MARTIN COMPANY

Baltimore 3,
Maryland

Refer to: RJB-729

23 January 1964

United States Atomic Energy Commission

Division of Licensing & Regulation

Washington 25, D. C.

Gentlemen:

Re: (Renewal of Byproduct Material
License No. 19-1398-19)

Transmitted herewith are three (3) copies of an application for renewal of Byproduct Material License No. 19-1398-19.

All byproduct material previously authorized and possessed under 6 C and E of the expiring license have been disposed of; these radioactive materials were packaged in approved containers and shipped in compliance with I.C.C. regulations to Oak Ridge for land burial.

All byproduct material previously possessed under 6 D of the expiring license is currently authorized and possessed under license 19-1398-9.

Should any additional information be required, please contact me at AC 301, 687-3800, Ext. 9517.

Very truly yours,

Richard J. Brisson

Richard J. Brisson, Chief
Health Physics Section

RJB/js

B/14

THE AEROSPACE
DIVISION OF
MARTIN
MARIETTA

Form AEC-313R (9-62)	UNITED STATES ATOMIC ENERGY COMMISSION **APPLICATION FOR BYPRODUCT MATERIAL LICENSE—USE OF SEALED SOURCES IN RADIOGRAPHY**	Form approved. Budget Bureau No. 38-R137

SEE ATTACHED FORM AEC-313R INSTRUCTIONS—USE SUPPLEMENTAL SHEET WHERE NECESSARY

BE SURE ALL ITEMS ARE COMPLETED AND THAT ALL NECESSARY ATTACHMENTS ARE FURNISHED. IF ANY PORTION OF THE APPLICATION IS NOT APPLICABLE SPECIFICALLY SO STATE. DEFICIENT OR INCOMPLETE APPLICATIONS MAY BE RETURNED WITHOUT CONSIDERATION.

1(a) NAME AND ADDRESS OF APPLICANT

Martin Marietta Corporation
Baltimore 3, Maryland

2. PREVIOUS LICENSE NUMBER(S) *(Indicate if application is for renewal or amendment of an existing byproduct material license.)*

19-1398-19 (renewal)

1(b) APPLICANT IS: An individual ☐ A partnership ☐ A Corporation ☒ An Unincorporated Association ☐ Other ☐ If applicant is other than an individual, the applicable section on the reverse side must be completed.

3. LOCATION(S) WHERE SEALED SOURCES WILL BE USED AND/OR STORED. *(If use will be made in states other than named in 1(a), they should be listed here.)*

Middle River Plant
Middle River, Md.

4. SEALED SOURCES TO BE USED IN RADIOGRAPHY

BYPRODUCT MATERIAL *(Element and Mass No.)*	SOURCE MODEL NUMBER	NAME OF MANUFACTURER	MAXIMUM ACTIVITY PER SOURCE	NUMBER OF SOURCES
A. Ir 192	A. A-424-1	A. Technical Ops.	A. 50 c	A. 4
B. Co 60	B. A-424-2	B. Tech Operations	B. 10 c	B. 2
C.	C.	C	C.	C.

5. RADIOGRAPHIC EXPOSURE DEVICES AND/OR STORAGE CONTAINERS TO BE USED WITH SOURCES LISTED ABOVE

MODEL NUMBER	NAME OF MANUFACTURER *(If custom made, attach complete design specification.)*
A. Model 412 or 498, Model 414 Storage	A. Technical Operations Co.
B. Model 402, Model 416 Storage	B. Technical Operations Co.
C.	C.

6. THE FOLLOWING INFORMATION IS ATTACHED AS A PART OF THIS APPLICATION: *(Check appropriate blocks and attach information called for in the instructions with this form.)*

	Not Applicable	Attached	Previously Submitted
(a) Description of radiographic facilities (Instruction 6-a)	☐	☒	☐ on (DATE)
(b) Description of radiation detection instruments to be used (Instruction 6-b)	☐	☒	☐ on (DATE)
(c) Instrument calibration procedures (Instruction 6-c)	☐	☒	☐ on (DATE)
(d) Personnel monitoring equipment (Instruction 6-d)	☐	☒	☐ on (DATE)
(e) Operating and emergency procedures (Instruction 6-e)	☐	☒	☐ on (DATE)
(f) Training program (Instruction 6-f)	☐	☒	☐ on (DATE)
(g) Internal inspection system or other management control (Instruction 6-g)	☐	☒	☐ on (DATE)
(h) Overall organizational structure (Instruction 6-h)	☐	☒	☐ on (DATE)
(i) Leak testing procedures (Instruction 6-i)	☐	☐	☒ on (DATE) 1/29/63

CERTIFICATE (This item must be completed by applicant)

7. 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.

Martin Marietta Corporation
Applicant Named in Item 1

By: Richard J. Brisson
Richard J. Brisson, Chief
Health Physics Section
Title of Certifying Official

DATE 1/23/64

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.

FORM AEC-313R (9-62)

LEGAL STRUCTURE OF APPLICANT

If applicant is a corporation, complete Items 8 through 11; if applicant is a partnership, complete Items 12 through 14; if applicant is an unincorporated association or a legal entity other than a partnership or corporation, complete Items 15 and 16. Attach separate sheets where space provided proves inadequate.

CORPORATION

8. STOCK OF APPLICANT CORPORATION

NO. OF SHARES AUTHORIZED	NO. OF SHARES ISSUED	NO. OF SHARES SUBSCRIBED	TOTAL NUMBER OF:	
			(a) Stockholders	(b) Subscribers
40,000,000 c.s.	21,488,239 (as of 11-30-63)	none	87,500	none

9. Is applicant corporation directly or indirectly controlled by another corporation or other legal entity? ..... YES ☐ ..... NO ☒
If answer is "YES" give name and address of other corporation or other legal entity and describe how such control exists and the extent thereof.

10. (a) Identify by name and address any individual, corporation, or other legal entity (1) owning 10 percent or more of the stock of applicant corporation issued and outstanding or (2) subscribing to 10 percent or more of the authorized but unissued stock of the corporation. None
(b) Identify by name and address all officers and directors of the corporation.

(See attached sheet)

11. Identify the State, District, Territory, or possession under the laws of which the applicant is incorporated.

Maryland

PARTNERSHIP

12. Name and address of each individual or legal entity owning a partnership interest in the applicant.

13. State the percent of ownership of the applicant partnership held by each of the individuals or legal entities listed in Item 12.

14. Identify the State, District, Territory, or possession under the laws of which the applicant partnership is organized.

OTHER

15. Describe the nature of the applicant and identify the State, District, Territory, or possession under the laws of which it is organized.

16. State the total number of members or persons holding an ownership in the applicant, identify each by name and address, and indicate the ownership interest thereof.

