

**KELLOGG RUST CONSTRUCTORS
RADIOGRAPHY PROGRAM**

**PART A
GENERAL**

8507170526 850529
REQ4 LIC30
42-16573-01 PDR



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
A-I

PAGE

1

CONT.
ON
PAGE

2

RESPONSIBILITY AND AUTHORITY

100 DEFINITIONS

100.1 "Radiographer" means any employee who performs, or who in attendance at the site where the sealed sources are being used, personally supervises radiographic operations and who is responsible to KELLOGG RUST CONSTRUCTORS INC. (hereinafter referred to as KRC) assuring compliance with the requirements of the U.S.N.R.C. or Agreement state byproduct material radiography regulations and the conditions of the KRC radiography license.

100.2 "Radiographer's Assistant" means any employee who, under the personal supervision of a KRC Radiographer, uses radiographic exposure devices, sealed sources, or related handling tools, or instrumentation, in radiography.

101 RESPONSIBILITY

101.1 The "Radiation Protection Officer (RPO)", Kenneth L. Kluge, shall have the overall responsibility and authority for the KRC radiography program, reporting in such capacity to L. J. Pucher, Vice President.

101.2 The "Assistant Radiation Protection Officer", Alan J. Burge, may assume responsibilities of the "Radiation Protection Officer" at his direction or in his absence. The "Assistant Radiation Protection Officer" reports directly to the Radiation Protection Officer, Kenneth L. Kluge, and reports in his absence to L. J. Pucher, Vice President.

101.3 The Radiation Protection Officer shall be responsible for the following:

101.3.1 The safety of all personnel performing or coming in contact with performance of radiography.

101.3.2 The training of all Radiographer's Assistant and Radiographers.

101.3.3 Reviewing radiation dosage records, survey records, inventory records, and personnel records.

101.3.4 The maintenance of all records specified in this program to be performed by the RPO.

101.3.5 The testing; written, verbal, or practical, of all personnel performing radiography.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10APR85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
A-I

PAGE

CONT.
ON
PAGE

2

RESPONSIBILITY AND AUTHORITY

101.3.6 Disciplinary action when required.

101.3.7 Periodic inspections of performance and equipment.

101.3.8 Refresher training of personnel, periodic and continuing.

101.3.9 Reviewing over with all personnel, any deficiency found and the required correction.

101.4 The Radiographer is responsible to the Radiation Protection Officer for the conduct of the KRC radiography program at each field jobsite.

102 AUTHORITY TO ACT AS A KRC RADIOGRAPHER OR RADIOGRAPHER'S ASSISTANT

No person shall be permitted to act as a KRC Radiographer or Radiographer's Assistant until such person has been trained, tested and certified as outlined in Proc. Ref. A-II of this manual.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10APR85							
APPROVED	K. KLUGE							

460615



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
A-II
 TRAINING, TESTING & CERTIFICATION
10 CFR 34.11

PAGE

1

CONT.
ON
PAGE

2

100 INITIAL TRAINING, TESTING AND RETRAINING 10CFR 34.11

100.1 Radiographer's Assistant - KRC Trained

All prospective Radiographer's Assistants shall receive the following from the Radiation Protection Officer, The Assistant Radiation Protection Officer or a KRC Radiographer, as the case may be:

100.1.1 Copies of the instruction in the KRC Radiography Operating Maintenance and Emergency Procedures set forth in Part B of this manual. The scope of instruction shall include the entirety of said Part except leak testing, source changing, and quarterly maintenance. The extent of instruction shall average a minimum of thirty minutes per working day for four weeks.

100.1.2 Instruction in the use of KRC radiographic exposure devices, sealed sources, related handling tools, and radiation survey instruments which will be employed in the assignment of the Radiographer's Assistant. The scope of instruction shall include the following:

(a) Radiation Survey Instrument

- (1) Reading scales and interpreting readings.
- (2) Basics of operation.
- (3) Battery check.
- (4) Replacing batteries.
- (5) Checking calibration.
- (6) Detection center.
- (7) Calibration sticker or tag.

(8) Performing surveys of radiation areas, exposure devices, and shipping containers.

(b) Radiographic Exposure Devices

- (1) Principles of operation.
- (2) Locking and securing.
- (3) Positioning source tube and drive mechanism for exposures.

(c) Dosimeters.

- (1) Reading scales and interpreting readings.
- (2) Principles of operation.
- (3) Charging.

(d) Setting up and monitoring radiographic control

100.1.3 Testing - Radiographer's Assistant

Upon completion of the training period, the radiographer's assistant candidate shall be examined by the following method:

(a) A written examination consisting of the KRC NRC Radiographer's Assistant's test. (Sample in Appendix A).

(b) A practical examination consisting of KRC Radiographer's Assistant's Practical Examination - Radiation Safety (Sample in Appendix A).

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10APR85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
A-II
 TRAINING, TESTING & CERTIFICATION
 10 CFR 34.11

PAGE

2

CONT.
ON
PAGE

3

100.1.4 Grading

A grade of 75% is required on the written portions for qualification as a Radiographer's Assistant. The practical examination shall be evaluated either as satisfactory or unsatisfactory. Emphasis shall be placed on the safety of the operation (vs. e.g. calculation of exposure time). Any operation which would jeopardize the safety of personnel would be considered unsatisfactory. If the trainee meets or exceeds these requirements, the trainee shall be designated as a Radiographer's Assistant and his name shall be added to the list of Qualified KRC Radiographer's Assistants. All questions answered incorrectly shall be reviewed with the trainee by the RPO.

100.2 Radiographers - KRC Trained

100.2.1 Training

All prospective Radiographers shall undergo an initial training consisting of a minimum of 44 hours of instruction by the Radiation Protection Officer. During such training each prospective Radiographer shall receive copies of and instruction in the subjects outlined in Appendix A of 10 CFR Part 34, and equivalent Agreement State regulations as follows:

- (a) Structure of the atom -2 hrs.
 Atomic Number (Z)
 Mass Number (A)
- (b) Radioactive Materials -2 hrs.
 Isotopes
 Radioisotopes
 Decay
 Activity
 Specific Activity
 Half Life
- (c) Characteristics of X-rays & -2 hrs.
 Gamma rays
 Electromagnetic Spectrum
 Wave Length
 Frequency
 Energy
 Intensity
 Photon
- (d) Interaction with Matter-Absorption -2 hrs.
 & Scatter
 Penetration
 Ionization
 Photo electric Effect
 Compton Effect
 Scatter

REVISION	0	1	2	3	4	5	6	7
BY	A.BURGE							
DATE	10APR85							
APPROVED	K.KLUGE							

460615



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
A-IITRAINING, TESTING & CERTIFICATION
10 CFR 34.11

PAGE

3

CONT.
ON
PAGE

4

- Bremsstrahlung
Half-Value Layer
- (e) Radiation and the Human Body -2 hrs.
Radiation Hazard
Internal and External Radiation
Exposure
External Radiation Hazard
Internal Radiation Hazard
- (f) Radiation Measurement Units -1 hr.
Rad, RBE, Rem.
Dose and Dose Rate
- (g) Radiation Effects -2 hrs.
Radiosensitivity of Body Cells
Somatic and Genetic Effects
Effects of Whole - Body Dose
- (h) Radiation Measuring Devices -1 hr.
Personnel Monitoring Devices
Pocket Dosimeter
Film Badge
Survey Meters
Ionization chamber Survey Meter
Geiger-Mueller Counter
Interpreting and understanding readings
- (i) Personnel Protection -2 hrs.
Dose Rate Calculations
Main Factors in Personnel Protection
Time
Distance
Shielding
- (j) X-ray generation -1 hr.
- (k) The x-ray machine -1 hr.
- (l) Gamma Ray Sources -4 hrs.
Isotope Radiography
Energy and Equivalent Energy
Isotope requirements
Characteristics and Merits of Isotopes
Gamma Ray Equipment
- (m) Operating and Emergency Procedures -16 hrs.
Inspection and Maintenance
Storage Containers
Leak Testing
Source Changing
Review
- (n) 10 CFR 19 -4 hrs.
10 CFR 20 (as applicable)
10 CFR 30 (as applicable)

REVISION	0	1	2	3	4	5	6	7
BY	A.BURGE							
DATE	10APR85							
APPROVED	K.KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
A-II
 TRAINING, TESTING & CERTIFICATION
 10 CFR 34.11

PAGE

4

CONT.
ON
PAGE

5

10 CFR 34

(o) KRC

-1 hr.

N.R.C. and Agreement

State Radioactive Material Licenses
and their Limitations(p) Case histories of Radiography
Accidents

-1 hr.

100.2.2 On-The-Job Training

A minimum of 3 months of OJT shall be given to each Radiographer's Assistant. This shall include but not be limited to the following:

(a) Inspection and Maintenance

(1) Daily

(2) Quarterly

(3) Non-Routine

(b) Operating Procedures

(c) Emergency Procedures (He shall be given a hypothetical situation)

(d) Handling and Use of Exposure Devices

(e) Survey Instruments and Performing Surveys

(f) Records

(g) Leak Testing

(h) Source Changing

100.2.3 Testing - Radiographers

Upon completion of the training period, the Radiographer candidate shall be examined by the following method:

(a) A written examination consisting of the KRC NRC Radiation Safety Examination for Radiographers, (Sample in Appendix B).

(b) A practical examination consisting of the KRC Radiographers Practical Examination - Radiation Safety, (Sample in Appendix B).

