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APPLICATION FOR RENEWAL
1966
AEC LICENSE #12-8271-1
RADIOGRAPHY WITH CO-60
GENERAL STEEL INDUSTRIES, INC.

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A/23

Form AEC-313R
(9-62)

UNITED STATES ATOMIC ENERGY COMMISSION

APPLICATION FOR BYPRODUCT MATERIAL LICENSE— USE OF SEALED SOURCES IN RADIOGRAPHY

Form approved.
Budget Bureau No. 38-R157

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

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 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

4. SEALED SOURCES TO BE USED IN RADIOGRAPHY Budd assembly No. 300-041706(B)

BYPRODUCT MATERIAL (Element and Mass No.)	SOURCE MODEL NUMBER	NAME OF MANUFACTURER	MAXIMUM ACTIVITY PER SOURCE	NUMBER OF SOURCES
A. Co^{60}	A. C-374	A. Nuclear Consultants Corp.	A. 280 mc	A. one
B. Co^{60}	B. C-375	B.	B. 260 mc calibrated	B. one
C.	C.	C	C. 7-22-62	C.

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

MODEL NUMBER	NAME OF MANUFACTURER *(If custom made, attach complete design specification.)*
A. Unitron 110A Ser. #1116	A. Budd Company Instruments Division.
B. Unitron 110A Ser. #1117	B. Budd Company Instruments Division.
C.	C.

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

	Not Applicable	Attached	Previously Submitted
(a) Description of radiographic facilities (Instruction 6-a)	☐	☒	☐ on Jan. 21, 1965 (DATE)
(b) Description of radiation detection instruments to be used (Instruction 6-b)	☐	☒	☐ on Jan. 21, 1965 (DATE)
(c) Instrument calibration procedures (Instruction 6-c)	☐	☒	☐ on Jan. 21, 1965 (DATE)
(d) Personnel monitoring equipment (Instruction 6-d)	☐	☒	☐ on Jan. 21, 1965 (DATE)
(e) Operating and emergency procedures (Instruction 6-e)	☐	☒	☐ on Jan. 21, 1965 (DATE)
(f) Training program (Instruction 6-f)	☐	☒	☐ on Jan. 21, 1965 (DATE)
(g) Internal inspection system or other management control (Instruction 6-g)	☐	☒	☐ on Jan. 21, 1965 (DATE)
(h) Overall organizational structure (Instruction 6-h)	☐	☒	☐ on Jan. 21, 1965 (DATE)
(i) Leak testing procedures (Instruction 6-i)	☐	☒	☐ on Jan. 21, 1965 (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 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.

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General Steel Industries, Inc.
Applicant Named in Item 1

By: J. Dielpier

Works Manager
Title of Certifying Official

DATE April 26, 1966

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.

GENERAL STEEL INDUSTRIES, INC.

OFFICERS

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Granite City, Illinois 62040

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Vice President
1417 State Street
Granite City, Illinois 62040

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Vice President & Treasurer
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GENERAL STEEL INDUSTRIES, INC.

DIRECTORS

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St. Louis, Missouri 63132

Mr. Stuart W. Cragin
Chairman Credit Committee
Morgan Guaranty Trust Company
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Mr. Edwin S. Jones, Executive Vice Pres.
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St. Louis, Missouri 63102

Mr. Preston D. Law, President
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Mr. Henry B. Pflager
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314 North Broadway
St. Louis, Missouri 63102

Mr. Nicholas P. Veeder
Chairman of the Board & President
Granite City Steel Company
20th & State Streets
Granite City, Illinois 62040

Mr. Charles P. Whitehead
Chairman of the Finance Committee
General Steel Industries, Inc.
515 Olive Street
St. Louis, Missouri 63101

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MEMORANDUM TO: Mr. T. Ditchfield January 28, 1966

To conform with 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, Mr. H. B. Norris, 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, Mr. Norris again must be notified and his permission granted.

These instructions were originally sent to Messrs. Roddy and McMillin. Due to the changes in personnel and the continued use of CO-60, I thought it wise to reissue these instructions.

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.

H. B. Norris
Radiation Safety Officer

HBN:ten

cc: WED LFB(6) MWL ROC

6. (a) DESCRIPTION OF RADIOGRAPHIC FACILITIES

January 25, 1963

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 calibrated 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.

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

		sources in casting	sources on floor
A.	Seat of the crane operator	0.5 mr./hr.	1 mr./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 IX

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.