U.S. GOVERNMENT PRINTING OFFICE : 1962 OF—659351

December 1963

MARTIN-MARIETTA CORPORATION

OFFICERS AND DIRECTORS

NAME	BUSINESS ADDRESS	RESIDENCE
George M. Bunker* (President & Chief Executive Officer)	350 Park Avenue New York, New York 10022	(b)(6) (6)
Grover M. Hermann* (Chairman of the Board)	101 East Ontario Street Chicago, Illinois 60611	
William B. Bergen (Vice President)	Friendship International Airport 40, Maryland	
Harry N. Huntzicker (Vice President)	101 East Ontario Street Chicago, Illinois 60611	
Paul A. Johnston (Vice President)	750 Third Avenue New York, New York 10017	
Joseph E. Muckley (Vice President)	350 Park Avenue New York, New York 10022	x6
C. Raymond Smith (Vice President)	350 Park Avenue New York, New York 10022	
Jess W. Sweetser (Vice President)	1120 Connecticut Ave., N. W. Washington, D. C. 20006	
William L. Lucas (Secretary & Treasurer)	350 Park Avenue New York, New York 10022	
William A. Burns (Director)	Trailmobile, Inc. Cincinnati, Ohio 45209	
Leigh R. Gignilliat, Jr. (Director)	American National Bank & Trust Company Chicago, Illinois 60690	
Clarence W. Miles (Director)	350 Park Avenue New York, New York 10022	
John E. Parker (Director)	2139 Wyoming Avenue, N. W. Washington, D. C. 20008	

* Also a Director

DUPLICATED
FOR DIV. OF COMPLIANCE

NAME	BUSINESS ADDRESS	RESIDENCE
Everett H. Pixley (Director)	Mellon National Bank and Trust Company Pittsburgh, Pennsylvania 15230	(b)(6) (6)
Alexander B. Royce (Director)	Chadbourne, Park, Whiteside & Wolff 25 Broadway New York, New York 10004	
Duncan M. Spencer (Director)	Fiduciary Trust Company of New York One Wall Street New York, New York 10005	
John L. Sullivan (Director)	Sullivan, Shea & Kenney 804 Ring Building Washington, D. C. 20006	

I. Description of Radiographic Facilities

A. Shielded Facility

The Martin Company Radiography Facility is located adjacent to the southwest corner of "D" Building at ground level. (Fig. 1, Plan view of Martin Complex)* The facility abuts a machine shop on the north wall and an earth hillside on the west wall. The south wall is adjacent to a locked fenced truckwell used for moving equipment in and out of the facility. The east wall adjoins a laboratory, an office and film processing area. (Fig. 2, Radiography Facility) Personnel entry into the facility is through a door from the laboratory through a mazed hall. A six-inch thick steel door locked from the inside is located on the south wall facing the truckwell. Access to the facility roof from the earth hillside on the westside is controlled by a fence and locked gate. The keys to these locks are controlled by the Senior Radiographer. The walls of the Radiography Facility are 24 inches of poured concrete. The north wall abutting the "D" Building Machine Shop benefits from an additional 10" of poured concrete making up the foundation support for "D" Building. The shielded facility roof is constructed of 6" thick poured concrete. An 18" wide, 12" thick strip is provided along the westside of the roof to reduce radiation streaming to the adjacent hillside. A right angle maze of 24" concrete at the entrance hall to the shielded room prevents direct streaming of radiation to the laboratory-office area.

1. Area Security Safeguards.

a. An area radiation monitor-alarm is installed inside the facility with a slave unit located outside above the personnel entrance. During radiographic exposure operations, the radiation above a preset level activates an audible (bell) and visual (red light) alarm system when the facility door is opened, thus warning the personnel of the presence of radiation.

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* All figures attached at the end of this document.

b. Locks - A special high integrity locking system has been established to control access to the radiographic facility, areas adjacent to this facility, radiographic sources and source storage area (s). This system consists of multi-combinated interchangeable core locks. Keys issued to allow facility access will not permit access to radiographic sources, etc.

All keys and spare lock cores are maintained, inventoried and issued (signature required) by the Chief, Health Physics Section. No keys are issued without the specific direction of the Senior Radiographer. In the event a key is lost, the lock core can be changed promptly, thereby re-establishing absolute control.

c. Signs in conformance with 10 CFR 20 are posted on the gates of the fenced truckwell, roof of the facility and upon the personnel entry door.

d. Position of Operator Relative to Source Exposure Point - When a radiographic exposure is conducted, the source holder and source cable are positioned inside the shielded facility and the source cranking mechanism and cable are threaded through the mazed hall to the laboratory area and the source is cranked out from this position.

B. Open Air Radiography

On occasion, it may be necessary to perform radiographic operations outside of the shielded radiographic facility. In cases of Open Air Radiography, the following shall apply:

1. The radiographer shall consult with Health Physics to review the radiographic location.

2. Personnel performing the operation at a new location, shall be reinstructed concerning proper safeguards and control of the operation.

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3. When required, Health Physics shall assist in conducting initial radiation surveys of the radiographic site. The source will be exposed in the position most likely to reflect the highest radiation levels. Ropes and signs shall be adjusted in order to establish the restricted area.
4. The method for source surveillance and control during periods of non-use shall be clearly indicated to all personnel involved.
5. Martin Company Security and Fire Protection personnel shall be informed of the area where work is to be performed, their participation, if required, and the nature of the hazard in the event of emergency.
6. A restricted area as defined in 10 CFR 20 shall be established around the radiographic exposure site. This zone shall be clearly posted with ropes and/or other barricades and radiation signs. Radiography personnel shall maintain visual surveillance during each source exposure to exclude unauthorized personnel from the area.

II. Radiation Detection Instruments

The following list represents some of the radiation detection instruments available at Martin Company for use during isotopic radiographic operations:

Manufacturer	Model No.	Radiations Detected	Range, mr/hr	No. Available	Use
Victoreen Inst. Co.	592	Gamma, X-ray	0-1000	3	Operational surveys
Victoreen Inst. Co.	740	Gamma, Beta X-ray	0-10,000	1	"
Eberline Inst. Co.	E-500B	Gamma, X-ray	0-2000	4	"
Victoreen Inst. Co.	CDV-715	Gamma, X-ray	10-500,000	6	Emergency

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III. Calibration of Instruments

The Health Physics Section shall perform the calibration of the portable instruments used for detecting and measuring radiation during radiographic operations. Calibration shall be performed at least once every three months or oftener as required. DRR. Note: Instrument calibration is authorized under Lic. No. 19-1398-5 WEM.

A. Procedure:

The following procedures shall apply:

1. A curve of radiation versus distance from the Health Physics calibration source should be consulted prior to using the source for calibrating radiation detection instruments. If this curve is not readily available, a curve may be generated in accordance with the following:

   a. Obtain latest source strength in curies from source inventory information in the Health Physics Office.

   b. The following information may be used to calculate radiation levels in R/hr at one foot distance.

      Cobalt 60 - Multiply source strength in curies by 14.

      Cesuim 137 - Multiply source strength in curies by 3.3.

      Iriduim 192 - Multiply source strength in curies by 5.9.

      Radium 226 - Multiply source strength in curies by 9.0.

   c. When the radiation output has been determined at one foot from a source (or any other known distance) the inverse square law for reduction of radiation intensity may be used to determine the intensity at any desired distance from the source. The inverse square law states that radiation intensity from a point source varies inversely as the square of the distance from the source:

$$\frac{I}{I_o} = \frac{(d_o)^2}{(d)^2}$$

Where I_o is the radiation intensity at distance d_o from the source, and I is the radiation intensity at distance d, from the source. This formula shows that doubling the distance decreases the intensity by a factor of four; increasing the distance by a factor of three, reduces the radiation intensity to one-ninth of its value, etc.

d. Plot a curve of source radiation level versus distance from the source on graph paper.

2. Check the calculated values by exposing a Condenser "R" meter chamber of appropriate energy range at the various distances from the source and plot this information on the same graph.

   Note: The Condenser "R" meter has been calibrated by the National Bureau of Standards and is used as a secondary calibration standard.

3. Compare the curve generated from the Condenser "R" meter chamber readings versus distance to the curve of the calculated values.

