Form - 313
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ATOMIC ENERGY COMMISSION

APPLICATION FOR BYPRODUCT MATERIAL LICENSE

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.)*

General Steel Industries
1417 State Street
Granite City, Illinois

(b) STREET ADDRESS(ES) AT WHICH BYPRODUCT MATERIAL WILL BE USED. *(If different from 1 (a).)*

Same

2. DEPARTMENT TO USE BYPRODUCT MATERIAL

Metallurgy Department

3. PREVIOUS LICENSE NUMBER(S). *(If this is an application for renewal of a license, please indicate and give number.)*

None

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.)*

Mr. Robert Ripley
(See attached)

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.)*

Mr. Robert Ripley with assistance from a consulting physicist from Nuclear Consultants Corporation

6. (a) BYPRODUCT MATERIAL. *(Elements and mass number of each.)*

Co-60

(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.)*

Metallic source of Cobalt in a sealed source. The sealed source will be obtained from the Budd Company, their source capsule assembly No. 300-041706(B). There will be two such sources mounted in the Budd Company's Model 110A Unitron Radiographic equipment, each source to be less than 1 curie each.

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.)*

This material (Co-60) will be in the form of a sealed source and will be used only within a specially constructed room in the plant for radiographic inspections of large steel castings. The source capsule assembly number is The Budd Company, Model 300-041706(B) and will be used in a rollout type camera, The Budd Company's Model 110A Unitron Radiographic equipment.

(Continued on reverse side)

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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 COURSE (Circle answer)
a. Principles and practices of radiation protection	See attached		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
		See attached		

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/cm^2)	USE (Monitoring, surveying, measuring)
NRD Model GS-404	1	beta gamma	0-5 0-50 0-500 0-5000 0-5000 mr/hr	30 mg/cm^2	Monitoring and Surveying

11. METHOD, FREQUENCY, AND STANDARDS USED IN CALIBRATING INSTRUMENTS LISTED ABOVE: Every three months or after each repair by a physicist from Nuclear Consultants, Co-60 and Ra-226 Bureau of Standards sources are used for the calibration.

12. FILM BADGES, DOSIMETERS, AND BIO-ASSAY PROCEDURES USED. *(For film badges, specify method of calibrating and processing, or name of supplier.)*
Bi-weekly film badge service is supplied by Nuclear Consultants Corp., and each person is supplied with a 0-200 mr pocket dosimeter manufactured by the Victoreen Instrument Company.

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 See attached

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.
See attached

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. The Budd Company

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.

Applicant named in item 1

Date _____ By: _____

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.

Form AEC-313b (6-55)

APPLICATION FOR BYPRODUCT MATERIAL LICENSE
SUPPLEMENT B—SEALED SOURCES

Form approved.
Budget Bureau No. 38-R028.3.

If application is for byproduct material to be used in or manufactured as a "sealed source" complete this supplement and attach to the application for byproduct material license. Applicant for *use* of sealed source should complete Section I. An applicant desiring to *manufacture* a sealed source should complete Section II. If information has been submitted previously and there are no changes in the sealed source and/or device design or other changes in information submitted previously, details requested below may be omitted *provided* reference is made on line below to the application or other document on which this information appears:

SECTION I—USE (*See instructions*)

1. IF SEALED SOURCE OR DEVICE CONTAINING SEALED SOURCE IS MANUFACTURED COMMERCIALLY, GIVE FOLLOWING INFORMATION:

A. Manufacturer or supplier of sealed source and/or device The Budd Company, Phoenixville, Pa.

B. Make and model number of sealed source and/or device Capsule assembly 302-041736(B) Unitron 130A

C. Person who will hold legal title to sealed source General Steel Industries, Granite City, Ill.

2. (*a*) NAME OF PERSON WHO WILL PERFORM NECESSARY PERIODIC LEAKAGE TESTS (*6-month intervals for beta-gamma; 3-month period for alpha emitters. See instructions*)

Physicists from Nuclear Consultants Corp., St. Louis, Mo.

(*b*) IF ABOVE PERSON IS NOT THE SUPPLIER, MANUFACTURER, NOR A COMMERCIAL LABORATORY ROUTINELY OFFERING SUCH SERVICES, GIVE BRIEF STATEMENT OF EXPERIENCE OR TRAINING OF SUCH PERSON IN TECHNIQUES TO BE EMPLOYED, A STATEMENT OF LEAK TESTING PROCEDURES INCLUDING EVIDENCE OF ITS EFFICACY AND INSTRUMENTATION TO BE USED:

Nuclear Consultants Corp. is a laboratory routinely offering this service under AEC licenses #24-4206-1(J62)

3. ARRANGEMENTS WHICH WILL PREVAIL FOR PERFORMING INITIAL RADIATION SURVEY (*if appropriate*), SERVICING MAINTENANCE, REPAIR, CONTROL, AND DISPOSAL, ETC., OF THE SOURCE:

A radiation physicist from Nuclear Consultants Corporation will make a complete radiation survey of the facilities upon the completion of the installation. A copy of this final report will be forwarded to the U.S. AEC as well as the state health department. The Budd Company will arrange for servicing, maintenance, repair and disposal (and placement) of the source. See attached for further detail.