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

See attached drawing for the radiographic room. This room is 22 feet wide by 60 feet long and the walls are constructed of 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 Mr. Norris and the radiographers working under his supe[illegible] the keys. The building superintendent never goes into the room without first contacting Mr. Norris. 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 and measure 6 x 6 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 inaccessable to personnel being used to store drums of oil. The west wall faces a run way through which small [illegible] or tractors move castings, molds and other material. The closest work area is some 15 to [illegible] 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 [illegible] (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 castir it is placed nearly in the center o. ie room. If there are two (the maximum handled at any one time) they cannot both be centered of course which results in each being slightly closer to the side walls. Most work is done with the capsule inside the casting with the film placed on the outside. For this reason very small source to film distances (3 to 6 inches) are used and hence the reason for the small sources (300 mc each). This technique, with the source inside the casting results in considerable absorption of the radiation in the casting and hence results in much reduced radiation fields.

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

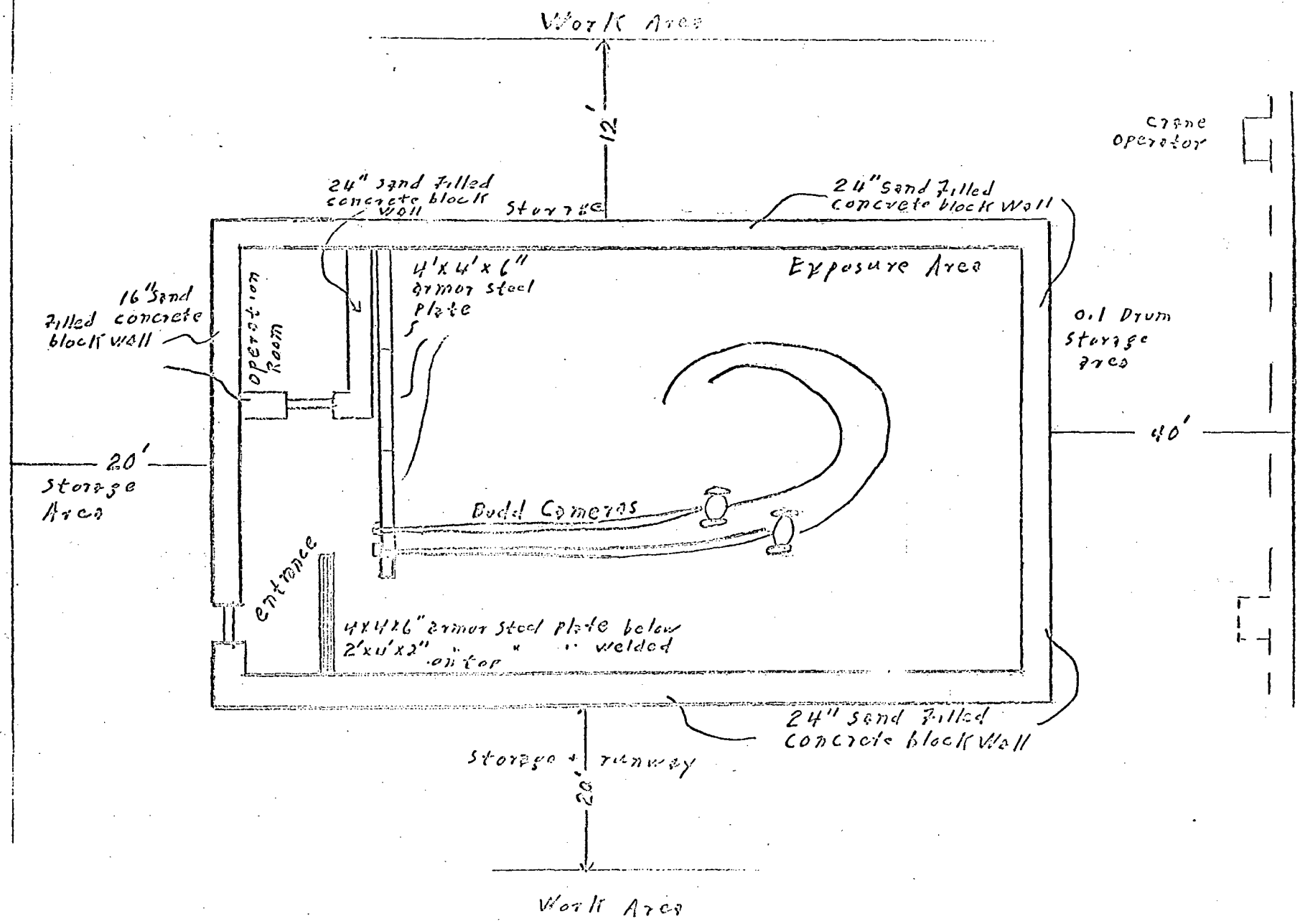
The operator of the radiographic units will be some 25 to 35 feet away from the exposed sources and will operate behind 4 inches of armor plate steel.

