



**United
Technologies**

Research Center

Date: July 9, 2001

To: Bill Ward
U.S. Nuclear Regulatory Commission
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Number of pages (including cover sheet): 11

Subject: Supporting Documents to Registration Certificate NR-655-D-101-S

Per our telecon, enclosed is the August, 16 1990 letter.

Please contact me if you have any questions.

Thank you,
Glenn Janowsky
United Technologies Research Center



August 16, 1990

U.S. Nuclear Regulatory Commission
Division of Fuel Cycle and Material Safety
Material Licensing Branch
Washington, D.C. 20555

Attention: Steven Baggett

Subject: Application for Device Registration Certificate Amendment

Reference: (a) Application for LTG1 Radiation Safety Evaluation and Device Registration dated July 15, 1986
(b) NRC Device Registration Certificate NR-655-D-101-S
(c) Application for Device Registration Certificate Amendment and Materials License Amendment dated December 16, 1988
(d) NRC Materials License 06-07522-011, Amendment No. 41 issued to United Technologies Corporation, United Technologies Research Center

Enclosures: (A) Check for Application Fees
(B) References

Dear Sir:

Please amend the reference (b) Registration Certificate for the United Technologies Research Center (UTRC) LTG1 Layer Thickness Gage to include the changes listed below.

1. Sealed Source Model Designation⁽¹⁾

Add one additional sealed source designation so that the Gadolinium-153 sealed source capsule used in the LTG1 can be any one of the four listed below (i.e., add source D):

A. Model Gd-1S
GNI, Inc.
202 Medical Center Blvd
Webster, TX 77598

B. Model PHI-153
Isotope Products Laboratories
1800 North Keystone St
Burbank, CA 91504

C. Model NER 8430
DuPont
Medical Products Dept
331 Treble Cove Road
N. Billerica, MA 01862

D. Model GDCCY1
Amersham Corp.
2636 South Clearbrook Dr
Arlington Heights, IL 60005

(1) Ref. b. pg. 1 (attached)
Ref. a. section 1.5, pg. 1 (attached)
Ref. c. section 1, pg. 1 (attached)

In the past, 350 millicurie Gd-153 sealed sources were obtained from U.S. vendors: Gulf Nuclear Industries, Isotope Products Laboratories, and Dupont.

These vendors obtained the Gd-153 from Oak Ridge National Laboratories (ORNL). There is no longer a U.S. supplier producing Gd-153. Amersham Corp. (United Kingdom) manufactures and packages Gd-153. The standard, readily available Amersham Gd-153 source capsule has a nominal activity of one curie and the following specifications:

Model No.: GDCCY1
 Product Code No.: GDC10410
 Capsule: X2093
 ANSI Classification: C64444

This source capsule is registered with the NRC.

The Amersham Gd-153 has lower high-energy Europium impurity levels than the ORNL Gd-153. This allows the use of an Amersham one curie source in the LTG1 device while maintaining low stray radiation levels of less than 2 mr/hr. The measured radiation profiles are as follows:

Distance	Dose (mr/hr)			
	Shutter Closed		Shutter Open	
	ORNL 350 mCi	Amersham 1 Ci	ORNL 350 mCi	Amersham 1 Ci
5 cm	0.05	Bkg	0.40	Bkg
30 cm	Bkg	Bkg	Bkg	Bkg
100 cm	Bkg	Bkg	Bkg	Bkg
Background	0.03	<0.10	0.03	<0.10

Measurements were made using a Victoreen 440 ionization meter.

2. Quality Control

A. Dimensional Tolerances of Source Housing Components⁽²⁾

Small modifications to the collimator and collimator holder were required to accommodate the larger Amersham source capsule (Amersham 7 mm diameter by 10 mm long vs 4.7 mm by 7.9 mm). The ID of the machinable tungsten collimator had to be enlarged and the overall length increased. The depth of the opening in the stainless steel collimator holder was also increased. The minimum allowable wall thickness of the machinable tungsten collimator as stated in the LTG1 Device Registration will remain unchanged at 0.100 inches.

B. Sealed Source Evaluation⁽³⁾

The requirements for evaluating an unshielded, as-received Gd-153 source capsule must be changed from 300 mr/hr at 12 inches to read, the dose rate should not exceed 300 mr/hr at a distance of 20 inches.

