

U. S. ATOMIC ENERGY COMMISSION
BYPRODUCT MATERIAL LICENSE

License No. 12-08271-01
Page 1 of 2 Pages
Amendment No. 08

Pursuant to the Atomic Energy Act of 1954 and Title 10, Code of Federal Regulations, Chapter 1, Parts 30, 32, 33, 34, and 35, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, own, possess, transfer and import byproduct material listed below; and to use such byproduct material for the purpose(s) and at the place(s) designated below. This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, and is subject to all applicable rules, regulations, and orders of the Atomic Energy Commission now or hereafter in effect and to any conditions specified below.

<p style="text-align: center;">Licensee</p> <p>1. General Steel Industries, Inc.</p> <p>2. 1417 State Street Granite City, Illinois 62040</p>	<p>In accordance with application dated March 15, 1972,</p> <p>3. License number 12-08271-01 is amended in its entirety to read as follows:</p> <hr/> <p>4. Expiration date July 31, 1977</p> <hr/> <p>5. Reference No.</p>
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<p>6. Byproduct material (element and mass number)</p> <p>A. Cobalt 60</p> <p>B. Cobalt 60</p>	<p>7. Chemical and/or physical form</p> <p>A. Budd Company Model 41706 Sealed Sources</p> <p>B. Radionics Model P60-100 Sealed Sources</p>	<p>8. Maximum amount of radioactivity which licensee may possess at any one time</p> <p>A. No single source to exceed 1 curie</p> <p>B. No single source to exceed 80 curies</p>
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9. Authorized use

- A. For use in Budd Company Model 110 AB exposure devices for industrial radiography.
- B. For use in Radionics Model P60-100-2 exposure devices for industrial radiography.

CONDITIONS

- 10. Byproduct material shall be used only at the licensee's address stated in Item 2 above.
- 11. The licensee shall comply with the provisions of Title 10, Chapter 1, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation," and Part 34, "Licenses for Radiography and Radiation Safety Requirements for Radiographic Operations."

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U. S. ATOMIC ENERGY COMMISSION
BYPRODUCT MATERIAL LICENSE
Supplementary Sheet

License Number 12-08271-01

Amendment No. 08

CONDITIONS

(continued)

12. The licensee is authorized to receive, possess, and use sealed sources of Iridium 192 or Cobalt 60 where the radioactivity exceeds the maximum amount of radioactivity specified in Item 8 of this license provided:
- A. Such possession does not exceed the quantity per source specified in Item 8 by more than 20% for Iridium 192 or 10% for Cobalt 60;
 - B. Records of the licensee show that no more than the maximum amount of radioactivity per source specified in Item 8 of the license was ordered from the supplier or transferor of the byproduct material; and
 - C. The levels of radiation for radiographic exposure devices and storage containers do not exceed those specified in Section 34.21, 10 CFR 34.
13. Except as specifically provided otherwise by this license, the licensee shall possess and use byproduct material described in Items 6, 7, and 8 of this license in accordance with statements, representations, and procedures contained in application dated March 15, 1972, as amended May 19, 1972, and July 17, 1972.

For the U. S. Atomic Energy Commission
Original Signed by
Nathan Bassin

by Materials Branch

Division of Materials Licensing
Washington, D. C. 20545

Date JUL 28 1972

N.B. 7/28/72

1. *N.B. Bassin*

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**U. S. ATOMIC ENERGY COMMISSION
BYPRODUCT MATERIAL LICENSE**

License No. 12-08271-01
Page 1 of 2 Pages
Amendment No. 00

Pursuant to the Atomic Energy Act of 1954 and Title 10, Code of Federal Regulations, Chapter 1, Parts 30, 32, 33, 34, and 35, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, own, possess, transfer and import byproduct material listed below; and to use such byproduct material for the purpose(s) and at the place(s) designated below. This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, and is subject to all applicable rules, regulations, and orders of the Atomic Energy Commission now or hereafter in effect and to any conditions specified below.

Licensee		In accordance with application dated March 15, 1972.	
1. General Steel Industries, Inc.		3. License number 12-08271-01 is amended in its entirety to read as follows:	
2. 1417 State Street Granite City, Illinois 62040		4. Expiration date July 31, 1977	
		5. Reference No.	
6. Byproduct material (element and mass number)	7. Chemical and/or physical form	8. Maximum amount of radioac- tivity which licensee may possess at any one time	
A. Cobalt 60	A. Rodd Company Model 41708 Sealed Sources	A. No single source to exceed 1 curie	
B. Cobalt 60	B. Radionics Model R60-100 Sealed Sources	B. No single source to exceed 50 curies	

9. Authorized use

- A. For use in Rodd Company Model 110 50 exposure devices for industrial radiography.
- B. For use in Radionics Model R60-100-2 exposure devices for industrial radiography.

Conditions

- 10. Byproduct material shall be used only at the licensee's address stated in Item 2 above.
- 11. The licensee shall comply with the provisions of Title 10, Chapter 1, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation," and Part 34, "Licenses for Radiography and Radiation Safety Requirements for Radiographic Operations."

BYPRODUCT MATERIAL LICENSE

Supplementary Sheet

License Number 12-08271-01Amendment No. 08

CONDITIONS

(continued)

12. The licensee is authorized to receive, possess, and use sealed sources of Iridium 192 or Cobalt 60 where the radioactivity exceeds the maximum amount of radioactivity specified in Item 8 of this license provided:
- A. Such possession does not exceed the quantity per source specified in Item 8 by more than 20% for Iridium 192 or 10% for Cobalt 60;
 - B. Records of the licensee show that no more than the maximum amount of radioactivity per source specified in Item 8 of the license was ordered from the supplier or transferor of the byproduct material; and
 - C. The levels of radiation for radiographic exposure devices and storage containers do not exceed those specified in Section 34.21, 10 CFR 34.
13. Except as specifically provided otherwise by this license, the licensee shall possess and use byproduct material described in Items 6, 7, and 8 of this license in accordance with statements, representations, and procedures contained in application dated March 15, 1972, as amended May 19, 1972, and July 17, 1972.

For the U. S. Atomic Energy Commission

Original Signed By

Nathan Bassin

by

Division of Materials Licensing
Washington, D. C. 20545Date JUL 28 1972

GENERAL STEEL INDUSTRIES, INC.

CASTINGS DIVISION

1417 State Street
Granite City, Illinois 62040
618 • 452-2120

May 19, 1972

Mr. Nathan Bassin
Materials Branch
Division of Materials Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Sir:

Re: G.S.I. License Application No. 12-08271-01
Mr. Bassin's Letter of April 5, 1972

We have received and studied your comments with great care. In addition to our answers which are listed in this letter, we have enclosed correction sheets where necessary. Also enclosed are two copies of our operating and emergency operating instructions as you requested. They are taken from the License application under consideration at this time. A letter listing qualifications of the radiation safety officer is also enclosed.

In Paragraph 1, reference is made to the exposure devices. These devices and their respective sealed sources of Co⁶⁰ were purchased from four to ten years ago. At the time of purchase, the Budd Company and Radionics, Inc. were actively engaged in the manufacture of exposure devices. They did manufacture our devices and their name plates are attached to the devices. On our original License application and on all subsequent applications, we have always used the original manufacture and model number as listed on the name plate of the exposure device itself. The reference to Nuclear Consultants should be eliminated and Budd Company substituted. A corrected copy of AEC 313R is enclosed.

In the second paragraph, the three Victoreen model 592B is correct. The reference to Nucor Model CS-40A will be changed accordingly. A corrected page is enclosed.

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1972 JUN 5 AM 10 54

U.S. ATOMIC ENERGY COMM.
REGULATORY
MAIL SECTION

St. Louis Testing Laboratories do our calibration under their AEC License No. 24-00188-02 as stated in our application. We have a copy of this license in our file. The AEC Licensing Guide, Appendix C requires that all the information relating to calibration procedures be submitted to AEC by the testing laboratory and approved before they are granted a License. The final paragraph of Appendix C of the Licensing Guide states that if this information has been previously submitted to AEC, it is not required on an application for industrial radiography such as ours. Since St. Louis Testing Laboratories have submitted this information in order to receive their License, I did not feel it was necessary for GSI to submit it as part of the GSI License. It further states that only a reference to the calibration laboratory is necessary. For this reason, I have asked St. Louis Testing Laboratory for a copy of only their License for our file and referenced this data in our application to the AEC.

In the third paragraph, reference is made to the GSI quarterly inspection and maintenance program. In our license application, we state that a radiographer or a supervisor or the radiation safety officer do the quarterly check. We will change this to read "the NDT supervisor or the radiation safety officer and a radiographer" will conduct the quarterly survey. We feel that if one of the radiographers themselves are present, the entire group will have a greater level of confidence and knowledge of our program. The procedure details are as listed under IIA to I inclusive of the Inspection and Maintenance Program. The daily aspect of the Inspection and Maintenance Program is conducted by the radiographer. The quarterly aspect is conducted by a radiographer and an NDT supervisor or the radiation safety officer. The six (6) month aspect is conducted by the Mechanical Repair Crafts in the presence of a radiographer and his supervisor or the radiation safety officer. The description of the work to be performed is covered in the actual procedure itself which is part of this application.

In the fourth paragraph, reference is made to operating and emergency operating procedures. The copies given to the radiographers and posted on the bulletin board are merely xerox copies of the pages in the License application.

As we stated in our letter of introduction that accompanied our present License application, it has been updated. Therefore, the present instructions given to the radiographer are xerox copies of those in the License application under which we are presently operating and may differ in a few words here and there from the present application under consideration. When the subject application is approved, xerox copies will be made from the "originals" and distributed to the radiographers.

In the fifth paragraph, reference is made to the qualifications of the individual conducting the training schools. In my capacity as radiation safety officer, I conduct all classes and organize the program. A copy of a letter listing my qualifications and history in the field of radiation is attached.

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1972 JUN 5 AM 10 54

U.S. ATOMIC ENERGY COMM.
REGULATORY
MAIL SECTION

Mr. Nathan B. n

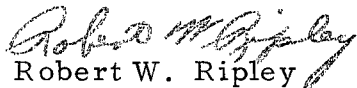
May 19, 1972

Page 3

In addition to this, I have qualified under Mil S-23008 radiography and magnetic particle inspection of HY-80 submarine castings. I have also qualified under Mil Std 271 and Navships 250-637-3, and three supervisors, including myself, will receive the radiographic examination under Nav Ship 250-637-3 by a member of DCASR in a few weeks. The entire group as part of GSI Quality Assurance program operated under a program qualified to Mil Q9858. On occasion, Mr. John Abbott or Mr. Walter Richter, NDT supervisor, will assist me in the training program.

See diagram of department, Table I.

Sincerely,


Robert W. Ripley
Radiation Safety Officer

RWR:crr

Enclosure

TECHNICAL ORGANIZATION & OPERATING CHART

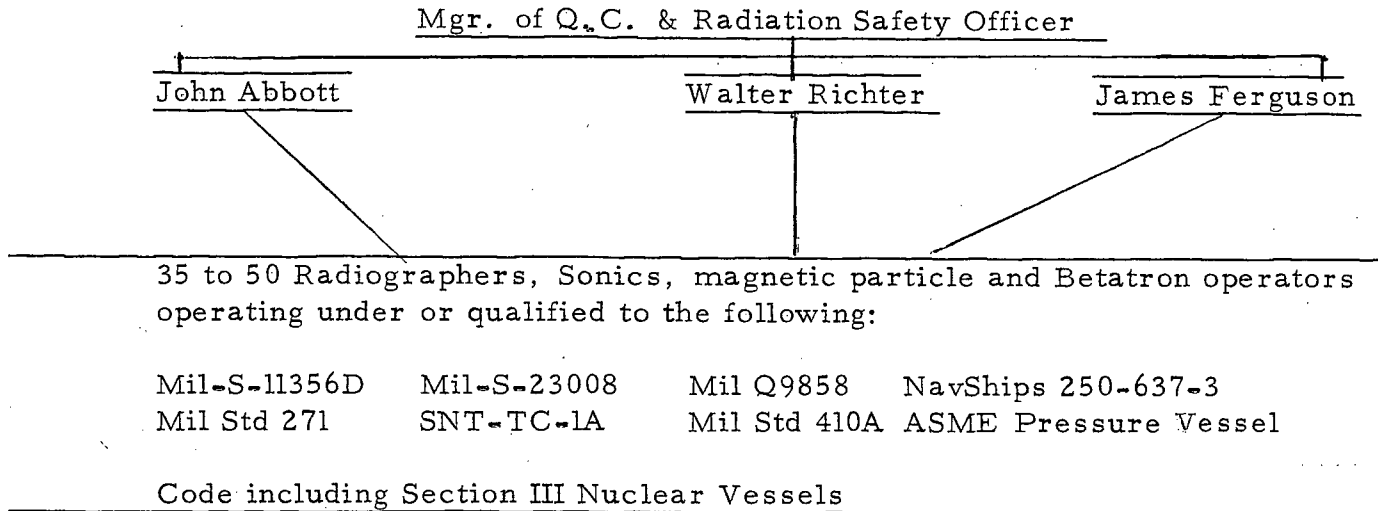


TABLE I

Mr. J. Ferguson attended SNTD classes in radiography in Philadelphia, Pa. and the Sperry School at Darbury, Conn. He has had six (6) years of experience in radiography.

Mr. Walter Richter has attended and passed the Initial Training class for Radiographers at GSI and attended a lecture series in St. Louis sponsored by the Dupont Co. He has had ten (10) years of experience in radiography.

Mr. John Abbott has attended classes in N. D. T. and radiography at the University of Missouri, Rolla campus, and has qualified to ASNT TC-1A level 2 in radiography. He has three (3) years experience in radiography.

These four individuals, Messrs. Ripley, Abbott, Richter and Ferguson have all the responsibility for operations, training, safety, AEC compliance, and Illinois State Board of Health compliance of the radiography program.

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1972 JUN 5 AM 10 54

U.S. ATOMIC ENERGY COMM.
REGULATORY
MAIL SECTION

[Faint, mostly illegible text, possibly a letter or report, with some words like "A", "B", "C", "D", "E", "F", "G", "H", "I", "J", "K", "L", "M", "N", "O", "P", "Q", "R", "S", "T", "U", "V", "W", "X", "Y", "Z" visible.]

ADMINISTRATIVE CHART

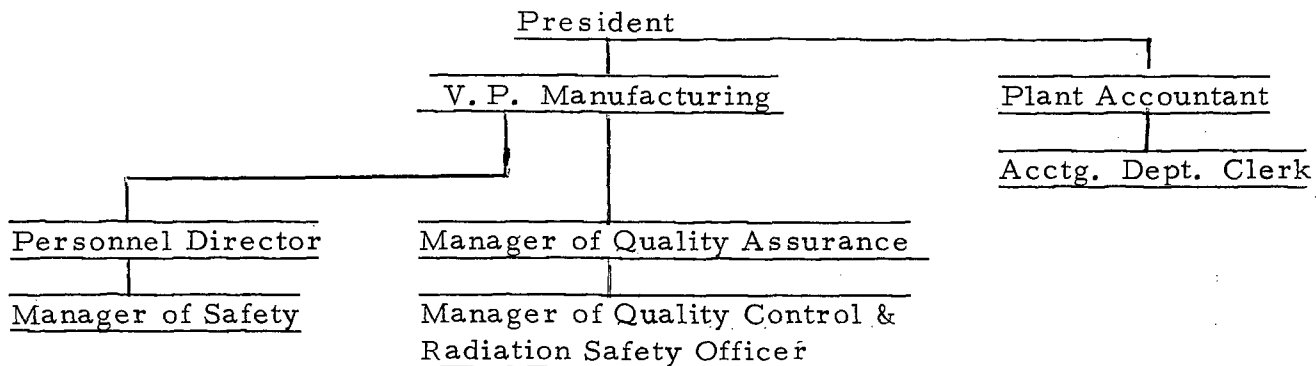
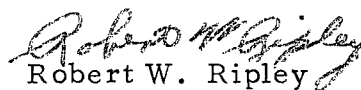


TABLE II

Table II gives the administrative section of the GSI program. Their function is not in the technical group but is part of our system of checks and balances, accounting and management control. The function and qualification of the accounting clerk and Manager of Safety is outlined in the License application. This group exercises control over the technical group in the area of accounting and inventory controls, special audits on our operations, maintenance of records as outlined in Pages 115 and 116 of the application.

We hope the above answers to your review of our application are satisfactory and meet with your approval.

Sincerely,


Robert W. Ripley
Radiation Safety Officer

RWR:crr

28406

UNITED STATES ATOMIC ENERGY COMMISSION
**APPLICATION FOR BYPRODUCT MATERIAL LICENSE—
USE OF SEALED SOURCES IN RADIOGRAPHY**

**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
General Steel Industries, Inc.
1417 State Street
Granite City, Illinois 62040

2. PREVIOUS LICENSE NUMBER(S) (Indicate if application is for renewal or amendment
of an existing byproduct material license.)
Renewal of License #12-8271-1

1(b) APPLICANT IS: An individual A partnership A Corporation An
Unincorporated Association Other If applicant is other than an individ-
ual, 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.)
General Steel Industries, Inc.
1417 State Street
Granite City, Illinois 62040

4. SEALED SOURCES TO BE USED IN RADIOGRAPHY
Budd Assembly No. 300-041706 (B)
Radionics Inc. P60-100-2

BYPRODUCT MATERIAL (Element and Mass No.)	SOURCE MODEL NUMBER	NAME OF MANUFACTURER	MAXIMUM ACTIVITY PER SOURCE	NUMBER OF SOURCES
A. Co60	A. C-374	A. Budd Co. Inst. Div.	A. 280 mc	A. one
B. Co60	B. C-375	B. Budd Co. Inst. Div.	B. 260 mc. calibrated 7-22-62	B. one
C. Co60	C. P60-100	C. Radionics Inc.	C. 80 curie	C. one

5. RADIOGRAPHIC EXPOSURE DEVICES AND/OR STORAGE CONTAINERS TO BE USED WITH SOURCES LISTED ABOVE
(Gamma Ind. Nuclear Systems)

MODEL NUMBER	NAME OF MANUFACTURER (If custom made, attach complete design specification.)
A. Unitron 110A Serial #1116	A. Budd Company Instruments Division
B. Unitron 110A Serial #1117	B. Budd Company Instruments Division
C. 1 Model P60-100-2	C. Radionics Inc. (Gamma Ind. Nuclear Systems)

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)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> on Feb. 17, 1969 (DATE)
(b) Description of radiation detection instruments to be used (Instruction 6-b)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> on Feb. 17, 1969 (DATE)
(c) Instrument calibration procedures (Instruction 6-c)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> on Feb. 17, 1969 (DATE)
(d) Personnel monitoring equipment (Instruction 6-d)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> on Feb. 17, 1969 (DATE)
(e) Operating and emergency procedures (Instruction 6-e)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> on Feb. 17, 1969 (DATE)
(f) Training program (Instruction 6-f)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> on Feb. 17, 1969 (DATE)
(g) Internal inspection system or other management control (Instruction 6-g)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> on Feb. 17, 1969 (DATE)
(h) Overall organizational structure (Instruction 6-h)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> on Feb. 17, 1969 (DATE)
(i) Leak testing procedures (Instruction 6-i)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> on Feb. 17, 1969 (DATE)

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 CON-
FORMITY 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.

General Steel Industries, Inc.

Applicant Named in Item 1

By: Richard L. Hill

DATE March 15, 1972

President, Castings Division
Title of Certifying Official

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
6,000,000	2,519,060	2,519,060	8700	8700

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.
 (b) Identify by name and address all officers and directors of the corporation.

(b) See attached

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

Delaware

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.

Memorandum to Mr. W. H. Rapp:

I have been asked to state my qualifications for Radiation Safety Officer at General Steel operating under A. E. C. License No. 12-8271-1.

My experience with radiography began in 1949 and continued uninterrupted until 1964.

In 1949, I set up what I believe to be the first artificial isotope installation in this area at "The Key Co." located in East St. Louis, Illinois. This company manufactured high alloy and stainless steel high pressure valve bodies and high pressure, high temperature valve bodies and return bends for oil refining catalytic cracking towers. At that time, I attended a school conducted by Dr. Konniker of Nuclear Consultants, St. Louis, Mo. This course included radiation hazards and health, legal requirements of the A. E. C. and operation of manipulating and monitoring equipment. I believe we used sources of .5 to 2.0 curies. My title was Nondestructive Testing Supervisor and later Assistant Plant Metallurgist. About 1954, Key Co. was purchased by A. C. F. Industries and the operation was transferred to Houston, Texas. I did not wish to relocate so I sought and found employment at General Steel Industries in Granite City. I was employed as Chief Chemist and supervised the chemical and test laboratories and the nondestructive testing group which included two sources of radium (approximately 500-800 milligrams).

In 1960-61, this facility was converted to Co⁶⁰. At that time, I attended a school "Radiation Health Physics" conducted by the Budd Instrument Division of the Budd Company. The school consisted of lab and lectures in safety radiation health physics, title 10, exposure equipment, and survey meter operations. At this time, I was appointed and approved as Radiation Safety Officer for General Steel. During this period, I set up the entire practice, license application, operating procedure, emergency procedure, and training program. The installation and practice was approved by A. E. C. on its first application for license. I also qualified as radiographer supervisor under Mil S-11356D.

During this period of time, I worked with the Civilian Defense Agency, attended two schools on radiation hazards and decontamination as a result of an atomic mishap, and received a card, if my memory serves me right, as a Radiation Decontamination Warden. For several years during this period of time I was one of two Decontamination Officers for this company in the event of atomic mishap or hostile action. These schools were a joint effort of the C. D. A. and Southern Illinois University and held at the Granite City High School as night classes. I attended a more comprehensive school for one year on all aspects of Nondestructive testing at Rolla University, St. Louis campus night school. This was a college credit course.

