Department of Mechanical Engineering
THE UNIVERSITY OF TEXAS AT AUSTIN

Nuclear Engineering Teaching Laboratory • Austin, Texas 78758
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December 13, 2007

Gary S. Janosko, Deputy Director
Fuel Facility Licensing Directorate
Division of Fuel Cycle Safety and Safeguards
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: License Renewal Application for SNM-180

Ref: Docket 70-157, SNM-180 (Amendment 3 as corrected)

Sirs:

Attached you will find a renewal application for NRC Special Nuclear Material License 180 which has a current expiration date of February 29, 2008. This license application is exempt from the licensing fee in accordance with 10 CFR 170.11 as the licensee is a non-profit educational institution. As requested in your letter dated October 11, 2007, the Nuclear Engineering Teaching Laboratory has implemented the applicable portions of the revised 10 CFR 20 as of January 1, 1994. Due to the content of this renewal application, it has been marked to be withheld from public disclosure under 10 CFR 2.390. Please direct any requests for additional information or questions to me at (512) 232-5373 or by my email at sokelly@mail.utexas.edu.

Sincerely,

Sean O'Kelly
Associate Director
Nuclear Engineering Teaching Laboratory
The University of Texas at Austin

Enclosure: Application for Renewal of NRC License SNM-180

cc: S. Biegalski, Director (cover letter only)
J. Beaman, Chair (cover letter only)
B. Streetman, Dean (cover letter only)
H. Liljestrand, ROC Chair (cover letter only)
S. Pennington, RSO (cover letter only)

APPLICATION FOR RENEWAL
OF LICENSE SNM-180
SPECIAL NUCLEAR MATERIALS

Submitted to

Director, Office of Nuclear Materials Safety and Safeguards
Fuel Cycle Safety Branch
Division of Industrial and Medical Nuclear Safety
U.S. Nuclear Regulatory Commission
Washington. D.C. 20555

by

Nuclear Engineering Teaching Laboratory
J.J. Pickle Research Campus
10100 Burnet Road, Building No. 159
Austin, Texas 78758
December, 2007

1) **10 CFR 70.22(a)(1) Name of Applicant:**

Nuclear Engineering Teaching Laboratory
Department of Mechanical Engineering
The University of Texas at Austin
J.J. Pickle Research Campus, Bldg. No. 159 Austin. Texas 78712

Sean O'Kelly, Associate Director
J.J. Pickle Research Campus, Bldg. No. 159
U.S. Citizen

Stephen Biegalski, Director
J.J. Pickle Research Campus, Bldg. No. 159
U.S. Citizen

Joseph Beaman, Chairman,
Mechanical Engineering ETC 5.214; ETC 7.150
U.S. Citizen

Ben Streetman, Dean. College of Engineering
EJC 10.310
U.S. Citizen

Steven Leslie, Provost and Executive Vice President
Main 201
U.S. Citizen

2) **10 CFR 70.22(a)(2) Activity and location for which Special Nuclear Material License is requested:**

The Nuclear Engineering Teaching Laboratory of the University of Texas at Austin uses Special Nuclear Material to supplement the training and instruction programs in the field of nuclear engineering. The items described in this application are used for junior, senior and graduate level laboratory courses in the Nuclear Engineering Program of the Mechanical Engineering Department.

The licensed materials are to be used in experiments in the Nuclear Engineering Laboratory facilities located at the University's J.J. Pickle Research Campus (formerly known as the Balcones Research Center). Laboratory facilities associated with the Nuclear Engineering Program include a research reactor with appropriate Nuclear Regulatory Commission license (R-129).

A diagram of the facility location and floor plan is included in Appendix A-1, 3. The Nuclear Engineering Teaching Laboratory building designation is Building 159 at the J.J. Pickle Research Campus. The primary location for storage and operation of the special nuclear materials will be Room [redacted] of Building 159.

3) 10 CFR 70.22 (a)(3) Requested duration of license is for 10 years.

4) 10 CFR 70.22(a) (4) Description of Special Nuclear Material:

The Special Nuclear Material to be covered by this license is an extension of the previously granted license, SNM-180, dated February 27, 1958, and later amendments.

I. ^{235}U Subcritical Reactor Assembly

A. Description of Subcritical Assembly

A homogeneous system is assembled of [redacted] grams of UO2 impregnated in high density polyethylene with a total weight of [redacted] grams. The UO2 is enriched to [redacted] U-235, for a total U-235 composition of [redacted] grams.

The assembly consists of a cylindrical core with 10"diameter and 14" length assembled from 8 fuel disks into one unit. Axial and radial holes in the assembly may be filled with 36 smaller fuel disks of about 1"diameter. The cylindrical core unit contains [redacted] grams of U-235 with the fuel plugs totaling [redacted] grams of U-235. (One fuel plug is unaccounted for and the loss was reported to NRC in 1974)

The fuel assembly operation is supplemented by 3 reflector assemblies, 3" polyethylene, 6" polyethylene, and 10" graphite. An additional graphite block provides an external thermal source.

B. Usage

The subcritical assembly and the reflector media material are used with neutron sources to demonstrate the concepts of subcritical multiplication, thermal diffusion, fermi age, flux measurement and other basic nuclear engineering principles. Both neutron detection systems and foil activation techniques are applied in various experiments to monitor neutron flux levels and flux shape.

II. Plutonium-Beryllium Neutron Sources

A. Description of Individual Sources

1. M-797 source contain [redacted] gm Pu sealed in a tantalum and stainless steel capsule with dimension of 1.02" O.D. x 1.46" high. The Pu is [redacted] enriched in (Pu-239 + Pu-241). The source has a total strength of [redacted] neutrons/second (12-3-61).

2. M-798 source contains [redacted] gms of Pu sealed in a tantalum and stainless steel capsule with dimensions of 1.021" O.D. x2.182" high. The Pu is

[redacted] enriched in (Pu-239 + Pu-241). The source has a total strength of [redacted] neutrons/second (6-4-65)

3. M-799 source contains [redacted] gms of Pu sealed in a tantalum and stainless steel capsule with dimensions of 1.31" O.D. x 2.72" high. The Pu is [redacted] % enriched in (Pu-239 + Pu-241), making a total of [redacted] gms (Pu-239 + Pu-241). The source has a total strength of [redacted] neutrons/second (12-3-61).

4. M-196 source contains [redacted] gms of Pu sealed in a tantalum and stainless steel capsule with dimensions of 1.42" O.D. by 3.60" long. The Pu is [redacted] % enriched in (Pu-239 + Pu-241). The source strength is approximately [redacted] neutrons/second.

5. Source MRC-N-SS-W-PU8Be-58 contains [redacted] gms of Pu-238 (corrected for decay) in a tantalum and stainless steel capsule with dimensions 1" O.D. by 1.5" long. Source emission rate is approximately [redacted] neutrons/second.

6. Source MRC-N-SS-W-PU8Be-314 contains [redacted] gms of Pu-238 (corrected for decay) in a tantalum and stainless steel capsule with dimensions 1.5" O.D. by 3.5" long. Source emission rate is approximately [redacted] neutrons/second.

The total quantity of plutonium contained in all sources is [redacted] gm but the quantity requested on the license (and currently licensed) is [redacted] gm to accommodate round-off to a whole number.

B. Usage

The plutonium-beryllium neutron sources are used for neutron detector calibration, subcritical reactor multiplication source, neutron shielding and neutron dose measurement experiments. Operation of the subcritical reactor assembly is accomplished by insertion of a neutron source into the radial or axial access hole or by positioning a source near the core assembly.

III. Manhattan College Zero Power Reactor (MCZPR) Fuel

A. Description of Material

The seventeen (17) sealed-source slightly irradiated reactor fuel elements contain [redacted] gm of ^{235}U with an enrichment of [redacted] % as uranium silicide in an aluminum matrix. The materials are currently stored in a non-critical linear array of aluminum storage tubes in the [redacted], Room [redacted] of Building 159 on the J.J. Pickle Research Campus. The storage configuration is 1x9x2, with two elements stacked in most single storage tubes. Each storage tube has tamper-indicating seals and the materials are monitored by a criticality alarm system in accordance with 10 CFR 70.24. This configuration was approved in license amendment 2 in a letter from NRC dated April 22, 2005 (TAC L31843).

B. Usage

The elements are currently stored and monitored in anticipation of a future use for research and education purposes. The particular use of individual, several or all of the fuel elements has not been defined at this date. This license renewal application does not change the status of the MCZPR fuel elements and the elements will continue to be in possession only, non-use status.

5) 10 CFR 70.22(a)(6) Technical Qualifications of Applicant:

I. Administrative Structure

Staff qualifications for responsible utilization of licensed special nuclear materials in the Nuclear Engineering Teaching Laboratory (the Laboratory) include the administration of a special nuclear material license, a nuclear reactor operating license, and a state radioactive materials license. The administrative structure consists of a Radiation Safety Committee, Radiation Safety Officer, Reactor Oversight Committee, Laboratory Director, and Laboratory Staff. Laboratory staff includes reactor operators, health physicist, research associates, technicians, administrative secretary and student research assistants.

II. Radiation Safety Committee

The Radiation Safety Committee is established through the office of the University President and contains 3 faculty and/or staff members from Science or Engineering Departments.

A. Duties of the Radiation Safety Officer

A Radiation Safety Officer acts as the delegated authority of the Radiation Safety Committee with responsibility to the University Safety Engineer. Policies and practices set forth by the Radiation Safety Committee regarding the safe use of radioisotopes and sources of radiation on the University campus are implemented by the Radiation Safety Officer.

The duties of the Radiation Safety Officer are numerous but consist primarily of establishing, monitoring, and curtailing programs for the safe use of radioactive materials and radiation sources with respect to state or federal requirements. Some specific duties include periodic surveys and inspection, maintenance of radioisotope records and personnel exposures, disposal of radioactive wastes, periodic leak tests of sealed radiation sources, calibration of radiation detection instruments, help in the training of staff, aide in preparation of procedures, define proper radioactive material handling methods, and act as liaison for state and federal license responsibilities.

B. Qualifications of Radiation Safety Officer

Qualifications of the Radiation Safety Officer require a Bachelor's degree in engineering, physics or related field. Preferred qualifications require an advanced degree in health physics or radiological health or certification as a Safety Professional or Health Physicist. Experience required is three years work in radiation safety and/or radiological health plus a thorough working knowledge of Texas Regulations for Control of Radiation and supporting regulations issued by the United States Nuclear Regulatory Commission. Preferred experience includes knowledge of particle accelerators and nuclear reactors.

III. Reactor Oversight Committee

A Reactor Oversight Committee (formerly known as the Nuclear Reactor Committee) responsible to the Dean of the College of Engineering with at least three members knowledgeable in the fields of nuclear safety shall review, evaluate, approve and audit activities and procedures associated with the operation of the Laboratory facility. Jurisdiction shall include all nuclear reactor, special nuclear material and radiological operations in the facility and general safety standards. The Radiation Safety Officer and Laboratory Director are members of the committee. Laboratory facility operation will be under the direct control of the Laboratory Director or an NRC-licensed senior operator designated by the Laboratory Director.

IV. Laboratory Administration

A. Duties of the Laboratory Director

Daily activities of the laboratory are managed and directed by the Laboratory Director who may or may not be an NRC licensed senior operator and whose responsibility is to direct and supervise the operation of the nuclear reactor and other laboratory activities either directly or by delegation to the Laboratory staff. A Laboratory Associate Director or Assistant Director will perform the Director's duties in the absence of the Laboratory Director.

B. Qualifications of the Laboratory Director

The position of Laboratory Director requires a Bachelor's degree in engineering or science with three years experience in a related field. Preferred qualification is a Master's or PhD. degree in a field of nuclear engineering or science with appropriate experience. Experience preferred is five years including two in a supervisor position. Knowledge of nuclear facility operation, radiation detection systems, data acquisition and analysis systems, electronic and mechanical measuring equipment and utilization of computer equipment are required skills. The Laboratory Director is generally a faculty member with a PhD in nuclear engineering or a related field. The Associate Director's qualifications will be equivalent to the Director position.

V. Laboratory Staff

A. Reactor Operations

Duties of a reactor operator include operation and maintenance of the reactor and associated equipment, review of procedures and regulations, instruction and assistance of students or researcher, and assist in record maintenance and report preparations. Qualifications require engineering or science degree or appropriate laboratory experience with radioactive materials and radiation detectors. Pursuit of an NRC operator or senior reactor operator license is required. Preferred experience includes advanced knowledge of electronics, computer programming or other valuable laboratory discipline.

B. Health Physicist

The Health Physicist (HP) shall direct monitoring and training programs in order to protect the reactor and laboratory personnel from radiation hazards, and to assure compliance with federal, state, and UT Austin regulations. Additionally the HP administers the Laboratory's safety program and provides technical assistance to all personnel using radiation and radioactive materials at the reactor facility.

Qualifications for this position are a Bachelor's degree in health physics, radiological health, nuclear engineering, or nuclear medicine or equivalent knowledge and training. Preferred qualification is a Master's degree in health physics, radiological health, nuclear engineering, or nuclear medicine.

C. Other Laboratory Staff

An administrative secretary aids in the preparation of reports and documents. Other staff, students or researchers, are employed as projects warrant. The minimum staff is considered to consist of a laboratory director, at least two reactor operators, health physicist, and one part-time technician. Additional technical support is also available from faculty members of the Mechanical Engineering Department employed to teach courses in the Nuclear Engineering Program.

