FORM AEC-2
(3-64)
Previous editions are obsolete.

FORM APPROVED
BUREAU OF BUDGET NO. 38-R002

UNITED STATES ATOMIC ENERGY COMMISSION

APPLICATION FOR SOURCE MATERIAL LICENSE

Pursuant to the regulations in Title 10, Code of Federal Regulations, Chapter 1, Part 40, application is hereby made for a license to receive, possess, use, transfer, deliver or import into the United States, source material for the activity or activities described.

1. (*Check one*)
   - ☐ (*a*) New license
   - ☐ (*b*) Amendment to License No. ______
   - ☒ (*c*) Renewal of License No. STB-53
   - ☐ (*d*) Previous License No. ______

2. NAME OF APPLICANT

General Electric Co., Aircraft Engine Group

3. PRINCIPAL BUSINESS ADDRESS

Mail Drop B-14
Cincinnati, Ohio 45215

4. STATE THE ADDRESS(ES) AT WHICH SOURCE MATERIAL WILL BE POSSESSED OR USED

General Electric Co., Cincinnati, Ohio 45215
General Electric Co., Peebles, Ohio 45660

5. BUSINESS OR OCCUPATION

Devel. & Mfg. jet engines

6. (*a*) IF APPLICANT IS AN INDIVIDUAL, STATE CITIZENSHIP

(*b*) AGE

7. DESCRIBE PURPOSE FOR WHICH SOURCE MATERIAL WILL BE USED

A)Up to 4% Thorium in magnesium alloy utilized in jet engine parts for strength weight ratio. B) Up to 4% Thorium in nickel base alloy utilized in jet engine parts for high temperature thermal fatigue resistance. c) Depleted uranium used as flywheel on a caterpiller model 400A inertia weld machine.

8. STATE THE TYPE OR TYPES, CHEMICAL FORM OR FORMS, AND QUANTITIES OF SOURCE MATERIAL YOU PROPOSE TO RECEIVE, POSSESS, USE, OR TRANSFER UNDER THE LICENSE

(*a*) TYPE	(*b*) CHEMICAL FORM	(*c*) PHYSICAL FORM (*Including % U or Th.*)	(*d*) MAXIMUM AMOUNT AT ANY ONE TIME (*in pounds*)
NATURAL URANIUM			
URANIUM DEPLETED IN THE U-235 ISOTOPE	Depleted uranium encased in steel	100%	7275 kilograms
THORIUM (ISOTOPE)	Magnesium alloy Nickel alloy	Max 4% thorium Max 4% thorium	546 kilograms thorium 500 kilograms thorium

(*e*) MAXIMUM TOTAL QUANTITY OF SOURCE MATERIAL YOU WILL HAVE ON HAND AT ANY TIME (*in pounds*)

1046 kilograms thorium plus 7275 kilograms depleted uranium

9. DESCRIBE THE CHEMICAL, PHYSICAL, METALLURGICAL, OR NUCLEAR PROCESS OR PROCESSES IN WHICH THE SOURCE MATERIAL WILL BE USED, INDICATING THE MAXIMUM AMOUNT OF SOURCE MATERIAL INVOLVED IN EACH PROCESS AT ANY ONE TIME, AND PROVIDING A THOROUGH EVALUATION OF THE POTENTIAL RADIATION HAZARDS ASSOCIATED WITH EACH STEP OF THOSE PROCESSES.

See Attachment 9TH and 9U

10. DESCRIBE THE MINIMUM TECHNICAL QUALIFICATIONS INCLUDING TRAINING AND EXPERIENCE THAT WILL BE REQUIRED OF APPLICANT'S SUPERVISORY PERSONNEL INCLUDING PERSON RESPONSIBLE FOR RADIATION SAFETY PROGRAM (OR OF APPLICANT IF APPLICANT IS AN INDIVIDUAL).

See Attachment 10TH and 10U

11. DESCRIBE THE EQUIPMENT AND FACILITIES WHICH WILL BE USED TO PROTECT HEALTH AND MINIMIZE DANGER TO LIFE OR PROPERTY AND RELATE THE USE OF THE EQUIPMENT AND FACILITIES TO THE OPERATIONS LISTED IN ITEM 9; INCLUDE: (a) RADIATION DETECTION AND RELATED INSTRUMENTS (including film badges, dosimeters, counters, air sampling, and other survey equipment as appropriate. The description of radiation detection instruments should include the instrument characteristics such as type of radiation detected, window thickness, and the range(s) of each instrument).

