

DEPARTMENT OF THE ARMY US ARMY RESEARCH, DEVELOPMENT AND ENGINEERING COMMAND ARMY RESEARCH LABORATORY ABERDEEN PROVING GROUND MD 21005-5067 Br.J

REPLY TO ATTENTION OF

RDRL-LOA-T

6 September 2012

## MEMORANDUM FOR NRC LICENSING ASSISTANCE TEAM

03004555

SUBJECT: REQUEST FOR LICENSE AMENDMENT TO NRC LICENSE 19-12056-02

1. Army Research Laboratory requests the amendment of license 19-12056-02 to allow the possession of up to 880 Ci of tritium gas in sealed ampoules. This material will be used for R& D prototyping work and will be stored and assembled at our Adelphi Maryland location.

2. A NRC form 313 is included with attachments detailing this request.

3. The onsite RSO for this request will be Mr. Michael Borisky who is available at 301-394-6310 to answer any concerns your group may have or to provide clarification. Additional oversight will be provided by Patrick Marine the ARL APG site RSO and RSO of record on license 19-12056-02 who is available at 410-278-5699. Thank you for your consideration of this matter.

Marne

Sincerely Patrick Marine Army Research Lab at APG Radiation Safety Officer/LSO/RFSO Health Physicist 410-278-5699 patrick.m.marine.civ@mail.mil

REC RG 1 SEP 14 12 PM08:43



NMSS/RGN1 MATERIALS-002

NRC FORM 313 (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 G SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO	JIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. THE NRC OFFICE SPECIFIED BELOW.
APPLICATION FOR DISTRIBUTION OF EXEMPT PRODUCTS FILE APPLICATIONS WITH:	IF YOU ARE LOCATED IN:
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	ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND APPLICATIONS TO: MATERIALS LICENSING BRANCH U.S. NUCLEAR REGULATORY COMMISSION, REGION III
ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS:	2443 WARRENVILLE ROAD, SUITE 210 LISLE, IL 60532-4352
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, VIRGINI ISLANDS, OR WEST VIRGINIA,	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:	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 19408-2713	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)	2. NAME AND MAILING ADDRESS OF APPLICANT (Include ZIP code)
A. NEW LICENSE	Department of the Army
B AMENDMENT TO LICENSE NUMBER BML 19-12056-02	U.S. Army Research Lab
	ATTN: KDRL-LOA Aberdeen Proving Ground Md. 21055-5066
3. ADDRESS WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED	4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION
Assembly at: Army Research Lab, Aberdeen Proving Ground,	
the assembly at various locations around the country as needed to	(410) 278-5699 (443) 619-2795
including SOCOM, MacDill AFB, Tampa, FL; SOCOM, Ft.	BUSINESS EMAIL ADDRESS
Bragg, NC; DTRA, Springfield, VA	patrick.m.marine.civ@mail.mil
SUBMIT ITEMS 5 THROUGH 11 ON 8-1/2 X 11" PAPER. THE TYPE AND SCOPE OF INFORM	TION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.
5. RADIOACTIVE MATERIAL Sec attached a. Element and mass number, b. chemical and/or physical form; and c. maiximum 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. See attached	8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS.
9. FACILITIES AND EQUIPMENT. See attached	10 KAUATION SAFETY PROGRAM. See attached
11. WASTE MANAGEMENT. SR2 attached	FEE CATEGORY ENCLOSED \$
13. CERTIFICATION. (Must be completed by applicant) THE APPLICANT UNDERSTANDS THE	AT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING
THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THI CONFORMITY WITH THILE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35 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 C RIA	E APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN , 36, 39, AND 40, AND THAT ALL INFORMATION CONTANED HEREIN IS TRUE AND CORRECT TO NINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO
ANT DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS CERTIFYING OFFICER TYPED/PRINTED NAME AND TITLE	SIGNATURE DATE
FOR NRC USE ONLY	
TYPE OF FEE FEE LOG FEE CATEGORY AMOUNT RECEIVED CHE	COMMENTS
APPROVED BY DATE	

NRC FORM 313 (05-2012)