SECTION II—MANUFACTURE

4. IF SEALED SOURCE TO BE MANUFACTURED OR FABRICATED BY THE APPLICANT IS DESIGNED TO TRANSMIT ONLY GAMMA RAYS AND CONTAINS IN ELEMENTAL FORM (*but not powders*) COBALT 60, IRIDIUM 192, GOLD 198, TANTALUM 182, OR THULIUM 170, GIVE FOLLOWING INFORMATION AND DISREGARD QUESTIONS 5 THROUGH 12 ON THIS SUPPLEMENT:

(*a*) Quantity of byproduct material per source and model number

(*b*) Leak testing procedure to be employed:

(*c*) Attach annotated engineering drawing of source container and holder, if any:

(*d*) Describe label to be affixed to source container and/or source holder (*or attach copy. See instructions*):

(*Continued on reverse side*)

General Steel Industries

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L.-S.- 9.

The General Steel Industries have for years employed various forms of radiant energy for the non-destructive testing of steel castings. The standard x-ray equipment has been employed for many years. Some 20 years ago General Steel purchased the first 2½ MEV betatron in the St. Louis area to check large castings produced for the military. Over the years a group of highly qualified radiographers have been trained and are presently performing such duties on a three shift basis.

We feel from their background and experience, each of the following qualify as "Radiographers" as defined in CFR Title 10 part 31 and hence wish to submit their names and background and ask that they be listed as licensed users under this proposed license.

Mr. Robert Ripley will be in charge of the overall radiographic facility, personnel and project. Mr. Ripley has had extensive training and experience, not only in the general field of radiography but more specifically in the field of gamma radiography. He was employed for some 9 years at the Key Company in East St. Louis. For some 6 years of this time he was engaged in radiography. In addition to the usual standard x-ray equipment, Mr. Ripley obtained experience in the handling of Ra 226, up to 1000 mg, 500 mc Co-60 sources, a 2 curie CO-60 source and Ir 192 sources up to 20 curies. From 1950 through approximately 1953, Mr. Ripley was listed as the licensed user on the AEC license held by the Key Co., East St. Louis, Ill. Unfortunately we do not have this number at hand to refer you to.

Since joining General Steel Industries, Mr. Ripley has been in charge of the radiographic facilities which include standard x-ray equipment, a 24 MEV betatron, and to date two Ra 226 sources each 500 mg. In his supervisory capacity Mr. Ripley has 6 radiographers under his direction. In general there are two for each of three shifts. He is responsible not only for the radiographic work (quality, etc.) but also for the radiation safety program already in force at the plant.

In January of this year Mr. Ripley attended the radiographers' course given by the Budd Company, held in Chicago, Illinois. This course covered the major items in Appendix A of Title 10, part 31, plus a complete description and training period on the type of roll out camera we will obtain from them. (Unitron Model No. 110A)

In addition to Mr. Ripley, we wish to list the following personnel as radiographers under this license.

Mr. William E. Davis, Plant Metallurgist. Graduate of St. Louis University with BS in chemistry and minor in physics. Has had formal courses in both atomic and nuclear physics at St. Louis University. Although not routinely engaged in radiographic work at the present time, he has had some 10 to 12 years experience in the field using standard x-ray equipment as well as the 24 MEV betatron and radium sources up to 1000 mg. Mr. Davis is Mr. Ripley's immediate supervisor, since the radiographic section falls under the metallurgical department. In addition to the formal college courses and the 10 - 12 years of experience, Mr. Davis has also taken two civil defense courses, one offered by the State of Illinois and the second by Southern Illinois University. The first was a

What about radiographic instructions?

Radiological Civil Defense course. In this course radiation effects were studied, methods of survey, operation and calibration of geiger mueller and ionization type survey meters, units of radiation, characteristics of radiation, hazards of exposure and decontamination procedures to mention a few subjects. The second course was a civil defense course in industrial decontamination. This as mentioned above was given by Southern Illinois University by members of their staff. Much of the same material as in the above course was covered including again radiation hazards, use of survey meters, dosimeters, film badges, control of exposure, surveying and of course stressed more the procedures and techniques involved in decontaminating large industrial areas after a nuclear incident.

It should also be mentioned that Mr. Ripley took and received certificates for the same two courses. Mr. Davis also supervised the radiographic work for the AEC uranium processing performed by Mallinckrodt Chemical Company for a period of 9 years.

Other Radiographers

1. Mr. William Greer

Mr. Greer has been employed as a radiographer at General Steel Industries for approximately 10 years. He has had extensive experience in all standard x-ray equipment as well as the 24 MEV betatron and the 2 500 mg of Ra 226 sources. Informal lectures and discussions over the years by Mr. Ripley and Mr. Davis have covered all the areas listed in Apendix A of Title 10, Part 31, a refresher course covering -

1. Fundamentals of radiation safety
   (a) Characteristics of gamma radiation
   (b) Units of radiation
   (c) Hazards of radiation exposure

(d) Levels for licensed material

(e) Control of radiation dose

II. Radiation detection instrumentation

(a) Survey meter

(1) Operation

(2) Calibration

(3) Limitations

(b) Survey techniques

(c) Personnel monitoring

(1) Film dosimetry

(2) Pocket dosimetry

(3) Pocket chambers

III. Emergency operating procedures (See attached)

IV. Title 10, parts 20 and 31 training is presently being conducted for Mr. Greer and the below listed individuals by physicists from Nuclear Consultants Corporation in St. Louis, Missouri. The radiographic equipment, storage containers, etc. will be reviewed again by Mr. Ripley and Mr. Davis.

2. Mr. Morrell Peterson

Mr. Peterson has had over 10 years experience in radiography at General Steel Industries doing standard x-rays, 24 MEV betatron, and 500 mg sources of Ra 226, some informal training and courses as listed above.