Appendix A-5 contains a block diagram of the administrative structure. Specific data on key personnel is contained in Appendix A-6, 8.

6) 10 CFR 70.22(a)(7) Facilities and Equipment for Handling Special Nuclear Material

I. Areas of Storage and Use

All the special nuclear materials described in this license are stored in Building 159 Room [redacted] which contains a TRIGA nuclear reactor. Construction of the room consists of fireproof exterior walls, provisions for continuous radiation monitoring, and controlled access monitoring.

1. Routine assembly, operation and storage of the subcritical core is in open areas of the Room [redacted] of the Laboratory. Core storage is in a 55 gallon barrel protected from exposure to combustible materials.

2. The fuel pellets are used in the reactor laboratory area (Room [redacted] or in adjacent controlled laboratory areas. Storage of the pellets is in a safe located in the reactor laboratory or with the cylindrical core.

3. The plutonium-beryllium neutron sources are stored in a 16 foot deep storage well located in the reactor laboratory. Because of the value of the plutonium-beryllium neutron sources as calibration standards, the sources may be transported in an appropriate shipping container to other laboratory facilities for temporary use.

4. MCZPR fuel elements are stored in a 1 by 2 by 9 linear array in Room [redacted] of Building 159. This room is located within Room [redacted] and is normally locked. The fuel storage area is monitored by a criticality monitoring system in accordance with 10 CFR 70.24.

All materials are stored such that radiation levels at the container surfaces are less than 2 mr/hr.

II. Shields, Equipment and Handling Devices

The low specific activity of the non-operating subcritical core material allows for direct handling of materials. A polyethylene jacket protects the core assembly disk units against the small risk of radioactive contamination from the fuel pellet disks. Tweezers and small lead shields or other shield material are available to handle radioactive foils generated by neutron exposure in the subcritical assembly. Signs and rope are available to define radiation areas during assembly operation.

Routine handling of the plutonium-beryllium sources is accomplished with long-handled tongs and long threaded rods. Shielding material such as paraffin, borated polyethylene, lead, concrete block, and shield casks are available to provide improved radiation safety in various neutron source applications.

The MCZPR fuel elements may be handled individually in accordance with existing procedures for inspection.

III. Measuring and Monitoring Devices

Personnel monitoring devices are required of all persons working in the laboratory with radiation sources if the individual is likely to exceed 10% of their allowable annual limits in accordance with 10 CFR 20.1502. Monitoring of additional individuals for particular environments is at the discretion of the Laboratory HP. Film badges or equivalent personnel dosimetery for laboratory personnel that are sensitive to gamma radiation (minimum measurable quantity ("M")of 10 mrem), energetic beta ("M" of 40 mrem), fast neutron ("M" of 20 mrem), and thermal neutron ("M" of 10 mrem), are provided by Landauer or other vendor as required. Direct-reading pocket dosimeters (ionization chambers) are available for dose measurements of gamma radiation (0-200 mrem).

Portable radiation monitors utilized in the facility shall have the capability to detect alpha, beta, gamma, and neutron radiation. Operational parameters should include the ability to detect alpha above 4 MeV, beta above 100 keV, gamma and x-radiation above 7 keV, and neutrons over the energy range from 0.025 (thermal) to about 10 MeV. In addition, sufficient portable instruments should be available to detect radiation fields at ranges of up to 50 R/hr for gamma and neutron radiation.

The Nuclear Engineering Teaching Laboratory shall maintain and calibrate these portable radiation detection instruments, or radiation detection instruments with equivalent performance characteristics (i.e., range, sensitivity, type of radiation detected) or have the means for the instruments to be calibrated.

Specialized detection systems are available for analytical radiation measurements that are routinely required in a gamma spectroscopy laboratory. The reactor room is continuously monitored by local area radiation monitors with preset alarms (5 mr/hr) and a continuous air monitor with filter for particulate monitoring that also provides an audible alarm indication. A gamma spectroscopy system (HpGe) and alpha-beta windowless proportional counter plus other miscellaneous detectors and equipment represent substantial capability to analyze radioactive materials.

Neutron monitoring by BF_3 proportional counters and U-235 fission counters with associated electronics are available to monitor and demonstrate operation of the subcritical assembly. Other detection systems, such as gaseous, scintillation or solid state detectors, allow students to count neutron activated foils.

Criticality monitoring is performed by two independent Ludlum Model 375 Area Monitors. One system is configured as a gamma radiation detector and one system is configured as a neutron monitor. The detectors (gamma and neutron) are located adjacent to the stored Manhattan College Zero Power Reactor (MCZPR) fuel in Room [redacted] The digital display and alarm units are mounted outside the locked storage room. Only the MCZPR fuel is monitored for inadvertent criticality as the other materials under this license were previously considered exempt from the requirements of 10 CFR 70.24.

IV. Radioactive Waste Disposal

Sources of radioactive waste material from the operation of the subcritical assembly are slightly contaminated gloves and tools from contract with the polyethylene impregnated fuel pellets, activation products exposed in the assembly, and fission products generated by operation. These materials are expected to have very low contamination levels based on previous experience.

Provisions exist through the Office of Environmental Health and Safety for the collection and disposal of low level radioactive waste materials such as gloves, rags, and paper created by routine handling and maintenance of the assembly. Disposal of materials to the sanitary sewer system are also monitored by the Radiation Safety Officer and Laboratory Health Physicist as allowed by state licenses. Subcritical irradiations are at fluxes of approximately 10^8 neutrons/sec for a few minutes to hours. In general, foils or materials irradiated in the assembly are short half-life and reusable, and thus do not represent a radioactive waste stream. Alternatively, these materials or foils may be stored until the radioactive hazard decays.

Calculations indicate that the total fission product inventory of the assembly should not exceed a few microcuries of fission product activity. Contained as an integral part of the assembly, the activity is primarily a hazard while directly handling the subcritical assembly and is not considered waste until the assembly is decommissioned. (Calculations in Appendix A-10).

7) 10 CFR 70.22(a)(8) Safety procedures to protect health and minimize danger to life or property

Procedures are applied to establish safe conduct of activities with radioactive materials and radiation sources. The procedures in effect satisfy various requirements of federal USNRC licenses for special nuclear materials and state licenses for radioactive materials. Procedures are reviewed by staff, researchers and students during initial training as radiation workers and at regular intervals following initial training. The laboratory staff may draft procedures and minor changes may be approved by a supervisor with concurrence of the Laboratory Director. Substantive changes to procedures are reviewed and approved by the Reactor Oversight Committee. The Procedures are categorized into four basic functional groups; monitoring, calibration, operation, and emergency.

I. Monitoring Procedures

A. Access to laboratory areas is controlled by staff personnel.

B. Personnel dosimetry badges are required in the laboratory for staff when radiation sources are in use.

C. Dosimeters are required for occasional visitors and unusual source handling conditions.

D. Status of special nuclear material is verified by periodic inventory (6 mo.cycles).

E. Status of plutonium-beryllium is monitored by leak tests of source (6 mo. cycles).

II. Operating Procedures

A. Routine operation of the subcritical assembly shall consist of insertion of one of the plutonium-beryllium sources (including fuel pellets and non-fissile foils) into the subcritical core assembly with any of the designed conditions for reflector or moderator components.

B. Routine operation of the subcritical assembly will be authorized by the reactor supervisor.

C. A survey of gamma and neutron radiation levels during operation will be made and an area radiation monitor with alarm will be continuously active or a monitor available at all times during operation.

III. Emergency Procedures

A. Basic emergency procedures and the Laboratory emergency plan (approved by NRC under R-129) in effect for radiological emergencies in the Nuclear Engineering Teaching Laboratory are contained in Appendix A-12,16.

B. Special precautions for material storage are required to minimize the potential for airborne radioactivity from exposure to fire hazards. Storage of the subcritical assembly when not in use will be in a tightly closed 55 gallon barrel. The barrel is stored away from flammable materials. The PuBe sources are stored in deep (16 feet) storage pits when not in use. All materials licensed under this application will be stored within the confines of Room [redacted] which is locked and alarmed when the facility is not occupied. The laboratory is constructed of firewall and concrete construction. Leakage to the environment during normal operation is controlled by weather stripping entrances, pressure control zones and filtered exhausts.

IV. Training Program

The primary use of radiation sources and the subcritical assembly in the Nuclear Engineering Teaching Laboratory is to support and extend the education of undergraduate and graduate students in basic concepts of nuclear engineering. All staff and students must complete a formal training program in accordance with 10 CFR 19.12 before performing experiments with radioactive materials. This program will consist of material on radiation interactions, radiation hazards, dose measurements, and laboratory procedures. Experiments are performed with the supervision of laboratory staff. Staff personnel are trained to handle materials by a combination of formal classroom education and laboratory training by other qualified staff, depending on the nature of responsibility required.

V. As Low as Reasonably Achievable (ALARA) Program

The "as low as reasonably achievable" goal of a radiation safety program is supported by the procedures of the Radiation Safety Committee, Reactor Oversight Committee and Nuclear Engineering Teaching Laboratory. Many experiments performed on a routine basis do not represent significant radiation doses. Less routine experiments may be occasionally required that represent more significant doses but these experiments are strictly reviewed and controlled under the Laboratory Radiation Work Permit (RWP) program.

Both occasional and periodic review of radiation doses of staff, students, and visitors is carried out by laboratory staff and the campus Office of Environmental Health and Safety. A review of annual dose reports, experiments performed and significant deviations from expected values will be reviewed by the Laboratory ALARA Committee as required.

8) 10 CFR 70.53 and 70.54, Material Control and Accountability

The Nuclear Engineering Teaching Laboratory maintains a special nuclear material inventory and reporting program in accordance with 10 CFR 74.13 for the University of Texas at Austin. The facility Reporting Identification Symbol (RIS) for the University of Texas at Austin is ZV S. Annual material status reports are made to the Nuclear Materials Management and Safeguards Systems (NMMSS) within sixty (60) calendar days of the beginning of the physical inventory as required by 10 CFR 74.19(c). Transfers and receipts of special nuclear materials are reported in accordance with 10 CFR 70.54 and 10 CFR 74.15 to the NMMSS. Specific procedures for these reports are contained in NUREG/BR-0006 and NUREG/BR-0007.

The current total inventory (SNM-180 and R-129) of special nuclear material at the Nuclear Engineering Teaching Laboratory exceeds the definition of moderate strategic significance per 10 CFR72.2. However, a significant quantity of the materials are in use within the TRIGA research reactor core and are exempt from the physical protection requirements per 10 CFR 73.60. The Laboratory controls the total quantity of materials such that the facility does not exceed the Category III quantity of special nuclear material of low strategic importance.

9) 10 CFR 73, Physical Protection of Plants and Materials

The Nuclear Engineering Teaching Laboratory implements the requirements of 10 CFR 73 through its NRC approved Physical Security Plan. The latest revision of the Physical Security Plan (October 2006) implements additional security procedures required after September 11, 2001. The Security Plan and implementing procedures require a report to the NRC within one hour of the discovery of a loss or theft of special nuclear material in accordance with 10 CFR 74.11. The requirements and procedures of the Physical Security Plan and the Laboratory security systems also serve to maintain compliance with NRC Order EA-05-090.

10) 10 CFR 70.25 Financial Assurance and Recordkeeping for Decommissioning

The subcritical assembly and Pu239Be sources are U.S. Government loaned special nuclear material and the MCZPR sealed-source fuel elements are U.S. Government owned material. As such, the disposal costs for retrieval and final disposition of these materials will be the responsibility of the U.S. Department of Energy (DOE). The Pu238Be sealed sources will be transferred to DOE under a source retrieval program or disposed of directly as radioactive waste, if appropriate. Additional decommissioning costs associated with laboratory cleanup or decontamination from the use of these materials shall be the responsibility of the University of Texas at Austin. The University is a public university and an institution supported by the State of Texas with assets greater than $50 million. Estimated decommissioning costs for SNM-180 are estimated to be less than $50,000.00 which the University of Texas at Austin and the State of Texas are financially capable of funding.

The Nuclear Engineering Teaching Laboratory has a fully implemented Health Physics monitoring and survey program in accordance with 10 CFR 20 that includes documentation of spills or other contamination events. Routine quarterly environmental liquid samples are performed independently by the Texas Department of State Health Services and the results are reported to the Laboratory. All contamination events, personnel radiation exposure and facility effluent release are tracked and records are retained for the lifetime of the facility and materials license. The HP program is inspected every other year by the U.S. Nuclear Regulatory Commission as a part of the monitoring of the reactor facility license (R-129) and annually by the State of Texas.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TEXAS 76011-4005

May 2, 2005

Mr. Sean O'Kelly
University of Texas at Austin
J.J. Pickle Research Campus Bldg. 159
Nuclear Engineering and Teaching Laboratory
10100 Burnet Road
Austin, Texas 78712

SUBJECT: NRC INSPECTION REPORT 070-00157/05-002 (FORM 591M)

Dear Mr. O'Kelly:

This letter and the enclosed NRC Form 591M refer to the inspection conducted on April 19, 2005, at your facility in Austin, Texas. This inspection was an examination of activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. Within these areas, the inspection consisted of selected examination of procedures and representative records, and interviews with personnel. The inspection findings were discussed with Donna O'Kelly of your staff at the conclusion of the inspection. A final telephonic exit was conducted with you on April 26, 2005.

