

June 9, 2004

Dr. Sheldon Landsberger  
Director, Nuclear Engineering Teaching Laboratory  
The University of Texas at Austin  
Pickle Research Campus, Building 159  
Mail Code R9000  
Austin, TX 78712-1024

SUBJECT: NRC SPECIAL INSPECTION REPORT NO. 50-602/2004-201

Dear Dr. Landsberger:

This letter refers to the inspection conducted on May 24-26, 2004, at your University of Texas Nuclear Engineering Teaching Laboratory facility. The inspection included a review of activities authorized for your facility. The enclosed report presents the results of that inspection.

Areas examined during the inspection are identified in the report. Within these areas, the inspection consisted of selective examinations of procedures and representative records, interviews with personnel, and observations of activities in progress. Based on the results of this inspection, no safety concerns or noncompliances of NRC requirements were identified. No response to this letter is required.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) <http://www.nrc.gov/reading-rm/adams.html>.

Should you have any questions concerning this inspection, please contact Mr. Craig Bassett at (404) 562-4712.

Sincerely,

**/RA/**

Patrick M. Madden, Section Chief  
Research and Test Reactors Section  
New, Research and Test Reactors Program  
Division of Regulatory Improvement Programs  
Office of Nuclear Reactor Regulation

Docket No. 50-602  
License No. R-129

Enclosure: NRC Inspection Report No. 50-602/2004-201  
cc w/enclosure: Please see next page

University of Texas

Docket No. 50-602

cc:

Governor's Budget and  
Planning Office  
P.O. Box 13561  
Austin, TX 78711

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Test, Research, and Training  
Reactor Newsletter  
University of Florida  
202 Nuclear Sciences Center  
Gainesville, FL 32611

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U. S. NUCLEAR REGULATORY COMMISSION  
OFFICE OF NUCLEAR REACTOR REGULATION

Docket No: 50-602

License No: R-129

Report No: 50-602/2004-201

Licensee: The University of Texas at Austin

Facility: Nuclear Engineering Teaching Laboratory

Location: Pickle Research Campus, Bldg. 159  
10100 Burnet Road  
Austin, TX 78758

Dates: May 24-26, 2004

Inspector: Craig Bassett

Approved by: Patrick M. Madden, Section Chief  
Research and Test Reactors Section  
New, Research and Test Reactors Program  
Division of Regulatory Improvement Programs  
Office of Nuclear Reactor Regulation

## EXECUTIVE SUMMARY

The University of Texas  
Nuclear Engineering Teaching Laboratory  
Report No.: 50-602/2004-201

The primary focus of this special, announced inspection included onsite review and observation of the licensee's project to replace the TRIGA Mark II Reactor Reflector. The inspection also consisted of review of the licensee's safety programs including: design change and review and audit functions, radiation protection, material control and accountability, and security. The licensee's replacement project and safety programs were acceptably directed toward the protection of radiation worker and public health and safety, and in compliance with NRC requirements.

### Background

- In the latter part of 1999, the licensee noted bulging in various parts of the reactor Reflector as a result of a small water leak.
- After much analysis, review, and preparation, the licensee successfully vented the gases from the Reflector in February 2000.
- Although the reactor could be operated with a damaged Reflector, the licensee obtained the funds and initiated a Reflector replacement project in late 2003.

### Design Change and Review and Audit Functions

- The 10 CFR 50.59 review of the Reflector replacement satisfied Technical Specification requirements.

### Radiation Protection

- Special surveys were completed and documented as required by 10 CFR Part 20, the Technical Specifications, and licensee procedures.
- Postings and signs met regulatory requirements.
- Personnel dosimetry was being worn as required and recorded doses were within the NRC's regulatory limits of 10 CFR Part 20.
- Portable survey meters were being calibrated and maintained according to Technical Specifications and licensee procedures.
- Radiation protection training for the Self Contained Underwater Breathing Apparatus divers was acceptable.
- ALARA principles were effectively implemented by the use of long handled tools, temporary shielding, and mockup training.

Material Control and Accountability

- Special Nuclear Materials and other radioactive material were acceptably tracked and controlled under the licensee's material control and accountability program.

Security

- Security activities and systems satisfied Physical Security Plan requirements.

