	Leak smear of Sb-Be source.
13 December 1983	Q-4 Radiation survey of unrestricted areas.
13 December 1983	Q-5 Radiation survey of restricted areas.
22 December 1983	Q-3 Quarterly Radiological Emergency Drill.
5 January 1984	S-4 Measurement of Argon-41 concentration in stack effluent.
12 January 1984	A-1 Measurement of stack dilution air flow rate.
25 January 1984	Replaced all four control blade magnetic clutch current indicator lamps.
26 January 1984	S-1 Measurement of control blade drop times.

26 January 1984	S-5 Measurement of control blade controlled insertion times.
27 January 1984	Q-2 Calibration check of area and stack radiation monitors.
15 February 1984	Q-1 Quarterly check of scram functions.
15 March 1984	Completed installation of Safety Channel #2 replacement High Voltage Power Supply.
16 March 1984	A-2 performed UFTR Nuclear Instrumentation calibration check and calorimetric heat balance to verify thermal power.
21 March 1984	Q-4 Radiation survey of unrestricted areas.
23 March 1984	Q-5 Radiation survey of restricted areas.
3 April 1984	S-3 Semiannual inventory of special nuclear material.
5 April 1984	Replaced rupture disk broken by operator error and made up demineralized water to primary coolant tank.
6 April 1984	Leak smear of PuBe source.
11 April 1984	Replaced units decade board of Safety Blade 2 position indicator.
13 April 1984	Q-2 Calibration check of area and stack radiation monitors.
20 April 1984	Q-1 Quarterly check of scram functions.
26 April 1984	Q-3 Quarterly Radiological Emergency Drill.
8 May 1984	S-4 Measurement of Ar-41 concentration in stack effluent.
8 May 1984	A-1 Measurement of stack dilution air flow rate.
10 May 1984	Leak smear of Sb-Be source.
21 May 1984	Installed hot cave absolute filter and holder.
24 May 1984	Replaced security system batteries.
30 May 1984	Overhauled APD blower to restore full air flow.
1 June 1984	Q-5 Radiation survey of restricted areas.
13 June 1984	Manufactured three (3) new rabbit capsules.
14 June 1984	Replaced all three (3) pump motor fuses in deep well pump following failure causing trip at power.

22 June 1984	Q-4 Radiation survey of unrestricted areas.
11 July 1984	Repaired north area radiation monitor following power amplifier failure which had casued damages resulting in loss of the coincidence trip of the evacuation alarm.
18 July 1984	Repaired the 2-pen recorder to restore free pen movement.
18 July 1984	Q-2 Calibration check of area and stack radiation monitors.
20 July 1984	Q-3 Quarterly Radiological Emergency Drill.
24 July 1984	S-1 Measurement of control blade drop times.
24 July 1984	Q-1 Quarterly check of scram functions.
31 July 1984	S-5 Measurement of control blade controlled insertion times.
1 August 1984	Replaced rupture disk broken by operator error and added ~60 gallons of demineralized water to primary coolant storage tank.
1 August 1984	Replaced shield tank ceramic filter.
1 August 1984	Cleaned Safety Channel 2 trip test circuitry.
6 August 1984	Overhauled and cleaned all contacts on portal monitors.
10 August 1984	Replaced rupture disk broken by operator error and added ~20 gallons of demineralized water to the primary coolant storage tank.
11 August 1984	Cleaned and aligned contacts on linear pen module to restore proper tracking of power level.
13 August 1984	Replaced worn and broken harness temperature record/recorder section power supply.
15 August 1984	Completed cleaning of secondary side of UFTR heat exchanger.
17 August 1984	Replaced security system batteries.
28 August 1984	Removed, cleaned and replaced secondary water flow sensing device.
31 August 1984	Tightened cross bar to restore proper temperature recorder print wheel operation.

VI. CHANGES TO TECHNICAL SPECIFICATIONS AND STANDARD OPERATING PROCEDURES

A. The new Technical Specifications for the UFTR were issued on August 30, 1982 and officially established on September 30, 1982. Two sets of requested corrections/changes to the Technical Specifications were submitted to the NRC during the previous 1982-1983 reporting period.

In a letter dated October 27, 1982, following extensive review of the new Technical Specifications transmitted with the UFTR license renewal, the UFTR administration transmitted a package containing proposed corrections for fourteen (14) pages of the new UFTR Technical Specifications as transmitted with the letter dated August 30, 1982 granting a 20 year license renewal. These corrections/changes were requested as being necessary to make these Tech Specs conform with those submitted to and verbally approved by the NRC Staff. In addition to a series of typographical and nomenclature errors, certain corrections were needed to make these Tech Specs conform to desired and approved UFTR operational requirements as well as to avoid unnecessary vagueness at several points. Most changes corrected simple typographical errors, omissions or misinterpretations which had rendered the Tech Specs vague, incorrect or incomplete at the point involved. Several other changes were requested as necessary because of errors in the Tech Specs submitted with the UFTR Safety Analysis Repor ; however, as explained in the letter, none of these requested corrections represent any change in currently accepted UFTR operation. These proposed changes were approved by the Nuclear Regulatory Commission as Ammendment No. 15 to Facility Operating License No. R-56 dated June 27, 1984.

In another letter, dated August 19, 1983, it was noted that certain reporting requirements on permanent changes in UFTR facility organization and on significant changes in the UFTR transient or accident analysis had been inadvertently omitted from the NRC-approved UFTR Technical Specifications. Therefore, to conform with the ANSI/ANS 15.18-1979 standard and longstanding UFTR practice, a proposed addition to the Tech Specs remedying this omission was transmitted to the NRC. This proposed change was approved by the Commission as Amendment No. 14 for Facility Operating License No. R-56 dated March 6, 1984.

At this time, no further requests for changes in the approved Tech Specs are expected for the operation of the UFTR with its present high-enriched fuel at a rated power level of 100 kWth.

B. <u>Revisions to Standard Operating Procedures</u>

All existing UFTR Standard Operating Procedures were reviewed and rewritten into a standard format during the 1982-1983 reporting period as required following an NRC inspection during the year. The final approved version of each SOP (except security response procedures) is permanently stored in a word processor to facilitate future revisions.

Table VI-1 contains a complete list of the approved UFTR Standard Operating Procedures prior to the current year. The latest revision number and date for each non-security related procedure is listed in Table VI-1. During the 1983-1984 reporting year, few changes were required in the UFTR Standard Operating Procedures. Several "Technical Change Notices" were issued to correct minor discrepancies or better express the intent of several procedures to include SOP-0.1, SOP-0.2 and SOP-A.5. One procedure (UFTR-SOP-F.1) was the subject of a revision where a number of significant changes were made to allow the SOP to better implement the intention of the Physical Security Plan (withheld from public disclosure). Details on this revision are not incorporated in this report since this procedure contains information to be withheld from public disclosure. One new procedure was approved during the 1983-1984 reporting year. In January, 1984, after review and approval of its previous implementation by the Reactor Safety Review Subcommittee, UFTR-SOP-E.6, "Argon-41 Measurement Concentration" was approved. As a new SOP, this entire E.6 procedure is contained in Appendix A for reference purposes.

Table VI-2 contains a complete listing of the approved UFTR SOPs as of the end of the 1983-1984 reporting year. Again, it is expected that only minor changes will be needed in these SOPs over the next few years. However, a number of completely new procedures continue under development.

C. Revisions to Other Documents.

Revision 7 of the UFTR Security Plan updating the quoted quantities and locations of SNM under the UFTR R-56 license was submitted to NRC on November 21, 1983. Approval was received in February, 1984. The Plan is withheld from public disclosure.

Revision 1 to the new UFTR Emergency Plan was approved as a minor change by our Reactor Safety Review Subcommittee on July 12, 1984. The changes basically clarified several typographical errors and addressed holdup of water from the emergency decontamination shower. The details of this revision are contained in Appendix B to this report and are not considered to impact significantly on Emergency Plan implementation.