Within the scope of this inspection no violations or deviations were identified; therefore, no response to this letter or the enclosed NRC Form 591M 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 made available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

Should you have any questions concerning this inspection, please contact Mr. Rick Muñoz at (817) 260-8220 or the undersigned at (817) 860-8287.

Sincerely,

for Robert A. B...

Jeffrey Cruz, Chief
Nuclear Materials Inspection Branch

Docket No.: 070-00157
License No.: SNM-180

Enclosure: As stated

cc w/enclosure:
Texas Radiation Control Program Director

NRC FORM 591M PART 1
(10-2003)
10 CFR 2.201

U.S. NUCLEAR REGULATORY COMMISSION

SAFETY INSPECTION REPORT AND COMPLIANCE INSPECTION

1. LICENSEE/LOCATION INSPECTED:	2. NRC/REGIONAL OFFICE
University of Texas at Austin Nuclear Engineering and Teaching Laboratory Austin, TX 78758 REPORT NUMBER(S) 05-002	USNRC Region IV 611 Ryan Plaza Drive, Suite 400 Arlington, Texas 76011-4005

3. DOCKET NUMBER(S)	4. LICENSEE NUMBER(S)	5. DATE(S) OF INSPECTION
070-00157	SNM-180	04/19/2005

LICENSEE:

The inspection was an examination of the activities conducted under your license as they relate to radiation safety and to compliance with the Nuclear Regulatory Commission (NRC) rules and regulations and the conditions of your license. The inspection consisted of selective examinations of procedures and representative records, interviews with personnel, and observations by the inspector. The inspection findings are as follows:

[X] 1. Based on the inspection findings, no violations were identified.

[ ] 2. Previous violation(s) closed.

[ ] 3. The violation(s), specifically described to you by the inspector as non-cited violations, are not being cited because they were self-identified, non-repetitive, and corrective action was or is being taken, and the remaining criteria in the NRC Enforcement Policy, NUREG-1600, to exercise discretion, were satisfied.

________ Non-Cited Violation(s) was/were discussed involving the following requirement(s) and Corrective Action(s):

[ ] 4. During this inspection certain of your activities, as described below and/or attached, were in violation of NRC requirements and are being cited. This form is a NOTICE OF VIOLATION, which may be subject to posting in accordance with 10 CFR 19.11.

(Violations and Corrective Actions)

Licensee's Statement of Corrective Actions for Item 4, above.

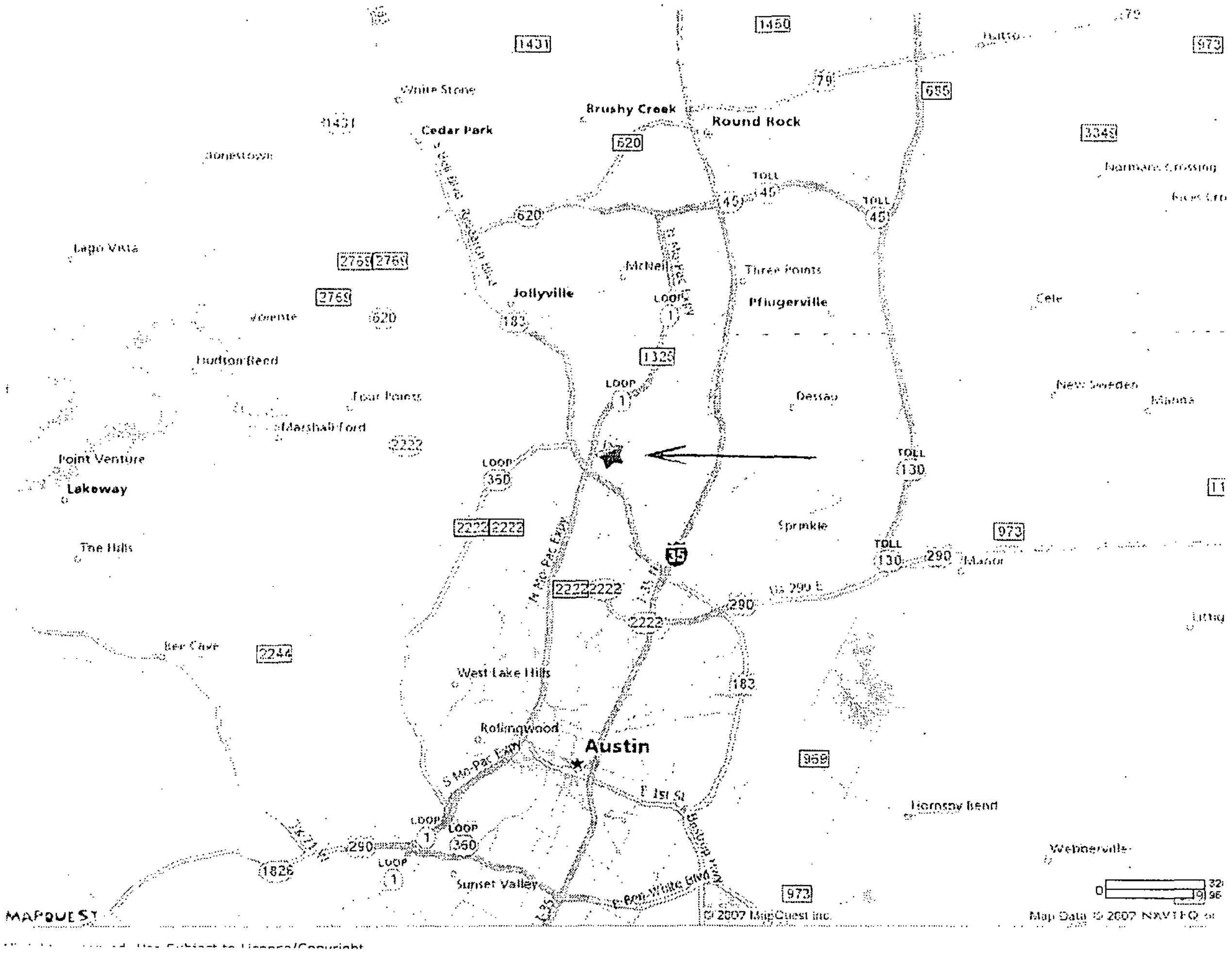
I hereby state that, within 30 days, the actions described by me to the inspector will be taken to correct the violations identified. This statement of corrective actions is made in accordance with the requirements of 10 CFR 2.201 (corrective steps already taken, corrective steps which will be taken, date when full compliance will be achieved). I understand that no further written response to NRC will be required, unless specifically requested.

Title	Printed Name	Signature	Date
LICENSEE'S REPRESENTATIVE			
NRC INSPECTOR	Rick R. Munoz	[signature]	05/2/05

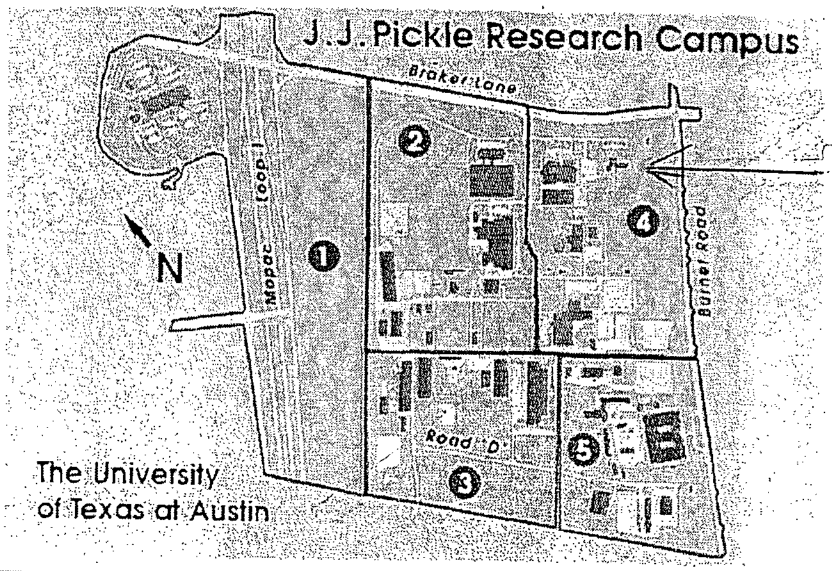
APPENDIX

To Renewal Application for SNM-180

1. Nuclear Engineering Teaching Laboratory Location
2. Nuclear Engineering Teaching Laboratory Building
3. Nuclear Engineering Teaching Laboratory Line Management
4. Subcritical Assembly Description and Multiplication Report
5. Manhattan College Zero Power Reactor Description and Storage Safety Report
6. Vita/Resume of NETL Director, Associate Director, Health Physicist
7. Specifications for Ludlum 375 Criticality Monitor
8. NETL Procedures for Fuel Movement
9. NETL Emergency Plan (NRC License R-129)
10. NETL Emergency Response Procedures



J.J. Pickle Research Campus Location in Austin, Texas



NETL

Building 159 Location on J.J. Pickle Research Campus

FIRST LEVEL FLOOR PLAN

Figure 3-4

SECOND LEVEL FLOOR PLAN

Figure 3-5

THIRD LEVEL FLOOR PLAN

Figure 3-6

FOURTH LEVEL FLOOR PLAN

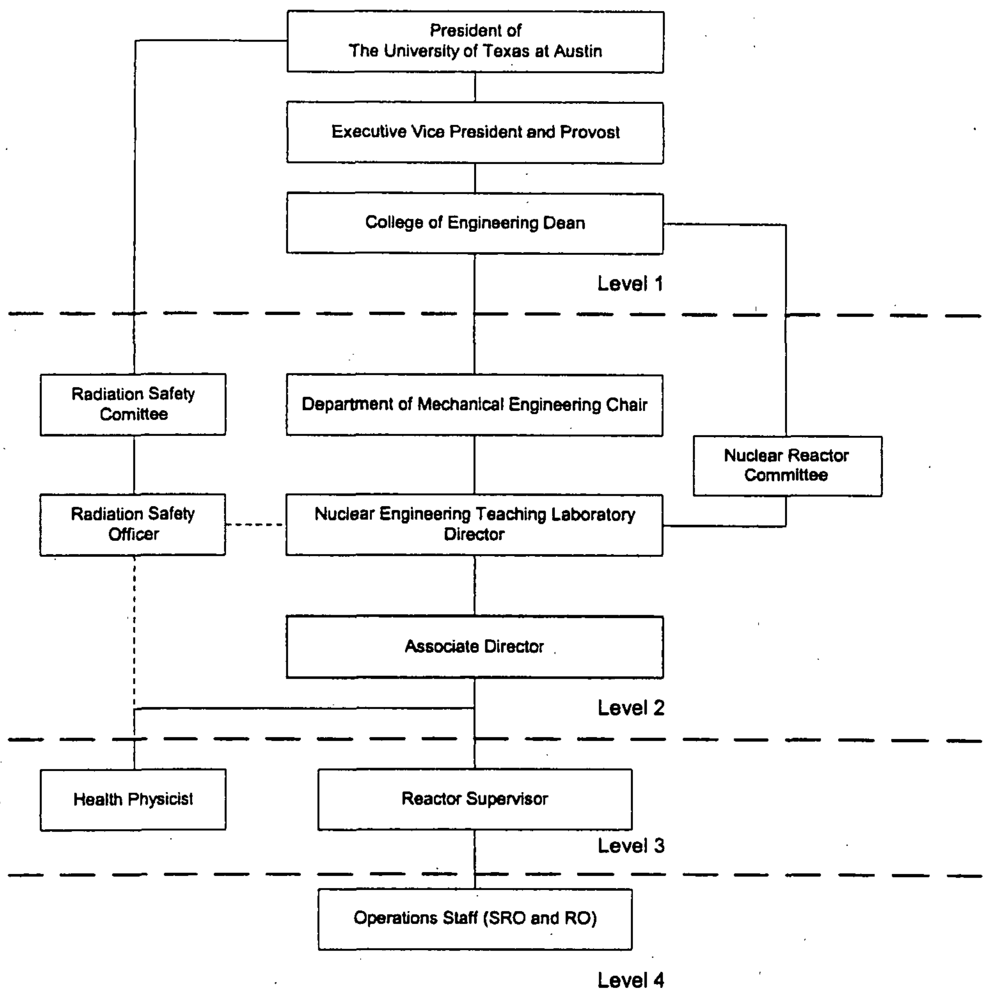
Figure 3-7

6.0 ADMINISTRATIVE CONTROLS

6.1 Organization

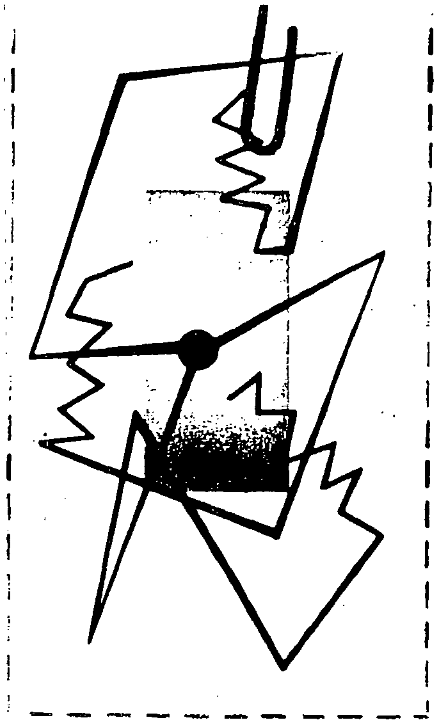
6.1.1 Structure

The facility shall be under the control of the Director, Associate Director or a delegated Senior Reactor Operator. The management for operation of the facility shall consist of the organizational structure as follows:



Responsibility ——
Communication - - -

Appendix E

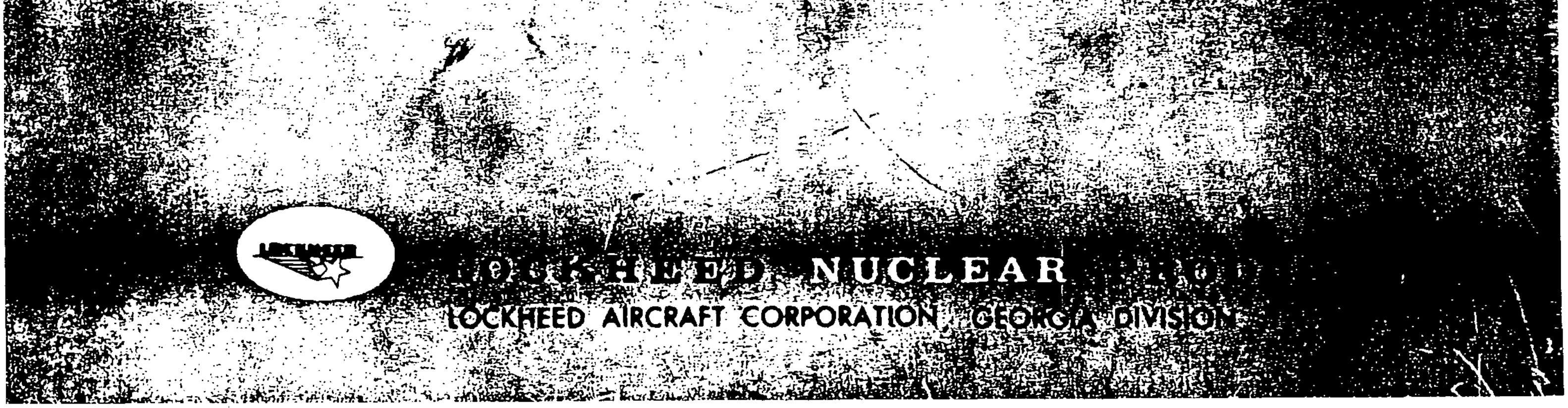


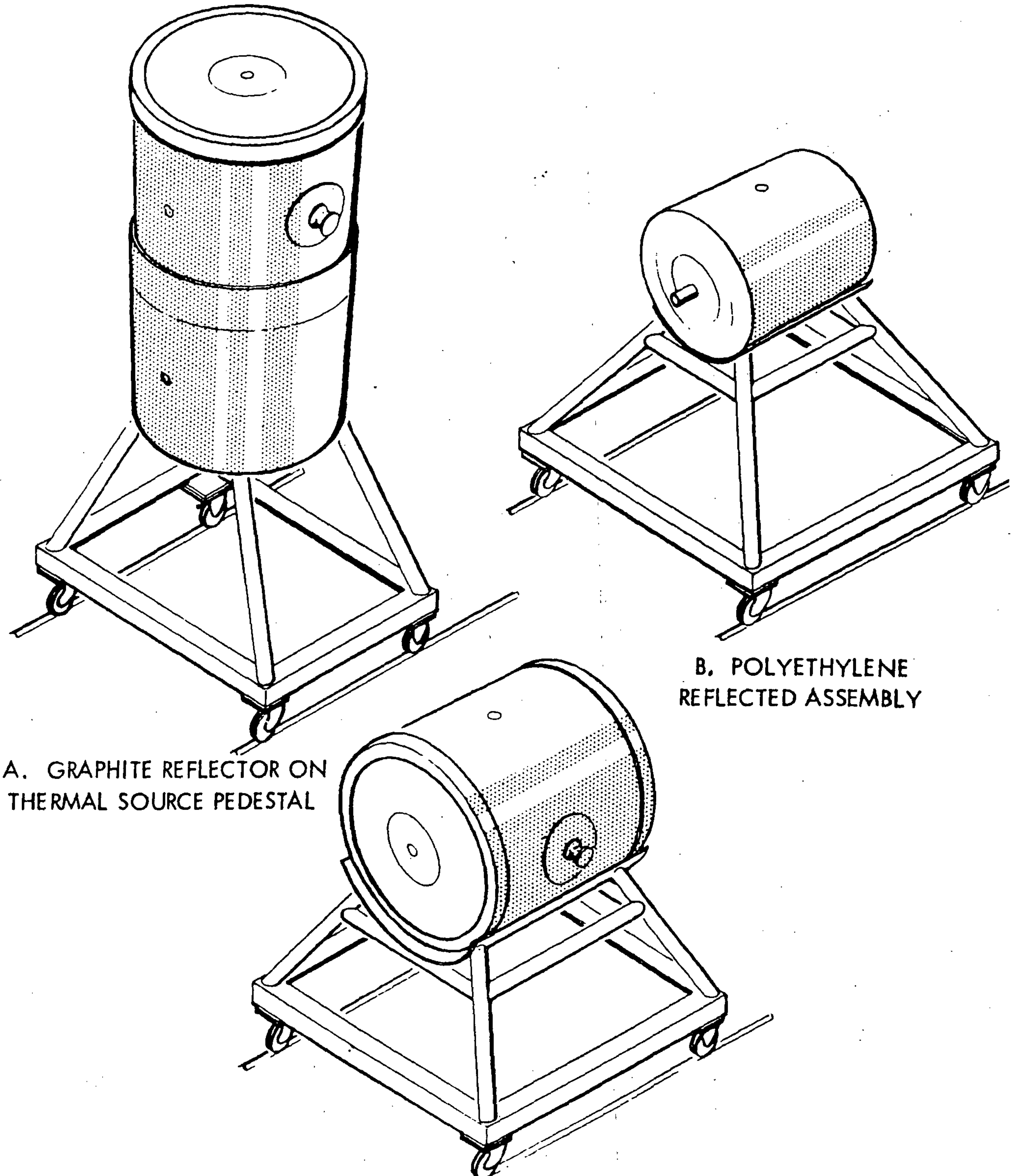
NR 57

UNIVERSITY OF TEXAS

SUBCRITICAL REACTOR

Multiplication Test Report



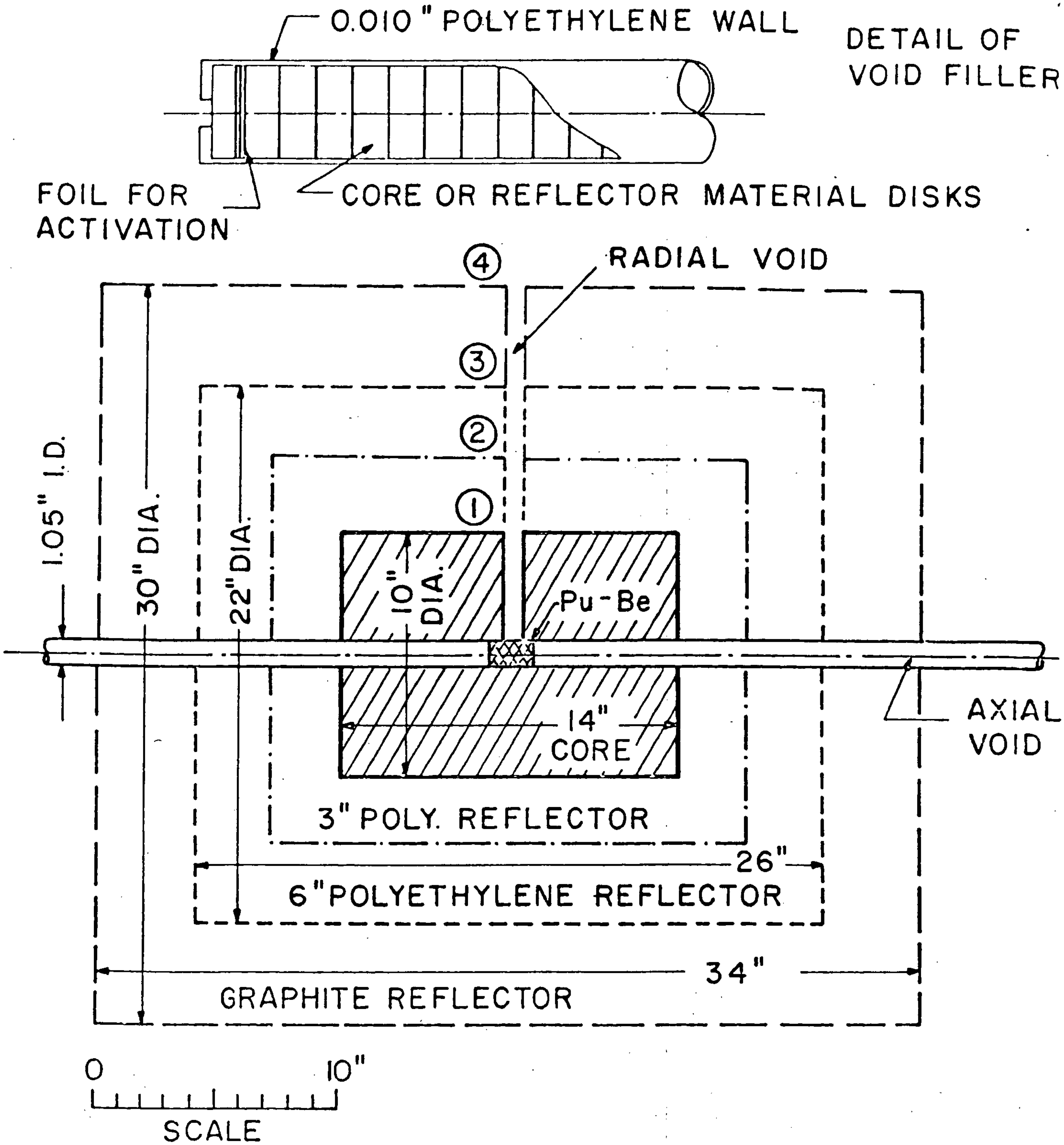


A. GRAPHITE REFLECTOR ON THERMAL SOURCE PEDESTAL

B. POLYETHYLENE REFLECTED ASSEMBLY

C. GRAPHITE REFLECTED ASSEMBLY

FIGURE 1 SUBCRITICAL REACTOR ASSEMBLIES



0.010" POLYETHYLENE WALL
DETAIL OF VOID FILLER
FOIL FOR ACTIVATION
CORE OR REFLECTOR MATERIAL DISKS
RADIAL VOID
4
3
2
1
1.05" I.D.
30" DIA.
22" DIA.
10" DIA.
Pu-Be
14" CORE
AXIAL VOID
3" POLY. REFLECTOR
26"
6" POLYETHYLENE REFLECTOR
34"
GRAPHITE REFLECTOR
0
10"
SCALE

FIGURE 1

TABLE II

COMPARISON OF EXPERIMENTAL AND THEORETICAL MULTIPLICATION VALUES

Reflector	EXPERIMENTAL	THEORETICAL* Selengut-Goertzel Model	THEORETICAL* Two-Group Diffusion Analysis	Absorption Rate Analysis
10" Graphite	7.3	6.33	--	--
6" Polyethylene	4.1	5.03	--	--
3" Polyethylene	6.6	--	--	--
10" Water	4.1	4.95	--	4.32
Bare Core	2.7	--	2.97	--

* Eichenbaum, F. D., Final Physics Report -- University of Texas Subcritical Reactor, Lockheed Nuclear Products, NR 57, March 1959.

Fission Product Buildup in Subcritical Assembly

Experimental measurements with a neutron source of 1.6×10^6 n/sec generate a neutron density approximately but conservatively represented by $n(x) = a(\sin bx)/x$ in both axial and radial dimensions. The constants are determined to be $a = 50 \times 10^{-3}$ n/cm^2, and $b = .18$ cm^{-1}. The total fission rate in the assembly is then determined by $\int \Sigma_f\, n(\vec{r})\, V\, d\vec{r}$ where V is the thermal neutron velocity 2.2×10^5 cm/sec. The total fissions/sec are calculated to be 9.65×10^4. With an energy release of 185 MeV/fission the power of the assembly will be (9.65×10^4 fission/sec) x (185 MeV/fission) x (1.60×10^{-13} watts/MeV) equals 2.86×10^{-6} watts. A source strength of 8.82×10^6 n/sec would generate 15.8×10^{-6} watts. The smaller source represents about 90 watts-sec of power/year of continuous operation. A more realistic estimate is 100 hours/year or about 5.71 watts-secs with the larger source. From 1960 till 1985 100 hr/yr operation with the larger neutron source results in (25 yr) x (3.15×10^7 sec/yr) x (1.15×10^{-5}) x (9.65×10^4 fissions/sec) x (8.82×10^6 n/sec) / (1.6×10^6 n/sec) is 4.80×10^{12} fissions. Assuming that after 100 days the fission products beta decay at a rate of 10^{-8} decays per fission then (4.8×10^{12} fissions) x (10^{-8} decays/fission) x (3.7×10^4 decays/μ curie) is less than 1.5 μ curies of activity.