100.2.4 Grading

A grade of 75% on the written examinations are required for qualification as a Radiographer. The practical examination shall be evaluated either as satisfactory or unsatisfactory. If the Radiographer candidate meets or exceeds these requirements, the Radiographer candidate shall be designated a Radiographer and his name shall be added to the list of Qualified KRC Radiographers and Radiographer's Assistants. All questions missed shall be reviewed and discussed by the RPO with the Radiographer.

100.3 Radiographer's Assistants - Previously Trained

Previously trained Radiographer's assistants shall receive from the RPO or the Assistant RPO a minimum of four hours instruction covering the following topics:

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
A-II
 TRAINING, TESTING & CERTIFICATION
 10 CFR 34.11

PAGE

5

CONT.
ON
PAGE

6

- (a) Operating and Emergency Procedures
- (b) Radiation Survey Instruments and Use
- (c) Personnel Monitoring Equipment and Use
- (d) Radiographic Exposure Devices, including practical instruction in use of devices.

100.4 Radiographers - Previously Trained

Previously trained Radiographers shall receive from the RPO or the Assistant RPO a minimum of eight hours training to include the following topics:

- (a) Radiation Measuring Devices (Survey Instruments)
- (b) Personnel Monitoring Devices
- (c) Personnel Protection Factors
- (d) Complete Review of the KRC Radiography Program
- (e) Review of applicable Agreement State and/or NRC Regulations
- (f) KRC MRC and/or Agreement State Licenses and their limitations
- (g) Instruction in the use of KRC Radiographic Exposure Devices Source Changers, Sealed Sources, Related Handling Tools, and Radiation Survey Instruments which will be employed in the assignment of Radiographer.

100.5 Testing and Grading - Previously Trained Radiographers and Radiographer's Assistants

Previously trained Radiographers and Radiographer's Assistants shall be tested and graded by the same method as Radiographers and Radiographer's Assistants trained by KRC.

101 PERIODIC TRAINING AND UPDATING

101.1 All Radiographer's Assistants and Radiographers shall have periodic training before each assignment to a specific Radiography project and at least 5 hours of such training every 10 months during any one specific radiography project. Such periodic training shall be the responsibility of the Radiation Protection Officer and shall include, but not be limited to:

REVISION		1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
A-II
 TRAINING, TESTING & CERTIFICATION
 10 CFR 34.11

PAGE

6

CONT.
ON
PAGE

101.1.1 Refresher in license limits, both N.R.C. and those Agreement States for which KRC holds a valid license;

101.1.2 Updating with regard to N.R.C. Regulations, and Agreement State Regulations;

101.1.3 Equipment use;

101.1.4 Safety.

101.2 The Radiation Protection Officer shall transmit to Radiographers or Radiographer's Assistants copies of any Instructions regarding changes in N.R.C. or Agreement State regulations and KRC Operating and Emergency Procedures as they occur and such other instruction as he from time to time may deem necessary.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10APR85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
A-III

PAGE

CONT.
ON
PAGE

INSPECTION 10 CFR 34.11 (d)

1

100 INSPECTION

100.1 The Radiation Protection Officer will make an unannounced inspection of the activity of each KRC Radiographer at least once every three months to assure compliance of each Radiographer with applicable federal, state and local regulations, and the KRC Radiography Operating and Emergency Procedures and to ascertain the need for corrective measures, if any.

100.2 The Radiation Protection Officer shall communicate in writing to each Radiographer so inspected the necessary corrective measures to be undertaken by the Radiographer and shall by a subsequent unannounced inspection determine the degree of the Radiographer's implementation thereof.

100.3 Violation by a Radiographer or a Radiographer's Assistant, as the case may be, of any part of the KRC Radiography Program may in the discretion of the Radiation Protection Officer be cause for termination of his employment in such capacity by KRC.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
A-IVRECORD CONTROL, RETENTION
AND NOTIFICATION

PAGE

1

CONT.
ON
PAGE

2

100 QUARTERLY INVENTORY-10CFR 34.26

100.1 The Radiation Protection Officer shall conduct a quarterly physical inventory to account for all sealed sources received and possessed under the KRC Radiography license.

100.2 The records of the inventories shall be maintained in the Houston Office of KRC for inspection by proper federal, state or local authorities and shall include the quantities and kinds of byproduct material, location of sealed sources and the date of inventory.

101 UTILIZATION LOGS-10CFR 34.27

101.1 The Radiation Protection Officer shall maintain in the Houston Office of KRC for inspection by proper federal, state or local authorities current utilization logs. The information shall be maintained on form K-24-1 "FIELD RADIOGRAPHIC TECHNICIAN INDIVIDUAL WHOLE BODY RADIATION DOSAGE RECORD" showing among other things for each exposure device utilized by a KRC Radiographer the following:

101.1.1 A description (or make and model number) of the radiographic exposure device or storage container in which the sealed source located.

101.1.2 The identity of the Radiographer to whom assigned.

101.1.3 The plant or site where used and dates of use.

✓101.1.4 The recording of the physical radiation survey required to be made to determine that each sealed source is in its shielded condition prior to securing the radiographic exposure device and storage container.

101.1.5 The survey meter model number and serial number.

102 PERSONNEL MONITORING RECORDS-10CFR 20.401, 10CFR 34.33

102.1 The Radiation Protection Officer shall maintain in the Houston Office of KRC for inspection by proper federal, state or local authorities records showing the daily and weekly radiation exposures of all individuals for whom personnel monitoring is required under applicable regulations and shall utilize therefore KRC form K-24-1 "FIELD RADIOGRAPHIC TECHNICIAN INDIVIDUAL WHOLE BODY RADIATION DOSAGE RECORD".

102.2 The Radiation Protection Officer shall retain in the Houston Office of KRC the original or a copy of the film badge reports received from the film badge processor.

REVISION	0	1	2	3	4	5	6	7
BY	A.BURGE							
DATE	10APR85							
APPROVED	K.KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
A-IVRECORD CONTROL, RETENTION
AND NOTIFICATION

PAGE

2

CONT.
ON
PAGE

103 LEAK TEST RECORDS & REPORTS-10CFR 34.25

103.1 The Radiation Protection Officer shall maintain at the Houston Office of KRC records of the results of such leak tests of sealed sources as the KRC Radiographer may be required to have performed while the source is in his possession, i.e. where a source in the possession of a KRC Radiographer has not been leak tested within the preceding six months.

103.2 In case a test conducted while the source is in the possession of a KRC Radiographer reveals the presence of .005 microcuries or more of removable radioactive material, the Radiation Protection Officer shall immediately see that the Radiographer in possession of the source immediately withdraws the equipment involved from use and shall cause it to be decontaminated and repaired or disposed of in accordance with applicable regulations and the Radiation Protection Officer shall file the reports required by 10CFR 34.25(d) or the equivalent Agreement State regulations.

104 OTHER RECORDS AND NOTIFICATION-10CFR 19.13, 20.402, 20.403, 20.405,

20.407, 20.408, 20.409 (SEE APPENDIX C FOR EXPLANATION OF FORMS)

104.1 When the condition exists specified therein or at the request of persons so entitled, as the case may be, the Radiation Protection Officer shall make or cause to have made reports or notifications specified in 10 CFR sections 19.13, 20.402, 20.403, 20.405, 20.407, 20.408, 20.409 or the equivalent Agreement State Regulations.

104.2 The Radiation Protection Officer shall, in addition to other reports and records required by the Part:

104.2.1 Maintain records of inspections made by him under Proc. Ref. A-III of this Part and of corrective measures, if any, instituted by him.

104.2.2 Maintain examination and re-examination papers of Radiographers and Radiographer's Assistants.

104.2.3 Maintain records of the blood test examination required of each Radiographer or Radiographer's Assistant.

104.2.4 Maintain a current List of Qualified Radiographers and Radiographer's Assistants.

104.2.5 Notify the appropriate federal, state and local authorities, as required, of any contemplated changes to or modifications in this Program or the equipment or devices to be used therein.

REVISION	0	1	2	3	4	5	6	7
BY	A.BURGE							
DATE	10APR85							
APPROVED	K.KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
A-V

PAGE

CONT.
ON
PAGE

1

WORK ASSIGNMENT AND PREPARATION

100 RESPONSIBILITY

100.1 The Radiation Protection Officer shall be responsible for the assignment of specific Radiographers and Radiographer's Assistants for particular projects.

100.2 Recognizing that there are many similarities between N.R.C. regulations and those of the several Agreement States, it is, nevertheless, the responsibility of the Radiation Protection Officer to advise Radiographers and Radiographer's Assistants of any differences particular to those Agreement States with which KRC holds a valid byproduct material license.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10APR85							
APPROVED	K. KLUGE							

**KELLOGG RUST CONSTRUCTORS
RADIOGRAPHY PROGRAM**

**PART B
OPERATING, MAINTENANCE, AND
EMERGENCY PROCEDURES FOR RADIOGRAPHERS**



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.

B-I

CONT.

ON

PAGE

PAGE

PROJECTORS

1

2

100 PROJECTORS (THESE ARE ALSO STORAGE CONTAINERS)

100.1 Technical Operations Projector Model 660

This must not be accepted if a source of more than 100 curies of Ir 192 + 20% is in it, as measured by the supplier. It is provided with 25 feet of flexible cable from source shield to control unit, and one, two or three 7 foot sections of source tube.

