DEPARTMENT OF MECHANICAL ENGINEERING
THE UNIVERSITY OF TEXAS AT AUSTIN

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50-192

April 14, 1992

Carl Robertson
U.S. Dept. of Energy
Idaho Operations Office
785 Doe Place
Mailstop 1131
Idaho Falls, Idaho 83402

Dear Sir:

Enclosed are seven (7) copies of the Annual Report from the Nuclear Engineering Teaching Laboratory at the University of Texas at Austin. These documents are being submitted according to contract DE-AC07-ER03919 Amendment A015.

Sincerely,

Thomas L. Bauer
Assistant Director
Nuclear Engineering
Teaching Laboratory

TLB:mm
Enclosure

Distribution
1 B. W. Wehring
3 NETL
1 Document Control Desk - NRC
1 Region IV - NRC
7 DOE
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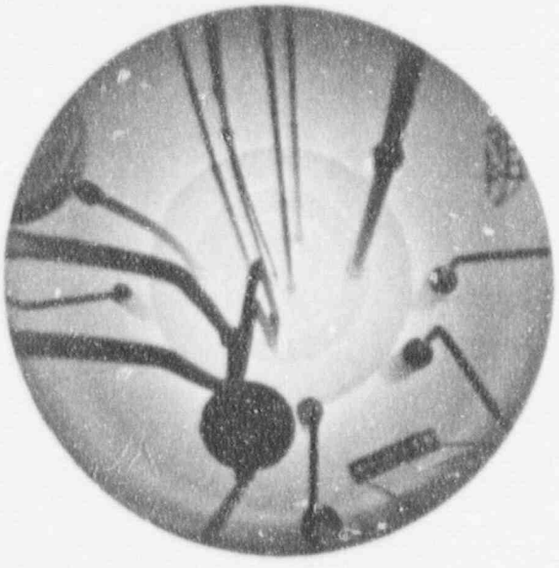
IE47
1/1



NUCLEAR REACTOR LABORATORY

TECHNICAL REPORT

THE UNIVERSITY OF TEXAS
COLLEGE OF ENGINEERING
DEPARTMENT OF MECHANICAL ENGINEERING

1991 ANNUAL REPORT

of

The University of Texas at Austin
Nuclear Engineering Teaching Laboratory
at Taylor Hall Room 104

January 1, 1991 - December 31, 1991

Bernard W. Wehring, Director
512/471-5787
T. L. Bauer, Assistant Director/Reactor Supervisor
512/471-5787

March 1992

Balcones Research Center
Nuclear Engineering Teaching Laboratory
10100 Burnet Road
Austin, Texas 78758

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1. INTRODUCTION

The Nuclear Engineering Teaching Laboratory (NETL) at The University of Texas at Austin prepares an annual report to provide information about program activities. Information in this report satisfies the requirements of the U.S. Nuclear Regulatory Commission (NRC) docket number 50-192 and the U.S. Department of Energy contract number DE-Ac07-ER03919 Amendment A015. The report covers the period from January 1, 1991 to December 31, 1991.

Activities of the NETL program are part of the College of Engineering Department of Mechanical Engineering. Development of the nuclear program by the university began in the years prior to 1960, with the location of most of the program activities in one of the original engineering buildings. Building space in Taylor Hall has provided classroom, laboratory and office areas. By the year 1985 the nuclear program was the only engineering program still functional in the building that has become the location of the College of Natural Sciences Department of Computer Science. Other university organizations such as the Computation Center are also in areas of the building.

Taylor Hall

Most NETL program laboratory activities were at two locations in Taylor Hall. Floor plans of these two laboratory areas, a Nuclear Reactor Laboratory and an Activation Analysis Laboratory, are shown in Figures 1 and 2. The Nuclear Reactor Laboratory is the site of a TRIGA Mark I reactor that has steady-state and pulse modes. Power operation of the reactor was at 250 kilowatts steady-state and approximately 250 megawatts pulse. At the time of initial facility acceptance the power level was at 10 kilowatts. The Activation Analysis Laboratory provided gamma spectroscopy systems for analysis of neutron activation reactions. These reactions are products of irradiation experiments in reactor experiment facilities. Data acquisition and analysis was done with high efficiency, high resolution detectors. Intrinsic purity germanium detectors provide radiation detection with automatic control and acquisition systems run by microcomputers.

Other NETL program laboratory activities are now functional at Building 159 of the Balcones Research Center. This facility provides multipurpose facility for several engineering and science programs. A Nuclear Radiation Laboratory provided an experiment facility for flux and energy measurements of neutrons from fusion, fission, and other neutron production reactions. Three sources available are the D-T reaction from a Cockcroft-Walton type accelerator, spontaneous fission reaction from the isotope californium-252 and the alpha-neutron reaction from plutonium-beryllium. Activities of the laboratory include detection, measurement and analysis.

NETL program equipment and materials provide support for different types of facility activities. Supplemental equipment and radioactive materials include a subcritical assembly, gamma irradiator, portable x-ray unit and various isotopic radiation sources. Equipment, instrumentation systems and detection devices for monitoring, measurement and calibration of ionizing radiation are in routine use or available for special applications. Radioactive material inventories contain radioisotope sources for gamma rays, neutron emissions, x-ray excitation, and reference standards for several types of experimental programs.

Developmental goals of university and engineering programs have been the major cause of change to the NETL program. Initiation of a project to move activities of the NETL program to the Balcones Research Center (BRC) began in October 1983 and was completed in August 1991. The program move is in response to needs of the main campus for expansion of other educational programs, addition of research facilities, and the development of the research center into a major research site for science and engineering.

A Dismantling and Decommissioning Plan (DDP, docket 50-192) for the Taylor Hall facility was submitted to the Nuclear Regulatory Commission (NRC) on May 3, 1985. An order to authorize the activities that will lead to the license termination was issued on March 9, 1987. Project plans indicate that the DDP activities will occur in the third or fourth quarter of 1992. The R-92 operating license has been amended to a possession only license.

Building 159
Balcones Research Center

Project authorization to move NETL program activities to the Balcones Research Center (BRC) site was approved by The University of Texas System Board of Regents on October 13, 1983. A submittal for a construction permit and an operation license was made to the Nuclear Regulatory Commission on November 9, 1984. Subsequent to a site visit on January 22 thru 24 a license amendment was requested on February 27, and responses to NRC questions were prepared. The construction permit was issued June 4, 1985.

Preliminary architectural and engineering plans were approved by The University of Texas System Board of Regents on August 8, 1985. Final plans were approved on April 10, 1986 and the bid to a general contractor was awarded on December 4, 1986. CIT Construction Inc. of Stafford, Texas, was specified as the general contractor and start of construction was recorded on February 10, 1987. Facility completion was scheduled for 16-18 months after start of construction. Project delays by the general contractor led to removal of the contractor. Completion of the project was the responsibility of the surety, Firemans Insurance Company. Acceptance of the building for occupancy was on May 1, 1989, with subsequent termination of construction contract activities on January 31, 1990.