4. Calibrate the instruments by placing them at various distances from the source in order to get meter readings on all scales. Adjust the appropriate calibration potentiometer to correct the meter reading when the reading varies more than ± 20% from the values obtained from the calibration curve.

5. If the instrument cannot be adjusted in order for the readings to fall within this range, it shall be submitted to the Instrument Shop for repairs.

6. Attach a calibration tag to the instrument and record the calibration information on the appropriate instrument data card located in the Health Physics Office.

IV. Personnel Monitoring Equipment

A. Film Badge and Dosimeter Description

All isotopic radiography personnel shall wear the film badge supplied by the Health Physics Section (presently Martin Co. is utilizing film badges provided by Health Physics Services, Inc., Baltimore, Maryland) and a self-reading dosimeter (Bendix Model 862, 866 or equivalent) or two pocket chambers (non self-reading type Victoreen, Model 362) while performing radiographic operations.

B. General Instructions

Dosimeters shall be read and the reading recorded daily on the gamma radiography data sheet. Film badges shall be processed immediately after noting off-scale or unusual dosimeter readings. Film badge results shall be maintained by Health Physics.

V. Operating and Emergency Procedures

A. Operating Instructions for Use of Personnel Monitoring Equipment

1. Dosimeters:

a. Dosimeters are available through Health Physics. These dosimeters measure the amount of gamma and x-ray radiation received up to 200 mr (Model 862), or 500 mr (Model 866).

b. All radiography personnel shall wear a self-reading dosimeter or two non-self readers at all times while conducting radiography.

c. Dosimeters are delicate instruments, and should be treated as such. Jarring or dropping the dosimeter may cause a high reading. Furthermore excessive humidity may also cause a high reading. Immediately notify your supervisor and/or Health Physics if you suspect malfunction of your dosimeter.

d. If a dosimeter should go off-scale, stop work and immediately notify your supervisor and Health Physics. This condition will be thoroughly investigated by Health Physics.

e. All dosimeters shall be charged daily at the start of each shift. At the end of each shift the radiographer in charge shall read the self reading dosimeter. If non-self reading dosimeters were worn, they shall be read in the Health Physics Office. All dosimeter readings shall be recorded on the Gamma Radiography Data Sheet.

2. Operating Instructions for Dosimeter Chargers: (Self-reading dosimeters)

a. Insert dosimeter into charging socket.

b. Hold dosimeter in contact (pressure required against spring).

c. Turn knob or adjust pulsing lever to set dosimeter to zero. (follow instructions on the charger).

d. Remove dosimeter from charger and check hairline position by looking through dosimeter at a source of light.

3. Film Badges

Film badges shall be worn during working hours. These badges are issued by Health Physics and changed on a periodic schedule prescribed by the Health Physics Section. If a Film Badge is lost, damaged or misplaced, the Health Physics Section shall be notified immediately before radiographic operations continue. A new badge will be assigned and an investigation will be conducted to ascertain the radiation exposure the badge received up until the time it was lost, damaged or misplaced.

4. Placement of Film Badges and Dosimeters

Personnel film badges and dosimeters shall be worn affixed to that portion of the body that is most likely to receive the highest radiation exposure.

B. <u>Operating procedures for Ir 192, Model 412, 498 and CO 60, Model 402 projectors in the Shielded Facility, Southwest Corner "D" Building</u>

1. Film badges and dosimeters shall be worn at all times while conducting radiography as per paragraph V. A.

2. Turn survey instrument on, allow at least 1 minute warm-up time, then check zero. If instrument does not function properly, or has not been calibrated within the last 3 months, secure another one from Health Physics that is calibrated and functioning properly.

3. Check the radiation detector slave unit mounted above the door to the shielded room. If the amber light is on, there is a malfunction in the circuitry. If the red light is on, the radiation level in the room is greater than normal background*. In either case, don't enter the room, notify Health Physics.

4. If there is no indication of radiation or malfunction on the detector slave unit, unlock the door and enter the facility carrying an operating survey instrument. If the reading on the instrument does not exceed normal background, it can be assumed it is safe to enter.

5. Survey the projector that is to be used to confirm the location of the radioactive source and note the maximum reading for future reference. (Radiation levels should not exceed the maximum level as posted by Health Physics on the radiation tag attached to the projector.)

6. Remove the cables and cranking device from storage and thread them through the entrance maze, taking care that the cables are not kinked or twisted.

7. Make the radiographic set-up on item (s) to be radiographed, using lead collimator when appropriate. Make sure that the source cable is free from sharp bends and is securely fastened in the exposure position.

8. (a) On the Ir 192, Model 412, 498 projectors, unlock the padlock and unscrew the retaining nut while observing the survey instrument to assure that the source has not moved from its shielded position. Attach the source cable to the projector by turning the nut on the projector counter-clockwise.

* Normal background radiation level, just inside the room at Location A (Fig. 3) is generally less than 2 mr/hr.

(b) On the CO 60, Model 402 projector, it is necessary to unlock the cabinet before the cables can be removed. The retaining plug is held in place by two bolts which have to be removed and the source cable can then be fastened by two Allen head bolts.

9. Take the survey instrument and leave the area via the entrance maze, hook the chain with radiation sign across the entrance to the shielded facility.

10. Expose the source by turning the crank counter-clockwise, lay crank assembly inside the door at location B (refer to Fig. 3). Close and lock the door.

11. Survey outside of the building to determine that the radiation is 2 mr* or less in any given hour at the boundary of the restricted area. This survey must be made each time the position of the source is changed in the room.

12. After the desired exposure time, return the source to the projector by turning the crank clockwise.

13. Check the detector slave unit over the entrance door to determine that the radiation has returned to normal background. (If the radiation level has not returned to normal, this could be an indication that the source has not returned to its shielded position.)

14. Open the door, remove the chain and cautiously enter the room carrying an operating survey meter:

* Note 1: The Commissions Regulations pertaining to permissible levels of radiation in unrestricted areas, as set forth in Section 20.105 (b) of Part 20, are 2 millirem in any one hour or 100 millirem in any seven consecutive days. It should be noted, therefore that the regulations do not limit radiation dose rates to a maximum of 2 mr/hr, but permit higher dose rates providing that the total quantity of radiation in any unrestricted area during any one hour does not exceed 2 millirem; and during any seven consecutive days does not exceed 100 millirem.

a. If radiation is no greater than normal background, proceed to the projector and monitor it, taking note that the reading is the same as it was on the initial survey. Survey the source cable from the projector to the cable termination to ensure that the entire source has returned to the projector.

b. If the radiation level is greater than normal background, immediately lock the personnel entry door and notify Health Physics.

15. All projectors shall be monitored and locked, in addition all shielded facility doors shall be locked unless the radiographer can maintain visual surveillance and control access.

16. A log shall be kept of each exposure in accordance with the data required on sample form, Fig. #4.

C. "Open Air" radiography using Cobalt 60, Projector Model 402 or Ir 192 Projectors, Model 412 or 498.

1. Film badges and dosimeters shall be worn at all times while conducting radiography in accordance with paragraph V. A.

2. Notify Health Physics prior to operation giving the following information:

a. Job location

b. Starting time

c. Radioactive source to be used

d. Number of personnel to be utilized to control access to the radiographic site.

Note: Health Physics and the Senior Radiographer shall judge the adequacy of the number of personnel utilized to control the restricted area.