TABLE VI-1

LISTING OF APPROVED UFTR STANDARD OPERATING PROCEDURES
(August 31, 1983)

O. Administrative Control Procedures

- 0.1 Operating Document Controls (REV 0, 2/83)
- 0.2 Control of Maintenance (REV 2, 4/83)

A. Routine Operating Procedures

- A.1 Pre-operational Checks (REV 12, 1/83)
- A.2 Reactor Startup (REV 9, 4/83)
- A.3 Reactor Operation at Power (REV 9, 10/82)
- A.4 Reactor Shutdown (REV 8, 10/82)
- A.5 Experiments (REV 3, 4/83)
- A.6 Operation of Secondary Cooling Water (REV 1, 10/82)
- A.7 Determination of Control Blade Integral or Differential Reactivity Worth (REV 0, 3/82)

B. Emergency Procedures

- B.1 Radiological Emergency (REV 3, 4/83)
- B.2 Fire (REV 7, 4/83)
- B.3 Threat to the Reactor Facility (Expanded into F-Series Procedures)
- B.4 Flood (REV 1, 4/83)

C. Fuel Handling Procedures

- C.1 Irradiated Fuel Handling (REV 3, 4/83)
- C.2 Fuel Loading (REV 4, 4/83)
- C.3 Fuel Inventory Procedure (REV 2, 4/83)

D. Radiation Controls Procedures

- D.1 Radiation Protection and Control (REV 3, 4/83)
- D.2 Radiation Work Permit (REV 8, 4/83)
- D.3 Primary Equipment Pit Entry (REV 1, 4/83)
- D.4 Removing Irradiated Samples From UFTR Experimental Ports (REV 2, 4/83)

E. Maintenance Procedures

- E.1 Changing Primary Purification Demineralizer Resins (REV 2, 4/83)
- E.2 Alterations to Reactor Shielding and Graphite Configuration (REV 2, 4/83)
- E.3 Shield Tank and Shield Tank Recirculation System Maintenance (REV 2, 4/83)
- E.4 Withdrawn
- E.5 Withdrawn

F. Security Plan Response Procedures (Reactor Safeguards Material, Disposition Restricted)

- F.1 Physical Security Controls
- F.2 Bomb Threat
- F.3 Theft of (or Threat of the Theft of) Special Nuclear Material
- F.4 Civil Disorder
- F.5 Fire or Explosion
- F.6 Industrial Sabotage
- F.7 Procedure Controls (Original)

TABLE VI-2

LISTING OF APPROVED UFTR STANDARD OPERATING PROCEDURES
(August 31, 1984)

O. Administrative Control Procedures

- 0.1 Operating Document Controls (REV 0, 2/83)
- 0.2 Control of Maintenance (REV 2, 4/83)

A. Routine Operating Procedures

- A.1 Pre-operational Checks (REV 12, 1/83)
- A.2 Reactor Startup (REV 9, 4/83)
- A.3 Reactor Operation at Power (REV 9, 10/82)
- A.4 Reactor Shutdown (REV 8, 10/82)
- A.5 Experiments (REV 3, 4/83)
- A.6 Operation of Secondary Cooling Water (REV 1, 10/82)
- A.7 Determination of Control Blade Integral or Differential Reactivity Worth (REV 0, 3/82)

B. Emergency Procedures

- B.1 Radiological Emergency (REV 3, 4/83)
- B.2 Fire (REV 7, 4/83)
- B.3 Threat to the Reactor Facility (Expanded into F-Series Procedures)
- B.4 Flood (REV 1, 4/83)

C. Fuel Handling Procedures

- C.1 Irradiated Fuel Handling (REV 3, 4/83)
- C.2 Fuel Loading (REV 4, 4/83)
- C.3 Fuel Inventory Procedure (REV 2, 4/83)

D. Radiation Controls Procedures

- D.1 Radiation Protection and Control (REV 3, 4/83)
- D.2 Radiation Work Permit (REV 8, 4/83)
- D.3 Primary Equipment Pit Entry (REV 1, 4/83)
- D.4 Removing Irradiated Samples From UFTR Experimental Ports (REV 2, 4/83)

E. Maintenance Procedures

- E.1 Changing Primary Purification Demineralizer Resins (REV 2, 4/83)
- E.2 Alterations to Reactor Shielding and Graphite Configuration (REV 2, 4/83)
- E.3 Shield Tank and Shield Tank Recirculation System Maintenance (REV 2, 4/83)
- E.4 Withdrawn
- E.5 Withdrawn
- E.6 Argon-41 Concentration Measurement (REV 0, 1/84)

F. Security Plan Response Procedures (Reactor Safeguards Material, Disposition Restricted)

- F.1 Physical Security Controls
- F.2 Bomb Threat
- F.3 Theft of (or Threat of the Theft of) Special Nuclear Material
- F.4 Civil Disorder
- F.5 Fire or Explosion
- F.6 Industrial Sabotage
- F.7 Procedure Controls (Original)

VII. RADIOACTIVE RELEASES AND ENVIRONMENTAL SURVEILLANCE

A. Gaseous (Argon-41)

Month	Release	Average Monthly Concentration*
September, 1983	4.0×10^{6} μCi/Month	1.4×10^{-9} μCi/ml
October, 1983	1.3×10^{7} μCi/Month	4.4×10^{-9} μCi/ml
November, 1983	7.96×10^{6} μCi/Month	2.2×10^{-9} μCi/ml
December, 1983	5.52×10^{7} μCi/Month	1.87×10^{-8} μCi/ml
January, 1984	3.69×10^{7} μCi/Month	1.33×10^{-8} μCi/ml
February, 1984	1.93×10^{7} μCi/Month	6.96×10^{-9} μCi/ml
March, 1984	2.65×10^{7} μCi/Month	9.54×10^{-9} μCi/ml
April, 1984	9.74×10^{6} μCi/Month	3.51×10^{-9} μCi/ml
May, 1984	2.09×10^{7} μCi/Month	7.35×10^{-9} μCi/ml
June, 1984	1.67×10^{7} μCi/Month	5.86×10^{-9} μCi/ml
July, 1984	1.62×10^{7} μCi/Month	5.70×10^{-9} μCi/ml
August, 1984	2.22×10^{6} μCi/Month	7.82×10^{-10} μCi/ml

TOTAL ARGON-41 releases = 228.6 Ci

* UFTR Technical Specifications require average Argon-41 release concentration averaged over a month to be less than 4.0×10^{-8} μCi/ml. Total releases and average monthly concentrations are based upon periodic Argon-41 release measurements made at equilibrium full power (100 Kw) conditions. The results for these measurements used in calculating the gaseous Ar-41 release data are summarized as follows:

Months	Releases Per Unit Energy Generation	Instantaneous Argon-41 Concentration at Full Power
Sept. '83 - Dec. '83	4910.0 μCi/Kw-hr	12.15×10^{-8} μCi/ml
Jan. '84 - April '84	5781.1 μCi/kw-hr	15.0×10^{-8} μCi/ml
May '84 - Aug. '84	374[illegible] 9 μCi/kw-hr	9.49×10^{-8} μCi/ml

B. Liquid Waste from the UFTR/Nuclear Sciences Complex[1]

There were approximately 105,900 liters discharged from the waste holding tanks to the campus sanitary sewage system during this reporting period. These batch discharges are summarized as follows:

Month	Volume (liters)	Concentrations (μCi/ml)
January,, 1984	69,000	1.04×10^{-7}
July, 1984	36,875	NDA[2]

The UFTR normally releases approximately 1 liter of primary coolant per week to the holding tank as waste from primary coolant sampling. The average activity for this coolant was 5.75×10^{-7} μCi/ml for this annual reporting period.

C. Environmental Monitoring

The UFTR maintains film badge and dosimeter monitoring (new for the 1982-1983 reporting period) in areas adjacent to the UFTR complex. The following are the badge and TLD totals for this reporting period from September 1983 through August 1984.

Film Badge Designation	Total Yearly Exposure (mrem)[3]	TLDs[4]	Total Yearly Exposure (mrem)[3]
A1	M	1	M
A2	20	2	40
A3	M	3	M
A4	M	4	M
A5	M	5	M
A6	M	6	M
A7	M	7	M
		8	M
		9	M
		10	M
		11	M
		12	M

Note 1: The effluent discharged into the holding tanks comes from twenty labortories within the Nuclear Sciences Center as well as the UFTR complex.

Note 2: NDA - No detectable activity, MDA = 2.4×10^{-9} μCi/ml (Minimum Detectable Activity).

Note 3: M denotes minimal (<10 mrem) meaning background only.

Note 4: The first seven TLDs are attached adjacent to the corresponding numbered film badge monitors.

D. Personal Radiation Exposure

The following is a list of any UFTR-associated personnel exposures significantly greater than minimum detectable during the reporting period:

December, 1983

E. Barreto	20 mR	deep/whole body

January, 1984

H. Gogun	20 mR	shallow/whole body
H. Gogun	20 mR	deep/whole body
E. Barreto	70 mR	shallow/whole body

February, 1984

E. Barreto	40 mR	shallow/whole body

March, 1984

E. Barreto	80 mR	shallow/whole body

It should be noted that Mr. Barreto is the NAA laboratory technician who is not an actual UFTR Staff member but works closely with staff members to implement NAA research projects.

For visitors, students, or other non-permanent UFTR personnel, no individual had a non-zero dosimeter exposure measurement above 10% allowable for this reporting period. In most cases, the values of one or two mR recorded dosimeter exposures are probably due to uncertainty in reading the devices.

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.

NAA Research - Trace Element Analysis of Human Blood Serum and Bone Marrow Samples, Dr. G.S. Roessler, Dr. W.E. Bolch, E. Barreto**.

Blood and serum samples have been analyzed for trace element concentrations from sick as well as healthy patients relative to Leukemia. Results have also been compared with standards. The objective is to correlate trace element concentrations (high or low) with certain diseases. The initial project in this series has been completed at the end of the reporting year with inconclusive results; future studies in this area are planned.

