FORM NRC-2
(7-77)
10 CFR 40

Approved by GAO
R0203

U.S. NUCLEAR REGULATORY 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-1084
- ☐ (d) Previous License No. _____

2. NAME OF APPLICANT: National Aeronautics and Space Administration

3. PRINCIPAL BUSINESS ADDRESS: Lyndon B. Johnson Space Center, Houston, Texas 77058

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

Same as Item 3.

5. NAME OF PERSON TO BE CONTACTED CONCERNING THIS APPLICATION: C. M. Barnes, D.V.M., Ph.D.

6. TELEPHONE NO. OF INDIVIDUAL NAMED IN ITEM 5: (A. C. 713) 483-5281

7. DESCRIBE PURPOSE FOR WHICH SOURCE MATERIAL WILL BE USED

Uranium-238 . . . . . .Depleted uranium storage casks and collimators.

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 (*kilograms*)
NATURAL URANIUM			
URANIUM DEPLETED IN THE U-235 ISOTOPE	Uranium-238	Nickel plated uranium metal	25
THORIUM (ISOTOPE)			

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

Twenty-five (25)

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.

The procedures and facilities shall be reviewed for potential hazards as stated in Attachment 2, JSC Radiological Health Manual, Part 3.

10. LIST THE NAMES AND ATTACH A RESUME OF THE TECHNICAL QUALIFICATIONS INCLUDING TRAINING AND EXPERIENCE OF APPLICANT'S SUPERVISORY PERSONNEL AND THE PERSON RESPONSIBLE FOR THE RADIATION SAFETY PROGRAM (OR OF APPLICANT IF AN INDIVIDUAL).

The individual users shall be reviewed for training and experience by the JSC Radiological Safety Committee as stated in Attachment 2. Resumes of Radiological Health personnel may be found in Attachment ..

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 Appendix D, Attachment 2, JSC Radiological Health Instrumentation Film Badge Service provided by R. S. Landauer, Jr., & Co.

(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).

Instrumentation calibration in accordance with Part 3.12 of Attachment 2.

19404

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.

Not Applicable.

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 2.

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

See Attachment 2.

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

See Attachment 2.

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.

(b) Detailed procedures for waste disposal. See Part 3.13, Attachment 2.

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.

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.*

BY A. Lieberg M.D.
(Signature)

Dated JUL 14 1981

for Robert O. Piland
(Print or type name)

Director of Space and Life Sciences
Lyndon B. Johnson Space Center
(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.

Attachment 1
National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Reference: Item 10, NRC-2
August 1, 1981

RADIOLOGICAL HEALTH OFFICER - C. M. Barnes, D.V.M., Ph.D.

The Radiological Health Officer at JSC is responsible for planning, directing and coordinating all aspects related to operations administered by the Center. The experience and training of Dr. Barnes is stated below:

A. Pertinent Training

1. Doctor of Veterinary Medicine, 1944, Texas A & M University, College Station, Texas.

   Doctor of Philosophy, 1957, in Comparative Pathology, University of California, Davis, California.

2. Radiation Protection Training:

Where Trained	Duration of Training	On Job	Formal Course
Principles and Practices of Radiation Protection			
Hanford Atomic Products Opns.	2 yrs.	Yes	No
University of California, Berkeley and Davis, California	2 yrs.	Yes	Yes
Oak Ridge National Lab.	2 wks.	No	Yes
Radioactivity Measurement and Monitoring Techniques			
Hanford Atomic Products Opns	2 yrs.	Yes	No
University of California	2 yrs.	Yes	Yes
Mathematics and Calculus Basic To Use and Measurement of Radioactivity			
University of California	2 yrs.	No	Yes
Biological Effects of Radiation			
Hanford Atomic Products Opns.	2 yrs.	Yes	No
University of California	2 yrs.	No	Yes
Related Formal Training:			
College Mathematics	14 hrs.		
College Physics	15 hrs.		
Radiation Physiology	3 hrs.		
Research in Radiation Biology	19 hrs.		