3. Turn survey meter on and allow at least 1 minute warm-up time, check the zero, if the instrument does not function properly, or has not been calibrated within the last 3 months, obtain another one from Health Physics that is calibrated and is functioning properly.

4. Check the detector slave unit over the door to the shielded room. If the amber light is on, it indicates a malfunction in the circuitry, if the red light is on, the radiation level is above normal background. In either case, don't enter the room, notify Health Physics.

5. If there is no indication of radiation or malfunction on the detector slave unit, unlock the door and cautiously enter the room with survey meter on. If the reading on the instrument does not exceed normal background, it can be assumed it is safe to enter.

6. Survey the projector to be used to confirm the location of the radioactive source, note the maximum reading for future reference. (Radiation levels should not exceed the maximum level as posted by Health Physics on the radiation tag attached to the projector.)

7. Take all necessary items to be used, i.e., radiation rope and signs, film packs, timer, log book containing gamma radiography data sheets, nomenclature and a minimum of 2 calibrated, operable survey instruments.

8. (a) The Ir 192 projectors will normally be transportated to the radiographic site by the radiographic personnel.

   (b) If the CO 60 projector is to be used, it will be necessary to call in-plant transportation, precautions as stated in paragraph V. G. shall be followed.

9. In case of an accident in transportation of the radioactive source, the procedures in paragraph V. H.5 shall be followed.

10. Immediately upon arrival of the projector at the radiographic site, it shall be surveyed to determine if damage occurred during transportation.

11. It is the radiographer's responsibility to notify the area supervisor and call the Security Dispatcher, Ext. 280 and give the radiographic location and approximate length of time the area will be restricted.

12. By calculations, determine the approximate dimensions of the area to be restricted. Refer to chart in paragraph V. E.3.

13. Rope off this area and hang radiation signs on it in such a manner that they can be easily read outside the restricted area.

14. Evacuate the area of all unauthorized and/or unmonitored personnel.

15. Make the radiographic set-up, taking advantagesof all possible shielding i.e., collimators, heavy equipment, etc. Do not place the film on the part to be radiographed at this time.

16. Unwind crank assembly and straighten the cables.

17. Unlock the projector and unscrew the retaining plug.

18. If Ir 192 projectors are being used, connect source cable by turning the large nut on the projector counter-clockwise. If CO 60 projector is being used, the cabinet must be unlocked to gain access to the crank assembly. Two bolts must be removed from the retaining plug. The source cable is held in place by two Allen head bolts.

19. The set-up should be made in such a manner that the crank assembly is the maximum distance possible from the exposed source, also taking advantage of any local shielding.

20. Post personnel at strategic points on the restricted area boundaries to control access to the area.

21. Make sure the area is evacuated of unauthorized and/or unmonitored personnel.

22. Expose the source by turning crank counter-clockwise. Place an operating survey meter near the operator. Note the dose rate to the operator.

23. After the source is in the exposed position, survey and adjust restricted area to confirm with paragraph V. E.3 and record the survey including a sketch of the area on the back side of the Gamma Radiography Data Sheet. (Fig. 4)

24. Return the source to the projector by turning crank clockwise, monitor projector and source cable, radiation level should be the same as the initial survey on the projector.

25. In case the source did not return to the projector, maintain control of the area and initiate the emergency procedures set forth in paragraph V. H. 2d.

26. When the source has been returned to the projector, place the film on part to be radiographed.

27. Conduct radiographic exposure and return the source to the projector as previously described in 24 and 25 above.

28. The radiographer is always responsible for maintaining control and surveillance of the restricted area.

29. In the event that unauthorized personnel insist upon entering the restricted area during source exposure, the source is to be immediately returned to its shielded container. The individual's name and badge number shall be taken and his supervisor notified.

30. In the event that an unauthorized person enters the restricted area during source exposure, immediately obtain the individual's name and clock number, and notify Health Physics.

31. The projector is never, under any circumstances, to be left unattended while unlocked. If the radiographer must leave the area, the projector must be locked, monitored and secured in accordance with 10CFR31.

32. Upon completion of the radiography or at the end of a working shift, the projector shall be locked, monitored and secured as above.

33. The supervisor of the area and the Security Dispatcher, Ext. 280 shall be notified of the status of the area.

34. Rope and radiation signs shall be removed when the projector is removed from the radiographic site.

35. The projector shall be stored in the shielded facility located southwest corner "D" Building, or other storage facility established in compliance with the applicable sections of 10CFR20, 31. Notify Health Physics and Security Dispatcher (Ext. 280) if stored in a facility other than the shielded facility.

36. Complete the final survey required and sign the Gamma Radiography Data Sheet. (Fig. 4)

D. Changing the Radiographic Sources

Upon receiving a new radiographic source, the following shall apply:

1. Do not open the source container.
2. Place the new source storage container/changing device in the shielded facility.
3. Notify Health Physics.
4. Health Physics shall monitor during the removal of the metal seal and the four bolts holding the cover of the source changer in place.
5. Lift cover and remove the manufacturer's instructions which includes source changing procedures, source specification sheet, decay curve and leak test results. Monitor the interior for the presence of surface contamination.
6. If the container is contaminated, Health Physics shall prescribe the appropriate course of action.
7. When cleared by Health Physics, follow the manufacturer's procedure for changing the source.
8. After completing the change, the projector shall be locked and monitored.
9. Health Physics shall supply and attach to the projector a tag containing information pertinent to the source, i.e., source strength, maximum radiation level and date.
10. Enter this survey data in the radiographic log book.

11. The changer/storage container containing the decayed source shall be monitored and a tag with all pertinent data attached to the chamber holding the source.

12. Replace the cover, tighten the four bolts, seal container with wire/lead seal and prepare for return to manufacturer. (Health Physics shall survey and place appropriate ICC shipping label on container prior to shipment)

E. Instructions for Posting and Restricting Radiographic Areas

1. Radiation Areas

Radiation Areas are those areas which contain radiation levels such that a person continuously present in the area could receive an exposure in excess of 5 millirem in any one hour. Radiation areas must be posted with signs bearing the radiation caution symbol and the words "CAUTION RADIATION AREA." Use these signs to mark the perimeter of the restricted area.

2. Restricted Area

A restricted area is that area into which the radiographer must control access for purposes of radiation safety. This restriction must be extended to include those areas containing radiation levels such that a person continuously present in the area could receive an exposure in excess of 2 millirem in any one hour. Normally, the perimeter of the restricted area would be at the 2 mr/hr* isodose line, but for exposure of short duration, the following charts may be used to determine the distance from the source to the perimeter of the restricted area. The chart may be used for Cobalt 60 sources of five and ten curies strength and for Iridium 192 sources of twenty, thirty, forty and fifty curies strength. If the source strength is between those given in the table, use the higher source strength.

* Refer to Note 1, Page 9.