To operate, unlock storage cover with key. Rotate selector lever to connect position to release cover. Remove the cover from the control cable connector and insert drive cable pin into source cable end. Then insert control cable plug into control cable connector. Rotate selector lever on source shield to operate position. By turning the hand crank in the expose (counter-clockwise) direction, the source is moved out of the source shield to the specimen. To retract, turn the hand crank in the retract (clockwise) direction until the source is in the source shield.

Even though the source shield contains 28 pounds of depleted uranium 238, and is thereby "portable", hand carrying shall, nevertheless, be limited to instances where absolutely necessary. Excessive personal exposures can result from hand carrying the unit close to the body or legs; in no case shall it exceed one-half hour per person per week. Monitoring equipment as described in PROC. REF. B-IX shall be worn on that part of the body nearest the source shield when carried.

100.2 Technical Operations Projector Model 683

This must not be accepted if a source of more than 100 curies of Iridium 192 + 20% is in it as measured by the supplier. It is provided with 16 feet of flexible control cable from source shield to control unit and one 10 ft. guide tube. The source is permanently connected to the drive cable so there is not a disconnect device between the source and drive cable.

To operate, place brake lever in ON position. Unlock the storage plug. Unclamp the storage plug from the output port fitting and place the plug in the storage adapter. Clamp the source guide tube to the output fitting. Place brake lever in the OFF position. By turning the hand crank in the expose (counter-clockwise) direction, the source is moved out of the source shield to the specimen. To retract, turn hand crank in the RETRACT (clockwise) direction until the source is in the shield. Place brake lever in ON position.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10APR85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROJECTORS

PAGE

2

CONT
ON
PAGE

3

Even though the source shield contains 29 pounds of depleted uranium 238, and is thereby "portable", hand carrying shall, nevertheless, be limited to instances where absolutely necessary. Excessive personal exposures can result from hand carrying the unit close to the body or legs; in no case shall it exceed one-half hour per person per week. Monitoring equipment as described in PROC. REF. B-IX shall be worn on that part of the body nearest the source shield when carried.

100.3 Technical Operations Projector Model 684

This must not be accepted if a source of more than 10 curies of Cobalt 60 + 10% is in it, as measured by the supplier. It is provided with 25 feet of flexible cable from source shield to the control unit, one master 7 foot section of guide tube with end stop and two 7 foot sections of extender guide tube.

To operate, unlock storage cover with key. Rotate selector lever to connect position to release cover. Remove the cover from the control cable connector and insert drive cable pin into source cable end. Then insert control cable plug into control cable connector. Rotate selector lever on source shield to operate position. By turning the hand crank in the expose (counter-clockwise) direction, the source is moved out of the source shield to the specimen. To retract, turn the hand crank in the retract (clockwise) direction until the source is in the source shield.

The source shield contains 150 lbs. of depleted uranium and total approximate weight is 225 lbs. It is necessary to order cart TO-706 to transport. Additional length source travel and control cables are available on SPECIAL order.

100.4 Technical Operations Projector Model 741

This must not be accepted if a source of more than 30 curies of Cobalt 60 + 10% is in it, as measured by the supplier. It is provided with 25 feet of flexible cable from source shield to the control unit, one master 7 foot section of guide tube with end stop and two 7 foot sections of extender guide tube.

To operate, unlock storage cover with key. Rotate selector lever to connect position to release cover. Remove the cover from the control cable connector and insert drive cable pin into source cable end. Then insert control cable plug into control cable connector. Rotate selector lever on source shield to operate position. By turning the hand crank in the expose (counter-clockwise) direction, the source is moved out of the source shield to the specimen. To retract, turn the

REVISION	0	1	2	3	4	5	6	7
BY	A.BURGE							
DATE	10APR85							
APPROVED	K.KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.

B-I

PAGE

3

CONT.
ON
PAGE

4

PROJECTORS

hand crank in the retract (clockwise) direction until the source is in the source shield.

The source shield contains 200 lbs. of depleted uranium and total approximate weight is 300 lbs. It is necessary to order cart TO-706 to transport. Additional length source travel and control cables are available on SPECIAL order.

100.5 Technical Operations Projector Model 680

This must not be accepted if a source of more than 100 curies of Cobalt 60 + 10% is in it, as measured by the supplier. It is provided with 25 feet of flexible cable from source shield to the control unit, one master 7 foot section of guide tube with end stop and two 7 foot sections of extender guide tube.

To operate, unlock storage cover with key. Rotate selector lever to connect position to release cover. Remove the cover from the control cable connector and insert drive cable pin into source cable end. Then insert control cable plug into control cable connector. Rotate selector lever on source shield to operate position. By turning the hand crank in the expose (counter-clockwise) direction, the source is moved out of the source shield to the specimen. To retract, turn the hand crank in the retract (clockwise) direction until the source is in the source shield.

The source shield contains 285 lbs. of depleted uranium and total approximate weight is 405 lbs. It is necessary to order cart TO-706 to transport. Additional length source travel and control cables are available on special order.

100.6 Technical Operations Projector Model 900

This must not be accepted if a source of more than 100 curies of IR 192 (+20%) is in it, as measured by the supplier. It is provided with 25 feet of flexible cable from source shield to control unit and one, two or three 7 foot sections of source tube. 14 foot and 21 foot sections of source tube may also be used if available.

To operate, unlock the storage cover with key, rotate selector lever to "connect" position to release cover, remove the cover from the control cable connector and insert drive cable pin into source cable end. Then insert control cable plug into control cable connector. Rotate selector lever on source shield to "operate" position. By turning the hand crank in the expose (counter-clockwise) direction, the source is moved out of the source shield to the specimen. To retract, turn the

REVISION	0	1	2	3	4	5	6	7
BY	A.BURGE							
DATE	10APR85							
APPROVED	K.KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-I

PAGE

4

CONT.
ON
PAGE

5

PROJECTORS

hand crank in the retract (clockwise) direction until the source is in the source shield. The total weight of the projector is 44 lbs. of which 28 pounds is depleted uranium used for source shielding, thereby making the unit "portable." Hand carrying shall, nevertheless, be limited to instances where absolutely necessary. Excessive personal exposures can result from hand carrying the unit close to the body; in no case shall it exceed one-half hour per person per week. Monitoring equipment as described in PROC. REF. B-IX shall be worn on that part of the body nearest the source shield when carried.

100.7 Technical Operations Projector Model 910

This must not be accepted if a source of more than 25 curies of IR 192 (+20%) is in it, as measured by the supplier. It is provided with 25 feet of flexible cable from source shield to control unit, and one two or three 7 foot sections of source tube. 14 foot and 21 foot sections of source tube may also be used if available.

To operate, unlock storage cover with key. Rotate selector level to "connect" position to release cover. Remove the cover from the control cable connector and insert drive cable pin into source cable end. Then insert control cable plug into control cable connector. Rotate selector lever on source shield to "operate" position. By turning the hand crank in the expose (counter-clockwise) direction, the source is moved out of the source shield to the specimen. To retract, turn the hand crank in the retract (clockwise) direction until the source is in the source shield.

The total weight of the projector is 34 lbs. of which 18 pounds is depleted uranium used for source shielding, thereby making the unit "portable." Hand carrying shall, nevertheless be limited to instances where absolutely necessary. Excessive personal exposures can result from hand carrying the unit close to the body; in no case shall it exceed one-half hour per person per week. Monitoring equipment as described in PROC. REF. B-IX shall be worn on that part of the body nearest the source shield when carried.

100.8 Technical Operations Projector Model 920

This must not be accepted if a source of more than 200 curies of IR 192 (+20%) is in it, as measured by the supplier. It is provided with 25 feet of flexible cable from source shield to control unit and one, two or three 7 foot sections of source tube. 14 foot and 21 foot sections of source tube may also be used if available.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10APR85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-I

PAGE

5

CONT.
ON
PAGE

PROJECTORS

To operate, unlock the storage cover with key. Rotate selector lever to "connect" position to release cover. Remove the cover from the control cable connector and insert drive cable pin into source cable end. Then insert control cable plug into control cable connector. Rotate selector lever on source shield to "operate" position. By turning the hand crank in the expose (counter-clockwise) direction, the source is moved out of the source shield to the specimen. To retract, turn the hand crank in the retract (clockwise) direction until the source is in the source shield.

The total weight of the projector is 48 lbs. of which 32 pounds is depleted uranium used for source shielding, thereby making the unit "portable." Hand carrying shall, nevertheless, be limited to instances where absolutely necessary. Excessive personal exposures can result from hand carrying the unit close to the body; in no case shall it exceed one-half hour per person per week. Monitoring equipment as described in PROC. REF. B-IX shall be worn on that part of the body nearest the source shield when carried.

REVISION	0	1	2	3	4	5	6	7
BY	A.BURGE							
DATE	10APR85							
APPROVED	K.KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-II

PROCUREMENT OF BY-PRODUCT MATERIAL AND EQUIPMENT

PAGE

1

CONT.
ON
PAGE

2

100 ORDERING BYPRODUCT MATERIAL AND EQUIPMENT

100.1 The Radiographer shall procure all Shipping Containers, Capsule Containers and Projectors and Replacements thereof or of the sources therefore from the supplier thereof-Technical Operations.

100.2 All such procurement shall be in accordance with KRC procurement procedures as may be changed from time to time, but all procurement shall specify that the supplier is responsible for all transportation to and from the jobsite, with all deliveries to and re-deliveries from the Radiographer to take place at the job site.

100.3 When ordering projectors with radioactive sources, no source stronger than the ones specified on Supplementary Sheet No. 1 must be ordered. However, it is permissible to receive sources which are stronger than supplied herein, since it is common practice by the supplier of such sources to overcharge projectors. The limitation on this overcharge is 20% for Iridium 192 and 10% for Cobalt 60, the basis being the Specification on Supplementary Sheet No. 1.

