DEPARTMENT OF THE ARMY
US ARMY RESEARCH, DEVELOPMENT AND ENGINEERING COMMAND
ARMY RESEARCH LABORATORY
2800 POWDER MILL ROAD
ADELPHI MD 20783-1197

October 30, 2012

J-6
MS-16

Safety Office

Nuclear Regulatory Commission
Region 1
Attn: Mr. Dennis Lawyer
Mail Control Number 579166
475 Allendale Road
King of Prussia, Pennsylvania 19406

03004555

Dear Mr. Lawyer,

Enclosed find an application for amendment to our BML 19-12056-02 license that would allow us to possess and handle up to 880 curies of tritium in the form of sealed sources. This amendment would allow us to possess and handle the tritium at our Aberdeen and Adelphi locations, as well as at demonstration sites around the nation.

The primary Radiation Safety Officer for this license is Mr. Patrick Marine, 410-278-5699, and the alternate is Mr. Michael Borisky, 301-394-6310. If you have any questions please contact them directly.

Your assistance with this request is greatly appreciated.

Sincerely,

Teresa Kines
Associate Director for
Laboratory Operations

Enclosure

579166

NRC FORM 313 **U.S. NUCLEAR REGULATORY COMMISSION**
(05-2012)
10 CFR 30, 32, 33,
34, 35, 36, 39, and 40

APPLICATION FOR MATERIALS LICENSE

APPROVED BY OMB: NO. 3150-0120 **EXPIRES: (05/31/2015)**

Estimated burden per response to comply with this mandatory collection request: 4.3 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 Information Services Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to Infocollects.Resource@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, the 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:

OFFICE OF FEDERAL & STATE MATERIALS AND
ENVIRONMENTAL MANAGEMENT PROGRAMS
DIVISION OF MATERIALS SAFETY AND STATE AGREEMENTS
U.S. NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS:

IF YOU ARE LOCATED IN:

ALABAMA, CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, FLORIDA, GEORGIA, KENTUCKY, MAINE, MARYLAND, MASSACHUSETTS, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, NORTH CAROLINA, PENNSYLVANIA, PUERTO RICO, RHODE ISLAND, SOUTH CAROLINA, TENNESSEE, VERMONT, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA,

SEND APPLICATIONS TO:

LICENSING ASSISTANCE TEAM
DIVISION OF NUCLEAR MATERIALS SAFETY
U.S. NUCLEAR REGULATORY COMMISSION, REGION I
2100 RENAISSANCE BOULEVARD, SUITE 100
KING OF PRUSSIA, PA 19406-2713

IF YOU ARE LOCATED IN:

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

MATERIALS LICENSING BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, IL 60532-4352

ALASKA, ARIZONA, ARKANSAS, CALIFORNIA, COLORADO, HAWAII, IDAHO, KANSAS, LOUISIANA, MISSISSIPPI, 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 BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
1600 E. LAMAR BOULEVARD
ARLINGTON, TX 76011-4511

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)*

A. NEW LICENSE

✓ B. AMENDMENT TO LICENSE NUMBER BML-19-12056-02

C. RENEWAL OF LICENSE NUMBER

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include ZIP code)*

Department of the Army
U.S. Army Research Lab
ATTN: RDRL-LOA
Aberdeen Proving Ground, Maryland 21055

3. ADDRESS WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

Army Research Lab, Aberdeen Proving Ground, Maryland. Army Research Lab, 2800 Powder Mill Road, Adelphi, Md, Demonstrations and testing at various locations around the country as needed including: MacDill Air Force Base, Tampa, FL; Ft. Bragg, NC; DTRA, Springfield, VA; and others locations.