The Balcones Research Center facility provides laboratories for the TRIGA reactor, a neutron generator, radiation measurement systems, preparation and processing of radioactive samples, and office space. Although the facility will move the present TRIGA facility and other program activities into a single building at the Research Center, several improvements to the reactor facility will extend facility capability. These include above ground shield structure for access to horizontal beam tubes, and an increase of power and pulse parameters. Plans are to utilize the present fuel and move some other components from the old to the new facility. A few components such as control rod drives have been subject to rework procedures to assure appropriate functional operation. Many components such as reactor structure, instrumentation, and control system are new components.

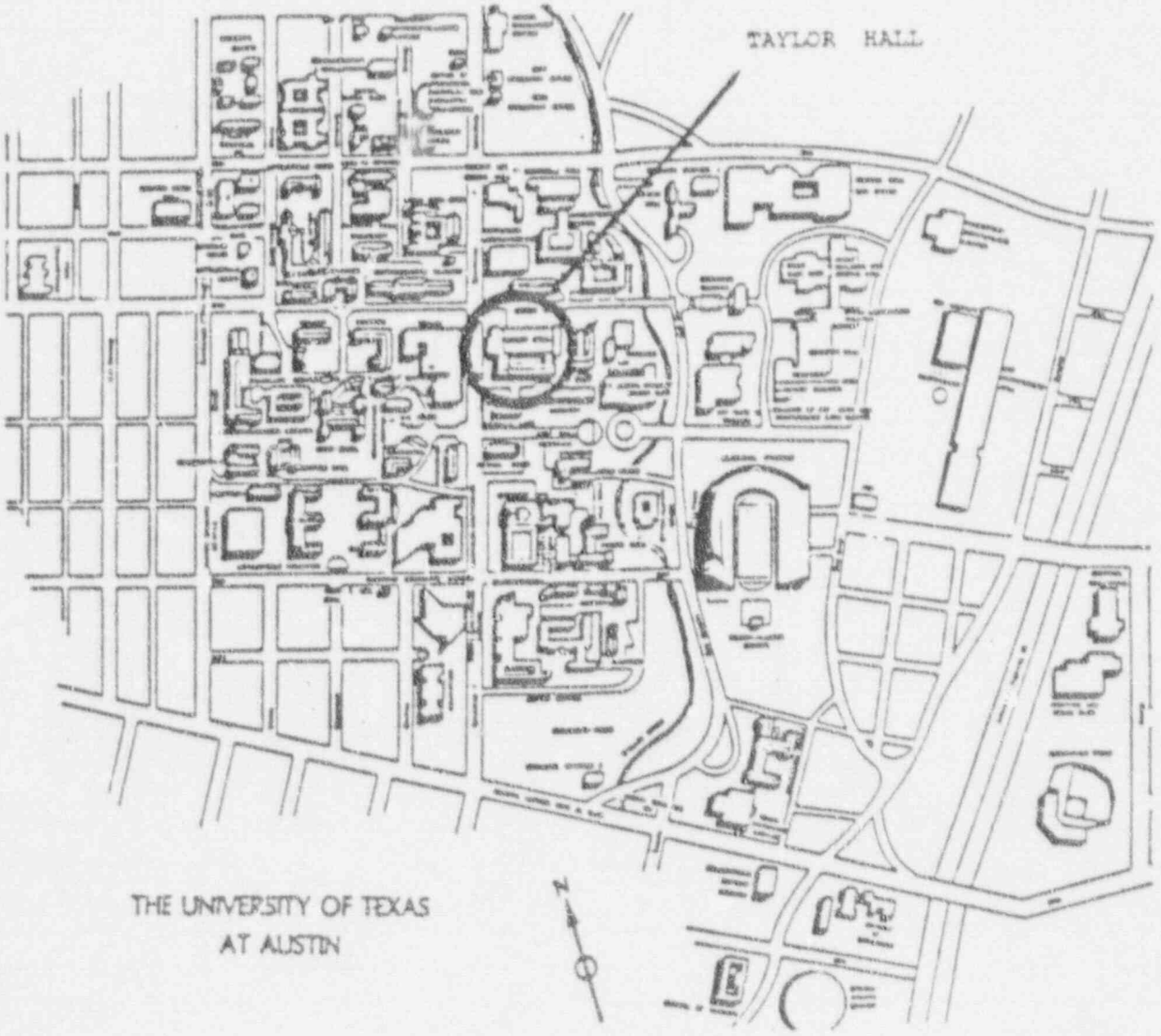
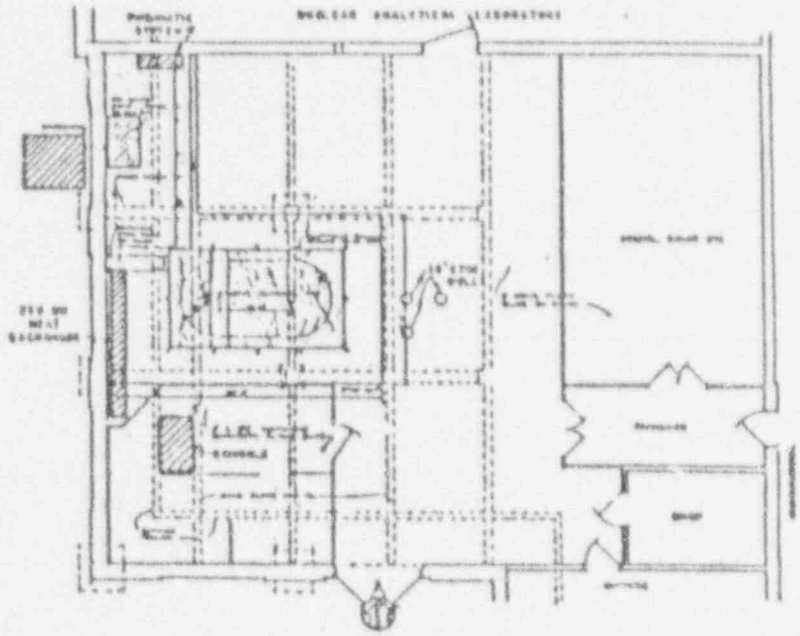
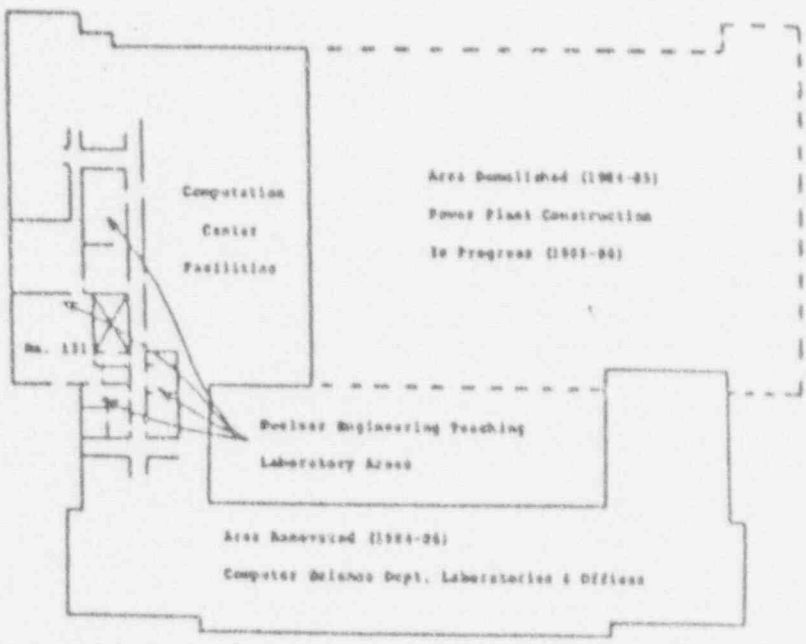