Mr. W. H. Rapi
October 22, 1971
Page 2

In 1964, the foundries at Eddystone, Pa. and Cranite City were consolidated and necessitated changes in organization. I became Assistant Plant Metallurgist and concentrated my efforts in the metallurgical aspect of foundry operations and in 1970 became Manager of Plant Metallurgy. On September 28, 1971, I was asked to become Manager of Quality Control with direct supervision of the radiographic facility.

During this interim period, I have tried to keep abreast of the A. E. C. program in its entirety as a matter of keen personal interest in one of the most exciting and useful scientific developments of our generation. I sincerely believe my educational background and experience has only improved since my resignation as Safety Officer in 1964.


R. W. Ripley

RWR:crr

cc: R.L.I. File(2)

EMERGENCY OPERATING PROCEDURES

EMERGENCY NO. 1 FOR 6 BUILDING ENCLOSURE

SOURCE CANNOT BE RETRACTED INTO THE SOURCE HOLDER OR THE SURVEY INDICATES THAT IT IS NOT WITHIN THE HOLDER WHEN IT SHOULD BE. THE RADIOGRAPHER SHALL:

1. The warning lights will 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. If not available, use list of names and numbers below - in order listed.
3. Unlock door, leave radiation room, and lock door from the outside. Retain key in your possession.
4. Using survey meter, survey area immediately surrounding radiographic area, and post any area of greater than 5 mr/hr radiation level.
5. Maintain vigilance at doorway until R. W. Ripley or alternate arrives.
6. Under no circumstances should the radiographer even attempt to recover a source that has become detached or stuck in the source cable. He may assist the Radiation Safety Officer or other qualified person after they have arrived on the scene.

THE RADIATION SAFETY OFFICER SHALL

1. Obtain full story, evaluate, rectify if possible.
2. If necessary, call the Budd Company. Exposure room will remain locked and all warning lights will remain on until area is safe. Radiographer will maintain personnel vigilance at exposure room door if gravity of situation warrants.
3. Extra vigilance and restrictions will be maintained until area is declared safe.
4. Record will be made of the incident.
5. A.E.C. will be notified, if necessary, in compliance with Title 10, Part 20, Paragraph 20.403.
6. State Board of Health and GSI Safety Department will be notified if necessary.

General Steel Industries, Inc.
General Operation Procedure for Use of Cobalt 60 Radiographic Sources

All "Radiographers" (as defined in Title 10, Part 34), shall:

1. Read and understand Parts 20 and 34 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 and the Radionic Panoramic camera.
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 the Radiation Safety Officer.
6. Receive instructions in health physics, monitoring and personnel monitoring and dosimetry from GSI personnel or other sources as deemed necessary. (See initial training program)

Above instructions will include lectures, actual use of exposure devices and survey instruments, and practical problems, utilizing Appendix A, Part 34, Title 10, as an outline. A copy of this training program is attached as 6 (f).

There will be no transportation of sources or exposure devices to any field location; however, they may be moved to any of the special radiographic rooms within the plant. All records will be maintained by the Radiation Safety Officer or by the Division Accountant in the Division Accounting Department at the same address.

Keys to Radiographic Facilities will be in the possession of the Radiation Safety Officer, the Nondestructive Testing shift supervisors, and the Qualified Radiographer on the shift. It will be the Radiographer's responsibility to turn in the assigned key to the Shift Supervisor at the end of the shift who in turn will assign it to the Qualified Radiographer on the following shift. Keys to Radiographic Facilities shall remain in the possession of the assigned people and shall not be transferred to another person regardless of position or title without the approval of the Radiation Safety Officer. Lost keys must be immediately reported to the Radiation Safety Officer. All Radiographers must wear film badges and pocket chambers or dosimeters when working in a radiation field environment, whether the source of radiation be Co60 sources, x-ray, or betatron.

Operating Procedure for Use of Cobalt-60 Radiographic Sources of Less Than 300 milligrams in No. 6 Building - Radiographic Enclosure.

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. 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 area). Using the 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. Follow maintenance and inspection procedures and make daily and quarterly checks and be present when the 6 month check is made.
5. 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 the 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.
6. Turn on red warning lights. These lights are strategically located on the top of the exposure room walls, and over the outside entrance so that they may easily be observed by any personnel passing by the area adjacent to the exposure room.
7. Unlock Budd Camera devices.
8. 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. The source may now be exposed utilizing the control cable from behind the armor plate shields. Observe the source position indicator.

9. Make necessary entries in Utilization and Survey Log.
10. "Radiographer" retires to small room outside of radiation area to time and wait for exposure to be completed. At no time should he enter the exposure area (forward of the steel shields) when sources are exposed.
11. After exposure is completed, retract source into source holder with control cable from behind armor plate shielding.
12. Make an operational survey of the entire area, taking special note of source tube and camera device.
13. Lock camera device. This should be done even though a second exposure is to be performed within the next few minutes.
14. Make necessary entries into Utilization and Survey Log. (See attached.)
15. Turn off warning light.
16. Steps No. 3 to No. 14 inclusive may be repeated a number of times within a shift or between trips to the darkroom and film storage area. Darkroom and office are over 500 yards from exposure room.
17. Before leaving the room whether to go to lunch or darkroom or at the end of the shift, a final survey of source holder and source tube will be made and noted in the log. Be sure to sign the log.
18. Leave exposure room and lock door from the outside. Never leave room, even for a few minutes, without locking from the outside.
19. A final dosimeter reading will be made and recorded at the end of each shift. Film badges and pocket chambers or dosimeters as noted above will be worn throughout the eight hour shift, regardless of work being performed.
20. See Emergency Procedure for proper action in case of an emergency. In case of emergency, follow those procedures and call Radiation Safety Officer at once.

Telephone Numbers

(Call in order listed)

1. Robert W. Ripley 910 Echo Drive, Collinsville, Ill. 344-0049
Ext. 214, A. C. 252
2. John Abbott 2795 Sorrell Dr., Florissant, Mo. 831-0126
Ext. 282 or 286

Operating Procedure for Use of Cobalt -60 Radiographic Sources of Less
Than 300 millicuries in No. 6 Building - Radiographic Enclosure. (Continued)

3. Phil Wells 315 Kingdom St., Bealto, Ill. 377-6113
Ext. 342, A. C. 445
4. G. N. Little 1612 Garfield, G. C., Ill. 877-2723
Ext. 244, A. C. 342

Operating Procedure for Use Of Cobalt 60 Radiographic Sources In The
Betatron omgof 80 Curies Maximum

All radiographers must wear film badges and pocket chambers or dosimeters whenever working around penetrating radiation, whether it be from the Betatrons or the Co⁶⁰ sources.

1. Unlock the door to the Control Room from the outside, enter and immediately lock the door. In the event another radiographer must enter the Control Room while it is locked, he will have to knock on the door.
2. Using the survey meter, make an entrance survey of exposure device (Radionic Panoramic Camera Model P60-100-A) making certain no source is exposed.
3. Make the necessary entries in the utilization and survey log.
4. Follow inspection and maintenance procedure and make daily and/or quarterly checks and be present when the 6 month check is made.
5. Always place the casting as far south as the handling crane will permit, approximately 54' from the north wall. The casting will be as close as is practicable to the east wall. Set up the exposure film and fix the position of the source tube. Make certain the source tube is firmly fixed in the position required and that any angle in the tube is not too sharp to prevent movement of the source within the tube. The Co⁶⁰ camera will be set approximately 3' from the east wall and 32' from the north wall. The control crank unit will be inside the control room.
6. Turn on red warning lights. These lights are strategically located at the entrance door to work area and at the double leaf door. Lights may easily be observed by any personnel passing by the area adjacent to the exposure room.
7. Check the area monitor and make certain it is turned on and is set at 5 mr/hr or less.
8. Unlock the Radionic's camera device.
9. Have casting and camera located so that control cable may be operated from inside the control room.
10. The Budd Camera with a source of less than 1 curie is operated outside the control room as per sketch #2. The operator shall retract the source from at least 12 feet back from the exposure side of the 10' thick sand filled wall and no more than 3 feet from the control room wall.

11. Radiographer returns to the Control Room outside the radiation area to time and wait for the exposure to be completed. At no time should he enter the exposure area (forward of the 10'0" thick sand filled wall) when the source is exposed.
12. Make the necessary entries in utilization and survey log.
13. After the exposure is completed, retract the source into the camera by means of the control cable from inside the control room if the 80 curie source is used. If the less than 1 curie is used, it is operated from the outside of the control room as per Sketch #2.
14. Make an operational survey of the entire area, taking special note of source tube and camera device.
15. Lock camera device. This should be done even though a second exposure is to be performed within the next few minutes.
16. Make necessary entries in the utilization and survey log . (See attached)
17. Turn off warning lights.
18. Steps No. 3 to No. 14 inclusive may be repeated several times before going to lunch or the end of the shift. Darkroom and offices are located in the processing area behind the 10'0" thick sand filled wall.
19. Before leaving the room, whether to go to lunch or darkroom or at the end of the shift, a final survey of source holder and source tube will be made and noted in the log. Be sure to sign the log.
20. Leave exposure room and lock door from the outside. Never leave room, even for a few minutes, without locking from the outside.
21. 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.
22. See Emergency Procedure for proper action in case of an emergency. In case of emergency, follow those procedures and call the Radiation Safety Officer at once.

Operating Procedure for Use Of Cobalt 60 Radiographic Sources In The
Cyclotron Room of 80 Curies Maximum (Continued)

Telephone Numbers
(Call in order listed)

- | | | | |
|----|------------------|------------------------------------|---------------------------------|
| 1. | Robert W. Ripley | 910 Echo Dr. , Collinsville, Ill. | 344-0049
Ext. 214, A. C. 252 |
| 2. | John Abbott | 2795 Sorrell Dr. , Florissant, Mo. | 831-0126
Ext. 282 or 286 |
| 3. | Phil Wells | 315 Kingdom St. , Bealto, ill | 377-6113
Ext. 342, A. C. 445 |
| 4. | G. N. Little | 1612 Garfield, G. C, Ill. | 877-2723
Ext. 244, A. C. 342 |

6 (e) Procedure for Moving Sealed Sources Between Radiographic Enclosures

The sources contained in rubber tire equipped cameras and covered under this license may be moved from one Radiographic Enclosure Area to another in accordance with the following procedure:

1. The Qualified Radiographer will enter the Radiographic Enclosure containing the source and make an Entry Survey and record readings on Move Check Form.
2. He will remove the operating cables from the wall and secure them to the top of the camera unit.
3. The camera may then be moved by a Qualified Radiographer and a second workman as follows; the time for starting the move shall be entered on the Move Check Form:
 - (A) The Qualified Radiographer will direct all movements of and be responsible for the safe movement of the source.
 - (B) He will direct the actions of second man when moving the source.
 - (C) During the movement of the source, the Qualified Radiographer will monitor the radiation field level and record the highest reading taken on the Move Check Form.
 - (D) On arrival at destination, the Qualified Radiographer will install the operating cables in the drilled access holes in the Radiographic Enclosure; he will check to see that the camera unit is locked and will make a final survey. The time when the source is secured at the new location and the final survey reading will be entered on the Move Check Form.
 - (E) The second man will have the responsibility to handle the unit and move it under the direction of the Qualified Radiographer.
4. In the event of accident or other occurrence that causes the radiation field to exceed the safe limit of 2.0 mrs. during the move, the Qualified Radiographer and the second man will proceed as follows:
 - (A) The Qualified Radiographer, the second man, will withdraw to a safe point where survey readings do not exceed 2.0 mrs.

4. (B) The Qualified Radiographer will remain within
(Cont'd.) sight of the source and warn all persons approaching
of the potential danger and instruct to move from the
area.

(C) The Second Man will be instructed to go to the
nearest Supervisor and secure his and his peoples
assistance for the Qualified Radiographer who will
post people at a safe distance as determined by the
survey meter. These people will be instructed to
warn all persons to stay away from the area, and to
remain on station until relieved.

(D) The Second Man will then proceed to advise the
nearest Quality Control Supervisor who will then
advise R. W. Ripley or one of his alternates listed
on the following page immediately of the condition
existing.

(E) There shall be no attempt made to correct any
high radiation condition until R. W. Ripley or one of
his alternates is on the scene to direct the operations.

(F) Applicable sections of the Emergency Operating
Procedure shall be followed to verify that an over
exposure of the individuals moving the source has
not occurred.

Alternates for R. W. Ripley and Telephone Numbers:
(Call in order listed)

1. Robert W. Ripley 910 Echo Dr., Collinsville, Ill. 344-0049(home)
Plant Ext. 214, A. C. 252
2. John Abbott 2795 Screll Dr., Florissant, Mo. 831-0126(home)
Plant Ext. 282 or 286
3. Phil Wells 315 Kingdom St., Bethalto, Ill. 377-6113(home)
Plant Ext. 342, A. C. 445
4. G. N. Little 1612 Garfield, G. C., Ill. 877-2723(home)
Plant Ext. 244, A. C. 342

Transporting Sealed Sources - Check-Off Form

Moving Sealed Sources - Between Radiographic Enclosures

1. Source being moved _____
2. From _____
(Radiographic Enclosure)
3. To _____
(Radiographic Enclosure)
4. I have read and understand the Procedure for Moving Sealed Sources between Radiographic Enclosures

(Qualified Radiographer)
5. Entry Survey Results _____
6. Time and date move started _____
7. Time and date move completed _____
8. Highest Survey Reading during move _____
9. Final Survey Results _____
10. Source Secured _____

Radiation Safety Officer

EMERGENCY OPERATING PROCEDURES

EMERGENCY NO. 1 FOR 6 BUILDING ENCLOSURE

SOURCE CANNOT BE RETRACTED INTO THE SOURCE HOLDER OR THE SURVEY INDICATES THAT IT IS NOT WITHIN THE HOLDER WHEN IT SHOULD BE. THE RADIOGRAPHER SHALL:

1. The warning lights will 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. If not available, use list of names and numbers below - in order listed.
3. Unlock door, leave radiation room, and lock door from the outside. Retain key in your possession.
4. Using survey meter, survey area immediately surrounding radiographic area, and post any area of greater than 5 mr/hr radiation level.
5. Maintain vigilance at doorway until R. W. Ripley or alternate arrives.
6. Under no circumstances should the radiographer even attempt to recover a source that has become detached or stuck in the source cable. He may assist the Radiation Safety Officer or other qualified person after they have arrived on the scene.

THE RADIATION SAFETY OFFICER SHALL

1. Obtain full story, evaluate, rectify if possible.
2. If necessary, call the Budd Company. Exposure room will remain locked and all warning lights will remain on until area is safe. Radiographer will maintain personnel vigilance at exposure room door if gravity of situation warrants.
3. Extra vigilance and restrictions will be maintained until area is declared safe.
4. Record will be made of the incident.
5. A.E.C. will be notified, if necessary, in compliance with Title 10, Part 20, Paragraph 20.403.
6. State Board of Health and GSI Safety Department will be notified if necessary.

EMERGENCY OPERATING PROCEDURES (Continued)

Telephone Numbers
(Call in order listed)

1. Robert W. Ripley 910 Echo Drive, Collinsville, Ill. 344-0049
 Ext. 214, A. C. 252
2. John Abbott 2795 Sorrell Dr., Florissant, Mo. 831-0126
 Ext. 282 or 286
3. Phil Wells 315 Kingdom St., Bernalto, Ill. 377-6113
 Ext. 342, A. C. 445
4. G. N. Little 1612 Garfield, G. C., Ill. 877-2723
 Ext. 244, A. C. 342

EMERGENCY PROCEDURE - BETA1 ON BUILDINGS

EMERGENCY 1A

The source cannot be retracted into the source holder, or a survey indicates it is not within the holder when it should be.

THE RADIOGRAPHER SHALL:

1. The warning lights will be on in accordance with operating procedure and by the area monitor. If they are not on, turn them on.
2. Make certain the large double leaf door is shut. Pull electric master switch if it is safe to do so.
3. Retain possession of survey meter at all times and observe the read out constantly.
4. Leave exposure room and lock control room door. Retain key in your possession.
5. Call Mr. R. W. Ripley by auto call or telephone. If he is not available, use names and numbers listed below in order listed.
6. Use survey meter to discover any area of radiation outside of exposure room if necessary.
7. Maintain vigilance in control room doorway (if the area is safe) until the Radiation Safety Officer or his alternate (as listed below) arrives.
8. Under no circumstances should the radiographer even attempt to recover a source that has become detached or stuck in the source cable. He may assist the Radiation Safety Officer or the other qualified person after they have arrived at the scene.

Telephone Numbers
(Call in order listed)

- | | | | |
|----|------------------|-----------------------------------|---------------------------------|
| 1. | Robert W. Ripley | 910 Echo Dr., Collinsville, Ill. | 344-0049
Ext. 214, A. C. 252 |
| 2. | John Abbott | 2795 Sorrell Dr., Florissant, Mo. | 831-0126
Ext. 282 or 286 |
| 3. | Phil Wells | 315 Kingdom St., Bethalto, Ill. | 377-6113
Ext. 342, A. C. 445 |
| 4. | G. N. Little | 1612 Garfield, G. C., Ill. | 877-2723
Ext. 244, A. C. 342 |

THE RADIATION SAFETY OFFICER SHALL:

1. Obtain full story from the radiographer, evaluate and rectify if possible to do so in a safe manner.
2. If necessary, obtain professional advice or assistance from equipment manufacturer. Exposure room will remain locked and all warning lights will remain on. A radiographer or person of responsibility as designated by the Radiation Safety Officer will maintain vigilance over the area until it is declared safe by the Radiation Safety Officer.
3. Incident will be recorded in maintenance and inspection daily report form or as dictated by seriousness of emergency and Title 10 requirements.
4. A. E. C. will be notified in compliance with Title 10, Part 20, Paragraph 20.403.
5. State Board of Health and GSI Safety Department will be notified.

EMERGENCY OPERATING PROCEDURES (Continued)

EMERGENCY NO. 2 POCKET DOSIMETER READS OFF SCALE

THE RADIOGRAPHER SHALL:

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 or alternate listed below and notify him of these results for his evaluation before making any other exposures.

THE RADIATION SAFETY OFFICER SHALL:

1. 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.
2. If film badge report substantiates dosimeter reading, the radiographer will be sent to the corporation doctor with a full report.
3. AEC will be notified in conformance with Title 10, Part 30, Paragraph 20.403 by the Radiation Safety Officer.
4. State Board of Health and GSI Safety Department shall be notified.

Telephone Numbers
(Call in order listed)

- | | | | |
|----|------------------|-----------------------------------|--------------------------------|
| 1. | Robert W. Ripley | 910 Echo Dr., Collinsville, Ill. | 344-0049
Ext. 214, A.C. 252 |
| 2. | John Abbott | 2795 Sorrell Dr., Florissant, Mo. | 831-0126
Ext. 282 or 286 |
| 3. | Phil Wells | 315 Kingdom St., Bethalto, Ill. | 377-6113
Ext. 342, A.C. 445 |
| 4. | G. N. Little | 1612 Garfield, G. C., Ill. | 877-2723
Ext. 244, A.C. 342 |

PERIODIC INSPECTION AND MAINTENANCE PROCEDURE

Additions to G. S. I. operating procedure to conform to A. E. C.
December 13, 1970 Amendment to Title 10, Part 34:

The purpose of this procedure is to provide for periodic inspection and maintenance of the radiographic exposure device and area safeguards applicable to this amendment. The procedure is divided into 3 parts to conform to the daily, tri-monthly, and semi-yearly requirements applicable to the G. S. I. , Inc. radiographic installation.

- I. The following operations will be performed by the radiographers once each day that the exposure device is used:
 - A. The initial radiation survey will be made as required by G. S. I. Standard operating procedure and so noted in the utilization log.
 - B. The exposure device will be visually inspected for any damage that may impair its use or shielding integrity and so noted under Item 1 of Daily Check Form.
 - C. The device will be checked to determine if the source is properly placed inside the shield. This will be determined by a level of 50 mr/hr. An increase above this level at a distance of one meter from the exposure device will be evidence of an improperly retracted source. Note and follow per item 2 of the daily check form.
 - D. The locking mechanism will be checked by unlocking and locking of the exposure device. The operating condition will be noted in Item 3 of the Daily Check Form.
 - E. The first production exposure will then be made following G. S. I. standard operating procedure. The following will be noted: Changes in operating characteristics of the exposure device, operation of source position indication, and the operation of the crank mechanism. These items will be checked off as their condition under Items 4, 5, and 6 respectively of the Daily Check Form.
 - F. In the event of a malfunction, noted on the Daily Check Form in conformance with I, A. through E, the following steps will be taken:
 1. The supervisor or safety officer will be notified immediately.
 2. The supervisor or safety officer will evaluate and correct the problem.
 3. Any action taken will be recorded on the Daily Check Form.

4. If the above malfunctions are minor and do not involve a radiation hazard as defined under Title 10, Part 34, Paragraph 34.21 or Table 10, Part 20, Paragraph 20.403, use of the exposure device will continue if possible while corrections are being instituted. Corrective action will be initiated within 24 hours.
5. In the event of a major malfunction which may result in unsafe conditions or a radiation hazard, the G.S.I. emergency procedure, #1, will be put into effect immediately.
6. All action taken will be recorded in the Daily Check Form.
7. All entries in the Daily Check Form will be initiated by the individual making the entry.