(2) Ref. a, section 3.5.A.2, pg. 8 (attached)

(3) Ref. a, section 3.5.B.3, pg. 8 (attached)

3. Shipping⁽⁴⁾

UTRC will transport the source in the assembled housing to the user site. The housing has full radiation shielding and the shutter mechanism is in the off position.

The source housing will be packaged and shipped according to the provisions of 49 CFR 173.422 for excepted instruments or articles. The source housing will be contained in a strong, tight package with a notice including the name of the consignor or consignee and the statement; "This package conforms to the conditions and limitations specified in 49 CFR 173.422 for excepted radioactive material, instruments and articles, UN2911".

4. Training Program

The cover letter which accompanied the original LTG1 device registration application dated July 15, 1986 states that the user training program will be conducted by UTRC's Radiation Safety Officer L.L. Packer and will run a minimum of four hours.

This statement will be changed to allow qualified users as designated by the Radiation Safety Officer to conduct the training program, and said training program will run a minimum of one hour. The general outline of the training program⁽⁵⁾ remains unchanged. Experience with training operators has shown that the training material can be adequately conveyed in about an hour.

5. Fees

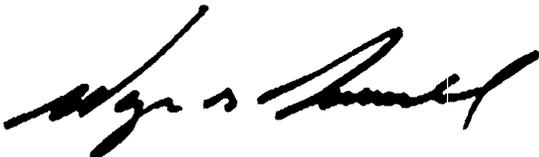
Enclosure (B) is a check drawn to the Nuclear Regulatory Commission in the amount of \$920.00 to cover the application fee:

Category 9A \$920.00 Device Evaluation Amendment

I hope this information will be sufficient to allow you to review and act favorably on the requested amendment. Questions of a technical nature relating to this application should be directed to L.L. Packer at (203) 727-7009. Questions of an administrative nature should be directed to W. H. Leete at (203) 727-7306.

Very truly yours,

UNITED TECHNOLOGIES CORPORATION
Research Center



Wayne G. Burwell
Director of Research

(4) Ref. c, section 3.1.2, pg. 4 (attached)
Ref. c, section 3.1.5, pg. 4 (attached)

(5) Ref. a, enclosure A, section 3.10G, pg.
12 & 13 (attached)

(1) Reference b, pg. 1

**REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF DEVICE**

NO: NR-655-D-101-S DATE: FEB 20, 1987 PAGE: 1 of 5

DEVICE TYPE: Layer Thickness Gage

MODEL: LTG1

MANUFACTURER/DISTRIBUTOR: United Technologies Corporation
United Technologies Research Center (UTRC)
Silver Lane
East Hartford, CT 06108

SEALED SOURCE MODEL DESIGNATION: GNI Incorporated Model GD-1S

ISOTOPE: Gadolinium-153 MAXIMUM ACTIVITY: 350 millicuries

LEAK TEST FREQUENCY: 6 months

PRINCIPAL USE: (D) Gamma Gauge

CUSTOM DEVICE: _____ YES NO

The Layer Thickness Gauge (LTG1) is specifically designed and constructed by UTRC for use only by United Technologies Corporation (UTC) divisions, subsidiaries and vendors under exclusive contract to UTC for the production of certain jet engine components requiring the use of an LTG1. UTC will retain ownership of any LTG1 fabricated for use by a vendor.

The following information is submitted in support of United Technologies Research Center's (UTRC) application for NRC's radiation safety evaluation and registration of a nonportable gaging device containing byproduct material.

Section 1. SUMMARY DATA

1. Date: July 15, 1986
2. Applicant: United Technologies Corporation
United Technologies Research Center (UTRC)
Silver Lane
East Hartford CT 06108
UTRC is the manufacturer and distributor of the device

Technical Contact at UTRC regarding questions about this submittal is:

L. L. Packer, Chief OR G.A.Gruver
Chemical Analysis and Processing
203-727-7009 203-727-7469

3. Device Type: Layer Thickness Gage
4. Model: LTG1
5. Radioactive Source Model Designation:
Model Number GD-1S (Registered in Texas)
- Manufactured by: GNI Incorporated
202 Medical Center Blvd.
Webster Texas 77598
6. Isotope and Maximum Activity: Gadolinium-153 350 millicuries

It is proposed that this device will be used under a specific license to be procured by each intended user, or under an properly amended materials license if the user already has a materials license.