## REPORT DETAILS

### Summary of Plant Status

The licensee's TRIGA Mark II research reactor was shutdown for replacement of the Reflector. During the inspection, licensee staff and divers from Applied Research Laboratories - University of Texas worked the project to replace the defective Reflector.

#### 1. Background

In the fall of 1999, the licensee began experiencing problems with the reactor's Reflector. Upon investigation, the licensee discovered that the Reflector had pressurized and bulged due to a small water leak. After a safety analysis was conducted under the 10 CFR 50.59 review program, the licensee determined that they could safely vent the gas. On February 25, 2000, following staging of the required equipment and materials, and after many trial runs, the licensee drilled a hole through the reflector top plate under the pool water following approved procedures. The drilling equipment performed as designed, thus allowing the licensee to control the flow of gas out of the reflector. However, the venting caused flooding of the Reflector, saturating the graphite and filling voids in the Reflector.

Prior to venting the Reflector, the licensee had concluded that they could safely operate the reactor with the Reflector in a flooded condition but that repairs or replacement of the Reflector would be necessary at some point in the future. Funds were obtained that permitted the purchase of a replacement in 2003 and a new Reflector was fabricated by General Atomic, the original manufacturer of the TRIGA reactor. Plans were also formulated to replace the Reflector without draining the 28 foot reactor pool using divers equipped with Self Contained Breathing Apparatus (SCUBA) from the University of Texas (UT) Applied Research Laboratories (ALL).

Consequently the reactor was shutdown on March 19, 2004, to begin the radioactive decay of various reactor and Reflector components. The fuel was unloaded from the core and removed from the reactor pool by mid-April. Following many planned preparation and training activities, the actual Reflector replacement began May 24, 2004.

#### 2. Design Change and Review and Audit Functions

##### a. Inspection Scope (IP 69001)

In order to ensure that the replacement of the Reflector met the requirements stipulated in the licensee's design change program and the requirements of Technical Specification (TS) Section 6.2, Revision 1, Amendment No. 4, dated, May 10, 2001, were being completed, the inspector reviewed the following:

- The University of Texas Nuclear Engineering Teaching Laboratory (NETL) 10 CFR 50.59 staff review of the reactor Reflector replacement project
- administrative controls outlined in NETL Procedure Number (No.) ADMIN 3.0, "Personnel and Operator Qualifications," Revision (Rev) 0, dated September 1991
- UT Nuclear Reactor Committee (UT-NRC) meeting minutes and records for March 2003
- NETL Procedure No. ADMIN 2.0, "Design Features and Quality Assurance," Rev 1, dated September 1991
- NETL Procedure No., CHRTR, "Nuclear Reactor Committee Charter," Revision dated September 1, 2000

b. Observations and Findings

UT-NRC meeting minutes and records for March 10, 2003 were reviewed. The inspector determined that the Reflector replacement required a facility staff review followed by a UT-NRC review and subsequent approval. As outlined by the licensee, the change involved replacing the damaged Reflector with a new one fabricated by the original vendor using the original drawings and to the original specifications. The inspector determined that the licensee review had been performed as required and the project, including the use of divers, had been reviewed and approved by the UT-NRC. From the review, the inspector also determined that the licensee's design change program was focused on safety and met 10 CFR 50.59.

c. Conclusions

The 10 CFR 50.59 review of the Reflector replacement project satisfied TS requirements.

**3. Radiation Protection Program**

a. Inspection Scope (IP 69001)

The inspector reviewed selected aspects of the following to verify compliance with 10 CFR Parts 19 and 20 and TS Sections 3.3.3, 4.3.3, and 6.6.1 during the Reflector replacement project:

- radiological signs and posting in various areas of the facility
- special surveys and monitoring documented on the appropriate survey maps
- daily dosimetry/exposure results following Reflector replacement work
- Radiation Work Permit (RWP) No. 2004-011 used to control the diving operations portion of the Reflector replacement work
- RWP No. 2004-012 used to stipulate controls for persons assisting in the Reflector replacement work
- RWP No. 2004-13 used to establish controls for inspecting, cleaning, and refurbishment of the Reflector bellows
- Personnel training records for the ALL SCUBA divers
- E.O. Full Face Manual, Chapter 6, Appendix A, "Pre-Mission Inspection Checklist"
- E.O. Full Face Manual, Chapter 6, Appendix B, "Pre-Dive Setup Checklist"
- E.O. Full Face Manual, Chapter 6, Appendix C, "Supervisor's Equipment Checks Prior to Water Entry in Surface-Supplied Diving"
- Diving Safety and Planning Checklist
- Post Dive Checklist
- ALARA preparations and materials used to promote ALARA
- NETL Procedure No. ADMIN-4, "Radiation Protection Program," Rev 0, dated September 1991
- NETL Procedure No. HP00-1, "Radiation Monitoring - Personnel," Rev 2, dated November 8, 2000
- NETL Procedure No. HP00-2, "Radiation Monitoring Facility," Rev 2, dated November 8, 2000
- NETL Procedure No. HP00-3, "NETL ALARA Program," Rev 2, dated November 8, 2000

- NETL Procedure No. HP00-4, "Radiation Protection Training," Rev 2, dated November 9, 2000
- NETL Procedure No. HP00-5, "Radiation Monitoring Equipment," Rev 2, dated April 24, 2001
- NETL Procedure No. HP00-7, "Radiation Work Permits (RWP)," Rev 2, dated April 19, 2001
- NETL HP1 Form-A, "Daily Exposure Logsheet"
- NETL HP1 Form-B, "Visitor Dosimeter Record"

b. Observations and Findings

(1) Surveys

During the inspection the inspector observed and reviewed various special radiation and/or contamination surveys that were conducted prior to, and at various intervals during, the Reflector replacement project. It was noted that the surveys were annotated on a detailed map with additional information indicating the time, date, and person performing the survey. Results of the surveys were evaluated by the licensee Health Physics and management personnel. NETL staff and ALL diving personnel were briefed on the conditions and radiation levels found during the surveys. No levels were detected that exceeded expected conditions.

During the inspection the inspector conducted various radiation surveys along side licensee representatives. Areas surveyed at the facility included the Reactor Bay upper and lower levels and associated storage areas. The radiation levels noted by the inspector were comparable to those found by the licensee and no anomalies were noted.

(2) Postings and Notices

Caution signs, postings, and controls for radiation and high radiation areas were as required in 10 CFR Part 20, Subpart J. Requirements were also established and implemented to maintain control of and limit the spread of contamination during and following diving operations. Licensee and diving personnel observed the precautions for access to radiation and other controlled areas.

(3) Dosimetry

The inspector noted that the licensee used optically stimulated luminescent (OSL) dosimeters for whole body monitoring of staff personnel for beta and gamma radiation exposure with an additional component to measure neutron radiation. The licensee used thermoluminescent dosimeter (TLD) finger rings for extremity monitoring. Pocket dosimeters (PD) were used to determine doses received on a daily basis. Dosimetry issued to diving personnel also included OSL dosimeters for whole body and extremity monitoring. TLD finger rings were issued to the divers for extremity monitoring as well and PD were also used to determine daily doses received. The issuing criteria met or exceeded the requirements of 10 CFR 20.1502 for individual monitoring. The OSL dosimetry was supplied and processed by a National Voluntary Laboratory Accreditation Program (NVLAP) accredited vendor while the PD were read at the end of each shift. A review of the PD results indicated that daily radiological exposures were within the licensee's expectations and 10 CFR Part 20 limitations.

It was also noted that each diver was also provided with an alarming electronic dosimeter that functioned not only as a dosimeter, but as a detector as well. The electronic dosimeters were used to periodically keep the divers and the licensee Health Physicist informed as to the dose rates in the pool around the Reflector during the diving operations.

The PD results showed that the highest one-day whole body exposure received by a single facility employee during the first two weeks of the Reflector replacement job was  $\leq 15$  millirem (mrem) deep dose equivalent. (The 15 mrem was not from the Reflector but from work on the bellows.) The highest one-day whole body exposure received by a single ALL SCUBA diver was  $\leq 10$  mrem deep dose equivalent. The highest one-day extremity exposure for the diver was  $\leq 30$  mrem.

Through direct observation the inspector determined that dosimetry was acceptably used by facility and diving personnel and exit frisking practices were in accordance with radiation protection requirements.