II. The following operations as listed on the Quarterly Check Form will be performed at 3 month intervals. In each instance, the manual provided by the manufacturer of the exposure device will be used as a guide to perform these operations:

- A. Examine source and drive cable for wear and/or damage.
- B. Examine source and drive cable tube for wear and/or damage.
- C. Examine the source & drive cable tube connectors for wear and/or damage.
- D. Inspect the inside of the source tube for rust, dirt, or sludge build up.
- E. Inspect all mating components for wear, damage and proper connections.
- F. The cable drive gear box will be inspected for damage, wear, and lubricant. The condition of all required labels will be checked.
- G. All of the above inspections will be noted in the respective area in the Quarterly Check Form.
- H. The checks may be performed by a radiographer or a supervisor or the safety officer. All notations in the Quarterly Check Form will be signed.
- I. The above are preventive maintenance steps to ascertain deterioration of the radiation exposure device through regular production use, before it can create a radiation hazard or unsafe condition. Indications of deterioration noted on the Quarterly Check Forms will dictate the following steps:
 1. Supervisor will be notified by individual performing the check.

2. The condition will be evaluated by the supervisor or Safety Officer.
3. Any condition that requires corrective action will be reported to the G. S. I. Mechanical Repair Supervisor within 24 hrs.
4. All action taken will be noted on the Quarterly Check Form and signed by radiographer, supervisor or Safety Officer.

III. The following operations will be performed at 6 month intervals as noted on the Six Month Check Form. These checks will be made by mechanical repair department crafts in the presence of a radiographer, his supervisor, or the Radiation Safety Officer.

- A. The door locks on small door used by personnel and the large door used to bring in castings will be inspected and their condition noted in Item 1 of the Six Month Check Form.
- B. In the presence of a radiographer, his supervisor, or the Radiation Safety Officer, an inspection will be made to ascertain if all visible and audible warning devices are functioning properly. Conditions will be noted in the Six Month Check Form, in Item 2.
- C. This inspection will not include a calibration of radiation level monitoring equipment. This equipment is calibrated and documented as outlined elsewhere in the approved G. S. I. license application.
- D. All operations will be recorded in the Six Month Check Form and signed by the inspector.
- E. Any malfunction of area safeguards will be reported immediately to the Radiation Safety Officer. Corrective action will begin immediately.
- F. All action taken will be recorded in the Six Month Check Form and signed off by the Supervisor or Radiation Safety Officer.

IV. It is especially noted here that Items I, II, and III are all additional steps to be taken to conform to the 1970 amendments to Title 10. In no way are they to be interpreted to rescind or supercede any other section of the G.S.I. license.

The radiographer will continue to maintain his usual daily vigilance at all times.

V. Three forms are attached to and become a part of this procedure:

1. Daily Check Form
2. Quarterly Check Form
3. Six Month Check Form

28406

VI. If as a result of these inspection and maintenance procedures the Co source is exposed creating a radiation hazard, Emergency Operation Procedure #1 will be followed.

DAILY CHECK FORM

Operation to be Performed	Mon.	Tue.	Wed.	Thur.	Fr.	Sat.	
Week of _____ 19__							
1. Damage to the exp. device which may impair its operation.							
2. Proper position of source inside the shield.							
3. Operation of locking mechanism.							
4. Changes in operating characteristics.							
5. Operation of source position indicator.							
6. Operation of the crank mechanism.							

Action taken on above noted malfunctions:

QUARTERLY CHECK FORM

Operation to be Performed	Feb. 15 19__	Mar. 15 19__	Aug. 15 19__	Nov. 15 19__
1. Source and drive cable wear or damage.				
2. Source and drive cable tube wear or damage.				
3. Source and drive cable tube connectors wear or damage.				
4. Rust, dirt, or sludge build up in the source tube.				
5. Mating components connections.				
6. Cable drive gear box damage or wear and proper labeling.				

Action taken on above noted malfunctions:

SIX MONTH CHECK FORM

Operation to be Performed:	Nov. 15 19__	May 15 19__
I. Door Interlocks A. Small door B. Large door II. Visual warning devices A. Small door red lights B. Big door " " C. Radiation monitor red lights D. Exterior, Bldg. " " E. " " warning signs III. Audible warning devices A. Radiation monitor horn		

to be taken on above noted malfunctions:

Section 6 (e) Page 67

LCY.
Received

04147

GENERAL STEEL INDUSTRIES, INC.

CASTINGS DIVISION

1417 State Street
Granite City, Illinois 62040
618 • 452-2120

March 10, 1972

Mr. Nathan Bassin
Materials Branch
Division of Materials Licensing
Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Bassin:

Enclosed is the up dated application for renewal of license no. 12-8271-1 for five year period.

From an operations standpoint, it contains two changes on which we would like to have an expeditious reply and at least tentative approval to proceed promptly. They are as follows:

1. The procedure by which we may transfer the Co⁶⁰ sources from the GSI to the Government betatron
2. The procedure by which we may use an "under 1 curie" Co⁶⁰ source in the betatron building as pictured in Drawing #2

We have attached a copy of our initial training home study book for your information. We do not wish to consider it as part of the license application.

Additional copies have been sent to the Illinois State Board of Health and to the A.E.C. District Office.

Thank you for your consideration.

26827

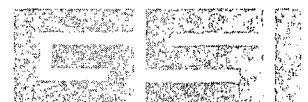
Yours truly,

Robert W. Ripley
Robert W. Ripley

Radiation Safety Officer

10 5.

RWR:crr
Enclosure



APPLICATION FOR RENEWAL

1972

AEC LICENSE #12-8271-1

RADIOGRAPHY WITH Co60

GENERAL STEEL INDUSTRIES, INC.
CASTINGS DIVISION

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Informational Attachment

Initial Training Text

BOARD OF DIRECTORS

Angus S. Alston, President
Southwestern Bell Telephone Co.
1010 Pine Street
St. Louis, Missouri 63101
(314) 247-9800 --Sta. 4221

Joseph H. Bascom
Chairman of the Board
Broderick & Bascom Rope Company
10440 Trenton Avenue
St. Louis, Missouri 63132
(314) 426-7000

Maurice R. Chambers
Chairman of the Board and
Chief Executive Officer
INTERCO, Inc.
1509 Washington Boulevard
St. Louis, Missouri 63103
(314) 231-1100

Stuart W. Cragin, Chairman
Credit Policy Committee
Morgan Guaranty Trust Company
23 Wall Street
New York, New York 10015
(212) 425-2323

Duncan C. Dobson
7811 Carondelet Avenue
Room 307
St. Louis, Missouri 63105
(314) 727-1033

Douglas Grymes, President
Koppers Company, Inc.
Pittsburgh, Pennsylvania 15219
(412) 391-3300

W. Ashley Gray, Jr., President
General Steel Industries, Inc.
One Memorial Drive
St. Louis, Missouri 63102
(314) 436-6800

Edwin S. Jones
Chairman of the Board and
Chief Executive Officer
First National Bank in St. Louis
305 North Broadway
St. Louis, Missouri 63102
(314) 421-2000

Preston D. Law
514 Pine Cone Lane
Nokomis, Florida 33555
(813) 488-2919

Edwin B. Meissner, Jr.
Senior Vice President
General Steel Industries, Inc.
One Memorial Drive
St. Louis, Missouri 63102
(314) 436-6800

Frederic M. Peirce
Chairman of the Board and
Chief Executive Officer
General American Life Insurance Co.
1501 Locust Street
St. Louis, Missouri 63103
(314) 231-1700

Nicholas P. Veeder
Chairman
Granite City Steel Company
Granite City, Illinois 62040
(618) 452-1100

September, 1971

EXECUTIVE and GENERAL OFFICES

General Steel Industries, Inc.
 One Memorial Drive
 St. Louis, Mo. 63102

(314) 436-6800

		<u>Night Phone</u>
W. Ashley Gray, Jr.	President	436-6804
Taylor S. Desloge	Vice President and Treasurer	436-6800
George K. Hoblitzelle	Vice President and Secretary	436-6802
Edwin B. Meissner, Jr.	Senior Vice President	
Thomas R. Remington	Vice President - Operations	436-6801

Charles F. Albertalli	Manager, Mfg. and Plant Engineering	
Charles E. Deaver	Supervisor - Employee Benefits	
P. Lewis Frazar	Employee Relations Assistant	
J. Dan House	Manager of Advertising	436-6806
John C. Kelly, Jr.	Manager of Data Processing	
William H. Laird, IV	Asst. Treasurer and Asst. Secretary	436-6800
Warren B. Lammert, Jr.	Corporate Controller	436-6805
Norman V. LeTourneau	Asst. Manager of Corporate Accounting	
Francis E. McBride	Asst. Treasurer and Asst. Secretary	
Joseph H. MacNaughton	Asst. Controller	
William W. Sant	Manager of Industrial Relations	436-6807
Edwin H. Schriefer	Manager of Corporate Accounting	436-6808
Austin G. Witter	Manager of Taxes	

GENERAL STEEL INDUSTRIES, INC.

CASTINGS DIVISION

1417 State Street
Granite City, Illinois 62040
618 • 452-2120

February 15, 1972

**Mr. James Melano
Senior Reviewer
Division of Licensing & Regulations
U.S. Atomic Energy Commission
Washington, D.C. 20545**

Dear Mr. Melano:

Enclosed is totally revised application for renewal of the U.S. Atomic Energy Commission By-product Material License #12-8271-1. It has been rewritten in order to incorporate changes made at General Steel, the large amount of paper work recently generated between GSI and the AEC, and the elimination of out dated data.

Your review of this application will be appreciated.

Yours truly,

R. W. Ripley
**R. W. Ripley
Manager of Quality Control**

RWR:crr

Enclosure

26827

UNITED STATES ATOMIC ENERGY COMMISSION
**APPLICATION FOR BYPRODUCT MATERIAL LICENSE—
USE OF SEALED SOURCES IN RADIOGRAPHY**

**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 General Steel Industries, Inc. 1417 State Street Granite City, Illinois 62040	2. PREVIOUS LICENSE NUMBER(S) (Indicate if application is for renewal or amendment of an existing byproduct material license.) Renewal of License #12-8271-1
---	---

1(b) APPLICANT IS: An individual <input type="checkbox"/> A partnership <input type="checkbox"/> A Corporation <input checked="" type="checkbox"/> An Unincorporated Association <input type="checkbox"/> Other <input type="checkbox"/> 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.) General Steel Industries, Inc. 1417 State Street Granite City, Illinois 62040
--	--

4. SEALED SOURCES TO BE USED IN RADIOGRAPHY
Budd Assembly No. 300-041706 (B)
Radionics Inc. P60-100-2

BYPRODUCT MATERIAL (Element and Mass No.)	SOURCE MODEL NUMBER	NAME OF MANUFACTURER	MAXIMUM ACTIVITY PER SOURCE	NUMBER OF SOURCES
A. Co60	A. C-374	A. Nuclear Consultants Corp.	A. 280 mc	A. one
B. Co60	B. C-375	B. " " "	B. 260 mc calibrated 7-22-62	B. one
C. Co60	C. P60-100	C. Radionics Inc.	C. 80 curie	C. one

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. Unitron 110A Serial #1116	A. Budd Company Instruments Division
B. Unitron 110A Serial #1117	B. Budd Company Instruments Division
C. 1 Model P60-100-2	C. Radionics Inc.

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)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> on Feb. 17, 1969
(b) Description of radiation detection instruments to be used (Instruction 6-b)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> on Feb. 17, 1969
(c) Instrument calibration procedures (Instruction 6-c)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> on Feb. 17, 1969
(d) Personnel monitoring equipment (Instruction 6-d)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> on Feb. 17, 1969
(e) Operating and emergency procedures (Instruction 6-e)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> on Feb. 17, 1969
(f) Training program (Instruction 6-f)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> on Feb. 17, 1969
(g) Internal inspection system or other management control (Instruction 6-g)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> on Feb. 17, 1969
(h) Overall organizational structure (Instruction 6-h)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> on Feb. 17, 1969
(i) Leak testing procedures (Instruction 6-i)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> on Feb. 17, 1969

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.

General Steel Industries, Inc.
Applicant Named in Item 1
By: Richard L. White
President, Castings Division
Title of Certifying Official

DATE March 15, 1972

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.


December 9, 1971

Memorandum to Mr. R. F. Harris:

To conform with the A. E. C. regulations for the use of the two Co 60 isotopes in our plant, the following must be carried out at all times:

1. Before anyone is allowed on the roof of #6 Building over the #6 Building x-ray cage, the Radiation Safety Officer, must be notified and his permission obtained.
2. Before anyone is allowed to work on the #6 Building overhead cranes, when and if this work is done over the #6 Building x-ray cage, the Radiation Safety Officer again must be notified and his permission granted.

This letter will become a part of our A. E. C. licensing application, replacing the original addressed to Mr. Barclay, dated January 29, 1963, and the first revision addressed to Mr. McMillin, dated January 3, 1964, and the second revision addressed to Mr. Ditchfield, dated November 27, 1964, and the third revision addressed to Mr. Ditchfield, dated January 28, 1966. At the present time, Robert W. Ripley is the Radiation Safety Officer.


R. W. Ripley
Radiation Safety Officer

RWR:crr

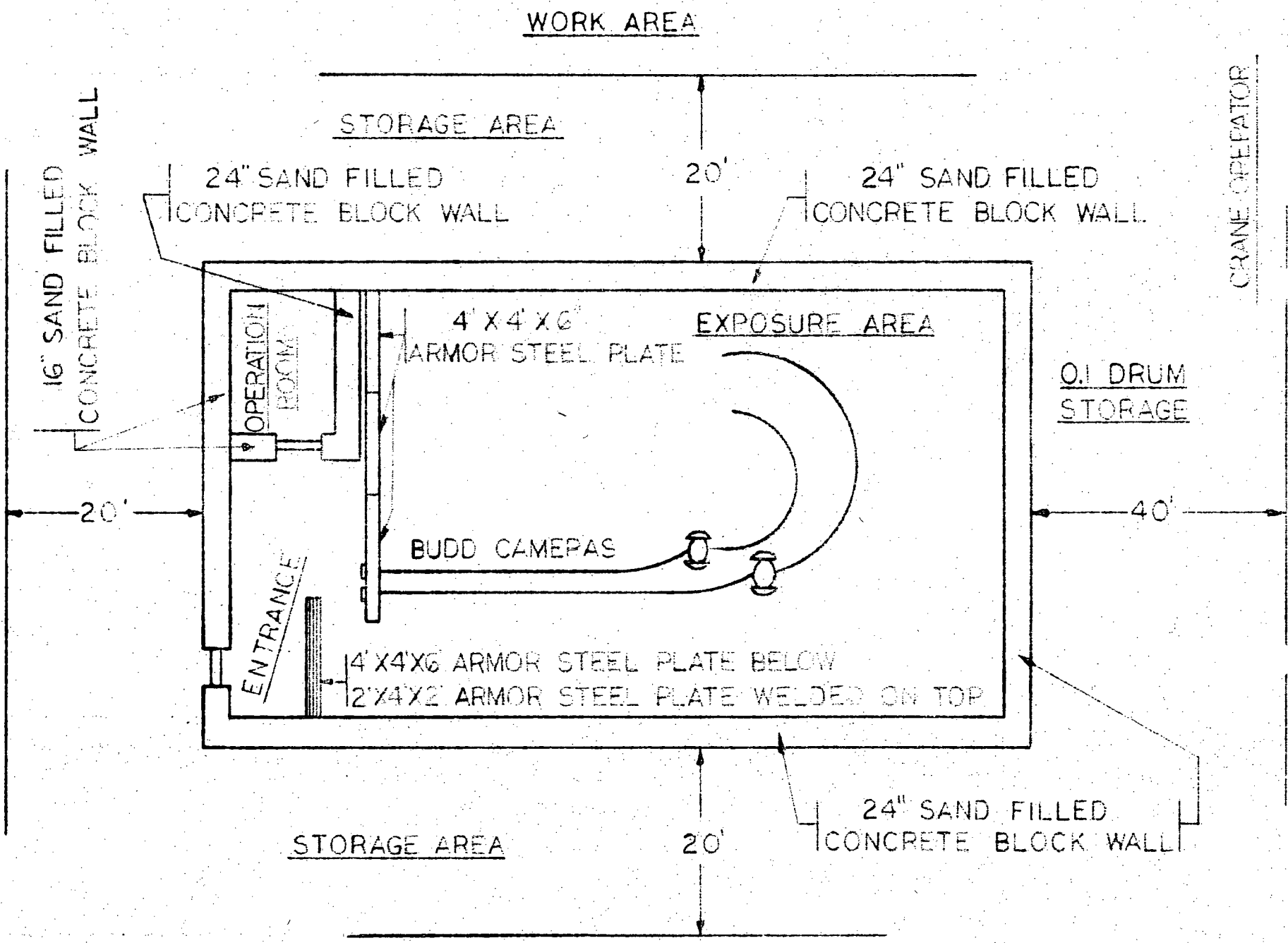
cc: JP(6) PCW

6 (a) Description of Radiographic Facilities
(Ref. Instruction 6 (a))

#6 Bldg., Radiographic Enclosure
Drawing of Facility
Description of Sources,
Operating Practices, and
Signal Devices
Report of Radiation Surveys
Dated June 24, 1962,
August 1, 1962, and
January 19, 1963

GSI Betatron Building
Drawing of Facility
Description of Sources,
Operating Practices, and
Signal Devices
Report of Radiation Surveys
Dated January 29, 1971

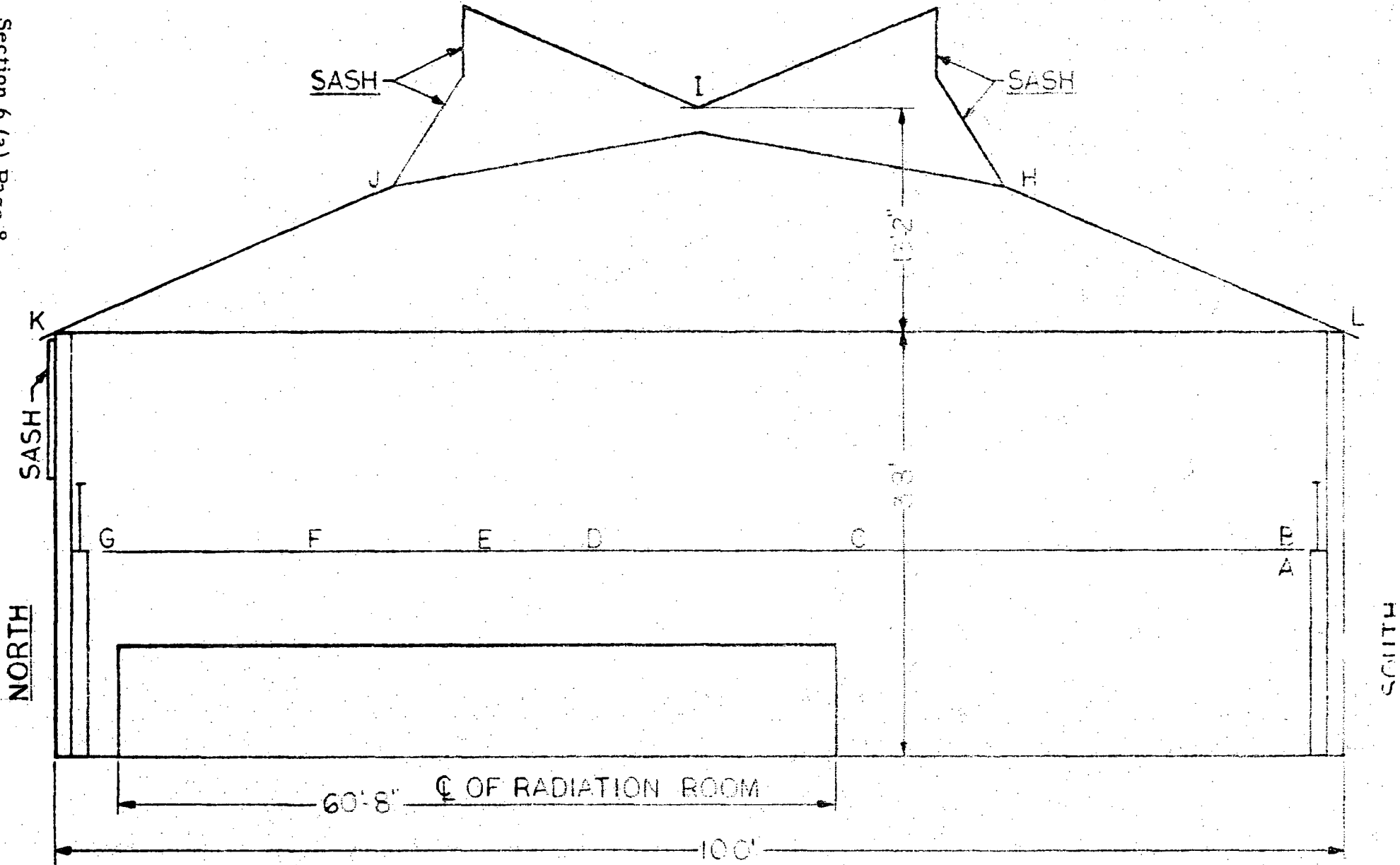
Government Betatron Building
Drawing of Facility
Description of Sources,
Operating Practices, and
Signal Devices



WORK AREA

NE 6 BUILDING

RADIOGRAPHIC ENCLOSURE DRAWING



CROSS SECTION THROUGH NO. 6 FINISHES BUILDING

NE 6 BUILDING
RADIOGRAPHIC ENCLOSURE DRAWING

6 (a) Description Of Sources, Operating Practices, & Signal Devices

General Steel Industries in its normal operation produces a wide range of very large 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 purchased two 300 mc Cobalt 60 sources from the Budd Company which are mounted in two Unitron Model 110A roll-out cameras. These sources and cameras will be used only in the specially constructed rooms 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 24 inches of sand filled 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. Red warning lights are installed on each wall and over the doorway. There is only one door into the room which is located on the north wall. This door is posted and always kept locked. Only the Radiation Safety Officer and the radiographers working under his supervision have access to the keys. The building superintendent never goes into the room without first contacting the Radiation Safety Officer. 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 20 inches thick made from cement blocks. Between the radiographic area and the control area are several large pieces of armor

plate steel as shields. These armor plates are 4 inches thick and measure six by six feet square.