3. Mr. Elmo Gruenfelder

Mr. Gruenfelder has had over 10 years experience in radiography at General Steel Industries doing standard x-rays, 24 MEV betatron,

(d) Levels for licensed material

(e) Control of radiation dose

II. Radiation detection instrumentation

(a) Survey meter

(1) Operation

(2) Calibration

(3) Limitations

(b) Survey techniques

(c) Personnel monitoring

(1) Film dosimetry

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2. Mr. Morrell Peterson

Mr. Peterson has had over 10 years experience in radiography at General Steel Industries doing standard x-rays, 24 MEV betatron, and 500 mg sources of Ra 226, some informal training and courses as listed above.

3. Mr. Elmo Gruenfelder

Mr. Gruenfelder has had over 10 years experience in radiography at General Steel Industries doing standard x-rays, 24 MEV betatron,

and 500 mg sources of Ra 226, same informal training and courses as listed above.

4. Mr. Claud Schloss

Mr. Schloss has had over 5 years experience in radiography at General Steel Industries doing standard x-rays, 24 MEV betatron, and 500 mg sources of Ra 226, some informal training and courses as listed above.

5. Mr. James Powers

Mr. Powers has had over 2 years experience in radiography at General Steel Industries doing standard x-rays, 24 MEV betatron, and 500 mg sources of Ra 226, some informal training and courses as listed above.

6. Mr. Edmund Warchol

Mr. Warchol has had over 2 years experience in radiography at General Steel Industries doing standard x-rays, 24 MEV betatron, and 500 mg sources of Ra 226, some informal training and courses as listed above.

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13. Facilities and Equipment

General Steel Industries in its normal operation produces a wide range of very large steel castings for the military and for industry. Extensive testing, including radiographic inspection is required for most of these castings. To date, we have used quite satisfactorily two 500 mg radium sources. These have been used with a fish pole technique with little radiation exposure to our personnel. To more easily comply with state regulations and to reduce our cost by purchasing rather than leasing material, we have decided to obtain two 300 mc Cobalt-60 sources from the Budd Company which will be mounted in two of their Unitron Model 110A rollout cameras. These sources and cameras will be used only in the specially constructed room inside the plant in Granite City. Although the cameras are of the portable type, they will not be used in other parts of the plant nor in the field.

See attached drawing for the radiographic room. This room is 22 feet wide by 60 feet long and the walls are constructed of 16 inches of solid concrete block. The room is located inside our foundry and hence does not have a roof. There is no basement nor open area under the room. The walls are approximately 10 feet high with three strands of barbed wire atop the wall to make certain unauthorized personnel do not enter. There is only one door into the room which is located on the north wall. This door is posted and always kept locked. Only Mr. Ripley and the radiographers working directly under his supervision have access to the keys, with the exception of the building superintendent. The superintendent never goes into the room without first

contacting Mr. Ripley. He does not have keys for the source storage containers. Inside the room, in the northeast corner, is a small viewing room of about six by six feet square. The walls of this room are 8 16 inches thick made from cement blocks. Between the radiographic area and the dark room area and control area are several large pieces of armor plate steel as shields. These armor plates are 4 inches thick and measure 6 x 6 feet square. One shields the dark room area and the second shields the control area from the radiographic area.

All areas immediately surrounding this room are either storage areas or run ways for the movement of material and castings. Except for the door area, the area for approximately 20 feet adjacent to the north wall is storage and not accessible to personnel. The area adjacent to the east wall is likewise primarily used for storage and although personnel can approach to within 4 or 5 feet of the wall, there is no working area closer than 20 feet away. The area behind the south wall is pretty much inexcessable to personnel being used to store drums of oil. The west wall faces a runway through which small trucks or tractors move castings, molds and other material. The closest work area is some 15 to 20 feet away.

All castings are placed in this room through the open ceiling by the use of overhead cranes. The large overhead cranes span the whole width of the large building (approximately 100 feet wide). The control cabin is located at the far south side of the large building and some 25 feet in the air. The distance from the wall of the radiographic room to a point directly under the control cabin

is approximately 40 feet. Hence, the closest distance from the wall to the cabin is on the order of 50 feet. Since the crane operator is working from a point so far behind the south wall of the room (although some 25 feet up) he is unable to see or place castings closer than 3 or 4 feet from this wall. If there is a single casting, it is placed nearly in the center of the room. If there are two (the maximum handled at any one time) they cannot both be centered of course which results in each being slightly closer to the side walls. Most work is done with the capsule inside the casting with the film placed on the outside. For this reason very small source to film distances (3 to 6 inches) are used and hence the reason for the small sources (300 mc each). This technique, with the source inside the casting results in considerable absorption of the radiation in the casting and hence results in much reduced radiation fields.

Sample calculations:

Let us assume both sources are exposed. Each are four feet from the south wall and six feet from the east and west walls.

300 mc x 1.33 mr/hr at 1 M = 399 or 400 mr per hour at 1 meter

The HVL for concrete is given as 2 to 2.5 inches depending on density. At 2 inches with a 16 inch wall we have 8 HVL's and at 2.5 it would represent 6 HVL so let us use 7 HVL's as a reasonable average $2^7 = 128$. Hence the 16 inches of concrete will reduce the radiation by a factor of 128 times. Take east wall first. If the source is 6 feet from the wall (6 x 12 = 72 + 16 (wall) = 88 inches). This represents 2.2 meters (88 ÷ 40 = 2.2). By the inverse square law ($(2.2)^2 = 4.84$), we have another reduction of a factor of 4.84.

