PSI

PHYSICAL SCIENCES INC.

29 April 2002

Sam Nunn Atlanta Federal Center
U.S. Nuclear Regulatory Commission, Region II
61 Forsyth Street, S.W., Suite 23T85
Atlanta, GA 30303-8931

To Whom it May Concern:

Please find enclosed an original and one (1) copy of the Application for Material License along with a check in the amount of $2,500.00 for the licensing fee. If you have any technical questions please contact Dr. Willi Schwarz at (703) 941-0495 ext. 114 or schwarz@psicorp.com. If Dr. Schwarz is unavailable you may contact the undersigned at (978) 689-0003 ext. 8160 or merlin@psicorp.com.

Sincerely,

Dr. Merlin G. Miller
VP, Systems Enterprise

/das

Enclosures: Application for Material License (original + 1 copy)
PSI Check No. 3154

20 New England Business Center ▮ Andover, MA 01810-1077 ▮ t 978.689.0003 f 978.689.3232
www.psicorp.com

NRC FORM 313 U. S. NUCLEAR REGULATORY COMMISSION

(8-1999)
10 CFR 30, 32, 33
34, 35, 36, 39 and 40

APPLICATION FOR MATERIAL LICENSE

APPROVED BY OMB: NO. 3150-0120 EXPIRES:09/31/2002

Estimated burden per response to comply with this mandatory information collection request: 7.4 hours. Submittal of the application is necessary to determine that the applicant is qualified and that adequate procedures exist to protect the public health and safety. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0120), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

APPLICATION FOR DISTRIBUTION OF EXEMPT PRODUCTS FILE APPLICATIONS WITH:

DIVISION OF INDUSTRIAL AND MEDICAL NUCLEAR SAFETY
OFFICE OF NUCLEAR MATERIALS SAFETY AND SAFEGUARDS
U.S. NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS:

IF YOU ARE LOCATED IN:

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, MAINE, MARYLAND, MASSACHUSETTS, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, PENNSYLVANIA, RHODE ISLAND, OR VERMONT, SEND APPLICATIONS TO:

LICENSING ASSISTANT SECTION
NUCLEAR MATERIALS SAFETY BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PA 19406-1415

ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA, PUERTO RICO, SOUTH CAROLINA, TENNESSEE, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA, SEND APPLICATIONS TO:

SAM NUNN ATLANTA FEDERAL CENTER
U. S. NUCLEAR REGULATORY COMMISSION, REGION II
61 FORSYTH STREET, S.W., SUITE 23T85
ATLANTA, GEORGIA 30303-8931

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND APPLICATIONS TO:

MATERIALS LICENSING SECTION
U.S. NUCLEAR REGULATORY COMMISSION, REGION III
801 WARRENVILLE RD.
LISLE, IL 60532-4351

ALASKA, ARIZONA, ARKANSAS, CALIFORNIA, COLORADO, HAWAII, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA, NEVADA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, OREGON, PACIFIC TRUST TERRITORIES, SOUTH DAKOTA, TEXAS, UTAH, WASHINGTON, OR WYOMING, SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING SECTION
U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TX 76011-8064

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S.NUCLEAR REGULATORY COMMISSION JURISDICTIONS.

1. THIS IS AN APPLICATION FOR *(Check appropriate item)*
   - [X] A. NEW LICENSE
   - [ ] B. AMENDMENT TO LICENSE NUMBER _____
   - [ ] C. RENEWAL OF LICENSE NUMBER _____

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include Zip code)*
   Physical Sciences Inc.
   20 New England Business Center
   Andover, Massachusetts 01810

3. ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED
   Physical Sciences Inc.
   5705-A General Washington Drive
   Alexandria, Virginia 22312

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION Willi G. Schwarz, Ph.D.

   TELEPHONE NUMBER 703-941-0495, x114

SUBMIT ITEMS 5 THROUGH 11 ON 8-1/2 X 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL.
   a. Element and mass number; b. chemical and/or physical form; and c. maximum amount which will be possessed at any one time.

6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED.

7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING EXPERIENCE.

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS.

9. FACILITIES AND EQUIPMENT.

10. RADIATION SAFETY PROGRAM.

11. WASTE MANAGEMENT.

12. LICENSEE FEES *(See 10 CFR 170 and Section 170.31)*
    FEE CATEGORY 3.M. AMOUNT ENCLOSED $ 2,500

13. CERTIFICATION. *(Must be completed by applicant)* THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, 36, 39 AND 40, AND THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

CERTIFYING OFFICER – TYPED/PRINTED NAME AND TITLE	SIGNATURE	DATE
George E. Caledonia President & CEO	George E. Caledonia	04/29/02

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	AMOUNT RECEIVED	CHECK NUMBER	COMMENTS
			$		
APPROVED BY				DATE	

PRINTED ON RECYCLED PAPER

NRC FORM 313 (8-1999)