Figure 1

Site Location of Nuclear Engineering
Teaching Laboratory



TAYLOR 131



TAYLOR HALL

Figure 2

Floor Plan of Nuclear Engineering
Teaching Laboratory

II. LABORATORY ADMINISTRATION

A. Organization

The present organizational chart of the NETL program is presented in Figure 3. Budgeted NETL funding for the primary staff is provided for a Supervisor/Assistant Director, research associate, operator, secretary, and part time assistant. Budget support is divided into full time positions for supervisor, reactor operator, research associate, and secretary. The balance of the budget supports a part time assistant, typically halftime, such as a student.

Additional funds now support a full time health physicist position. Other funds for the next several years are to be available for up to 2 additional positions associated with reactor experiment programs.

B. Personnel

Personnel associated with the laboratory consist of NETL staff, faculty, students, and certain other university personnel. The personnel involved in the NETL program during the past year are summarized in Table I.

C. Standing Committees

Two committees monitor the activities of the NETL programs. The Nuclear Reactor Committee functions through the College of Engineering and the Radiation Safety Committee functions through the Office of the President.

1. Nuclear Reactor Committee

The Nuclear Reactor Committee convened to review the activities related to facility operation during each quarter of the calender year. Committee meeting dates were January 4, April 4, July 24, and October 15, 1991. The committee composition is shown in Table 2. Committee responsibilities are the reactor operation, associated facility activities and engineering programs.

2. Radiation Safety Committee

The Radiation Safety Committee convened to review radiological safety practices at the university during each academic term. Committee meeting dates were April 22, 1991 and November 19, 1991. The committee composition is shown in Table 2. Committee responsibilities are the activities of university research programs that utilize radiation source materials.

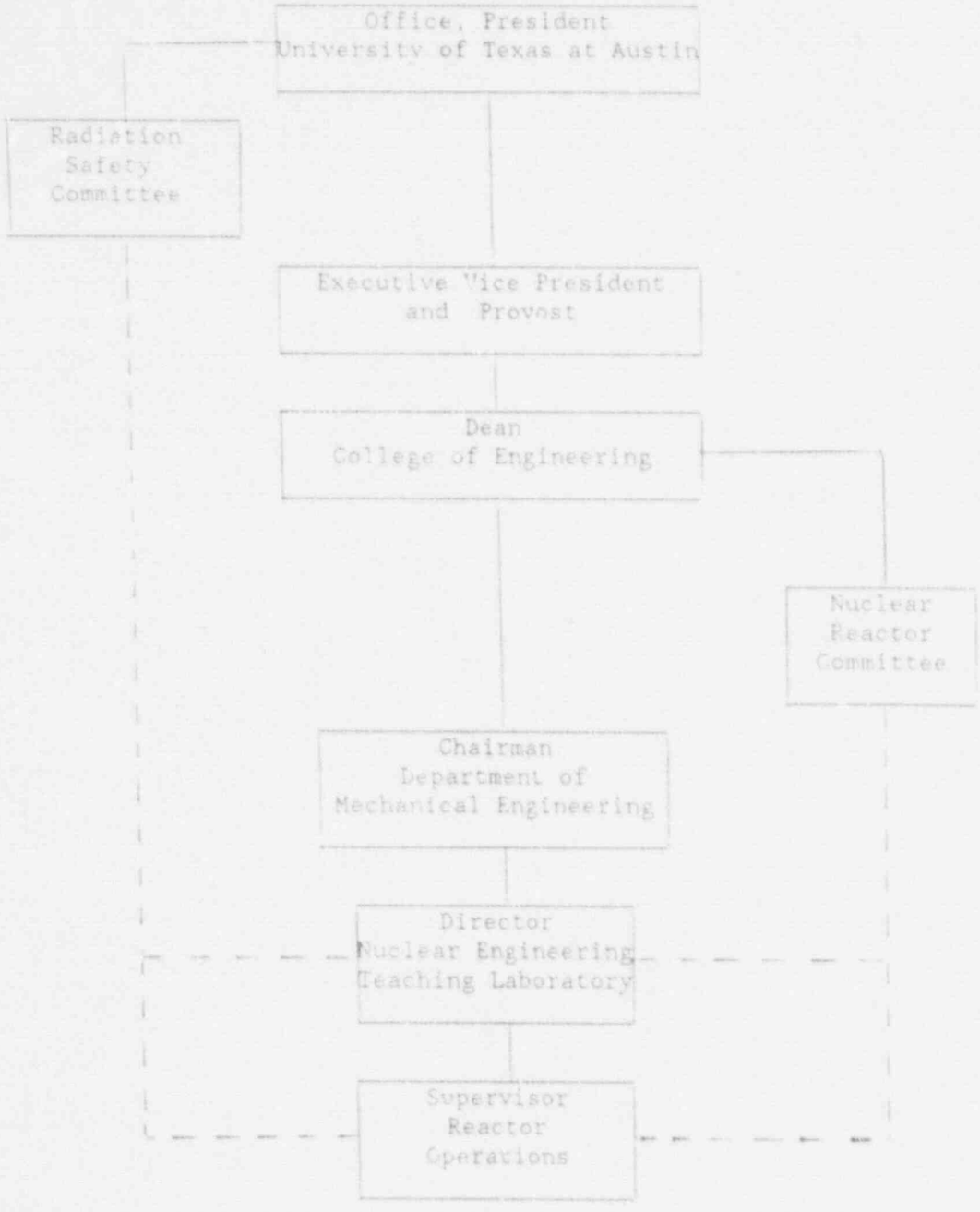


Figure 3

Organization Chart of the Nuclear
Engineering Teaching Laboratory

Table 1
Administration and Committees

Administration

The University of Texas System Board of Regents

Chairman	Louis A. Beecherl Jr.
Vice Chairman	Sam Barshop
Vice Chairman	Bill Roden
Executive Secretary	Arthur H. Dilly

Member (1991)	Member (1993)	Member (1995)
J.S. Blanton	Sam Barshop	R.J. Cruikshank
S.H. Ratliff	L.A. Beecherl Jr.	Tom Loeffler
Bill Roden	W.A. Moncrief Jr.	M.E. Ramirez
Chancellor	Hans Mark	

The University of Texas at Austin

President	William H. Cunningham (app: 9/1/85)
Executive Vice President and Provost	Gerhard J. Fonken (app: 9/1/85)
Dean of the College of Engineering	Herbert H. Woodson (app: 9/1/87)
Chairman of Department of Mechanical Engineering	Kenneth Diller (app: 9/1/90)