Cobalt 60

5 Curies Strength			10 Curies Strength		
Exposure Time In Any One Hour	Distance From Perimeter of Restricted Area	mr/hr Level	Exposure Time In Any One Hour	Distance From Perimeter of Restricted Area	mr/hr Level
60 min.	190 ft.	2 mr/hr	60 min.	270 ft.	2 mr/hr
30 min.	135 ft.	4 mr/hr	30 min.	190 ft.	4 mr/hr
10 min.	80 ft.	12 mr/hr	10 min.	110 ft.	12 mr/hr
5 min.	60 ft.	24 mr/hr	5 min.	80 ft.	24 mr/hr

Iridium 192

20 Curies Strength			30 Curies Strength		
Exposure Time In Any One Hour	Distance From Perimeter of Restricted Area	mr/hr Level	Exposure Time In Any One Hour	Distance From Perimeter of Restricted Area	mr/hr Level
60 min.	245 ft.	2 mr/hr	60 min.	300 ft.	2 mr/hr
30 min.	170 ft.	4 mr/hr	30 min.	210 ft.	4 mr/hr
10 min.	100 ft.	12 mr/hr	10 min.	120 ft.	12 mr/hr
5 min.	70 ft.	24 mr/hr	5 min.	85 ft.	24 mr/hr

Iridium 192

40 Curies Strength			50 Curies Strength		
Exposure Time In Any One Hour	Distance From Perimeter of Restricted Area	mr/hr Level	Exposure Time In Any One Hour	Distance From Perimeter of Restricted Area	mr/hr Level
60 min.	345 ft.	2 mr/hr	60 min.	385 ft.	2 mr/hr
30 min.	245 ft.	4 mr/hr	30 min.	280 ft.	4 mr/hr
10 min.	145 ft.	12 mr/hr	10 min.	160 ft.	12 mr/hr
5 min.	100 ft.	24 mr/hr	5 min.	110 ft.	24 mr/hr

F. Physical Radiation Surveys

1. Physical radiation survey during exposure period

   a. Determine from calculations of source strength the restricted area required.

   b. Rope off and post this area as required.

   c. Expose source as outlined in Part A or B of these procedures.

   d. Survey boundaries determined in Part (a) above using survey meter.

   e. Make adjustments to boundary as necessary to maintain readings at 2 mr/hr* or less, or as otherwise authorized by paragraph V. E.3 of the procedures for exposures of short duration.

   f. A record of these surveys must be maintained and should contain sketches and instrument readings, and explanatory notes if area was restricted to other than the 2 mr/hr* isodose line.

   g. If more than one exposure is taken in the same identical position, it is not necessary that the restricted area be resurveyed. Information as to the number of exposures and total exposure time in any one hour should be included on the Gamma Radiography Data Sheet. (Fig. 4)

2. Physical radiation survey of projector after completion of exposures.

   a. Return source to projector.

   b. Approach projector with operating survey meter and monitor the surface of the projector and source cable to determine the radiation levels. (Radiation level should not exceed the maximum reading posted on the Health Physics Radiation Tag)

   c. After determining that the source is in a safe condition, lock the projector.

3. Physical radiation survey prior to storage of projector after last exposure.

* Refer to Note 1, Page 9.

a. After determining from radiation survey, that source is in a safe condition in the projector, screw in safety plugs and lock projector.

b. Return projector to storage area.

c. Resurvey projector and record on the Gamma Radiography Data Sheet. (Fig. 4)

G. Movement of radiographic projectors, in-plant locations

1. Projector shall be surveyed by a radiographer, using an operating, calibrated, survey meter, prior to removal from any storage area.

2. No projector shall be moved unless all safety plugs are inserted, and projector is locked.

3. In-plant transportation will be accomplished under the supervision of a radiographer utilizing company vehicles clearly marked with the radiation caution symbol and the words "CAUTION RADIOACTIVE MATERIAL."

4. Call plant transportation to have projector moved to radiographic site, as required and instruct the driver regarding safety precautions.

5. In case of an accident involving in-plant transportation of radiographic projectors, the emergency procedures specified in V. H.5 should be followed.

H. Emergency Procedure for Radiographic Personnel

1. In the event of a plant emergency, such as a fire or an accident in an area where radiography is being conducted, immediately do the following:

a. Return source to the shielded position in the projector.

b. Perform physical radiation survey of the projector to assure that the source is in the shielded position.

c. Remove source cables and insert safety plugs. Lock projector.

d. Remove projector from danger area and if possible return to storage area.

e. Notify Health Physics.

f. If a radiographic projector cannot be removed from a danger area, do the following:

(1) Set up a restricted area if not already established as specified in V. E.3.

(2) Notify Security Dispatcher, Ext. 280 and request Health Physics assistance.

(3) Health Physics in conjunction with radiography supervision shall determine further course of action.

2. In the event of an accident involving a radiographic projector, such as a falling object hitting the projector or controls, immediately do the following:

a. Return source to shielded position in the projector if possible. Conduct a physical radiation survey to assure that the source is fully shielded and lock the projector.

b. Immediately notify Health Physics and supervision.

c. Do not use the projector until supervision and Health Physics have made an inspection and authorized continued use of the equipment.

d. In the event the source cannot be returned to the projector, immediately do the following:

(1) Set up and post a restricted area (if not already established).

(2) Do not allow unauthorized entry into this area.

(3) Notify Security Dispatcher, Ext. 280 and request Health Physics assistance.

3. In the event of incident involving the exposure of un-monitored personnel to radiation, immediately do the following:

a. Set up and maintain a restricted area (if not already established).

b. Record names and clock numbers of un-monitored personnel involved.

c. Notify your supervisor and Health Physics.

d. Supervisor and Health Physics shall investigate the incident.

e. Health Physics shall determine the course of action and shall notify the appropriate regulatory agency (s).

4. In the event of loss of source:

   a. Notify Security Dispatcher, Ext 280 and request Health Physics assistance.

   b. The following shall be performed by Health Physics and the radiographer:

      (1) Obtain all information on the last known location of the source.

      (2) Monitor the suspect location to locate the source, and replace it in a shielded container as soon as possible.

      (3) Check un-monitored personnel and handle as in paragraph 3 above.

      (4) Health Physics shall notify the appropriate regulatory agency (s).

5. Vehicular accident involving in-plant transportation of radiographic projectors.

   a. Upon notification of an accident involving the in-plant transportation of radiographic projectors, the following procedures shall be followed:

      (1) Restrict the area of the accident.

      (2) Notify Health Physics.

      (3) Use an operating calibrated survey meter to ascertain whether the source is in a safe condition within the projector.

         (a) If the source is safely within the projector and the vehicle is operable, continue to move the projector to radiographic site.

         (b) If source has become separated from the projector, follow instructions in paragraph V. H.2 or V. H.4 above.

6. Notification and reports of incidents to A. E. C.

   a. Health Physics shall notify the AEC in accordance with the current applicable regulations.

VI. Training Program

A. Conduct of Training Program

The Training Program shall be conducted by Martin Company Education Section under the direct supervision of the Chief, Health Physics in conjunction with radiography supervisory personnel.