Nuclear Engineering Teaching Laboratory
Technical Report

Criticality Safety Analysis for the Manhattan College Zero Power Reactor Fuel Elements Storage Rack

Prepared by
Sean O'Kelly
Associate Director

Submitted November 10, 2004

Revised February 10, 2005

Background and Introduction

The Manhattan Zero Power Reactor (MCZPR) fuel elements were transferred to the University of Texas at Austin in August 2004. The materials had been manufactured by the Department of Energy under the University Reactor Fuel Assistance Program to replace a highly enriched reactor core. The replacement core was essentially identical to the original fuel but used a higher fuel loading and lower enrichment. The Manhattan College chose to shutdown the reactor with essentially zero burnup on the fuel elements in the early 1990s. The Department of Energy (DOE) transferred the fuel elements to The University of Texas at Austin in August 2004. A total of 17 elements were received. Each element has a fuel loading of [redacted] grams with a density of [redacted] grams of uranium per cm^3 with an enrichment of [redacted]%. A total of [redacted]rams of U-235 was received in the fuel elements. These [redacted] elements have been stored in the DOT 6M-type 110 gallon drums at the NETL facility since August 2004.

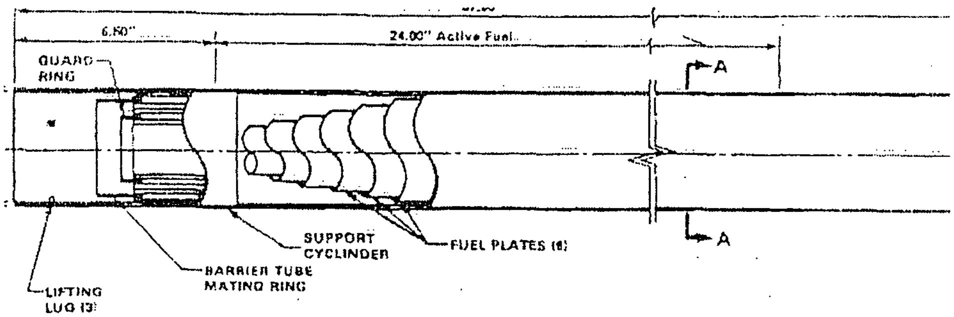


Figure 1. MCZPR Element

The MCZR elements are a uranium silicide-aluminum dispersion fuel developed by Argonne National Laboratory. The fuel elements consist of 6 concentric cylinders with a total active fuel region 24 inches (58.8 cm) tall (Figure 1). The total element length is 37 inches. The elements are designed to have a central Lucite hold-down rod in the middle but these rods will not be in place while in the stored condition. The fuel loading per cylinder is given here:

Cylinder Number	Fuel Loading (gms U-235	Inner Diameter (cm)	Outer Diameter (cm)
1	[redacted]	3.2	3.454
2	[redacted]	4.064	4.318
3	[redacted]	4.928	5.182
4	[redacted]	5.791	6.045
5	[redacted]	6.655	6.909
6	[redacted]	7.518	7.772

Table 1. MCZPR Element Uranium Loading

MCZPR Fuel Element Storage

The 6M-type drums are owned by the DOE and must be returned as soon as possible for the shipment of research reactor fuel to other facilities. The MCZPR elements will be unloaded and kept in a dry storage location until a final experimental design had been established and approved. This storage location will be in the [redacted] Room (Room [redacted]) of the Nuclear Engineering Teaching Laboratory (Figure 2).

Description of the [redacted] Room

The [redacted] Room [redacted] was originally planned as a radiation counting laboratory area near the UT TRIGA reactor but it has been used more for equipment and special nuclear material storage over the past ten years. There are multiple electrical outlets but no water or service air available in the room. The primary function for the AER has been to house the radioactive sample transfer pneumatic system blower and controls. Additionally, small quantities of special nuclear materials and reactor safeguards information are stored in a locked safe within the [redacted]

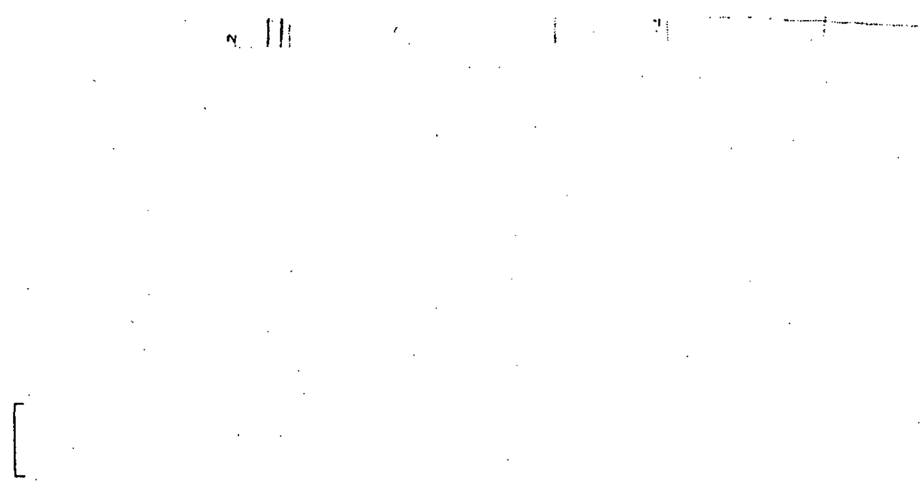


Figure 2. NETL Facility Drawing of [redacted] Room with MCZR element storage location shown

The [redacted] is located on the second level of the reactor room approximately 15 feet above the lowest level of the room. Hence, there is no way for the [redacted] to flood in the unlikely event the reactor pool (containing 10,000 gallons of demineralized water) were to drain into the reactor room.

The [redacted] room walls are fabricated from standard cinder block construction bricks. The single [redacted] door is a hollow fire-rated steel door with a key lock. The only keys available for the door are in the possession of the NETL Reactor Supervisor, stored in the locked key box in the reactor control room and maintained by the University Locks and Keys department. Ventilation to the room is provided by a variable speed exhaust fan. The fan vent is covered with a security grill and ventilation damper.

The [redacted] is within the NETL Protected Area of the Reactor Room. As such, the access to the area is strictly controlled by the used of computerized pass card systems and alarms. The door to the [redacted] is monitored by a motion sensor that alarms at the University Police Department. Full details of the facility security system is contained in the NRC approved Security Plan (approved 1990). The [redacted] is located approximately [redacted] feet from NETL 1 MW TRIGA research reactor and there is no coupling of the reactor neutron flux to the [redacted]. All NETL experimental neutron sources are stored in another location of the NETL facility and are never used or stored in the [redacted].

[redacted] Fire Protection Systems

The [redacted] has a heat sensing fire detector near the 12 foot ceiling that initiates a building alarm and an automatic signal to the local fire department. There is no sprinkler or fire suppression system in the room and no water pipes pass through the room. Fire prevention is maintained by controlling the amount of flammable materials stored within the confines of the [redacted]. A portable carbon dioxide fire extinguisher is stored in the room with a dry powder fire extinguisher just outside the room. An additional halogen-type extinguisher is kept approximately ten feet away for fire suppression within the nuclear instrumentation and controls system.

Criticality Storage Analysis

The MCZR elements will be stored in a vertical, linear 1 by 9 array for seventeen elements (Figure 3). An extra storage location is added to maintain the symmetry of the array. The storage rack will be constructed from 4 inch diameter 6061 alloy aluminum pipe in 8 foot lengths. These tubes will be held rigidly together by another aluminum rack and a lockable hinged lid will prevent the insertion of moderating materials. This rack array will be securely fastened to the wall of the storage room. The vertical tubes will be spaced such that they are very close together with no easily accessible area between tubes for moderator material to be accidentally inserted.

Criticality analysis of the proposed storage arrangement was performed using SCALE 5 (Standardized Computer Analysis for Licensing Evaluation). Various storage rack configurations were evaluated but the preferred arrangement (due to physical space in the [redacted] was the linear 2 by 9 configuration. A more limiting arrangement was expected to be a tight cylindrical or square design. A square 4 by 4 arrangement was tested with the region around the storage tubes flooded, dry, with and without a water reflector. These evaluations were followed by an analysis of a 2 by 9 array and stacked 1 by 9 storage racks.

The most limiting condition was a water moderated and reflected 4 by 4 storage rack. This system would be a supercritical arrangement with a calculated k_{eff} of 1.0866. The least limiting configuration is the proposed 1 by 9 dry storage array (against a concrete wall) with a k_{eff} of 0.5246 . The 2 by 9 array was also found to be marginally critical (multiplication approximately 1.0) if the system were water moderated and reflected. Although it is extremely unlikely that the [redacted] could ever flood by accident there was still a possibility of inadvertent criticality in the 2 by 9 array and it was discarded for a simple linear array with two fuel elements in a single storage tube. The actual margin from critical is greater than the conservative calculations due to the aluminum extensions on either end of the MCZPR fuel elements increasing the separation of elements and a total of 18 (rather than 17 actual) elements used in the calculations.

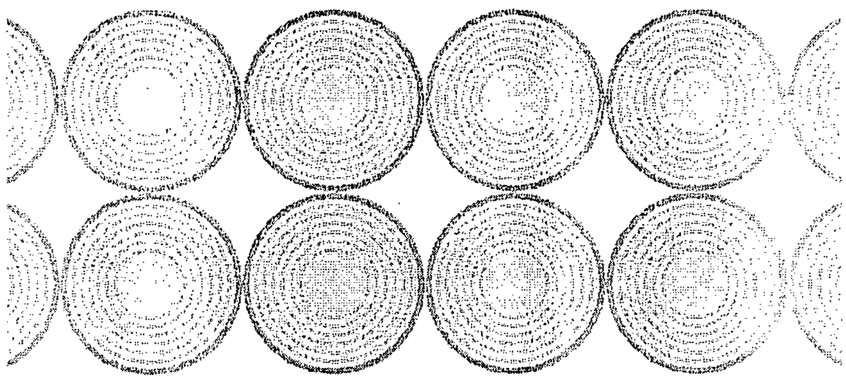


Figure 3. Partial 2 by 9 Array of MCZPR Elements Modeled in SCALE 5

MCZPR Storage Rack Configurations	Calculated Keff
4x4 Array, Water Moderated, Water Reflected	1.08660 + or - 0.00023
4x4 Array, Water Moderated, Bare	0.94998 + or - 0.00027
4X4 Array, Air Moderated, Bare	0.031943 + or - 0.000023
2x9 Array, Water Moderated, Water Reflected	0.98454 + or - 0.00071
2x9 Array, No Moderator, Bare	0.023299 + or - 0.000018
1x9x2 Array, Water Moderated, Water Reflected	0.72842 + or - 0.00067
1x9x2 Array, Air Moderated, Concrete Wall Moderated	0.5246 + or - 0.0010
1x9x2 Array, Air Moderated, Bare	0.014971 + or - 0.000039

Table 2. Summary of SCALE 5 Criticality Calculations

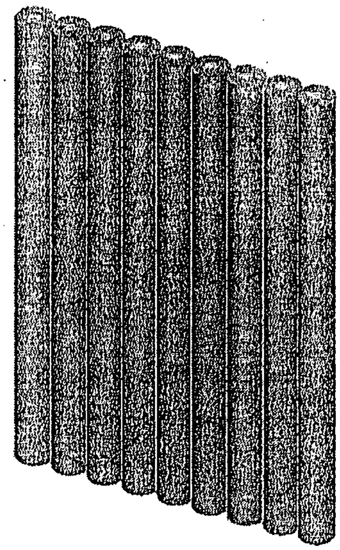


Figure 4. Proposed final design--1 by 9 by 2 Array

An example output file for the 4X4, Water Moderated, Bare SCALE run is given here:

```
*****************************************************************************************************
    ***                                                                    ***
    ***   mczpr storage with h2o                                           ***
    ***                                                                    ***

*****************************************************************************************************
    ***
    ***                    ******    final results table     ******
    ***
    ***     best guess system k-eff                       0.94998 + or - 0.00027
    ***
    ***     Energy of average lethargy of Fission (eV)    6.57296E-02 + or -  3.75616E-05
    ***
    ***     system mean free path (cm)                    3.08324E-01 + or -  3.41858E-05
    ***
    ***     system nu bar                                 2.44001E+00 + or -  6.23051E-06
    ***
    ***     k-effective satisfies the chi**2 test for normality at the 95 % level
    ***
    ***

*****************************************************************************************************

*****************************************************************************************************
         congratulations!  you have  successfully traversed the perilous path through keno v in  13.58650 minutes
*****************************************************************************************************
```

Transfer and handling of MCZPR Elements

The NETL facility is under the direct supervision of an on-duty NRC-licensed Senior Reactor Operator (SRO) during the normal operational day. The NETL facility has standard procedures for handling special nuclear materials, reactor fuel and radioactive materials. Any fuel handling or manipulation at the NETL facility is supervised by an SRO and conducted by a member of the NETL staff (usually a Reactor Operator or

Health Physicist). The MCZPR elements will be unloaded and handled one unit at a time. Each element will be inspected for corrosion or damage from prior storage, identified by a unique serial number and placed into a designated location of the AER fuel storage array.