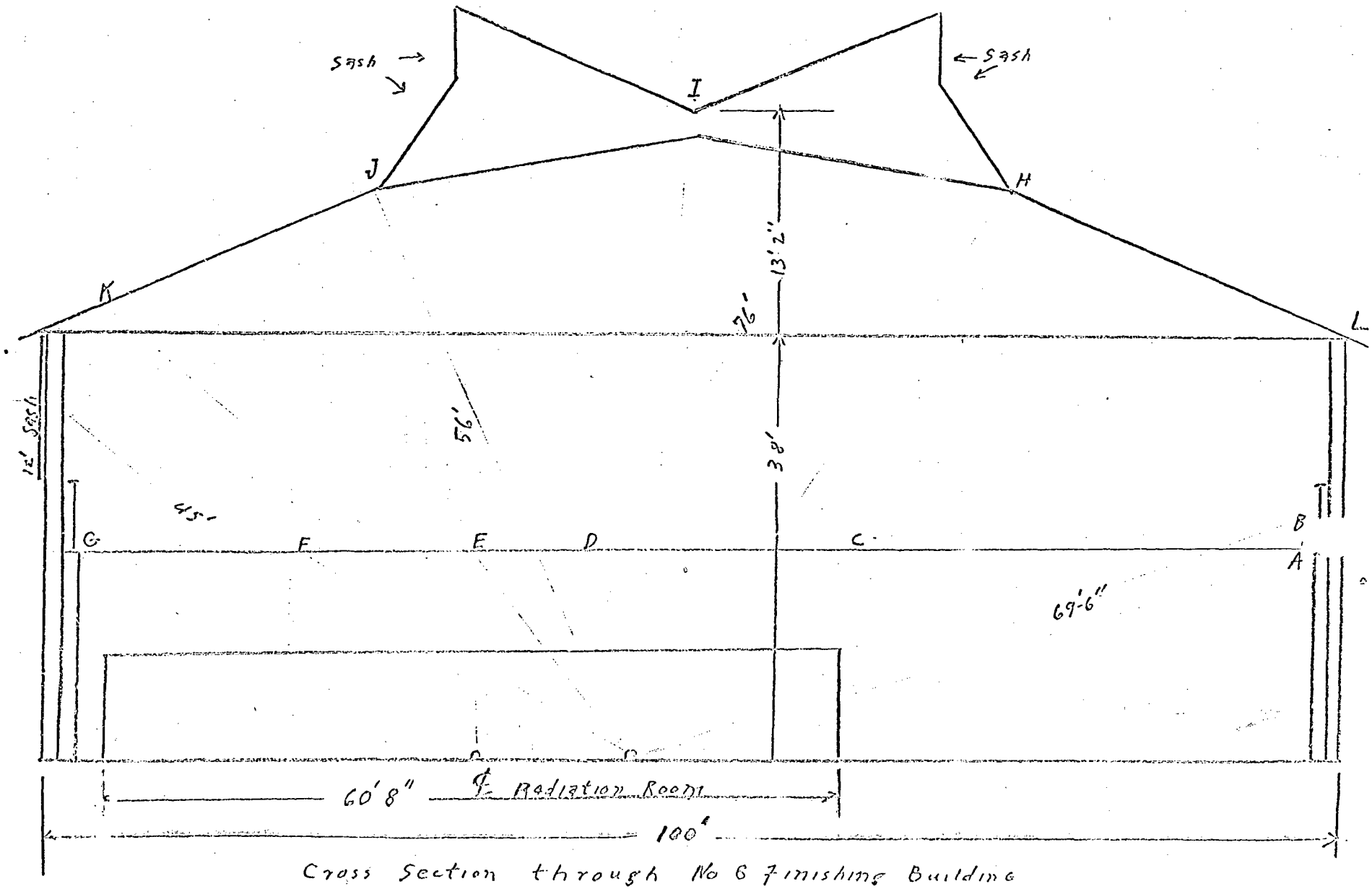
The only door to the room is locked and posted on the outside and is likewise locked from the inside when a radiographer is inside working. Because of the noise level in the plant it would be possible for unauthorized personnel to enter the room unnoticed even with the operator in the room if he did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

him. There a buzzer on the door to signal the rator 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 radiograph 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 radiograph enclosure in conformance with A.E.C. regulations.