See Attachment 11TH (a) and 11U (a)

(b) METHOD, FREQUENCY, AND STANDARDS USED IN CALIBRATING INSTRUMENTS LISTED IN (a) ABOVE, INCLUDING AIR SAMPLING EQUIPMENT (for film badges, specify method of calibrating and processing, or name supplier).

See Attachment 11TH (b) and 11U (b)

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11(c). VENTILATION EQUIPMENT WHICH WILL BE USED IN OPERATIONS WHICH PRODUCE DUST, FUMES, MISTS, OR GASES, INCLUDING PLAN VIEW SHOWING TYPE AND LOCATION OF HOOD AND FILTERS, MINIMUM VELOCITIES MAINTAINED AT HOOD OPENINGS AND PROCEDURES FOR TESTING SUCH EQUIPMENT.

See Attachment 11TH (c)
For depleted uranium, no ventilation required because no airborne contaminants generated.

12. DESCRIBE PROPOSED PROCEDURES TO PROTECT HEALTH AND MINIMIZE DANGER TO LIFE AND PROPERTY AND RELATE THESE PROCEDURES TO THE OPERATIONS LISTED IN ITEM 9. INCLUDE: (a) SAFETY FEATURES AND PROCEDURES TO AVOID NONNUCLEAR ACCIDENTS, SUCH AS FIRE, EXPLOSION, ETC., IN SOURCE MATERIAL STORAGE AND PROCESSING AREAS.

See Attachment 12TH (a) and 12U (a)

(b) EMERGENCY PROCEDURES IN THE EVENT OF ACCIDENTS WHICH MIGHT INVOLVE SOURCE MATERIAL.

See Attachment 12TH (b) and 12U (b)

(c) DETAILED DESCRIPTION OF RADIATION SURVEY PROGRAM AND PROCEDURES.

See Attachment 12TH (c)
No radiation survey program required for uranium.

13. WASTE PRODUCTS: *If none will be generated, state "None" opposite (a), below. If waste products will be generated, check here* ☒ *and explain on a supplemental sheet:*

(*a*) Quantity and type of radioactive waste that will be generated. (None for uranium)

(*b*) Detailed procedures for waste disposal.

14. IF PRODUCTS FOR DISTRIBUTION TO THE GENERAL PUBLIC UNDER AN EXEMPTION CONTAINED IN 10 CFR 40 ARE TO BE MANUFACTURED, USE A SUPPLEMENTAL SHEET TO FURNISH A DETAILED DESCRIPTION OF THE PRODUCT, INCLUDING:

(*a*) PERCENT SOURCE MATERIAL IN THE PRODUCT AND ITS LOCATION IN THE PRODUCT.

(*b*) PHYSICAL DESCRIPTION OF THE PRODUCT INCLUDING CHARACTERISTICS, IF ANY, THAT WILL PREVENT INHALATION OR INGESTION OF SOURCE MATERIAL THAT MIGHT BE SEPARATED FROM THE PRODUCT.

(*c*) BETA AND BETA PLUS GAMMA RADIATION LEVELS (*Specify instrument used, date of calibration and calibration technique used*) AT THE SURFACE OF THE PRODUCT AND AT 12 INCHES.

(*d*) METHOD OF ASSURING THAT SOURCE MATERIAL CANNOT BE DISASSOCIATED FROM THE MANUFACTURED PRODUCT. See Attachment 14

CERTIFICATE

(*This item must be completed by applicant*)

15. *The applicant, and any official executing this certificate on behalf of the applicant named in Item 2, certify that this application is prepared in conformity with Title 10, Code of Federal Regulations, Part 40, and that all information contained herein, including any supplements attached hereto, is true and correct to the best of our knowledge and belief.*

General Electric Company
Aircraft Engine Group
(*Applicant named in Item 2*)

Dated December 8, 1978

BY: J. D. Engel
(*Print or type name under signature*)

J.D. Engel
Manager of Industrial Hygiene
(*Title of certifying official authorized to act on behalf of the applicant*)

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.