NAA Research - Elemental Analysis of Silver Diffusion in Glass Slides, Dr. V. Ramaswamy, I. Najafi**, E. Lazo*.

In analyzing and evaluating a novel electrolytic process involving ion-exchanged waveguides for small signal processing applications, it becomes necessary to measure the profile of silver diffused in glass slides and also to determine the elemental composition of the glass slide. Therefore, NAA is being applied for short and long irradiation intervals and the activity of the slides measured afterwards. This work is proceeding well. The next step is to activate the slides, remove thin layers and remeasure the activity due to key elements such as the diffused silver. This last step of layer removal will be repeated until no silver is detected. This work is producing good results to date and is expected to continue.

NAA Research - Neutron Activation Analysis of Pine Cone Samples, Dr. N. Commerford, Dr. G.S. Roessler, E. Barreto*, Reactor Staff.

Various irradiation schemes (long and short) were explored for instrumental NAA of pine cone ash samples taken from trees grown in one type of soil versus a controlled soil. Specifically, NAA is being examined for possible use to relate elemental pine cone composition to the type of soil the parent tree experiences using activation products produced in the UFTR. The results of this work were expected to support a proposal seeking support for further research efforts in this area; however, results to date indicate the desired trace element levels are not present in sufficient quantities to support this analysis on the current NAA system.

NAA Research - Analysis of Hair Samples for Trace Elements, Dr. G.S. Roessler, Dr. W.G. Vernetson, E. Barreto*.

Human hair samples are irradiated for various time periods. The activated samples are then spectral analyzed using minicomputer methodology to determine and identify abnormal and elemental composition. Following several irradiations as part of a laboratory experiment and demonstration of neutron activation analysis techniques, this project has been suspended awaiting additional funding based on development of better analytical and experimental techniques.

UFTR Core Redesign (LEU Program) - Neutronics Analysis for UFTR Core Redesign - Dr. E.T. Dugan, Dr. W.C. Vernetson, Dr. N.J. Diaz, G. Kniedler**.

As part of the DOE Low Enrichment Uranium Program, investigations have been performed on the UFTR to determine the feasibility and desirability of replacing the 93% enriched MTR plate type fuel with 4.8% enriched, cylindrical SPERT fuel pins. For this redesign, the only permanent structural modification is the insertion of new grid assemblies into exisiting fuel boxes. Acceptable neutronic criteria (Possible k_{eff} range, maximum flux and degree of undermoderation) have been determined using industry-accepted, 4-group cross sections in one, two and three-dimensional diffusion theory calculations of k_{eff}, flux profiles, power peaking factors and coefficients of reactivity. First order perturbation calculations have been used to determine key kinetic parameters. Neutronic resultss to date indicate that the UFTR/SPERT core redesign can be accommodated to meet requisite neutronic criteria with an actual increase in peak thermal flux levels which will be very useful for NAA and other research projects requiring high thermal flux levels.

UFTR Core Redesign (LEU Program) - Thermal-hydraulic Analysis for Core Redesign - Dr. E.T. Dugan, Dr. W.G. Vernetson, Dr. N.J. Diaz, R. Hommerson**.

As part of the DOE LEU Program, thermal-hydraulic analysis related to redesign of the UFTR core using SPERT fuel rods is being performed. Computer analysis has been undertaken to evaluate the UFTR/SPERT design for steady-state conditions as well as transients arising in response to a step insertion of reactivity, a loss of coolant flow, and a loss-of-coolant accident. Results to date indicate required safety margins and transient response conditions can be maintained with the UFTR/SPERT core design.

UFTR Reactor Operations and NAA Lab Exercises - Dr. W.G. Vernetson, P.M. Whaley, Reactor Staff.

Mini-courses have been developed and presented as part of the UFTR DOE Reactor Sharing Program to provide practical reactor operations and health physics training as well as NAA laboratory experience for groups of students from Central Florida Community College Radiation Protection Technology program, Santa Fe Community College Nuclear Medicine Technology/Radiologic programs and the Hillsborough Community College Nuclear Medicine/Allied Health Technology program.

NAA Research - Neutron Activation Analysis of Seagrass Community Components - Dr. G. Chiu, Dr. Ranga Rao, Dr. W.G. Vernetson, D. Morton*, Reactor Staff.

Various seagrass communities have been exposed to used drilling fluids off the gulf ccoast of northwest Florida. the componentss of one of these communities consisting of sediments, water samples, grasses, shells and shellfish meats have been subjected to long and short irradiations to monitor the uptake of certain heavy metals, principally barium and chromium, both of which are suitable for ddetection using neutron activation analysis. Reactor time for this work is supported under the DOE Reactor Sharing Program. Results to date are encouraging and work is continuing.

NAA Research - Neutron Activation Analysis of Marine Sediments - Dr. J.H. Trefry, S. Metz*, R. Trocine*, Dr. W.G. Vernetson, Reactor Staff.

Under the DOE Reactor Sharing Grant, instrumental neutron activation analysis is being applied to marine sediments from the Gulf of Mexico and the Florida Atlantic Coast to obtain the spatial distribution of selected metals. Results of the work conducted at the UFTR facility under the Reactor Sharing Program are encouraging and the work is expected to continue with journal publications to follow at intervals.

NAA Research - Neutron Activation Analysis of Soil Samples Taken From Old Tailings Sites - Dr. G.S. Roessler, E. Barreto*, E. Lazo**, Reactor Staff.

Instrumental neutron activation analysis was applied to soil samples taken from around the old Mallincrodt Site near St. Louis, Missouri to determine thorium content. The results of this study are being used as an estimate of thorium content against which a new technique, X-Ray Flourescent Analyses, will be tested. Results to date show thorium content present but quantitative results are not accurate enought to complete the study without the X-Ray Fluorescent Analysis.

NAA Research - Neutron Activation Analysis of Processed Metals for Fusion Machinery - Dr. R. Abbasschian, Dr. S. Anghaie, E. Barreto*, E. Lazo*, Reactor Staff.

To achieve the desired properties and optimize the oxygen and carbon content of superalloys and copper-based alloys during a rapid solidification process a means of making accurate measurements (either electromagnetic levitation or directed solidification technique), of the density of each component in the alloy is essential. Instrumental neutron activation analysis is being applied to make these measurements of very small relative densities of components to study the effect of processing variables during supercooling. This work is in support of materials for fusion machine magnets.

NAA Research - Neutron Activation Analysis of Estuary Sediments - Dr. R. Byrne, Dr. G. Smith, Reactor Staff.

Under the DOE Reactor Sharing Grant, Instrumental Neutron Activation Analysis will be applied to estuary sediments from the Tampa Bay reegion of Florida to determine and quantify the spatial distribution of various rare earth metals. Work to date has been restricted to preparatory work as well as an exercise mapping the spatial variation of the flux in the UFTR vertical ports and another exercise to determine accurate values for the cadmium ratios for any ports to be used in the activations for this research. These are key parameters because of the resonance absorption characteristics of many rare earth metals. The NAA work on this project is expected to begin in the upcoming reporting year as sample preparations are nearing completion.

NAA Research - Neutron Activation Analysis of Hogtown Creek Samples - Dr. W.G. Vernetson, P.M. Whaley, J. Carswell**, E. Lazo*, Reactor Staff.

Hogtown Creek flowing through Gainesville is subject to various pollution sources. Neutron Activation Analysis is being applied to evaluate and quantify the presence of certain suspected elemental pollution indicators (chlorine, copper and chromium) at various points in the Hogtown Creek flow system. NAA is being performed on water samples as well as selected soil and plant samples at various stages in the creek's drainage system. Results to date do show elevated levels of some elemental indicators, especially chromium but this work is incomplete. Additional work will be required to determine the source of the contamination after quantification. This work is to form the basis for a science fair project and was used primarily to train a high school student in research methods under the Florida Foundation of Future Scientists summer high school student research program.

NAA Research - Neutron Activation Analysis of titanium Depositions on Glass Slides - Dr. W.G. Vernetson, Dr. P. Suchoski, D. Goldstein**, E. Barreto*.

Neutron activation analysis was used to evaluate the deposition of titanium on soda-lime-silicate glass slides. The objective is to determine the presence of impurities due to processing such slides for computer applications. In this case, new techniques are being developed and one isotope of concern is tungsten. Results to date show no tungsten contamination but the analysis is expected to continue. This work is to form the basis for a science fair project and was used primarily to train a high school student in research methods under the Floridda Foundation of Future Scientists summer high school student research program.

UFTR Transient Analysis - Implementation of DSNP Program Language to Analyze UFTR Operational Transients - Dr. E.T. Dugan, Dr. W.G. Vernetson, J. Samuels**.