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 used as a work area. 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 15 feet away. The area behind the south wall is pretty much inaccessible to personnel being used to store drums of oil. The west wall faces a run way 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

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source inside the casting results in considerable absorption of the radiation in the casting and hence results in much reduced radiation fields.

The large overhead crane is never operated over the areas 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 hour. 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. There is a buzzer on the door to signal the operator from the outside.

A large red light is mounted on the top of each wall. One is mounted on the north wall immediately above the door. These lights are turned on whenever an operator enters the source room or whenever sources are exposed. The light can easily be seen not only by someone attempting to enter the door, but also by the crane operator and anyone in this whole area of the plant.

Radiation area and radiation storage signs are posted on the entrance doorway. Additional radiation signs are posted within the radiographic enclosure in conformance with A. E. C. regulations.

The #6 Building area is presently shut down and no work is anticipated in this area in the foreseeable future. All radiography is performed in the Betatron Building (see Sketch 1 and 2). However, we are submitting

the procedure for 6 Building as outlined in our present approved license application since we may wish to reactivate the facility at a future date.

We do not plan on doing radiographic work in this area in the foreseeable future.

On August 1, 1962, a radiation survey was performed of the 6 Building radiographic Exposure Facility at the Granite City, Illinois Plant of General Steel Industries by Nuclear Consultants. 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. A copy of the reported radiation fields present is attached.

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.

We have made no changes in building construction, radiographic procedure, equipment, source type or size since this original survey was made by Nuclear Consultants.

The #6 Building enclosure was surveyed with two original sources of 280 and 260 millicuries of Co⁶⁰ (a total of 540 millicuries). Therefore, it is understood that no source or combination of sources greater than this total will be used in #6 Building enclosure under this license.

6 (a) Report of Radiation Surveys

To comply 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:

6 (a) Radiation Survey Nuclear Consultants Corporation, June 24, 1962

- 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 armor 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.

They are designed and approved by the A. E. C. to handle up to 10 curies of Co-⁶⁰. We will be using a maximum of 300-1000 mc Co-60. Each camera has approved locking devices.

III. Operation. The Unitron 110AB rollout cameras are operated remotely by means of a 25 foot extension control from behind the armor 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 armor 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 armor 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 of the average level was 0.8 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 0.85 mr/hr was found at the door leading into the exposure area.

2.4 Background level in s 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 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.

Mr. William E. Davis
Plant Metallurgist
General Steel Industries
1417 State Street
Granite City, Illinois

Dear Mr. Davis:

Enclosed you will find a cross sectional drawing of your foundry building #6 in the area of your radiographic room.

As you will recall, last Saturday (January 19, 1963) during my visit to your plant, I made a complete radiation survey of the area immediately above the radiographic room to determine, by measurement, the actual radiation fields present when your Co-⁶⁰ radiographic sources are in use.

I had previously made calculations of these fields for you; however, during your last A. E. C. inspection, the question was raised as to the actual measurements of these fields. Since it was a bad, snowy day, I declined the invitation to crawl around on top of the roof to make actual measurements. I did, however, personally climb into the crane cab and on top of this cab where there is a catwalk which spans the complete building immediately above the radiographic room.

These measurements were made with an NRD Model CS-40 ionization type survey meter. This meter had been ⁶⁰calibrated in our laboratories using a Bureau of Standards calibrated Co-⁶⁰ standard.

Two measurements were made - one with both sources placed inside of large casting as you would normally use them and the second set of readings were made with both sources laying unshielded on the floor of the radiographic room.

Table one shows the measurements actually taken. From this it can be seen that the crane operator is quite safe even when both sources are completely exposed. The field immediately above the sources on the catwalk reaches a maximum of 7 mr./hr. when both sources are completely exposed. This does not present a problem since you already have a company policy established that no-one is allowed on the catwalk without first checking with your office. No-one should, of course, be allowed on this catwalk when the sources are in use.

The other question posed by the inspector was the possible radiation fields on the roof. As I stated earlier, I did not physically go to the roof for measurements; however, I'm sure we have ample data to calculate the fields in the positions indicated on the roof. I have selected all points where it would be possible for maintenance men to be required to work. Table II gives the calculated values for these various positions.

Mr. William E. Davis
General Steel Industries

As can be seen from this table, the highest field is that in the ridge area immediately above the exposed sources at position I. This represents a field of 0.85 mr. /hr - well below the 2 mr. /hr for unrestricted areas and would mean a person would have to remain at this position about 120 hours per week in order to exceed the 100 mr. per week limit. A most unlikely situation.

I would, however, recommend you extend your company policy of requiring all maintenance men to clear through your office before going onto the catwalk of the crane to include going onto the roof also. In this manner you can be certain no workmen will be in these areas when the sources are exposed.

I further recommend you make this report a part of your permanent records and submit a copy to both the state and federal A. E. C. inspection agencies in answer to any questions they may have concerning the radiation fields and control of areas above your radiographic facilities.

Should you have any further questions, please call on me at your convenience.

Sincerely,

NUCLEAR CONSULTANTS CORPORATION

W. R. Konneker, Ph. D.
Certified Health Physicist

WRK:im
cc:WRK

enclosures

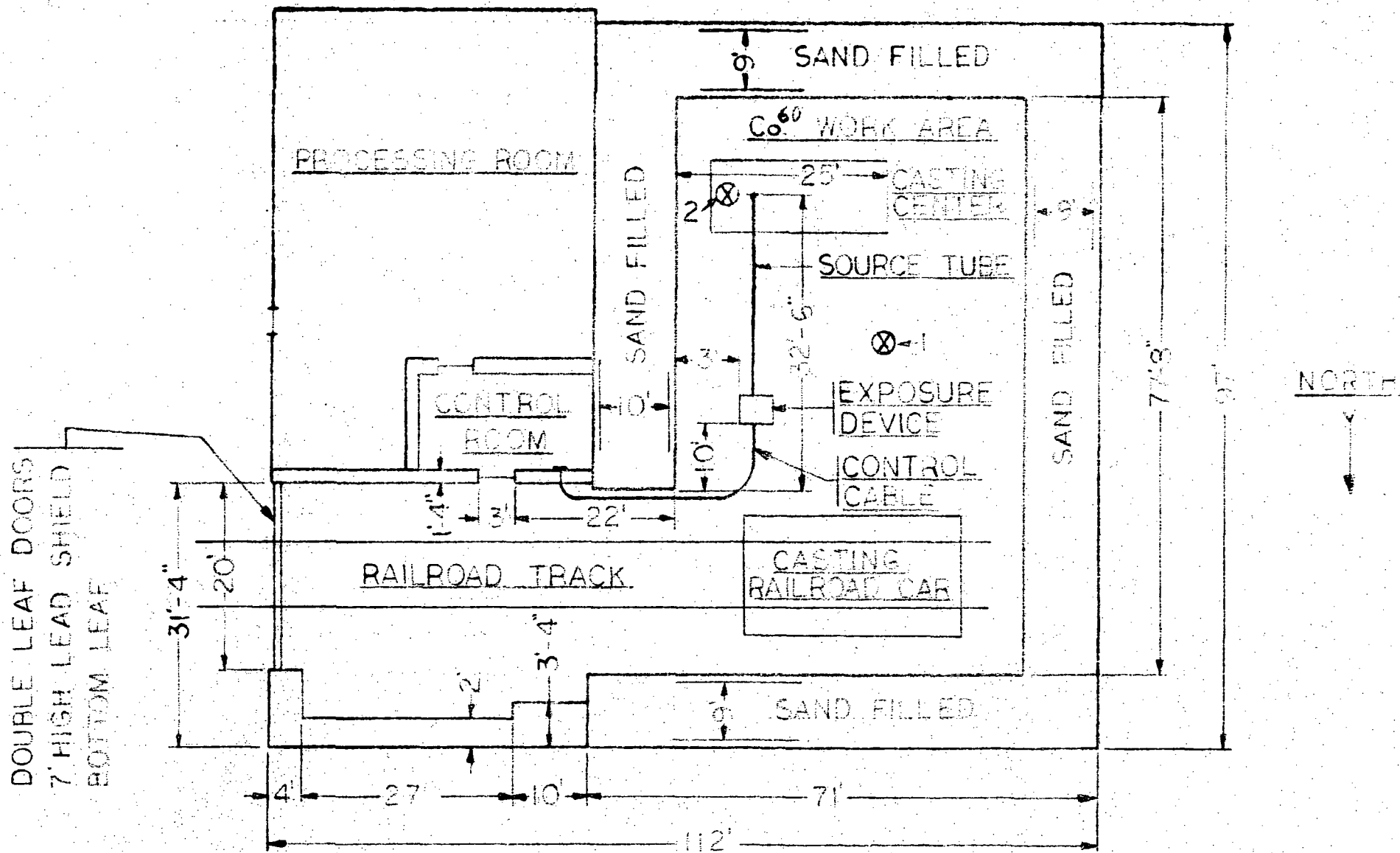
TABLE I

		<u>Sources in casting</u>	<u>Sources on floor</u>
A.	Seat of the crane operator	0.5 mr. /hr.	1mr. /hr.
B.	Catwalk on top of crane	1 mr. /hr.	1 1/2 mr. /hr.
C.	Catwalk immediately above wall	1 mr. /hr.	3 mr. /hr.
D.	Catwalk immediately above sources	3 1/2 mr. /hr.	7 mr. /hr.
E.	Catwalk about half-way between sources and operator's position	1 1/2 mr. /hr.	2 1/2 mr. /hr.
F.	Catwalk immediately above operator's position	1 mr. /hr.	1 1/2 mr. /hr.
G.	Catwalk immediately above end wall of room	0.5 mr. /hr.	1 mr. /hr.

TABLE II

All based on both sources completely exposed using closest measured point and the inverse square law. No additional shielding assumed.

L.	Area between two buildings 63' from sources (use measured field at C for calculation).	0.4 mr. /hr.
H.	Platform inside building used to work on window controls 60' from sources (used measured field at C for calculation).	0.52 mr. /hr.
I.	Ridge area on top of roof 52' from sources (used measured field at D for calculation).	0.85 mr. /hr.
J.	A second platform inside building used to work on window controls 56' from sources (used measured field at E for calculation).	0.45
K.	Edge of building 62 feet from sources (used measured field at F for calculation).	0.4 mr. /hr.

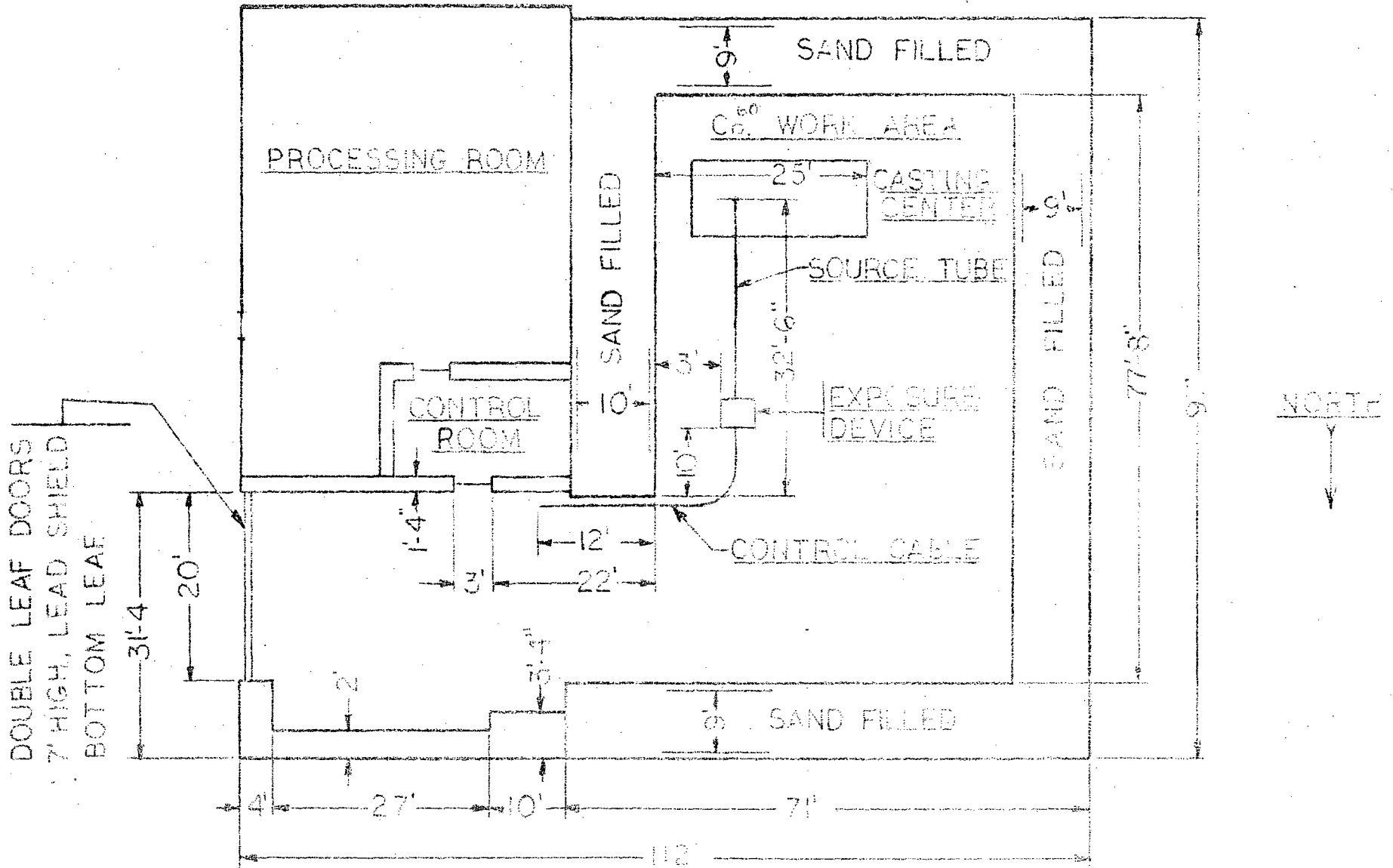


DRAWING NO. 1

80 CURIE SOURCE

G.S.I. BETATRON

CONCRETE BLOCK WALLS,
MORTAR FILLED, 25' HIGH



DRAWING NO 2

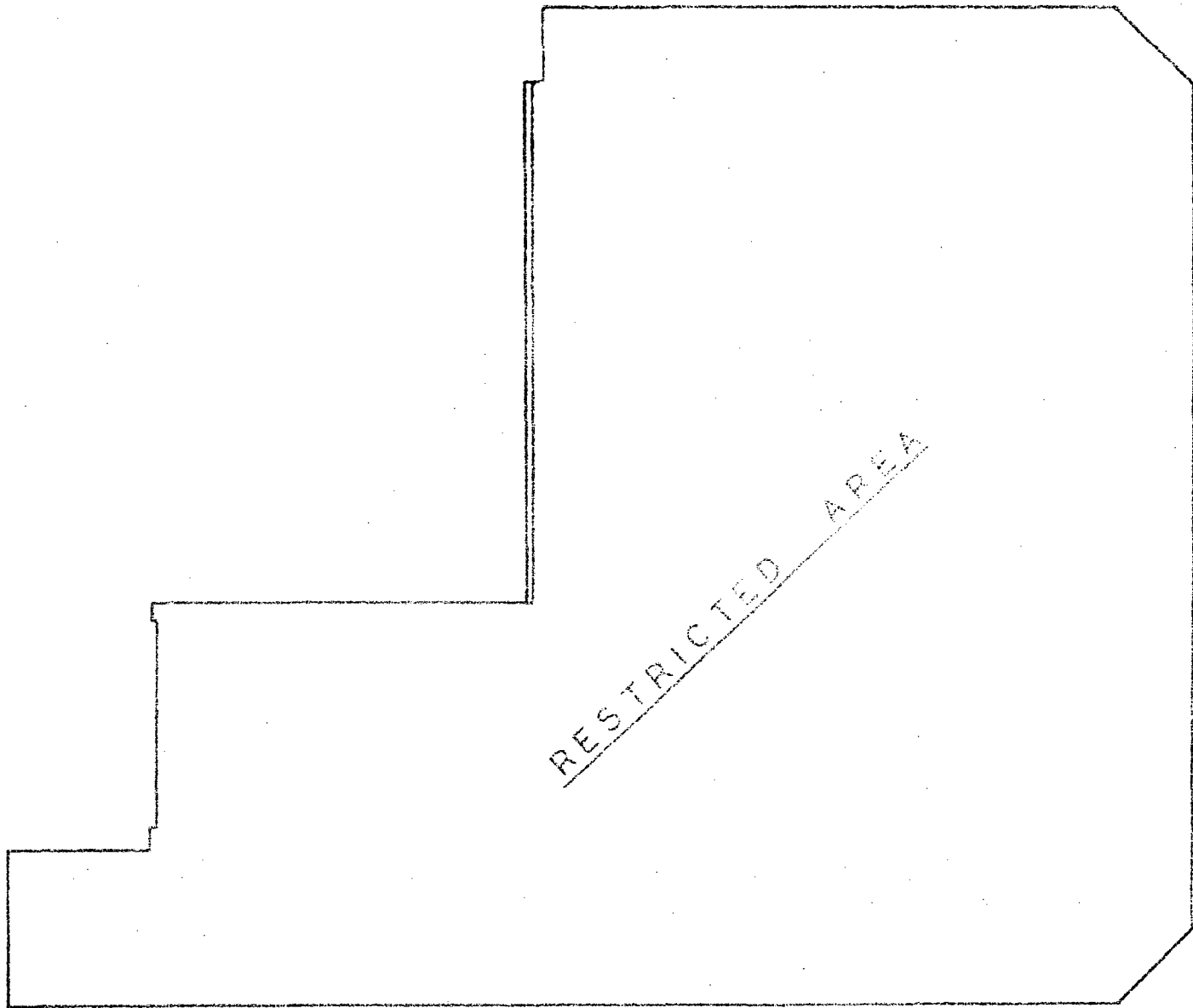
LESS THAN 1 CUPE

G. S. I. ESTABLISHMENT

NEW BRUNSWICK STATE
LABORATORY CENTER

⊗ MATCH POINT

Section 6 (a) Page 25



⊗ MATCH POINT

DRAWING NO 3A
OVER LEAF TO BE USED
OVER DRAWING NO 3

⊙ MATCH POINT

1/4 MILE (ESTIMATED)

STEEL MESH FENCE, 6' HIGH

PROCESSING AREA

SOURCE TUBE

EXPOSURE ROOM

CONTROL ROOM

EXPOSURE DEVICE

CONCRETE

DESK

CONTROL CABLE

LEFT

RIGHT

DOUBLE LEAF DOORS OPEN FROM INSIDE ONLY

CASTINGS CAR

CONCRETE WALLS 9' APART, SAND FILLED

NEAREST BUILDING 1000 FT. (ESTIMATED)