#### (4) Radiation Monitoring Equipment

Examination of selected radiation monitoring equipment in service at the facility indicated that the instruments had the acceptable up-to-date calibration sticker attached. Two meters were noted that were beyond the calibration due date but they were within the time frame allowed by procedure for a meter to remain in service.

#### (5) Radiation Work Permits

The inspector reviewed the Radiation Work Permits (RWP) that had been written for the Reflector replacement project as stipulated in NETL Procedure No. HP00-7. As noted above, RWP No. 2004-011 had been established to control the diving operations portion of the Reflector replacement work; RWP No. 2004-012 was used to stipulate controls for persons assisting in the Reflector replacement work; and, RWP No. 2004-13 established the controls for inspecting, cleaning, and refurbishment of the Reflector bellows. It was noted that the controls specified in the RWPs were acceptable and applicable for the work being done. Additional special instructions and precautions had been developed for the ALL divers. The RWPs had been initiated, reviewed, and approved as required. Licensee and ALL diving personnel were noted to sign-in on the appropriate RWP and to comply with the required controls and cautions. The RWP program was being implemented as required and was acceptable.

#### (6) Radiation Protection Training

The inspector had reviewed the radiation worker (rad worker) training given to NETL facility faculty and staff members during a previous inspection. Training records showed that staff personnel were acceptably trained in radiation protection practices. During this inspection the inspector conducted an in-depth review of the training that had been provided to the ALL divers who were helping with the Reflector project. The training records showed that diving personnel had also been acceptably trained in radiation protection theory and practices. The special training program for the ALL divers included training on contamination control, use of water as shielding, and maintaining doses ALARA by the use of specific tools and long tongs. The inspector

verified that the training received was in compliance with 10 CFR Part 19. The training was determined to be acceptable.

(7) ALARA

As noted briefly above, various methods and items of equipment were being used to maintain doses ALARA during the Reflector replacement project. Long handled tools, including tongs and pneumatic wrenches, were used to loosen nuts on bolts and to handle and pick up activated metal parts and debris. The licensee also used a temporary shield curtain placed in the reactor pool between the divers and the Reflector. The shield was constructed by suspending lead "blankets" from a reinforced frame to provide a 4 foot by 2 foot lead curtain of over two half value thicknesses to protect the divers. Other lead "blankets" were also available to be placed over "hot spots" if needed.

The inspector also noted that, before the actual Reflector replacement operation, the divers practiced using the long handled tools during mockup exercises in the ALL 40-foot pool. General Atomic supplied the licensee with a new TRIGA Reflector to be used in the training and mockup exercises. This allowed the divers to gain valuable experience with the actual equipment they would be working on in the reactor pool. The use of long handled tools and shielding, and the mockup training for the divers were exemplary methods of implementing the ALARA principles.

(8) Facility Tours

The inspector toured the Reactor Bay and selected support areas with licensee representatives. The inspector noted that radioactive material storage areas were properly posted. No unmarked radioactive material was noted.

c. Conclusions

The inspector determined that the radiation protection program and controls, established by the licensee for the Reflector replacement project, satisfied regulatory requirements because: 1) special surveys were completed and documented acceptably to permit evaluation of the radiation hazards present; 2) postings met regulatory requirements; 3) personnel dosimetry was being worn as required and recorded doses were within the NRC's regulatory limits; 4) radiation survey and monitoring equipment was being maintained and calibrated as required; 5) the radiation protection training given to the divers was acceptable; and, 6) appropriate ALARA practices were implemented including the use of long handled tools, shielding, and mockup training.

**4. Environmental Protection Program**

a. Inspection Scope (IP 69001)

To determine that the licensee was complying with the requirements of the 10 CFR Part 20 and TS Sections 3.3.3 during the Reflector replacement project, the inspector reviewed selected aspects of:

- NETL environmental monitoring program
- NETL Procedure No. HP00-2, "Radiation Monitoring Facility," Rev 2, dated November 8, 2000

- NETL Procedure No. MAIN-4, "Area Radiation Monitor Systems," Rev 3, dated May 30, 2000

b. Observations and Findings

The inspector verified that the continuous air monitor was operable and monitoring the reactor room air as required. No levels above the limits were noted during the Reflector operation. The program for the monitoring and release of radioactive gases was consistent with 10 CFR Part 20.