APPLICATION FOR MATERIALS LICENSE (ARDL)
- Supplement -

- Physical Sciences Inc. -

Information Requested in Items 5 through 11 of NRC Form 313

Item No.	Title and Response	Yes	Description Attached
5.	**RADIOACTIVE MATERIAL**		
	Sealed Source – Isotope: Hydrogen-3 (H-3) in sealed neutron tube – Manufacturer: SODERN 20 Avenue Descartes 94451 Limeil-Brévannes Cedex France Model: "Soditron" sealed neutron tube (see attached description for details) Used with power supply and control unit manufactured by: Activation Technology Corporation 2816 Janitell Road Colorado Springs, Colorado 80906 Models: N-250 and N-550 neutron generator systems – The Soditron sealed neutron tube is registered as part of an approved sealed source and device with the state of Georgia in SS&D Registration Certificate GA-1077-D101-S. – The maximum activity of H-3 in each sealed source will not exceed the maximum activity of 3.63 Ci (3.3 Ci nominal) listed for the sealed neutron tube in the approved SS&D registration certificate (referenced above). – The maximum number of sealed neutron tubes that will be possessed at any one time will not exceed two (2). The maximum number of sealed neutron tubes that will be used at any one time will not exceed one (1).	*	[Y]

Item No.	Title and Response	Yes	Description Attached
5.	**RADIOACTIVE MATERIAL** **Financial Assurance and Recordkeeping for Decommissioning** Not required as per limits for sealed sources specified in 10 CFR 30.35.	N/A	N/A
6.	**PURPOSE FOR WHICH LICENSED MATERIAL WILL BE USED** The sealed neutron tube will be used only for Research and Development, as defined in 10 CFR 30.4. Scientific experiments will be performed to test and demonstrate the measurement of material properties using fast and thermal neutrons. Neither animal studies nor tracer studies will be done. The sealed neutron tube will only be used as contained within the accelerator head (described under item 5. above), and according to the manufacturer's instructions and recommendations. No changes will be made to the sealed neutron tube or its encapsulation. For repair and maintenance, the sealed neutron tube contained within the accelerator head will be returned to the manufacturer in its original transport container.	*	[Y]
7.	**INDIVIDUALS RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE** **RSO** Name: Willi G. Schwarz, Ph.D. Training and Experience: see attached description **AU** The only Authorized User (AU) will be the RSO.	* * *	[Y] [Y]

Item No.	Title and Response	Yes	Description Attached
8.	**TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS** A description of the site-specific radiation safety program is attached.	*	[Y]
9.	**FACILITIES AND EQUIPMENT** A description of the facilities and equipment available for storage and use of the sealed neutron tube is attached.	*	[Y]
10.	**RADIATION SAFETY PROGRAM** **Audit Program** Submission not required during the licensing phase.	N/A	N/A
	Radiation Monitoring Instruments A description of the instrumentation that will be used to perform site surveys is attached. If required by applicable regulations for the proposed use, we are prepared to purchase additional monitoring instruments. As described in item 6, the proposed use involves neither the removal of sources from the sealed neutron tube nor any maintenance and repair that involves the source. We will use instruments that meet the radiation monitoring instrument specifications published in Appendix M to NUREG-1556, Vol. 7, 'Program-Specific Guidance About Academic, Research & Development, and Other Laboratory Licenses of Limited Scope', dated Dec. 1999. We reserve the right to upgrade our survey instruments as necessary.	*	[Y]

Item No.	Title and Response	Yes	Description Attached
10.	**RADIATION SAFETY PROGRAM**		
	Material Receipt and Accountability		
	The RSO will place all orders for sealed neutron tubes and will ensure that all sealed sources and devices are authorized by the license. During normal working hours, carriers will be instructed to deliver packages directly to the office of the RSO. Verification, surveying, opening, and documentation for inventory will be performed by the RSO as required. Outside of normal working hours, deliveries will not be accepted. For shipment and transportation, the sealed neutron tube contained within the accelerator head will be packaged in the manufacturer's original transport container, which complies with applicable DOT and NRC regulations. Physical inventories will be conducted at intervals not to exceed 6 months, to account for all sealed sources and devices received and possessed under the license.	*	[Y]
	Occupational Dose		
	We have done a prospective evaluation and determined that unmonitored individuals are not likely to receive, in one year, a radiation dose in excess of 10 percent of the allowable limits in 10 CFR Part 20 or we will monitor individuals in accordance with the criteria in the section entitled 'Radiation Safety Program – Occupational Dose' in NUREG-1556, Vol. 7, 'Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Academic, Research & Development and Other Licenses of Limited Scope', dated Dec. 1999.	*	[Y]
	Public Dose		
	No response is required during the license application phase.	N/A	N/A
	Safe Use and Emergency Procedures		
	A description of the procedures developed for safe use and emergencies is attached.	*	[Y]