RIGHT

⊙ MATCH POINT

STEEL MESH GATES

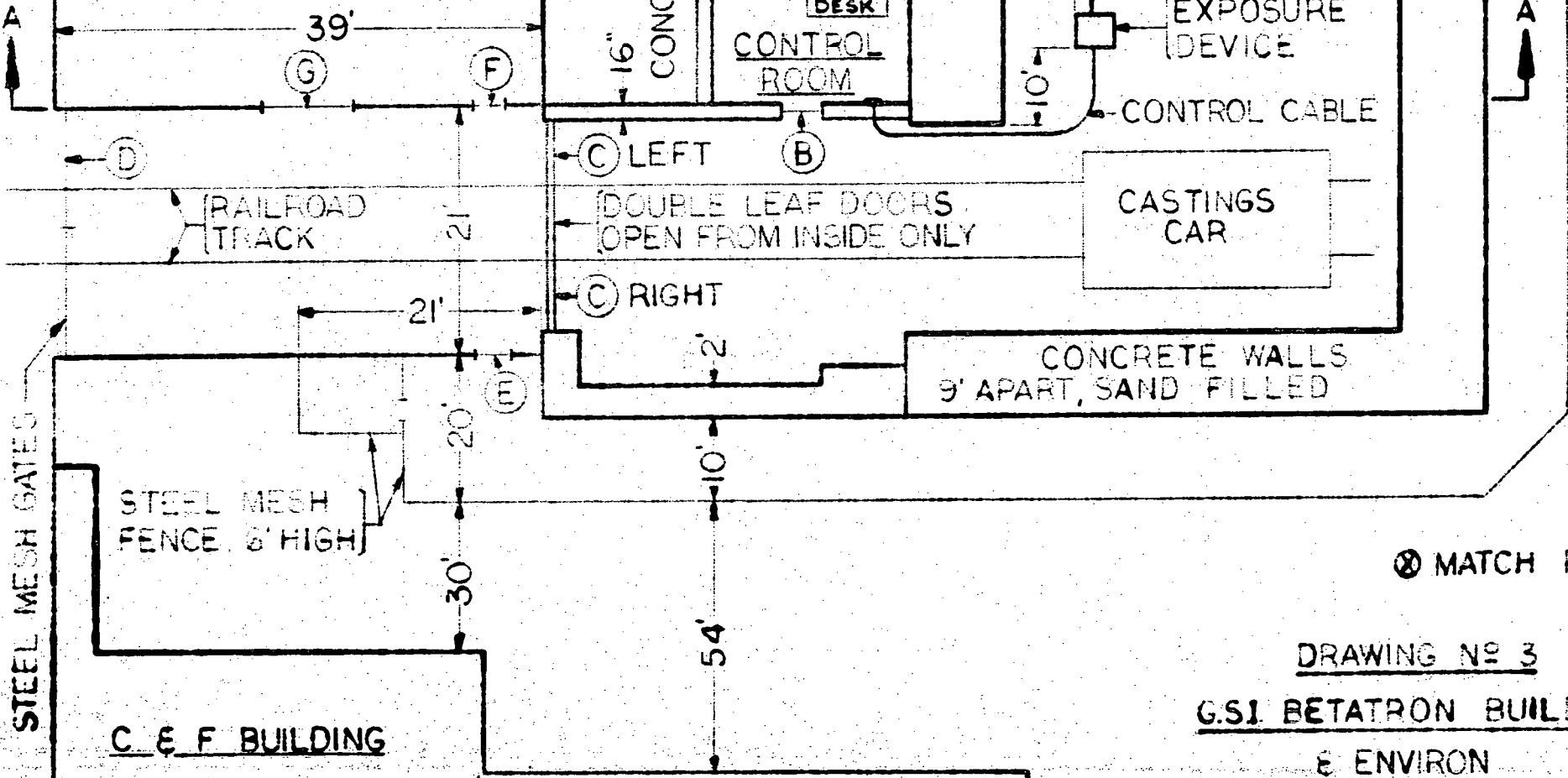
STEEL MESH FENCE, 6' HIGH

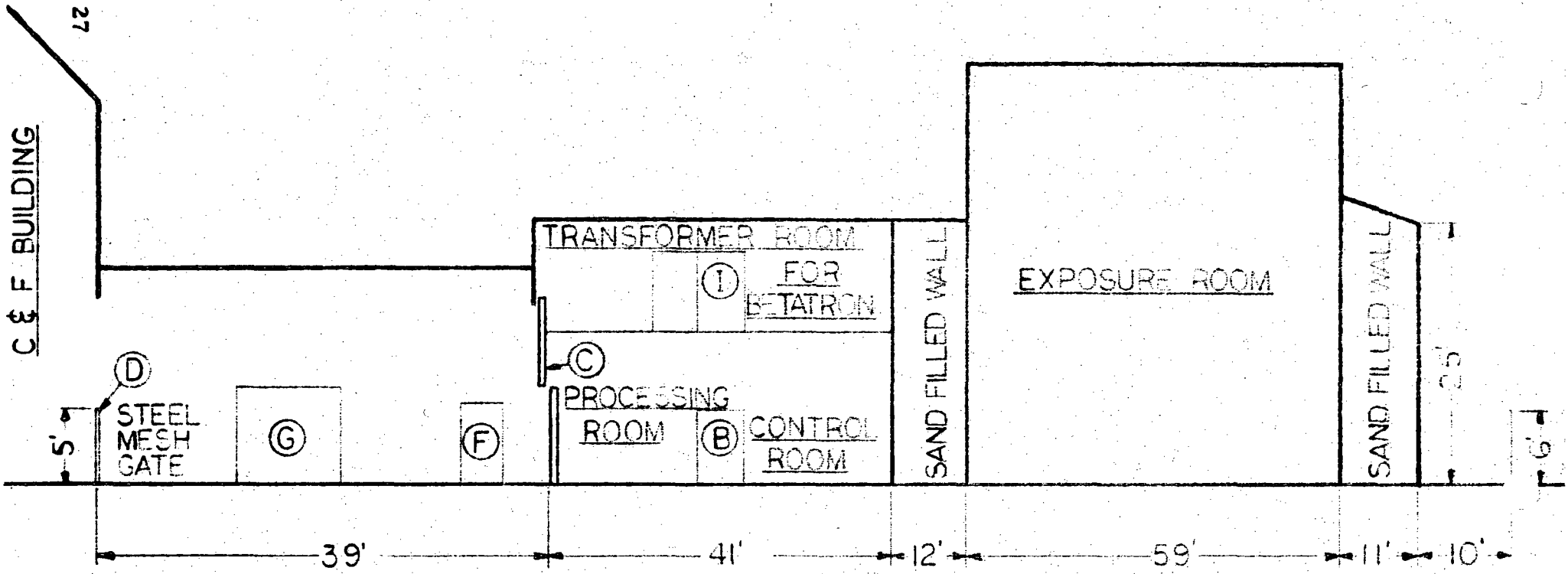
C & F BUILDING

DRAWING NO 3

G.S.I. BETATRON BUILDING

& ENVIRON





DRAWING NO 4

G.S.I. BETATRON BUILDING

SECTION A-A DRAWING NO 3

6 (a) GSI Betatron Building
Description of Sources, Operating Practices, and Signal Devices

A second radiation area at the Granite City Plant of General Steel Industries is the GSI Betatron Building. This area has been approved by the State Board of Health of Illinois for operation of a 25 M. E. V. Allis Chalmers Betatron. It is an ideal area for the 80 curie source of cobalt 60 which is mounted in radiographic camera model P60-100-2 manufactured by Gamma Industries of Baton Rouge, Louisiana.

The two Budd Co. cameras C-374 and C-375 are also operated in this area. Co60 sources of 280 and 260 millicuries were purchased with these cameras. These isotopes have decayed to below 100 millicuries at this time. Present thinking calls for the eventual replacement of one of these with a 800 - 999 millicuries of Co60. The other will be exchanged for a 250 - 300 millicuries of Co60.

The two Budd cameras with sources of less than 1 curie will be used in the Betatron Building according to Drawings #2 attached, without drilling additional holes in the control room wall. The 10' thick concrete and sand filled walls supply ample protection for less than 1 curie sources. The 80 curie source has been approved under the present license #12-8271-1 written in 1969 for operation as pictured in Drawing #1 attached. It will continue to be used in this manner. Any replacement for this source will be 80 curies or less. If greater, a re-survey will be made and submitted to the AEC in accordance with requirements.

The Betatron Building is constructed of double walls of 8" concrete "lap joint" slabs. The walls are 9 to 10 feet apart. The space between is filled with silica sand. The walls and sand are 25 feet high. Drawings #3 and #4 with Drawing #3A overleaf, gives dimensions and an outline of adjacent buildings. A 6'

wire mesh fence surrounds the exposure area 10' from the concrete walls. The entire building, including the fenced-in area, but excluding the processing area and control room, is considered as a restricted area (see Drawing 3A overleaf).

No. 10 C & F Building is the closest 100% occupancy building. It is attached to the Betatron Building by a 39' long corridor, which is used only to move castings and supplies in and out of the Betatron Building and 10 Building.

A castings transfer car which is powered by an electric motor and controlled by an attached hand control is used to transfer material into the exposure room by qualified personnel.

It is separated from the Betatron Building by large double leaf doors (C) in Drawings #3 and #4. The bottom door is lead lined. The doors are so heavy they require large electric motors to lift them. Controls for the doors are located and operated from the inside of the Betatron Building only. The other end of the corridor is separated from C & F No. 10 Building by large double gates of wire mesh, each side of which is posted with "Radiation Keep Out" signs.

There are no below ground level rooms in this area. Drawing #4 shows elevations of the area along the line A-A of Drawing #3. This building contains one room on a second elevation which is entered from the locked Betatron control room and houses the electrical apparatus necessary for the functioning of the 25 MEV Betatron. Maintenance checks are made in this room once each week for a total of one to four hours. The electrician is permitted to enter only when radiation sources are secured and he is required to wear a film badge when working in the area.

6 (a) Signal Devices

Entrance to the radiation area is made through door B and C. Drawing #3. Door C is the large double leaf door. It can only be opened from the interior of the building with the aid of an electric motor. Red warning lights are mounted on the corridor side of the door and a "Caution Radiographic Area" sign is on the door.

Door (B) is posted with a "Caution Radiation Area" sign and kept shut.

Gate D is posted with a "Keep Out" sign. The wire mesh fence is posted with "Caution Radiation Area" signs on all sides. The corridor area between gate D and door C is not considered as a restricted area as defined by AEC. It is restricted in the sense that access to it is limited to transfer of castings and supplies. It has an occupancy of less than 5%.

In the exposure room midway along the 10' sand filled wall separating the exposure room from the processing area, at a 5' to 6' height is an area monitoring device. At pre-set levels of radiation, this device sounds an alarm inside the exposure room and energizes a "Flashing Red Light" within the building. It also energizes "Flashing Red Lights" over a warning sign inside the control room at door B and on the outside of door C.

The audible alarm is plainly heard at door B inside the control room if the door is opened by mistake. Near the monitoring device is a large button labeled "panic button." When this is pushed, an alarm goes off in the control room to notify the radiographers that, in spite of all precautions, someone is in the exposure room.

Door B may be opened at all times from the exposure room side. One wall of the control room has large windows; all inhabitants of this room are visible to people in the processing area. Door A is kept locked at all times when either the Co⁶⁰ or Betatron is in use.

6 (a) Radiation Survey Report - R. W. Ripley, January 29, 1971

A radiation survey was made of the entire area by Robert Ripley, Radiation Safety Officer, and Walter Richter, an NDT supervisor. The procedure followed and results obtained were as follows:

The 80 curie source was placed at a 5 foot height at the two locations marked X on Drawing #1. A chart was made and is attached as Table 1. Radiation levels listed are the highest found for either location. During each survey, the source was not shielded in any manner (such as being inside a casting or shielded by another casting) as it would be in actual operation.

The survey was made with the source at location #1, Drawing #1, outside the casting radiographic center as one of the worse possible locations for radiation leakage. The source will not be used at this point in normal operating practice. Radiation levels at the right side of the double leaf door (C) were 4.4 mr/hr (see Table 1 and Drawings #3 and 4) at a height of 12 feet, which is just above the horizontal junction of the double leaf door. The doorway (E) is used once or twice a year in order to check the transformers located at (T) on Drawing #3.

The angle of radiation from location #1, Drawing #1, was such as to just cut the corner of the end of the 10' thick wall, miss the corner of the 4' concrete block wall at the double leaf door and not be blocked by the castings car, thus giving maximum radiation level at the double leaf door (C).

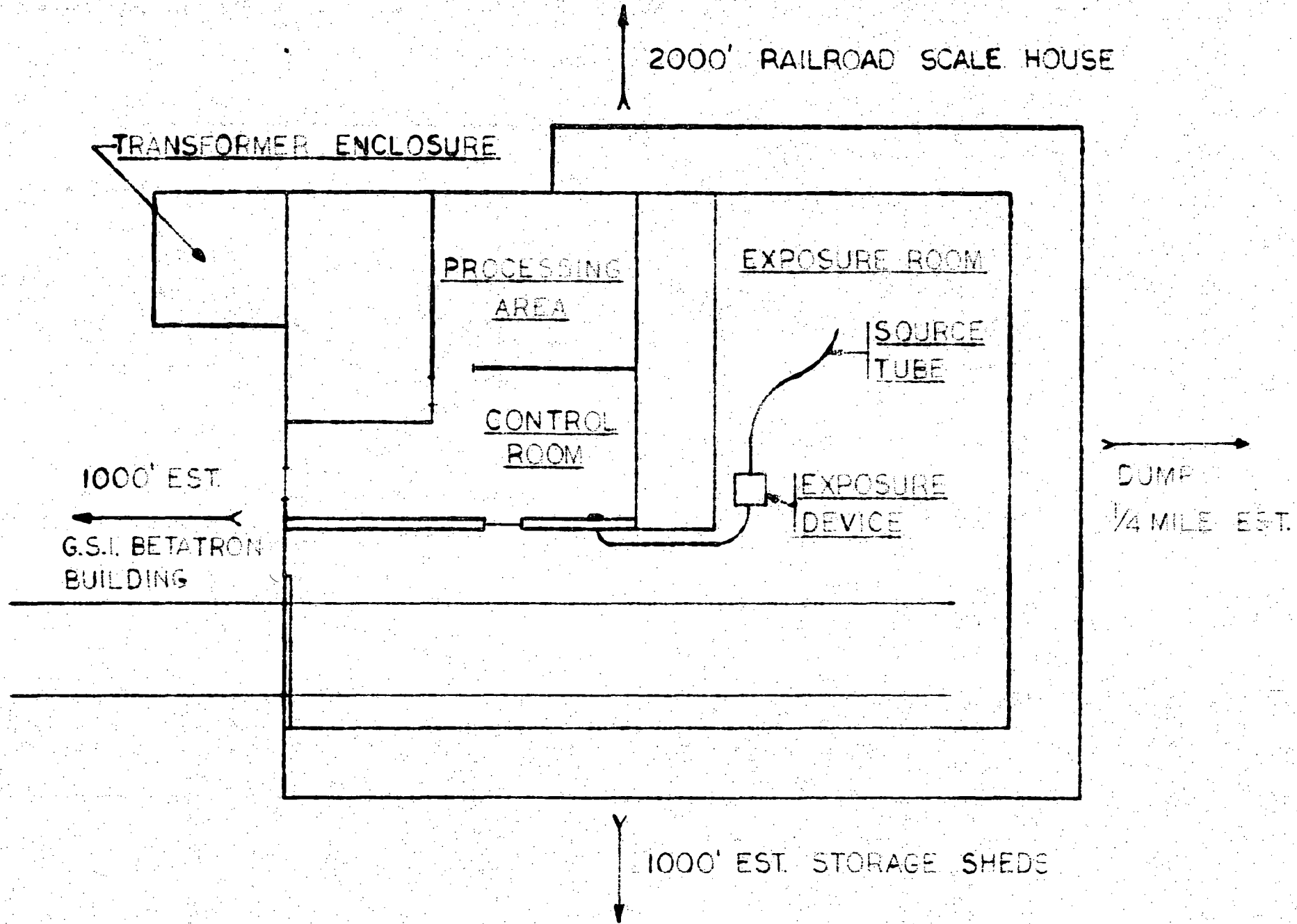
As a result of the survey, the Betatron Building is considered safe for radiography while following GSI operating procedures. The 2 mr/hr restricted area is confined to the exposure room area as surrounded by the 9' and 10' sand filled concrete walls including the passage area up to the exterior surface of the double leaf door (C). As an extra precaution, the fenced-in area is included as a restricted area and so posted. See Drawing 3A restricted area overleaf, for the restricted area boundary.

RADIATION SURVEY CHART - BETATRON BUILDING

Location	Radiation Level	Remarks
Control Room	3.0 mr/hr	meter held against door joint (B) sketch # 4
" "	.6 mr/hr	2' from door
" "	.1 mr/hr	at control desk
Processing Room	.05 mr/hr	highest reading in the area against wall
Concrete Exterior Wall	.05 mr/hr	highest level, survey meter against wall at 5' height, entire exterior wall surveyed
Transformer Room	1.5 mr/hr	at meter door (D) in sketch # 4
" " "	2.0 mr/hr	at open area in ceiling - wall junction near door (C) sketch # 4
Outside Surface of Double Leaf Door (C) sketch # 4	.3 mr/hr	left side 5' high
	1.8 mr/hr	left side at horizontal door joint 10' high
	2.5 mr/hr	left side 2' above horizontal joint at 12' height
	.2 mr/hr	left side 10' from door 12' high
	.4 mr/hr	right side 5' high
	3.4 mr/hr	right side at horizontal door joint 10' high
	4.4 mr/hr	right side 2' above horizontal door joint 12' high
	1.8 mr/hr	right side 10' from door 12' high
Corner at Door E	.4 mr/hr	{ taken against exterior surface of wall
Corner at Door F	.2 mr/hr	

GSI BETATRON
 RADIATION SURVEY CHART
 TABLE I

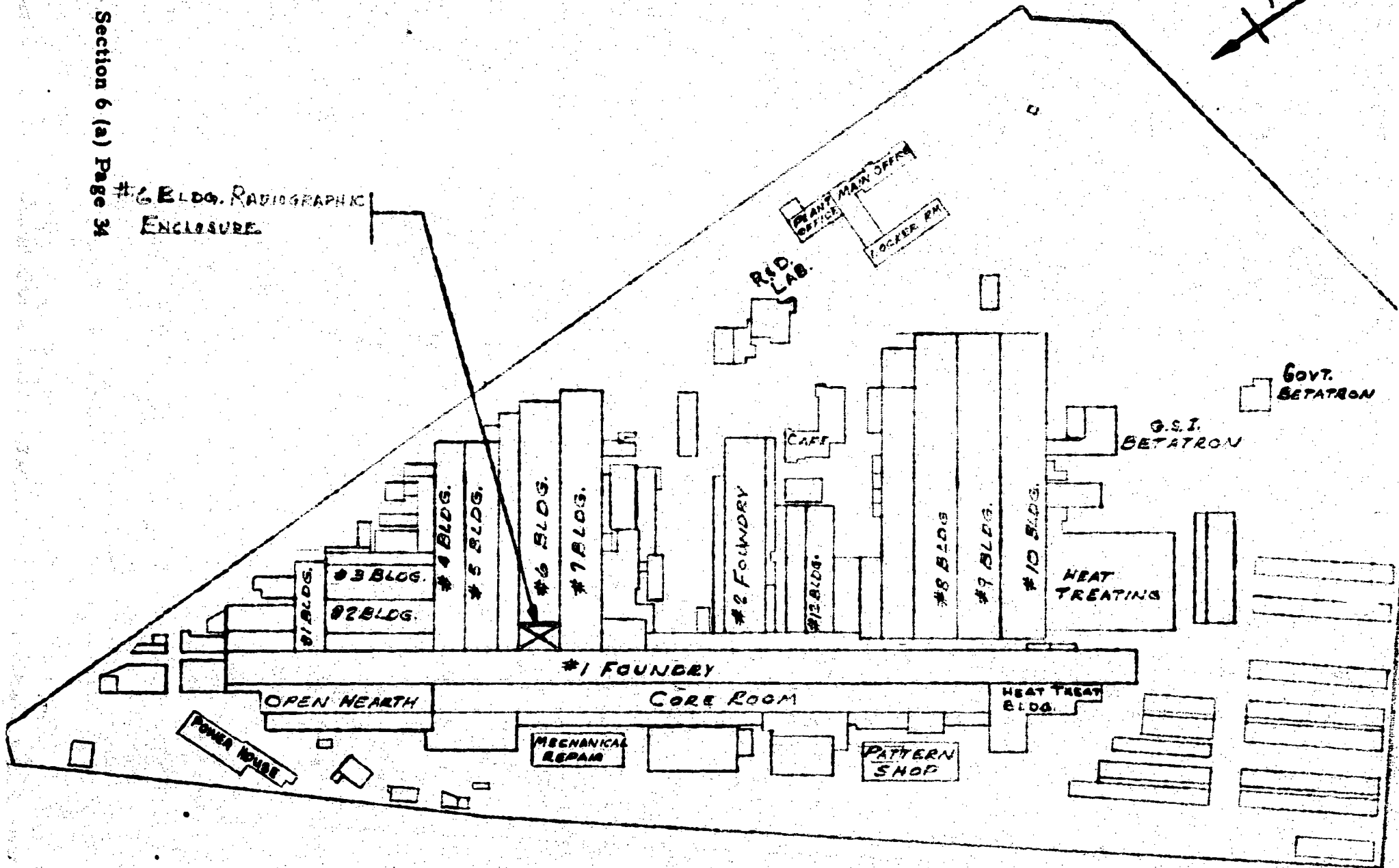
Table I



DRAWING NO. 5
GOVERNMENT BETATRON
BUILDING AND ENVIRONS



#6 BLDG. RADIOGRAPHIC ENCLOSURE



GENERAL STEEL INDUSTRIES INC.
GRANITE CITY, ILL.

N 9 38189-2

DWR.1C

o (a) Government Betatron Building

Description of Sources, Operating Practice and Signal Devices

In addition to the GSI Betatron, our facilities include a second Betatron Building which is owned by the U. S. Government. The Government Betatron Building houses a 23 MEV Betatron manufactured by Allis-Chalmers Manufacturing Company.

This facility has been out of service since December 31, 1970. We expect, based on production forecasts, to reactivate this facility in the near future and request approval for use of sealed sources in this building accordingly. The facilities description, description of sources, operating practices and safety devices which will be employed when reactivated are as follows:

The construction of this building is the same as the GSI Betatron from the standpoint of radiographic room size, wall and roof construction, wall thicknesses, and other characteristics which must be considered in measuring radiographic field containment. The control room and processing area is arranged differently as may be determined by a comparison of the two Facilities Drawings; however, this difference does not have effect on the Radiation Safety of operating personnel.

We will use the following sealed sources in this facility:

Source: 80 curie, Co⁶⁰

Radiographic Camera: Gamma Industries, Baton Rouge, La.
Model P60-100-2

Source: 280 millicuries Co⁶⁰

Radiographic Camera: Budd Manufacturing Company
Ser. C-374

Source: 260 millicuries, Co⁶⁰

Radiographic Camera: Budd Manufacturing Company
Ser. C-375

As stated previously, the two later sources have decayed to less than 100 millicuries and will eventually be replaced with one 800-999 millicurie Co^{60} source and one 250-300 millicurie source Co^{60} .

The wall of the Government Betatron Building is drilled as shown on the Facility Drawing at approximately the same location as described for the GSI Betatron Building so the same operating practices will apply for the Co^{60} sources as outlined in section 6(e) Operating Procedure for Use of Co^{60} , Radiographic Sources in the Betatron Room of 80 Curies Maximum.

In order to use the listed sources in all permanent facilities, it is necessary to transport them from one location to another. The movement of sources from one location to another will be handled as outlined in Section 6 (e) Procedure for Moving Sealed Sources Between Radiographic Enclosures.