GENERAL ELECTRIC

AIRCRAFT ENGINE GROUP

GENERAL ELECTRIC COMPANY . . . . CINCINNATI, OHIO 45215
Phone (513) 243-2000

Nov. 30, 1978

N.R.C. Source Materials License #STB-53 Renewal Application

Attachment 9TH

For magnesium-thorium alloy
Jet engine components of magnesium-thorium alloy are received as precast or forged stock and require only conventional machining operations (such as surface turning and milling, and hole drilling and threading) to fabricate a finished component. Largest component machined or handled at one time weighs 72 pounds. No external radiation hazard present and surface radiation level is quite low such that items can be safely handled by hand. Air sampling of machining operations on magnesium-thorium alloy over the last ten years has indicated that airborne radiation is low, usually at natural background levels and that exhaust systems for thorium per se have not been required. If changes in processing technique would produce excess radiation level in air, then exhaust systems would be added as described in attachment 11. No chemical or metallurgical processing done on these components except the above machining procedures. Because of the low radiation levels, no film badging or biological monitoring will be done unless changes in processing and air sampling analysis indicate a need. We have complete medical and laboratory facilities and full-time physicians to do biological monitoring if such would become necessary.

For nickel-thorium alloy
Nickel-thorium alloy is received precast or forged from a selected vendor and then General Electric fabricates the items into certain jet engine components using conventional machining as noted above, wet and dry grinding, spot and tack welding, heat treatment, and electrolytic depletion processes for hole drilling and metal scalloping. Various combinations of the above are used in fabrication. Machining, grinding and welding are standard industrial processes, heat treat is at 2450 degrees F up to 8 hours, and electro-depletion processes are essentially the removal of small amounts of metal by use of current, electrodes, and inorganic electrolyte solutions.
Each operation is first evaluated by the Radiation Protection Officer noted in Attachment 10. Evaluations consist of surface and general air monitoring with radiation survey meters and air samplings to determine airborne radiation. From these results, the extent of radiation exposure can be determined and where necessary controls such as exhaust ventilation added to bring radiation exposure within limits of N.R.C. Title 10, part 20. To date our experience with the nickel-thorium has indicated that air concentrations have been within allowable limits. Air samples are taken at least every 90 days for ongoing processes, and more frequently for new processes until stable conditions are indicated. It should be noted that the nature of jet engine component fabrication is a batch process rather than assembly line. Under these conditions of very intermittant processing the extent of any radiation exposure is further reduced.
The largest single piece fabricated or handled at one time is 100 pounds, however 99 percent of components will be five pounds or less. No external radiation hazard exists from general handling. Typically the alloy surface radiation beta/gamma level is a few tenths of a millirem per hour. No film badging or biological monitoring planned because of low radiation level as noted above for magnesium.

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Attachment 9U: General Electric will use two 8000 pound flywheels on the Caterpiller Model 400A Inertia Welder to provide the inertia energy used to weld jet engine parts together. There will be no chemical, physical, or metallurgical processing done on the flywheels. There are no radiation hazards as the uranium will be fully encased in $\frac{1}{4}$ inch steel. The radiation levels through the steel will be low and no personnel will receive 25% of the annual allowable dose. Personnel will be at least ten feet away from the flywheels. The area of use is secured by 10 ft. high chain link fence plus the 8000 pound weight prevents unauthorized removal.

The two 8000 pound flywheels are lifted separately into the inertia welder by overhead crane of sufficient capacity. The flywheels are secured in the inertia welder by a series of 1 inch diameter bolts.

Attachment 10TH: J.D. Engel, Sc.D., Manager of Industrial Hygiene and Radiation Protection Officer for General Electric Aircraft Engine Group, is responsible for this radiation protection program. He is part of the Medical Department of General Electric and has had eleven years experience in radiation safety and industrial hygiene at General Electric. He provides similar radiation controls for our N.R.C. license #34-00499-10 for industrial radiography; #34-00499-07 and 08 for byproduct material as well as STB-53. In addition he is responsible for radiation protection for use of some 40 X-ray producing devices (including 8 mev linear accelerator) used in manufacture and inspection of jet engines and components. Previous to General Electric, experience included three years work in toxicology using radioisotopes to study metabolism of toxic compounds at the University of Cincinnati College of Medicine, Department of Environmental Health; and four years as graduate student in doctorate program in environmental health at the University of Cincinnati. Radiation health and safety training has included several graduate-level courses in connection with the doctorate program (80 hours lab and lecture). Supervisory personnel involved in the fabrication of magnesium or nickel alloys containing up to four percent thorium are given instruction and training in radiation safety by J.D. Engel. Such supervisory personnel are with college degrees or college-level training.

Attachment #10U: J.D. Engel, Sc.D., Radiation Protection Officer, is also responsible for the radiation protection program for the depleted uranium flywheels. Supervisory personnel involved in use of flywheels will be trained by J.D. Engel in radiation safety aspects of encased depleted uranium, including physical control of flywheel and not abandoning them.