Item No.	Title and Response	Yes	Description Attached
10.	**RADIATION SAFETY PROGRAM** **Surveys** Sealed source leak tests will be performed at the intervals approved by NRC or an Agreement State and specified in the SSD Registration Certificate. Leak tests will be performed by an organization authorized by NRC or an Agreement State to provide leak testing services to other licensees or using a leak test kit supplied by an organization authorized by NRC or an Agreement State, to provide leak test kits to other licensees and according to the sealed source manufacturer's and kit supplier's instructions. For maintenance and repair, the sealed neutron tube contained within the accelerator head will be returned to the manufacturer in its original transport container. **Transportation** No response is required during the license application phase. **Minimization of Contamination** No response is required if the applicant's responses meet the criteria in the following sections: "Radioactive Material – Sealed Source", "Facilities and Equipment", "Radiation Safety Program – Safe Use and Emergency Procedures", "Radiation Safety Program – Leak Test", and "Waste Management".	* N/A N/A	[Y] N/A N/A
11.	**WASTE MANAGEMENT** **Sealed Source Disposal and Transfer** We will dispose of the sealed source via transfer to an authorized recipient. No changes will be made to the sealed neutron tube or its encapsulation. For shipping, we will use the manufacturer's original transport container, which complies with applicable NRC and DOT requirements.	*	[Y]

Attachment to Item No. 5

SODITRON Neutron Tube and Accelerator Head

The Soditron neutron tube is a sealed, metal-ceramic vacuum tube measuring 155 mm (6.1 in) in length and 25 mm (1.0 inch) in diameter. The tube consists of a cold cathode ion source (Penning type); a deuterium-tritium (D-T) gas reservoir, ionized via an internal permanent magnet; a 5 micron (0.0002 in) thick target consisting of titanium hydride loaded with a mixture of deuterium and tritium. The beta radiation from the tritium remains contained within the vacuum tube. When a high voltage (90 - 100 kV) is applied across the tube, the deuterium and tritium ions are accelerated across the reservoir, where they undergo fusion reactions with the target to produce 14 MeV neutrons. Upon loss of power, the tube ceases to produce neutrons.

For additional safety and to ease handling, the neutron tube is contained in a sealed Lucite enclosure which itself is contained inside the neutron-emitting module (MEN) or accelerator head. This is a 2 mm (0.08 inch) thick aluminum tube that is 430 mm (17 inches) long and 102 mm (4.0 inches) in diameter. The total weight of the accelerator head is 11.3 kg (25 lbs). In addition to containing the neutron tube, the accelerator head contains the high voltage forming circuitry and wiring that control the tube. A picture of the accelerator head is shown in Figure 1.

No prototype testing criteria for this type of source application has been established. ANSI N540-1975, "Classification of Radioactive Self-Luminous Light Sources" does not apply since this source is not luminous. ANSI/HPS N43.6-1997 "Sealed Radioactive Sources – Classification" (equivalent to ISO 2919) has a usage application for "General neutron source application", but the Soditron neutron tube contains only tritium and it only produces neutrons when a high voltage is applied across it. Thus, the description that follows contains a listing of prototype testing that the source has passed, and comparisons with existing sealed sources that contain tritium. This analysis concentrates on the test results from other tritium sources, comparison of the Soditron neutron tube contained within the accelerator head to other tritium sources, and a justification that the Soditron neutron tube contained within the accelerator head will perform at least as well in those testing environments.

The Soditron neutron tube contained within the accelerator head has been subjected to prototype tests involving

- temperature: 400 °C (752 °F) for a period of one hour, followed by a thermal shock into room-temperature water
- drop tests: dropped multiple times from a height of 60 cm (2 ft).

No malfunction occurred nor was there any loss of shielding or containment integrity. These tests are consistent with expected operating and potential emergency conditions. Under operating conditions, the neutron tube contained within the accelerator head will be placed in a non-moving shield assembly and not subjected to movement or proximity to other objects. During installation and exchange, the accelerator head will be moved only between the shield assembly and the manufacturer's transport container.

For comparison, the neutron tube contained within the accelerator head is compared to Safety Light Corporation's Model 880-12-6-XX (NR-579-D-110-G) tritiated commercial exit sign. This exit sign is used because of the similar use (drop) conditions during handling when performing source installation and exchange. The exit sign has been subjected to testing criteria under ANSI N540-1975 and achieved classification of T6GC1333444.

The end result of containing the neutron tube within the sealed Lucite and metal enclosures is that two additional barriers (in addition to the metal-ceramic tube envelope) must fail for there to be a release of tritium. Thus, under the expected handling conditions, the accelerator head encapsulation will prevent leakage of tritium. The majority of the tritium contained within the neutron tube is in solid form (titanium hydride), with a smaller amount in gaseous form (as opposed to being entirely in gaseous form). Therefore, there is less likelihood of leakage and spread of contamination in the event of tube rupture. In summary, as long as the neutron tube remains contained within the accelerator head encapsulation, the integrity of the radiation source is maintained.

The sealed neutron tube will only be used contained within the accelerator head, and according to the manufacturer's instructions and recommendations. No changes will be made to the sealed neutron tube or its encapsulation. For repair and maintenance, the sealed neutron tube contained within the accelerator head will be returned to the manufacturer in its original transport container.