100.4 It is the responsibility of the Radiographer to see that all procurement rental orders are in conformance with the limits of KRC License.

101 RECEIVING BYPRODUCT MATERIAL AND EQUIPMENT

101.1 The Radiographer shall NOT ACCEPT ANY Shipping Containers, Capsule Containers, Projectors and replacements thereof or of the sources therefore UNLESS EACH IS IN COMPLETE ACCORDANCE WITH KRC LICENSE with regards thereto, including but not limited to:

- Isotope Type
- Source Model
- Curiage
- Capsule Container Model
- Shipping (Storage) Container Model
- Projector Model

as the case may be, AND WITHOUT REGARD for whether an error in delivery was caused by the Radiographer, by his procurement specification or otherwise.

101.2 The Radiographer shall NOT accept delivery of any Projector or Shipping Container UNLESS each is labeled with the radiation symbol sign reading: "Caution (or Danger) Radioactive Material(s)", and has a label stating the quantity and kind of radioactive material in the

REVISION	0	1	2	3	4	5	6	7
BY	A.BURGE							
DATE	10APR85							
APPROVED	K.KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
B-II

PROCUREMENT OF BY-PRODUCT MATERIAL AND EQUIPMENT

PAGE

2

CONT
ON
PAGE

3

Projector or Shipping Container and the date of measurement of the quantity.

101.3 The Radiographer shall NOT accept delivery of any Capsule Container UNLESS it is marked with the radiation symbol and a sign reading "Caution - Radioactive Material - To Be Used By Authorized Personnel Only".

101.4 The Radiographer shall NOT accept delivery of any Projector or Shipping Container UNLESS

101.4.1 In the case of Projector Models T/O 660, 683, 900, 910 and 920, the Projector has no radiation level in excess of fifty (50) milliroentgens per hour at six (6) inches from any exterior surface of the Projector. This is in addition to a maximum 200 mr/hr at any exterior surface and 10 mr/hr at 1 meter from any exterior surface required for all KRC projectors. In making his check of any exterior surface (all around and top and bottom) the Radiographer should keep in mind that Technical Operations Projectors T/O 660, 683, 900, 910 and 920 tend to leak more at the bottom. Shipping Containers tend to leak most through the lid.

101.5 The Radiographer shall NOT accept any Projector or Shipping Container, as the case may be, until in each case he has made the following examinations and feels that such is satisfactory;

101.5.1 Technical Operations Projectors 660, 680, 683, 684, 741, 900, 910 and 920

- (a) Check locking plug for locking;
- (b) Check locking plug for removing;
- (c) Check source tubing for dents;
- (d) Check control indicators.

Shipping Container:

- (a) Check padlock and key;
- (b) Check to see if cover is secure;
- (c) Check to see that Capsule Container is not stuck.

101.6 The Radiographer shall NOT accept delivery of any Projector or Shipping Container UNLESS he has received a leak test certificate from the supplier showing a leak test of the source contained therein within six (6) months prior to the time of attempted delivery.

101.7 The results of the radiation level check at the time when a projector or shipping container is received are to be recorded on form K-25 "RADIOGRAPHY EQUIPMENT RUNNING INVENTORY CONTROL AND QUARTERLY

REVISION	0	1	2	3	4	5	6	7
BY	A.BURGE							
DATE	10APR85							
APPROVED	K.KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-IIPROCUREMENT OF BY-PRODUCT MATERIAL
AND EQUIPMENT

PAGE

3

CONT.
ON
PAGE

PHYSICAL INVENTORY". This form is to be sent to the Radiation Protection Officer immediately upon receipt and checking of each projector or shipping container. This form is also to be used for a quarterly physical inventory report to the Radiation Protection Officer. For this report, the form has to show all equipment in use at the project at the end of each calendar quarter.

101.8 When it has been determined by the radiographer that the requirements of B-II, 101.1 thru B-II, 101.7 have been met he shall write on the leak test report: RECEIVED (date) and signed immediately below. The original of this shall be sent immediately to the RPO. The radiographer shall retain a copy.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
B-III

LOCKING, SECURING AND STORAGE OF EQUIPMENT

PAGE

1

CONT.
ON
PAGE

2

100 LOCKING & SECURING

100.1 Shipping Containers shall be locked and locking plugs and other locks shall be in place and locked at all times and places except at the site of exposure. Thus, all opening of Shipping Containers and connecting of source tubing and other unlocking shall take place ONLY at a site of exposure and Shipping Containers and Projectors shall be in a locked condition during any movement as well during storage.

100.2 No Projector or Shipping Container shall be left about the jobsite other than at the proper storage areas as outlined in 2. below EXCEPT when under the continuous surveillance of the Radiographer's Assistant or the Radiographer.

100.3 The Radiographer shall be responsible for the safekeeping of keys to Projectors, Shipping Containers and Storage Areas and for seeing that they do not come into the hands of unauthorized personnel, no matter what their rank with respect to him.

101 STORAGE AREAS

101.1 The Radiographer has the responsibility to see that proper storage space is provided for all Shipping Containers and Projectors. He may ask the assistance of the construction superintendent or other parties to assist him in providing for such space but this shall in no way diminish his responsibility with regard thereto. In any case, where the Radiographer feels that he is unable to obtain proper storage space, he shall immediately contact the Radiation Protection Officer.

101.2 Permanent nature storage space shall be chosen with a view to exclusive use for radiography storage, if possible, and in any event shall be capable of being locked and kept so locked. Where separate radiography storage space is not obtainable, and part of a general locked storage space must be used, all radiographic equipment is to be segregated in one part of the area which shall be roped off or otherwise clearly delineated and marked by use of radiation symbol signs reading: "Caution (or Danger) Radioactive Materials." The locked access door to the storage space shall be marked with such a sign. The radiographer shall survey the storage area surfaces and record readings on and complete form K-26 "Survey of Storage Area".

101.3 Temporary Storage, in the case of Technical Operations Models 684, 741 and 680 which are so heavy that movement is awkward, shall be accomplished by securing the projector in a locked wooden or metal box. Radiation symbol signs reading "Caution (or Danger) Radioactive

REVISION	0	1	2	3	4	5	6	7
BY	A.BURGE							
DATE	10APR85							
APPROVED	K.KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-IIILOCKING, SECURING AND STORAGE OF
EQUIPMENT

PAGE

2

CONT.
ON
PAGE

Materials" are to be affixed to the storage box on all accessible sides. The radiographer shall survey the storage area surfaces and record readings on a complete form K-26 "Survey of Storage Area".

101.4 Storage Area Radiation Level

101.4.1 The maximum permissible radiation level shall be 0.6 mr/hr at any surface except as permitted below.

101.4.2 If the storage area is located a distance equal to or greater than the largest dimension (diameter or side) of the storage area from all areas which are occupied by a person(s) more than 50 hours in seven consecutive days, the maximum permissible radiation level may be 2 mr/hr.

RELATION	0	1	2	3	4	5	6	7
DATE	A. BURGE							
APPROVED	10 APR 85							
	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-IVA

PAGE

CONT.
ON
PAGE

TRANSPORTATION WITHIN JOBSITE LIMITS

1

100 The Radiographer shall be responsible for the movements of Shipping Containers and Projectors about the jobsite.

100.1 The Radiographer shall see that his exposure and that of his assistant from the surface of Projectors and Shipping Containers is kept to a minimum by employment of the advantages of distance and time. So that exposure will not be a limitation on the number of radiographs that can be taken by the Radiographer, the Radiographer, where ever possible, should so supervise the work that the Assistant Radiographer, if one is available, is physically transporting the equipment with the Radiographer making the shots.

100.2 The Radiographer shall label any truck, or other conveyance, including elevators, on all four sides, if possible, with the radiation symbol sign reading: "Caution (or Danger) Radioactive Materials."

100.3 The Radiographer should limit personnel in any truck or other conveyance to himself, his assistant, and driver.

NOTE: While no personnel monitoring equipment will probably be required for the driver (operator in the case of a crane or elevator) if the Radiographer so supervises the handling that the driver is exposed, if at all, for only a few minutes, he is A THIRD PERSON AND MUST BE TREATED AS SUCH. (For further discussion on third parties, see PROC. REF. B-VIII RADIOGRAPHIC AREA CONTROL, 101.6 and 102.6 Personnel Monitoring.)

100.4 The Radiographer, if the need arises, may obtain the assistance of certain other construction personnel as may be assigned to him by the Construction Superintendent in order to move or assist in the movement of equipment within the jobsite limits. Such persons ARE TO BE ISSUED THE SAME PERSONNEL MONITORING EQUIPMENT AS IS REQUIRED FOR RADIOGRAPHERS under IX PERSONNEL MONITORING EQUIPMENT USE AND RECORDS of this PART B and the records required thereunder shall also be kept as to them. HOWEVER, such persons are NOT to act as Radiographer's Assistants as they are not so qualified.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10APR85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-IVB

TRANSPORTATION OUTSIDE JOBSITE LIMITS

PAGE

1

CONT.
ON
PAGE

2

100 RESPONSIBILITY AND PREPARATION FOR TRANSPORTATION

100.1 The Radiographer shall be responsible for the transportation of shipping containers by private or company motor vehicle, and the preparation for shipment of a shipping container by a common carrier between KRC jobsites and other KRC facilities.