7. Leak Test Frequency: Six (6) months
9. Principal Use: Code D Gamma Gage
10. Custom Device: Yes

The Layer Thickness Gage (LTG1) is specifically designed and constructed by UTRC for use only by United Technologies Corporation (UTC) divisions, subsidiaries and vendors under exclusive contract to UTC for the production of certain jet engine components requiring the use of an LTG1. UTC will retain ownership of any LTG1 fabricated for use by a vendor, but the vendor will obtain, with UTRC's assistance, a specific license authorizing him to possess and use the LTG1.

(1) Reference c, section 1, pg. 1

December 16, 1988

U. S. Nuclear Regulatory Commission
Nuclear Materials Safety & Safeguards Branch
Region I
King of Prussia, PA 19406

Attention: John Glenn

Subject: Application for Device Registration Certificate Amendment and Materials License Amendment

Reference: (a) NRC Device Registration Certificate NR-655-D-101-S
(b) NRC Materials License 06-07522-01, Amendment No. 41 issued to United Technologies Corporation, United Technologies Research Center
(c) Letter to D. Mackenzie (NRC) from L. Packer (UTRC) dated January 19, 1987
(d) Letter to J. Glenn (NRC) from L. Packer (UTRC) dated April 30, 1987

Enclosures: (A) Gd-153 sealed source test results from DuPont
(B) Check for Application Fees

Dear Sir:

Please amend the reference (a) Registration Certificate for the United Technologies Research Center (UTRC) LTG1 Layer Thickness Gage to include the changes listed below.

1. Sealed Source Model Designation

Add two additional sealed source designations so that the Gadolinium-153 sealed source capsule used in the LTG1 can be any one of the three listed below (i.e., add sources B and C):

A. Model Gd-1S
GNI, Inc.
202 Medical Center Blvd
Webster, TX 77598

B. Model PHI-153
Isotope Products Laboratories
1800 North Keystone St
Burbank, CA 91504

C. Model NER 8430
DuPont
Medical Products Dept
331 Treble Cove Road
N. Billerica, MA 01862

- (2) Reference a, section 3.5.A.2, pg. 8
- (3) Reference a, section 3.5.B.3, pg. 8

3.5 Quality Control

UTRC has a quality control program and procedures to insure that each LTG1 meets the design specifications for a custom device as represented to NRC in this application.

A. Dimensional Tolerances of Source Housing Components

The following components of the source housing assembly will be inspected to insure that dimensional tolerances are within specification after fabrication:

1. Source capsule components to be provided to GNI meet tolerances as described in Figure 8 and are tested to insure good fit.
2. **Machinable tungsten collimator will have a minimum wall thickness greater than 0.100 inches.**
3. Machinable tungsten frontal shield will have a minimum thickness greater than 0.100 inches.
4. The copper inner cooling jacket will have a minimum thickness in the beam area of 0.025 inches.

Additional inspections during source housing assembly will be done to insure that the high temperature ceramic adhesive was applied to properly seal the 0.01 inch thick stainless steel window over the collimator aperture and to properly seal the mating surfaces of the two-piece collimator assembly.

B. Sealed Source Evaluation

1. All packing slips and leak test certificates from GNI for incoming Gd-153 sealed sources will be checked for conformance to UTRC's order before testing begins.
2. The radiation field from an unshielded, as-received Gd-153 source capsule is measured at contact through 1/8 inch of lead to determine the presence of high energy contamination. This dose rate must be less than 25 mr/hr for a 350 mCi source.
3. **The dose rate from an unshielded, as-received Gd-153 source capsule is measured at one foot. The dose rate should not exceed 300 mr/hr. This ensures that the source intensity does not exceed 350 mCi of gadolinium 153.**

Note: All dose rate readings will be obtained with an ion chamber dose rate meter such as the Victoreen 440 meter.

4. The sealed source will then be leak checked. The source is wiped and the wipe is measured using a windowless flow gas proportional counter such as a NMC PC-55 proportional counter. The removable contamination must be less than 0.005 microcuries.