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Attachment 11TH (a): Surface and general area radiation levels are monitored with the following radiation survey meters:

Victoreen Model 490 Thyac III equipped with alpha, beta, gamma probe (0-200mR/hr. range)

Victoreen Model 440 alpha, beta, gamma (0-300mR/hr. range)

Air samples are taken with Staplex high volume (75 cfm) air samplers using Whatman #41 filter paper and then analyzed for thorium activity using a Nuclear Measurements Corp. Model PC3B internal proportional counter. Wipe tests (for fires etc.) are made with Whatman #50 smear tabs and analyzed with the Model PC3B.

Process control equipment where required is as follows (note that magnesium alloy is machined only, and the nickel alloy may be machined, ground, welded, heat treated, or holes drilled by electrolytic depletion processes):

For machining: Our machining processes yield particles as chips and turnings which are too heavy to become airborne and consequently need no exhaust.

For grinding: If air sampling indicates need for ventilation, we use American Air Filter Rotoclone exhaust equipped with absolute filters and air flow maintained at 200 cfm per square foot face of grinding booth or cabinet. Where feasible down-draft exhaust booths are used.

For welding: An exhaust line of 4 inch diameter providing air capacity of at least 400 cfm and located within 6 inches of welding source is used. The exhaust system is equipped with absolute filters to remove particulate matter.

For heat treatment: Uses a barium chloride salt bath at 2350 degrees F in furnace equipped with exhaust system and absolute filters.

For electrolytic depletion processes: Provided with exhaust of 400 cfm through 4 inch ducts mainly to remove hydrogen gas and acid electrolyte mist.

All exhaust systems are designed following specifications in the "Industrial Ventilation" manual published by American Conference of Governmental Industrial Hygienists.

Attachment 11TH (b): Radiation survey meters listed are calibrated at least every 90 days using the Technical Operations Company Model 571 calibration unit contining about 15 millicuries of cobalt-60 under N.R.C. license #34-00499-10. Meter batteries are checked periodically. The Nuclear Measurements Model PC3B is calibrated against standardized thorium sources. The Staplex air samplers are calibrated with manometers and/or Anemotherm Model 60 air velocity meter.

Attachment 11TH (c): Ventilation equipment, where required is checked for proper air flow every 90 days using Anemotherm Model 60 air velocity meter. Filters are checked periodically and replaced when saturated.

Attachment 11U (a): While no radiation hazard exists from these flywheels we do have (as in 11TH) Victoreen Model 490 Thyac III and Victoreen Model 440 meter to measure radiation.

Attachment 11U (b): Radiation meters are calibrated quarterly using Tech/Ops Model 571 Cobalt-60 calibration unit under N.R.C. license 34-00499-10.

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Attachment 12TH (a): With respect to fires and explosions, the areas in which fabrications of nickel-thorium and magnesium-thorium alloys are performed are under control of the General Electric Fire Department manned around the clock with a full-time staff of between 15 to 20 professional fire fighters and full range of fire fighting equipment including pumpers, ladder-wagon, foam trucks, etc., all of which are located right on the General Electric property in Cincinnati, Ohio. Likewise, the Peebles, Ohio, jet engine test site has its own fire truck and fire fighters. All fire fighting personnel are trained and periodically retrained in fire and explosion control techniques. Radiation safety measures are given to the fire fighters by J.D. Engel, Radiation Protection Officer.

General Electric property includes:
At Cincinnati, Ohio: 400 acres land (6,000,000 square feet under roof)
At Peebles, Ohio: 5500 acres; outdoor jet engine test facilities

All fabrication on magnesium or nickel-thorium alloys performed at Cincinnati, Ohio. Only testing of jet engines performed at Peebles, Ohio.

Attachment 12TH (b)
In such event as fire, explosion, or serious accident, all personnel in the area are evacuated and fire department called in to control and put out the fire, render first aid if needed. We have our own 1971 Cadillac four stretcher capacity ambulance in case of such emergency. Likewise registered nurses and two full-time medical doctors are available. Fire fighting personnel are equipped with a variety of protective clothings and self-contained breathing devices as needed. In case of fire involving magnesium or nickel-thorium alloys, the radiation protection officer, J D. Engel is called in to make radiation surveys, wipe tests, or air samplings. Decontamination procedures are applied if radiation onitoring indicates any radiation contamination above the prescribed limits of N.R.C. Title 10, Part 20 relating to protection against radiation.