19404

B. Experience with Radiation

1. Present assignment is, Radiological Health Officer, Johnson Space Center, NASA, Houston, Texas. Responsible for planning, directing, coordinating, and supervising all aspects of radiological problems involved in manned space flight. Prescribes the radiation dose criteria for manned space probes; provides biological data and equations relating to crew safety and mission success; evaluates experimental results from ground based and in-flight experiments as related to human in-flight safety; establishes research programs to accurately simulate in controlled experiments those conditions likely to occur in manned space flight; monitors and technically supervises the research activities of the Johnson Space Center in meetings with the Radiation Panel, National Academy of Science, the Department of Energy, the Department of Defense, and other organizations with authority to commit the Center in matters pertaining to radiobiological research; responsible for technical documentation, budget estimates, and other recommendations for equipment, medical material, and allied developments for laboratory and other facilities required in long range problems.

2. 1966-1967: Chief, Veterinary Services, USAF Air Proving Ground Center and the USAF Special Air Warfare Center, Eglin AFB, Florida 32542. Responsible for management of all veterinary programs including routine public health activities, research into hazards of lasers, and biological, radiological, and chemical warfare agents conducted on site.

3. 1952-1962: Manager, Life Sciences Program, USAF-USAEC Aircraft Nuclear Propulsion Office, Headquarters, U.S. Atomic Energy Commission, Germantown, Maryland. Was responsible for a contractual effort of approximately 2 million dollars annually in basic biological research with particular reference to radiation toxicology, development of radiation protective drugs, field testing of toxic materials. This biological research program was in support of the nuclear powered rocket for space use (Project Rover), the nuclear powered ramjet (Project Pluto), and the Systems for Nuclear Auxilliary Power for space and earth application (Project SNAP). Coordinated this program with that of the Biology and Medicine Division, AEC, the Department of Defense, and other research groups. Developed the protocol and led discussions with national safety advisory groups resulting in federal approval of the first use of nuclear power sources in Space.

4. 1956-1958: Manager, Life Sciences, and Human Factors Project Officer, Detachment 1, Hq., Air Research and Development Command, Wright Patterson AFB, Ohio. This work consisted of managing the radiobiological and human factors effort necessary to support development of a nuclear powered bomber for the Air Force.

technical monitor of approximately ten contracts (1.5 million dollars) involving radiation toxicology studies in domestic and wild animals, crew compartment habitability design studies and basic radiation exposure criteria. Conducted hazards testing of nuclear fuel elements and simulated various accidents involving nuclear powered aircraft.

5. 1954-1956: Graduate student, University of California, Berkeley, and Davis campuses. Curriculum was in comparative pathology with a fair share of the program slanted toward medical physics and radiation biology with nominal coursework in advanced pathology. The graduate committee was composed of Professors Joseph G. Hamilton and John H. Lawrence in Medical Physics; Professor E. L. Dobson in Radiation Physiology; Professor D. R. Cordy in Pathology; and Professor Logan M. Julian in Research in Radiation Biology. The Ph.D. degree in Comparative Pathology was received on June 5, 1957. Title of Thesis was: "A Comparative Study of the Reticuloendothelial System in Developing Chickens." This research used radioactive tracer colloid material to permit a quantitative analysis of the phagocytic function in reticuloendothelial cells.

6. 1952-1954: Training with Industry at the Experimental Animal Farm, the General Electric Company, Hanford Atomic Products Operation, Richland, Washington. Activity centered about studies on the toxicology in domestic animals of various fission products released to the atmosphere at the Hanford nuclear production facility. Training was received in the management of an experimental animal farm which included sheep, swine, poultry, and laboratory animals in a controlled environment. Research was primarily radioiodine toxicity in sheep. However, brief studies were conducted on toxicity in chickens and plutonium inhaled by dogs. Four months of this period was spent on Eniwetok Atoll assisting in the investigation of nuclear fallout problems in the local fauna and flora resulting from hydrogen bomb testing at that site.