References:

- Sealed Source and Device (SS&D) Registration Certificate GA-1077-D101-S.

- Specifications for Models N-250 and N-550 Neutron Generator Systems, Activation Technology Corp., 2816 Janitell Road, Colorado Springs, Colorado 80906, Phone: (719) 576-6557.

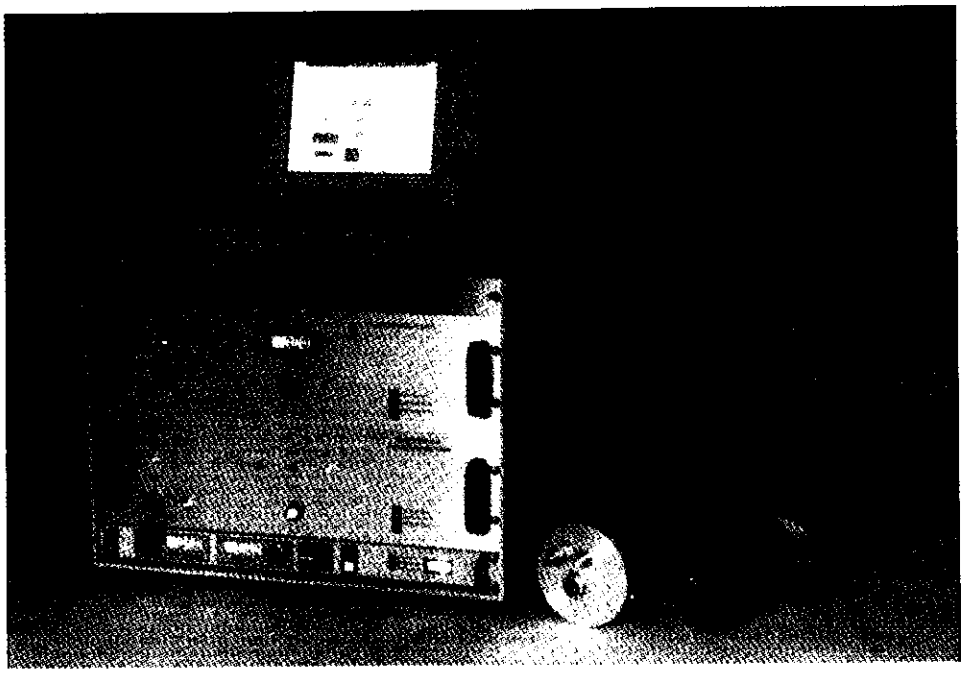

Figure 1. Photograph of encapsulated accelerator heads (bottom right) containing the Soditron sealed neutron tube.

Courtesy of Activation Technology Corporation.

Attachment to Item No. 7

RSO Training and Experience

Name: Willi G. Schwarz, Ph.D.

Training and Experience:

(1) Formal Training

Ph.D., Experimental Atomic and Nuclear Physics, 1991
University of Heidelberg, Heidelberg, Germany

(2) Didactic Training

- Radiation Physics and Instrumentation:
  University of Heidelberg, 2 hrs per wk for 1 yr, 1984-85
  (Lectures and Hands-on Laboratory)

- Radiochemistry:
  University of Heidelberg, 2 hrs per wk for ½ yr, 1984
  (Lectures)

- Radiation Protection and Biological Hazards:
  Radiological Worker I Training, 1994
  Los Alamos National Laboratory (LANL, Los Alamos, NM)
  (Lectures, Self-Study, Theoretical and Practical Test)

  General Employee Radiological Training, 2000
  Brookhaven National Laboratory (BNL, Upton, NY)
  (Self-Study and Theoretical Test)

(3) Practical Experience

Since 1985, development and characterization of radiation detectors as well as experimental investigation of radiation-matter interactions for basic and applied nuclear science research both in the laboratory and at accelerator facilities:

a) University of Heidelberg, Physics Institute, 1985-92

   - Laboratory use of Sr-90, Am-241, Cs-137, Co-60

b) Paul-Scherrer-Institute (PSI), Switzerland, 1985-95
   (formerly Swiss Institute for Nuclear Research (SIN))

- Laboratory use of Sr-90, Na-22, Co-60
- Accelerator experiments using beams of muon (μ) and pion (π) particle radiation at 10-100 MeV energy

c) Rutherford Appleton Laboratory (RAL), UK, 1987-92
(ISIS Spallation Neutron Source)

- Laboratory use of Sr-90, Na-22, Co-60
- Accelerator experiments using beams of muon (μ) particle radiation at 15-30 MeV energy

d) Los Alamos National Laboratory (LANL), Los Alamos, NM, 1992-1995
(Los Alamos Meson Physics Facility, LAMPF;
now Los Alamos Neutron Scattering Center, LANSCE)

- Laboratory use of Sr-90, Am-241, Cs-137
- Accelerator experiments using beams of muon (μ) and pion (π) particle radiation at 20-120 MeV energy

e) Naval Research Laboratory (NRL), Washington, D.C., 1997-2000

- Laboratory use of Tc-99m, Co-57, Cs-137, Am-241

f) Brookhaven National Laboratory (BNL), Upton, NY, 2000-present
(National Synchrotron Light Source, NSLS)