Work Area
12'
Crane operator
24" sand filled concrete block wall
Storage
24" sand filled concrete block wall
Exposure Area
4'x4'x6" armor steel plate
16" sand filled concrete block wall
Operation Room
0.1 Drum Storage area
40'
20' Storage Area
Budd Cameras
entrance
4x4x6" armor steel plate below
2'x4'x2" " " " welded
on top
24" sand filled concrete block wall
Storage + runway
20'
Work Area



Cross Section through No 6 Finishing Building

On August 1, 1962, Nuclear Consultants conducted a radiation survey of our radiographic facility; a copy is attached under 313R-6A.

In the interim period no changes have been made in building construction, radiographic procedure, equipment source type or size.

The work load will be approximately the same in 1966 as it was in 1965.

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

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

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

GENERAL

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

I. Instrumentation. A Precision Radiation Instruments, Inc., Model 107c, Serial No. 607H geiger counter was used for the radiation survey. The ranges for this instrument are 0.04, 0.2, 2.0 and 20 mr/hr. This

instrument has been calibrated with CO-60. Also, a NUCOR CS-40A "Cutie-Pie" survey meter was used to cross-check when possible, but no levels were found which exceeded the range of the geiger counter.

II. Facility and Source Description. This facility is located on the ground level of the plant. It is composed of concrete block walls 24 inches thick (minimum) and approximately 10 feet high with 3 strands of barbed wire at the top. These walls form an enclosure which is posted and always kept locked. Only qualified personnel, as named in the AEC license, are permitted access to this area. Such personnel are routinely monitored for exposure to external ionizing radiation. Additional shielding is afforded individuals inside the exposure area in the form of 4' x 4' x 6" steel 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 [illegible] operated remotely by means of a 25 foot extension control from behind the a[illegible] 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 retired 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 the average level was 0.08 mr/hr. A maximum level of 0.12 mr/hr was found immediately outside the entrance door.

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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 sources 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 this room was found to be 0.05 mr/hr.

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

CONCLUSIONS

From the above survey the following conclusions may be drawn:

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

II. Normal usage of the Operations Room located in 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.

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

3. (a) Description of radiation detection instruments to be used -

We have two model CS-40A Nucor Survey Meters, serial number 1207 and 1193 manufactured by the Nuclear Corporation of America.

A general description of the instruments and their operation follows: A more specific method of operation is described in the operating procedure.

The Nucor Model CS-40A Survey Meter is a portable, transistorized ionization chamber type instrument for the detection and measurement of nuclear radiation caused by the presence of beta or gamma type radioactivity. It consists of an air ionization chamber, a high-gain transistorized DC amplifier, a transistorized power supply and a large 4 1/2 inch indicating meter. The instrument is contained in an aluminum instrument case measuring 10" x 4 1/2" x 4 3/4". The instrument ranges are 0-5, 50, 500, 5,000 and 50,000 mr/hr. The instrument is powered by a single Mercury battery (Mallery type RM-42R or equivalent) providing an operating life in excess of 500 hours. For ease of maintainence and fabrication the instrument has been constructed in three subassemblies namely: (A) Probe Assembly, (B) Amplifier, (C) Power Supply Assembly.

Operation -

Operation of the CS-40A is extremely simple. The instrument has been calibrated and fully tested before shipment and the operator need only adjust the motor ZERO ADJUST on the top of the instrument case and select the desired meter range to obtain accurate radiation measurement. In addition to the OFF and ZERO positions five ranges on which the meter reading is multiplied by 10,000, 1,000, 100 and 10 and 1 are provided giving the instrument the ability to measure fields ranging from 1 mr/hr to 50 mr/hr. To set the CS-40A into operation, simply turn the selector switch into the ZERO position. This applies filament voltage to the electrometer tube and power to the time delay circuit. Approximately 1.5 seconds after this