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Patrick Marine, Radiation Safety Officer

BUSINESS TELEPHONE NUMBER	BUSINESS CELLULAR TELEPHONE NUMBER
(410) 278-5699	(443) 619-2765

BUSINESS EMAIL ADDRESS

patrick.m.marine.civ@mail.mil

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. LICENSE FEES *(See 10 CFR 170 and Section 170.31)*

FEE CATEGORY AMOUNT ENCLOSED $

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
Ms. Teresa Kines, Associate Director for Laboratory Operations		2 Nov 12

FOR NRC USE ONLY

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

Item 5. Radioactive Material

a. Element and Mass Number: H-3 (tritium)

b. Chemical and/or Physical Form: Commercially available "sealed source registry" registered tubes, cells, or ampoules with Tritium gas sealed tritium-phosphor inside. These sealed tritium-phosphor sources are typically used in sealed night vision cells or medical radiochemistry labs. These sealed tritium-phosphor cells will be sandwiched between layers of photovoltaic cells. An example appears in the charts attached. In this way a long-lived electrical power source can be created to power ground sensors and network nodes for potential future military application. An optical index-matching epoxy [Norland Optical Adhesive 83H or equivalent] will allow all light output from the tritium-phosphor sources to reach the photovoltaic cells while also providing structural protection to these sandwiched tritium-phosphor sources. To provide even further protection, the assemblies will typically be placed inside a watertight aluminum or plexiglass case which will then be filled with a silicon rubber shock absorbing adhesive [Conathane EN-2521, or equivalent]. See the attached charts for an example of a typical assembly.

At the present time, we have identified the following commercial supplier for sealed tritium - phosphor sources covered under New York State Department of Health, Department of Environmental Radiation Protection, NY-1271-S-101-S, Registry of Radioactive Sealed Sources and Devices, 14 Dec 2006.

mb-Microtec
Freiburgstrasse 634, 3172 Niederwangen, Switzerland
www.mbmicrotec.com
US contact: 510-479-7523
908 Niagara Falls Blvd
North Tonawanda, New York 14120-2019 , USA
http://www.traserusa.com/en/home/index.php

We also wish to be granted the authority to purchase or borrow and possess other sealed sources as long as they are likewise registered on an NRC or agreement state sealed source registry.

c. Maximum Amount that will be possessed at any one time: Each tritium source will typically contain about 100 mCi. The tritium-phosphor sources will be assembled with photovoltaic cells into bundles of up to but not exceeding the Department of Transportation limited quantity package activity limit of 22 Ci. This will allow the bundles to be shipped in limited quantity packages. During development and demonstration efforts, these bundles will be temporarily connected by wires to provide as much electric power as needed. In order to provide the flexibility and power needed, we request permission to assemble and possess forty (40) of these bundles, not to exceed 22 Ci each, for a total possession limit of of 880 Ci of tritium.

Item 6, Purposes for Which Licensed Material Will Be Used

The sealed tritium-phosphor sources will be sandwiched in between layers of photovoltaic cells, an example of which is shown in the attached charts. In this way a long-lived electrical power source can be assembled to power ground sensors and network nodes for potential future military application.

Item 7, Individuals Responsible for Radiation Safety Program and Their Training and Experience

Patrick Marine, Radiation Safety Officer, and Michael Borisky, Alternate Radiation Safety Officer. Michael Borisky will provide the on-site Radiation Safety oversight for the activities conducted at the Adelphi Laboratory Center under this license. See previous license application, amendment, and renewals for the training and experience of Mr. Marine and Mr. Borisky.

Item 8, Training for Individuals Working in or Frequenting Restricted Areas.

The existing training program under this license will be applied to those assembling or handling the tritium sources and bundles. See previous license application, amendment, and renewals for description of training program.

Item 9, Facilities and Equipment.

The tritium-phosphor sources will be shipped by the suppliers to the Army Research Laboratory, Adelphi, MD. All sources/bundles will be labeled as radioactive material, and the area posted as a radioactive material storage area as appropriate. When the assemblies are shipped to non-Adelphi locations to provide demonstrations, they will likewise be appropriately labeled and the areas appropriately placarded.