Nuclear Reactor Committee

Chairperson:	H. L. Marcus (app: 9/1/77)
Member:	B. W. Wehring(app: 9/1/90)
Member:	D. E. Klein (app: 9/1/77)
Member:	J. C. Reis (app: 9/1/90)
Member:	R.S. Charbeneau (app: 9/1/89)
Member, student:	J. McWhirter (app: 9/1/89)
Ex officio member:	T. L. Bauer (app: 6/1/7)
Ex officio member:	H. W. Bryant (app: 11/1/73)
Ex officio member:	H. H. Woodson (app: 9/1/87)
Ex officio member:	K. R. Diller (app: 9/1/90)

Radiation Safety Committee

Chairperson:	E. L. Sutton (app: 9/1/84)
Member:	G. W. Hoffman (app: 9/1/84)
Member:	D. E. Klein (app: 9/1/83)
Member:	S. A. Monti (app: 9/1/85)
Member:	L. O. Morgan (app: 4/1/7)
Member:	B. W. Wehring (app: 9/1/89)
Member:	B. Cook (app: 9/1/89)
Ex officio member:	H. W. Bryant (app: 11/1/73)
Ex officio member:	W. H. Cunningham (app: 9/1/85)

Table 2
Personnel

Facility Personnel
Staff

Director	B.W. Wehring
Assistant Director/Supervisor	T.L. Bauer
Manager of Analytical Services	F.Y. Iskander
Manager of Neutron Beam Projects	K. Ünlü
Manager of Reactor Operations	M.G. Krause
Post Doctoral Fellow	T. Emoto
Health Physicist	R.C. Woodard/John C. White
Nuclear Technical Specialist I	R. Manteufel
Administrative Associate	J.G. Rawlings
Senior Office Assistant	M. McGee

Support Personnel
Safety Personnel

Safety Coordinator	H.W. Bryant
Radiation Safety Specialist	L.W. Hamlin

Researchers

College of Engineering

T.L. Bauer	Nuclear Reactor Lab.	
F.Y. Iskander	Neutron Activation Lab.	Research Associate Faculty
N.E. Hertel	Nuclear Radiation Lab.	Assoc. Prof.
D.E. Klein	Mech. Engineering	Prof.

University Departments

D.S. Barker	Geology	Prof.
T.L. Bergman	Mech. Engineering	Assoc. Prof.
J. Reis	Pet. Engineering	Assoc. Prof.
P.S. Schmidt	Mech. Engineering	Assoc. Prof.
D. Smith	Geology	Prof.

Students

Graduate Assistants

G. Miller	Kuo-Pen Cheng
J. Kim	H. Vega Carrillo
B. Hall	C. Rios Martinez
B. Nabelssi	J. McWhirter

Undergraduate Student Assistants

R. Manteufel	S Bertrum-McUne
S. Midgett	C. Lindemann
W. Rosella	M. Razzaque

D. Report to the College of Engineering

Each year the Reactor Committee provides a report to the Dean of the College of Engineering describing activities of the committee and a review or assessment of the operation of specific portions of the NETL program concerning the reactor and other radiation producing equipment.

Note: Bids for the facility at the Balcones Research Center were opened October 21, 1986 and award of the general contract was approved December 4, 1986. The University of Texas System Board of Regents entered into a contract with CIT Construction Inc. of Stafford, Texas. Total project cost for the proposed facility was $5,452,560. An additional $408,140 is being held in reserve for dismantling activities at the Taylor Hall facility. Authorized total cost is $5,860,700.

III. LABORATORY DEVELOPMENT

A. Organization

Dr. Bernard W. Wehring as the Director of the NETL Program, has been responsible for laboratory development. Dr. Thomas L. Bauer continued as Reactor Supervisor/Assistant Director during the past year.

The facility staff during the 1991 calendar year consisted of three managerial positions, designated for Reactor Operations, Neutron Analytical Services and Neutron Beam Projects. All three positions are held by present staff.

The Nuclear Reactor Committee had no changes during the 1991 calender year. Dr. H.H. Woodson continues as the Dean of the College of Engineering. Dr. K.R. Diller continue as chairman of the Department of Mechanical Engineering. Dale Klein continues as Associate Dean for Research in the College of Engineering.

B. Nuclear Engineering Teaching Laboratory

The Nuclear Engineering Teaching Laboratory is part of the Nuclear Engineering Program at The University of Texas.

The Nuclear Engineering Teaching Laboratory's central feature is a Mark I TRIGA thermal fission reactor. Originally licensed by the Atomic Energy Commission to operate at 10 kw in 1963, the nuclear reactor and the associated laboratory equipment have been updated over the past years and the research capabilities of the Laboratory are now more diverse. In 1968, the facility license was amended to allow the TRIGA reactor to operate at a steady state power level of 250 kw which increased experimental capabilities. Routine operations of the reactor were terminated on April 30, 1988 in preparation to move facility operations. No reactor operation was performed during 1989 or 1990. Several key routine surveillances will continue to be performed until fuel is moved. Fuel was moved from the Taylor Hall site to the Balcones Research Center in August of 1991.

Other radiation producing devices maintained by the Laboratory are a 750 curie Co-60 irradiator, vertical neutron beam tube, subcritical assembly, industrial x-ray source, 14 MeV neutron generator, and several isotopic neutron sources. Different types of radiation detection devices provide the capacity to monitor or analyze the various radiation sources.

One of the functions of the nuclear reactor and its associated equipment has been to teach and demonstrate the fundamentals of reactor operation. Another function has been the demonstration of specific applications of nuclear technology. Classes that routinely utilize the reactor facility and a few others that use the facility on an infrequent basis will resume

normal schedules as facilities become available. Classes such as ME 361F and ME 389R have been scheduled for the Balcones Research Center NETL facility. No tours or class activities are presently being pursued at Taylor Hall.

Access to the Taylor Hall facility has been curtailed pending the dismantling activities. All activities of the program have been moved to the BRC site. Reactor fuel from Taylor Hall was moved to the reactor pool and storage wells at the BRC NETL facility.

The use, operation, regulation and inspection of the Nuclear Engineering Teaching Laboratory as operated at Taylor Hall room 131 and BRC building 159 is controlled by the United States Nuclear Regulatory Commission, the Nuclear Reactor Committee of The University of Texas, the Director of the Nuclear Engineering Teaching Laboratory, the Radiation Safety Committee and the Texas Department of Health Division of Radiation Control.

C. Nuclear Radiation Laboratory

The Nuclear Radiation Laboratory is utilized by staff and students of the Nuclear Engineering Program at The University of Texas at Austin. A 14 MeV Texas Nuclear neutron generator is the main feature of the laboratory. Five californium-252 neutron sources are also available for use. The facility, with installed shielding, provides an area where students and staff can perform experiments utilizing not only the high energy neutrons from the neutron generator but fission spectrum neutrons from Cf252. In addition to the neutron generator and the californium sources, other smaller radioactive sources are also used within the confines of the Nuclear Radiation Laboratory.

The laboratory was located in an area of the Engineering Science Building. Equipment for radiation measurements have been moved from the ENS site and the area released by survey for unrestricted use. Activities are now part of the BRC facility, Bldg. 159, room 1.102. All radiation sources for this room 1.102 laboratory are subject to the university broad license for radioactive materials and radiation producing equipment.