B. Description of Radiography Training Program

1. Fundamentals of Radiation

   a. Atomic Structure

   b. Ionization

   c. Radioactivity - Radioisotopes

2. Characteristics of Gamma Radiation

   a. The Curie

   b. Specific Activity

   c. Half Life

   d. Energies of Gamma Radiation

3. Units of Radiation Dose

   a. The Roentgen (R)

   b. The RAD (Radiation Absorbed Dose)

   c. The REM (Roentgen Equivalent Man)

   d. Dose and Dose Rate

4. Detection and Measurement of Radiation

   a. Portable Instruments (Typical)

      (1) Basic Operating Principles

      (2) Calibration

      (3) Limitations

   b. Fixed Monitoring System

      (1) Basic Operating Principle

      (2) Alarm Function

Who does training?

c. Personnel Monitoring Devices

(1) Film Badge

(2) Dosimeters (self-reading)

(3) Pocket Chambers

5. Levels of Radiation from Common Gamma Sources

a. Cobalt 60

b. Iridium 192

c. Thulium 170

d. Cesium 137

e. Radium

6. Methods of Controlling Radiation Exposure

a. Time

b. Distance

(1) Inverse Square Law

c. Shielding

(1) Half value, Tenth value layers

(2) Material - Lead, Iron, Concrete

(3) Collimation

d. Use of Nomographs

7. Exposure of Radiation

a. Atomic Energy Commission Regulations

(1) Part 20 Requirements

(2) Part 30 Requirements

(3) Part 31 Requirements

b. Maximum Permissible Doses

c. Chronic Radiation Exposure

d. Acute Radiation Exposure

(1) Biological Effects

(2) Degree of Injury

8. Radiographic Facilities

   a. Description of Martin Shielded Facility

   b. Open Air or Field Radiography Sites

      (1) Distance

      (2) Local Shielding (Collimators)

      (3) Posting

      (4) Surveillance

      (5) Unauthorized Entry

   c. Source Control

      (1) In Use

      (2) Not In Use - Storage

9. Radiographic Equipment to be Used

   a. Martin Company Radiographic Exposure Devices

      (1) Description

      (2) Operating Principles

      (3) Practical Training

   b. Control Procedures

10. Emergency Procedures

   a. Emergency Call List

   b. Typical Emergency Conditions

      (1) Source Stuck Outside Container

      (2) Damaged Cable

      (3) Lost Source

      (4) Shielding - Time - Distance

11. Final Examination

   In lieu of conducting the previously outlined program, personnel may attend Picker Radiography School or an equivalent training school. Upon completion of the Training School Program, additional training on Martin Co. equipment

would be provided and such personnel must demonstrate competence in handling the equipment in addition to successfully completing a written and/or oral examination.

All radiographers must continue to maintain and periodically demonstrate a thorough familiarity with Radiographic Equipment, Operating and Emergency procedures and current applicable Federal Regulations supplied through the Health Physics Section.

C. Samples of typical examination Questions and Answers

1. What is ionization?

Ans. The process or the result of any process by which a neutral atom or molecule acquires either a positive or a negative charge.

2. Define the term "half-life". What are the half-lives of Co^{60} and Ir^{192}?

Ans. The time required for a radioisotope to lose 50% of its activity.

Co^{60} Half-life 5.3 yrs.

Ir^{192} Half-life - 74 days

3. Define a Curie.

Ans. The quantity of a radioactive nuclide disintegrating at a rate of 3.7×10^{10} atoms per second.

4. Explain the difference between dose and dose rate.

Ans. Dose Rate - The measure of radiation dose delivered per unit time, i.e., mr/hr.

Dose - The radiation delivered to the specific area of interest.

5. What is meant by "chronic exposure?"

Ans. Low doses of radiation received over long periods of time.

6. What are the three (3) means of controlling external radiation dose?

Ans. Time, Distance and Shielding

7. What is meant by the term "Half Value Layer" and what are the half value layers of lead for Co^{60} and Ir^{192}?

Ans. The thickness of material which will reduce the radiation by one

half its original intensity.

Co^{60} Lead HVL = 1/2 inch

Ir^{192} Lead HVL = 1/6 inch

8. What is the purpose of a collimator?

Ans. To reduce radiation scattering and focus the radiation to a single area.

9. What is the normal allowable annual dose of ionizing radiation to the whole body or critical organs permitted by Federal Regulations?

Ans. 5 REM/yr.

10. What is the Martin Company emergency dose limit?

Ans. 25 REM whole body.

11. Assume a person is exposed to a very high dose rate from a Co^{60} or Ir - 192 source.

a. Can this person become radioactive?

Ans. No

b. Can this person become contaminated?

Ans. No, unless the sealed source has ruptured.

c. When the source is no longer present, is ionization from gammas still taking place in his body?

Ans. No

12. List several advantages and disadvantages of film badges and dosimeters?

Ans. Film Badge Advantages - a. Lasting record of exposure

b. Measures total cumulative exposure

c. Can be used to differentiate between types of radiations

d. Not shock sensitive

Disadvantages - a. Film subject to environmental and external damage. (fading, fogging, etc.)

b. Must wait for processing to get dose results.

c. Energy dependent.

d. Orientation of film during exposure is a problem.

Ans. Dosimeter Advantages - a. May be used (self-reader) to keep track of exposure during operation.

b. Can be recharged as required.

c. May be used to measure dose rate in extreme emergency condition.

Disadvantages - a. Energy dependent (generally gamma only)

b. Can be accidently discharged.

c. Off scale total exposure cannot be determined.

13. Noticeable blood changes occur at what general levels of acute radiation exposure?

Ans. 25 to 50 REM.

14. Who must be notified by the radiographer prior to making "Open Air" exposures, and what information is given?

Ans. a. Health Physics, Security, Area Supervision

b. Source to be used and type of operation

c. Starting time

d. Precautions

e. Length of time to complete operation

15. Each radiation survey instrument shall be calibrated at intervals not to exceed what time period?

Ans. 3 months

16. What is the general course of action you would follow if a source became stuck out at the end of the source tube after a routine exposure?

Ans. a. Attempt to crank the source back to its shield.

b. Notify Health Physics and radiography supervision.

c. Maintain surveillance over the area until assistance arrives.

d. Carefully shield the exposed source with available shielding, i.e., earth, concrete block, sand bags, lead, etc.

e. Carefully disconnect source tube at the projector and attempt to loosen source by wriggling the drive cable.

17. What is the procedure required when a radiographer loses a film badge during a shift?

Ans. a. Leave the radiographic site.

b. Notify Health Physics.

c. Obtain a new film badge.

18. Who has the responsibility for securely locking the source container and performing the final survey on the projector and where is this information recorded?

Ans. The Radiographer - final survey on Gamma Radiography Data Sheet.

19. What is the title of the Federal Regulations governing use of radiography sources?

Ans. Title 10, Part 31.