A calibrated neutron counter and a previously installed criticality monitor will be in operation when moving all the elements into final [redacted] storage as is standard practice when handling critical quantities of nuclear materials. Additionally, a standard so-called "1/M criticality experiment" will be conducted during the fuel transfer. The 1/M experiment evaluates the margin to criticality by performing an inverse neutron counting experiment as the materials are loaded. Work will be stopped and the project will be evaluated in the unlikely event there is a statistical increase in the number of neutron counts between MCZPR element transfers.

Following the transfer of all the MCZPR into the AER storage, the lid will be closed, locked and a serial numbered security seal will be attached to indicate tampering. The materials will be routinely inventoried with all special nuclear materials at the NETL.

Conclusion

The staff at the NETL have concluded the MCZPR elements may be safely transferred and stored in the facility. The NETL has begun acquiring the materials to build the storage rack. The Nuclear Reactor Committee of the University of Texas at Austin (oversight committee for the NETL) has reviewed the proposed storage rack design under 10 CFR 50.59 and found it satisfactory.

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The University of Texas at Austin
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Austin, TX 78712
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E-mail:biegalski@mail.utexas.edu

Professional Preparation

University of Maryland	Nuclear Engineering	B.S.	[redacted]
University of Florida	Nuclear Engineering	M.E.	1992
University of Illinois	Nuclear Engineering	Ph.D.	1996

University of Illinois, Nuclear Engineering	Postdoctoral Appt.	1996
National Institute for Standards and Technology	Postdoctoral Appt.	1996-1997

Professional Certification: Licensed as a Professional Engineer in the State of Virginia
Licensed as a Professional Engineer in the State of Texas

Professional Experience:

Assistant Professor **Sept. 2002 - Present**
The University of Texas at Austin
Austin, TX 78712

- Director of Nuclear Engineering Teaching Laboratory (NETL)
- Computational Fluid Dynamics of flow through BWR fuel assemblies.
- Design of High Temperature Test and Training (HT3R) reactor.
- Nuclear reactor operations.
- Development of finite element codes to solve the coupled neutron transport and thermoelastic equations governing the behavior nuclear assemblies.
- Develop $\beta-\gamma$ coincidence spectrum analysis algorithms.
- Develop aerosol sampling system that optimizes detection limits for atmospheric radionuclides.
- Conduct nuclear forensic studies for nuclear non-proliferation.
- Develop and utilize neutron radiography and tomography
- Manage, develop, and utilize prompt gamma-activation analysis (PGAA), neutron depth profiling (NDP), and neutron radiography (NR) facilities.

Senior Nuclear Scientist **June 1997 – Aug. 2002**
Veridian (formerly Pacific Sierra Research)
Arlington, VA 22209

- Director of Radionuclide Operations at the Center for Monitoring Research (CMR) and prototype International Data Center (pIDC) [June 1997 – December 2000].
- Supervise the manufacturing, testing, and installation of Radionuclide Sampler/Analyzer (RASA) units at locations around the world.

- Develop and execute Independent Operations, Test and Evaluation (IOT&E) of Atmospheric Radioxenon Sampler/Analyzer (ARSA).
- Guide the development of radionuclide technologies to monitor the world for nuclear weapons tests in support of the Comprehensive Nuclear Test Ban Treaty.

Associate Engineer **May 1992 - October 1992**
Virginia Power
Glen Allen, Virginia
• Responsible for RETRAN model development and qualification.
• UFSAR accident analysis with RETRAN code.
• Assisted in human factors analysis in PRA development.

Honors:

- National Research Council Post-Doctoral Fellowship recipient
- Sigma Xi Scientific Research Society
- Alpha Nu Sigma Honor Society
- American Nuclear Society, Best Paper Award, 1994.

Publications
(Selected from 2 book chapters, 45 peer-review journal articles, and 39 peer-reviewed conference proceedings)

1. Zs. Révay, R. K. Harrison, E. Alvarez, S. R. Biegalski, S. Landsberger, "Construction and characterization of the redesigned PGAA facility at The University of Texas at Austin", accepted in *Nuclear Instruments and Methods: B*, 2007.

2. L. Cao, S. Biegalski, S. O'Kelly, "A high spatial resolution neutron radiography system and its performance evaluation," accepted in *Nuclear Instruments and Methods: B*, 2007.

3. J. Wright, O. Nelson, J. Koltick,M. LaBar, J. Bolin, S. Biegalski, J.R. Howell, "High-Temperature Materials & Process (HTMP) Laboratory Teaching & Test Reactor (HT3R) at the University of Texas Basin," American Nuclear Society Embedded Topical: International Topical Meeting on the Safety and Technology Nuclear Hydrogen Production, Control, and Management, 2007 Annual Meeting of the American Nuclear Society, Boston, MA, June 24 – 28, 2007.

4. S. R. Biegalski, K. S. Ball, M. R. Charter "Analysis of Valve Flutter in Turbulent Flow," submitted to the *Journal of Fluids and Structures*, 2006.

5. S. R. Biegalski, E. Alvarez, T. Green, "Confirmation of Germanium Interference with Hydrogen for Prompt Gamma-ray Activation Analysis," *Nuclear Instruments and Methods: B*, Vol 243(1), 253-255, 2006.

6. T. Green, S. Biegalski, S. O'Kelly "Neutron Energy Spectrum Determination and Flux Measurement Using MAXED, GRAVEL, and MCNP for RACE Experiments," accepted to the *Journal of Radioanalytical and Nuclear Chemistry*, 2006.

7. S. C. Wilson, S. R. Biegalski, R. Coats "Computational Modeling of Coupled Thermomechanical and Neutron Transport Behavior in a Godiva-like Nuclear Assembly", accepted to *Nuclear Science and Engineering*, 2006.

8. S. R. Biegalski, T. C. Green, G. A. Sayre, W. C. Charlton, D. J. Dorsey, S. Landsberger, "Flux Weighted Efficiency Calibration of The University of Texas at Austin PGAA Facility," *Journal of Radioanalytical and Nuclear Chemistry*, 265(2), pp. 303-308, 2005.

9. E. J. Artnak, S. R. Biegalski, J. R. Howell, R. Gauntt, K. C. Wagner, "Benchmarking the MELCOR Radiative Heat Transfer Model with FLUENT" *Transactions of the American Nuclear Society*, Vol. 93, pp. 681-682, 2005.

10. S. C. Wilson and S. R. Biegalski "An Iterative Method for Simulation of Dynamic Behavior in Fast Burst Reactors," *Transactions of the American Nuclear Society*, Vol. 93, p. 590-591, 2005.

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Professional Summary

- Over 25 years of results-driven performance in the nuclear field involving personnel and projects management, reactor operations and nuclear engineering.
- Proven record of effective facility management producing overall improvement in administration and operations at two top tier university research centers
- Developed and implemented successful strategic business plans at major research centers resulting in significant expansion of research and commercial activities

Experience

1999-Present, Associate Director, University of Texas at Austin Nuclear Engineering Teaching Laboratory, Austin, Texas

- Directly responsible for the overall administration and management of the 1.1 Mw research reactor, nuclear and radiation engineering research programs and a $6M research facility
- Responsible as Co-PI for university and national lab collaboration grant to enhance reactor research and infrastructure over five years. Total grant is $7M of only 1 of 4 awarded nationally
- Collaborated with Texas A&M University, 12 European laboratories and Idaho State Universities to perform accelerator driven subcritical experiments on UT and TAMU reactors using electron linac
- Primarily responsible for coordination and direction of $300K reactor repair project
- Coordinated and directed various training fellowship programs with the IAEA
- Selected by IAEA to perform safety review of international research reactor programs
- Requested by LLNL to establish and coordinate the training program for staff and engineers of the Moroccan Center for Nuclear Energy and Science and to act as consultant during the initial testing and qualification of their research reactor facility
- Selected by Dept of Energy and Dept of State to act as technical consultant under programs to re-train scientists and technicians in Libya and other North Africa countries
- Selected as reviewer for research (NEER) and equipment (URI) grants for the DOE
- Taught graduate level Nuclear Reactor Theory course
- Taught fundamentals of reactor theory and operations to NETL reactor operators
- Assisted in the teaching of graduate and undergraduate nuclear engineering laboratories
- Licensed Senior Reactor Operator on NETL UT and Texas A&M TRIGA research reactors, first dual site licensed person in the U.S. maintaining operator license at two facilities
- Elected as 2006 Chairman of the U.S. National Organization of Test, Research and Training Reactors (TRTR)
- Elected as 2005-2006 Treasurer of the Operations and Power Division of the American Nuclear Society
- Selected as member of Nuclear Reactor Safety Committee for the U.S. Geological Survey and U.S. Department of the Interior

1994-1999, Assistant Director, Texas A&M University Nuclear Science Center, College Station, Texas

- Directed and managed 30 employees and graduate students at a university research and commercial service center. Supervised activities included reactor operations, maintenance, experiments, facility improvements, training, safety, administration and fiscal matters
- Primarily responsible for turning around facility from a $250K budget deficit to $100K profit in two years with aggressive marketing to industry and researchers and efficient use of personnel resources
- Designed, built and tested proprietary method of producing medical isotopes. Negotiated distribution contract with startup medical device manufacturer
- Designed and received funding to replace facility radioactive waste processing system
- Consultant with U.S. petroleum service company and PetroBras, Brazil, to perform radioactive gas tracing and efficiency measurement of oil refinery cracking columns

- Collaborated with LANL and ORNL in research programs to convert weapons plutonium into mixed-oxide (MOX) reactor fuel. Developed novel experimental method and received $150K DOE funding for the simulation of reactor fuel temperatures using liquid metal cooling to demonstrate gallium migration in MOX from converted weapons plutonium.
- Licensed Senior Reactor Operator on 1 Mw NSC Reactor

1992-1994, Reactor Supervisor, Texas A&M University Nuclear Science Center
- Supervised all reactor operations and maintenance over two shifts
- Developed simple neutron beam experiments in diffraction and time of flight
- Trained and qualified over 30 reactor operator and health physics personnel
- Responsible for nuclear and radioactive material inventory and security
- Certified radioactive and hazardous materials shipper under 10 CFR 49

1988-1992, Senior Reactor Operator, Texas A&M University Nuclear Science Center
- Second shift senior staff operator while attending university full time

1979-1988, U.S. Navy, Reactor Operator
- 5 strategic nuclear patrols on USS Benjamin Franklin (SSBN-640B)
- Honorably discharged as E-6, ET1(SS)
- Nuclear Classroom Instructor (S5G) teaching nuclear theory, instrumentation and operations
- Supervised 12 individuals during reactor plant refueling and overhaul

Education
- Currently attending part-time Ph.D. graduate program in Nuclear and Radiation Engineering at The University of Texas at Austin. All course work completed.
- M.S., Industrial Engineering, reliability engineering and quality control emphasis, 2000, Texas A&M University, Thesis title: "*Bayesian Reliability and Failure Analysis of Small Diameter, High Power Electrical Heaters for the Simulation of Reactor Fuel Temperatures.*
- B.S., Physics (cum laude), [redacted] Texas A&M University
- U.S. Navy Nuclear Power and Nuclear Electronics Technician Maintenance Schools 1979-1981

Professional Membership
- American Nuclear Society
  Member of Operations and Power Program Committee 2000-2004
  2005-2006 Treasurer
- American Society of Engineering Education
  Member of Nuclear and Radiation Engineering Division Executive Committee 2003-2004, 2004-2005
- American National Standards Institute Section 15 Standards Committee, Lead Reviewer on ANSI 15.8-Quality Assurance Programs at Research Reactors

Professional Presentations, Proceedings and Workshops

S. O'Kelly, *"Minimizing Radiation Dose During Major Reactor Repairs,"* International Topical Meeting on Operating Nuclear Facility Safety 2004, Washington DC, November 2004.

S. O'Kelly, *"Status of Neutron Beam Experiments at The University of Texas,"* Trans. ANS Winter Conference 2004, Washington DC, November 2004.

S. O'Kelly, T. Green, W. Charlton, *"Reactor-Accelerator Coupled Experiment (RACE) at The University of Texas at Austin,"* Trans. ANS Winter Meeting 2004, Washington DC, November 2004.

S. Landsberger, S. Biegalski, L. Katz, S. O'Kelly, L. Welch, *"Development of Nuclear and Radiochemistry Laboratories at the University of Texas,"* ASEE 2004 Conference, Salt Lake City UT, June 20-23, 2004

S. O'Kelly, S. Biegalski, W. Charlton, *"Long Distance Reactor Laboratory with Low Cost Equipment,"* ASEE 2004 Conference, Salt Lake City UT, June 20-23, 2004.

S. O'Kelly, M. Spellman, "*Focusing on the Research Reactor as an Educational Resource*". Trans. Vol. 89, Winter ANS Meeting , New Orleans, LA, Nov 16-20, 2003.

F. J. Davis, D.S. O'Kelly, "*The Need for a Nuclear Undergraduate Collaboration for Education Sharing,*" Trans. Vol. 89, Winter ANS Meeting, New Orleans, LA, Nov 16-20, 2003.