This building is equipped with audible and visible warning lights wired into the betatron circuitry. When sealed sources are used in this facility, a calibrated area monitor, incorporating signal lights visible in the control room and at the entry door to the radiation area will be employed.

This building is entered through two doors. The entry into the Radiation Area from outdoors is a double leaf door of a size to permit entry of a rail car. This door is electrically operated from inside the Radiation Area only. The second entry into the Radiation Area is from a pedestrian size door from the Control Room Area. Entry to the Control Room Area from outdoors is through a pedestrian size doorway which is locked at all times with keys controlled as noted previously.

This doorway also has a buzzer with the control button located outdoors so people can contact the operator and gain entry with his approval.

Each of the three doors described have posted on them at eye level height a sign which contains the Radiation Symbol and reads, "Caution, Radiation Area".

The Government Betatron Control Room is equipped with a direct telephone line to the GSI Betatron Control Room which will be manned at all times when sealed sources are used in the first location.

6 (a) Government Betatron Radiation Survey

We anticipate that since building construction is the same as the GSI Betatron Facility, that radiation field levels would be approximately the same outside the building and in the control room.

As a verification measure, we plan to conduct a survey when the sealed sources are moved and supply the Survey Report as addendum to this application for information purposes only.

6. (b) DESCRIPTION OF RADIATION DETECTION
INSTRUMENTS TO BE USED

6 (b) Survey Meters

We have 3 Victoreen Model 592B survey meters, serial numbers 3432, 4032, and 4048. The Victoreen Model 592B Survey Meter is a battery operated ion chamber instrument for the measurement of X and gamma radiation over the range of 1 to 1000 mr/hr. Three linear ranges with full scale sensitivities of 1000, 100 and 10 mr/hr are provided. A rugged fiberglass reinforced case houses the component and ion chamber assembly. The case has a top and bottom section held together by two dzus fasteners. The meter, two controls and a carrying handle are on the top surface of the instrument.

The meter is graduated from 0 to 10 mr/hr. The OFF-ON range selection switch knob and zeroing control knob are located to the left and right of the carrying handle at finger tip reach. Three range positions, X100, X10 and X1, are marked on the case top. A guard ring protects the zeroing knob against accidental displacement.

Reference data:

- a. Range 0-10, 0-100, 0-1000 mr/hr.
- b. Energy range is 50 kev to 1.3 mev.
- c. Accuracy is 10% at full scale (0.50 to 1.3 mev)
- d. Battery complement. Three RM-4 mercury cells 1.3 volts each. Six number 412 Eveready 22.5 volt batteries.
- e. Battery life 300 hours.
- f. Weight 4-3/4 pounds.
- g. Dimensions: 9-7/8 inches by 4-11/16 inches by 4-1/4 inches.
- h. Tube complement: One 5886A, one CK5470X and one VS10.

Operating Steps of the Model 592B

- a. Turn the range to zero position.
- b. Adjust the zero control so that the meter reads exactly zero. In the zero position, the input has been switched to a reference potential

the instrument has been switched to maximum sensitivity

X1, which allows accurate zeroing in a radiation field.

- c. Turn the range switch to the C100, X10 or X1 range as required and the instrument will measure gamma radiation in mr/hr.

Each time the instrument is turned off it is advisable to zero the switches again when a new measurement is made using the X100, X10 ranges. This applies to situations when frequent measurements are made as in surveys.

6 (b) Area Monitor

An area monitor manufactured by Beta Industries of Baton Rouge, La. is located in the exposure room of the betatron building.

The meter is graduated from 0 to 5 mr/hr with three range positions of 1X, 10X, and 100X at a given preset level of radiation it actuates an audible alarm and a flashing red light in the exposure room. It also controls the red warning lights in the control room and on the outside of the large double leaf door.

We maintain two of these instruments, Serial numbers 0012 and AM101. They are calibrated at least once each 6 months by Gamma Industries, Inc., a division of Nuclear Systems, P. O. Box 2543, Baton Rouge, La. 70821. Calibration records are maintained in the Betatron building. After any repairs are performed, the instrument is recalibrated.

6. (c) INSTRUMENT CALIBRATION PROCEDURES

6 (c) Calibration procedures

The three Nucor CS-40A survey meters are calibrated by the St. Louis Testing Laboratories, 2810 Clark Street, St. Louis, Missouri 63103. The President of the corporation is Mr. C. D. Trowbridge.

The calibration is performed under AEC License #24-00188-02, expiration date September 30, 1973. A statement of calibration is affixed to the meter at the time of check, plus the due date of the next calibration. Because we have three meters, one is sent out for calibration each month. We try to always have two or more calibrated survey meters available for use. A formal certification of calibration is submitted to GSI for file. If the instrument is out of calibration or if repair is indicated, it is recalibrated after repair, regardless of next due date for calibration.

The area monitors as described under 6 (b) are calibrated every six months by Gamma Industries, P. O. Box 2543, 2255 Ted Dunham Avenue, Baton Rouge, Louisiana 70821.

The calibration is performed under their AEC License #17-00363-03. A statement of calibration is affixed to the meter at the time of calibration plus the due date of the next calibration.

If the instrument requires repair, it is always recalibrated after repair.

Calibration Certificates are received by the Radiation Safety Officer who reviews, initials, and forwards them to the Plant Accountant for permanent file.

6 (d) PERSONNEL MONITORING EQUIPMENT

6 (d) Personnel Monitoring Equipment

The N. D. T. Department at GSI maintains three Victoreen Minometers, Serial No. 387-2140, 187-439 and a model 6876, Serial No. 901. They are used with Victoreen pocket chambers.

In addition, we use, on various occasions, Bendix dosimeter charger 906, Serial No. 01012 and 00533 with pocket chamber #638 and Eberline radiation monitors RT-1.

Film badges are supplied by R. S. Landauer, Jr. & Co., 3920 216th St., Matteson, Ill., area code 312. Each individual radiographer wears his personal film badge and the film badge report becomes the permanent record of the individual exposure dose. Forms AEC 4 & 5 are maintained for each individual. At least 4 extra film badges are received each week in the event they are needed.

Blood counts under the supervision of GSI physician, Dr. Brennan, are taken at time of employment and separation.

The wearing of personal monitoring equipment and procedures to follow in the event of discharged dosimeters are covered in detail in the section 6 (e) Operating and Emergency Operating Procedures.

**6. (e) OPERATING, EMERGENCY,
& MAINTENANCE - INSPECTION
PROCEDURES**

General Steel Industries, Inc.
General Operation Procedure for Use of Cobalt 60 Radiographic Sources

All "Radiographers" (as defined in Title 10, Part 34), shall:

1. Read and understand Parts 20 and 34 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 and the Radionic Panoramic camera.
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 the Radiation Safety Officer.
6. Receive instructions in health physics, monitoring and personnel monitoring and dosimetry from GSI personnel or other sources as deemed necessary. (See initial training program)

Above instructions will include lectures, actual use of exposure devices and survey instruments, and practical problems, utilizing Appendix A, Part 34, Title 10, as an outline. A copy of this training program is attached as 6 (f).

There will be no transportation of sources or exposure devices to any field location; however, they may be moved to any of the special radiographic rooms within the plant. All records will be maintained by the Radiation Safety Officer or by the Division Accountant in the Division Accounting Department at the same address.

Keys to Radiographic Facilities will be in the possession of the Radiation Safety Officer, the Nondestructive Testing shift supervisors, and the Qualified Radiographer on the shift. It will be the Radiographer's responsibility to turn in the assigned key to the Shift Supervisor at the end of the shift who in turn will assign it to the Qualified Radiographer on the following shift. Keys to Radiographic Facilities shall remain in the possession of the assigned people and shall not be transferred to another person regardless of position or title without the approval of the Radiation Safety Officer. Lost keys must be immediately reported to the Radiation Safety Officer. All Radiographers must wear film badges and pocket chambers or dosimeters when working in a radiation field environment, whether the source of radiation be Co60 sources, x-ray, or betatron.

Operating Procedure for Use of Cobalt-60 Radiographic Sources of Less Than 300 milligrams in No. 6 Building - Radiographic Enclosure.

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. 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 area). Using the 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. Follow maintenance and inspection procedures and make daily and quarterly checks and be present when the 6 month check is made.
5. 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 the 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.
6. Turn on red warning lights. These lights are strategically located on the top of the exposure room walls, and over the outside entrance so that they may easily be observed by any personnel passing by the area adjacent to the exposure room.
7. Unlock Budd Camera devices.
8. 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. The source may now be exposed utilizing the control cable from behind the armor plate shields. Observe the source position indicator.

9. Make necessary entries in Utilization and Survey Log.
10. "Radiographer" retires to small room outside of radiation area to time and wait for exposure to be completed. At no time should he enter the exposure area (forward of the steel shields) when sources are exposed.
11. After exposure is completed, retract source into source holder with control cable from behind armor plate shielding.
12. Make an operational survey of the entire area, taking special note of source tube and camera device.
13. Lock camera device. This should be done even though a second exposure is to be performed within the next few minutes.
14. Make necessary entries into Utilization and Survey Log. (See attached.)
15. Turn off warning light.
16. Steps No. 3 to No. 14 inclusive may be repeated a number of times within a shift or between trips to the darkroom and film storage area. Darkroom and office are over 500 yards from exposure room.
17. Before leaving the room whether to go to lunch or darkroom or at the end of the shift, a final survey of source holder and source tube will be made and noted in the log. Be sure to sign the log.
18. Leave exposure room and lock door from the outside. Never leave room, even for a few minutes, without locking from the outside.
19. A final dosimeter reading will be made and recorded at the end of each shift. Film badges and pocket chambers or dosimeters as noted above will be worn throughout the eight hour shift, regardless of work being performed.
20. See Emergency Procedure for proper action in case of an emergency. In case of emergency, follow those procedures and call Radiation Safety Officer at once.

Telephone Numbers

(Call in order listed)

1. Robert W. Ripley 910 Echo Drive, Collinsville, Ill. 344-0049
Ext. 214, A. C. 252
2. William H. Rapp 13 Woodside Dr., Belleville, Ill. 1-397-6231
Ext. 244, A. C. 242

Operating Procedure for Use of Cobalt-60 Radiographic Sources of Less Than 300 milliries in No. 6 Building - Radiographic Enclosure. (Continued)

3. John Abbott 2795 Sorrell Dr., Florissant, Mo. 831-0126
Ext. 282 or 286
4. Phil Wells 315 Kingdom St., East St. Louis, Ill. 377-6113
Ext. 342, A. C. 445

**Operating Procedure for Use Of Cobalt 60 Radiographic Sources In The
Betatron Rooms of 80 Curies Maximum**

All radiographers must wear film badges and pocket chambers or dosimeters whenever working around penetrating radiation, whether it be from the Betatrons or the Co⁶⁰ sources.

1. Unlock the door to the Control Room from the outside, enter and immediately lock the door. In the event another radiographer must enter the Control Room while it is locked, he will have to knock on the door.
2. Using the survey meter, make an entrance survey of exposure device (Radionic Panoramic Camera Model P60-100-A) making certain no source is exposed.
3. Make the necessary entries in the utilization and survey log.
4. Follow inspection and maintenance procedure and make daily and/or quarterly checks and be present when the 6 month check is made.
5. Always place the casting as far south as the handling crane will permit, approximately 54' from the north wall. The casting will be as close as is practicable to the east wall. Set up the exposure film and fix the position of the source tube. Make certain the source tube is firmly fixed in the position required and that any angle in the tube is not too sharp to prevent movement of the source within the tube. The Co⁶⁰ camera will be set approximately 3' from the east wall and 32' from the north wall. The control crank unit will be inside the control room.
6. Turn on red warning lights. These lights are strategically located at the entrance door to work area and at the double leaf door. Lights may easily be observed by any personnel passing by the area adjacent to the exposure room.
7. Check the area monitor and make certain it is turned on and is set at 5 mr/hr or less.
8. Unlock the Radionic's camera device.
9. Have casting and camera located so that control cable may be operated from inside the control room.
10. The Budd Camera with a source of less than 1 curie is operated outside the control room as per sketch #2. The operator shall retract the source from at least 12 feet back from the exposure side of the 10' thick sand filled wall and no more than 3 feet from the control room wall.

**Operating Procedure for Use Of Cobalt 60 Radiographic Sources In The
Be ron Room of 80 Curies Maxim (Continued)**

11. Radiographer returns to the Control Room outside the radiation area to time and wait for the exposure to be completed. At no time should he enter the exposure area (forward of the 10'0" thick sand filled wall) when the source is exposed.
12. Make the necessary entries in utilization and survey log.
13. After the exposure is completed, retract the source into the camera by means of the control cable from inside the control room if the 80 curie source is used. If the less than 1 curie is used, it is operated from the outside of the control room as per Sketch #2.
14. Make an operational survey of the entire area, taking special note of source tube and camera device.
15. Lock camera device. This should be done even though a second exposure is to be performed within the next few minutes.
16. Make necessary entries in the utilization and survey log . (See attached)
17. Turn off warning lights.
18. Steps No. 3 to No. 14 inclusive may be repeated several times before going to lunch or the end of the shift. Darkroom and offices are located in the processing area behind the 10'0" thick sand filled wall.
19. Before leaving the room, whether to go to lunch or darkroom or at the end of the shift, a final survey of source holder and source tube will be made and noted in the log. Be sure to sign the log.
20. Leave exposure room and lock door from the outside. Never leave room, even for a few minutes, without locking from the outside.
21. 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.
22. See Emergency Procedure for proper action in case of an emergency. In case of emergency, follow those procedures and call the Radiation Safety Officer at once.

Operating Procedure for Use Of Cobalt-60 Radiographic Sources in The
Bethel Room of 80 Curies Maximum (Continued)

Telephone Numbers
(Call in order listed)

1. Robert W. Ripley 910 Echo Drive, Collinsville, Ill. 344-0049
Ext. 214, A. C. 252
2. William H. Rapp 13 Woodside Dr., Belleville, Ill. 1-397-6231
Ext. 244, A. C. 242
3. John Abbott 2795 Sorrell Dr., Florissant, Mo. 831-0126
Ext. 282 or 286
4. Phil Wells 315 Kingdom St., Bethalto, Ill. 377-6113
Ext. 342, A. C. 445

The sources contained in rubber tire equipped cameras and covered under this license may be moved from one Radiographic Enclosure Area to another in accordance with the following procedure:

1. The Qualified Radiographer will enter the Radiographic Enclosure containing the source and make an Entry Survey and record readings on Move Check Form.
2. He will remove the operating cables from the wall and secure them to the top of the camera unit.
3. The camera may then be moved by a Qualified Radiographer and a second workman as follows; the time for starting the move shall be entered on the Move Check Form:
 - (A) The Qualified Radiographer will direct all movements of and be responsible for the safe movement of the source.
 - (B) He will direct the actions of second man when moving the source.
 - (C) During the movement of the source, the Qualified Radiographer will monitor the radiation field level and record the highest reading taken on the Move Check Form.
 - (D) On arrival at destination, the Qualified Radiographer will install the operating cables in the drilled access holes in the Radiographic Enclosure; he will check to see that the camera unit is locked and will make a final survey. The time when the source is secured at the new location and the final survey reading will be entered on the Move Check Form.
 - (E) The second man will have the responsibility to handle the unit and move it under the direction of the Qualified Radiographer.
4. In the event of accident or other occurrence that causes the radiation field to exceed the safe limit of 2.0 mrs. during the move, the Qualified Radiographer and the second man will proceed as follows:
 - (A) The Qualified Radiographer, the second man, will withdraw to a safe point where survey readings do not exceed 2.0 mrs.

4. (B) The Qualified Radiographer will remain within
(Cont'd.) sight of the source and warn all persons approaching
of the potential danger and instruct to move from the
area.

(C) The Second Man will be instructed to go to the
nearest Supervisor and secure his and his peoples
assistance for the Qualified Radiographer who will
post people at a safe distance as determined by the
survey meter. These people will be instructed to
warn all persons to stay away from the area, and to
remain on station until relieved.

(D) The Second Man will then proceed to advise the
nearest Quality Control Supervisor who will then
advise R. W. Ripley or one of his alternates listed
on the following page immediately of the condition
existing.

(E) There shall be no attempt made to correct any
high radiation condition until R. W. Ripley or one of
his alternates is on the scene to direct the operations.

(F) Applicable sections of the Emergency Operating
Procedure shall be followed to verify that an over
exposure of the individuals moving the source has
not occurred.

Transporting Sealed Sources - Check-Off Form

Moving Sealed Sources - Between Radiographic Enclosures

1. Source being moved _____
2. From _____
(Radiographic Enclosure)
3. To _____
(Radiographic Enclosure)
4. I have read and understand the Procedure for Moving Sealed Sources between Radiographic Enclosures

(Qualified Radiographer)
5. Entry Survey Results _____
6. Time and date move started _____
7. Time and date move completed _____
8. Highest Survey Reading during move _____
9. Final Survey Results _____
10. Source Secured _____

Radiation Safety Officer

EMERGENCY OPERATING PROCEDURES

EMERGENCY NO. 1 FOR 6 BUILDING ENCLOSURE

SOURCE CANNOT BE RETRACTED INTO THE SOURCE HOLDER OR THE SURVEY INDICATES THAT IT IS NOT WITHIN THE HOLDER WHEN IT SHOULD BE. THE RADIOGRAPHER SHALL:

1. The warning lights will 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. If not available, use list of names and numbers below - in order listed.
3. Unlock door, leave radiation room, and lock door from the outside. Retain key in your possession.
4. Using survey meter, survey area immediately surrounding radiographic area, and post any area of greater than 5 mr/hr radiation level.
5. Maintain vigilance at doorway until R. W. Ripley or alternate arrives.
6. Under no circumstances should the radiographer even attempt to recover a source that has become detached or stuck in the source cable. He may assist the Radiation Safety Officer or other qualified person after they have arrived on the scene.

THE RADIATION SAFETY OFFICER SHALL

1. Obtain full story, evaluate, rectify if possible.
2. If necessary, call the Budd Company. Exposure room will remain locked and all warning lights will remain on until area is safe. Radiographer will maintain personnel vigilance at exposure room door if gravity of situation warrants.
3. Extra vigilance and restrictions will be maintained until area is declared safe.
4. Record will be made of the incident.
5. A.E.C. will be notified, if necessary, in compliance with Title 10, Part 20, Paragraph 20.403.
6. State Board of Health and GSI Safety Department will be notified if necessary.

EMERGENCY OPERATING PROCEDURES (Continued)

Telephone Numbers
(Call in order listed)

1. Robert W. Ripley 910 Echo Drive, Collinsville, Ill. 344-0049
Ext. 214, A. C. 252
2. William H. Rapp 13 Woodside Dr., Belleville, Ill. 1-397-6231
Ext. 244, A. C. 242
3. John Abbott 2795 Sorrell Dr., Florissant, Mo. 831-0126
Ext. 282 or 286
4. Phil Wells 315 Kingdom St., Bethalto, Ill. 377-6113
Ext. 342, A. C. 445

EMERGENCY PROCEDURE - BETATRON BUILDINGS

EMERGENCY 1A

The source cannot be retracted into the source holder, or a survey indicates it is not within the holder when it should be.

THE RADIOGRAPHER SHALL:

1. The warning lights will be on in accordance with operating procedure and by the area monitor. If they are not on, turn them on.
2. Make certain the large double leaf door is shut. Pull electric master switch if it is safe to do so.
3. Retain possession of survey meter at all times and observe the read out constantly.
4. Leave exposure room and lock control room door. Retain key in your possession.
5. Call Mr. R. W. Ripley by auto call or telephone. If he is not available, use names and numbers listed below in order listed.
6. Use survey meter to discover any area of radiation outside of exposure room if necessary.
7. Maintain vigilance in control room doorway (if the area is safe) until the Radiation Safety Officer or his alternate (as listed below) arrives.
8. Under no circumstances should the radiographer even attempt to recover a source that has become detached or stuck in the source cable. He may assist the Radiation Safety Officer or the other qualified person after they have arrived at the scene.

Telephone Numbers

(Call in order listed)

- | | | | |
|----|------------------|------------------------------------|-----------------------------------|
| 1. | Robert W. Ripley | 910 Echo Drive, Collinsville, Ill. | 344-0049
Ext. 214, A. C. 252 |
| 2. | William H. Rapp | 13 Woodside Dr., Belleville, Ill. | 1-397-6231
Ext. 244, A. C. 242 |
| 3. | John Abbott | 2795 Sorrell Dr., Florissant, Mo. | 831-0126
Ext. 282 or 286 |
| 4. | Phil Wells | 315 Kingdom St., Bethalto, Ill. | 377-6113
Ext. 342, A. C. 445 |

THE RADIATION SAFETY OFFICER SHALL:

1. Obtain full story from the radiographer, evaluate and rectify if possible to do so in a safe manner.
2. If necessary, obtain professional advice or assistance from equipment manufacturer. Exposure room will remain locked and all warning lights will remain on. A radiographer or person of responsibility as designated by the Radiation Safety Officer will maintain vigilance over the area until it is declared safe by the Radiation Safety Officer.
3. Incident will be recorded in maintenance and inspection daily report form or as dictated by seriousness of emergency and Title 10 requirements.
4. A. E. C. will be notified in compliance with Title 10, Part 20, Paragraph 20.403.
5. State Board of Health and GSI Safety Department will be notified.

EMERGENCY OPERATING PROCEDURES (Continued)

EMERGENCY NO. 2 POCKET DOSIMETER READS OFF SCALE

THE RADIOGRAPHER SHALL:

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 or alternate listed below and notify him of these results for his evaluation before making any other exposures.