The Dynamic Simulator for Nuclear Power (DSNP) Plants programming language is being implemented to anlayze selected UFTR heat up and cooldown transients. Results from DSNP calculations are being compared and evaluated relative to existing and new transient UFTR output recored on various output devices. This analysis will serve as a teaching aid for the DSNP programming language and will hopefully allow fast-running analysis of UFTR transients for class exercises and other similar applications with the Nuclear Engineering Sciences Department.

Cerenkov Noise Detector Development - Development of a Detector of Reactor Core Perturbations - Dr. E.E. Carroll, Prof. G.J. Schoessow, H. Carvajal**, C. Levy*, N. Yunessi*, Reactor Staff.

A new design Cerenkov detector is being developed and tested using the prompt-gamma radiation deriving from the reactor core. The detector is being located in the thermal column entrance port with shielding plugs removed and substituted by lithiated paraffin plugs made for the purpose of reducing the neutron flux to acceptable values when the reactor is running at power. Samples of these lithiated paraffin plugs were irradiated to assure that no unexpected activation products would be formed were the plugs to see a large flux. Other work has involved spectroscopic analysis of the gamma energies emitted from the thermal column where the detector will be placed. The Cerenkov detector is to be moved at various angles for various power levels with the ultimate objective to develop a detector system that is able to detect reactor perturbations at various power levels through large thicknesses of material by means of high-energy, penetrating, fission-produced gamma rays.

UFTR Risk Assessment - Dr. W.G. Vernetson, R. Griffith.

Currently a probabilistic risk assessment of the University of Florida Training Reactor is being conducted. This project has determined an estimate of the probability of occurrence of a set of postulated maximum credible UFTR accidents. The results will be used to show that the UFTR poses no significant risk to the general population and environment around the UFTR and to demonstrate proficiency in PRA analyses as additional PRA projects are undertaken. Specifically, research is continuing to obtain better data for the maximum credible accidents and extend the methodology to examine risk associated with less serious but more likely-to-occur UFTR-related accidents.

UFTR Operator Training and Requalification - Dr. W.G. Vernetson, Reactor Staff.

Lectures and hands-on operations on the reactor are necessary to license operators for the UFTR. the requalification program establishes a required number of startups, weekly checks, daily checks, drills, and lectures for each operator. Operator participation is mandatory in order to maintain assurance of proficiency levels and to be able to demonstrate the requisite operator skills.

Reactor Operations Course Instruction and Demonstrations

Course	Instructor
CHS-5110	Dr. K. Williams
ENU-3002	Dr. G.S. Roessler
ENU-4104	Dr. A.M. Jacobs
ENU-4134	Dr. W.G. Vernetson
ENU-4612/5615L	Dr. E.E. Carroll
ENV-4201/5206	Dr. C.E. Roessler
ENV-4241	Dr. C.E. Roessler
EEL-4280	Dr. R. Westphal
ENV-6211	Mr. D.L. Munroe

NAA Research - Rabbit System Remote Handling Facility Development and Implementation - Dr. G.S. Roessler, Dr. W.G. Vernetson, E. Barreto*, E. Lazo*, Reactor Staff.

Radiation and contamination surveys are performed in the radiochemistry laboratory where the new NAA Instrumentation and Counting Facility has been constructed. Reactor power running was also done to allow periodic checkout of the "Rabbit" facility to assure efficient rapid transfer for remote sample insertion and removal from the UFTR core region especially when new rabbit capsules are first utilized.

Gaseous Release Determinations - Argon-41 Stack Measurements - Dr. W.E. Bolch, Dr. W.G. Vernetson, P.M. Whaley*, Reactor Staff.

A cobalt-60 Standard Sample has been applied in standardized controlled measurements of radioactivity (Ar-41) in stack effluent. A direct detailed standard operating procedure (UFTR-SOP-E.6: Argon-41 Concentration Measurement) has been developed and approved on January 19, 1984 as the best practicable evaluation of Ar-41 releases from the UFTR facility as required by UFTR Technical Specification on Effluents Surveillance in Section 4.2.4, Paragraph (2).

This SOP has been applied and will continue to be applied to obtain a statistically significant number of data points and eventually to investigate the effect of variable core vent flow on total Ar-41 releases.

Nuclear Engineering Laboratory I - (ENU-4505L) - Dr. E.E. Carroll, Jr., Reactor Staff.

ENU-4505L is the nuclear engineering laboratory for undergraduate senior level students in Nuclear Engineering Sciences. The UFTR is used for a variety of exercises and experiments, including radiation dose measurements, measurement of induced radioactivity and reactor physics parameters as well as operational measurements.

Nuclear Engineering Laboratory II - (ENU-6516L) - Dr. E.E. Carroll, Jr., Reactor Staff.

ENU-6516L is the main laboratory course for Nuclear Engineering graduate students. It involves radiation and reactor-related measurements and experimentation on a more advanced level than ENU-4505L particularly in applying computers for acquisition of data and subsequent analysis of that as part of the laboratory report requirements.

Reactor Operations Laboratory (ENU-4905) - Dr. W.G. Vernetson, Reactor Staff.

Students of the Reactor Operations Lab (Summer Semeter, 1984) spent about three (3) hours weekly at the controls of the UFTR performing reactor operations under supervision of licensed reactor operators. The lab encompasses training in reactivity manipulations, reactor checkouts, operating procedures, standard and abnormal operations and all applicable regulations. Specific exercises directed toward development of understanding of light water power reactor behavior are included as this laboratory course serves as basic preparation for students entering the utility industry in the test and startup area as well as plant operations.

Reactor Operations - (ENU-5176L) - Dr. E.T. Dugan, Dr. W.G. Vernetson, Reactor Staff.

Students in the reactor operations course (Spring, 1984) spent about two hours weekly at the controls of the UFTR performing reactor operations under supervision of licensed reactor operators. The lab encompasses training in reactivity manipulations, reactor checkouts, operating procedures, standard and abnormal operations and all applicable regulations. Specific exercises directed toward development of understanding of light water power reactor behavior are included as this laboratory course serves as basic preparation for students entering the utility industry in the test and startup area as well as plant operations. A special effort is made to correlate UFTR exercises with the classroom lectures on various aspects of LWR operation.

Radiation Protection and Control Field Exercises - (ENV-6211) - D. Munroe, H. Norton, M. DesRoches*, Reactor Staff.

This course provides students in various disciplines with practical experience in radiation protection and control such as performing radiation surveys in and around the UFTR cell and environs, calibrating area radiation monitors, etc. These exercises also serve as training for radiation control technicians.

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

1. Dana Morton, "Effects of Drilling Fluids on an Experimental Seagrass (Thalassia testudinum) Community: Potential for Bioaccummulaton of Barium and Chromium," Masters' Thesis in Biology Department, University of West Florida, Pensacola, degree expected May, 1985*.

2. E.T. Dugan, N.J. Diaz and R. Hommerson, "Thermal Hydraulic Calculations For Modificaton of the UFTR From High Enrichment MTR Fuel to Low Enrichment SPERT Fuel," International Symposium on the Use and Development of Low and Medium Flux Research Reactors, MIT, October, 1983, and also Atomkernenergie/Kerntechnik, 44, pp. 515-521, 1984.

3. E.T. Dugan, N.J. Diaz and G. Kniedler, "Neutronic Calculations for Modification of the UFTR From High Enrichment MTR Fuel to Low Enrichment SPERT Fuel," International Symposium on the Use and Development of Low and Medium Flux Research Reactors, MIT, October, 1983, and also Atomkernenergie/Kerntechnik, 44, pp. 508-514, 1984.

4. J. Samuels, "Implementation of DSNP (Dynamic Simulator of Nuclear Plants) and Application to the Analysis of Transients for the UFTR," Masters' Thesis Project in Nuclear Engineering Sciences Department, University of Florida, degree expected May, 1985.

5. R.E. Griffith, "A Probabilistic Risk Assessment of the University of Florida Training Reactor," Masters' Thesis Project in Nuclear Engineering Sciences Department, University of Florida, January, 1984.

6. W.G. Vernetson and P.M. Whaley, "Expanded Scope of Education and Training Programs at the University of Florida Training Reactor," paper proposed for the 1985 ANS-Reactor Operations Division meeting planned for August, 1985 in Williamsburg, Virginia.

7. John E. Carswell, "Application of Neutron Activation Analysis to Determine the Concentration of Copper, Chromium and Chlorine in Environmental Samples," a summer project report of a Florida Foundation of Future Scientists student (prepared for consideration for use as a High School Science Fair project), Nuclear Engineering Sciences Department, University of Florida, August, 1984.

8. Mark Goldberg, "Application of Neutron Activation Analysis to Determine Concentraton of Titanium Diffused into Glass Slides," a summer project report of a Florida Foundation of Future Scientists student (prepared for consideration for use as a High School Science Fair project), Nuclear Engineering Sciences Department, University of Florida, August, 1984.

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* It is expected that the results of this work will be published in a journal article at a future date under Dr. Ranga Rao, Biology Department, University of West Florida, Pensacola.