## **Item 5. Radioactive Material**

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

**b.** Chemical and/or Physical Form: Tritium gas sealed inside of commercially available rectangular or cylindrical shaped sealed tritium-phosphor tubes, cells, or ampoules. These sealed tritium-phosphor tubes are typically used in sealed night vision cells or medical radiochemistry labs, and are available from the commercial sources identified below. These sealed tritium-phosphor cells will be sandwiched in between layers of photovoltaic cells as shown in the attached pictures. In this way a long-lived electrical power source can be created to power ground sensors and network nodes for military application. An optical index-matching epoxy [Norland Optical Adhesive 83H or equivalent] will allow all light output from the tubes, cells, or ampoules to reach photovoltaic cells while also providing structural protection to these sandwiched components. To provide even further protection, the assemblies will typically be placed inside a RoseBopla (or equivalent) watertight aluminum case which will then be filled with a silicon rubber shock absorbing adhesive [Conathane EN-2521, or equivalent]. See the attachment for an illustration of a typical assembly. At the present time, we have identified the following commercial suppliers for the tritium -phosphor tubes, cells, or ampoules:

mb-Microtec Freiburgstrasse 634, 3172 Niederwangen, Switzerland <u>www.mbmicrotec.com</u> US contact: 510-479-7523 908 Niagara Falls Blvd

North Tonawanda, New York 14120-2019, USA http://www.traserusa.com/en/home/index.php

- trigalight® are made out of a borosilicate glass vessel, (mostly tubes) whose inner walls are coated with a phosphorescent material.
- Every trigalight® is filled with tritium up to a max. pressure of 2.5 bar and sealed completely gas proof.

Moravek Biochemicals and Radiochemicals http://www.moravek.com/ 577 Mercury Lane Brea, CA 92821 U.S.A. 1-800-447-0100

**c. Maximum Amount that will be possessed at any one time:** Each tube, cell, or ampoule typically contains 100 mCi. Tubes, cells, or ampoules will be assembled with photovoltaic cells into bundles of up to but not exceeding the Department of Transportation limited quantity activity limit of 22 Ci. This will allow the bundles to be shipped in limited quantity packages. These bundles can then 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 posses forty (40) of these bundles, for a total of 880 Ci of tritium.

## Item 6, Purposes for Which Licensed Material Will Be Used

The sealed tritium-phosphor cells will be sandwiched in between layers of photovoltaic cells as shown in the attached pictures. In this way a long-lived electrical power source can be created to power ground sensors and network nodes for 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. See previous license application, amendment, and renewals for description of training program.

#### Item 9, Facilities and Equipment.

The tritium-phosphor cells units will be shipped by the suppliers to the Army Research Laboratory - Adelphi, bldg 500, Adelphi, MD. Because of the sealed nature of the tubes, cells, and ampoules, 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.

The assembly of the sealed tritium-phosphor cells with layers of photovoltaic cells will be performed in a fume hood and/or a small room, each of which will be equipped with one-pass ventilation that provides at least 6 air exchanges per hour with exhaust to the out doors. 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.

All sources, sub-assemblies, and assemblies will be labeled as containing radioactive material, and areas will be posted as "radioactive material" storage areas as appropriate. When the assemblies are shipped to non-Adelphi locations to provide demonstrations, they will likewise be appropriately labeled with the areas appropriately placarded.

#### Item 10, Radiation Safety Program.

The existing radiation safety program under this license will be applied. See previous license application, amendment, and renewals for description of training program. As an additional

precaution, wipe/leak testing will be conducted in the storage and assembly area on a monthly basis to check for any tritium leakage. When assemblies are shipped to other locations for demonstrations, DOT regulations will be followed, and a trained radiation worker will be at the target site to receive the package, ensure proper handling and storage, and prepare the shipment for return of the assemblies to Aldephi, Md.

## 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 to possess the items, or disposed of as radioactive waste through the Army Radioactive Waste Program, Rock Island, Illinois.