- Laboratory use of Fe-55
- Accelerator experiments using X-ray beams

Attachment to Item No. 8

Site-Specific Radiation Safety Training Program

The sealed neutron tube will remain in the designated laboratory room during storage and use (see description attached to item 9). During neutron tube operation, access to the designated laboratory room, will be prohibited for all individuals, except the RSO and Authorized Users. Other site personnel will be allowed access to the laboratory room only when the neutron tube is not in use. When not in use, the encapsulated sealed source will be stored in a locked fire-resistant steel cabinet to which unauthorized individuals have no access. The multiple sealed enclosures of the accelerator head, within which the sealed neutron tube is contained, provide complete shielding of the 18.6-keV beta radiation from tritium. Therefore, site personnel are unlikely to receive a measurable dose of radiation from the sealed source.

All personnel likely to require access to the laboratory room, in which the sealed neutron tube will be used and stored, will receive site-specific radiation safety training by the RSO. Site personnel comprises two groups:

A. Scientific, Engineering, and Technical Staff;
B. Administrative and Housekeeping Staff.

Individuals from both groups will be allowed access to the laboratory room only when the neutron tube is not in use (see above) and after receiving site-specific safety training by the RSO. Each individual from group A will be provided with a radiation badge and may access the laboratory room without escort. Individuals from group A may enter the laboratory room frequently and for longer periods of time (several hours). Each individual from group B will be required to be escorted by the RSO or an AU for access to the laboratory room. Individuals from group B may enter the laboratory room only occasionally and for short periods of time (a few minutes). Consequently, site-specific radiation safety training for group A will be more detailed and extensive than for group B.

Individuals from group A will receive training in a) general radiation safety and regulatory requirements as applies to sealed sources, and b) site-specific safety requirements. General topics to be covered will include: radiation exposure and effective dose, biological effects, ALARA concept, RSO duties, personnel dosimetry, employee protection, and others as needed. Site-specific topics to be covered will include:

1. User status and obligations
2. License conditions
3. Restricted area
4. Potential hazards in the laboratory room where the sealed source is stored and used
5. Appropriate radiation safety procedures
6. Appropriate response to unsafe conditions or emergencies
7. Employee's right to be informed of radiation exposure
8. Locations where postings are made available
9. Emergency procedures, including RSO contact information and immediate steps
10. Procedure for receiving packages, including notification of RSO and receiving area.

Training will be provided via instruction by the RSO (about 1½ hours), including site tour of the laboratory area, demonstration of badge use and emergency procedures, printed copy of hand-out containing information on applicable radiation safety requirements, and question-and-answer period. In addition to Authorized Users, at least one monitored individual from group A will be trained in the emergency shutdown procedure for the accelerator head.

Individuals from group B will receive training in the following specific topics: a) to not enter the laboratory room without escort by the RSO or an AU, b) to contact the RSO or an AU if access to the laboratory room is needed for any reason, c) to recognize posted symbols and warning signs, and d) how to contact the RSO in case of questions or emergencies. Training will be provided via instruction by the RSO (about 30 minutes), including site tour of the laboratory area, printed one-page hand-out containing a summary of relevant safety information, and question-and-answer period.

All site personnel will receive refresher training on an annual basis, and whenever there is a significant change in duties, regulations, or the terms of the license.

Attachment to Item No. 9

Facilities and Equipment

The sealed neutron tube and accelerator head will be used to perform scientific experiments to test and demonstrate the measurement of material properties using fast and thermal neutrons. During storage and use, the sealed neutron tube contained within the accelerator head will remain in the designated laboratory room. Figure 1 shows a drawing of the laboratory room, which will contain all components, instrumentation, and required safety equipment.

When not in use, the sealed neutron tube contained within the accelerator head will be stored and locked inside a fire-resistant steel cabinet (OSHA and NFPA compliant). The storage cabinet will be labeled on the outside with the appropriate warning signs for licensed materials. The key to the storage cabinet will reside in the office of the RSO. Only the RSO and Authorized Users will be allowed to unlock and open this storage cabinet, and to handle the accelerator head containing the sealed neutron tube. The sealed neutron tube will only be used as contained within the accelerator head, and according to the manufacturer's instructions and recommendations. No changes will be made to the sealed neutron tube or its encapsulation. For repair and maintenance, the sealed neutron tube contained within the accelerator head will be returned to the manufacturer in its original transport container.

Measurements will employ the following main components: 1) the accelerator head containing the sealed neutron tube; 2) radiation shielding around the accelerator head; 3) electronic control unit and power supply; and 4) detector units and readout electronics. The experiment setup, including the accelerator head, the detector units, the material sample, and the surrounding moderation and shielding material will be located in the center of the 22x23-sq.ft. laboratory room. The experiment setup consists of a lower assembly and an upper assembly. The lower assembly is a shielded container of 2.5 x 2.5 sq.ft. cross-section and 2.8 ft. height, designed to contain the material sample. The upper assembly is designed to house the shielded accelerator head.

