DOE/ER/75811--T1

Final Report
University Reactor Sharing Program

FG03-92ER75811
Project Period 9/30/92 to 9/29/94

Nuclear Engineering Teaching Laboratory
The University of Texas at Austin

Program Director

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1. Introduction

Over the past 20 years, the number of nuclear reactors on university campuses in the US has declined from more than 70 to less than 40. Contrary to this trend, The University of Texas at Austin constructed a new reactor facility at a cost of $5.8 million. The new reactor facility houses a new TRIGA Mark II reactor which replaces an in-ground TRIGA Mark I reactor located in a 50-year old building. The new reactor facility was constructed to strengthen the instruction and research opportunities in nuclear science and engineering for both undergraduate and graduate students at The University of Texas.

On January 17, 1992, The University of Texas at Austin received a license for operation of the new reactor. Initial criticality was achieved on March 12, 1992, and full power operation, on March 25, 1992. The UT-TRIGA research reactor provides hands-on education, multidisciplinary research and unique service activities for academic, medical, industrial, and government groups. Support by the University Reactor Sharing Program increases the availability of The University of Texas reactor facility for use by other educational institutions which do not have nuclear reactors.

2. Reactor Facility at The University of Texas

The new reactor facility is located at the off-campus J.J. Pickle Research Campus and contains 2 major laboratory experimental areas, a 3600-sq-ft bay housing an above-ground TRIGA Mark II nuclear reactor and a 900-sq-ft bay (30 x 30 x 30 ft shielded room) for a neutron generator. The TRIGA reactor is licensed for 1-MW steady state power operation and 3.00-dollar power-pulse transients. The design of the reactor allows for a wide variety of in-core, out-of-core, and neutron-beam experiments. The neutron generator provides an intense source of DT or DD fusion neutrons; the design of the neutron generator room allows for shielding measurements as well as dosimetry and spectroscopy studies. In addition, the new

reactor facility contains 8 support laboratories (2340 sq ft), 6 supplemental support areas (1430 sq ft), and 12 rooms of conference and office space (2570 sq ft).

3. Reactor Facility Staff

The new reactor facility is called The Nuclear Engineering Teaching Laboratory and is affiliated with the Nuclear Engineering Program, both of which are in the Department of Mechanical Engineering at The University of Texas. The organization of the new Nuclear Engineering Teaching Laboratory consists of three divisions, each with a manager and workers. The remaining staff, called the administration, supports the three divisions.

The Operations and Maintenance Division (OMD) is responsible for the safe and effective operations of the TRIGA nuclear reactor, the neutron generator facility, the gamma irradiation facility, and the NETL computer system. Other activities of OMD include neutron and gamma irradiation services, giving reactor short courses, and teaching utility operator/engineering training courses.

The Nuclear Analytical Services Division (NAS) is responsible for providing, in a safe and effective manner, analytical services such as Neutron Activation Analysis, low level radiation counting, and isotope production. Other activities of NAS include teaching NAS short courses.

The Neutron Beam Projects Division (NBP) is responsible for the development and operation of the experimental projects associated with neutron beam tubes. Projects under development at this time include a cold neutron source/neutron guide facility, neutron depth profiling, neutron-capture cancer therapy studies, and neutron radiography/tomography.

4. Research Facility Status

The Neutron Activation Analysis (NAA) laboratory is functional. Two high-purity Ge detectors with sample changers are connected to a Nuclear Data Genie system based on a VAX 3130 workstation. NAA is one of the most sensitive methods used to measure the concentration of trace amounts of many elements.

A neutron depth profiling (NDP) instrument has been designed and constructed at one of the neutron beam ports of the UT-TRIGA. NDP is an isotope-specific nondestructive nuclear technique for measuring the concentration-versus-depth distributions in the near-surface region of solids. This technique is an effective tool for determining profiles of boron, helium, lithium and nitrogen for depths up to a few micrometers.