THE RADIATION SAFETY OFFICER SHALL:

1. 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.
2. If film badge report substantiates dosimeter reading, the radiographer will be sent to the corporation doctor with a full report.
3. AEC will be notified in conformance with Title 10, Part 30, Paragraph 20.403 by the Radiation Safety Officer.
4. State Board of Health and GSI Safety Department shall be notified.

Telephone Numbers

(Call in order listed)

1. Robert W. Ripley 910 Echo Drive, Collinsville, Ill. 344-0049
Ext. 214, A. C. 252
2. William H. Rapp 13 Woodside Dr., Belleville, Ill. 1-397-6231
Ext. 244, A. C. 242
3. John Abbott 2795 Sorrell Dr., Fbrissant, Mo. 831-0126
Ext. 282 or 286
4. Phil Wells 315 Kingdom St., Baha, Ill. 377-6113
Ext. 342, A. C. 445

PERIODIC INSPECTION AND MAINTENANCE PROCEDURE

Additions to G. S. I. operating procedure to conform to A. E. C. December 13, 1970 Amendment to Title 10, Part 34:

The purpose of this procedure is to provide for periodic inspection and maintenance of the radiographic exposure device and area safeguards applicable to this amendment. The procedure is divided into 3 parts to conform to the daily, tri-monthly, and semi-yearly requirements applicable to the G. S. I. , Inc. radiographic installation.

- I. The following operations will be performed by the radiographers once each day that the exposure device is used:
 - A. The initial radiation survey will be made as required by G. S. I. Standard operating procedure and so noted in the utilization log.
 - B. The exposure device will be visually inspected for any damage that may impair its use or shielding integrity and so noted under Item 1 of Daily Check Form.
 - C. The device will be checked to determine if the source is properly placed inside the shield. This will be determined by a level of 50 mr/hr. An increase above this level at a distance of one meter from the exposure device will be evidence of an improperly retracted source. Note and follow per item 2 of the daily check form.
 - D. The locking mechanism will be checked by unlocking and locking of the exposure device. The operating condition will be noted in Item 3 of the Daily Check Form.
 - E. The first production exposure will then be made following G. S. I. standard operating procedure. The following will be noted: Changes in operating characteristics of the exposure device, operation of source position indication, and the operation of the crank mechanism. These items will be checked off as their condition under Items 4, 5, and 6 respectively of the Daily Check Form.
 - F. In the event of a malfunction, noted on the Daily Check Form in conformance with I, A. through E, the following steps will be taken:
 1. The supervisor or safety officer will be notified immediately.
 2. The supervisor or safety officer will evaluate and correct the problem.
 3. Any action taken will be recorded on the Daily Check Form.

4. If the above malfunctions are minor and do not involve a radiation hazard as defined under Title 10, Part 34, Paragraph 34.21 or Table 10, Part 20, Paragraph 20.403, use of the exposure device will continue if possible while corrections are being instituted. Corrective action will be initiated within 24 hours.
5. In the event of a major malfunction which may result in unsafe conditions or a radiation hazard, the G.S.I. emergency procedure, #1, will be put into effect immediately.
6. All action taken will be recorded in the Daily Check Form.
7. All entries in the Daily Check Form will be initiated by the individual making the entry.

II. The following operations as listed on the Quarterly Check Form will be performed at 3 month intervals. In each instance, the manual provided by the manufacturer of the exposure device will be used as a guide to perform these operations:

- A. Examine source and drive cable for wear and/or damage.
- B. Examine source and drive cable tube for wear and/or damage.
- C. Examine the source & drive cable tube connectors for wear and/or damage.
- D. Inspect the inside of the source tube for rust, dirt, or sludge build up.
- E. Inspect all mating components for wear, damage and proper connections.
- F. The cable drive gear box will be inspected for damage, wear, and lubricant. The condition of all required labels will be checked.
- G. All of the above inspections will be noted in the respective area in the Quarterly Check Form.
- H. The checks may be performed by a radiographer or a supervisor or the safety officer. All notations in the Quarterly Check Form will be signed.
- I. The above are preventive maintenance steps to ascertain deterioration of the radiation exposure device through regular production use, before it can create a radiation hazard or unsafe condition. Indications of deterioration noted on the Quarterly Check Forms will dictate the following steps:
 1. Supervisor will be notified by individual performing the check.

2. The condition will be evaluated by the supervisor or Safety Officer.
3. Any condition that requires corrective action will be reported to the G.S.I. Mechanical Repair Supervisor within 24 hrs.
4. All action taken will be noted on the Quarterly Check Form and signed by radiographer, supervisor or Safety Officer.

III. The following operations will be performed at 6 month intervals as noted on the Six Month Check Form. These checks will be made by mechanical repair department crafts in the presence of a radiographer, his supervisor, or the Radiation Safety Officer.

- A. The door locks on small door used by personnel and the large door used to bring in castings will be inspected and their condition noted in Item 1 of the Six Month Check Form.
- B. In the presence of a radiographer, his supervisor, or the Radiation Safety Officer, an inspection will be made to ascertain if all visible and audible warning devices are functioning properly. Conditions will be noted in the Six Month Check Form, in Item 2.
- C. This inspection will not include a calibration of radiation level monitoring equipment. This equipment is calibrated and documented as outlined elsewhere in the approved G.S.I. license application.
- D. All operations will be recorded in the Six Month Check Form and signed by the inspector.
- E. Any malfunction of area safeguards will be reported immediately to the Radiation Safety Officer. Corrective action will begin immediately.
- F. All action taken will be recorded in the Six Month Check Form and signed off by the Supervisor or Radiation Safety Officer.

IV. It is especially noted here that Items I, II, and III are all additional steps to be taken to conform to the 1970 amendments to Title 10. In no way are they to be interpreted to rescind or supercede any other section of the G.S.I. license.

The radiographer will continue to maintain his usual daily vigilance at all times.

V. Three forms are attached to and become a part of this procedure:

1. Daily Check Form
2. Quarterly Check Form
3. Six Month Check Form

VI. If as a result of these inspection and maintenance procedures the Co⁶⁰ source is exposed creating a radiation hazard, Emergency Operation Procedure #1 will be placed in effect immediately.

DAILY CHECK FORM

Operation to be Performed Week of _____ 19__	Mon.	Tue.	Wed.	Thur.	Fr.	Sat.	
1. Damage to the exp. device which may impair its operation.							
2. Proper position of source inside the shield.							
3. Operation of locking mechanism.							
4. Changes in operating characteristics.							
5. Operation of source position indicator.							
6. Operation of the crank mechanism.							

Action taken on above noted malfunctions:

QUARTERLY CHECK FORM

Operation to be Performed	Feb. 15 19 ____	Mar. 15 19 ____	Aug. 15 19 ____	Nov. 15 19 ____
1. Source and drive cable wear or damage.				
2. Source and drive cable tube wear or damage.				
3. Source and drive cable tube connectors wear or damage.				
4. Rust, dirt, or sludge build up in the source tube.				
5. Mating components connections.				
6. Cable drive gear box damage or wear and proper labeling.				

Action taken on above noted malfunctions:

SIX MONTH CHECK FORM

Operation to be Performed	Nov. 15 19 _____	May 15 19 _____
<p>I. Door Interlocks</p> <p>A. Small door</p> <p>B. Large door</p> <p>II. Visual warning devices</p> <p>A. Small door red lights</p> <p>B. Big door " "</p> <p>C. Radiation monitor red lights</p> <p>D. Exterior, Bldg. " "</p> <p>E. " " warning signs</p> <p>III. Audible warning devices</p> <p>A. Radiation monitor horn</p>		

Action to be taken on above noted malfunctions:

Section 6 (e) Page 67

6 (f) RADIOGRAPHERS TRAINING PROGRAM

1. Narrative Description
2. Initial Training
3. Refresher Training
4. Periodic Training
5. Sample Test Attachments
6. Radiographer Evaluation Form
7. Initial Training Bibliography
8. Test and Exam Schedule

NARRATIVE DESCRIPTION OF GSI TRAINING PROGRAM

At General Steel Industries, radiographers are members of the C.I.O. Bargaining Unit. They are on a seniority list with other N. D. T. classifications and are on the high end of the salary range. As such, no new people can be hired as radiographers. They all move up a line of progression by seniority. All radiographers have had prior experience in the N. D. T. area including operation of the 25 MEV Betatron. We do not include radiographer assistants as defined by the A. E. C. in the isotope work.

By contract agreement with the Union, we have a work classification of radiographer's assistant. This classification is a "helper" and works with the radiographer whether he is working with isotopes or the Betatron. He does not do any work described in 10 CFR34 and cannot therefore be defined as an assistant radiographer by A. E. C. rules and regulations. His work is primarily in the dark room, helping move and locate the 20 to 40 ton castings being radiographed and the preparation of film cassettes.

Under these conditions, the training program consists of only (a) in paragraph 3, Appendix G of A. E. C. Licensing Guide dated November, 1970.

A radiographer is selected from the NDT seniority list in conformance with Union Management contract agreement. He (or she) will have had 1-5 years general experience with one of these years in the Betatron field or in the radiographer assistant (helper) classification.

The prospective radiographer is given 20 hours of formal lecture and lab work as outlined under the classroom training section which covers all items listed in Appendix A, Part 34. A text book entitled "Radiation Health Physics" was prepared by the GSI staff for home study and a classroom supplement. A copy is enclosed with this license application. The class is conducted by the Radiation Safety Officer. The GSI Safety Director attends or assists and the GSI Insurance Agency has furnished literature at these classes.

Actual operation of safety equipment, monitoring and surveying equipment and exposure devices are included in the lab work. A typical quiz and a final exam are attached as At1 and At2. He is then assigned to a radiographer for the "on the job" training and evaluated on "Radiographer Evaluation Form, At3. At this point, he is either approved by the Radiation Safety Officer, required to take additional training, or disqualified.

Refresher or periodic training falls into one of two categories. When and if any new equipment is purchased or any new rules and regulations are printed by A. E. C. or State Board of Health or when any changes are made in procedure, all radiographers are educated to the new requirements. The very nature of these types of changes makes additional training necessary.

The second category is in maintaining proficiency with present methods and procedures. A four (4) hour class session will be conducted at 1 year intervals. Prior to this class, a questionnaire is distributed to the radiographers (At4). Based on these answers, areas of uncertainty and lack of knowledge will be discovered and used for establishing the level of class discussion. At the end of the class, a short test will be given covering the items discussed in the class. A sample test is At5. Due to the nature of this type of refresher school, no two tests will be alike. A level of 80% of their original test grade on each radiographer's first school test is required. See At6.

INITIAL TRAINING PROGRAM - G. S. I. CASTINGS DIVISION, GRANITE CITY

Conducted by: Radiation Safety Officer

Assisted by: Safety Dept. Personnel
(if necessary) NDT Supervisors
NDT Radiographers
Outside sources if required

	<u>Test Evaluation Criteria</u>
I. Fundamentals of Radiation Safety	
A. Radiation - 2 hours	
1. atomic structure	1. GSI Text
2. isotope and radiation	2. General College Chemistry & Physics
3. alpha, beta and gamma	3. NDT handbook by Robert McMasters
4. interaction with matter	
5. x-radiation and gamma radiation	
B. Glossary - 2 hours	AEC & Government Literature
1. terms - lear them first	
2. significance and explanation of	
C. Radiation Levels - 1 hour	AEC Title 10, Parts 20 and 34
1. unrestricted area, define, explain dangers in	
2. radiation area, define, explain dangers in	
3. high radiation area, define, explain dangers in	
D. Health Hazards from Radiation - 1 hour	AEC & Government literature, GSI text, Argonne National Laboratory Literature
1. whole body effects	
2. reversibility and irreversibility	
3. skin effect	
4. reproductive organs - genetics and future generations	
5. effect on blood	
E. Methods of Controlling Radiation Dosage - 1 hour	College physics texts, Budd Co. & St. Louis Testing School Literature
1. time	
a. equations	
b. explanation	
2. distance	
a. equations	
b. explanation	
3. shielding	
a. equations, charts and graphs	
b. absorption factors	
c. half value layers	

II. Radiati Detection Instruments - 1 hour

1 Manufacturers Data
and Informational
Sheets

A. Radiation Detection Instruments

1. Nucor CS 40A survey meter
 - a. principle of operation
 - b. operation technique
 - c. limitations
 - d. calibration
2. Film Badge
 - a. principle of
 - b. use of
 - c. limitations
3. Victoreen Minometer and Pocket Chambers
 - a. principle of
 - b. use of
 - c. limitations

B. Survey Techniques - 1 hour

1. General
 - a. background and its significance
 - b. equations
2. Our Operation at GSI
 - a. technique
 - b. documentation and records
3. Quiz

Title 10, Parts 20 & 34
Budd Co. & St. Louis
Testing School Texts
Government Literature
GSI License Application
GSI Operational Procedures

III. Radiographic Equipment - 1 hour

Manufacturers
Literature, GSI License
Application, GSI
Operational Procedures,
Title 10, Parts 20 & 34

A. Exposure Devices

1. Diagrams
 - a. explanation
 - b. limitations
 - c. advantages
2. Operation of
 - a. theory
 - b. our procedure
3. Storage Container
 - a. requirements
 - b. qualifications of Devices
 - c. A. E. C. requirements

- IV. Procedure - 3 hours
- GSI Operational
Procedures, GSI
License Application
- A. Regular Operation Procedure
1. review step by step
 2. explanation of
- B. Emergency Operating Procedures
1. review step by step
 2. explanation of
- V. A. E. C. Regulations - 2 hours
- Title 10, Part 20 & 34
& Amendments
- A. Title 10, Part 20
1. review
 2. explain
- B. Title 10, Part 34
1. review
 2. explain
- C. Title 10, Amendments
1. review
 2. explain
- VI. Review - 3 hours
- VII. Examination - 2 hours
- VIII. Equipment and Operation Of in the Radiographic Installation Itself.
Evaluations Made From Observations Of Each Individual by Radiation
Safety Officer.
- A. Exposure Devices
1. Actual operation of, by each individual until he becomes
proficient in its operation.
 2. Actual recording of any and all records required by A. E. C.
and GSI.
- B. CS 40A Survey Meter
1. Actual operation of, by each individual until he becomes
proficient in its operation.
 2. Actual recording of any and all records required by A. E. C. & GSI.

C. Pocket Chamber and Minometer

1. Actual operation of, by each individual until he becomes proficient in its operation.
2. Actual recording of any and all records required by A. E. C. and G. S. I.

D. Film Badge

1. Actual practice and full explanation of procedure of receipt, use and mailing to Badge Service Company.

IX. Two weeks on the job training with a qualified radiographer. Include 1 day or 8 observations and 8-9 days (2 weeks total) or 12 operations whichever is larger.

X. Evaluations utilizing Radiographer Evaluation Form (at 3) are made by the Radiation Safety Office.

REFRESHER TRAINING PROGRAM

- I. At yearly intervals, information tests will be given to all radiographers. (At 4)
- II. Tests will be graded and filed.
- III. A four (4) hour class will be set up to cover the areas discovered by the informational test in which the radiographers are deficient. A test grade 80% or higher of this original test grade will indicate continued proficiency. Less than this will require refresher training only for those radiographers making the low grades. A second successive low grade will result in disqualification.
- IV. A final test will be given, graded, and filed. (At 5)
- V. Page 2 of the Radiographer Evaluation Form (At 3) will be used to summarize the individual radiographer educational history.

PERIODIC TRAINING PROGRAM

Periodic training involves possible changes in equipment, technique, procedure, A. E. C. regulations and any changes in the overall radiography program at GSI. These changes by their nature will make it mandatory that all radiographers, supervisors, or management personnel be either notified or educated. It may be as simple as a notice such as the following is placed on the radiographer's bulletin board. "Effective September 28, 1971, Robert W. Ripley is the new Radiation Safety Officer with offices in the Betatron Building."

It may involve a 1 to 4 hour special class for more detailed education and discussion of new procedures such as was involved with the December, 1970 amendment to Title 10.

If a class is required, a quiz of some type depending on the subject matter and/or on the job training will be given. Results will be filed and summarized on Page 2 of Radiographer Evaluation Form (At3)

AT #1

INITIAL TRAINING QUIZ

SAMPLE

SAMPLE TEST

1. A 10 curie cobalt source is to be used in the center of a 20 ft. square room constructed with 24 inch concrete walls. What is the radiation intensity at the outside wall? Use 3' as H. V. L. of concrete and 14,000 mr/hr/curie at 1 foot.

2. If a survey meter shows a 2 mr/hour gamma radiation level from Co-60 and a man is in this area for 2 hours, what radiation dosage will he receive?

3. If the Nucor survey meter reads 3 mr/hr and the range scale pointer is on 100X, what is the radiation level? IX? 1000?

4. Radiation Exposure Dosage may be reduced by three methods. What are they?

5. Explain the term 5 (N-18).

6. What are the 3 primary parts of an atom?

7. List everything you can from the expression 27 Co-59.

8. Describe or define alpha, beta and gamma radiation.

9. Granite City, Illinois is in regional office area number _____
with operation offices in _____

10. Define to the best of your ability -

a. H. V. L.

b. isotope

c. half life

d. background radiation

e. curie

ANSWERS

1. Use the inverse square law $\frac{I_1}{I_2} = \frac{d_2^2}{d_1^2}$

$$I_1 = 10 \times 14,400 = 144000 \text{ mr/hr}$$

$$I_2 = x \text{ (unknown intensity)}$$

$$d_1 = 1 \text{ foot } d_1^2 = 1 \times 1 = 1$$

$$d_2 = 12' d_2^2 = 12 \times 12 = 144$$

144000	=	144
x	=	1
144x	=	144000
x	=	1000 mr/hr at 12 feet with no shielding

24" of concrete = $24 \div 3 = 8 \text{ H. V. L.}$

$$1/2 \times 1/2 \times 1/2 \times 1/2 \times 1/2 \times 1/2 \times 1/2 \times 1/2 = 1/256$$

1000 mr/hr $\div 256 = 3.9 \text{ mr/h}$ 2 feet with 24" of concrete shielding.
2. $2 \times 2 = 4 \text{ mr. or mrems}$
3. 300 mr/hr, 3 mr/hr 3000 mr/hr or 3R/hr
4. Time, distance, shielding
5. N = age at last birthday, age minus 18 times 5 equals the individual dosage allowed. It is used with the AEC-4 form to calculate accumulated occupational dosage.
6. electrons, protons, neutrons
7. 27 is the atomic number, 59 is the mass number Co is the element (cobalt). It has 27 electrons, 27 protons, and 32 neutrons.
8. Alpha particles, ejected from the nucleus, have low penetrating power, are positive in nature.

Beta particles are more penetrating than alpha, it may vary with its energy, are negative in nature.

Gamma is non particle, electromagnetic waves of varying wave length energy, most penetrating, similar to x-rays.

10. (H. V. L.) The thickness of a material required to reduce radiation by one half.

(Isotope) Atoms with the same chemical properties with the same number of electrons and protons but a different number of neutrons.

(Half life) The period of time required for an isotope to decay to 1/2 of its intensity.

(Background radiation) Radiation from the normal environment exclusive of any source radiation.

(Curie) A measure of the amount of quantity of radioactive material. It is also a unit of disintegration rate, 3.7×10^{10} disintegration/sec.

ATTACHMENT # 2
INITIAL TRAINING FINAL EXAM
(SAMPLE)

A. E. C. - Test # 1

1. What is the utilization log?
2. At what distances do you survey the exposure device and what levels of radiation are allowed at these distances for the 80 curie source?
For the small Co60 source?
3. How often must the survey meter be calibrated?
4. How often must we have a leak test?
5. Where are copies of the operating procedure and emergency procedures kept?
6. What are (2) personnel monitoring devices that are required by the A. E. C. for radiographers to wear?
7. Radiation levels are measured in terms of _____ dosage in terms of _____.
8. What is a curie?
9. Of the (3) types of radiation, alpha, beta, and gamma, which is the most dangerous? Most penetrating? Which is electromagnetic in nature? Which is particle in nature?
10. What is form A. E. C. -3?
11. What is form A. E. C. -4?
12. Where are copies of the G. S. I. licensee application kept?
13. If you go into the radiation room on a Monday morning and the source is missing, what would you do? What should the licensee (G. S. I.) do?
14. What are the (3) ways of reducing levels of radiation?
15. A 10 curie source is used in the center of a 20 foot square room constructed with 24" concrete walls. What is the radiation intensity at the outside surface of the room? (24" concrete - 8 half value layers) (Use 14,400 mr/hr 1 foot for 1 curie of cobalt.)

A. E. C. - Test # 1
Answer Sheet

1. A log of each day's operation and radiation surveys; it is required by A. E. C. regulations.
2. 1 meter - 10 mr/hr or 200 mr/hr at the exterior surface
50 mr/hr at 6 inches
3. Every three months maximum.
4. Every six months maximum.
5. In the Control Room and in Radiation Safety Officer's office.
6. Pocket chamber or dosimeter and film badges.
7. roentgens dosage in terms of rems.
8. A measurement of the amount of radiation; it's a rate of decay or 3.7×10^{10} disintegrations/second.
9. (a) each, under different conditions
(b) gamma
(c) gamma
(d) alpha and beta
10. Notice to employees, lists regional offices.
11. Form on which total dose is accumulated.
12. In the Control Room and in the Radiation Safety Officer's Office.
13. 1) follow emergency procedure
2) telephone or telegraph regional office immediately
3) written report within 30 days to Washington office.