RADIOLOGICAL SAFETY OFFICER - Arnold W. Orsak

The position of Radiological Safety Officer has been established to perform the functions and responsibilities prescribed in 10 CRF 33. Mr. A. W. Orsak is presently appointed to this position. The Radiological Safety Officer also administers the day-to-day operation of the radiation protection program supported by one health physicist. The experience and training of Mr. Orsak is stated below:

A. Pertinent Training

1. Graduate, Sam Houston State College, 1963.
Bachelor of Science in Biology; minor in chemistry.

2. Radiation Protection Training

a. Basic Radiological Health, USPHS, 2 weeks, 1964.
b. Occupational Radiation Protection. USPHS, 2 weeks, 1965.
c. Management of Radiation Accidents, USPHS, 2 weeks, 1965.
d. Radium Hazards and Control. USPHS, 1 week, 1965.
e. Medical X-ray Protection, USPHS, 2 weeks, 1964.
f. Orientation in Occupational Health, USPHS, 1 week, 1964.
g. Radiflo Supervisors Course, C. E. Corporation, 2 weeks, 1966.
h. Radef Monitors Instructor's Course, OCDM, 1 week, 1964.

B. Experience with Radiation

1. Supervisor of Radiological Health Services, Kelsey-Seybold Clinic, contractor to Johnson Space Center (JSC), January 1969 to present. Appointed Radiological Safety Officer for JSC, Houston, Texas, March 1969.

2. Supervisor at Texas Instruments, Dallas, Texas.
500 curies of Krypton 85 in hermetic seal checks and two 150 KV X-ray machines were used for internal defect check of transistors and integrated circuits. Responsibilities included Radiological Health Training, Radiation Instrument repair and calibration and periodic radiological health surveys. (1966-1968).

3. Radiation Health Specialist - Texas State Department of Health, Austin, Texas. (1963-1966).

Duties:

a. Calibration of survey instruments with sealed gamma (Max. 300 mCi) and neutron sources (Max. 5 Ci).

b. Radiation hazards evaluation surveys of radioisotopes (kilocurie quantities), and machine produced radiation (up to 14 MeV).

c. Inspection of radioactive material licensees which included colleges, hospitals, research laboratories, radiographers, well loggers and clinics, for compliance with Texas State Regulation.

d. Investigation of incidents such as lost sources, over-exposures and contamination monitoring and clean-up.

e. Evaluation of applications and procedures for Texas license.

f. Prepare for appropriate signatures new and amended Radioactive Material License, containing special conditions which might apply.

g. Radiation Safety Officer for State Health Department (1965-1966) which involved accountability, leak tests and surveys for approximately six civil defense source sets and 10 calibration sources. All sources ranged from 2 to 300 mc (cobalt and cesium).

ALTERNATE RADIOLOGICAL SAFETY OFFICER - Dennis J. Waggett

The program at JSC is fast moving, requiring daily action at the Radiological Safety Officer level, and an alternate to the Radiological Safety Officer has been designated to assure immediate action and continuance of the program. Mr. D. J. Waggett, Health Physicist is designated as Alternate Radiological Safety Officer and his experience and training is stated below:

A. Education and Training

1. San Jacinto Jr. College - AA Degree

2. University of Houston

3. Radiological Health Short Courses:

   a. Nuclear Warfare School, U. S. Navy

   b. Environmental Surveillance and Analysis; Tracerlab

   c. Laser Beam Analysis and Biological Effects; Tracerlab

   d. Basic Radiological Health Course; USPHS

   e. Occupational Radiation Protection Course; National Center for Radiological Health

   f. Radionuclide Analysis by Gamma Spectroscopy Course; USPHS

B. Experience with Radiation

Health Physicist - Johnson Space Center/Kelsey-Seybold Clinic, September 1966 to present.

Duties:

a. Radioactive materials, including sealed and unsealed sources, multicurie sources, neutron sources and special nuclear material, a 120 curie Co-60 High Range System and a 100 curie Co-60 irradiator.

b. Radiation Producing Equipment, routine radiological considerations of such devices as radiography units, medical, dental and radiography X-ray units and a Van de Graaff Accelerator.

c. Radiological Surveys - Routine radiological surveys of NASA buildings and laboratories, such as isotope storage areas, neutron generators and miscellaneous diffraction equipment.

d. Environmental surveillance consisting of air, water, soil and vegetation collection with subsequent laboratory preparation and analysis for radioactive material control.

e. Leak testing of sealed sources held under NRC License granted to NASA-JSC.

f. Decontamination - Routine decontamination of laboratory equipment and laboratory work areas.