100.1.1 The shipping container shall be surveyed by a Radiographer prior to transportation or shipment. The survey shall be performed in accordance with PROC. REF. B-VII of the KRC Radiography Program, "Radiation Survey Instruments and Use".

100.1.2 A Radiographer shall be in constant attendance during transportation by private or company motor vehicle of a loaded shipping container and during the preparation of a shipping container for shipment by a common carrier.

100.1.3 The attending Radiographer shall verify that each individual assisting in the transportation of a shipping container by private or company vehicle or assisting in the preparation of a shipping container for transportation by a common carrier is wearing radiation detection devices as specified in PROC. REF. B-IX, "Personnel Monitoring Equipment, Use and Records". The records required shall be maintained accordingly.

101 TRANSPORTATION BY PRIVATE OR COMPANY MOTOR VEHICLE

101.1 When transportation of loaded shipping containers to field sites or other remote locations is accomplished by a private or company motor vehicle. The vehicle shall be clearly marked with the standard radiation caution symbol and the word "Radioactive". Letters shall be black and at least four inches high on a yellow background and shall be displayed on the front, rear, and each side of the transporting vehicle.

101.1.1 The shipping container shall be firmly secured inside the transporting vehicle by the use of ropes, straps or wedge blocks as to avoid bouncing or other movement.

101.1.2 The outer surfaces and the passenger compartment of the transporting vehicle shall be surveyed with calibrated radiation survey meter in order to ensure that radiation levels do not exceed 2 mr/hr. Lead or other shielding materials shall be added around the shipping container if necessary to reduce the radiation level. The shielding shall also be secured to make it immobile.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-IVB

TRANSPORTATION OUTSIDE JOBSITE LIMITS

PAGE

2

CONT.
ON
PAGE

101.1.3 The level of radiation in the passenger area of the transporting vehicle shall be periodically checked with the Radiation Survey Meter during the transportation operation. A noticeable change in the radiation level may indicate that the shielding or the shipping container has shifted. If this occurs, the vehicle shall be stopped and the shipping container and its shielding shall be secured. The vehicle shall then be resurveyed.

101.1.4 Whenever a shipping container is transported on public roads in a private or company vehicle, at least one copy of KRC Form "Shipper's Certification for Radioactive Materials", properly completed, shall be placed in the drivers area.

101.1.5 The following equipment shall be packed in the passenger area of the transporting vehicle:

- (a) At least two operable survey meters which have been calibrated within the preceding 90 days (with spare batteries).
- (b) At least 500 feet of barricade rope or tape.
- (c) At least five (5) "Danger High Radiation Area" signs.
- (d) At least ten (10) "Danger or Caution Radiation Area" signs.
- (e) A copy of the KRC Radiography Program Manual.

101.1.6 In case of any accident involving a motor vehicle transporting a loaded shipping container, the Emergency Procedures specified in PROC. REF. B-XIV "Emergency Procedures" shall be followed.

102 SHIPPING BY COMMON CARRIER

102.1 Shipment of Shipping Containers between jobsites and other KRC Facilities by a common carrier shall be performed in accordance with PROC. REF. B-VI "Shipping Instructions" with the following exception:

102.1.1 Complete KRC Form "Shipper's Certification for Radioactive Materials" per instructions and retain a copy.

103 SOURCE RECEIVED RECEIPT

103.1 Request a "Source Receipt" from the jobsite or other KRC facilities receiving the shipping container. When received, file the receipt and send one copy to the Radiation Protection Officer.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10APR85							
APPROVED	K. KLUGE							

460615

SHIPPER'S CERTIFICATION FOR RADIOACTIVE MATERIALS

(TWO COMPLETED AND SIGNED COPIES OF THIS CERTIFICATION
SHALL BE HANDED TO THE CARRIER) (PRINT OR TYPE)

THIS SHIPMENT IS WITHIN THE LIMITATIONS PRESCRIBED FOR CARGO - ONLY AIRCRAFT OR SURFACE							
NATURE AND QUANTITY OF CONTENT					PACKAGE		
PROPER SHIPPING NAME	RADIO-NUCLIDE	GROUP	FORM	ACTIVITY NUMBER OF CURIES	CATEGORY I -WHITE II -YELLOW III-YELLOW	TRANSPORT INDEX	TYPE AND NRC ID NUMBER
SPECIAL FORM N.O.S. NA 9182 CARGO AIRCRAFT ONLY OR SURFACE	IRIDIUM 192 COBALT 60	III	SPECIAL FORM ENCAPSULATION		YELLOW II	1	TYPE "B" USA/ B(U)
<u>ADDITIONAL CERTIFICATES OBTAINED BY THE SHIPPER WHEN NECESSARY</u> SPECIAL FORM ENCAPSULATION CERTIFICATE XX TYPE "B" PACKAGING CERTIFICATE XX							
<u>SPECIAL HANDLING INFORMATION</u> FOR CARGO AIRCRAFT ONLY OR SURFACE TRANSPORTATION							
I hereby certify that the contents of this consignment are fully and accurately described above by proper shipping name, and are classified, packed, marked, labelled and in proper condition for carriage by air according to National government regulations, and for International shipments the current IATA Restricted Article Regulations.							
NAME AND FULL ADDRESS OF SHIPPER				NAME AND TITLE OF PERSON SIGNING CERTIFICATE			
KELLOGG RUST CONSTRUCTORS INC.				RADIOGRAPHER			
				SIGNATURE			



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-VLEAK TESTING, REPAIR, TAGGING,
OPENING, MODIFICATION AND REPLACE-
MENT OF SEALED SOURCES

PAGE

1

CONT.
ON
PAGE

2

100 REPAIRING, OPENING AND MODIFICATION

100.1 The repair, opening or any other modifications of a projector or sealed source container shall be performed only by persons specifically authorized by the N.R.C. or authorities of the agreement state to do so. All such work with regard to KRC equipment is to be performed by the supplier thereof and the Radiographer shall communicate with such supplier; for a Radiographer or his assistant to perform or attempt to perform such work is a violation of the KRC License.

101 LEAK TESTING

101.1 Each source is required by N.R.C. Regulations to be leak tested at intervals not to exceed six (6) months, or as specified by the regulations of the applicable agreement state.

101.2 Each new source, upon receipt, shall be checked for a leak test record. Any leak test which reveals the presence of 0.005 microcurie or more of removable radioactive material shall be considered evidence that the sealed source is leaking. The Radiographer shall immediately stop work with the equipment, place it in a storage area and immediately arrange for the supplier to remove it from the jobsite. The Radiographer shall also notify the Radiation Protection Officer as he must notify the N.R.C. or Agreement State Authority.

101.3 All leak test reports are to be transmitted to the Radiation Protection Officer in Houston for record purposes.

101.4 Five months after the last leak test, the Radiographer shall perform a leak test with one of the following leak test kits:

101.4.1 Technical Operation's leak test kit - Model 518.

101.4.2 Gamma Industries KOWIPE leak test kit.

101.4.3 Gulf Nuclear LTK-1 leak test kit.

101.4.4 Suntrac Services SIT-1 leak test kit.

101.5 Leak Test Kit Contents:

Flexible swab holder with swab
Vial of Edta solution (unless premoistened swab or wipe)
Plastic envelope
Mailing box
Identification sheet

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

LEAK TESTING, REPAIR, TAGGING,
OPENING, MODIFICATION AND REPLACE-
MENT OF SEALED SOURCES

PROC. REF
B-V

PAGE

2

CONT.
ON
PAGE

3

101.6 Leak Test Procedure

101.6.1 Be sure source is fully retracted into projector (use a survey meter to be sure that radiation levels are normal).

101.6.2 Remove source tube from face of shield or remove shipping plug.

101.6.3 Wet the swab with Edta Solution (SIT-1 leak test kit contains premoistened swabs). Shake off excess and insert the swab into the hole in the shield. Wipe the interior of the hole thoroughly by rotating swab holder.

101.6.4 Withdraw swab and place in plastic envelope.

101.6.5 The swab should now be monitored by turning the survey meter to its most sensitive range. Place the meter in a low background area and move the swab in its plastic envelope to the meter, not the meter to the swab.

101.6.6 If there is no indication on the meter, or if the indication is no more than 0.2 MR per hour above background, put the plastic envelope with the swab in the mailing box and mail to the vendor. Be sure to fill out and return the identification sheet.

101.6.7 If the swab should show more than 0.2 MR per hour, do not mail. Contact Technical Operations, Inc. for specific instructions. Notify the Radiation Protection Officer immediately.

102 REPLACEMENT OF SEALED SOURCES

102.1 Source Changers

The source changers used are T/O designed to contain 200 curies ($\pm 20\%$) of IR 192 using depleted U238 shielding to meet the requirements for DOT Type B shipping container and to permit field exchange of old for new sources without exposing the radiographer to unsafe radiation levels. The source changers are shipped with the following:

- (a) Source decay chart and leak test certificate for new source.
- (b) Source identification plate. Affix to project or it is placed in.
- (c) Return shipping labels.
- (d) Tamperproof seals.
- (e) Instruction Manual.

Return the container promptly and prepaid. Rental charges will be made for containers held beyond normal transportation time.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

LEAK TESTING, REPAIR, TAGGING,
OPENING, MODIFICATION AND REPLACE-
MENT OF SEALED SOURCES

PROC. REF.
B-V

PAGE

3

CONT.
ON
PAGE

4

102.2 Drive Cable to Source Assembly Connection

102.2.1 To Engage Connectors

(a) With fingernail move lock pin back from keyway (Pressure on pin is downward toward stored position of source).