voltage has been applied the power oscillator is energized and all required voltages are applied to the instrument. In this position the ZERO ADJUST control should be adjusted for a zero meter reading. It is to be noted that in this position the instrument may be zeroed in a radioactive field of any intensity without effecting the calibration of any of the five ranges. When meter zeroing has been accomplished, turn the selector switch to the X 10,000 position. In taking measurements, it is always desirable to have the selector switch set on the position which gives a near mid-scale deflection. This switch has been designed so that the first position encountered provides the highest scaling factor. This prevents the possibility of meter damage which could result from an excessive amount of radiation sending the meter pointer rapidly off scale. After it has been determined that the amount of radioactivity is not sufficient to deflect the needle near mid-scale, turn the selector switch to lower ranges until the deflection is such that the most accurate reading is obtained. The reading times the scaling factor is the amount of radioactivity present in milliroentgens per hour. A meter sensitivity control is provided at the bottom of the instrument for calibration of the CS-404. However, this control has been preset and normally will not require readjustment unless components, other than the battery are replaced. Re-calibration should not be attempted unless a known source is available and the proper method known. The screw-driver adjustment on the top of the meter is also preset and should not be moved unless the meter needle indicates something other than zero with the selector switch in the OFF position.

6. (c) INSTRUMENT CALIBRATION PROCEDURES

The two Nucor CS-40A survey instruments are calibrated by the Nuclear Consultants Corporation, 9842 Manchester Road, St. Louis 19, Missouri. The President of this corporation is Mr. W. R. Konneker, Ph.D.

Nuclear Consultants use four CO-60 isotopes of 1.0 mc, 2.0 mc, 4.0 mc and 16.0 mc. These sources are calibrated by the National Bureau of Standards. A minimum of three checks are made on each scale of the survey meter in the range of 1.0 to 4000 mr/hr. Nuclear Consultants submits to G.S.I. an actual plot of these findings on graph paper along with their statement of calibration. If the instrument is out of calibration, it is repaired and re-calibrated.

6. (d) PERSONNEL MONITORING EQUIPMENT

Form AEC-313R
(9-62)

UNITED STATES ATOMIC ENERGY COMMISSION

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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

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 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

4. SEALED SOURCES TO BE USED IN RADIOGRAPHY Budd assembly No. 300-041706(B)

BYPRODUCT MATERIAL *(Element and Mass No.)*	SOURCE MODEL NUMBER	NAME OF MANUFACTURER	MAXIMUM ACTIVITY PER SOURCE	NUMBER OF SOURCES
A. Co^{60}	A. C-374	A. Nuclear Consultants	A. 280 mc	A. one
B. Co^{60}	B. C-375	B. Corp.	B. 260 mc calibrated	B. one
C.	C.	C	C. 7-22-62	C.

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

MODEL NUMBER	NAME OF MANUFACTURER *(If custom made, attach complete design specification.)*
A. Unitron 110A Ser. #1116	A. Budd Company Instruments Division.
B. Unitron 110A Ser. #1117	B. Budd Company Instruments Division.
C.	C.

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

	Not Applicable	Attached	Previously Submitted
(a) Description of radiographic facilities (instruction 6-a)	☐	☒	☐ on Jan. 21, 1964 (DATE)
(b) Description of radiation detection instruments to be used (Instruction 6-b)	☐	☒	☐ on Jan. 21, 1964 (DATE)
(c) Instrument calibration procedures (Instruction 6-c)	☐	☒	☐ on Jan. 21, 1964 (DATE)
(d) Personnel monitoring equipment (Instruction 6-d)	☐	☒	☐ on Jan. 21, 1964 (DATE)
(e) Operating and emergency procedures (Instruction 6-e)	☐	☒	☐ on Jan. 21, 1964 (DATE)
(f) Training program (Instruction 6-f)	☐	☒	☐ on Jan. 21, 1964 (DATE)
(g) Internal inspection system or other management control (Instruction 6-g)	☐	☒	☐ on Jan. 21, 1964 (DATE)
(h) Overall organizational structure (Instruction 6-h)	☐	☒	☐ on Jan. 21, 1964 (DATE)
(i) Leak testing procedures (Instruction 6-i)	☐	☒	☐ on Jan. 21, 1964 (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 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: _____

T. Ditchfield
Works Manager
Title of Certifying Official

DATE January 21, 1965

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.