- (4) Reference c, section 3.1.2, pg. 4
Reference c, section 3.1.5, pg. 4

- (2) UTRC will transport the source in the assembled housing to the user site. The housing has full radiation shielding and the shutter mechanism is in the off position. A commonly used UTRC procedure for packaging and transporting gadolinium-153 off-site to a user location was given in Item 10, Reference (d), and is repeated below:

UTRC will ship the source housing assembly in an approved D.O.T. 7A shipping carton, conforming to all conditions and limitations specified in 49 CFR 173.422 for excepted radioactive material, instruments and articles, n.o.s. UN2911. The transport index is determined by measuring dose rate at 1 meter from the package containing the fully shielded source; measured levels are background. The package contains a copy of the leak test certificate inside. The package is shipped Radioactive 1 -White Label (no transport index required). The Shippers Certificate is filled out and attached to the outside of the box. UTRC may also elect to transport the gage to and from the customer's site, locked in a company vehicle or company authorized vehicle. All licensed material will be transported in accordance with 10 CFR, Part 71.

- (3) UTRC will remove the original LTG1 source housing from the gage assembly bracket and install the replacement.
- (4) UTRC will perform a contamination survey at the user site to confirm that no contamination remains from the original source. Leak test wipes will be prepared. Operations in the area will be resumed when either:
- a. Negative leak test results are obtained by qualified UTRC personnel counting the wipes at the user site using a portable wipe test counter (such as the Victoreen Model 05-578; see data sheets attached) able to detect contamination on each wipe sample of 2000 dpm.
- or: b. The wipes will be checked on-site using a sensitive contamination meter such as a Victoreen Minimonitor-125 G-M meter. If the results are negative, UTRC will advise the user that the area is uncontaminated and that operations can be resumed. The wipes will then be taken to UTRC for the standard, complete leak test analysis.
- (5) UTRC will transport the original source housing back to UTRC where it will be disassembled prior to source disposal. [Note: The original Gd-153 source activity may have decayed sufficiently so that the source will qualify as "limited quantities of radioactive materials" as defined in 49 CFR Part 173.423 (i.e., < 200 mCi). If this is the case, the source may be packaged and transported conforming to all conditions and limitations specified in 49 CF Part 173.421 for excepted radioactive material, limited quantity, n.o.s., UN2910.]

(5) Reference a, enclosure A, section 3.10G, pg. 12

G. UTRC will conduct a user training Program as detailed below.

The basic elements of the training program will meet the requirements set forth in Title 10 Sections 19 and 20, and deal with:

- Instruction of personnel
- Accountability of byproduct materials

Personnel responsible for using the layer thickness gage will be instructed by UTRC in the following items:

- (1) Basic requirements of Title 10 Sections 19 and 20 regarding instruction of personnel in record keeping and accountability
- (2) The nature of the radiation emitted by gadolinium-153
- (3) Concepts of dose rate and means of measuring radiation emitted by gadolinium-153
- (4) Layer Thickness Gage safety features, including beam shutter, water cooling, radiation shielding, heat shield, source temperature thermocouple and cooling water flow switch
- (5) Mechanical construction features of the Layer Thickness Gage, including bracket alignment
- (6) Operation of the LTG shutter mechanism and periodic checking to ensure that the rotating mechanism properly locks the shutter in the open and closed positions
- (7) Use of photographic film to check beam alignment relative to parts and detector housing
- (8) Maintenance procedures for:
 - a. removal of stray powder buildup on the source and detector housings
 - b. insuring proper air cleanoff nozzle attached to the outside of the source and detector housings (to keep stray powder from accumulating in the beam)
 - c. source thermocouple replacement
 - d. cooling water flow indicator
 - e. cooling water flow switch
 - f. protective heat shield for source assembly
- (9) Method for performing wipes required for six month leak testing and mailing wipes to UTRC for assay (see Appendix B)
- (10) Removal and reinstallation of the Layer Thickness Gage from the plasma spray rig
- (11) Procedures for shipping LTG to UTRC for source replacement

(5) Reference a, enclosure A, section 3.10G, pg. 13

(12) Procedures to follow in the event the LTG system is inoperable due to:

- a. Inadequate water flow
- b. Source thermocouple indicating a high temperature condition
- c. damage to the source shutter mechanism
- d. water leaks in the cooling water system

(13) Emergency procedures to follow in the event of:

- a. fire
- b. explosion
- c. loss of cooling water

(14) Source disposal - user is required to return the LTG to UTRC for source removal and for UTRC to certify that the LTG contains no residual radioactive material