(b) Slide drive - cable connector into keyed sleeve and release pin.

(c) Test connection by pulling between source and drive cable.

WARNING

DO NOT MOVE SOURCE ASSEMBLY MORE THAN 1/2 INCH FROM ITS STORED POSITION WHEN CONNECTING/DISCONNECTING OR WHEN TESTING FOR PROPER CONNECTION.

102.2.2 To Disengage Connectors

(a) With fingernail move lock pin back from keyway.

(b) Slide drive - cable connector out through keyway and release pin.

CAUTION

MOVE CONNECTOR SIDEWAYS ONLY. DO NOT BEND OR TWIST.

102.3 Source Changing Instruction T/O 660 Projector

102.3.1 Locate the 650 source changer and 660 projector in a restricted area.

102.3.2 Position the units to minimize any bend radius in the source guide tube and control cable and set the projector as for an exposure and the source changer in the upright position.

102.3.3 Open the source changer

(a) To remove the cover, break the seal and unbolt.

(b) To remove the source hold down cap, break seal and unbolt.

CAUTION

WHEN CAP IS REMOVED, SOURCE CONNECTOR IS EXPOSED. SPECIAL CARE SHOULD BE TAKEN NOT TO DISLODGE SOURCE WHEN HANDLING THE CHANGER.

102.3.4 Connect extension source guide tube from projector to the fitting above empty chamber (avoid sharp bends).

102.3.5 Close and latch the source guides.

REVISION	0	1	2	3	4	5	6	7
BY	A.BURGE							
DATE	10APR85							
APPROVED	K.KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-7LEAK TESTING, REPAIR, TAGGING,
OPENING, MODIFICATION AND REPLACE-
MENT OF SEALED SOURCES

PAGE

4

CONT.
ON
PAGE

5

102.3.6 Crank source into the source changer.

102.3.7 Approach the exposure device, source changer and source guide tube with the survey meter. Survey the exposure device on all sides, to assure that the source is not in the device, survey the guide tube and survey the source changer on all sides to ensure that the source is fully within the source changer.

102.3.8 Open the guides and disconnect the cable from the source assembly.

102.3.9 Disconnect the source guide tube from the changer.

102.3.10 Connect the guide tube to the fitting above the camber containing the new source.

102.3.11 Crank the projector drive cable until the connector butts the source connector.

102.3.12 Couple the connectors.

WARNING

WHEN TESTING CONNECTORS FOR PROPER CONNECTION, DO NOT MOVE SOURCE MORE THAN 1/2 INCH FROM ITS STORED POSITION.

102.3.13 Close and latch the source guides.

102.3.14 Crank source to full retraction within projector.

102.3.15 Survey the exposure device and source guide tube to assure that the source is in the projector.

102.3.16 Lock the projector.

102.3.17 Disconnect the source guide tube from changer.

102.3.18 Affix ID plate of new source to projector.

102.3.19 Perform receiving as required by Proc. Ref. B-II-101.

102.3.20 Prepare source changer for shipping.

- (a) Attach ID plate of old source to hold down cap.
- (b) Bolt holddown cap in place and seal (source guides open).
- (c) Bolt changer cover in place and seal.
- (d) Affix proper shipping labels and return to Technical

REVISION	0	1	2	3	4	5	6	7
BY	A.BURGE							
DATE	10 APR 85							
APPROVED	K.KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-VLEAK TESTING, REPAIR, TAGGING,
OPENING, MODIFICATION AND REPLACE-
MENT OF SEALED SOURCES

PAGE

5

CONT.
ON
PAGE

6

Operations, Inc. Complete shipping labels, surveys, and documentation required in Proc. Ref. B-VI Shipping Instructions.

102.4 Source Changing Instructions T/O 900, 910 and 920 Projectors

102.4.1 Locate the 850 source changer and 900, 910 or 920 projector in a restricted area.

102.4.2 Position the units to minimize any bend radius in the source guide tube and control cable and set the projector as for an exposure and the source changer in the upright position.

102.4.3 Remove the source changer cover plate by breaking the seal wire and removing the bolts.

102.4.4 Connect extension source guide tube from the projector to the fitting above the empty chamber (avoid sharp bends).

102.4.5 Assure that the lock assembly of the chamber containing the source is in the locked position. Unlock the key operated lock over the empty chamber and slide the lock bar to the OPEN position.

102.4.6 Crank the source into the source changer.

102.4.7 Approach the exposure device, source changer and source guide tube with the survey meter. Survey the exposure device on all sides to assure that the source is not in the device, survey the guide tube and survey the source changer on all sides to ensure that the source is fully within the source changer.

102.4.8 Slide the lock bar to the locked position and engage the key operated lock.

WARNING

DO NOT REMOVE THE GUIDE TUBE FROM THE SOURCE CHANGER FITTING UNTIL THE LOCK SLIDE IS IN THE LOCK POSITION AND THE KEY OPERATED LOCK IS ENGAGED.

102.4.9 Disconnect the source guide tube from the source changer lock assembly. Disconnect the drive cable from the source assembly.

102.4.10 Couple the drive cable to the new source assembly and connect the source guide tube to the fitting on the source changer. Unlock the key operated lock on the chamber containing the source to be transferred and slide the lock bar to the OPEN position.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10APR85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

LEAK TESTING, REPAIR, TAGGING,
OPENING, MODIFICATION AND REPLACE-
MENT OF SEALED SOURCES

PROC. REF.
B-V

PAGE

6

CONT.
ON
PAGE

102.4.11 Crank the source to full retraction within the projector.

102.4.12 Survey the exposure device and source guide tube to assure that the source is in the projector.

102.4.13 Lock the projector.

102.4.14 Disconnect the source guide tube from the changer.

102.4.15 Affix the ID plate of the new source to the projector.

102.4.16 Perform receiving as required by Proc. Ref. B-II-101.

102.4.17 Prepare source changer for shipping.

(a) Attach ID plate of old source to source changer.

(b) Remove the keys from the lock plungers and bolt the two cover plates to the source changer and seal.

(c) Affix proper shipping labels and return to Technical Operations, Inc. Complete shipping labels, surveys and documentation required in Proc. Ref. B-VI Shipping Instructions.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
B-VI

PAGE

CONT.
ON
PAGE

1

2

SHIPPING INSTRUCTIONS

100 GENERAL

To prepare the radioactive material for shipment the Radiographer shall survey the projector or source changer and complete the necessary forms and labels. He shall place the labels on the shipping containers.

101 SHIPPING PLUG AND SEAL

The Radiographer shall verify that the shipping plug is in place for projectors and that the seals are attached on both projectors and source changers.

102 RADIATION LEVELS

The Radiographer shall record the radiation levels in mr/hr six inches from the projector or source changer on the running inventory form K-25.

103 HAZARDOUS MATERIAL LABEL

103.1 Determination of Proper Label

Packages shipped by KRC will almost always be Yellow-II. Survey the package on all sides; both at the surface and one meter (3.3 feet) from the surface. The surface readings shall not exceed 50 mr/hr and the readings at one meter shall not exceed 1 mr/hr. If the readings comply with this the label is Yellow-II and the transportation index is 1. If any of the readings exceed these limits, contact the RPO for instructions on shipment as Yellow-III.

103.2 Label Information

Complete two labels using a weather durable marker with the following information:

103.2.1 Contents: Iridium 192 or Cobalt 60.

103.2.2 Activity: Current activity in curies followed by the word "curies".

103.2.3 Transport Index: 1.

103.3 Label Attachment

Attach the two labels on the container on opposite sides.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
B-VI

PAGE

2

CONT.
ON
PAGE

SHIPPING INSTRUCTIONS

104 SHIPPER'S CERTIFICATION

104.1 Complete KRC's form "Shipper's Certification for Radioactive Materials" in duplicate by

104.1.1 RADIONUCLIDE: X out the inappropriate isotope.

104.1.2 ACTIVITY: Put in current number of curies.

104.1.3 TYPE AND NRC ID NO.: Complete the NRC ID Number using the appropriate number as determined below:

TECHNICAL OPERATIONS MODEL NUMBER	DEVICE	NRC ID NO.
650	SOURCE CHANGER	USA/9032 B(U)
660	PROJECTOR	USA/9033 B(U)
680	PROJECTOR	USA/9035 B(U)
683	PROJECTOR	USA/9053 B(U)
684	PROJECTOR	USA/9028 B(U)
741	PROJECTOR	USA/9027 B(U)
850	SOURCE CHANGER	USA/9147 B(U)
900	PROJECTOR	USA/9141 B(U)
910	PROJECTOR	USA/9149 B(U)
920	PROJECTOR	USA/9143 B(U)

104.1.4 NAME AND FULL ADDRESS OF SHIPPER: Your full address (jobsite).

104.1.5 NAME AND TITLE OF PERSON SIGNING CERTIFICATE: Print or type name on line above RADIOGRAPHER and sign both copies.

104.2 Retain a copy and give two originals to carrier.

105 SHIPPING LABEL

Place a shipping label on the box which has Technical Operations address on it.

1 SOURCE RETURN RECEIPT

Request a source return receipt from Technical Operations. When received, file the receipt and send a copy to the Radiation Protection Officer immediately.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
B-VII

PAGE

CONT.
ON
PAGE

RADIATION SURVEY INSTRUMENTS AND USE

1

2

100 AUTHORIZED MANUFACTURER/MODELS

The radiation survey instruments shall be a Ludlum-Model No. 4 or 5, a Victoreen - Model 492, an Eberline - Model E-510-G or a G.E. Smith - Model GS-1000. All survey instruments used shall be capable of measuring through the range of 0 Milliroentgens per hour through 1 Roentgen per hour.