## Goals & Objectives

- Build device for field demonstration
  - ✓ demonstrate tritium safety in PS
  - ✓ demonstrate long-lived capability
  - ✓ lead to sensor adaptation
- Build two demonstration devices PlanA - COTS nightvision cells PlanB - Radiochemical Packaging "I love it when a plan comes together"

## Impact ARL/Army/Soldier

## Advantages:

- power source for long-lived sensors
- drop & forget detection
- contains low-loss on-board power management
- burst-mode capability

## **Disadvantages:**

- low-average-power node support only (100µW)

Collaborations/Resources

Collaborations:

- General Atomics (packaging, optical conversion)
- ORNL (phosphors)
- ARL (power management)

Funding: \$200k total

- GA (\$100k added AMRDEC task)

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- ORNL (\$20k MIPR)

## **GENERAL ATO**

WARFIGHTER FOCUSED





Communicatio-Node self-PS

Long-lived PS for sensors 22mm <sup>3</sup>H<sub>2</sub> Light Source 8nhr Panel 0.8x20x4mm



## Plan A. COTS Tritium iBat (100uW ibat) ARL $1 \, cm^2 \, PV$ Inexpensive: ~\$9k power components \$860 T panels, \$400 PV panels Long Lasting: 12yr half Life 10.0mm **Compact:** 25cc 1.0mm **Commercial Component Vendors:** moiotec IXYS (PV panels) MB Microtec (T-panels) Source: 120Ci <sup>3</sup>H<sub>2</sub> Light Motivation: inexpensive, off the shelf materials, Source easily fabricated example 20cm >How much Tritium Do we need? >For 100 uW trickle charge ≻Wopt → We ➢Assume 20% PV conversion ≻~500uW light output required >Wrad→Wopt >Initial measurement indicates >30mCi tritium source ~130nW/cm<sup>2</sup> >120Ci will generate 520uW optical Each quad of power ≻5 exit signs upply is size of 9x6x2 cr

cigarette pack, and

less toxic

- Power management and control
- Awaiting license approval



# Plan B. GA/ORNL tBat

- Previous efforts
  - 1. GA Engineered Package
    - Welded PV outer capsule
  - 2. ORNL phosphor design
    - Sol Gel Phosphor Encapsulation
- Tritium filled ampoule

*Moravek Biochemicals and Radiochemicals* <sup>13</sup>C, <sup>14</sup>C, <sup>2</sup>H, <sup>3</sup>H, <sup>15</sup>N, <sup>35</sup>S labeled and non-labeled compounds

577 Mercury Lane Brea, CA 92821 U.S.A.

1-800-447-0100











Double encapsulated fuel pellet







#### TECHNICAL DATA:

• Color: Unpainted Version–Bare Aluminum. Special colors are available. See paint specifications in the Technical Section.

- Material: Aluminum, AL Si 12, see Aluminum specification sheets in the Technical Section.
- Gasket Temperature Range: Neoprene Gasket -40°F to +212°F Silicone Gasket -76°F to +266°F RFI Gasket -40°F to +392°F
- Impact Resistance: >7Nm, EN50014
- Captive Stainless Steel Lid Screws
- Protection Classifications:

NEMA Types-up to Nema 4X IP 66, EN 60529

http://www.rosebopla.com/Prod\_Pgs/Basic\_Boxes/Prod\_01\_Aluminum\_Unpaint ed.htm Diecast Aluminum Watertight 01 Enclosures (Unpainted) Part Number Length Inches/mm Width Inches/mm Height Inches/mm Weight Lbs. CAD010813068 4.92/125 3.15/ 80 2.24/ 57 .95 301-696-9800



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UNCLASSIFED\\DISTRIBUTION LIMITED

WARFIGHTER FOCUSED.



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



• For use with low energy(<200keV)  $\beta$  emission





- - 4) ECS300 (ocean) SLMD121H08 (8-array)
  - 6) White Box cell (no leads)

WARFIGHTER FOCUSED

This is to acknowledge the receipt of your letter/application dated		
A copy of your action has been forwarded to our License Fee & Accounts Receivable Branch, who will contact you separately if there is a fee issue involved. Your action has been assigned <b>Mail Control Number</b> <u>579166</u> When calling to inquire about this action, please refer to this control number. You may call us on (610) 337-5398, or 337-5260.		
(0.00)		

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