Because of the sealed nature of the sources, no special facilities or equipment should be needed. We will however take precautions to isolate any accidental release or tritium, and minimize any resulting contamination of facilities, equipment, and property, as well as any dose to personnel. We will designate a separate room for storage and assembly activities. The assembly of the sealed tritium-phosphor sources with layers of photovoltaic cells will be performed in a fume hood and/or a small room equipped with one-pass ventilation that provides at least 6 air exchanges per hour with exhaust to the outdoors. Bulk storage of the tritium containing components and assemblies will also be conducted in this ventilated space. Tritium containing assemblies and components will be removed from the ventilated area from time to time to allow for on-site demonstrations, shipment to other sites for demonstrations, and for on-site and off-site evaluation of assemblies and sub assemblies. But the bulk of the tritium will be kept in a fume hood or ventilated room. It is anticipated that only tens of curies will need to be removed from the hood or ventilated room at any one time.

Item 10, Radiation Safety Program.

The existing radiation safety program under this license will be applied. See previous license application, amendment, and renewals for a description of the Radiation Safety Program. As an additional precaution, wipe/leak testing will be conducted in the storage and assembly area on a periodic basis to check for tritium leakage. When assemblies are shipped to other locations for demonstrations, they will be shipped as limited quantity packages following DOT and NRC regulations. At the demonstration site, a trained radiation worker will be present to receive the package, ensure proper handling and storage, and prepare the shipment for return to Aldephi, Md. At sites that have an NRC license or agreement state license, the receipt, handling, and shipment may be performed by those site personnel under their license.

Item 11, Waste Management.

When the items are no longer needed by ARL, they will either be returned to the manufacturer, transferred to another organization possessing an NRC license or agreement state license, or disposed of as radioactive waste through the Army Radioactive Waste Program, Rock Island, Illinois.

Plan A. COTS Tritium iBat

(100uW ibat)

ARL

Inexpensive: ~$9k power components
$860 T panels, $400 PV panels

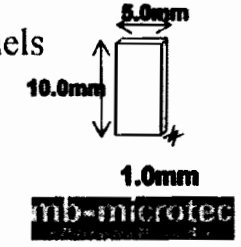
Long Lasting: 12yr half Life

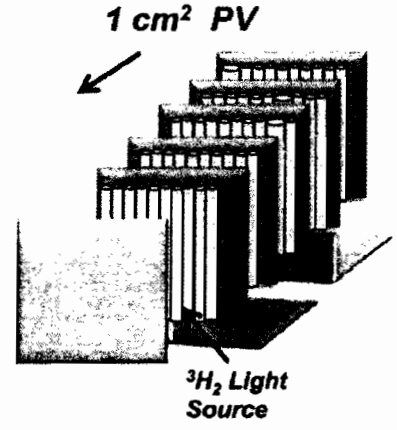
Compact: 25cc

Commercial Component Vendors:
IXYS (PV panels)
MB Microtec (T-panels)