101 PROCUREMENT

The Radiographer shall procure his survey instrument from the KRC Tool Depot in South Houston.

102 CALIBRATION

102.1 No survey meter shall be accepted for use or used by a Radiographer unless it has been calibrated within three (3) months of date of delivery or of use as the case may be, as shown on the calibration date tag attached to the survey meter and the Certification of Calibration which shall also specify that the calibration was a 2 points of each scale.

102.2 NO CALIBRATION BY A RADIOGRAPHER - All calibration will be performed by one of the following qualified subcontractors employed for that purpose by the South Houston Tool Depot:

Nuclear Sources and Services	- Houston, Texas
Gamma Industries	- Houston, Texas
Atomic Energy Laboratories of	
The Southwest	- Houston, Texas
G.E. Smith	- Houston, Texas

Qualified subcontractors will be employed by The South Houston Tool Depot, not the jobsite, thus, the radiographer must anticipate the need for calibrated survey instruments in time to request them without interference of his schedule.

102.3 Subcontractors performing survey instrument calibrations shall calibrate the instrument at two points on each scale and the instruments reading after adjustment shall read within $\pm 20\%$ of the actual radiation level. The Subcontractor shall provide a certificate of calibration indicating the meter type and serial number, date of calibration, what radiation field strengths were used at the two points on each scale and what the survey instrument indicated.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-VII

PAGE

2

CONT.
ON
PAGE

RADIATION SURVEY INSTRUMENTS AND USE

102.4 In order to insure a separate record of latest calibration of a survey meter, upon receipt of a meter, the Radiographer shall check the Certification of Calibration against the tag information. A calibration tag should be attached to the survey meter at all times. The Radiographer shall immediately send a copy of the Certification of Calibration to the RPO.

103 USE OF INSTRUMENT

103.1 A RADIOGRAPHIC OPERATION shall NOT be conducted UNLESS a calibrated and operable radiation survey meter as described in 100, AUTHORIZED MANUFACTURER/MODELS, above, is available and used at each site where the radiographic exposures are made. The Radiographer shall, therefore, use his survey meter to make a physical radiation survey of each Shipping Container or Projector:

103.1.1 before removal from storage,

103.1.2 before, during, and at the end of any movement thereof,

103.1.3 after each exposure to determine that the source has been returned to its shielded condition,

103.1.4 prior to securing the Projector or Shipping Container to determine that the source is in its shielded condition,

103.1.5 to determine if the Shipping Container or Projector is acceptable for delivery to him, and

103.1.6 to determine and maintain area control and for any other purpose required by applicable regulations or instructions of the Radiation Protection Officer.

104 SURVEY RECORDS

The Radiographer shall maintain a record of the result of physical radiation surveys made of each Shipping Container or Projector

104.1 before removing the projector from the storage area,

104.2 after the projector has been returned to the storage area. The record of surveys shall be kept in duplicate on the "INDIVIDUAL WHOLE BODY RADIATION DOSAGE RECORD" K-24. The original of each of these reports to be transmitted monthly to the Radiation Protection Officer in Houston with the duplicate retained at the jobsite.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-VII SUPP

PAGE

1

CONT.
ON
PAGE

2

SURVEY INSTRUMENT CALIBRATION

100 AUTHORIZATION OF CALIBRATION BY RADIOGRAPHER

With specific permission from the Radiation Protection Officer, Radiographers may calibrate survey instruments as delineated in this procedure.

101 PERSONNEL TRAINING AND QUALIFICATION

101.1 Only trained, tested and certified KRC Radiographers shall be allowed to perform survey instrument calibrations.

101.2 Personnel designated to calibrate survey instruments shall be administered a minimum of two hours training, covering basic radiation safety and preparation and operation of the Tech/Ops Meter Calibration Kit. Personnel shall satisfactorily demonstrate the ability to calibrate survey instruments following this procedure.

102 RADIATION SOURCE

Type - Cesium 137

Initial Strength - 165 Millicuries

Calibration Certified by Tech/Ops, Inc.

Source Model No. - Tech. Ops 77302

103 SOURCE SHIELDING DEVICE

Tech/Ops Model 773 meter calibration kit consisting of a cesium 137 source permanently attached to a movable rod which is installed in a lead shield casting. This assembly is enclosed in a welded steel cylinder which measures 5 inches wide, 5 inches deep and 8-1/2 inches high. The unit is equipped with a carrying handle which also serves as a source locking bar to prevent unauthorized use of the calibrator. A shipping cover is also attached to provide an additional means of securing the source.

The source is exposed by raising the source rod which positions the source in a 36° x 20° collimated beam port.

The unit is equipped with three attenuators (Transmission of 0.25, 0.10 and 0.10) to allow a survey instrument with three ranges to be calibrated at 20% and 80% of each range without changing the position of the survey instrument. The Model 773 can be used to calibrate survey instruments with ranges up to 2000 milliroentgens per hour.

REVISION	0	1	2	3	4	5	6	7
BY	A.BURGE							
DATE	10APR85							
APPROVED	K.KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
B-VII SUPP

PAGE

2

CONT.
ON
PAGE

3

SURVEY INSTRUMENT CALIBRATION

104 SAFETY OF OPERATING PERSONNEL

Personnel operating the Model 773 Meter Calibration Kit shall use a calibrated and operable survey instrument and wear personnel monitoring devices as prescribed by PROC. REF. B-IX of the KRC Radiography Program.

105 PROCUREMENT OF METER CALIBRATION KIT

105.1 Meter Calibration Kits shall be procured from Technical Operations, Inc.

105.2 All Procurement shall specify that the supplier is responsible for all transportation to and from the jobsite, with all deliveries to and re-deliveries from the Radiographer to take place at the jobsite.

105.3 Only the Model 773 Meter Calibration Kit shall be ordered.

106 RECEIVING THE 773 METER CALIBRATION KIT

106.1 Delivery shall not be accepted unless the Meter Calibration Kit is labeled with the radiation symbol sign reading: "Caution (or danger) Radioactive Materials", and has a label stating the quantity and kind of radioactive material in the calibration kit and the date of measurement of the quantity.

106.2 Survey the device for excessive radiation levels. Delivery shall not be accepted if the maximum surface radiation level exceeds 200 mr/hr at the surface and 10 mr/hr at three feet from the surface of the device. Inspect the device for shipping damage and insure that the device is locked.

106.3 Delivery shall not be accepted unless a leak test certificate is received from the supplier showing a leak test of the source contained therein was performed within six (6) months prior to the time of attempted delivery.

106.4 The results of the radiation level check at the time the meter calibration kit is received are to be recorded on K-25 "Radiography Equipment - Running Inventory Control and Quarterly Physical Inventory". This form is to be sent to the Radiation Protection Officer immediately upon receipt and checking of the meter calibration kit. This form is also to be used for a quarterly physical inventory report to the R.P.O. each calendar quarter.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-VII SUPP

PAGE

CONT.
ON
PAGE

SURVEY INSTRUMENT CALIBRATION

3

4

106.5 When it has been determined by the Radiographer receiving the calibration source that the requirements of 106.1 through 106.4 have been met, he shall write on the Leak Test Report:

Received _____ (date) _____ and sign immediately below. The original of this shall be sent immediately to the R.P.O. The Radiographer shall retain a copy.

107 STORAGE OF THE METER CALIBRATION KIT

107.1 Permanent nature storage space shall be chosen with a view to exclusive use for radiation producing device storage, if possible, and in any event shall be capable of being locked and kept so locked. The Radiographer assigning the duties of meter calibration shall be responsible for safe keeping of the keys to the calibration kit storage area.

107.2 Where separate storage space is not obtainable, and part of a general locker storage space must be used, all radiation producing equipment is to be segregated in one part of the area which shall be roped off or otherwise clearly delineated and marked. All storage areas shall be identified by the use of radiation symbol signs reading "Caution (or danger) Radioactive Materials". Locked access doors to storage areas shall be marked with such a sign.

107.3 The maximum permissible radiation level shall be 0.6 mr/hr. at any storage area surface or boundary.

10 The person responsible for calibration shall survey the storage area, surfaces or boundaries and record readings on and complete Form K-26 "Survey of Storage Area".

108 SHIPPING THE METER CALIBRATION KIT

108.1 Write the appropriate Isotope, the number of Millicuries contained, and the radiation level on the exterior of the package, onto the shipping label.

108.2 Check that the source handle is locked in a shielded position.

108.3 Record the radiation levels at 6" from the calibration kit on all sides and at crate exterior.

108.4 Affix shipping label.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-VII SUPP

PAGE

4

CONT.
ON
PAGE

5

SURVEY INSTRUMENT CALIBRATION

108.5 Complete Technical Operations Form "Shippers Certification for Radioactive Materials" per instructions and retain a copy.

108.6 Request "Source Return Receipt" from Technical Operations. When received, file the receipt and send one copy to the Radiation Protection Officer immediately.

109 LEAK TESTING OF THE CALIBRATION KIT

Leak Testing shall be performed on the Meter Calibration Kit at intervals not to exceed six (6) months. Any leak test which reveals the presence of .005 microcurie or more of removable radioactive material shall be considered evidence that the sealed source is leaking. The Radiographer responsible for calibration shall immediately stop work with the calibrator, place it in its storage area and immediately arrange for the supplier to remove it from the jobsite. The Radiation Protection Officer shall be notified as he must notify the N.R.C. or Agreement State Authority. All Leak Test Reports are to be transmitted to the Radiation Protection Officer in Houston for record purposes.