D. Neutron Activation Analysis Laboratory

The Neutron Activation Analysis Laboratory has provided nuclear analytical support for individual projects ranging from student project support for classes to measurements for faculty research projects. Student project support is in the areas of engineering, chemistry, physics, geology, biology, zoology, and other areas. Research project support includes elemental measurements for environmental and investigative research projects. Scientific articles based upon the results of sponsored and non sponsored research by this laboratory have been published or accepted for publication in several journals and proceedings, and have been presented at conferences at the state, national and international level.

Radiation measurement systems available include gamma-ray spectroscopy with three HpGe detectors coupled to a microcomputer controlled acquisition and analysis system, Si(Li) detector and multichannel analyzer for X-ray measurements, alpha-beta proportional counter, scintillation detectors, neutron detectors and associated electronic modules to accomplish several types of standard nuclear measurements. An important function of the laboratory is to support various research applications with the neutron activation analysis method or other techniques related to nuclear radiation measurements. This laboratory is fully functional at the SRC site, Bldg. 159, room 3.112. All research and teaching activities at the Taylor Hall site have been completed.

Table 3

Courses Utilizing the Reactor and Associated Facilities

Course Number	Course Description
Mechanical Engineering Department	
ME 361F	Instrumentation and Methods - radiation measurements, reactor instrumentation.
ME 361G	Reactor Operations - reactor kinetics reactor parameters, instrumentation characteristics and regulation.
ME 377K	Projects in Mechanical Engineering - individual study and experiment projects for undergraduates.
ME 389R	Nuclear Engineering Laboratory - studies for graduate students in nuclear methods in measurement and analysis.
ME 5389R	Special projects course for nuclear engineering laboratory studies as a summer course for foreign students.
ME 397	Current Studies in Engineering - special projects course for graduate study of selected topics.

IV. Facility Operations Summary

A. Operating Experience

No reactor operations, pulse or steady-state, have been performed since April 31, 1988. Established operating procedures and other required procedures remained unchanged. Routine reactor operation remained terminated throughout the calender year. No power operation was performed. Fuel remained in a storage configuration until shipment during August 1991. Estimates and measurements of the reactivity establish the configuration to be a Keff < 0.8. Amendment of the facility license has been made for possession only.

Activities for the 50-192 facility consisted of surveillance and administration. No new experiments were proposed or approved. Radiological surveillance activities continue on schedule.

B. Reactor Shutdowns

No scrams can occur with the storage condition of the reactor. The data in Tables 4 and 5 are for reference only.

Reactor shutdowns (scrams) occurring during the reporting period are summarized in Table 4, categorized according to the type of initiating event. Safety system scrams are protective actions to shutdown the reactor that are caused by the proper operation of the safety system but are not the result of an operator error or an intentional action of the operator. Operator error scrams are the result of judgement errors or procedural errors. Instrument and power failure scrams are protective actions that result from loss of safety system function. Intentional scrams are operator initiated scrams such as tests. Manual action scrams are classified either safety or intentional as determined by the cause of the manual scram action. Inadvertent scrams are all unintentional shutdowns of the reactor by the protective action of the safety system. Table 5 compares the number of inadvertent shutdowns during this reporting period to previous reporting periods.

Table 4

Reactor Safety System*
(scrams)

Safety System	0
Operator Error	0
Instrument Error	0
Power Failure	0
Subtotal	0
Intentional	0
Total	0

Table 5

Safety System Events*
(inadvertent)

		1971	13	1981	7
		1972	6	1982	6
1963	10	1973	10	1983	6
1964	9	1974	4	1984	5
1965	3	1975	7	1985	2
1966	4	1976	5	1986	9
1967	3	1977	9	1987	2
1968	11	1978	11	1988	1
1969	15	1979	12	1989	0
1970	11	1980	7	1990	0

* No reactor operation during the years of 1989 to 1991.

Table 6

Performance Data 1991 (4)

Reactor Operation Hours, Fuel Burn-up and Irradiated Samples

Quarter	Reactor Operation (hours)	Total Burn-up Fuel (kwhrs)	Samples Irradiated (number)
First	0	0	0
Second	0	0	0
Third	0	0	0
Fourth	0	0	0
Total	0	0	0

Notes:

(1) Reactor operation hours record the console key on time or the time power is applied to the rod control system. Third and Fourth greater operation time attributed to fuel movement activities this reporting period.

(2) One full power hour is 250 kilowatt-hours.

(3) Samples that are irradiated in the experimental facilities of the reactor such as the RSR, PNT or CT

(4) No reactor operation during the year

Table 7
Annual Utilization Data

Year	Reactor Operation (hours)	Total Burn-up Fuel (kwhrs)	Samples Irradiated (number)
1967	154.5	846	265
1968	342.6	28168	2449
1969	260.8	49985	1452
1970	222.0	36477	1640
1971	262.5	53912	2990
1972	222.8	48389	1946
1973	318.6	45794	1347
1974	226.5	27641	778
1975	207.0	20450	363
1976	135.7	11312	468
1977	139.3	7509	164
1978	171.9	26870	178
1979	311.6	72616	1568
1980	184.1	11760	150
1981	258.5	18165	330
1982	247.6	16150	294
1983	266.2	24028	477
1984	179.6	24806	667
1985	139.9	18607	473
1986	183.1	18660	633
1987	393.9	43786	1394
1988	147.1	24257	941
1989	23.9	0	0
1990	0	0	0
1991	0	0	0
Total	4893.2	630188	20967

Note:

(1) Data for 1967 includes all data recorded for previous operation at 10 kW from 1963-1967.

(2) Operation power of 250 kilowatts was initiated in 1968

(3) No operation after 1988.

C. Utilization

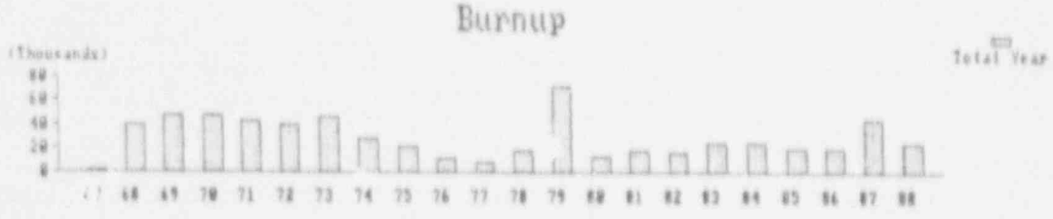
Reactor utilization data is no longer applicable as summarized in Table 6. A summary of reactor utilization since initial criticality is shown in Table 7. Bar graphs comparing annual burnup and quantities of samples irradiated since initial criticality are shown in Figures 4 and 5. The 50-192 facility did not irradiate any samples during the years of 1989 to 1991.

D. Maintenance

During this reporting period maintenance consisted primarily of water system repair and adjustment. Air particulate continuous air monitor and area radiation monitors remain in routine operation and surveillance.

E. Facility Changes

No operation of the reactor in the steady-state or pulse mode is planned pending removal of equipment and components. No facility changes were made during this reporting period. All fuel elements were removed to the Balcones Research Center NETL building 159.



