MARTIN COMPANY

Baltimore,
Maryland
21203

November 18, 1966

Refer to: ACC-518
CWK:845

U. S. Atomic Energy Commission
Division of Materials Licensing
Washington, D. C. 20545

Attention: Mr. Robert E. Brinkman

Subject: Proposed Amendment to Byproduct Material License No. 19-01398-20

Gentlemen:

Three copies of a proposed amendment to Byproduct License No. 19-01398-20 are enclosed. Thank you for your effort in reviewing this application.

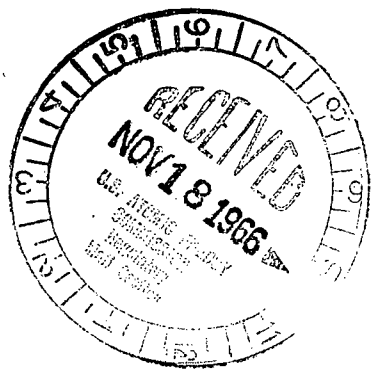
Very truly yours,

Martin Company
MARTIN-MARIETTA CORP.
Baltimore, Maryland

C W Keller

C. W. Keller, Nuclear
Accountability & Licensing
Representative

/plm



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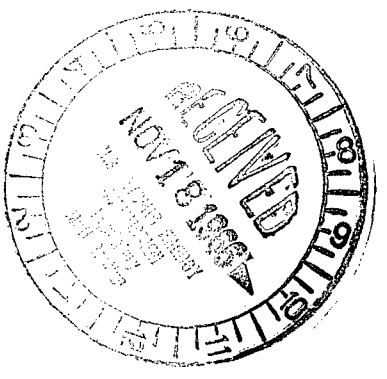
A DIVISION OF
MARTIN MARIETTA

APPLICATION FOR AMENDMENT

to

BYPRODUCT MATERIAL LICENSE NO. 19-01398-20



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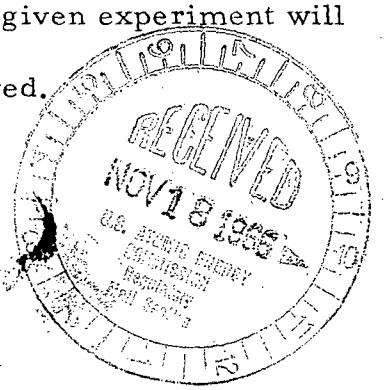
GENERAL DISCUSSION

The Martin Marietta Corporation hereby requests that Byproduct Material License No. 19-01398-20 be amended to include the complete investigation of the physical and chemical properties of materials which has been exposed to neutron and gamma irradiation at ambient temperatures. The research and development program to be performed in the Martin radiochemistry laboratory (KJ Building) in Middle River, Maryland will be limited to 500 millicuries of any byproduct material between atomic numbers 3 and 83 inclusive. Of primary interest at this time is the investigation of the properties of Phosphorous sesquisulfide (P_4S_3), a proposed reactor coolant compound, and the compatibility between P_4S_3 and zircalloy, a proposed containment material. After irradiation at the Wright-Patterson Air Force Base - Nuclear Engineering Test Facility or other off-site location, a sufficient decay period will elapse to assure decay of short life isotopes before receipt at Martin. The radioactive material remaining from irradiation of P_4S_3 and zircalloy are Phosphorus-32, Sulfur-35 and a Zirconium-95: Niobium 95 mixture. The quantity of radioactive material handled in any given experiment will approximate one quarter of the curie amount received.