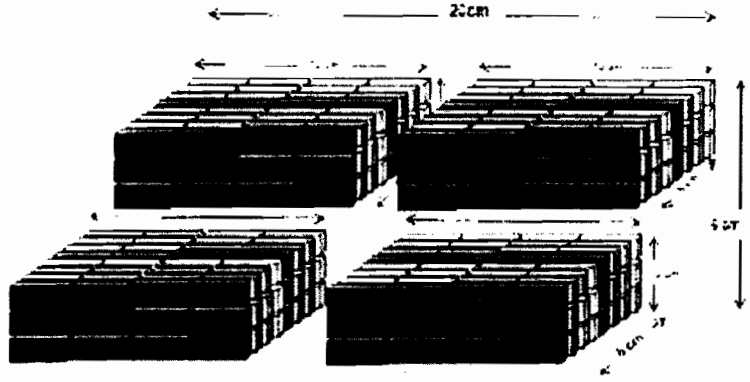
Source: 120Ci

Motivation: inexpensive, off the shelf materials, easily fabricated example



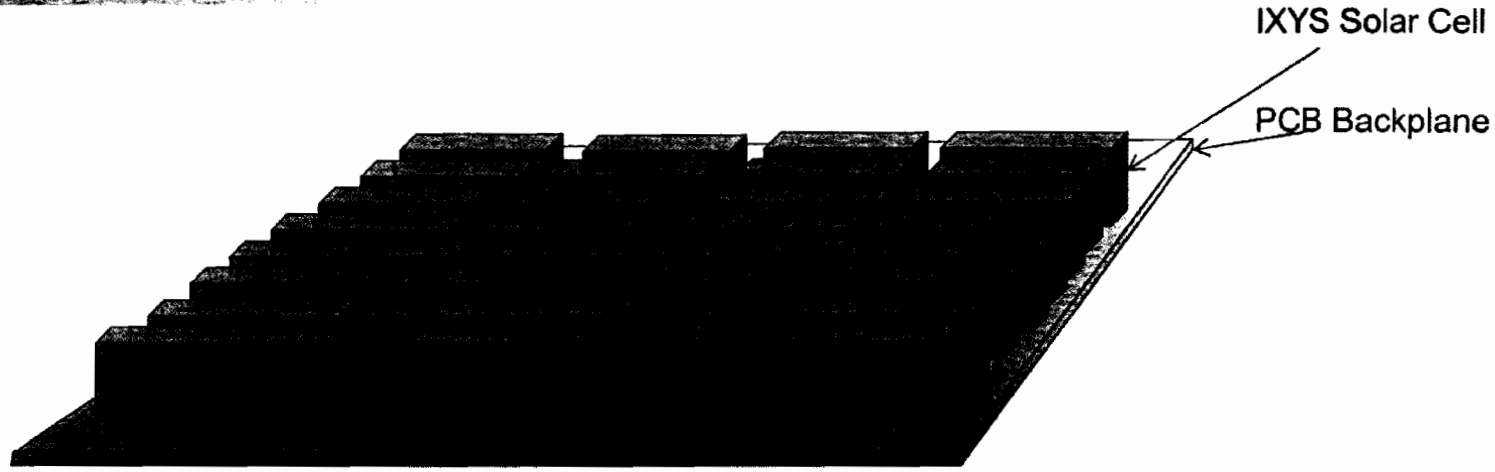


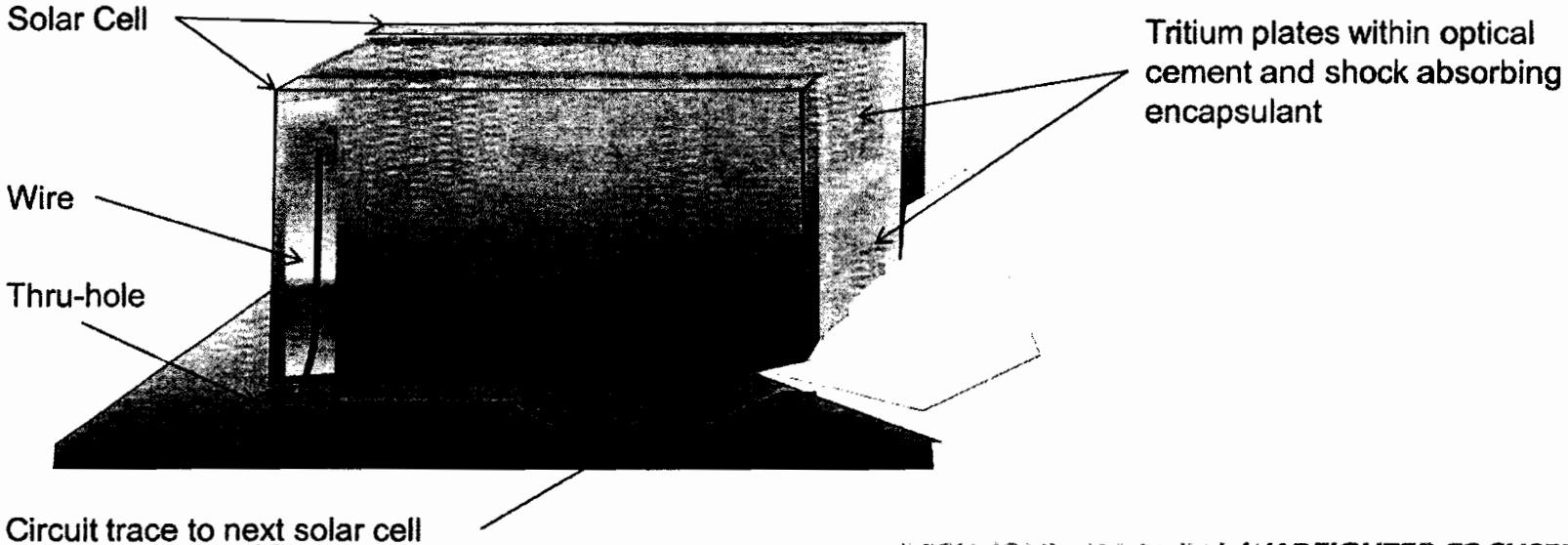
- ➢How much Tritium Do we need?
- ➢For 100 uW$_e$ trickle charge
  - ➢Wopt → We
    - ➢Assume 20% PV conversion
    - ➢~500uW light output required
  - ➢Wrad→Wopt
    - ➢Initial measurement indicates
      - ➢30mCi tritium source ~130nW/cm²
    - ➢120Ci will generate 520uW optical
    - ➢5 exit signs