Annual Burnup versus Operation Year

Figure 4

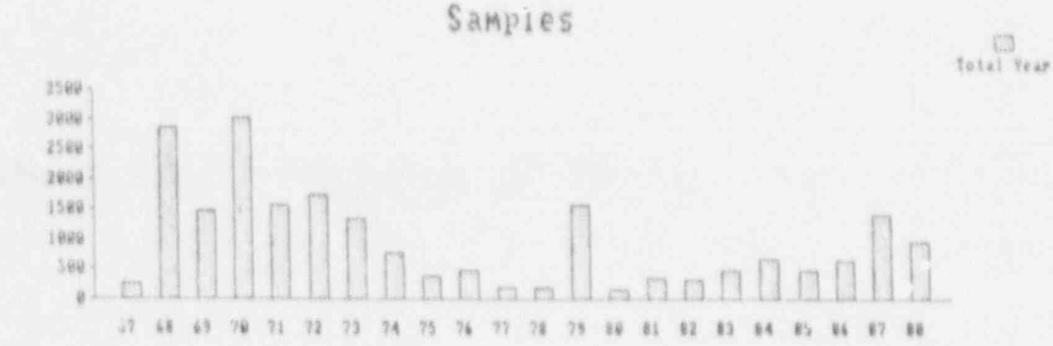


Figure 5

Samples Irradiated versus Year

F. Radiation Exposures

A summary of radiation exposures during this reporting period to facility personnel, students, and visitors is shown in Table 8. The average exposure per individual and the greatest exposure per individual for each group is summarized in Table 9. No exposures in excess of the limits of 10CFR20 occurred during this period.

G. Area Radiation Surveys

An annual summary of the normal radiation levels measured in the laboratory is shown in Table 10. The results of routine surface and pool water contamination surveys are summarized in Table 11. Environmental surveys performed outside the laboratory are summarized in Table 12.

H. Radioactive Effluents

1. Gaseous Wastes

Gaseous discharge during periods of reactor operation consisted of leakage of Ar41 from the reactor laboratory. The total estimated amount of radioactivity released was calculated based on experimental data. No radioactive gaseous discharges were made during the reporting period.

2. Liquid Waste

No liquid radioactive waste was discharged during the reporting period. Efforts are made to avoid liquid waste disposal by appropriate evaporation or absorption techniques

for small volumes and purification by resin treatment for large volumes.

3. Solid Waste

The activity and amounts of solid waste discharged during the reporting period are summarized in Table 14. All solid waste materials were packaged and shipped, along with radioactive waste generated in other departments, by the Safety Office. The Safety office contracts for radioactive waste disposal services.

No solid waste disposal was made form Taylor Hall during the reporting period. Approximately one cubic meter of radioactive waste is in storage pending disposition of the facility dismantling and decontamination. The dismantling and decontamination process will remove these wastes along with the removal requirements for structures and equipment, and cleaning requirements for surfaces and equipment.

Table 8

Summary of Personnel Radiation Exposures

Range of Exposure in REM	Number of Individuals		
	Staff	Students	Visitors
No measurable exposure	9	3	92
Measurable exposure less than 0.1	2	0	1
0.1 - 0.25	0	0	0
0.25 - 0.5	0	0	0
0.5 - 0.75	0	0	0
0.75 - 1.0	0	0	0
1.0+	0	0	0

Table 9

Radiation Exposure Groups

Group	Annual Exposure per Individual in mrem*	
	Average	Greatest
Staff	81	360
Students	25	150
Visitors	< 10	10

* These numbers include the radiation doses during the fuel move from Taylor Hall to BRC Bldg. 159.

Table 10

Laboratory Radiation Levels

Location	Average (mR/hr)	Maximum (mR/hr)
Control Console Area 10 ft. from core axis 6 ft. above pool	2.16×10^{-2}	5.48×10^{-2}
Water System Area 12 ft. from core axis 4 ft. above pool	2.28×10^{-2}	5.48×10^{-2}
Above Core 0 ft. from core axis 16 ft. above pool	5.?1.	1.2×10^{-1}

Table 11

Laboratory Contamination Levels

Location	Average	Maximum
Floors	28 dpm	61 dpm
Surfaces	30 dpm	63 dpm
Pool Water	5.3 pCi/l	30 pCi/l

Table 12

Environmental Surveys

Location	Average	Maximum
1	.01 mR/hr	.01 mR/hr
2	.01 mR/hr	.01 mR/hr
3	.01 mR/hr	.02 mR/hr
4	.01 mR/hr	.01 mR/hr
5	.01 mR/hr	.01 mR/hr
6	.01 mR/hr	.01 mR/hr
7	15 pCi/l	37 pCi/l

Table 13

Monthly Gaseous Waste Discharge
(ARGON-41)

MONTH	EFPH (HRS)	VOLUME (M^3)	ACTIVITY (μCi)	REL. CONC. ($\mu Ci/CM^3$) x10-12	% MPC
1					
2					
3					
4					
5			NO RELEASES		
6					
7					
8					
9					
10					
11					
12					

Monthly Gaseous Waste Discharge
(gas or particulate)

Month	Isotope	Total Release (Ci)	(m^3)	Point of Release Concentration (pCi/m^3)	Percent of Maximum (> 20%)
Jan					
Feb					
Mar					
Apr					
May					
Jun			NO RELEASES		
Jul					
Aug					
Sep					
Oct					
Nov					
Dec					
Total					

Table 14

Monthly Liquid Waste Discharge

Month	Isotope	Total Release (Ci)	Total Release (m^3)	Point of Release Concentration (pCi/m^3)	Percent of Maximum (%)
Jan	-				
Feb	-				
Mar	-				
Apr	-				
May	-				
Jun	-	NO RELEASES			
Jul	-				
Aug	-				
Sep	-				
Oct	-				
Nov	-				
Dec	-				

Table 15

Monthly Solid Waste Disposal

Month	Isotope	Total Release (μCi)	Total Release (ft^3)	Form Chemical/Physical	Remarks
Jan	-				
Feb	-				
Mar	-				
Apr	-				
May	-				
Jun	-	NO RELEASES			
Jul	-				
Aug	-				
Sep	-				
Oct	-				
Nov	-				
Dec	-				

V. Laboratory Inspections

A. NRC Inspections

One license inspection for the R-92 license took place during the 1991 calender year. Inspection dates were August 1,7,8,21 and 22, 1991. Inspections of R-92 activities regarding radiation protection and transportation were done during this inspection.

Activities of the construction permit CPRR-123 were subject to inspection once during the year. Inspection was July 25. No violation of the docket 50-602 construction permit was identified during inspections.

No NRC inspection took place during the calender year for the SNM-180 special nuclear material license. An amendment was made to the SNM-180 license to allow possession of the reactor fuel elements at the Balcones Research Center NETL Building 159. Upon issuance of the docket 50-602 license (R-129, not available in 1991) the SNM-180 license amendment will automatically expire.

B. TDH Inspections

The Texas Department of Health Bureau of Radiation Control inspections consist of a review of activities and radioactive materials used at The University of Texas at Austin as authorized by TDH License (L00-85). One inspection by the State of Texas took place during the calendar year on April 15 - 17, 1991. The inspection included the activities at the Balcones Research Center facility. No violations were noted.