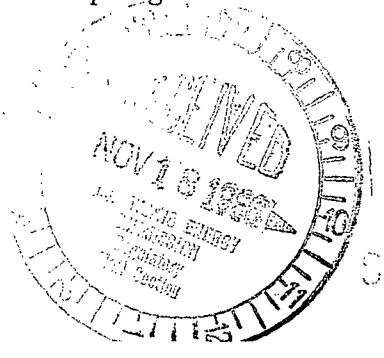


EXPERIMENTAL PROGRAM

The research and development program will include such experiments as the measurement of the inactive gas produced by radioactive decay, the definition of the gamma-beta and infra-red spectrums, and the determination of such physical properties as the melting point, the viscosity and partial dissociation of the material. Metallographic examination of coupons will be performed to define corrosion, to investigate changes in granular structures, and to determine the stress-strain curve. When deemed necessary, experimental techniques will be developed using inactive material prior to performing the experiment with radioactive material. The following discussion details the general steps and precautions to be taken during our experimental program using P_4S_3 and Zircalloy.

(1) Gamma-Beta Spectrums. Each glass vial, containing approximately 2 grams of P_4S_3 and a zircalloy-2 coupon weighing 0.08 grams, will be counted before opening with a multichannel analyzer and a methane-flow beta proportional counter. No activity will be released from the vials since they will remain sealed during these measurements.

(2) Gas Analysis. Each P_4S_3 vial will be broken behind a shielded area inside an open fan exhaust hood and a gas sample will be drawn into an evacuated sample bottle. The non-radioactive gas composition will be analyzed employing a mass-spectrograph. This sampling will be



accomplished with a valve-filter type glass transfer system so that entrainment of P_4S_3 power will be eliminated. Development of this sampling technique will be performed with inactive P_4S_3 prior to analysis of the active P_4S_3.

(3) I. R. Spectrum. Approximately one gram of P_4S_3 will be dissolved and the spectrum of the solution measured on a spectrophotometer. The dissolution will be performed behind the shielded area in an open hood and measurement of the solution will be in a controlled area in the radiochemistry laboratory. The sample of solution will be sealed in a glass vial to eliminate spillage and the transfer of the glass vial will be performed in a container to reduce possibility of breakage. Handling tools will be used to reduce personnel exposure.

(4) Melting Point. The melting point will be determined by the classical capillary tube method behind the shielded area in an open hood. The capillary tube will be sealed and the method of powder transfer to the capillary tube will be developed to reduce dispersal.

(5) Viscosity. The viscosity of the P_4S_3 will be measured in a closed glass system located in a high temperature furnace which is positioned in an exhaust controlled hood provided in case of glass breakage. A satisfactory method of sealing the active P_4S_3 powder in glass has been performed.

(6) P and S Dissociation. The presence of free sulfur and free phosphorous mixed in with the P_4S_3 will be determined by collecting elemental P in the cold end of a heated sealed glass tube and by employ-

ing the solvent extraction method. These experiments will be performed in a shielded area of the open hood.

(7) Metallographic Studies of Zircalloy-2. Determination of the compatibility of zircalloy-2 with P_4S_3 under the influence of neutron and gamma radiation will be made with standard metallographic equipment and methods in a shielded area of the open hood. The methods to be used on active zircalloy-2 coupons will be defined prior to the actual experimentation.

SAFETY CRITERIA

The likelihood of undue radiation exposure and contamination will be minimized by:

1. The radioisotope handling procedures from receipt of the P_4S_3 quartz vials to waste disposal will be under the surveillance of the Martin Company Health Physics Section.
2. The radioisotope laboratory is relatively isolated, has absolute type filtered ventilation, and continuous sampling of the stack effluent. The atmosphere in the work area is continuously sampled for airborne radioactivity by a constant air monitor.
3. All radioisotope handling will take place inside a ventilated hood and behind a shielded area within the hood to reduce personnel exposure.

4. Cold runs of the wet chemistry operations have been made using inactive P_4S_3 as simulated material in order to define the measurement procedures and to establish safe handling methods.

5. The planned radioisotope experiments will be conducted with an anticipated activity of 30 millicuries in order to further refine the handling procedures. Handling tools will be used to minimize exposure where possible.