We have two Victoreen Minometers, serial numbers 387-2140 and 187282, used in conjunction with five pocket chambers model 3A, serial numbers F8786, F6062, F8819, 14468, 14368 and 13626. The pocket chambers are also manufactured by Victoreen and cover the range of 0-200 mr. A record is maintained of the daily exposure of each man.

Film badges are supplied by the R. S. Landauer, Jr. & Co., 3920 - 216th Street, Matteson, Illinois, area code 312. Each individual has his own film badge and the film badge report becomes the permanent record of the individuals exposure. Forms AEC 4 & 5 are maintained for each individual.

Blood counts under the supervision of G.S.I.'s physician, Dr. John F. Brennan are taken at time of employment and separation.

6. (e) OPERATING AND EMERGENCY PROCEDURES

General Steel Industries, Inc.

OPERATION PROCEDURE FOR USE OF COBALT-60 RADIOGRAPHIC SOURCES

All "Radiographers" (as defined in Title 10, Part 31), 24-MEV Betatron, shall

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

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

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

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

5. Receive instructions and procedures from Mr. H. B. Norris

6. Receive instructions in health physics, monitoring and personnel monitoring and dosimetry from a physicist from Nuclear Consultants Corporation, or other source including G.S.I. personnel.

Above instructions will include lectures, actual use of exposure devices and survey instruments, and practical problems, utilizing Appendix A, Part 31, Title 10, CFR, as an outline. 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, nor in fact, shall they be moved from the special radiographic room within the plant. All records will be maintained by Mr. H. B. Norris, or by the corporation accountant (inventory) in the corporation accounting department at the same address.

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

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

OPERATING PROCEDURE FOR USE OF COBALT-60 RADIOGRAPHIC SOURCES -

(continued)

They must also wear the pocket chambers provided when working with the CO-60.

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

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

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

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

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

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

6. Unlock Budd Camera devices.

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

General Steel Industries, Inc.

OPERATING PROCEDURE FOR USE OF COBALT-60 RADIOGRAPHIC SOURCES -

(continued)

Page Three

8. Make necessary entries in Utilization and Survey Log.

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

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

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

12. Lock camera device. This should be done even though a second exposure is to be performed within the next few minutes.

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

14. Turn off warning light.

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

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

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

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

19. See Emergency Procedure for proper action in case of an emergency. In case of emergency follow those procedures and call Mr. H. B. Norris at once. His telephone number shall be known to all radiographers, and is always on file in the company guard house, which is open 24 hours a day - 7 days a week.

General Steel Industries

EMERGENCY OPERATING PROCEDURE

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

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

1. The warning lights will still be on in conformance with operating procedure. If the emergency happens at any other time, turn on warning lights.

2. Call H. B. Norris by auto call or telephone.

3. Unlock door, leave radiation room, and lock door from the outside.

4. Using NRD Model CS-40A survey meter, survey area immediately surrounding radiographic area, and post any area of greater than 5 mr/hr.

5. Maintain vigilance at door way until Mr. Norris arrives.

THE RADIATION SAFETY OFFICER SHALL -

1. Obtain full story, evaluate, rectify if possible.

2. If necessary, call Nuclear Consultants Corporation or the Budd Company. Exposure room will remain locked and all warning lights will remain on until area is safe. Radiographer will maintain personel vigilance at exposure room door if gravity of situation warrants.

3. Record will be made of the incident.

4. AEC will be notified, if necessary, in compliance with Title 10, Part 20, Paragraph 20.403.

EMERGENCY NO. 2: POCKET DOSIMETER READS OFF SCALE

1. Do not extrapolate.

2. Recharge dosimeter, check it after 15 minutes, repeat this step. If it reads off scale both times it is probably faulty.

3. Develop casting exposure films, see if they have the correct density with no distortion. Any misalignment of source or

General Steel Industries, Inc.

RADIOGRAPHY OPERATING PROCEDURE

(continued)

Page Two

source tube that could result in over-exposure 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 M. B. Norris and notify him of these results for his evaluation before making any other exposures

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

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

8. AEC will be notified in conformance with Title 10, Part 30, Paragraph 20.403.

6. (f) TRAINING PROGRAM

Date	Entrance Survey	Source Time				Operational Survey				Final Survey	Holder Locked		Casting		Radio grapher
		No. 1		No. 2		No. 1		No. 2							
		Out	In	Out	In						1	2	Pattern No.	Serial No.	