9. W.G. Vernetson, "Summary Evaluation of the Florida Power Corporation Reactor Operations Training Program Conducted February 15 - March 6, 1984," Nuclear Engineering Sciences Department, University of Florida, May 4, 1984.

10. W.G. Vernetson, "Summary and Certification of the Reactor Usage Operations Program for Georgia Power Company Degreed Personnel Conducted August 10-11, 1984," Nuclear Engineering Sciences Department, University of Florida, August 16, 1984.

11. H. Carvajal-Osorio and E.E. Carroll, "Out-of-Core Gaseous Cerenkov Detector for Reactor Noise Analysis," paper accepted for ANS winter meeting in Washington, D.C., November 11-15, 1984.

12. H. Carvajal-Osorio, "Development of an Out-of-Core Gama Radiation Detector for Nuclear Reactor Diagnostics," doctoral dissertation project within Nuclear Engineering Sciences Department, University of Florida, degree expected December, 1985.

13. Charles G. Levy, "Recent Progress in the Cerenkov Detector Experiments at the University of Florida," Senior Project, Nuclear Engineering Sciences Department, August 3, 1984.

14. John Trefry, "Interim Report to the National Oceanic and Atmospheric Administration on P-PRIME Project," Florida Institute of Technology, September 30, 1984.

15. Eduardo M. Barreto, "Trace Element Analysis of Serum From Bone Marrow Transplant Patients Using Neutron Activation Analysis," Doctoral Dissertation, University of Florida, August, 1984.

16. W.R. Marion, C.E. Roessler, G.S. Roessler and H.A. VanRinsvelt, "Environmental Contaminants in Birds: Phosphate-Mine and Natural Wetlands," Final Report to the Florida Institute of Phosphate Research, University of Florida, Gainesville, May, 1984.

17. A.W. Sorenson, T. Guilarte, J. Enterline, A. Mahoney, G. Roessler, K. Neilson, "The Evaluation of a Food Composition Data Base," Grant Application to the Department of Health and Human Services, Public Health Service, March, 1984.

18. W.G. Vernetson, "Final Report on a Reactor-Based Radiation Protection and Control Cooperative Work Training Program for Central Florida Community College Students," August 13, 1984.

19. W.G. Vernetson and N.J. Diaz, "Brochure on University of Florida Nuclear Facilities Division Reactor Operations Training Programs," August, 1984.

20. W.G. Vernetson, "Reactor Usage Operations Program Manual for Georgia Power Company Degreed Personnel," August, 1984.

21. N.J. Diaz and W.G. Vernetson, "Nuclear Reactor Operations Training Manual," Crystal River III Nuclear Power Plant, Florida Power Corporation, February, 1984.

22. V. Ramaswamy and I. Najafi, "Ion-Exchanged Waveguides for Small Signal Processing Applications - A Novel Electrolytic Process," Proposal to be submitted to various agencies, August, 1984.

23. J. Samuels, "The Application of DSNP (Dynamic Simulator for Nuclear Power Plants Programming Language) as a Teaching Aid," presentation at ANS Eastern Regional Student Conference, Transactions Page A-7, April 5-7, 1984.

APPENDIX A

UFTR STANDARD OPERATING PROCEDURE E.6

ARGON-41 CONCENTRATION MEASUREMENT

UFTR OPERATING PROCEDURE E.6

1.0 Argon-41 Concentration Measurement

2.0 Approval

Reactor Safety Review Subcommittee		1/17/84 Date
Facility Director		2/9/84 Date

3.0 Purpose and discussion

3.1 Air in the cracks and void spaces in the reactor is activated in the neutron flux near the core; the core vent system is designed to prevent the isotopes formed from exfiltrating to the UFTR cell by means of exhausting air from the core into the environment. This effluent air stream is continuously monitored by the stack radiation monitor.

3.1.1 A sample of the effluent air stream is also periodically analyzed to ensure that the most significant isotope, Argon-41, does not exceed acceptable limits for effluent discharge as specified in the UFTR Technical Specifications.

3.1.2 In addition, as required by UFTR Technical Specifications surveillances, the 100 kW instantaneous release concentration and the average monthly release of Argon-41 are calculated and reported in the UFTR monthly report and the Annual Activity Report submitted to the Nuclear Regulatory Commission.

3.2 An accurate determination of the efficiency of the counting system used to analyze the samples is essential to determine the Argon-41 concentration. A Cobalt-60 standard, counted on the systems to be used, permits determination of the efficiency of the systems over a small energy range that brackets the Argon-41 decay energy. The Cobalt-60 standard is impregnated in a plastic matrix inside a Marinelli beaker, duplicating the geometry of the sample itself.

3.3 Samples should be drawn from the core vent effluent and then analyzed with as little delay as possible in order to prevent excessive decay of the Argon-41 (110 minute half life) and resultant poor counting statistics. This provision will ensure that a statistically significant Argon-41 decay rate occurs over a relatively short count time. Consequently this procedure should be coordinated with the laboratory intended to provide the analysis.

3.4 The Argon-41 emission level as indicated by the stack monitor requires about four (4) hours of reactor operation to stabilize; therefore the UFTR should be operated at steady state full power for at least four (4) hours prior to collecting the core vent effluent samples.

3.5 The following material should be available for use in drawing the sample:

3.5.1 Purge volume container (a one gallon plastic carton is recommended as it is of sufficient size, and easily obtained);

3.5.2 Plastic, tygon, or polyethylene hose, at least 18 inches long;

3.5.3 Bucket capable of holding all the water from the purge volume and the Marinelli beakers (1 gallon purge and about 1 gallon-4 liters- from the beakers);

3.5.4 Cobalt-60 standard source;

3.5.5 Marinelli beakers (4 beakers, nominally 1 liter each).

4.0 Limits and precautions

4.1 The Argon-41 discharge concentration shall be measured semi-annually at intervals not to exceed 8 months as per UFTR Technical Specifications Section 4.2.4, Paragraph (2).

4.2 The concentration of Argon-41 in the gaseous effluent discharge of the UFTR is determined by averaging it over one month as per State of Florida regulation and UFTR Technical Specification Section 4.2.4, Paragraph (1); therefore the monthly release rate of Argon-41 is based on an average release using values calculated for the instantaneous release rate and a period of one month.

4.3 A factor of 200 may be used to account for atmospheric dilution of Argon-41 for determination of stack effluent concentrations, as per UFTR Technical Specifications, Section 4.2.4, paragraph (2). This dilution is in addition to that resulting from the operation of the stack Diluting Fan, which is required to produce stack air flow at a rate of 10,000 cfm or greater as per Technical Specifications, Section 3.4.2, Paragraph (2).

4.4 After calculations as indicated in Sections 4.2 and 4.3, discharge concentrations of Argon-41 shall not exceed MPC (4.0 E-8 microCuries/ml); release from the facility above the maximum permissible limits (MPC) as specified in Appendix B, Table II, 10 CFR 20 when averaged over 30 days is immediately reportable as a violation of Technical Specifications, Section 3.4.2, which contains the limiting conditions for operation concerning Argon-41 discharge.

4.5 This procedure for the measurement of Argon-41 effluent discharge concentrations is based on sampling core vent flow prior to dilution by the Diluting Fan, and prior to inclusion of the authorized atmospheric dilution factor of 200.

4.6 Three samples are required to be analyzed and averaged for reportable concentrations; however, four (4) will normally be drawn and counted so that one inconsistent sample or faulty measurement may be disregarded, and the requirement for three samples will still be met.

4.7 All time measurements should be made using the same timepiece, or time standards must be correlated to calculate delay times.

4.8 Argon-41 detection efficiency must be calculated for each detector used in the counting process.

4.9 The volumetric vent and stack air flow will be determined concurrently with the determination of the Argon-41 discharge concentration.

4.10 It is recommended that personnel accomplishing the measurment of stack air flows maintain radio-communications with an operator at the control console.

5.0 References

5.1 UFTR Semi-annual File S-4

5.2 UFTR Technical Specifications

5.3 UFTR Safety Analysis Report

6.0 Records required

6.1 Calculations and results shall be retained as specified in UFTR Technical Specifications, Section 6.7, "Records"

6.2 Letter generated by the Reactor Manager specifying limits on monthly KiloWatt-hours of UFTR energy generation to prevent exceeding the limits on the average Argon-41 discharge concentration

6.3 UFTR Daily Operations Log

6.4 Monthly report tabulations of UFTR kW-hr energy generation

6.5 Annual Report summarizing Argon-41 releases

7.0 Instructions

7.1 Conduct a reactor startup as per SOP A.2 and allow the Argon-41 emission level indicated by the stack monitor to stabilize (at least 4 hours).