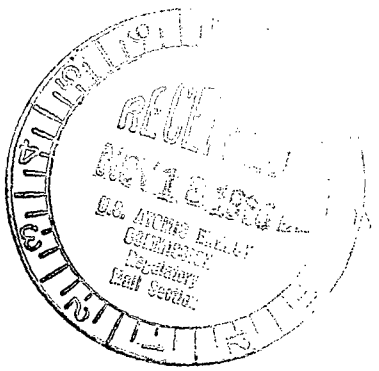
6. Typical wet chemistry operations will involve batches of P_4S_3 containing 0.03 curie of beta emitters. Typical metallographic examination of the zircalloy-2 coupons will require handling of approximately 5×10^{-4} curies of beta and gamma emitters.

RADIOACTIVE WASTE DISPOSAL

Solid radioactive waste generated during property measurements will be removed from the hood utilizing standard packaging techniques, sealed in a plastic bag and placed in a closed I. C. C. approved waste container for ultimate disposal at an approved site. Liquid wastes shall be poured into an absorbing medium in plastic bottles and handled as solids.

HAZARD EVALUATION

Any external radiation hazard arises from the harder components of the bremsstrahlung produced by the P^{32} and S^{35} betas, and from the gammas emitted from the Zr^{95}-Nb^{95} isotopes. The exposure received by the individuals performing the experimental work will be closely monitored by the Health Physics Section. Dose rate measurement of the activated sample has been performed at the surface of a quartz vial containing two grams of P_4S_3 and a zircalloy-2 coupon. After three weeks of decay from the time of reactor shutdown, the dose rate at instrument contact at the surface of the containment vial was 400 mr/hr. It is not anticipated that any major external radiation exposure will occur during the measurement of the physical and chemical characteristics of these radioactive materials since at least an additional 9 weeks of decay time will have elapsed before receipt of the radioactive materials.



Form AEC-313 (5-58)	ATOMIC ENERGY COMMISSION **APPLICATION FOR BYPRODUCT MATERIAL LICENSE**	Form approved. Budget Bureau No. 38-R027.4.

INSTRUCTIONS.—Complete Items 1 through 16 if this is an initial application. If application is for renewal of a license, complete only Items 1 through 7 and indicate new information or changes in the program as requested in Items 8 through 15. Use supplemental sheets where necessary. Item 16 must be completed on all applications. Mail three copies to: U. S. Atomic Energy Commission, Washington 25, D. C. Attention: Isotopes Branch, Division of Licensing and Regulation. Upon approval of this application, the applicant will receive an AEC Byproduct Material License. An AEC Byproduct Material License is issued in accordance with the general requirements contained in Title 10, Code of Federal Regulations, Part 30 and the Licensee is subject to Title 10, Code of Federal Regulations, Part 20.

1. (a) NAME AND STREET ADDRESS OF APPLICANT. *(Institution, firm, hospital, person, etc.)*	(b) STREET ADDRESS(ES) AT WHICH BYPRODUCT MATERIAL WILL BE USED. *(If different from 1 (a).)*
Martin-Marietta Corporation Martin Company Baltimore, Maryland 21203	
2. DEPARTMENT TO USE BYPRODUCT MATERIAL	**3. PREVIOUS LICENSE NUMBER(S).** *(If this is an application for renewal of a license, please indicate and give number.)*
Baltimore Division	Byproduct License 19-1398-20 Renewal
4. INDIVIDUAL USER(S). *(Name and title of individual(s) who will use or directly supervise use of byproduct material. Give training and experience in Items 8 and 9.)*	**5. RADIATION PROTECTION OFFICER** *(Name of person designated as radiation protection officer if other than individual user. Attach resume of his training and experience as in Items 8 and 9.)*
James C. Neace John H. Gray V. Truscello	Richard J. Brisson

6. (a) BYPRODUCT MATERIAL. *(Elements and mass number of each.)*	(b) CHEMICAL AND/OR PHYSICAL FORM AND MAXIMUM NUMBER OF MILLICURIES OF EACH CHEMICAL AND/OR PHYSICAL FORM THAT YOU WILL POSSESS AT ANY ONE TIME. *(If sealed source(s), also state name of manufacturer, model number, number of sources and maximum activity per source.)*	
A. Americium-241	Any form	350 curies
B. Curium-242	Any form	20 millicuries
C. Any byproduct material Atomic Nos. 3-83	Any form	80 millicuries total
D. Curium-244	Any form	D 5 millicuries
E. Polonium-210	Any form	E 60 microcuries
F. Cesium-137	Any form	F 30 microcuries
G. Promethium-147	Any form	G 20 microcuries