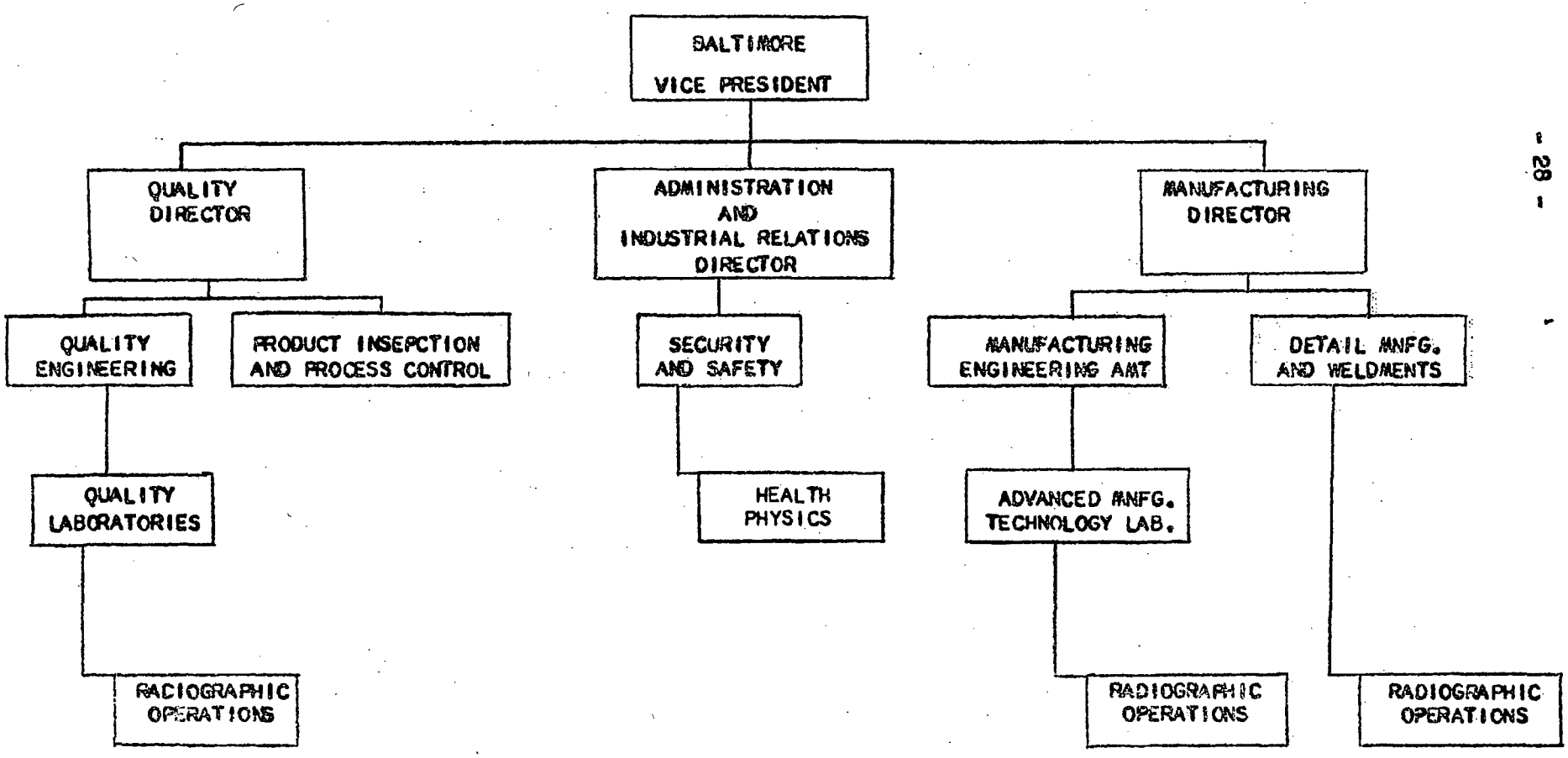
20. What is the LD - 50 Dose?

Ans. 400 R whole body.

VII. Description of Overall Organization Structure and Internal Inspection System.

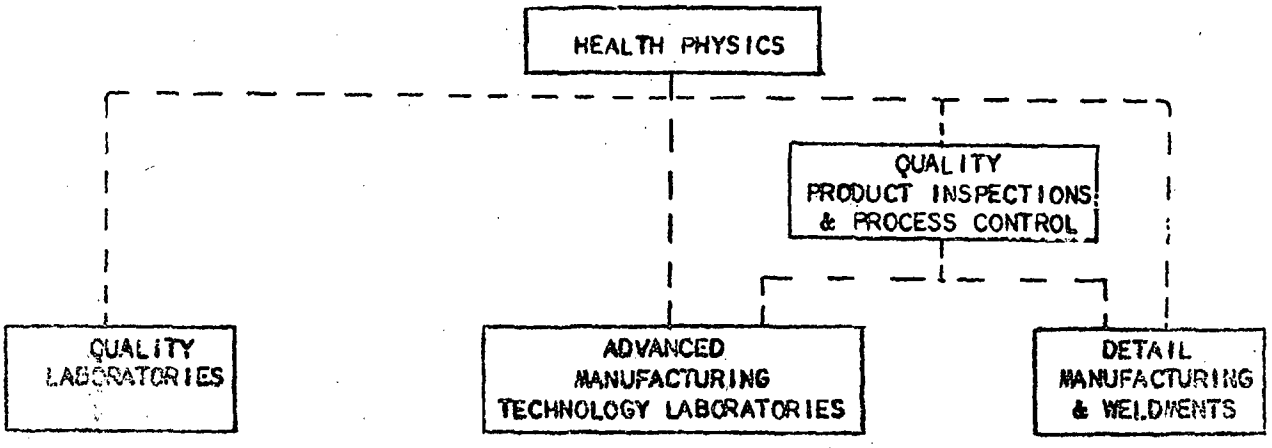
A. Organizational Structure

The following diagram shows the organizational relationships as they affect radiographic operations conducted by the Baltimore Divisions of the Martin-Marietta Corporation.



B. Internal Inspection System

The following diagram shows the management system established to control the potential hazard resulting from radiographic operation.



1. The Chief, Health Physics Section is responsible for the development and conduct of an effective radiological safety program. He is delegated the authority for this program through several official company organizational documents.

   (a) Operating Instruction No. ER-O-O-B3 entitled - Health and Safety Administration.

   This document provides for the establishment and surveillance of radiological safety practices and procedures. It also provides that the Chief, Health Physics Section represent the Director, Administration and Industrial Relation on radiological safety matters with Government agencies.

   (b) Procedure No. OP-B4.107 entitled - Control of Radioactive Isotope Materials

   This document establishes that the Chief, Health Physics Section shall review and approve Byproduct Material purchase requests and the plans for the use of these materials to assure that employees are properly educated to handle equipment and/or work in areas where radioactive materials are used; monitor employees handling such materials and the controlled area in which they work to assure compliance with radiological safety requirements; obtain governmental approvals authorizing purchase, use transfer and disposal of such materials; check all incoming and outgoing shipments of radioactive material to ensure compliance with Federal and State regulations. Radioactive materials shall only be used in controlled areas by personnel who have been approved to handle such materials by the Chief, Health Physics Section.

2. The Chief, Quality Laboratories supervises the development of non-destructive testing techniques. He is responsible for the safe conduct of radiographic operations in accordance with company procedures and other regulatory requirements.

3. The Chief, Advanced Manufacturing Technology Laboratories supervises the developmental testing of new manufacturing techniques. He is responsible for the safe conduct of radiographic operations in accordance with company procedures and other regulatory requirements.

4. The Superintendent, Weldments supervises the production and radiography of manufactured items. He is responsible for the safe conduct of radiographic operations in accordance with company procedures and other regulatory requirements.

5. Personnel representatives from the Quality Products Inspection and Process Control Department inspect to assure that radiographic operations within manufacturing are conducted only by certified radiographers.

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(b)(4)