Radiation Safety Training Program for Industrial Radiographers at General Steel Industries Granite City Plant

Conducted by:

1. William E. Davis - Plant Metallurgist
2. Robert W. Ripley - Assistant Plant Metallurgist
3. Dr. W. Konneker - Nuclear Consultants Physicist
4. G. E. Burgess, Jr. - Manufacturing Department
5. H. B. Norris - Manager, Nondestructive Testing

I. Fundamentals of Radiation Safety

A. Radiation - 4 hrs.

1. atomic structure
2. isotope & radiation
3. alpha, beta & gamma
4. interaction with matter
5. x-radiation & gamma radiation

B. Glossary - 2 hrs.

1. terms - learn them first
2. significance & explanation of

C. Radiation Levels - 2 hrs.

1. unrestricted area, define, explain dangers in
2. radiation area " " " "
3. high radiation area " " " "

D. Health Hazards from Radiation - 2 hrs.

1. whole body effects
2. reversibility & irreversibility
3. skin effect
4. reproductive organs - genetics & future generations
5. effect on blood

E. Betatron - 2 hrs.

1. theory
2. operation of
3. hazards of
4. radiation from
5. comparison with gamma from CO-60
6. safety devices, procedure & explanation of

F. Methods of Controlling Radiation Dosage - 3 hrs.

1. time
   a. equations
   b. explanation

2. distance
   a. equations
   b. explanation

3. shielding
   a. equations, charts & graphs
   b. absorbtion factors
   c. half value layers

II. Radiation Detection Instruments - 3 hrs.

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 & Pocket Chambers
   a. principle of
   b. use of
   c. limitations

B. Survey Techniques - 3 hours

1. General
   a. background & its significance
   b. equations

2. Our Operation at G.S.I.
   a. technique
   b. documentation & records

III. Radiographic Equipment - 1 hour

A. Budd Co. Exposure Device

1. Diagrams
   a. explanation
   b. limitations
   c. advantages

2. Operation of
   a. theory
   b. our procedure

3. Storage Container
   a. requirements
   b. qualifications of Budd Co. Device
   c. A.E.C. requirements

IV. Procedure - 3 hours

A. Regular Operation Procedure
   a. review step by step
   b. explanation of

B. Emergency Operating Procedures
   a. review step by step
   b. explanation of

V. A.E.C. Regulation - 2 hours

A. Title 10 Part 30
   a. review
   b. explain

B. Title 10 Part 31
   a. review
   b. explain

C. Title 10 Part 30
   a. review
   b. explain

VI. Review - 3 hours

VII. Examination - 2 hours

VIII. Equipment & Operation of in the Radiographic Installation Itself

A. Budd Co. Exposure Device

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. & G.S.I.

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. & G.S.I.

C. Pocket Chamber & 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. & G.S.I.

D. Film Badge

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

2. Explanation of records required by A.E.C. & G.S.I.

IX. A. 4 weeks on-the-job training as an assistant radiographer.

X. Evaluation utilizing attached "Radiographers Training Evaluation Form".

PERIODIC TRAINING

Periodic training falls into two categories. The first involves possible changes in equipment, technique, procedure, and AEC regulations, which, by their very nature makes it mandatory that the radiographer be fully informed, trained, and competent. The occurrence of these changes is completely unpredictable. When and if they occur, each radiographer will receive all necessary training.

REFRESHER INSTRUCTION

The second category consists of refresher instruction in radiation protection. The radiographer will be given a test, similar to the sample previously submitted, once each year. If an individual's grade drops below 20% of his previous test grade, he will receive 8 hours of refresher instructions covering the area of weakness exposed by his test grade. He will then be given a retest. All test results will be filed for AEC inspection.

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   Instruments Division Budd Co.

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3. Instruction Manual Nucor CS-40A Survey Meter
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4. Measurements of Radioactivity
   National Bureau of Standards
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5. Los Alamos Handbook of Radiation Monitoring
   Los Alamos Scientific Laboratory
   U. S. Government Printing Office

6. Protection Against Radiation from Radium Cobalt 60 & Cesium 137
   National Bureau of Standards
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   National Bureau of Standards
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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
    L. Jacobson
    J. J. Nickson
    Argonne National Laboratory

11. Radioactive Isotopes as Source in Industrial Radiography
    Gerald H. Tenney
    Los Alamo Scientific Laboratory

12. The Lethal Effects of Radiation
    Edward Spaena, Ph. D.
    Scientific American

13. General College Chemistry
    L. B. Richardson
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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 Manner 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.