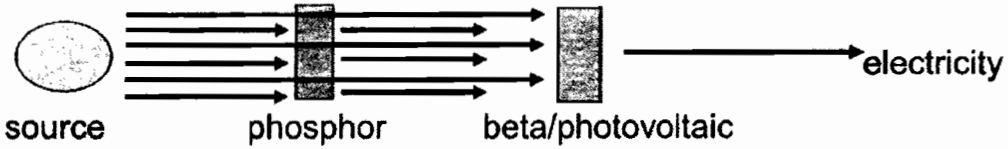
Each quad of power upply is size of cigarette pack, and less toxic

- Power management and control
- Awaiting license approval

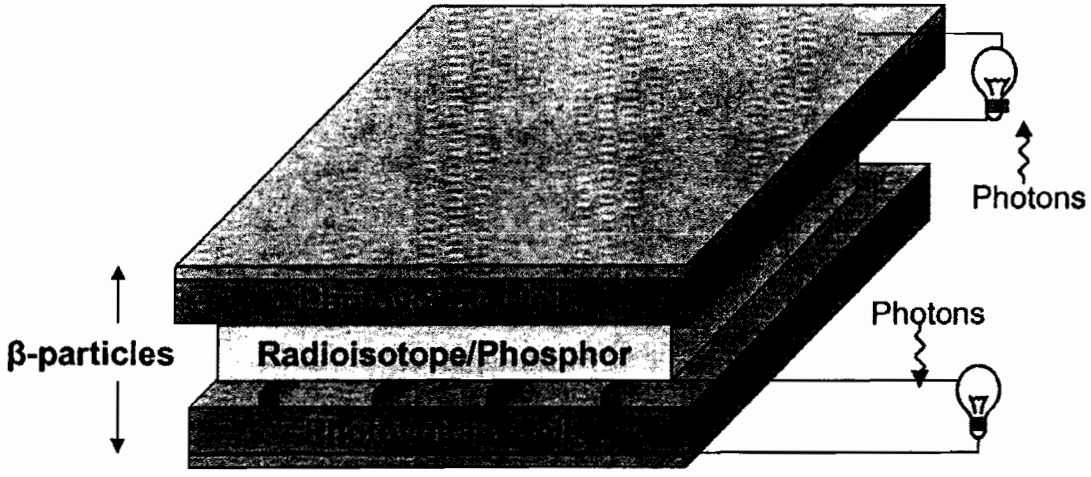




Hybrid



Hybrid with unique phosphor uses both direct and indirect conversion methods to offer best lifetime and power performance



- For use with low energy(<200keV) β emission