7.2 Collect samples representative of core vent effluent as follows :

7.2.1 Collect a purge volume in the designated container as follows :

7.2.1.1 Fill the purge volume container with water;

7.2.1.2 Check closed the sample line quick-throw valve on the stack monitor access plate;

7.2.1.3 Connect one end of the hose t: the sample line connection;

7.2.1.4 Place enough water in the bucket so that the purge volume container opening may be placed completely under water, forming a water seal that holds water in the purge volume container while the bulk of the container remains above the surface of the water . the bucket;

7.2.1.5 Place the loose end of the hose connected to the sample line under the surface of the water in the bucket, and into the neck of the purge volume container;

7.2.1.6 Open the sample line quick throw valve, so that the water in the purge volume container no longer has a water seal holding water in that container;

7.2.1.7 When the purge volume container is drained, close the sample line quick throw valve, remove the hose from the container, remove the container from the bucket.

7.2.2 Collect 4 air samples in the Marine '' beakers as follows :

7.2.2.1 Fill the beakers completely with water (the recommended method is to submerge the beaker and open all valves on the beaker, repositioning the beaker under water to remove as much air as possible).

7.2.2.2 Connect the loose end of the hose to the sample line connection on the beaker.

7.2.2.3 Open the quick throw valve on the sample line connection on the beaker;

7.2.2.4 Open the quick throw valve on the sample line connection mounted on the stack monitor access plate;

7.2.2.5 Open the pet-cock on the beaker, allowing water to gravity drain into the bucket, replaced by core vent effluent air, until all the water is removed.

7.2.2.6 Close the pet-cock, and record the time on UFTR Form SOP-E.6A.

CAUTION

All time measurements should be made using the same timepiece to prevent inaccuracies in calculating delay times of samples

7.2.2.7 Close the sample line connection quick-throw valves on the the Marinelli beaker and on the stack monitor access plate.

7.2.2.8 Repeat the process (in Steps 7.2.5.1 through 7.2.2.7) for for all 4 beakers. When all 4 beakers are filled with core vent effluent, transport the samples to the counting facility reserved for sample analysis.

7.3 Analyze the samples;

7.3.1 Count each sample and the Co-60 standard using a GeLi detector system (or a system of comparable capability) and a multi-channel analyzer.

7.3.1.1 Record the time when counting begins for each sample on UFTR Form SOP-E.6A.

7.3.1.2 Count the Cobalt-60 standard separately on each detector used to provide the basis for an independent measurement of each detector efficiency for Cobalt-60.

7.3.1.3 Determine the net number of counts under the peak at 1.293 MeV. for each sample, and the number of counts under the two peaks for Co-60 (1173 Kev and 1332 Kev).

7.3.1.4 Record the net count rate (number of counts/sample count time in minutes) on UFTR Form SOP-E.6A.

7.3.2 Calculate the delay time (as previously noted) between the time the sample was taken and the time when the counting begins; record the applicable delay time on UFTR Form SOP-E.6A separately for each sample.

7.3.2.1 Using the recorded delay time, correct the count rates back to the time sampling was completed using the radioactive decay formula as noted on UFTR Form SOP-E.6A :

$$\text{CPM(CORRECTED)} = \text{CPM} \times \text{EXP}[(0.693/110 \text{ min}) \times \text{DELAY TIME(min)}]$$

7.3.2.2 To obtain the average concentration, average the count rates and record on UFTR Form SOP-E.6A.

7.3.3 Using the calibration data for the Co-60 source, calculate the applicable decay time of the source to the date on which it is used.

7.3.4 Calculate the activity of the Co-60 source in DPM; then determine the counting efficiency for each of the two Co-60 peaks; record the results of that calculation on UFTR Form SOP-E.6B.

7.3.4.1 Interpolate between the efficiencies for the Co-60 peaks (1.17 and 1.33 MeV) to find the efficiency for the Ar-41 energy peak (1.29 MeV)

7.3.5 Using the calculated detector efficiency for Argon-41, determine the activity of the samples in DPM, (CPM/EFFICENCY)

7.3.5.1 Record calculated sample activities on UFTR Form SOP-E.6A.

7.3.6 Record the average value of the sample activities on UFTR Form SOP-E.6A.

7.3.7 Convert the average sample activity (DPM) to microCuries by using the equivalence that one microCurie is 2.22E6 DPM and record these results on UFTR Form SOP-E.6A.

7.3.8 Determine the average Argon-41 concentration (activity) of the samples (microCuries/ml) by dividing the Curie content by the volume of the sample (the volume of the Marinelli beaker); record the undiluted concentration value on form UFTR Form SOP-E.6A.

7.3.9 Determine applicable average stack air flow rate (see section 7.4) and record the value on UFTR Form SOP-E.6B.

7.3.10 Calculate the diluted effluent concentration by multiplying the undiluted concentration (from 7.3.8) by the formula given below. (This value shall be recorded as the instantaneous Argon-41 stack release concentration on UFTR Form SOP-E.6B.)

$$\frac{\text{CORE VENT FLOW (CFM)}}{200 \times [\text{CORE VENT FLOW (CFM)} + \text{MEASURED STACK FLOW (CFM)}]}$$

7.3.11 The determination of the total monthly release (Curies) of Argon-41 for the monthly UFTR General Activities and Utilization Report will be calculated as follows :

$$\text{RELEASE (Curies)} = [\text{KW-HR OPERATION}] \times [\text{EFFLUENT CONCENTRATION @ 100 KW(Ci/ml)}]$$
$$\times [\text{STACK FLOW (cfm)}] \times [60 \text{ min/hr}][28317 \text{ ml/ft}^3]$$

7.4 The volumetric air flow will be determined concurrently with the measurement of the Argon-41 discharge concentration.

7.4.1 Measure chimney action at the stack exhaust.

7.4.1.1 It is recommended that personnel accomplishing the measurment of the stack air flow rate maintain radio-communications with an operator at the control console.

7.4.1.2 Secure the core vent and the dilution fans.

7.4.1.3 Using a 3 by 3 grid-sectional pattern, measure with an anemometer the air flow at the center of each of 9 sections at the exhaust of the stack for 1 minute each; record values on UFTR Form SOP-E.6C.

7.4.1.4 Record the sum of all values.

7.4.1.5 Record the average of all values.

7.4.1.6 Record the correction factor for the averaged value determined from the calibration chart, Appendix II.

7.4.1.7 Record the sum of the average value and the correction factor as True Chimney Action.

7.4.2 Measure and calculate normal stack air flow rate :

7.4.2.1 Start the dilution fan.

7.4.2.2 Using a 3 by 3 grid-sectional pattern, measure with an anemometer the air flow at the center of each of 9 sections at the exhaust of the stack for 1 minute each; record values on UFTR Form SOP-E.6C.

7.4.2.4 Record the sum of all values.

7.4.2.5 Record the average of all values.

7.4.2.6 Record the correction factor for the averaged value determined from the calibration chart, Appendix II.

7.4.2.7 Record the sum of the average value and the correction factor as True Normal Action.

7.4.3 Calculate air flow as indicated on UFTR Form SOP-E.6C and enter that value on UFTR Form SOP-E.6A for use in the Argon-41 dilution calculation.

APPENDIX !

FORMS FOR ARGON-41 CONCENTRATION MEASUREMENTS AND CALCULATIONS

UFTR FORM SOP-E.6A

DETECTOR EFFICIENCY MEASUREMENT

PART I: DATA ON COBALT-60 STANDARD

Serial Number: ________________
Assay Date: ________________
Assay Activity: ________________

PART II: MEASUREMENTS ON COBALT-60 STANDARD

A Co-60 standard source with two primary gamma ray energies spanning the Ar-41 primary gamma energy is used to determine the efficiency of the detector system used to measure the Argon-41 activity in the UFTR core vent air samples. The calculations and results for the detector efficiency measurement are documented as follows:

ISOTOPE	ENERGY DETECTED (keV)	CALCULATED* ACTIVITY (A_2) (DPM)	MEASURED** ACTIVITY (DPM)	DETECTION EFFICIENCY***
Cobalt-60	E_1 = 1173	___ ________	________	ε_1 = ________
Cobalt-60	E_2 = 1332	________	________	ε_2 = ________

*Calculated activity of Co-60 source is based upon the initial activity (A_1) and the 5.271 year half-life: $A_2 = A_1 e^{-\lambda t}$ where $\lambda = 0.693/5.271$ yr.

**Measured activity is the activity recorded by the counting system.

***The Energy-dependent Detector Efficiency for the two Co-60 gamma energies is simply

$$\varepsilon(E) = \frac{\text{Measured Activity}}{\text{Calculated Activity}}$$

PART III: ARGON-41 DETECTION EFFICIENCY CALCULATION

The detector efficiency for Argon-41 gamma rays (E = 1293 keV) is determined as a simple linear interpolation of the efficiency for counting the two different energy Cobalt-60 gamma rays as follows:

$$\varepsilon_3 \text{ (1293 keV)} = \left(\frac{\varepsilon_1 - \varepsilon_2}{E_1 - E_2}\right) \times (E_2 - E_1) + \varepsilon_1$$

Resultant Argon-41 Gamma Detection Efficiency: ε_3(1293 keV) = ________________.