Attachment 12TH (c)
As noted in portions of Attachments 9,11,12, and 13, radiation survey program consists of surface monitoring of alloys to confirm that they are less than four percent thorium and taking of air samples of fabrication operations that generate airborne dispersions to determine concentration of radioactive material in air, and area surveys with radiation survey meter to determine compliance with requirements of N.R.C. Title 10, Part 20 on radiation protection. As shipments of nickel or magnesium thorium alloys are received, each item is given a yellow-magenta radiation tag (see attachment 12c(1)) indicating that the alloy contains a nominal amount of thorium and can be safely handled with hands, but to obtain control instructions. The tagging procedure serves as an audit to keep track of amount of thorium in the plant.

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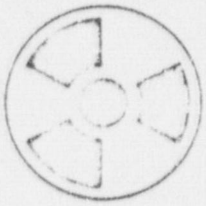
Attachment 12c(1)
Below is copy of radiation control tag used to indicate that item has a nominal amount of thorium in it and requires certain control procedures. Likewise these tags are used as audit on amount of thorium in plant. Tag is yellow cardstock with printing and radiation sysmbol in magenta.

GT 2740 (5-74)

SEE INSTRUCTION AEG 040.61



PART OR ARTICLE NO.	
PURCHASE ORDER NO.	

THE ATTACHED CONTAINS A NOMINAL AMOUNT OF:

RADIOACTIVE MATERIAL	THORIUM

CAN BE SAFELY HANDLED

MEDICAL APPROVAL	SIGNATURE J. D. ENGEL
PHONE 4040	DATE INDUSTRIAL HYGIENE

HOWEVER

DO NOT

SCRAP, MELT, MACHINE, WELD, PICKLE OR APPLY HEAT IN ANY FORM UNTIL YOU HAVE OBTAINED INSTRUCTIONS FROM THE ABOVE SIGNED.

AVOID INHALATION OR INGESTION OF POWDER IF THE ITEM IS SHATTERED.

THIS TAG IS TO ACCOMPANY PROPERTY THROUGH PLANT

Attachment 12U (a): With respect to fires and explosions, the area where the flywheels will be used are inspected daily by the on-site General Electric Fire Department manned 24 hours daily by 15 full-time fire fighters with full range of fire fighting equipment including pumpers and foam truck as noted in 12TH (a).

Attachment 12U(b): In event of accident such as fire or explosion, supervisory personnel are instructed to evacuate area and contact J.D. Engel (Radiation Safety) and the General Electric Fire department or our own ambulance if necessary. J.D. Engel will determine if any additional radiation safety measures are required or whether N.R.C. should be notified.

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Attachment 13TH (a)

Nickel base alloy

The quantity of nickel base radioactive waste containing thorium will range from a few pounds of alloy up to maximum of 27,500 pounds alloy containing 4 percent thorium (500 kilograms thorium). Value is on annual basis.

The waste nickel-thorium alloy is in form of small chips, trimmings, cuttings, scrap parts, and grinding fines, and scrap absolute air filters contaminated with thorium particles. Some waste is in form of liquid suspensions or solutions.

Magnesium base alloy

The quantity of magnesium waste will range up to maximum annual value of 30,000 pounds alloy (546 kilograms thorium). Waste will be in form of chips, turnings, and scrap parts. No liquid waste for magnesium alloy.

Attachment 13TH (b)

Nickel base alloy

The scrap is collected in 55-gallon metal drums and marked as containing scrap alloy containing four percent thorium and held separate from other scrap metal. When a substantial quantity is accumulated, bids are solicited from eligible scrap dealers. Upon receipt of an acceptable bid from a holder of a current N.R.C. or agreement state license for handling of this type of radioactive waste, shipment is prepared and monitored with survey meter and placed on truck in accordance with the current applicable N.R.C., I.C.C. or D.O.T. shipping regulations. Before acceptance of bid, copy of bidders license is required before shipment per N.R.C. part 40.51 regarding transfer of source material.

In addition, certain liquid suspensions and solutions of thorium in water are obtained from machining, grinding, and electrochemical depletion processes (i.e., drilling of small diameter holes and metal scalloping). Such liquids are placed in 55-gallon metal drums and checked for thorium concentration, and if necessary diluted with water to reduce thorium concentration to within radioactive level required for disposal into regular sewage system. Generally this dilution amounts to about ten gallons of water per pound of alloy fines.

Magnesium base alloy

Disposal is same as indicated for nickel alloy. Because of magnesium fire hazard, magnesium scrap is kept separate from nickel scrap.