The sealed neutron tube and accelerator head is described in detail in the attachment to item 5. For operation (neutron production), the RSO or Authorized Users will securely install the accelerator head inside the shielded upper assembly. The installation involves removing the top layer of the shielding material (lead, borated and pure polyethylene) at a height of 5 ft. above the laboratory floor, insertion of the accelerator head into a cylindrical polyethylene tube contained inside the shielded upper assembly, and reinstallation of the shielding material.

Surrounding the experiment setup will be multiple layers of radiation shielding to contain generated neutron and gamma radiation. The shielding will include an inner layer of pure polyethylene, to moderate fast neutrons to thermal energies via collisions with hydrogen atoms, and an outer layer of borated polyethylene (5% B), to effectively attenuate the thermalized neutrons via absorption by the boron atoms. The overall wall thickness of these two layers will be about 15 cm (6 in.). The same layers and material thicknesses will be used

for the vertical plugs on the top and bottom of the upper assembly containing the accelerator head. In addition, both the upper and lower assembly will be surrounded by a third shielding layer provided by stacked bricks of 100% lead to attenuate the gamma radiation from neutron scattering and activation interactions.

Additional shielding will be added where required to reduce the total dose rate to values not exceeding the public dose limit of 0.02 mSv/hr (2 mrem/hr) as well as the allowable limits in 10 CFR Part 20 for occupational exposure, when measured at a distance of 8 ft. or more from the accelerator head (see Figure 1). The circumference of the 8 ft.-radius area will be marked on the laboratory floor. During operation (neutron production), access to the laboratory room will be prohibited for all individuals, except the RSO and Authorized Users. In addition, access to the laboratories and hallways immediately surrounding the designated laboratory room will be limited to site personnel wearing radiation badges. Before starting operation, announcements via loudspeaker will be used to notify site personnel. Bright warning lights installed outside the laboratory doors, to the hallway and neighboring laboratory, respectively, will indicate that operation is On.

The electronics cabinet containing power supply and control unit for the accelerator head will be located on a bench at a distance larger than 10 ft. from the experiment. All necessary equipment needed to operate the neutron generator, control the detectors, and perform data acquisition will be located on this bench. The operator will work behind this bench at a distance larger than 10 ft. from the experiment. The distance from the operator work area to the closest exit door is only about 10 ft., and the path to this door (emergency exit) is straight and completely outside of the 8 ft.-radius circumference.

Sufficiently large polyethylene glove chambers that can be sealed and pressurized will be kept near the storage cabinet, as well as in a cabinet in the neighboring laboratory, such that any (unlikely) release of material from the accelerator head enclosure can be contained in case of damage to the sealed neutron tube.

Personnel dosimeters (radiation badges) will be stored in the facility's administrative section, which is located in a low-radiation area.