Session Organizer, Innovations in Nuclear Infrastructure and Education Program Reviews, ANS 2004 Meeting, New Orleans, LA

W. Charlton, S. O'Kelly, "*Accelerator Driven Subcritical System Experiment Plan at Texas A&M University and The University of Texas*" ISU Workshop on Accelerator Driven Subcritical Experiments, Idaho State University, August 21-22, 2003.

M.G. Krause, D.S. O'Kelly, "*Design considerations for NETL Replacement Reflector,*" 2003 Meeting of the Organization of Test, Research and Training Reactors, August 2003.

D.S. O'Kelly, "*University of Texas at Austin INIE Progress Review: Year 1,*" 2003 Meeting of the Organization of Test, Research and Training Reactors, August 2003.

S. Biegalski, S. O'Kelly, "*Innovations for the University of Texas Reactor Laboratory Class,*" Proc. ASEE, Nashville, TN 2003.

D. S. O'Kelly, "*The Innovations in Nuclear Infrastructure and Education Program: The Future of Nuclear Education,*" Proc. ASEE annual conference , Nashville, TN 2003.

D.S. O'Kelly, "*The Southwest Reactor and Research Consortium: A 21st Century Collaboration,*" Tran. Amer. Nuc. Soc. 2003.

D.S. O'Kelly, "*The Southwest Consortium,*" Organization of Test, Research and Training Reactors (TRTR), Salt Lake City, Utah, November 2002.

D.S. O'Kelly, Eight lecture Workshop "*Reactor Physics Testing and Quality Control*" CNESTEN, Rabat, Morroco, June 15-21, 2002.

D.S. O'Kelly, "*Ten Years of TRIGA Reactor Research at The University of Texas,*" Proceedings First TRIGA Reactor Users World Conference, Pavia, Italy, June 2002.

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S.K. Aghara, W.S. Charlton, and D .S. O'Kelly, "*Characterization of an In-Core Location at the University of Texas TRIGA II for Electronic Hardness Assurance Testing,*" Trans. Am. Nuclear. Society 2002.

D.S. O'Kelly, "*Quality Assurance Success and Failure at a Non-Power Reactor,*" ANS 2001 Winter Meeting, Reno Nevada, Session Organizer and Chair

D.S. O'Kelly, "*Nuclear Power in the 21st Century,*" meeting of the south Austin chapter of the Veterans of Foreign Wars, Onion Creek C.C., Austin, TX, June 2001.

S. Landsberger, C. Beard, W. Charlton, S. O'Kelly, M. Creatchman, "*Graduate Distance Learning in Nuclear and Radiation Engineering at the University of Texas at Austin,*" Annual ASEE meeting, Albuquerque, NM, June 2001 (presented)

D.S. O'Kelly, "*Manpower and Management Issues at Non-power Reactors,*" ANS summer meeting Milwaukee WI, June 2001, Session Organizer and Chair

D.S. O'Kelly, "*Hydrogen and Oxygen Gas Production in the UT TRIGA Reflector,*" ANS Trans. Vol 83, Washington, D.C., November 2000.

D.S. O'Kelly, *"UT TRIGA Reflector Pressurization and Venting,"* Annual meeting of Test, Research and Training Reactors, Raleigh, NC, October 2000

D.S. O'Kelly, S. Landsberger, G. Chubaryan, A. J. Teachout, J. Krohmer; *"An Accelerator Health Physics Course for Regulators"*, ANS, Trans. 1999

C. C. Allison, K.L. Peddicord, D.S. O'Kelly, *"Simulation of MOX Fuel Thermal Gradients to Study Gallium Interactions"*, Proc. ANS Topical Meeting on DOE Spent Fuel and Fissile Material, Management, Charleston, SC, Sept. 1998.

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D.S.O'Kelly, *"Measuring Building Effluent Stack Activated Charcoal Filter Efficiency Using Neutron Activation Analysis"*, Meeting of the Organization of Test, Research and Training Reactors (TRTR), October 1996.

D.S. O'Kelly, *"Neutron Activation Analysis of Semiconductor Materials at Texas A&M University Nuclear Science Center"*, SEMATECH Analytical Laboratory Managers Working Group Meeting, Austin, TX, October 1996.

D.S. O'Kelly, *"Radio-Argon Production and Handling at the Texas A&M University Nuclear Science Center"*, Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, Brazil, July 1996.

Grants and Contracts Awarded

Texas Engineering Experiment Station, RACE: Reactor-Accelerator Coupled Experiments, 2004, $70K

Department of Energy, University Reactor Instrumentation Program2004, *Portal Radiation Monitors*, $37K

Lawrence Livermore National Lab, *Reactor Operations and Maintenance Training Course*, June 2003, $69K

Department of Energy, *Innovations in Nuclear Infrastructure and Education*, 2002-2007, $2.6M

Lawrence Livermore National Lab, *Moroccan National Center for Nuclear Energy Science Workshop*, 5 day series of lectures presented in Rabat Morocco, June 2002, $9K

Department of Energy, University Reactor Instrumentation Program, *Redesign and Replacement of UT TRIGA Reactor Reflector*, 2002-2004, $255K

Department of Energy, University Reactor Sharing Program, 2002-2007, $80K

National Academies/National Research Council, International Atomic Energy Agency Fellowship Training Programs, 1999-2003, $75K

Department of Energy, University Reactor Instrumentation Program, *Upgrade of Digital Reactor Console Software and Health Physics Support*, 2001, $54K

Department of Energy, University Reactor Sharing Program, 2001, $16K

Ideas to Market LLP, *Evaluation of Ecomass Shielding*, 2000, $3K

Department of Energy, University Reactor Sharing Program, 1999-2000, $23K

Texas Department of Health, *"Accelerator Health Physics Training Course,"* 1999, $13K

Department of Energy, University Reactor Instrumentation Program, *Design and Construction of Radioactive Liquid Waste Processing System,"* 1998, $35K

Department of Energy, University Reactor Sharing Program 1998, $19K

Oak Ridge National Laboratory, *Design, Construction and Testing of Systems to Simulate Reactor Fuel Centerline Temperatures*, 1997, $225K

Department of Energy, University Reactor Instrumentation Program, *Upgrade of Wide Range and Logarithmic Neutron Monitors*, 1997, $35K

Curriculum Vitae
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Experience:

Laboratory Manager, The University of Texas at Austin, Nuclear Engineering Teaching Laboratory, 2000 – Present. Responsible for laboratory operations, including management, direction, and performance of routine and non-routine experiments. Also includes the management of the chemical and safety programs within the NETL as required to support the mission of the NETL and the NRE programs. Act as primary contact point and coordinator for new and established facility users in the scheduling of service/research activities using the NETL. Schedule reactor and laboratory availability with input from faculty, staff and experimenters. Scheduled areas include laboratories, radiation spectroscopy systems, and reactor experiments. Oversee the performance of neutron activation analysis and radiochemistry experiments. Coordinate, schedule, and perform calibration and operation of laboratory radiation counting systems. Coordinate directly with UT EH&S to manage all chemical inventory, safety, and disposal within the NETL building. Performance of laboratory contamination surveys.

Reactor Health Physicist, The University of Texas at Austin, Nuclear Engineering Teaching Laboratory, 2003 – Present. Responsible for the radiological protection/safety program at the NETL. Use and interpret State and Federal regulations and prepare written procedures and records to maintain and verify compliance with applicable regulations. Perform and guide the performance of radiation and contamination monitoring in all NETL laboratories in which radioactive materials are stored or used to maintain compliance with the federal and state licenses and regulations. Direct the use, calibration, and maintenance of all radiological monitoring instrumentation at the NETL with the assistance of the NETL Electronics Technician. Leak testing of sealed sources. Control the procurement, use, storage, shipping and disposal of radioactive and other hazardous materials. Provide initial, refresher, and job-specific radiological safety training to NETL faculty, staff, and students. Perform routine and non-routine safety reviews of experiments and facility modifications as an ex-officio member of the Nuclear Reactor Committee.

Manager, Beam Port Projects, University of Texas at Austin, Nuclear Engineering Teaching Laboratory, 1999 - 2000
This position is responsible for the research programs associated with all neutron experiments at the NETL. These research facilities include one of the few operational cold neutron sources in the United States, a neutron generator, a neutron depth profiling system and a real-time neutron radiography system.

Research Scientist, Texas A&M University, Nuclear Engineering Department, 1999.
Supervised graduate students with work on the accelerator. Also investigated the feasibility of expanding accelerator capabilities to include Accelerator Mass Spectroscopy (AMS), Particle Induced X-ray Emission (PIXE), and Rutherford Back Scattering (RBS).

Research Associate, Texas A&M University, Nuclear Engineering Department, 1996-99. Responsible for the re-assembly, updating, and testing of a 2 MV electrostatic accelerator for microbeam/radiation biology experiments. The accelerator had been disassembled and shipped from Pacific Northwest National Laboratories to Texas A&M University. Installed and maintained systems including control air, insulating gas handling system, high vacuum system, accelerator cooling system. Set-up interface hardware and software for computer control and automation of accelerator. Coordinated with commercial vendors and others in completion of accelerator building construction in a timely manner.

Graduate Research Assistant, Texas A&M University, Cyclotron Institute, 1989-96. Participated in numerous multi-parameter physics experiments involving multiple research groups and international collaborations. Assisted in the assembly and testing of the Neutron Ball, a 4π neutron detector using a Gd-doped scintillation cocktail and photomultiplier tubes in a 10-foot diameter array.

Graduate Teaching Assistant, Texas A&M University, Chemistry Department, 1988-90 Taught Freshman Chemistry Laboratories, Chemistry 111/Chemistry 112. Also taught laboratory for Chemistry 474 - Nuclear and Radiochemistry. Laboratory instruction included interaction of radiation with matter, simple coincidence experiments, and radiation shielding.

Hazardous Waste Coordinator, Idaho State University, 1986-88
Coordinated inventory and disposal of hazardous chemicals of various departments to ensure University compliance with federal regulations regarding hazardous chemical waste.

Teaching Experience:

Texas A&M University – 1988-1996. Various graduate research/teaching assistantships.

University of Texas at Austin – 1999 - Present

Summer Health Physics Laboratory – Summer 2000 – Summer 2004
Nuclear and Radiochemistry – Fall 2003, Fall 2004
Radioactive Waste Management – Spring 2005
Radiation and Radiation Protection – Fall 1005 – present
Nuclear Health Physics – Fall 2005 - present

Publications, Presentations, and Proceedings:

S. Landsberger, **D.J. O'Kelly**, S. Biegalski, S. O'Kelly, K. Foltz Biegalski, L. Welch, L. Katz, Development of a graduate curriculum in nuclear and radiochemistry and the research interactions with US Department of Energy national laboratories, Journal of Radioanalytical and Nuclear Chemistry, Vol. 270, No. 1 (2006) 253-257.

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J. Gardea-Torresday, S. Landsberger, **D. O'Kelly**, K.J. Tiemann, and J.G. Parsons, Use of neutron activation analysis to determine arsenic and antimony concentrations in creosote bushes collected near a lead smelter in El Paso, Texas, Journal of Radioanalytical and Nuclear Chemistry, Vol. 250, No. 3, December 2001.

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D.J. O'Kelly, L.A. Braby, J.R. Ford, S. Guetersloh, R. DePriest, *Biological Applications of Ion Beams,* Conference on the Application of Accelerators in Research and Industry, Denton, TX, November 1998.

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J. B. Natowitz, M. Gonin, K. Hagel, R. Wada, S. Shlomo, X. Bin, M. Gui, Y. Lou, D. Utley, T. Botting, R. K. Choudhury, L. Cooke, B. Hurst, **D. O'Kelly,** R. P. Schmitt, W. Turmel, H. Utsunomiya, G. Nebbia, D. Fabris, J. A. Ruiz, G. Nardelli, M. Poggi, R. Zanon, G. Viesti, R. H. Burch, F. Gramegna, G. Prete, D. Drain, B. Chambon, B. Cheynis, D. Guinet, X. C., A. Demeyer, C. Pasteur, A. Giorni, A. Lleres, P. Stassi, B. Viano, A. Menchaca-Rocha, M.E. Brandan, P. Gonthier, Dynamical and Statistical Properties of Hot Nuclei, Nucl. Phys. A538, 263 (1992).