VI. Public Service Activities

A. Lectures and Presentations

NETL faculty and staff assist various organizations with programs including but not limited to: "Nuclear Reactor Safety," "Nuclear Engineering and Society," "Research and Development of Energy Resources," and "Energy and the Environment."

The NETL staff provides tours as part of symposia designed to familiarize high school science teachers and students with the theory and technology associated with energy resources today. Course credit is available to participants of some programs. One such program has been funded by various electric utility companies in Texas. A number of groups tour the laboratory each year. Several examples of summer programs that tour the facility are the High School Science Teachers, Texas Energy Science Symposium and the World of Engineering.

B. Reactor Facility Tours

During 1991, no tours were held at Taylor Hall facilities. All tours were at the Nuclear Engineering Teaching Laboratory at the Balcones Research Center.

At the Balcones Research Center 29 with 570 people were given a tour of laboratory areas. Another 1165 visitors in groups less than 10 also visited the BRC facility.

Special activities have also been provided in the efforts to recruit minority students into the engineering fields. Students from several local high schools and students from several non engineering related college courses visited the facility. Numerous college engineering related classes and several student engineering organizations also toured the facility.

Safety personnel such as Austin Fire Department, UT Police Department, UT Safety Office and the Texas Department of Health also visited the facility to remain familiar with the laboratory and emergency response procedures unique to the facility.

C. Fuel Transfer Cask Loan

A three element transfer cask was obtained as part of the fuel element acquisition from the Northrup Corporation. The donated cask is designed for standard elements of TRIGA fuel and is to be available for loan to other university reactor programs. A container to ship the empty cask is also available. Charges for the cask use will apply only to shipment costs.

VII. Research Activities

The staff and users of the Nuclear Engineering Teaching Laboratory perform research, as both sponsored and non sponsored projects, in several different areas. Equipment and personnel are provided by the laboratory to supplement the research efforts of facility users, that include students, faculty, and others. The following section lists research projects active during the calendar year. Major research funding or grants are presented in Table 16 for users of the facility.

A. Fuel Assistance

Sponsor: U.S. Department of Energy

Personnel: Bernard W. Wehring
Thomas L. Bauer

The U.S. Department of Energy has provided research support by providing reactor fuel cycle assistance for the currently operating reactor core at The University of Texas at Austin TRIGA reactor.

B. Texas Energy Science Symposium

Sponsor: Texas Atomic Energy Research Foundation

Personnel: Dale Klein
Orlan Ihms, Texas Utilities Electric Company

The Texas Atomic Energy Foundation has sponsored a symposium for outstanding high school science students for over 25 years. The program is intended to encourage students to pursue careers in the sciences or engineering. Yearly attendance for the 4 day symposium consists of about 250 students and 150 high school science teachers.

C. Selenium and Other Metals in Fish Tissues

Sponsor: Department of Parks and Wildlife, State of Texas

Personnel: T.L. Bauer
F.Y. Iskander

Tissue from muscle and liver of fish samples from several Texas lakes are analyzed for several elements known to be toxic. Elements of interest are selenium, arsenic, mercury and zinc. This measurement is part of an environmental program for the State to examine the conditions of waters subject to certain types of power plant or industrial effluent releases.

Table 16

Research Funding

Department of Energy	
Fuel Assistance Program	.....
New Nuclear Engineering Teaching Laboratory	
(includes D&D for existing facility)	5,860,700
Texas Parks and Wildlife Department	
8/31/90 (Selenium & other meta's)	10,143
8/31/91 (Selenium & other metals)	10,143
Texas Advanced Technology Program	
Development of a Cold Neutron Source	
1/1/90 - 12/21/91	207,000
University Reactor Sharing, DOE	
9/1/89 - 2/28/92	5,950
University Instrumentation Program, DOE	
9/1/90 - 8/31/91 (Phase I)	32,850
University Instrumentation Program, DOE	
9/1/91 - 8/31/92 (Phase II)	8,290
University Nuclear Engineering Research, DOE	
Study of Neutron Focusing at the Texas	
Cold Neutron Source, 4/15/92 - 4/14/93	98,179
U.S. Nuclear Regulatory Commission	
An Expert System to Enhance Software	
Reliability, 9/30/91 - 9/29/93	99,998

D. Rare Earth Elements in Geological Samples

Sponsor: Department of Geology

Personnel: F.Y. Iskander
T.L. Bauer

Several geological samples including duplicates and several sources of standards are being examined by Instrumental Neutron Activation Analysis. The project is to determine the best procedures and applicable methods for the measurement of rare earths in specific geologic samples.

E. CR-39 Track Detectors for Fast Neutron Microdosimetry

Sponsor: College of Engineering

Personnel: B.W. Wehring
Jong-Youl Kim

The goal of this research is to provide the information and develop the techniques which are required to use the solid-state-nuclear-track-detector CR-39 for high-LET microdosimetry of fast neutrons. Central to this goal is the determination of factors which convert track-size distributions to absolute high-LET (or lineal energy) distributions. These conversion factors will be calculated, verified experimentally, and tabulated. In addition, improvements will be made in track readout and analysis using a computerized image analysis system. If fully developed, microdosimetry using Cr-39 track detectors would be state-of-the-art for fast-neutron personnel dosimetry around fission reactors, fusion reactors, and charged particle accelerators as well as for in-vivo microdosimetric measurements in research and medical applications.

F. Development of a Cold Neutron Source at The University of Texas Nuclear Reactor

Sponsor: Texas Advanced Technology Program

Personnel: B.W. Wehring
Kenan Unlu
Takashi Emoto

A cold neutron source has been designed and constructed for use with the UT TRIGA nuclear reactor. The Texas Cold Neutron Source consists of a cooled neutron moderator to lower the energies of the neutrons (increase their wavelengths) and neutron guides to transport the neutrons from the reactor. A cryogenic refrigerator connected to a 3-meter long neon heat pipe maintains 80 mL of mesitylene moderator at about 30K. The neutron guide system contains six 1-meter long elements, coated with Ni-58, and curved to a radius of 300 m. A source of cold neutrons will enhance the

use of the UT reactor for material research and basic physics measurements, and would greatly increase the utility of the new reactor facility.

G. Radiological Assessment of Low Level Waste Site

Sponsor: Texas Low Level Waste Disposal Authority

Personnel: Nolan E. Hertel
Randall Charbeneau

A performance assessment of the proposed site for Texas low level waste disposal is being done. Radiation exposure pathways of significance are being defined. Modeling of the pathways will assess the environmental impact of the disposal site.

H. Phantoms and Dosimetry

Sponsor: Department of Mechanical Engineering

Personnel: Nolan E. Hertel

Phantoms, sources, and geometries applied in laboratory calibrations of personnel dosimetry differ from the international definitions and practical use of dosimeters on personnel. Monte Carlo simulations of irradiation conditions were performed to provide insite into the dosimeter response.