PART IV: VERIFICATION

________________	________	________________	________
Form filled out by	Date	RM/FD Acknowledgment	Date

UFTR FORM SOP-E.6B

ARGON-41 STACK EFFLUENT CONCENTRATION

PART I: SAMPLING CONDITIONS

Argon-41 Detection Efficiency (From form SOP-E.6A): ____________________

Stack Air Flow Without Core Vent: ____________________

Reactor Power Level and Stack Monitor Readings Prior to Sampling: ____________________

Length of Reactor run Prior to Sampling: ____________________

PART II: RESULTS OF DATA ACQUISITION

SAMPLE NUMBER	TIME SAMPLING COMPLETED	TIME STARTED COUNTING	DELAY TIME (sec)	COUNT DURATION (min)	UNCORRECTED COUNT RATE (CPM)

PART III: RESULTS OF DATA REDUCTION

SAMPLE NUMBER	COUNT RATE COMPENSATED FOR DELAY (CPM)	SAMPLE DECAY RATE (CPM/ε_3)	SAMPLE ACTIVITY (Curies)	SAMPLE ACTIVITY (Ci/ml)	INSTANTANEOUS AR-41* CONC. IN STACK EFFLUENT (μCi/ml)

*Includes effects of core vent and diluting fan flow as well as NRC-TECH SPEC 200-to-1 atmospheric dilution factor.

PART IV: VERIFICATION

Form filled out by	Date	RM/FD Acknowledgment	Date

STACK DILUTION AIR FLOW MEASUREMENT

PART I: SAMPLING CONDITIONS

CHIMNEY CROSS SECTIONAL AREA: 6.354 ft^2

BAROMETRIC PRESSURE: ______

TEMPERATURE: ______

WIND SPEED AND DIRECTION: ______

GENERAL WEATHER CONDITIONS: ______

ANEMOMETER DESCRIPTION (NORMALLY TAYLOR ANEMOMETER - MODEL 3132) ______

NOTE: THESE MEASUREMENTS SHOULD BE MADE DURING CALM WEATHER.

PART II: RESULTS OF DATA ACQUISTION

Chimney Action

N

W

a	b	c
d	e	f
g	h	i

Normal Rate

N

W

a	b	c
d	e	f
g	h	i

PART III: RESULTS OF DATA REDUCTION

Chimney Action Sum: ______ ft/min

Chimney Action Ave: ______ ft/min

Correction: ______ ft/min

True Chimney Action: ______ ft/min

Normal Action Sum: ______ ft/min

Normal Action Ave: ______ ft/min

Correction: ______ ft/min

True Normal Action: ______ ft/min

STACK DILUTION AIR FLOW = (TRUE NORMAL ACTION - TRUE CHIMNEY ACTION) X CHIMNEY AREA

STACK DILUTION AIR FLOW = (______) X 6.345 FT^2

STACK DILUTION AIR FLOW = ______

PART IV: VERIFICATION

Form Filled Out By ______ Date ______ RM/RD Acknowledged ______ Date ______

APPENDIX II

TAYLOR ANEMOMETER CALIBRATION CHART

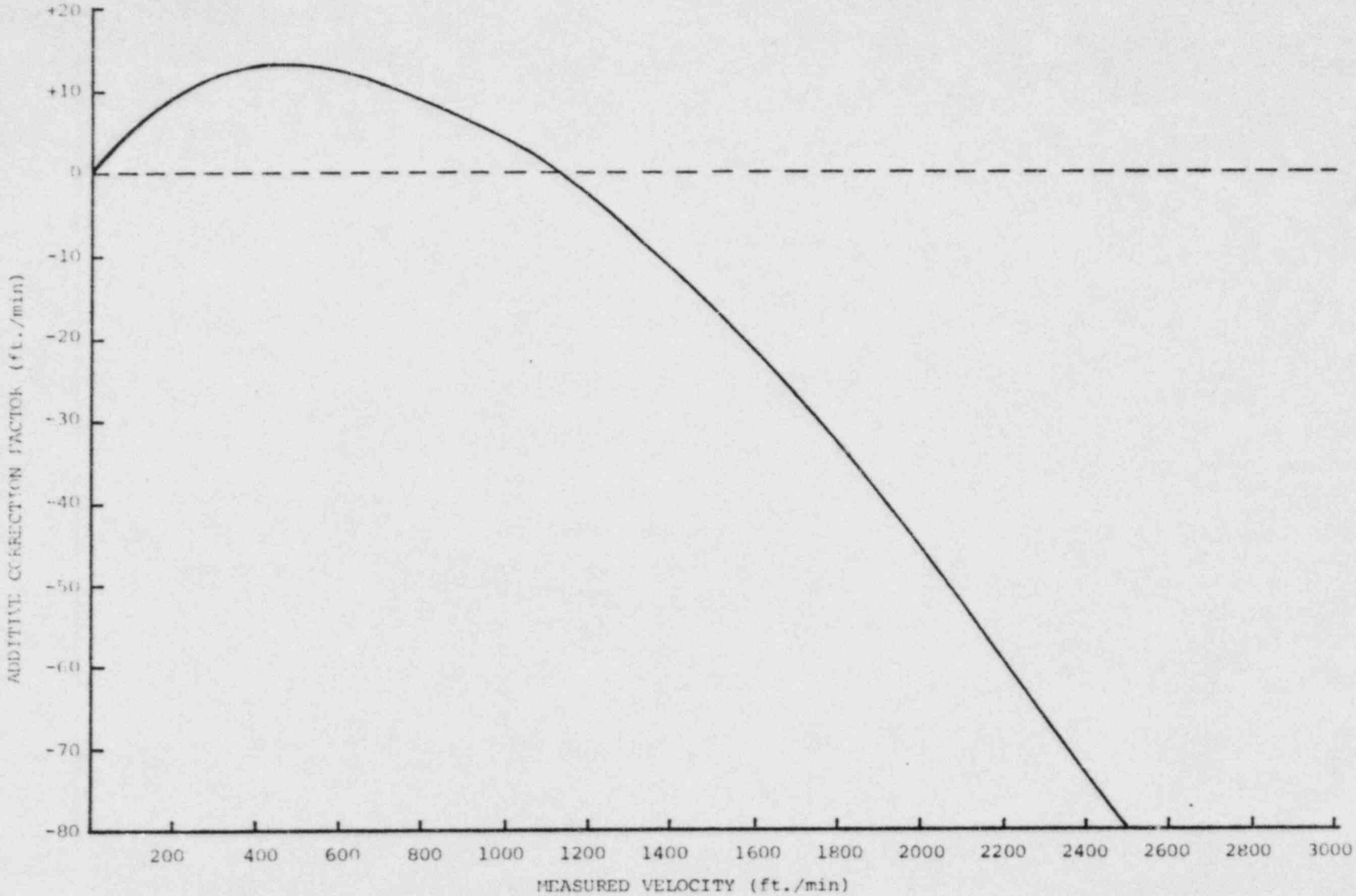

Figure E.6-1 Anemometer correction chart (Positive values are added to anemometer readings while negative values should be subtracted from anemometer readings.)

APPENDIX B

UFTR EMERGENCY PLAN

REVISION 1

NILS J. DIAZ, DIRECTOR
W.G. VERNETSON, REACTOR MANAGER
NUCLEAR REACTOR BUILDING
GAINESVILLE, FLORIDA 32611
PHONE (904) 392-1429 TELEX 56330

NUCLEAR FACILITIES DIVISION

UNIVERSITY OF FLORIDA

June 25, 1984

MEMORANDUM

TO: Reactor Safety Review Subcommittee

FROM: W.G. Vernetson

SUBJECT: UFTR Emergency Plan Revision 1

Attached are four pages to constitute Revision 1 of the UFTR Emergency Plan. All changes are clearly marked by vertical lines in the right hand margin. None of these changes is considered to change the Emergency Plan substantially; therefore, the Plan continues to meet the needs for responding to UFTR-related emergencies.

The revisions on pages 5-2 and 8-1 merely correct a poorly presented table and a typographical error respectively. These changes are not substantive but merely correct obvious errors.

The third revision page corrects the Section 8.4 description of the communications methods available for calling the Shands Hospital. There is only one telephone line in Room 108 NSC, not two as indicated in the original UFTR Emergency Plan. The red emergency phone is a dedicated line and number at the Shands Emergency Room which is available as indicated to advise Shands of incoming patients and their physical state to include whether they are contaminated or have received a significant radiation dose. This change is a minor change in that there are not two phones in the Emergency Support Center (Room 108 NSC) but the original descripton was never intended to claim two phones in Room 108 NSC. So again this is a minor change to bring the Emergency Plan to agree with the actual available communications which are still more than adequate to address UFTR-related emergencies.