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Education:

B.A., Chemistry, Idaho State University, Pocatello, ID (May [redacted]
Ph.D., Nuclear Chemistry, Texas A&M University, College Station, TX (December 1996)

Professional Affiliations:

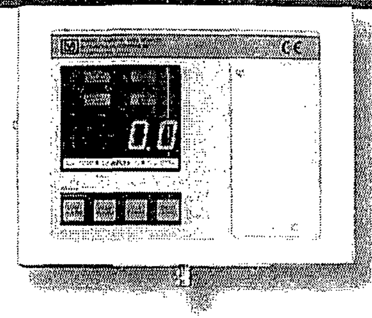
Member, Materials Research Society
Member, American Nuclear Society
Member, American Physical Society
Member, Health Physics Society

CRITICALITY MONITOR

Area Monitors

Specifications

Model 375



Part No. 48-2230

INDICATED USE: Area monitoring
SUGGESTED DETECTORS: G-M, proportional, scintillation, neutron
DISPLAY: 4 digit LED display with 0.8" (2 cm) digits
DISPLAY RANGE: 000.0 - 9999
DISPLAY UNITS: Can be made to display in µR/hr, mR/hr, R/hr, µSv/h, mSv/h, Sv/h, µrem/hr, mrem/hr, rem/hr, cpm, cps, and others
LINEARITY: Reading within 10% of true value with detector connected
RESPONSE: Typically 3 seconds from 10% - 90% of final reading
STATUS: *(green light)* instrument functioning properly
LOW ALARM: Indicated by yellow light and slow beep *(1 per second)* audible tone *(can be set at any point from 0.0 - 9999)*
HIGH ALARM: Indicated by red light and fast beep *(4 per second)* audible tone *(can be set at any point from 0.0 - 9999)*
NOTE: Audible indicators can be configured as a single beep of less than 1 second duration if desired
DET FAIL: *(red light and audible tone; greater than 68 dB at 2 feet)* indicates detector overload, no count from detector, or instrument failure
LOW BAT: *(yellow)* indicates less than 2 hours of battery power remaining
HIGH VOLTAGE: Adjustable from 200 - 2500 volts
THRESHOLD: Adjustable from 2 - 100 mV
DEAD TIME: Adjustable to compensate for dead time of detector and electronics *(can be read on display)*
OVERLOAD: Senses detector saturation *(indicated by display reading "-OL-")*
OVERRANGE: Indicates radiation field being measured has exceeded counting range of instrument *(indicated by display reading "- - - -")*
DATA OUTPUT: 9 pin connector providing 5 decade logarithmic output, RS-232 output, signal ground connection, FAIL and ALARM signals *(current sink)*, and direct connection to battery and ground
REMOTE(optional): Model 271 or 272 Remote units
CALIBRATION CONTROLS: Accessible from front of instrument *(protective cover provided)*
POWER: 95 - 135 VAC *(178 - 240 VAC available)*, 50-60 Hz single phase *(less than 100 mA)*, 6 volt sealed lead-acid rechargeable battery *(built in)*
BATTERY LIFE: Typically 48 hours in non-alarm condition; 12 hours in alarm condition
BATTERY CHARGER: Battery is continuously trickle charged when instrument is connected to line power and turned on
CONSTRUCTION: Wall mount aluminum housing with ivory powder coat paint
SIZE: 7.4" (18.7 cm)H X 9.7" (24.6 cm)W X 2.5" (6.4 cm)D
WEIGHT: 6.5 lbs (2.3kg)

VERSIONS WITH INTERNAL DETECTORS

MODEL	RANGE	PART NO.
M375/2	0.1mR/hr-1 R/hr	48-2410
M375/4	1mR/hr-10 R/hr	48-2411

PROCEDURE

FUEL-1

Movement of Fuel

Version
1.00

Approvals:

Facility Director, NETL — Date 2/17/05

Chairperson, Nuclear Reactor Committee — Date 2/17/05

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NUCLEAR ENGINEERING TEACHING LABORATORY
J. J. PICKLE RESEARCH CAMPUS
THE UNIVERSITY OF TEXAS AT AUSTIN

I. INTRODUCTION

A. PURPOSE

The instructions of this procedure are to control the movement of reactor fuel components within the reactor core grid structure and to or from storage locations.

B. DESCRIPTION

Reactivity changes occur as fuel is added to the reactor core or storage locations. To assure adequate safety margins for the proper performance of the control rod system, procedural controls define the requirements and limitations for fuel movement within the reactor core and storage areas. These rules include changing the arrangement of fuel components as well as fuel additions or deletions.

C. Schedule

Apply this procedure each time fuel is moved.

D. Contents

E. Attachments

Fuel Movement Log	1 Page
TRIGA Core Arrangement	1 Page
Storage Well Arrangement	1 Page
Pool Storage Rack Inventory	1 Page
MCZPR Storage Rack Inventory	1 Page

F. Equipment, Materials

Fuel Element Tool
Radiation Work Permit (RWP) - A RWP is required for this procedure only if irradiated fuel is to be moved outside of the reactor pool access area.

G. REFERENCES

Criticality Calculations

II. PROCEDURE

A. TRIGA Fuel Movement

1. A senior reactor operator shall supervise all movements of fuel, including movements to or from the reactor core grid structure and movements between storage locations. At least one person should assist with the handling of the fuel elements.

2. Restrict all fuel element arrays except the reactor core to an array limit of less than 20 elements.

   a. Store fuel elements in the fuel storage wells or in the reactor pool. Use the 19 element hexagonal array racks (these may by stacked two deep per well) or the 6 or staggered 12 element linear array racks.

   b. Elements not in storage racks or shipment casks should be in groups of three or less.

3. Plan fuel movement activities so as to minimize the number of individual moves required to achieve the desired result.

4. Move elements between the reactor core, storage racks, shipment casks or other locations with special fuel handling tool.

5. Maintain access control or restrict use of fuel handling tool by lock if fuel movements are not in progress.

6. Test fuel handling tool on non-fuel element prior to use.

7. Approve by inspection and test any device other than the fuel handling tool prior to use for movement of fuel. Handle the instrument elements with the extension tubes. Handle control followers with the extension rods.

8. Handle fuel elements carefully. Care should be taken not to bump or scrape elements. Minimize the possibility and potential consequences of an accidental drop of an element.

9. The Pool Area radiation monitor shall be functional during fuel movement in or to and from the reactor pool.

10. Verify a gamma sensitive survey instrument(with audible or alarm functions) is present in the area where the fuel movement will occur. A Radiation Work Permit (RWP) is necessary for movement of irradiated fuel beyond the immediate vacinity of the reactor pool access area.

11. The air particulate monitor or substitute monitor should be functioning.

12. Record all fuel element movements in the Fuel Element Log.

13. Acknowledge by verbal response each change of fuel handling tool opened or closed status if two persons operate the tool.

14. Acknowledge by verbal response the exchange or transfer of the fuel handling tool to another person.

15. Operate and monitor the reactor console during the movement of fuel to or from the reactor core.

    a. Prevent movement of any control rod drive by removing the neutron source from the core.
    b. Place the console in Manual Mode. Verify no control rods will withdraw.
    c. A log of any event will be automatically recorded to the control system history file.
    d. Removal of a fuel followed control rod from the core for inspection requires a minimum shutdown margin greater than 0.2% $\Delta K/K$ 2 rods out (i.e. with the rod being removed out and the remaining highest worth rod up).
    e. Movement of an instrument element requires disconnect and reconnect of instrument connections with a functional test prior to reactor operation.

16. Verify excess reactivity and shutdown margin if fuel movement is to or from the reactor core. Check by measurement or calculate by conservative estimate.

17. Compare control rod critical positions before and after movement and recalibrate if a change occurs due to movement of the fuel in the core.

18. Uppon completion of fuel movement the fuel handling tool shall be surveyed for contamination, bagged, and locked securely for storage in its designated location.

B. Criticality and Inventory Control of Materials in Storage

1. Storage and handling of large quantities of special nuclear materials (SNM), such as reactor fuel, carries the risk of accidental criticality if the materials are placed into a critical geometry or moderated with hydrogenous materials. Tracking of licensed SNM is required (10CFR74) and annually reported to the NRC via the Nuclear Materials Management and Safeguards System (NMMSS). The total quantity of SNM at the NETL shall not exceed a Category III (Low Strategic Significance) quantity of material as defined in 10CFR73.2 (<10kg unirradiated). The NETL Reactor Facility License, R-129, requires all fuel elements to be stored in a geometrical array where the effective multiplication is less than 0.8 for all conditions of moderation. TRIGA elements stored in a 19 element rack and MCZPR elements stored in a linear array are sufficiently subcritical.

2. SNM, other than irradiated fuel and the subcritical assembly, in quantities greater than 1.0 gram should be stored in room [redacted], the [redacted] Room [redacted]), when not actually in use or prepared for shipment. The subcritical assembly should not be stored near other fuel in the [redacted] but should be stored in its 55 gal drum maintained within the confines of the reactor bay. Sealed neutron sources (e.g. PuBe) shall NEVER be stored within the [redacted]. Neutron sources may be used within the [redacted] for Criticality Alarm instrument checks as noted below.

3. A Criticality Accident alarm system is required by 10CFR70.24 for SNM not stored underwater when the total quantity of enriched U-235 exceeds 700 grams. Monitoring is not required for fuel stored in the storage pits if they are maintained underwater. The NETL Criticality Accident monitor is a Ludlum 375 gamma and neutron monitor or

equivalent meeting the requirements of 10CFR70.24. The digital monitor should be mounted outside the [redacted] with the detectors located adjacent to the MCZPR fuel storage location. The detector system is calibrated annually and response checked quarterly using a neutron/gamma source. The audible alarm setpoint should be set between 5 and 20 mR/hr.

4. Routine entry into the [redacted] requires the SRO issue the key. The SRO will verify the individual has been trained to properly enter and work within the AER prior to key issue.

5. Individuals entering the [redacted] must note the readings of the Criticality Accident Monitor outside the [redacted] and verify the digital meters are at typical background levels (expected to be less than 5.0 mR/hr and 5.0 mrem/hr) prior to entry. If necessary, movement of moderator (e.g. graphite, polyethylene, water) materials into or within the AER requires SRO supervision.

6. Fuel element (TRIGA or MCZPR) movement within the NETL requires SRO supervision. The SRO will ensure fuel elements are moved in limited quantities and maintained in a subcritical configuration during movement.

C. TRIGA FUEL REFERENCE REACTIVITY VALUES

Core Location	TRIGA fuel vs. water	% ΔK/K
Ring A		4.00
Ring B		1.07
Ring C		0.85
Ring D		0.54
Ring E		0.36
Ring F		0.25
Ring G		0.19
3 elements (1D, 2E)		1.25
6 elements (6B)		6.42

1

DATE	TIME	ELEMENT #	OLD LOCATION	NEW LOCATION	COMMENTS/SRO

2
3

Core Arrangement

Reference___________ Configuration Number:
Date ___________ FUEL-GRAPHITE-WATER-OTHER
______-_______-_______-______

G-26 G-27 G-28 G-29 G-30

G-24 F-21 F-22 F-23 F-24 F-25 F-26 G-32

G-23 F-20 E-17 E-18 E-19 E-20 E-21 F-27 G-33

G-22 F-19 E-16 D-13 D-14 D-15 D-16 E-22 F-28 G-34
SHM2

G-21 F-18 E-15 D-12 C-09 C-10 C-11 D-17 E-23 F-29 G-35

G-20 F-17 E-14 D-11 C-08 B-05 B-06 C-12 D-18 E-24 F-30 G-36

F-16 E-13 D-10 C-07 B-04 B-01 C-01 D-01 E-01 F-01
REG TRNS

G-18 F-15 E-12 D-09 C-06 B-03 B-02 C-02 D-02 E-02 F-02 G-02

G-17 F-14 E-11 D-08 C-05 C-04 C-03 D-03 E-03 F-03 G-03

G-16 F-13 E-10 D-07 D-06 D-05 D-04 E-04 F-04 G-04
SHM1

G-15 F-12 E-09 E-08 E-07 E-06 E-05 F-05 G-05

G-14 F-11 F-10 F-09 F-08 F-07 F-06 G-06

G-12 G-11 G-10 G-09 G-08

Well # ____________ Date ____________

UPPER

	C-09	C-10	C-11	
	____	____	____	
	C-08	B-05	B-06	C-12
	____	____	____	____
C-07	B-04	A-01	B-01	C-01
____	____	____	____	____
	C-06	B-03	B-02	C-02
	____	____	____	____
	C-05	C-04	C-03	
	____	____	____	

LOWER

	C-09	C-10	C-11	
	____	____	____	
	C-08	B-05	B-06	C-12
	____	____	____	____
C-07	B-04	A-01	B-01	C-01
____	____	____	____	____
	C-06	B-03	B-02	C-02
	____	____	____	____
	C-05	C-04	C-03	
	____	____	____	

PAFormat Attachment a:\fuel1-a4.doc	Number – Rev.:	FUEL-1 1.00	Date: 2/14/05
	Procedure Title:	Movement of Fuel	

1

RACK #	Pool Rack Position					
	#1	#2	#3	#4	#5	#6
R1 Lower						
R1 Upper						
R2 Lower						
R2 Upper						
R3 Lower						
R3 Upper						
R4 Lower						
R4 Upper						
R5 Lower						
R5 Upper						
R6 Lower						
R6 Upper						
R7 Lower						
R7 Upper						
R8 Lower						
R8 Upper						
R9 Lower						
R9 Upper						
R10 Lower						
R10 Upper						
T1						
T2						
T3						

2 3 By: Date:

Pool Storage Rack Inventory

Stamp(Original-Red, Copy-Blue)

Date of Change | | | | |

NETL Director Approval | | | | |

COPY

1

RACK #	MCZPR Rack Position								
	#1	#2	#3	#4	#5	#6	#7	#8	#9
Upper Pin									
Lower Pin									

By: Date:

2
3

WITHHELD FROM PUBLIC DISCLOSURE

Emergency Response Plan for the UT TRIGA Mark II Reactor Facility
Nuclear Engineering Teaching Laboratory
October 31, 2006
Revision 2
34 Pages

WITHHELD FROM PUBLIC DISCLOSURE

Procedure PLAN-E Emergency Response Version 3.00
Nuclear Engineering Teaching Laboratory
11/1/06
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