Hence the total reduction would be 128 x 4.84 = 619.52. Since the radiation from a 300 mr source at 1 meter is 400 mr per hr, the contribution of this source to the field just outside the east wall would be 400 ÷ 619 = 0.64 mr per hr. The second source is a total of 16 x 12 = 192 + 16 = 208 inches or 208 ÷ 40 = 5.2 meters from this outside wall. Hence the inverse square law would reduce the radiation from this source by $(5.2)^2$ = 27.04 giving a total of 128 x 27.04 = 3456 time reduction. Hence 400 ÷ 3456 = 0.11 mr per hr. or a total outside this wall of 0.64 + 0.11 = 0.75 mr per hour. The same calculations would hold for the west wall.

The sources were presumed to be only four feet from the south wall. Hence 4 x 12 = 48 + 16 = 64 ÷ 40 = 1.6 meters from outside wall. By inverse square law we get 2.56. This with reduction of 128 times due to absorption in the concrete give us a reduction factor of 128 x 2.56 = 327.68. Therefore 400 ÷ 328 = 1.2 mr per hr. The second source would be a little over 11 feet from a point outside the wall just opposite the first source. Hence its contribution would be 11 x 12 = 132 ÷ 40 = 3.3 meters. $(3.3)^2$ = 10.89 or 10.89 x 128 = 1395.2 times reduction. Therefore 400 ÷ 1395 = 0.28 mr per hr. This gives us a total of 1.2 + 0.28 = 1.48 mr per hr.

As stated before the castings and hence the sources are never placed closer than 4 to 6 feet from the inside walls. As shown by the above calculations this would result in fields of well under 2 mr per hr. at the outside wall which in general is not accessable to personnel. No additional shielding has been considered by the usual placement of the source inside the castings. These are often 1 to 6 inches

thick, thereby offering from 1.5 to 8 HVL's of additional shielding. A maximum of 30% of each shift is used for actual exposure. The exposure times range from 1 or 2 minutes up to 1.5 hours. This means the source is seldom exposed for a total of more than 2 or 3 hours for each 8 hour shift.

The large overhead crane is never operated over the area where the radiographers' room is located except to place the castings to be radiographed into the room. It can be shown however that the maximum radiation field which could exist at the cabin of this crane is between 2 and 2.5 mr per hr. Since the occupancy factor in this position is virtually zero we consider this to be an unrestricted area.

The operator of the radiographic units will be some 25 to 35 feet away from the exposed sources and will operate behind 4 inches of armor plate steel.

The only door to the room is locked and posted on the outside and is likewise locked from the inside when a radiographer is inside working. Because of the noise level in the plant it would be possible for unauthorized personnel to enter the room unnoticed even with the operator in the room if he did not lock the door after him. There is a buzzer on the door to signal the operator from the outside.

Two large red lights are mounted on the top of the wall. One is mounted on the north wall immediately above the door and the second

one is mounted on the top of the south wall. These lights are turned on whenever an operator enters the radiograph room or whenever sources are exposed. The light can easily be seen not only by some one entering the door but also by the crane operator and anyone in this whole area of the plant.

General Steel Industries

OPERATING PROCEDURE FOR USE OF COBALT-60 RADIOGRAPHIC SOURCES

All "Radiographers" (as defined in Title 10, Part 31), in addition to having from two to ten years of experience in the use of X-ray equipment, radium sources and the 24-MEV Betatron, shall

1. Read and understand both Parts 20 and 31 of Title 10 of the Code of Federal Regulations.

2. Read and become well acquainted with the Instruction Manual for the Budd roll-out camera device.

3. Read and retain a copy of these Operating Procedures and the attached Emergency Operating Procedures.

4. Receive instructions in the operation of the exposure device and receive actual experience in its operation.

5. Receive instructions and procedures from Mr. Ripley and Mr. Davis.

6. Receive instructions in health physics, monitoring and personnel monitoring and dosimetry from a physicist from Nuclear Consultants Corporation.

Above instructions will include lectures, actual use of exposure devices and survey instruments, and practical problems, utilizing Appendix A, Part 31, Title 10, CFR, as an outline.

There will be no transportation of sources or exposure devices to any field locations, nor, in fact, shall they be moved from the special radiographic room within the plant. All records will be maintained by R. W. Ripley in the metallurgical laboratory, or by the corporation accountant (inventory) in the corporation accounting department at the same address.

Only "Radiographers" licensed by the AEC and assigned to this department shall have keys to the radiographic room and to the exposure device. Under NO conditions are you to loan or give your key to anyone, regardless of his position within the company, without the direct approval of Mr. Ripley, or Mr. W. E. Davis. If your keys are lost or misplaced, notify Mr. Ripley of this at once.

All "Radiographers" must wear film badges whenever working around radiation, whether it be X-ray, betatron or the Co-60 sources.

General Steel Industries

OPERATING PROCEDURE FOR USE OF COBALT-60 RADIOGRAPHIC SOURCES -

(Continued)

Page Two

They must also wear the pocket chambers provided.

A step-by-step procedure which is to be followed by each shift and each man is tabulated below:

1. Unlock the door to the radiographic room from the outside, enter and immediately lock the door from the inside. This is necessary due to the higher-than-normal noise level in the plant. A loud siren is located over the door, with a push-button activator on the outside, for use in the event another radiographer must enter the room while it is locked from the inside.