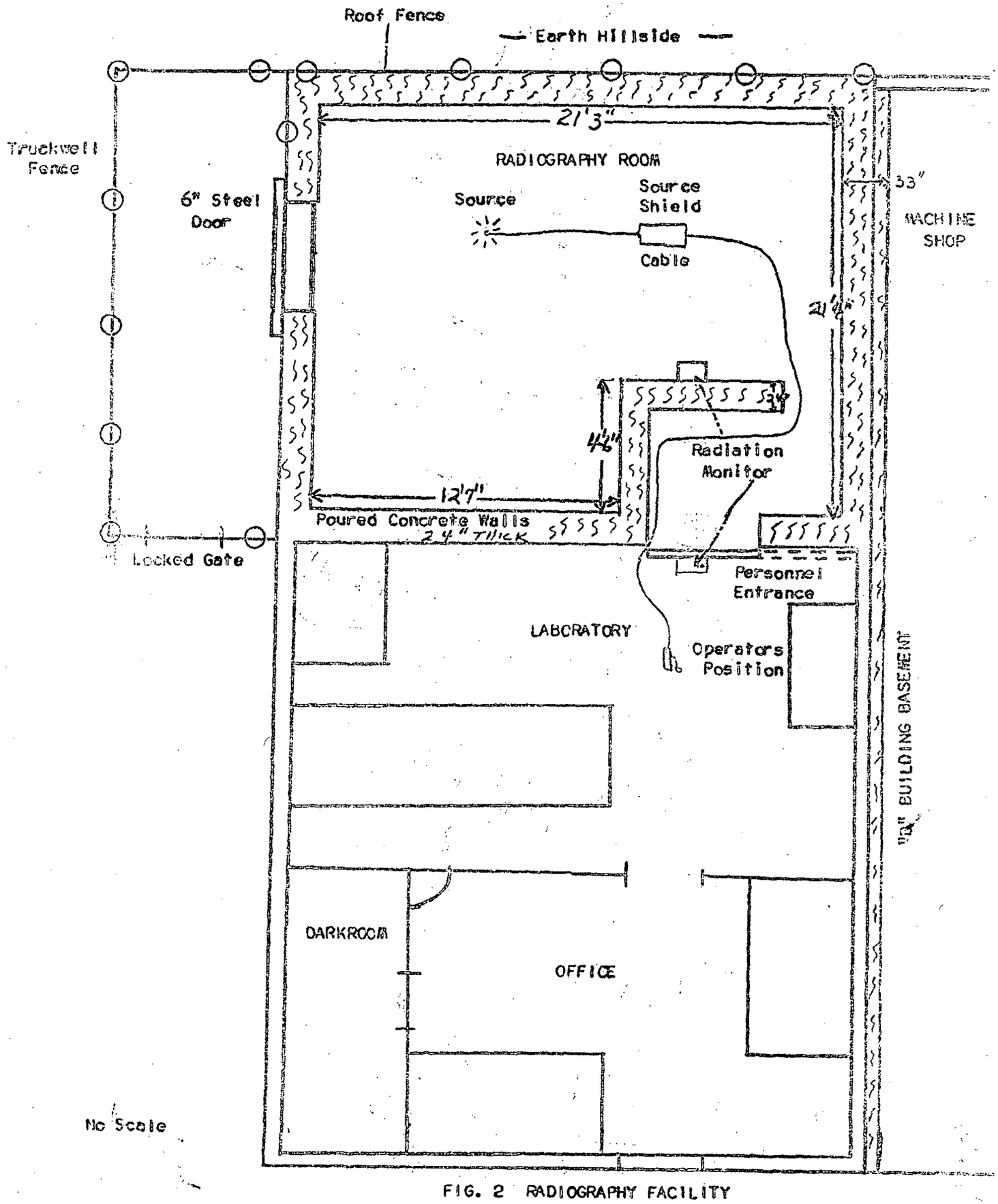

FIG. 2 RADIOGRAPHY FACILITY

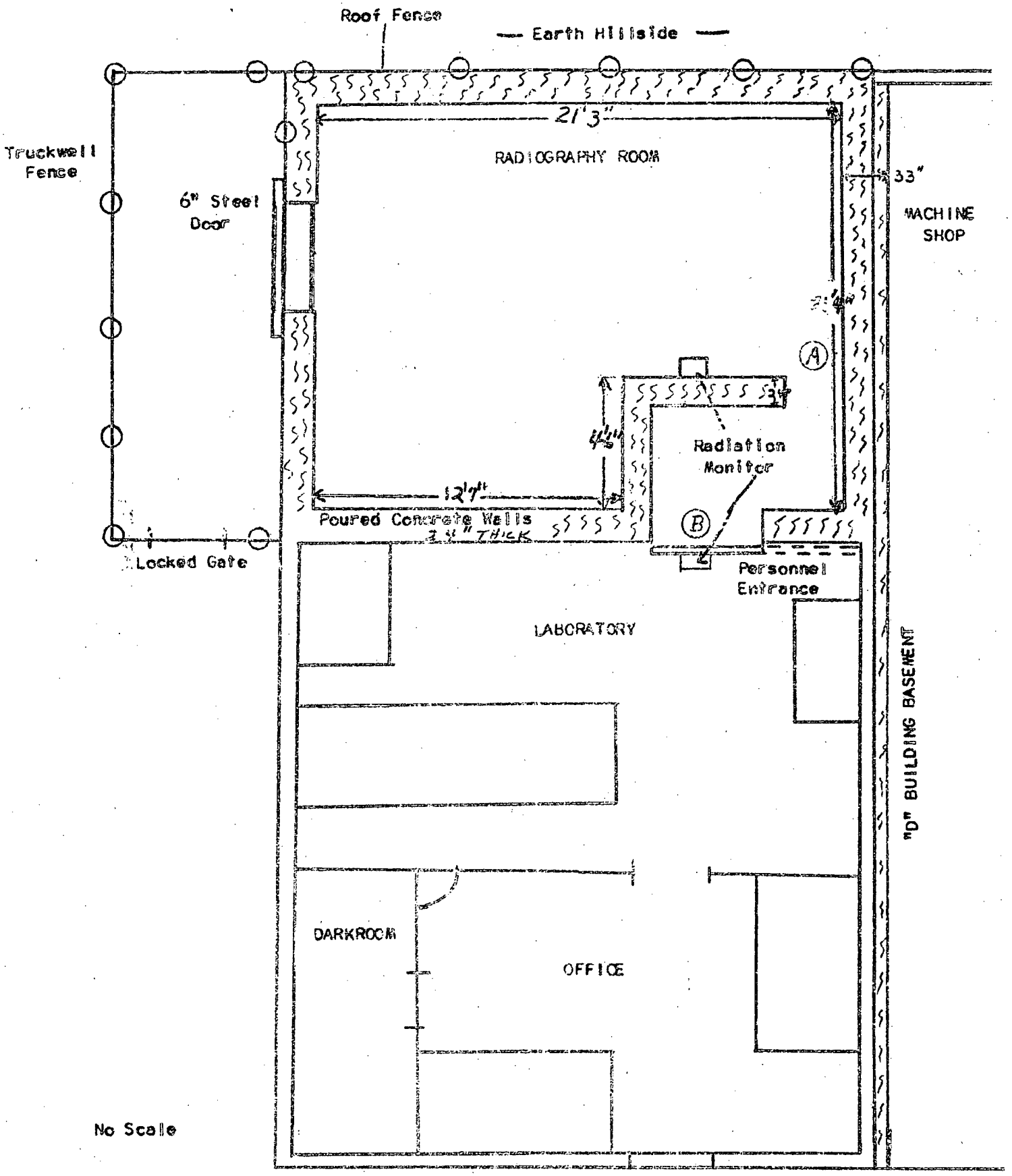

FIG. 3 RADIOGRAPHY FACILITY

FIG. 4

GAMMA RADIOGRAPHY DATA

AEC LICENSE NO. _____

Survey Instrument	Ser.No.

Dept.	Tele. Ext.	Order No.	Radiography Location	Date	Source, Serial No. & Strength	Projector Make & Model	Security Notified	Personnel	Dosimeter Reading	
									Start	Finish
						T.O. 412/498 Ir. 192				
						T.O. 402 CO 60				

Code	Film Size	Source/ Film Distance	Exposure Time			Material	Thickness	Maximum Dose Rate To Operator	Max. Dose Rate at Restricted area Boundary	Source Returned To Projector & Monitored	Comments
			Start	Finish	Total						

FINAL PROJECTOR SURVEY (LOCKED AND MONITORED)

Radiographer's Signature