The NETL reactor pool water was analyzed prior to beginning the Reflector replacement project. The only isotope identified was Antimony-124 and at concentrations of 3 percent of the limits of 10 CFR Part 20, Appendix B. During the project, water samples were analyzed daily following work in the reactor pool and no increased levels of any isotopes were noted.

c. Conclusions

Based on the analysis completed and the records reviewed, the effluent monitoring program satisfied NRC requirements.

## 5. Material Control and Accountability

a. Inspection Scope (IP 85102)

The inspector reviewed selected aspects of the licensee's material control and accountability program including:

- fuel storage records
- fuel element and irradiated components control and storage

b. Observations and Findings

During the inspection, the inspector toured the facility, observed the SNM and fuel storage areas, and verified that the licensee was using and storing SNM in the designated areas. The inspector also verified that the licensee had moved and maintained control over the reactor fuel elements and various other irradiated items in the reactor pool as required. The fuel elements and irradiated material had been stored in appropriate storage locations as specified by procedure.

c. Conclusions

SNM and other radioactive material were acceptably tracked and controlled under the licensee's material control and accountability program.

## 6. Security

a. Inspection Scope (IP 81431)

To verify compliance with the licensee's NRC-approved Physical Security Plan (PSP), the inspector reviewed:

- NETL Physical Security Plan for the UT TRIGA Mark II Reactor Facility, Revision No. 1, dated August 1990
- Computer based key and access control information
- security systems and equipment checks
- NETL Procedure Number ADMIN-5, "Protection Programs," Rev. 0, dated September 1991
- NETL Procedure Number PLAN-0, "Call and Notification," Rev. 2, dated November 9, 2000
- NETL Procedure Number PLAN-S, "Physical Security," Rev. 4, dated September 16, 2003

b. Observations and Findings

Physical protection systems (barriers, alarms, and equipment) were observed by the inspector and were determined to be in accordance with the PSP. The inspector also verified that access control was being implemented as stipulated in the PSP and NETL Procedure Number PLAN-S. Acceptable security and control was being provided and maintained by the staff, as well as NETL security personnel, as required.

c. Conclusions

Security activities and systems satisfied Physical Security Plan requirements.

**7. Exit Meeting**

The inspector presented the inspection results to members of licensee management at the conclusion of the inspection on May 26, 2004. The licensee acknowledged the findings.

## PARTIAL LIST OF PERSONS CONTACTED

### Licensee

M. Krause	Reactor Supervisor
S. Landsberger	Director, NETL
D. O'Kelly	Reactor Health Physicist and Laboratory Manager
S. O'Kelly	Associate Director, NETL

### Other Personnel

R. Banks	Engineering Scientist Associate (Diver), UT-ALL
C. Gage	Technical Staff Associate (Diver), UT-ALL
J. Piper	Research Scientist Associate (Diver), UT-ALL
R. Ray	TRIGA Reactor Group Representative, General Atomic
L. Thompson	Senior Engineering Scientist (Diving Supervisor), UT-ALL

## INSPECTION PROCEDURE (IP) USED

IP 69001	Class II Non-Power Reactors
IP 81431	Fixed Site Physical Protection of Special Nuclear Material of Low Strategic Significance
IP 85102	Material Control and Accounting

## ITEMS OPENED, CLOSED, AND DISCUSSED

### Opened

None

### Closed

None

## PARTIAL LIST OF ACRONYMS USED

ALARA	As Low As Reasonably Achievable
ALL	Applied Research Laboratories (University of Texas)
CFR	Code of Federal Regulations
E-Plan	Emergency Plan
HP	Health Physics
mrem	Millirem
NETL	Nuclear Engineering Teaching Laboratory
NRC	Nuclear Regulatory Commission
OSL	Optically stimulated luminescent (dosimeter)
PSP	Physical Security Plan
RSO	Radiation Safety Officer
RPP	Radiation Protection Program

RWP	Radiation Work Permit
SCUBA	Self-contained Underwater Breathing Apparatus
SNM	Special Nuclear Material
TLD	Thermoluminescent dosimeter
TS	Technical Specifications
URI	Unresolved Item
UT	University of Texas
UT-NRC	University of Texas Nuclear Reactor Committee