14. time, distance, shielding

15.
$$\frac{x}{144000 \text{mr/hr}} = \frac{1^2}{12^2} = 1000 \text{mr/hr (approx.)}$$

$$\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{256}$$

$$1000 \text{mr/hr} \div 256 = 3.9 \text{ mr/hr}$$

A. E. C. - Test # 1

Part II

1. What part of an atom determines its chemical combining properties?
Its elemental identity?
2. What does the atomic number signify?
3. What does the mass number signify?
4. Write all you can from the expression ${}_{28}^{60}\text{Co}$.
5. Gamma radiation comes from what part of an atom? The beta particle?
6. Name two forms of interaction of electromagnetic radiation with matter.
7. The penetrating power of gamma radiation is determined by its _____.
8. One curie of Co^{60} emits _____ per hour at _____ feet with an energy of 1.5 M. E. V.; at the end of one half life it emits _____ per hour at _____ feet with an energy of _____ M. E. V.
9. How many half lifes may our source go through before we have to stop using it? Why?
10. What is reversibility?
11. What is the first visible body indication of an over-exposure to radiation?
12. List in order of their penetrating power: gamma, alpha, and beta radiation.
13. What are the three methods of reducing exposure to radiation available to the radiographer?
14. Under what conditions may a radiographer wear another individual's film badge?
15. What do the numbers 10X & 1000X on the CS40A survey meter mean? If the scale needle indicates 3 mr/hr, what is the radiation intensity if the selector switch is set on 1X? 100X? 1000X?
16. Name and explain (2) weaknesses inherent in the pocket dosimeter? How do you compensate for these?

- 17. How many radiation surveys are made during an 8 hour day in the No. 6 Building cage?
- 18. There are three isotopes of hydrogen. How many are radioactive?
- 19. The pocket dosimeters we use detect gamma rays; how good are they for detection of alpha and beta? Why?
- 20. Co^{60} decays to _____. It emits _____ per _____ at _____ feet. Its half life is _____. It emits _____ radiation and _____ particles.

A. E. C. - Test # 1
Part II
Answer Sheet

1. orbital electrons
protons in nucleus
2. the number of orbital electrons, number of protons
3. the number of neutrons and protons in the nucleus
4. It is cobalt. Atomic number 28.
28 electrons. Mass number 60.
28 protons
32 neutrons
If it is cobalt, the atomic number should be 27.
5. nucleus
nucleus
6. Compton effect; photo electron effect: ion pair production,
Bremstrahlung effect.
7. energy
8. $\frac{14,400 \text{ mr}}{7,200 \text{ mr}}$ per hour at $\frac{\text{one}}{\text{one}}$ feet
energy of 1.5 M. E. V.
9. 1, 2, 3; it's a matter of economics.
10. ability of body cells to rebuild or repair themselves
11. redness of skin
12. gamma, beta, alpha
13. time, distance, shielding
14. none
15. multiplication factor
3 300 3,000

16. (1) Easily discharged by accident, requires separate measuring instrument, or you cannot extrapolate "off scale" readings.
(2) Be careful, frequent readings and use of film badge.
17. Depends on number of exposures, but there will be a minimum of two (entrance and final).
18. One
19. None, the alpha and beta particles will not penetrate the chamber walls.
20. nickel 14,400 mr hr/curie one feet 5.3 years
gamma radiation beta particles

ATTACHMENT # 4
RADIOGRAPHIC INFORMATIONAL TEST
(SAMPLE)

Information Test for Radiographers

1. Define "occupational dose."
2. What does "radiation" mean?
3. What is a "restricted area"?
4. What is "Source Material"?
5. What is meant by "survey"?
6. Define "rad."
7. Define "rem."
8. Define "dose."
9. Define "curie."
10. Who is permitted to make interpretations of regulation meanings?
11. Communications and reports are made to which office of the A. E. C. ?
12. What is the permissible dosage of an individual in a restricted area?
13. What exceptions are there to the stated permissible dosage?
14. What is meant by "accumulated dose"?
15. What information is obtained on Form AEC-4?
16. How are airborne radioactive material limits determined?
17. What restrictions are placed on minors regarding radioactive materials?
18. What restrictions are enforced for radiation levels in unrestricted areas?
19. Concentrations of radioactive materials in effluents are governed in which manner?
20. What are the restrictions in the medical applications of radiation?

21. How are bio-assays used in the regulations?
22. How does a "high radiation area" differ from a "radiation area"?
23. Describe a radiation symbol.
24. What 4 caution signs are designated by the regulations?
25. Is it necessary to label containers of radioactive material in a radiation area?
26. Is it necessary to post the A. E. C. regulations for licensed establishments?
27. Is it necessary to supply radiation exposure reports to employees in restricted areas?
28. What are the two basic instruction areas for personnel as stated by the regulations?
29. Is any authorization required for disposal of licensed material?
30. Can licensed material be disposed of by releasing it into sanitary sewers?
31. What is the common method of disposal of licensed material?
32. How shall Form AEC-5 be used?
33. What procedure should be followed if licensed material is missing?
34. Notification of an incident must be made to the A. E. C. in what period of time?
35. What radiation report can be requested by an employee?
36. At termination of employment, what report should be requested by an individual?
37. Define radiographer.
38. What is accomplished by a "leak test"?
39. What three types of training are required for a radiographer?
40. What are the radiation limits adjacent to the radiographer exposure devices?
41. Is it required that exposure devices be locked?

42. How often must radiation survey instruments be calibrated?
43. How frequently must a source be leak tested?
44. How frequently must source material be inventoried?
45. What is the purpose of the utilization log?
46. How frequently must a radiation survey be made?
47. Is it necessary to have direct surveillance of radiography by a radiographer?
48. What monitoring equipment is required in performing radiography?
49. Is it necessary to have written instructions for operating procedures?
50. Is it necessary to refer unusual equipment or operating conditions to the Radiation Safety Officer?

Information Test for Radiographers
Answer Sheet

1. The quantity of radiation absorbed by the body or any portion thereof excluding medical x-rays or therapy.
2. Alpha, beta, gamma, x-rays, including x radiation from the Betatron, but not including sonic or radio waves or visible or invisible light.
3. Any area, access to which is controlled by the licensee for purposes of protection to individuals from exposure to radiation from radioactive material.
4. Uranium or thorium, combinations thereof and in any physical or chemical form.
5. A tour through an area with a survey meter to evaluate and determine radiation levels or hazards.
6. A measure of the dose of any ionizing radiation to the body in terms of energy absorbed.
7. A measure of the dose of any ionizing radiation to the body in terms of biological effect relative to a dose of 1 r of x ray. In our facility, rem, rod, and r are the same.
8. "Dose" is the amount of radiation absorbed by the body or parts thereof.
9. A measure of the amount of radioactive material or a measurement of disintegration per unit of time.
10. A written interpretation by the General Counsel is recognized by the Commission.
11. Washington, D. C. or office listed on AEC-3 forms.
12. 1.25 rems/quarter whole body, or 3 rems/quarter when the 5(N-18) paragraph is used together with an AEC-4 form preferably filled out.
13. Due to repeated lowering of maximum permissible dosage, an AEC-4 form may result in a higher dose permitted after January 1, 1961. The excess may be ignored.

14. The total lifetime dosage of an individual.
15.
 - (1) radiation received from former employments
 - (2) correct age
 - (3) total dose to date
 - (4) additional dose permitted 5(N-18)
16. Not discussed at lecture or educational classes.
The question is thrown in to evaluate extent of extra reading or interest by the individual.
17.
 - (1) no exposure to airborne radiation
 - (2) a dosage of 10% or less of adult dose in a restricted area
18. Average radiation levels and occupancy factors calculated so no individual receives a dose in excess of .5 rem/year. If included in license application; otherwise 2 millirems per hour or 100 millirems/7 day week is maximum.
19. This question is not specific to our facility; answers are used to determine extent of radiographer's extra reading or study.
20. A. E. C. does not limit or regulate an individual's exposure to medical radiation.
21. This question is not specific to our facility; answers are used to determine extent of radiographer's extra reading or study.
22. In the level of radiation, posting requirements, entrance and surveillance requirements.
23. A yellow background, purple or magenta symbol. Symbol is a small central circle surrounded with three segments of a larger circle, at alternate 60°.
24.
 - (1) radiation symbol
 - (2) radiation area
 - (3) high radiation area
 - (4) storage container signs
25. It is not always required by A. E. C. regulations. For our facility it is always required.
26. Yes
27. Not always, but for our facility it is required.

28. (1) notification, posting and instruction of radiation area
(2) post regulation AEC-3
29. Yes
30. Under certain conditions it may.
31. Burial at sea or underground.
32. As a record of individual exposure to radiation.
33. Report to Regional Office by telephone or telegraph immediately; written report to Washington within 30 days; follow emergency operating procedure.
34. Follow emergency operating procedure. Immediately notify Regional Office by telephone or telegraph or a 24-hour notification period depending on degree of radiation hazard.
35. A summary of his individual radiation exposure history.
36. A full report of his or her exposure dosage while employed at that facility.
37. One who personally conducts or supervises radiographic operations and is responsible to the licensee for compliance to regulations and license conditions.
38. A check on condition of source; has any of it been scraped or rubbed off and thus contaminate the area?
39. original, refresher, periodic as new equipment or procedures are adopted, on the job.
40. 80 curie device 10/mr/hr at one meter
.5 " " 50/mr/hr at 6 inches
41. Yes, when not in use.
42. Every three months, maximum.
43. Six-month intervals.
44. Quarterly.
45. A record of each use of a source, who used it, and survey records made.

46. Before starting a shift, before each entrance into an exposure area, and after completing a shift or series of exposures.
47. Yes
48. A survey meter, film badge, pocket chamber dosimeter, and stationary monitoring device.
49. Yes
50. Yes

AT #5
REFRESHER TRAINING TEST

REFRESHER TRAINING TEST

1. What are three ways of reducing levels of radiation?
2. How often must the survey meter be calibrated?
3. Explain 5(N-18)
4. Distinguish between half value layer, half life.
5. At what distance are we to survey the 80 curie source? What is the maximum level of radiation permitted? What are the origins of these rules?
6. Where do we discard radioactive isotopes when we are through with them and buy a new replacement?
7. What is AEC 5?

8. Define Radiographer.

9. When can the door going into the control room in the betatron be unlocked?

10. Have you read the latest license application?
Have you read the latest operating procedure?

11. Define rem., curie, roentgen.

12. In case of emergency the radiographer is to call the Radiation Safety Officer or an alternate. Who are the R.S.O. and the three alternates?

13. What are the personnel monitoring devices worn by the radiographer? Who requires this?

14. What is leak test?

15. On the attached blank page write an essay on our radiography set up from any angle you select. It may be complimentary, objective, critical, but make it thoughtful and original.

ANSWERS

1. Time, distance, shielding
2. Every 90 days.
3. $N = \text{age at last birthday, age minus 18 times 5}$ equals the individual dosage allowed. It is used in conjunction with AEC-4 for calculating accumulated occupational dose.
4. Half value layer is the thickness of a material that is required to reduce radiation by one half.

Half Life is the period of time required for an isotope to decay to the point at which its intensity is reduced by one half.

5. A distance of one meter; 10 mr/hr, part 34 title 10 AEC rules and regulations.
6. Turn them in to the supplier of the new one if he has license for disposal.
7. A record of each individuals exposure to radiation.
8. An individual who performs radiographic operation uses radiographic exposure devices, sources and handling thereof, is responsible to the licensee for compliance with AEC regulations.
9. Only when someone is authorized to enter or leave
10. Yes Yes
11. A measure of the dose of radiation in terms of biological effect relative to a dose of one roentgen.

A curie is a measure of the amount of radioactive material; a measure of the amount of disintegrators per unit of time; or one curie equals 3.7×10^{10} disintegrations per second.

The roentgen is a unit of radiation intensity a measure of the ionization of air.

12. Robert Ripley; W. Rapp; P. Wells or John Abbott.

13. Pocket dosimeter, film badge, AEC
14. A smear taken at critical areas of the exposure device to be tested to see if any part of the source has been physically worn. The smear will pick up the worn traces, if any.
15. No answer for this one, almost any answer will get some credit based on content, attitude and originality.

ATTACHMENT # 3
RADIOGRAPHER EVALUATION FORM

RADIOGRAPHER'S TRAINING EVALUATION FORM

NAME _____ AGE _____ DATE _____

- 1. Quiz Grade _____
- 2. Final Exam Grade _____
- 3. Participation during lecture course _____

Comments _____

4. Proficiency at the end of two weeks in operation of:

	<u>Satis- factory</u>	<u>Unsatis- factory</u>
(a) Budd Co. Unitrons	_____	_____
(b) Radionic Camera Model P60-100-2	_____	_____
(c) CS-40 A Survey Meter	_____	_____
(d) Victoreen Minometer & Pocket Chamber	_____	_____
(e) GSI Operating Procedure	_____	_____
(f) Simulated Emergency Procedure Number 1	_____	_____
Number 2	_____	_____
(g) Utilization Log	_____	_____
(h) Personnel Monitoring Records	_____	_____
(i) Inspection & Maintenance Logs	_____	_____

5. Comments _____

6. Recommendations:

- (a) Additional two weeks "on-the-job training" _____
- (b) Additional academic knowledge _____

(c) Qualifies as Radiographer _____

(d) Disqualified _____

SIGNED _____

TRAINEE

RADIATION PROTECTION OFFICER

RADIOGRAPHER'S TRAINING EVALUATION FORM (CONTINUED)

Test	Test Date	Test Grade	Comments	R. S. O. Initials
Initial Training				
Final Exam				
Refresher Test				
Refresher Test				
Refresher Test				
Refresher Test				
Refresher Test				
Refresher Test				
Refresher Test				
Refresher Test				
Refresher Test				
Refresher Test				
Refresher Test				
Periodic Training				
Periodic Training				
Periodic Training				

1. Refresher test given each year.
2. Periodic training as necessary when new equipment, new procedures, new A. E. C. regulations, or other events occur, making it mandatory that some form of training be given.

**INITIAL TRAINING TEXT BIBLIOGRAPHY
SUGGESTED LIST FOR FURTHER STUDY**

A 67-page text book has been written and issued to each student radiographer for out-of-class reading and study. The following bibliography was used as reference material for the preparation of this text. It is also a list the radiographer may use for outside reading on his own initiative.

BIBLIOGRAPHY

1. Radiation Health Physics Program Outline
Instruments Division, Budd Co.
2. Instruction Manual Model 110A Unitron
Instruments Division, Budd Co.
3. Instruction Manual Nucor CS-40A Survey Meter
Nuclear Corp. of America
4. Measurements of Radioactivity
National Bureau of Standards
U. S. Government Printing Office
5. Los Alamos Handbook of Radiation Monitoring
Los Alamos Scientific Laboratory
U. S. Government Printing Office
6. Protection Against Radiation from Radium Cobalt 60 and Cesium 137
National Bureau of Standards
U. S. Government Printing Office
7. Radiological Monitoring Methods & Instruments
National Bureau of Standards
U. S. Government Printing Office
8. Protection Against Radiation from Sealed Gamma Sources
National Bureau of Standards
U. S. Government Printing Office
9. The Tolerance Dose
S. T. Cantril, M. D.
H. M. Parker
Argonne National Laboratory

10. The effects of Irradiation on the Blood & Blood Forming Tissues
S. T. Cantril
I. Jacobson
J. J. Nickson
Argonne National Laboratory
11. Radioactive Isotopes as Source in Industrial Radiography
Gerald H. Tenney
Los Alamos Scientific Laboratory
12. The Lethal Effects of Radiation
Edward Speena, Ph. D.
Scientific American
13. General College Chemistry
L. B. Richardson
A. J. Seanlett
Henry Holt & Co.
14. Background Information on the 25 Million Betatron Volt
Allis Chalmers Mfg. Co.
15. 25 Million Volt Betatron Manual
Allis Chalmers Mfg. Co.
16. The Use of Cobalt 60 for Industrial Radiography
A. Morrison
Physics Division
National Research Council of Canada
17. Radiation Physics & Bomb Phenomenology
U. S. Government Printing Office
18. Concrete as a Protective Barrier for Gamma Rays from Cobalt 60
R. J. Kennedy
H. O. Wyckoff
W. H. Snyder
National Bureau of Standards
U. S. Government Printing Office
19. Title 10 Atomic Energy Part 20 Standards for Protection Against Radiation
Code of Federal Regulations
20. Title 10 Atomic Energy Part 30 Licensing of Byproduct Material
Code of Federal Regulations
21. Title 10 Atomic Energy Part 31 Radiation Safety Requirements for
Radiographic Operation
Code of Federal Regulations

22. **Electron & Nuclear Physics**
J. B. Hoag, Ph. D.
D. Van Nostrand Company, Inc.

23. **N. D. T. Handbook, Vol. 1 and 2**
Robert C. McMasters

TEST AND EXAM SCHEDULE

TEST AND EXAM SCHEDULE

1. Initial Training for Radiographers
 - At. #1 quiz each one different
 - At. #2 final exam same test each time, no radiographer will repeat this series of classes
2. Refresher Classes
 - At. #4 informational tests two basic tests, changed on alternate years
 - At. #5 refresher test changed each time
3. All attachments(At.) are samples only.
4. Records of above will be filed with the individual radiographer evaluation form; this includes the actual tests, and grades. A grade of 75% will be considered passing except for the 80% factor outlined under refresher training.
5. Evaluation of tests and exam answers will be based on information from appropriate sources as listed in the initial training course outline. References and additional informational sources are listed in the Bibliography (At. 6).
6. All training classes are organized and instructed by the Radiation Safety Officer who shall be approved by the AEC before assuming this responsibility. The present Radiation Safety Officer, Robert W. Ripley, is approved by the AEC.

7. The Safety Department assists by forwarding information on radiation and State and Federal Regulations that is obtained from all levels of government and the GSI insurance agency.
8. Any NDT supervisor who assists in these classes shall have training and knowledge equal or superior to the level required by the AEC for a radiographer.

5. (g) INTERNAL INSPECTION SYSTEM

OR OTHER MANAGEMENT CONTROL

(h) OVERALL ORGANIZATIONAL STRUCTURE

LINE OF AUTHORITY AND CONTROL

The Granite City Plant Management Control System was set up to assure management as well as the AEC that all AEC and Management regulations, provisions and operating procedures are known and followed by all personnel concerned.

The Control Group is headed by the President of the Castings Division of G. S. I. The Director of Quality Assurance reports to the President. The Manager of Quality Control is also the Radiation Safety Officer and reports to the Director of Quality Assurance at the time of this application. We do not wish to restrict the Radiation Safety Officer and the management position of Manager of Quality Control. It is conceivable that in the future one man would not have both responsibilities. The radiographers work directly under the supervision of salaried foremen who report to the Manager of Quality Control.

The Castings Division Comptroller reports to the Division President. His department operates independently of the Quality Assurance Group. He supervises the actions of an individual designated to maintain files relating to radiation safety, license conformance, quarterly inventories on announced basis and who operate a pull-out file for calibration of survey instruments. He has copies of the license application, AEC and management regulations and receives instructions in this application from the Radiation Safety Officer.

A third department involved is the Personnel Department. The Director of Personnel reports to the Works Manager who is responsible to the Division President. The Manager of Plant Safety reports to the Director of Personnel. He maintains liasons with the State Board of Health, GSI Insurance Agency and works with the Radiation Safety Officer in areas of radiation safety. He conducts at least two unannounced audits of the radiographic facilities and makes a report directly to the President of the Division, with copies to the Director of Personnel and the Radiation of Safety Office. Areas of weakness or non-conformance will be detected and corrected promptly by the Radiation Safety Officer himself or through the Maintenance and Repair Department. He also maintains copies of the license application and AEC rules and regulations.

QUALIFICATIONS

For a radiographic installation no larger than the one at GSI, the primary responsibility for radiographic safety and AEC compliance rests with the Radiation Safety Officer. Other individuals and departments are involved as a matter of cross checks and controls on the radiographic facility and the Radiation Safety Officer a direct access to the Division President is thus available.

The Radiation Safety Officer must submit his qualifications to the AEC and be approved before he can act in that capacity. His knowledge and training will be greater than that prescribed for the radiographer.

The Accounting Department representative responsible for record keeping and quarterly inventories is furnished with copies of the license application and 10CFR part 34, 20 and all AEC - GSI rules, regulations and amendments applicable to his duties. He does not participate in the formal training program provided radiographer. He and the Radiation Safety Officer study and discuss these rules, procedures and regulations until they are understood by the accounting representative.

The Manager of Safety is responsible for all aspects of Safety and State and Federal compliance for the Castings Division. In all matters of radiation safety, he works closely with the Radiation Safety Officer. He maintains copies of AEC rules and regulations, State Board of Health rules and regulations and our license application. He attends all of the training schools, initial periodic and refresher. As a responsible member of the management team he maintains a higher than average knowledge of radiation physics and safety.

6. (i) LEAK TESTING PROCEDURES

Leak tests are performed in accordance with Part 34, Section 34.25 by St. Louis Testing Laboratories, Inc., 2810 Clark, St. Louis, Missouri 63103. These tests are performed in compliance with AEC License #24-00188-03, expiration date February 28, 1974. A certification of the exposure device is submitted to GSI and a file is maintained for AEC inspection.

U. S. ATOMIC ENERGY COMMISSION
BYPRODUCT MATERIAL LICENSING
Supplementary Sheet

License Number 12-08271-01

Amendment No. 09

General Steel Industries, Inc.
1417 State Street
Granite City, Illinois 62040

License Number 12-08271-01 is hereby terminated.



For the U. S. Atomic Energy Commission

Original Signed by

[Signature]

Materials Branch

Directorate of Licensing
Washington, D. C. 20545

Date JAN 30 1974

[Handwritten signature]
1/30/74

by _____

[Handwritten signature]

2388

APPLICATION FOR RENEWAL
1972

AEC LICENSE #12-8271-1

RADIOGRAPHY WITH Co60

GENERAL STEEL INDUSTRIES, INC.
CASTINGS DIVISION