PART III

SAMPLE TEST

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:

   1. the inside surface of the wall.

   2. the outside surface of the wall.

      a. use 3" as H.V.L. for concrete
      b. output of 14,400 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 one for 2 hours, what radiation dosage will he receive?

3. If the Nucor survey meter reads 3 and the range scale pointer is on 100X what is the radiation level? 1X? 10000X?

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 and discuss 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. inverse square law
    c. isotope
    d. half life
    e. gamma radiation
    f. ion
    g. background radiation
    h. curie
    i. millicurie
    j. ionization

PART IV

RADIOGRAPHERS TRAINING EVALUATION SHEET

6. (g) Internal inspection system or other management control.

(h) Overall organizational structure.

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

The control group is headed by Mr. Delancey J. Davis, Vice President and General Manager of the Granite City Plant. Mr. W. H. Rapp is the Quality Control Manager reporting to Mr. Delancey Davis. Mr. H. B. Norris, Manager of Nondestructive Testing is the radiation protection officer in direct supervision of all radiographic procedure and safety. He reports to Mr. W. H. Rapp, Quality Control Manager who is responsible to Mr. Delancey J. Davis.

Mr. Vince J. Tompkins, Plant Accountant, is responsible to the Works Manager. His department operates independently of the nondestructive testing group. Mr. Tompkins supervised the actions of Mr. Paul Wertley who conducts quarterly inventories, maintains records, and operates a pull-out file to insure compliance with Title 10, Part 31, concerning calibration of survey instruments and leak tests. He maintains the following records:

1.	Radiation survey instrument calibration records	31.104
2.	Leak tests certificate	31.105
3.	Quarterly inventory records	31.106
4.	Utilization log	31.107
5.	Film badge reports	31.203
6.	Pocket dosimeter reports	31.203
7.	Radiation survey records	31.303
8.	Blood count records	-- ---

In addition, the plant Safety Director, Mr. George Odum, who is responsible to Mr. Russell Crecelius, Plant Personnel Director, works in close association with Messrs. Norris and Rapp. Through Mr Crecelius, the Illinois

State Board of alth is advised of radiation safety operating procedures. Correspondence is maintained with the S. B. of H. in matters relating to A.E.C. license applications, and radiation instrumentation, as well as their own requirements.

In the routine of a day's operation, Mr. Norris has direct contact with the radiographers on duty. Mr. Norris is a nondestructive testing engineer, having graduated from the University of Wisconsin at Madison, Wisconsin. His background included consulting work for the A.E.C. He has spent over twenty years in nondestructive testing including time in charge of all nondestructive testing at Allis-Chalmers Mfg. Co. and also time at the Los Alamos Scientific Laboratories, in the nondestructive testing group. He has also been active in the National Society for Nondestructive Testing. He is at present directly responsible for all phases of radiography at the Granite City Plant. This includes two 24-MEV betatron installations, two CO-60 isotopes and two low voltage x-ray machines.

The pocket dosimeters are read and recorded at least once each day, and the radiation survey record is maintained in compliance with Part 31.303 a, b and c. Film badge reports are studied, recorded and filed each week. Operating and emergency procedures are known by each radiographer. Copies of these procedures are maintained in the gamma ray enclosure office and in the radiographer's office.

Mr. George Odum, Plant Safety Director, arranges individual blood counts. These tests are performed by the Clinical Laboratories, St. Louis, Mo. and their report is received and evaluated by Dr. John F. Brennan, Granite City Plant Physician at the plant dispensary. Those reports are also recorded and a file maintained.

The services of Dr. W. R. Konneker, Physicist and President of Nuclear Consultants, St. Louis, Missouri, are available.

In summary, three separate departments report on different, but well defined, aspects of radiation safety to the Vice President and Works Manager, and

thus act as checks on each other.

Mr. H. B. Norris -- Operating procedure and radiation protection.

Mr. Russell Crecelius -- Medical and liaison with the S.B. of H. of Illinois

Mr. Vincent J. Tompkins -- Facility inventory and records.

6. (i) Leak testing procedures.

Leak tests are performed in accordance with Part 31, Section 31.105 by the Nuclear Consultants Corporation, 9842 Manchester Road, St. Louis 19, Missouri. Nuclear Consultants conducts these tests under their license #24-4206-1 (J62) from the A.E.C.

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