The revision of Paragraph 8.3.1 on page 8-3 corrects the description of the decontamination facilities to coincide with changes to be incorporated as described and justified in the June 19, 1984 memorandum to the Emergency Plan Implementation File which is attached. This change is also considered a minor technical change though in this case it is needed because of an error in the original Emergency Plan. The change as incorporated and justified in the attached memorandum of June 19, 1984 updates the Emergency Plan so that it continues to meet its objectives for planning responses to UFTR emergencies.

WGV/ps

Enclosures

cc: N.J. Diaz

Table 5.1

UFTR Emergency Classification Guide

EMERGENCY CLASS	ACTION LEVEL	PURPOSE
Class 0 Less severe than the lowest class.	Civil disturbances or receipt of bomb threat non-specific to the Reactor. Personnel injury, with or without radiological complications. Minor fire or explosion within the operations boundary that is non-specific to the reactor or its control system.	(1) Alert staff to a possible escalation; (2) Initiate assessment; (3) Provide treatment.
Class I Notification of Unusual Event	Receipt of bomb threat with possible radiological release implications. Fire or minor explosion which might adversely effect the reactor or its control systems. Two area monitors above 50 mR/hr. Airborne contamination in excess of 10 MPC in the Reactor Cell and/or 2 MPC at the operations boundary when averaged over 24 hours.	(1) Assure that emergency personnel are ready to respond if situation escalates or to perform confirmatory radiation monitoring if required; (2) Provide current status information to off-site authorities.
Class II Alert	Visible damage to fuel bundle, other visible failure. Area monitors in reactor cell above 500 mR/hr. External radiation level of 10 mR/hr measured at Decon Room. Airborne contamination in excess of 100 MPC in the Reactor Cell and/or 20 MPC at the operations boundary when averaged over 24 hours. Major fire or explosion in the UFTR cell which has affected the reactor and/or its control systems.	(1) Assure that response centers are manned; (2) Assure that monitoring teams are dispatched; (3) Assure that personnel required for evacuation of on-site areas are at duty stations; (4) Provide consulation with off-site authorities; (5) Provide information to the public through the UF Public Information Office.

8.0 EMERGENCY FACILITIES AND EQUIPMENT

This section of the Emergency Plan delineates and briefly describes the emergency facilities, types of equipment and their location that are available in the event of a UFTR-related emergency.

8.1 Emergency Support Center

Emergency support is to be given from a location designated as the Emergency support Center (ESC) which is to be moved to successively larger distances from the reactor building as conditions warrant. Since the onset of an emergency condition (sounding of the UFTR Building evacuation siren) necessitates evacuation of the entire Reactor Building (UF Building #557), the Emergency Support Center is to be established in the Nuclear Sciences Center (UF Building #634) directly adjacent to the south of but separate from the Reactor Building. The Emergency Support Center is to be established initially in the Nuclear Sciences Decontamination Room, Room 108, NSC (Telephone Number 392-1428) located just outside the reactor building. If warranted by emergency conditions, Emergency Support Center locations are identified at increasing distances from the reactor building facility first floor entrance as follows:

Location 1. Nuclear Sciences Center Decon Room, Room 108 of the Nuclear Sciences Center, (Telephone Number: 392-1428).

Location 2. Parking Lot behind Nuclear Sciences Center (service drive)--To be used if the radiation level outside Room 108 NSC in the hall exceeds 10 mR/hr or if crowded conditions or involvement of contaminated and/or injured personnel make Location 1 undesirable or if high radiation areas, contamination, fire or other conditions warrant evacuation of the Nuclear Science Center.

8.2 Assessment Facilities

Equipment available at the Decontamination Room (Room 108 NSC) to be used to determine the need to initiate further emergency measures as well as that to be used for continuing assessment include a high level wide-range survey meter (teletector) as well as a low level GM meter (E-140) as well as two or more high level and low level dosimeters. In addition, the Radiation Control office in the Nuclear Sciences Center can provide additional portable survey meters and is equipped with low level counting equipment for assessment of swipes. A high volume air-sampler for evaluating airborne particulate activity is also available at the radiation control office. A pancake detector to check for surface contamination as well as personnel contamination is also available from or through the Radiation Control Office. A list of equipment available from Radiation Control for radiation dose and level assessment is presented in Table 8.1

Scintillation and semi-conductor gamma ray spectrometers are available in the Nuclear Engineering Department Laboratories, from the Radiation Control Office and elsewhere on the University of Florida campus for radioisotope identification. Additional equipment (portable survey and low level counting) is also available at, or through, the UF Radiation Control Office.

8.3.4 Shands Teaching Hospital and Clinics

The Shands Emergency Room handles all emergency cases and is also a designated radiation accident emergency facility with the capability of handling radiation exposed and contaminated victims. This facility also serves as the designated radiation accident emergency facility for the Crystal River 3 nuclear power plant on the coast of Florida about 75 miles away and necessarily provides continuing training, including the handling of radiation exposed or contaminated victims as outlined in its Plan for Emergency Handling of Radiation Accident Cases included as Appendix I to this UFTR Emergency Plan.

8.3.5 Other Medical Support

All conceivable medical assistance requirements can be supplied by Shands Teaching Hospital and Clinics so that assurance of services from off-site agencies is unnecessary.

8.4 Communications Equipment

The Decontamination Room (Room 108 NSC) outside the UFTR building is equipped with a normal telephone for primary communications (904-392-1428). Shands Hospital has a red emergency phone which is to be used to notify Shands directly of radiation accident or other victims about to be transported and to keep proper records on such personnel. Walkie-talkies are used for communicating with support groups around the facility, using Physical Plant frequency. The UPD will be the primary communication center and can provide communications assistance via portable, hand-held radio equipment. If Civil Defense actions are warranted, then they become the primary control center and direction/communications originate from this office.

The UFTR Building intercom system links the reactor control room, the facility director's office and the operating staff office for internal communications. Telephones also connect various areas of the UFTR Building to the control room, main Nuclear Engineering office and the outside. Word-of-mouth communications will provide back-up for internal communications.

8.3 First Aid and Medical Facilities

The Shands Teaching Hospital and Clinics, Inc., is a designated radiation accident emergency center. It has made a commitment through its "Plan for Emergency Handling of Radiation Accident Cases" to cope with irradiated and/or contaminated patients originating on the University of Florida Campus. The Shands Teaching Hospital and Clinics provides continuing training, including the handling of radiation exposure patients and contaminated victims as referenced in the "Plan for Emergency Handling of Radiation Accident Cases" which is included as Appendix I to this UFTR Emergency Plan.

8.3.1 Decontamination Facilities

A decontamination shower and sink is located in the Decon Room (Room 108 NSC) and may be utilized for limited decontamination purposes since both are plugged to hold up contaminated water which can then be directed to the radiological waste holdup tanks of the UFTR building. Other alternate showers and sinks are located in the Nuclear Sciences Center and the UFTR Facility complex; waste from these alternate facilities is directed to the waste holdup tanks. Note that waste from these tanks is not discharged into the sanitary sewer until cleared by the Radiation Control Office. Protective clothing and decontamination supplies are available in Room 108 NSSC and on the Emergency Equipment Cart. Additional supplies are available through the Radiation Control Office.

If the extent of the victim's injuries are such that he/she cannot be decontaminated on site, then the victim will be transported to the designated decontamination site at the Shands Teaching Hospital and Clinics Emergency Room by the Alachua County Ambulance Service or designated alternate using the multiple blanket contamination isolation method.

8.3.2 First Aid

First aid is available at the Nuclear Sciences Center Decontamination Room through several UFTR personnel who are trained in first aid, or from the University Police Department or Gainesville Fire Department personnel who are certified in CPR and advanced Red Cross first aid. In addition, Alachua County Ambulance Service personnel are not only qualified in first aid but can provide paramedical assistance. First aid kits are available in the UFTR control room and the Decon Room. Stretchers and litters as well as splints to immobilize broken bones are also available in the Decon Room.

8.3.3 Ambulance Service

Ambulance service is provided through the Alachua County Ambulance Service. For a contaminated victim, a designated health physicist will accompany the victim in the ambulance to advise on proper handling, to minimize personnel dose rates and the spread of contamination during transport, and to convey dose estimate and contamination information.

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W.G. VERNETSON, REACTOR MANAGER
NUCLEAR REACTOR BUILDING
GAINESVILLE, FLORIDA 32611
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NUCLEAR FACILITIES DIVISION

UNIVERSITY OF FLORIDA

November 27, 1984

Office of Nuclear Reactor Regulations
Standardization and Special Projects Branch
Director, Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Re: Facility License R-56
Docket No. 50-83

Dear Sir:

In compliance with our Technical Specifications reporting requirements, enclosed is one copy of the 1983-1984 University of Florida Training Reactor Annual Progress Report.

This document complies with the requirements of the UFTR Technical Specifications, Section 6.6.1.

Please advise if further information is needed.

Sincerely,

William G. Vernetson

William G. Vernetson
Acting Director of
Nuclear Facilities

WGV/ps

Enclosure

cc: P.M. Whaley
Acting Reactor Manager

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