2. Place film holder and any other equipment taken into the room in the small viewing room outside the radiation area (but within the radiographic room). Using the NRD Model CS-40A survey meter, make an entrance survey of each exposure device (Budd Company's Model 110A Unitron Radiographic Camera), making certain no sources are exposed.

3. Make the necessary entries in the Utilization and Survey Log. (See attached sample of log.)

4. Set up exposure film and fix position of source tube. Always place source as near center of room and as far from the walls as is practical. Never place source closer than four feet from the wall unless it is inside of casting. Make certain source tube is firmly fixed in position required, and that any angle in tube is not too sharp to prevent easy operation of source within the tube.

5. Turn on red warning lights. These lights are strategically located on the top of the exposure room walls, over the outside entrance and atop the south wall, so that they may easily be observed by any personnel passing by the area adjacent to the exposure room.

6. Unlock Budd Camera devices.

7. Have castings and camera located so that the control cable may be operated from behind one of the 4-inch thick armor-plate steel shields separating the radiographic area from the control area. The control cable shall be maintained behind this shielding at all times.

General Steel Industries

OPERATING PROCEDURE FOR USE OF COBALT-60 RADIOGRAPHIC SOURCES - (Continued)

8. Make necessary entries in Utilization and Survey Log.

9. "Radiographer" retires to small room outside of radiation area to time and waits for exposure to be completed. At no time should he enter the exposure area (forward of the steel shields) when sources are exposed.

10. After exposure is completed, retract source into source holder with control cable from behind armor-plate shielding.

11. Make an operational survey of the entire area, taking special note of source tube and camera device.

12. Lock camera device. This should be done even though a second exposure is to be performed.

13. Make necessary entries into Utilization and Survey Log. (See attached.)

14. Turn off warning light.

15. Steps No. 3 to No. 14, inclusive, may be repeated from two to five times before going to lunch, or between trips to the dark-room and film storage area, or the end of the shift. Dark-room and office are over 500 yards from exposure room.

16. Before leaving the room, whether to go to lunch or dark-room or at end of shift, a final survey of source holder and source tube will be made and noted in the log. Be sure to sign the log.

17. Leave exposure room and lock door from the outside. Never leave room, even for a few minutes, without locking from the outside.

18. A final dosimeter reading will be made and recorded at the end of each shift. Film badges as noted above will be worn throughout the eight-hour shift, regardless of work being performed.

19. See Emergency Procedure for proper action in case of an emergency. In case of emergency follow those procedures and call Mr. Ripley at once.

WRK:bjs

General Steel Industries

EMERGENCY OPERATING PROCEDURE

A telephone is located in the small room protected from the radiation area but within the locked exposure room. Any deviation from normal operating procedure may be reported to the supervisor in charge of radiography without the necessity of the radiographer's leaving the locked exposure room. All men handling the source will be radiographers within the definition of Part 31, Paragraph 31.3.

EMERGENCY NO. 1: SOURCE CANNOT BE RETRACTED INTO THE SOURCE HOLDER OR THE SURVEY INDICATES THAT IT IS NOT WITHIN THE HOLDER WHEN IT SHOULD BE.

1. The warning lights will still be on in conformance with operating procedure. If the emergency happens at any other time, turn on warning lights.
2. Call R. W. Ripley by auto call or telephone.
3. Unlock door, leave radiation room, and lock door from the outside.
4. Using NRD Model CS-40A survey meter, survey area immediately surrounding radiographic area, and post any area of greater than 5 mr/hr.
5. Maintain vigilance at doorway until Mr. Ripley arrives.
6. Obtain full story, evaluate, rectify if possible.
7. If necessary, call Nuclear Consultants Corporation or the Budd Company. Exposure room will remain locked and all warning lights will remain on until area is safe. Radiographer will maintain personal vigilance at exposure room door if gravity of situation warrants.
8. Record will be made of the incident.
9. AEC will be notified, if necessary, in compliance with Title 10, Part 20, Paragraph 20.403.

EMERGENCY NO. 2: POCKET DOSIMETER READS OFF SCALE

1. Do not extrapolate.
2. Recharge dosimeter, check it after 15 minutes, repeat this step. If it reads off scale both times it is probably faulty.
3. Develop casting exposure films, see if they have the correct density with no distortion. Any misalignment of source or

source tube that could result in overexposure would not give a satisfactory radiograph.

4. Check survey instrument. If survey instrument and radiographs prove to be all right and dosimeter indicates a faulty discharge, assume dosimeter to be faulty. Use spare dosimeter.

5. Call R. W. Ripley and notify him of these results for his evaluation before making any other exposures.

6. If above indicates that the apparent overexposure may have actually occurred, send film badge in for processing with request for an immediate reply by telephone.

7. If film badge report substantiates dosimeter reading, the radiographer will be sent to the corporation doctor with a full report.

8. AEC will be notified in conformance with Title 10, Part 20, Paragraph 20.403.

WRK:bjs

General Steel Industries

COMPLIANCE TO REQUIREMENTS AS SET FORTH IN TITLE 10, PART 31

31:101 - The Budd Unitron Model 110A is designed and approved by the AEC to handle up to 10 curies of Co-60. We will be using a maximum of 300 to 1000 mc; hence the levels will be well below allowable limits.

31:102 - The Budd units are provided with locking devices.

31:103 - The Budd units are used for storing the material. These are locked and kept inside a locked room.

31:104 - We have obtained a Model CS-40A (Nuclear Corporation of America) ionization-type survey meter. The ranges are 0 - 5, 0 - 50, 0 - 500, 0 - 5000, 0 - 50,000 mr/hr. This will be calibrated every three months by physicists from Nuclear Consultants Corporation.