The Texas Cold Neutron Source (TCNS) has been developed by the staff of the NETL and is operational at another beam port of the UT-TRIGA. The TCNS consists of a moderator (mesitylene at 30 K), a neon heat pipe, a cryogenic refrigerator, and a curved neutron guide. Cold neutrons, with longer wavelengths and lower kinetic energies, enhance studies of the arrangement and interactions of atoms in condensed matter. Such neutron scattering measurements probe matter at the atomic scale in a way unmatched by other techniques. In addition, the curved neutron guide tube provides low background capabilities for nuclear chemistry and physics measurements. The Texas Cold Neutron Source is one of only three reactor based cold neutron sources in the US.

An expert system is being developed to research the application of artificial intelligence for the enhancement of safety systems at power reactors. A workstation with a symbolic language has been connected to the UT-TRIGA reactor digital control system to provide software functional diversity and redundancy. In addition, the workstation, in a passive role, will monitor the performance of the various reactor sensors. Finally, the expert system will make recommendations to the reactor

operator by integrating reactor data, online reactor parameters, regulations, procedures, and design considerations.

5. Activities Supported by Reactor Sharing

A list of activities supported by the Reactor Sharing grant is attached.

ANNUAL REPORT
2/29/92 - 2/28/93

DOE - UNIVERSITY REACTOR SHARING

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Grant Number: DE-FG03-92ER78511
9/30/92 - 9/29/93

Reactor Type/Power level: TRIGA Mark II
1 MW
licensed 1/17/92

A. Listing of NETL academic tours as follows:

Date	Participating Institution	Number of Visitors
2/29/92	TEAMS - Test of Engineering Aptitude Math & Science	15
3/24/92	LBJ High School Science Academy	73
3/26/92	LBJ High School Science Academy	60
3/27/92	TTESM Mexico	3
3/31/92	Rosebud Lott High School Phy/Chem II	11
4/2/92	Dunbar Science Club	55
4/3/92	Hico High School	20
4/4/92	Capitol Area Council of boy Scouts	43
4/9/92	Goldthwaite ISD	27
4/28/92	Natalia ISD	30
5/5/92	Salado High School Physics Class	4
5/11/92	UT Arlington	3

5/13/92	Austin HS Advance Chem/Phy Class	12
5/14/92	Taylor HS Physics Class	12
6/23/92	Welch Summer Scholars	16
7/28/92	Austin Community College	7
11/6/92	Round Rock Science Club	24
11/11/92	Church of Glad Tidings Trailblazer Grp	14

B. Neutron Activation Analysis academic projects as follows:

1. One sample with three standards irradiated for four hours for Crockette High School for $40.00.

2. Twenty three samples with ten standards irradiated for ten minutes and for four hours for graduate students from Monterey, Mexico, for $920.00.

ANNUAL REPORT
3/1/93-9/30/94

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Grant Number: DE-FG03-92ER78511
9/30/92 - 9/30/94

Reactor Type/
Power level: TRIGA Mark II
1 MW
licensed 1/17/92

A. Listing of NETL academic tours:

Date	Participating Institution	Number of Visitors
3/2/93	LBJ High School Science Academy	61
3/23/93	Jarrell High School Science Class	20
3/30/93	LBJ High School	76
4/27/93	Incarnate Word High School Science Class	8
7/27/93	Austin Community College - Chem Class	6
7/29/93	University of Zacatecas, Mexico	23
8/18/93	Texas Low Level Rad Waste Disposal Auth.	9
11/15/93	Austin High School Chem II	10
11/20/93	Round Rock High School Teachers	6
12/3/93	Round Rock High School Science Club	23
12/7/93	Austin Community College - Chem Class	16
12/8/93	Austin Community College - Chem Class	14
2/4/94	LBJ High School	29
2/9/94	Lampasas High School	26
2/11/94	LBJ High School	21
2/18/94	LBJ High School	31

2/25/94	Waco High School	20
3/25/94	LBJ High School	30
4/8/94	LBJ High School	19
4/15/94	LBJ High School	17
5/6/94	Luling High School	7
7/14/94	Austin Community College	8

B. Neutron Activation Analysis academic projects

1. Analysis of 15 samples for Nd, Fe, and Cu for The University of Texas at Arlington, total $600.00.