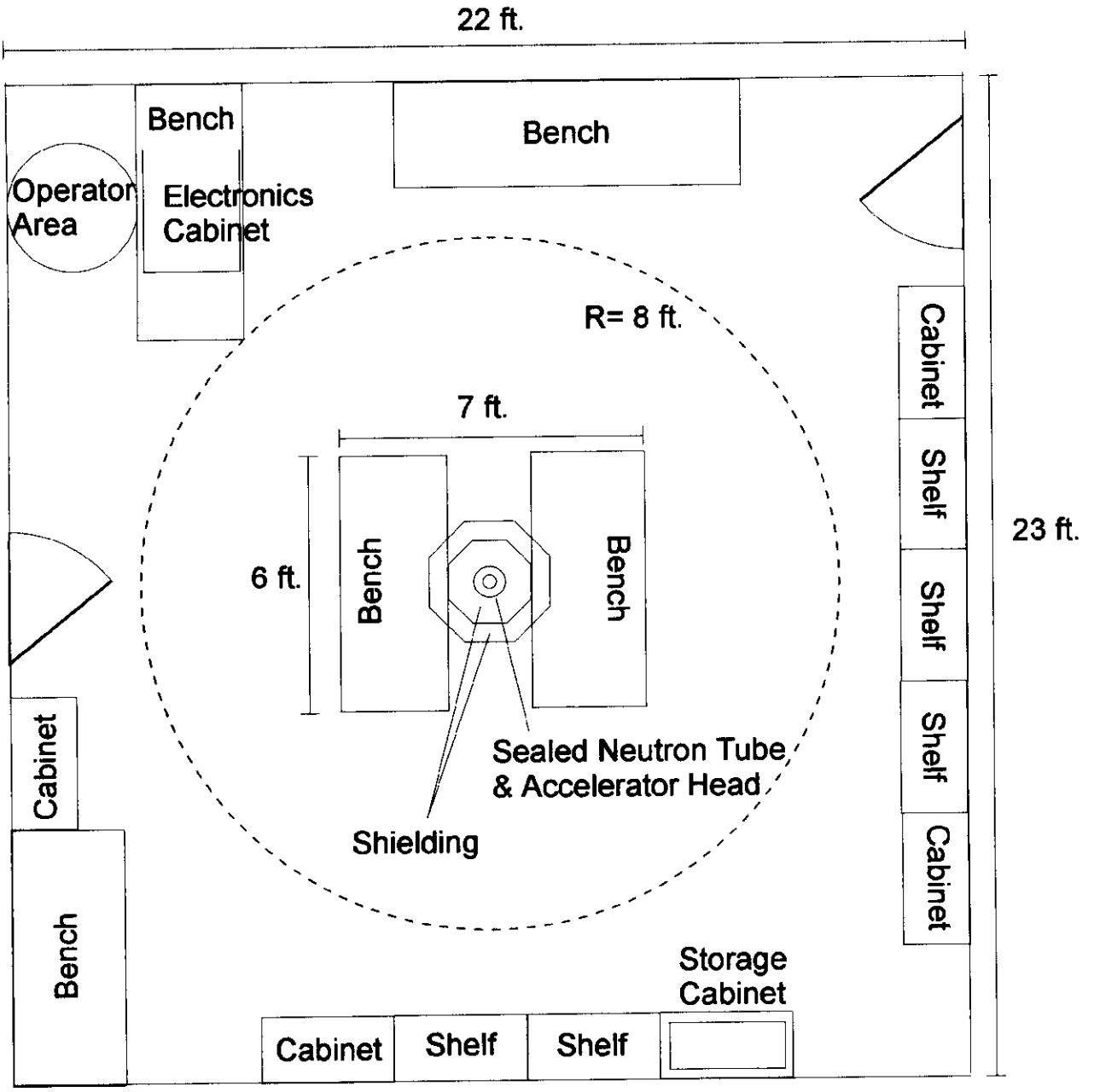

Figure 1. Layout of the designated laboratory room.

Attachment to Item No. 10.2

Radiation Monitoring Instruments

- Portable Beta/Gamma Exposure Rate Meter:

  Bicron Model RSO-5

Radiation:	Beta, Gamma, X-ray
Detector Type:	Ionization Chamber
Range:	4 linear ranges: 0-5 mR/h to 0-5000 mR/h
Efficiency:	80-120% for photons from 25 keV to 7 MeV
	40-90% for betas

- Portable Fast Neutron Count Rate Meter:

  Bicron Model FN1 probe, with Bicron Model SURVEYOR M count rate meter

Radiation:	Fast Neutrons
Detector Type:	BC-720 scintillator
Range:	4 linear ranges: 0-1000 cpm to 0-1,000,000 cpm
Efficiency:	1.6% at 19 MeV
	0.1% at 3.4 MeV
	0.01% at 0.7 MeV

- Portable Thermal Neutron Count Rate Meter:

  Bicron Model TN1 probe, with Bicron Model SURVEYOR M count rate meter

Radiation:	Thermal Neutrons
Energy Range:	BC-702 scintillator
Range:	4 linear ranges: 0-1000 cpm to 0-1,000,000 cpm
Efficiency:	10% at 1 eV
	30% at 0.1 eV
	60% at 0.01 eV

All required instrument calibrations will be performed annually by the instrument manufacturers or by a commercial service company authorized by the NRC or an Agreement State.

Attachment to Item No. 10.6

Procedures for Safe Use and Emergencies

As described in item 6, the proposed use involves neither the removal of sources from the sealed neutron tube nor any maintenance and repair that involves the source. The sealed source will remain in the designated laboratory room during both storage and use (see description attached to item 9). During operation of the sealed neutron tube, access to the laboratory room will be prohibited for all individuals, except the RSO and Authorized Users. When not in use, the encapsulated, sealed neutron tube will be stored in a locked fire-resistant steel cabinet to which unauthorized individuals have no access. Other site personnel will be allowed access to the laboratory room only when the neutron tube is not in use and after receiving site-specific radiation safety training by the RSO (see description attached to item 8).

General rules for working in the designated laboratory room:

- Wear a laboratory coat or other protective clothing at all times.
- Do not eat, drink, smoke, or apply cosmetics.
- Do not store food, drink, or personal effects.
- Wear personnel badges, if required, at all times.
- Be aware of the locations where name and phone number of the RSO are posted.

Procedures for safe handling and use of the sealed neutron tube:

- Only the RSO and Authorized Users are allowed to handle and operate the sealed neutron tube contained within the accelerator head.
- When handling the sealed neutron tube and accelerator head, wear polyethylene gloves to ensure that the high-voltage connectors are kept clean.
- Ensure that the accelerator head is not subjected to unnecessary shocks, stresses, or pressures greater than 5 bar (500 kPa, or 72.5 psi).
- When not in use, store the sealed neutron tube and accelerator head in a locked, fire-resistant steel cabinet.
- Before starting operation (neutron production), ensure that the accelerator head and the material to be measured are surrounded by appropriate radiation shielding (see the

description attached to item 9), such that occupational and public radiation doses will not exceed regulatory limits.