7. DESCRIBE PURPOSE FOR WHICH BYPRODUCT MATERIAL WILL BE USED. *(If byproduct material is for "human use," supplement A (Form AEC-313a) must be completed in lieu of this item. If byproduct material is in the form of a sealed source, include the make and model number of the storage container and/or device in which the source will be stored and/or used.)*

A. Preparation & examination of elements for neutron irradiation.

B. & C. Development of methods for separation of Curium-242 from Americium and fission products. Activation analysis. Spectrum decay and shielding studies.

D. - G. Preparation of plated sources for spectrum and shielding studies.

(Continued on reverse side)

Form AEC–313 (5-58) Page

TRAINING AND EXPERIENCE OF EACH INDIVIDUAL NAMED IN ITEM 4 *(Use supplemental sheets if necessary)*

8. TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB (Circle answer)	FORMAL COURS (Circle answer)
a. Principles and practices of radiation protection			Yes No	Yes No
b. Radioactivity measurement standardization and monitoring techniques and instruments			Yes No	Yes No
c. Mathematics and calculations basic to the use and measurement of radioactivity			Yes No	Yes No
d. Biological effects of radiation			Yes No	Yes No

9. EXPERIENCE WITH RADIATION. *(Actual use of radioisotopes or equivalent experience.)*

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION OF EXPERIENCE	TYPE OF USE

10. RADIATION DETECTION INSTRUMENTS. *(Use supplemental sheets if necessary.)*

TYPE OF INSTRUMENTS *(Include make and model number of each)*	NUMBER AVAILABLE	RADIATION DETECTED	SENSITIVITY RANGE *(mr/hr)*	WINDOW THICKNESS *(mg/cm²)*	USE *(Monitoring, surveying, measuring)*

11. METHOD, FREQUENCY, AND STANDARDS USED IN CALIBRATING INSTRUMENTS LISTED ABOVE.

12. FILM BADGES, DOSIMETERS, AND BIO-ASSAY PROCEDURES USED. *(For film badges, specify method of calibrating and processing, or name of supplier.)*

INFORMATION TO BE SUBMITTED ON ADDITIONAL SHEETS

13. FACILITIES AND EQUIPMENT. Describe laboratory facilities and remote handling equipment, storage containers, shielding, fume hoods, etc. Explanatory sketch of facility is attached. *(Circle answer)* Yes No

14. RADIATION PROTECTION PROGRAM. Describe the radiation protection program including control measures. If application covers sealed sources, submit leak testing procedures where applicable, name, training, and experience of person to perform leak tests, and arrangements for performing initial radiation survey, servicing, maintenance and repair of the source.

15. WASTE DISPOSAL. If a commercial waste disposal service is employed, specify name of company. Otherwise, submit detailed description of methods which will be used for disposing of radioactive wastes and estimates of the type and amount of activity involved.

CERTIFICATE (This item must be completed by applicant)

16. THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATE ON BEHALF OF THE APPLICANT NAMED IN ITEM 1, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PART 30, AND THAT ALL INFORMATION CONTAINED HEREIN, INCLUDING ANY SUPPLEMENTS ATTACHED HERETO, IS TRUE AND CORRECT TO THE BEST OF OUR KNOWLEDGE AND BELIEF.

RECEIVED MAR 31 1966 U.S. ATOMIC ENERGY COMMISSION Headquarters Mail Section

Martin-Marietta Corporation
Applicant named in item 1

Date March 29, 1966

By C. W. Keller
Nuclear Accountability & Licensing Rep.
Title of certifying official

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.

U.S. GOVERNMENT PRINTING OFFICE : 1961 OF—615965