31:105 - Leak testing of these sources will be performed by physicists from Nuclear Consultants Corporation every six months.

31:106 - A quarterly inventory will be kept in a special log.

31:107 - Utilization log: As described in the Procedure Manual attached, the radiographer must record in a special log the date and hour that the source is removed from the container, the time returned, the total lapsed time of the exposure, the number of the casting, and this must be signed by the radiographer.

31:201 - All persons whose names have been submitted as radiographers have

(1) been instructed in the subjects outlined in Appendix A,
(2) received copies of Instruction Manual, Procedure Manual, emergency procedures, and Parts 31 and 20,
(3) demonstrated competence to use all radiographic equipment available to them.

31:202 - Operating and Emergency Procedures: See attached.

31:203 - All personnel acting as radiographers are required to wear both film badges and pocket chambers. These are Victoreen 0-200 mr chambers. The film badges are returned and reported every two weeks, while the pocket chamber readings are recorded daily.

31:301 - As described in No. 13 of Form 313, the only door to the room is locked from the outside, or, if in use, from the inside. Large red lights atop the north and south walls are lit whenever source is exposed.

General Steel Industries

COMPLIANCE TO REQUIREMENTS AS SET FORTH IN TITLE 10, PART 31- (contd.)

31:302 - The door to the room is posted, and the area inside the radiographic room is also posted.

31:303 - A Nuclear Corporation of America Model CS-40 A calibrated survey meter is on hand at all times. As described in the operation manual, a survey must be made with this instrument each time the source is used and returned to its storage container. This survey will be recorded in the log book and signed by the radiographer.

bjs

Nuclear Consultants Corp.

Consultants to Industry on Radioisotopes

9842 Manchester Road, St. Louis 19, Missouri, 314—WOodland 2-2162
1717 Victory Boulevard, Glendale 1, California, 213—CHapman 5-3965
17907 Detroit Avenue, Cleveland 7, Ohio, 216—LAkewood 1-2222

Reply To:

AREA RADIATION SURVEY OF THE RADIOGRAPHIC EXPOSURE FACILITY at GENERAL STEEL INDUSTRIES GRANITE CITY, ILLINOIS

14 August 1962

ABSTRACT

On August 1, 1962 a radiation survey was performed of the Radiographic Exposure Facility at the Granite City, Illinois plant of General Steel Industries. This survey was performed during exposure of 2 Co-60 sources from 2 Budd Company Unitron Model 110AB units, which were arranged in several different typical operating positions.

The results of this survey show a high reading on the external walls of 1.2 mr/hr at 1 meter above the floor at the wall nearest the exposure location. The average reading, including background, was 0.15 mr/hr. Most readings did not exceed the background level of 0.05 mr/hr.

The survey of the "operations" room inside the radiographic exposure facility was 1.35 mr/hr at floor level directly at the door. The average reading, including background, was 0.30 mr/hr. Background levels of 0.05 mr/hr were found in this room. This room is entirely contained in the restricted area and is used by monitored personnel only.

GENERAL

In compliance with the State of Illinois and Federal regulations, an area radiation survey was requested on the Radiographic Exposure Facility of General Steel Industries of Granite City, Illinois. On June 24 and August 1, 1962, a physicist from

Nuclear Consultants Corporation performed surveys, the results of which follow:

I. Instrumentation. A Precision Radiation Instruments, Inc., Model 107c, Serial No. 607H geiger counter was used for the radiation survey. The ranges for this instrument are 0.04, 0.2, 2.0 and 20 mr/hr. This instrument has been calibrated with Co-60. Also, a NUCOR CS-40A "Cutie-Pie" survey meter was used to cross-check when possible, but no levels were found which exceeded the range of the geiger counter.

II. Facility and Source Description. This facility is located on the ground level of the plant. It is composed of concrete block walls 24 inches thick (minimum) and approximately 10 feet high with 3 strands of barbed wire at the top. These walls form an enclosure which is posted and always kept locked. Only qualified personnel, as named in the AEC license, are permitted access to this area. Such personnel are routinely monitored for exposure to external ionizing radiation. Additional shielding is afforded individuals inside the exposure area in the form of 4' x 4' x 6" steel armour plates, located strategically inside the facility. A sketch of this facility is attached.

The radiographic sources used in this area are 2 Budd Co. Unitron Model 110AB rollout cameras. These

cameras, though portable, are used only inside the exposure facility described above. Each camera contains a nominal 300 millicuries of Co-60.

III. Operation. The Unitron 110AB rollout cameras are operated remotely by means of a 25 foot extension control from behind the armour plate shielding. The source positioning tubes are located in proper exposure position prior to unlocking the Unitron cameras. Such cameras are then unlocked, after which the radiographer retires to a location behind the armour plate shielding from which location the sources are "run-out" into exposure position. He then retires to the operations room where he waits until the exposure is completed. At this time, still behind the armour plate, he proceeds to retract the sources into the cameras. The cameras are then locked until the next use.

Prior to any entry into the exposure area, the individual entering must monitor the area, and the cameras, with a survey meter to assure that all sources are contained within their shields. Additionally, no exposure is made without turning on the red warning lights located on each corner of the facility. For use in emergency, a phone is located inside the operations room. Since the outer door is locked from the inside during

exposures, no inadvertent entry to the area is possible.