- Before starting operation, ensure that the electronics cabinet, containing power supply and control unit, is located at a distance from the accelerator head to minimize exposure during operation.

- Before starting operation, ensure that all users and, if required, other site personnel wear their radiation badges.

- Before starting operation, turn on the neutron and gamma radiation monitoring instruments and check for proper operation.

- Before starting operation, notify site personnel (for instance, via loudspeaker) to ensure that applicable access restrictions are being observed during operation. Verify that the warning lights located outside the entrance doors to the laboratory are on, indicating operation.

- During operation, only the RSO and Authorized Users are allowed access to the designated laboratory room.

- During operation, ensure that the control unit and power supply remain accessible to the operator at all times.

- Immediately after starting operation, perform survey measurements of neutron and gamma dose rates at several, strategically located positions around the accelerator head inside the laboratory room (near entrance doors, along walls, near electronics cabinet, along 8 ft.-radius circumference around the source). Repeat these survey measurements at the same position periodically during operation, at least each time after resuming and before ending operation. Document measurements.

- If at any time during operation, the total dose rate measured at a distance of 8 ft. or more from the accelerator head exceeds either the public dose limit of 0.02 mSv/hr (2 mrem/hr) or the allowable limits in 10 CFR Part 20 for occupational exposure, stop operation. Improve shielding and/or operate at reduced high voltage to lower the dose rate as required.

- After completion of experiments, turn off the high voltage to the accelerator head (neutron production).

- In case of emergencies, use the emergency stop button located outside of the electronics cabinet to shut down the high voltage to the accelerator head.

Procedures for handling emergencies:

- Name and phone number of the RSO must be posted in conspicuous places, including in the hallway to the designated laboratory room, near the entrance to the laboratory room, and inside the laboratory room.

- Minor Fires:

  • Instructions to Site Personnel

    - Immediately attempt to put out the fire by approved methods, using a fire extinguisher, if other fire hazards or radiation hazards are not present.

    - Notify all persons present to vacate the laboratory room and have one individual immediately call the RSO. Call the fire department if instructed by the RSO or if the fire cannot be put out quickly.

    - Once the fire is out, isolate the area and help determine, under supervision of the RSO, as to whether the fire affected the location where the accelerator head is stored. Instruct all persons involved in combating the fire to assemble outside the laboratory room.

    - Allow no one to return to work in the laboratory room or leave the facility unless approved by the RSO.

    - Cooperate with the RSO in the investigation of the root cause.

  • Reminders to RSO

    - Once the fire is out, instruct all persons involved in combating the fire to remain near the laboratory room until the integrity of the sealed neutron tube contained within the metal enclosure of the accelerator head has been assessed.

    - If the fire affected the location where the accelerator head is stored, assess the integrity of the sealed neutron source contained within the metal enclosure of the accelerator head.

    - If the neutron tube contained within the accelerator head was damaged during the fire, consider the following precautionary measures:
      a) Place the accelerator head inside a polyethylene glove chamber, seal, and (if possible) pressurize the chamber with Nitrogen or Argon gas to prevent the (unlikely) release of any material from the accelerator head enclosure.
      b) Decontaminate all personnel involved in combating the fire by removing potentially contaminated clothing and flushing potentially contaminated skin with lukewarm water, then washing with a mild soap.

c) Determine a plan of surveying the laboratory room for potential contamination and the types of protective devices and survey equipment that will be necessary.

- Consult with fire safety officials to ensure that no other fire hazards exist.

- Determine cause and needed corrective actions. Document incident.

- If necessary, notify NRC.

- Major Emergencies:

• Instructions to Site Personnel

- Notify all persons in the laboratory room to leave immediately.

- Notify the fire department.

- Notify the RSO and other facility safety personnel.

- Upon arrival of emergency personnel, inform them of the present location of the sealed neutron tube and the best possible entrance route to the laboratory room, as well as any precautions to avoid risk of damaging the sealed neutron tube.

- Allow no one to return to work in the laboratory room unless approved by the RSO.

- Cooperate with the RSO in the investigation of the root cause.

• Reminders to RSO

- Coordinate activities with the environmental health & safety officer, and with local fire department.

- Consult with emergency personnel and set up a controlled area where, if necessary, their protective clothing and equipment can be decontaminated after the emergency is over.

- Once the emergency is over, do not allow the emergency workers to enter the laboratory room until a thorough evaluation is performed to determine the extent of damage and to assess the integrity of the sealed neutron source contained within the metal enclosure of the accelerator head.

- If the neutron tube contained within the accelerator head was damaged during the emergency, consider the following measures:
  a) Place the accelerator head inside a polyethylene glove chamber, seal, and (if possible) pressurize the chamber with Nitrogen or Argon gas to prevent the (unlikely) release of any material from the accelerator head enclosure.

b) Decontaminate the emergency workers and their equipment before they leave the controlled area, as well as all personnel involved in combating the fire.
c) Determine a plan of surveying the laboratory room for potential contamination and the types of protective devices and survey equipment that will be necessary.

- Document incident

- If necessary, notify NRC.