I. An Expert System to Enhance Software Reliability

Sponsor: U.S. Nuclear Regulatory Commission

Personnel: T.L. Bauer
B.W. Wehring
Mohit Dikshit

An expert system is being developed to provide functional software diversity, enhance on-line analysis of unusual conditions, and integrate design knowledge with regulatory requirements. The methodology developed will be tested by using the expert system with the digital control system of the UT research reactor. A computer workstation enhanced for operation with logic languages such as PROLOG or LISP will be connected to the output of the control console computer. From this study, features and parameters will be determined for an expert system as an element of a network communication system that supports complex reactor instrumentation functions.

J. Study of Neutron Focusing at the Texas Cold Neutron Source

Sponsor: U.S. Department of Energy

Personnel: K. Unlu
B.W. Wehring
Jong-Youl Kim
Carlos Rios-Martinez

A neutron focusing system and a Prompt Gamma-ray Activation Analysis (PGAA) facility will be developed to be used with the Texas Cold Neutron Source. Recent advances in the fabrication of Ni-coated silicon wafers and Ni-Ti multilayers for supermirrors make possible research into new systems for focusing neutrons. It is expected that using a focusing system with the newly developed Texas Cold Neutron Source, will provide higher neutron fluxes and lower background than standard thermal neutron beams. Therefore, the detection limits for neutron absorption experiments such as PGAA can be decreased. The use of focused cold neutrons for Neutron Depth Profiling will also be investigated.

VIII. Publications from the Nuclear Engineering Teaching Laboratory

Masters Thesis

1. H.J. Gepford,"Utilization of the Texas Cold Neutron Source for Neutron Scattering Research", Masters Thesis, Master of Science in Engineering (Nuclear Engineering), The University of Texas at Austin, 101 pp., May 1991.

2. E.L. Takesuye, "Photon Dose Equivalent in Phantoms", Masters Thesis, Master of Science in Engineering (Nuclear Engineering), The University of Texas at Austin, 182 pp., May 1991.

Reports and Papers

1. Woodard, R.C., T.L. Bauer, and B.W. Wehring, "Methods for Development of Health Physics Procedures at Research Reactors in Agreement States," Twenty Fourth Midyear Topical Meeting of the Health Physics Society, Raleigh, North Carolina, January 21-24, 1991.

2. Emoto, T., K. Unlu, T.L. Bauer, and B.W. Wehring, "Texas Cold Neutron Source," Applications of Cold Neutron Spectroscopy in Chemistry, Biology, and Physics, A Workshop at the National Institute of Standards and Technology, Gaithersburg, Maryland, June 4-5, 1991.

3. Woodard, R.C. and B.W. Wehring, "Radiation Training for Emergency Medical Personnel," Thirty-Sixth Annual Meeting of the Health Physics Society, Wahsington, DC, July 21-26, 1991.

4. Baur, T.L., an B.W. Wehring, "Digital Control for the UT-TRIGA," American Nuclear Society Winter Meeting, San Francisco, California, Novermber 10-14, 1001.

5. Wehring, B.W., and T.L. Bauer, "Status of The University of Texas Research Reactor Program" American Nuclear Society Winter Meeting, San Francisco, California, Novermber 10-14, 1991.

6. Hertel, N.E., R.C. Woodard, H.R. Vega-Carrillo, and B.W. Wehring, "Bonner Sphere Measurements of D_2O-Moderated ^{252}Cf Source," American Nuclear Society Winter Meeting, San Francisco, California, November 10-14, 1991.

7. Hertel, N.E., and J.C. McDonald, "Calculated Dosimetric Quantities for D_2O-Moderated Cf-252 Sources," Radiation Protection Dosimetry 35, 23 (1991).

8. Hertel, N.E., and J.C. McDonald, "Methods for the Calibration of Neutron Personnel Dosemeters in Terms of the Ambient Dose Equivalent," Radiation Protection Dosimetry 37, 149 (1991).

9. Pollard, C.G. R.J. Charbeneau, and N.E. Hertel, "Performance Assessment of Normal Release Scenarios at a Potential Texas Low-Level Radioactive Waste Disposal Site," (abstract), 1991 Summer Meeting of the Health Physics Society, Washington, D.C., July 21-26, 1991, Health Physics 60 Suppl., 2, S45 (1991).

10. Hertel, N.E., B.L. Hall, R.J. Charbeneau, and C.G. Pollard," Estimating Skyshine Doses at the Baoundaries of Low-Lesel Radioactive Waste Disposal Facilities Due to Partially Covered Wastes," (abstract), 1991 Summer Meeting of the Health Physics Society, Washington, D.C., July 21-26, 1991, Health Physics 60 Suppl., 2, S46 (1991).

11. Vega-Carrillo, H.R., C. Rios Martinez, L.L. Quirino Torees, M.E. Hertel, and F. Iskander, "Zinalco and Sircaloy-4 Nuclear Characterization," J. Radioanal Nucl. Chem. 150, 1 (1991).

12. Vega-Carrillo, H.R., N.E. Hertel, C.R. Martinez, and L.L. Quirino Torres, "Application of Bonner SphereSpectrometer in Californium-252 Spectrometry," Revista Mexicana de Fisica 37, 659 (1991).

13. Garcia, F.M., C.R. Martinez, L.L. Torres, H.R. Vega, F.L. Rivera, and F.Y. Iskander, "Elemental compostion of minerals from several mines in Zacatecas state". VIII International Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry, Mexico, July 1990. (Abstract: Radiat. Phys. Chem. 38 (2): 258, 1991 - Int. J. Radiat. Appl. Instrum., Part C).

14. Martinez, C.R., L.L. Torres, H.R. Vega, and F.Y. Iskander, "Monitoring of impurities in saline samples by neturon activation analysis". VIII International Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry, Mexico, July 1990. (Abstract: Radiat. Phys. Chem. 38 (2): 261, 1991 - Int. J. Radiat. Appl. Instrum., Part C).

15. Torres, L.L., H.R. Vega, C.R. Martinez, and F.Y. Iskander, "Determination of mineral content of mine tailings". VIII International Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry, Mexico, July 1990. (Abstract: Radiat. Phys. Chem. 38 (2): 257, 1991 - Int. J. Radiat. Appl. Instrum., Part C).

16. Vega, H.R., C.R. Martinez,L.L. Torres, and F.Y. Iskander, "Nuclear characterization of zinalco and zircalloy-4". VIII International Symposium on Nuclear Chemistry, Radiochemistry and Radiation Chemistry, Mexico, July 1990. (Abstract: Radiat. Phys. Chem. 38 (2): 263, 1991 - Int. J. Radiat. Appl. Instrum., Part C).

17. Woodard, R.c., and B.W. Wehring,"Radiation Training for Emergency Medical Personnel." Thrity-Sixth Annual Meeting of the Health Physics Society, 60, 539, 1991.

13. Woodard, R.C., T.L. Bauer, and B.W. Wehring, "Methodology for Development of Health Physics Procedures at Research Reactors in Agreement States," Implementation of Current NCRP and ICRP Guidance and Revised 10 CFR Part 20, Twenty Fourth Midyear Topical Meeting of the Health Physics Society, NRC-04-359, pp. 46-54 (North Carolina Chapter of the Health Physics Society and U.S. Nuclear Regulatory Commission, 1991).