VI. Radiation Survey. Following are the results of the radiation survey performed on this facility.

A. Exterior Surfaces, Unrestricted Area.

1. Exterior readings in storage areas and passageway.

1.1 On the surface of the floor at the outside walls the average level was 0.08 mr/hr. A maximum level of 0.12 mr/hr was found immediately outside the entrance door.

1.2 At 1 meter from the floor at the outside walls the average level was 0.15 mr/hr. The maximum level of 1.2 mr/hr was found immediately adjacent to the source location inside the facility.

1.3 At 2 meters from the floor at the outside wall the average level was 0.23 mr/hr. The maximum level of 1.2 mr/hr was again immediately adjacent to the source location inside the facility.

1.4 Background in this area was an average of 0.05 mr/hr.

The above reported levels could be reduced to 1/4

if the Partial Occupancy factor were applied to this unrestricted area.

B. Operations Room, Restricted Area.

2. Readings inside enclosure in Operations Room.

2.1 At the surface of the floor the average level was 0.31 mr/hr. A maximum level of 1.35 mr/hr was found at the door leading into the exposure area.

2.2 At 1 meter from the floor the average level was 0.26 mr/hr. The maximum level of 1.15 mr/hr was found at the door leading into the exposure area.

2.3 At 2 meters from the floor the average level was 0.33 mr/hr. The maximum level of 0.65 mr/hr was found at the door leading into the exposure area.

2.4 Background level in this room was found to be 0.05 mr/hr.

The above reported levels are found inside the restricted area which is accessible only to monitored personnel. An occupation factor of 1/2 has been found to apply for this area due to operations scheduling.

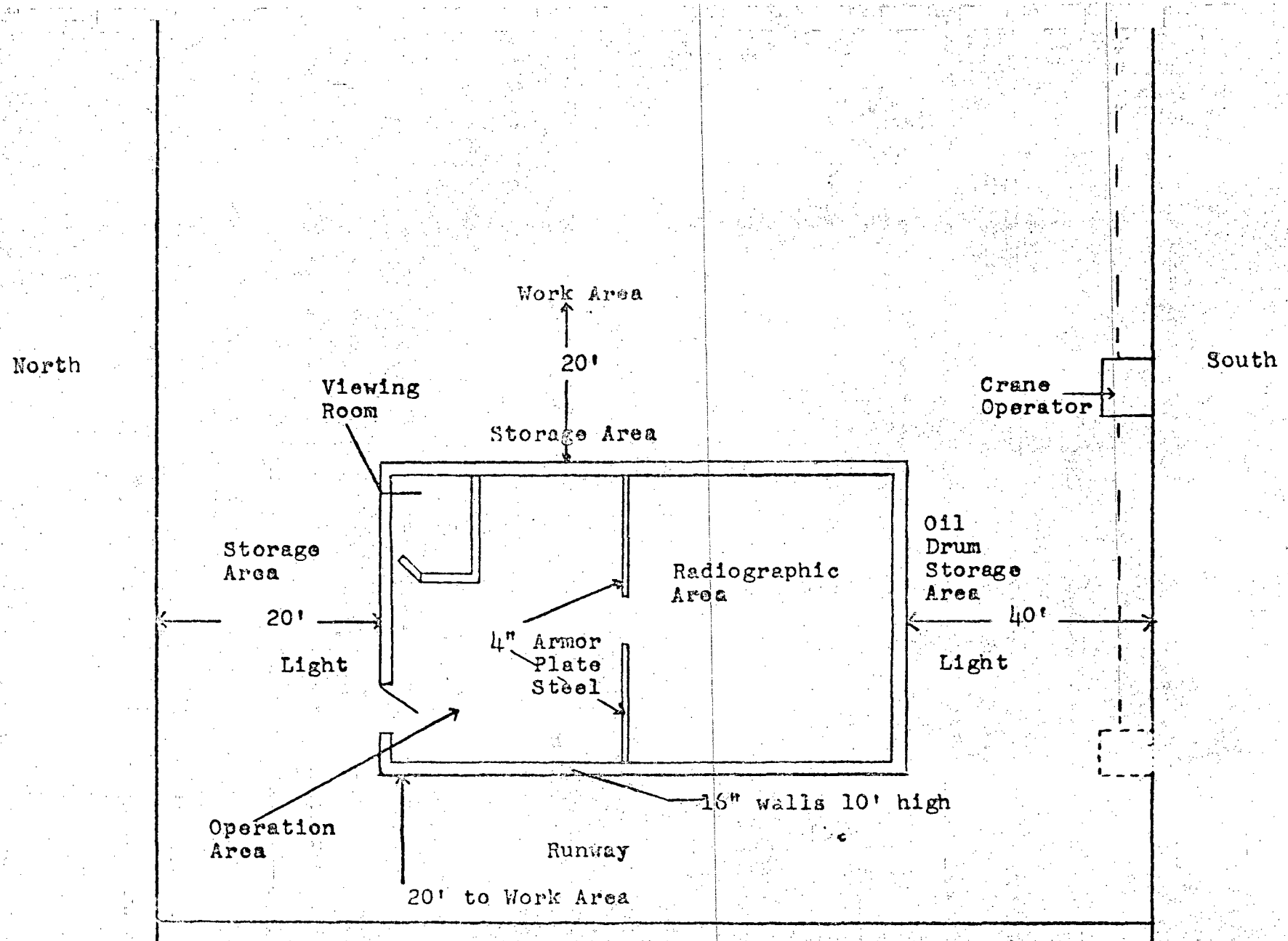
CONCLUSIONS

From the above survey the following conclusions may be drawn:

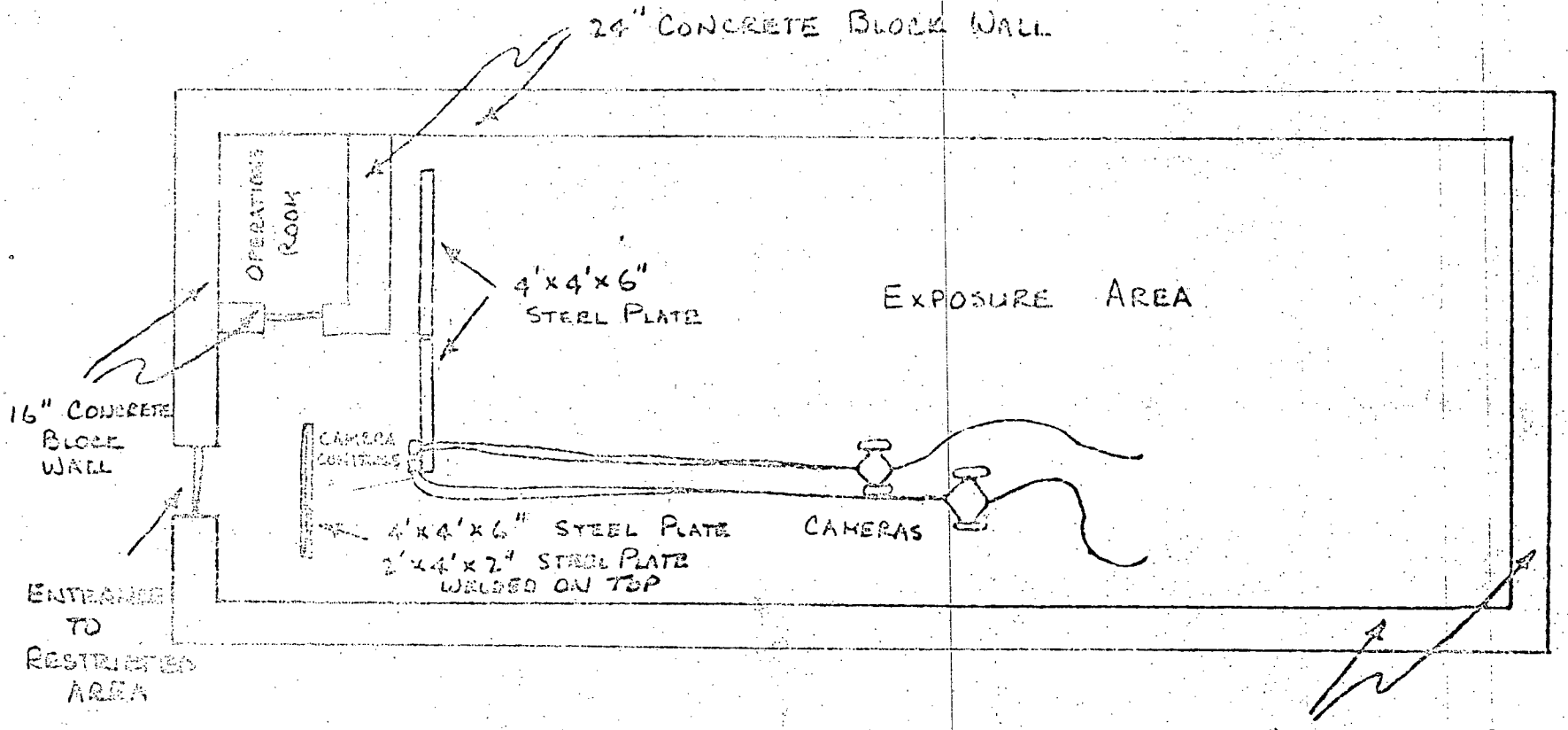
I. The existing facility is suitable for use for the radiographic procedures outlined in the AEC licensing request of March 7, 1962 (AEC 313) and subsequently approved on AEC license #12-3271-1. Such use will not result in exposure to non-occupational personnel in excess of the limits specified in Title 10, Code of Federal Regulations, Part 20.

II. Normal usage of the Operations Room located in the restricted area should not result in exposure to radiographers in excess of the permissible limits specified in Title 10, Code of Federal Regulations, Part 20 for occupationally exposed personnel. Indeed, if present occupancy factors continue, these individuals should not receive whole body exposures in excess of approximately 1/16 of the permissible limits during a normal 40 hour work week.

This report is respectfully submitted.


North
South
Work Area
20'
Viewing Room
Storage Area
Crane Operator
Storage Area
20'
Light
Radiographic Area
4" Armor Plate Steel
Oil Drum Storage Area
40'
Light
16" walls 10' high
Operation Area
Runway
20' to Work Area

SKETCH OF THE
RADIOGRAPHIC FACILITY
GENERAL STEEL INDUSTRIES
GRANITE CITY, ILL.



SHOWS ADDITIONAL SHIELDING
ADDED DURING JUNE-JULY 1962.
NOT DRAWN TO SCALE.

D. DAGER
8-16-62

Date	[illegible] Survey	[illegible]				[illegible]				[illegible] Survey	[illegible] Locked	[illegible]		[illegible]
		No. 1		No. 2		Source [illegible]		[illegible]				Pattern No.	[illegible] No.	[illegible]
		Out	In	Out	In	Holder	[illegible]	Holder	[illegible]					