109.1 Five months after the last leak test, the Radiographer responsible for meter calibration shall perform a leak test with a Technical Operations Leak Test Kit Model 518 following steps 1 through 9:

109.1.1 Place the Model 773 calibrator in a restricted area.

109.1.2 Remove the lock and rotate the handle from the top of the source rod. Remove the shipping cover.

109.1.3 Moisten the leak test swab with EDTA solution. Blot off the excess.

109.1.4 Wipe around the top of the source rod.

109.1.5 Standing away from the beam port, raise the source rod to the open position and wipe the exposed source rod thoroughly.

109.1.6 Place the leak test swab in the plastic envelope.

109.1.7 Set the survey meter on its most sensitive range and place the meter in a low background area. Move the swab, in its plastic envelope, to the meter, not the meter to the swab.

109.1.8 If the meter indication is less than 0.2 mr/hr. above background, place the plastic envelope with the swab into the mailing

REVISION	0	1	2	3	4	5	6	7
BY	A.BURGE							
DATE	10APR85							
APPROVED	K.KLUGE							

460615



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-VII SUPPPAGE
5CONT.
ON
PAGE
6

SURVEY INSTRUMENT CALIBRATION

box and mail to vendor. BE SURE TO FILL OUT AND RETURN THE IDENTIFICATION SHEET.

109.1.9 If the swab should show more than 0.2 mr/hr. DO NOT MAIL. Contact vendor for specific instructions and notify the Radiation Protection Officer immediately.

110 RADIATION AREAS

110.1 Radiation Area Control shall be in accordance with PROC. REF. B-VIII of the KRC Radiography Program.

111 PREPARING THE MODEL 773 FOR USE

111.1 Place the source shield in a restricted area so that the directional port is aimed horizontally. To minimize the effects of scattered radiation, the unit should be 16 feet from any wall in the direction of the primary beam.

111.2 Position a support horizontally from the Model 773 Instrument Calibration Device as shown in Figures 1 and 2.

111.3 Restrict access to the area where the radiation level is in excess of 2 milliroentgens per hour (See Figure 4).

112 OPERATING PROCEDURE*

112.1 Replace batteries in survey meter.

112.2 Turn on survey meter, and set the unit on the proper scale (See specific instructions). Allow it to "warm up" for approximately 10 minutes

112.3 Approach the meter calibrator with an operable, calibrated survey meter to check that the source is properly shielded.

112.4 Determine the activity of the source on the date of calibration from the decay chart provided with the source.

*NOTE

(a) The Ludlum Models 4 and 5 are both adjusted using the procedure specified for the Model 4.

(b) The Victoreen Model 492 and the G.E. Smith Model GS-100 can be adjusted using the procedure specified for the Eberline Model E-510G.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10APR85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-VII SUPP

PAGE

CONT.
ON
PAGE

SURVEY INSTRUMENT CALIBRATION

6

7

112.5 Determine the distance from the source at which the radiation intensity would be 800 mr/hr (Use Figure 3).

112.6 Using the tape measure attached to the Model 773, place the survey meter such that the axis of the detector is located at the proper distance from the source as determined above. The survey meter should be located so that the center of the detector is at the correct distance and centered on the centerline of the radiation beam. Position the meter to allow reading of the scale without placing yourself in the radiation beam (See Figures 1 and 2).

112.7 Unlock the handle of the Model 773. Remove the shipping plate. Remove all the attenuators from the radiation beam.

112.8 **CAUTION:** DO NOT ENTER THE AREA OF THE RADIATION BEAM WHILE THE SOURCE IS EXPOSED. ALWAYS RETURN THE SOURCE TO A SHIELDED POSITION BEFORE REMOVING THE SURVEY METER FOR ADJUSTMENT OR USE.

113 SPECIFIC INSTRUCTIONS

113.1 Set the meter to the (X100) scale. Standing away from the radiation beam, expose the source by manually raising the source rod. Note and record the survey meter reading, return the source to the stored position. The actual intensity is 800 mr/hr. If the reading is within $\pm 20\%$ of the actual intensity, continue checking the instrument. If the instrument reading is not within $\pm 20\%$ of the actual intensity, the instrument must be adjusted as follows:

113.1.1 Ludlum Model 4 - Adjust with small screwdriver by turning pot adjacent to the (X100) marking through the small hole in the case.

113.1.2 Eberline Model 510G - Remove case from meter to gain access to the three internal calibration pots marked Cal. (X1), (X10), (X100). Adjust with a small screwdriver by turning the pot marked (X100).

113.2 After adjustment, the meter shall be recalibrated.

113.3 Place the 0.25 attenuator in the beam. Repeat 113.1; the actual intensity is 200 mr/hr. If the reading is within $\pm 20\%$ of the actual intensity, continue checking the instrument. If the instrument reading is not within $\pm 20\%$ of the actual intensity, make the necessary adjustments to the instrument following 113.1.1 or 113.1.2.

113.4 Set the meter to the (X10) scale. Remove the 0.25 attenuator and place a 0.10 attenuator in the beam. Standing away from the radi-

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10APR85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

 PROC. REF
B-VII SUPP

PAGE

 CONT.
ON
PAGE

SURVEY INSTRUMENT CALIBRATION

7

8

ation beam, expose the source by manually raising the source rod. Note and record the survey meter reading, return the source to the stored position. The actual intensity is 80 mr/hr. If the reading is within $\pm 20\%$ of the actual intensity, continue checking the instrument. If the instrument reading is not within $\pm 20\%$ of the actual intensity, the instrument must be adjusted as follows:

113.4.1 Ludlum, Model 4 - Adjust via pot adjacent the (X10) marking.

113.4.2 Eberline, Model 510G - Adjust via internal pot marked "cal. (X10)".

113.5 After adjustment, the meter shall be recalibrated.

113.6 Place the 0.25 attenuator in the beam. Expose the source as in 113.4. The actual intensity is 20 mr/hr. If the reading is within $\pm 20\%$ of the actual intensity, continue checking the instrument. If the instrument reading is not within $\pm 20\%$ of the actual intensity, make the necessary adjustments to the instrument following 113.4.1 or 113.4.2.

113.7 Set the meter to the (X1) scale. Remove the 0.25 attenuator from the beam and place both 0.10 attenuators in the beam. Standing away from the radiation beam, expose the source by manually raising the source rod. Note and record the survey meter reading, return the source to the stored position. The actual intensity is 8 mr/hr. If the reading is within $\pm 20\%$ of the actual intensity, continue checking the instrument. If the instrument reading is not within $\pm 20\%$ of the actual intensity, the instrument must be adjusted as follows:

113.7.1 Ludlum, Model 4 - Adjust via the pot adjacent the (x1) marking.

113.7.2 Eberline, Model 510G - Adjust via internal pot marked "Cal. (X1)".

113.8 After adjustment, the meter shall be recalibrated.

113.9 Place the 0.25 attenuator in the beam. Expose the source as in 113.7. The actual intensity is 2 mr/hr. If the instrument reading is within $\pm 20\%$ of the actual intensity, the instrument is calibrated. If the reading is not within $\pm 20\%$ of the actual intensity, make the necessary adjustments to the instrument following 113.7.1 or 113.7.2.

113.10 After adjustment, the meter shall be recalibrated.

REVISION	0	1	2	3	4	5	6	7
BY	A.BURGE							
DATE	10APR85							
APPROVED	K.KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-VII SUPP

PAGE

8

CONT.
ON
PAGE

9

SURVEY INSTRUMENT CALIBRATION

114 SECURING THE RADIATION AREA

114.1 After meter calibration operations are completed, the meter calibrator shall be locked and a final survey of the device shall be performed.

114.2 The calibrator may remain in a set-up condition on the horizontal support for extended periods, provided the calibration area meets the requirements for storage areas given in Paragraph 107.

115 DOCUMENTATION OF CALIBRATION

115.1 A certificate of calibration indicating meter type and serial number, date of calibration, what radiation field strengths were used and what the meter indicated in those fields, shall be filled out by the Radiographer performing the calibration. One copy of the certificate of calibration shall be sent to the Radiation Protection Officer. The original shall be kept by the Radiographer at the jobsite.

115.2 A calibration tag shall be placed on the meter to indicate when the meter was calibrated and by whom.

116 DEFECTIVE METERS

Any meter than cannot be calibrated shall be returned to supplier for repair.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-VII SUPP

PAGE

9

CONT.
ON
PAGE

10

SURVEY INSTRUMENT CALIBRATION

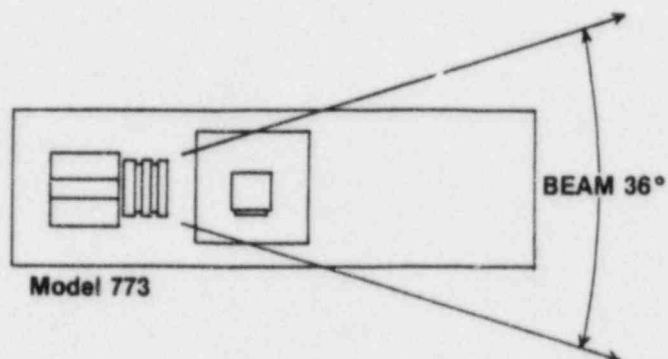


FIGURE 1

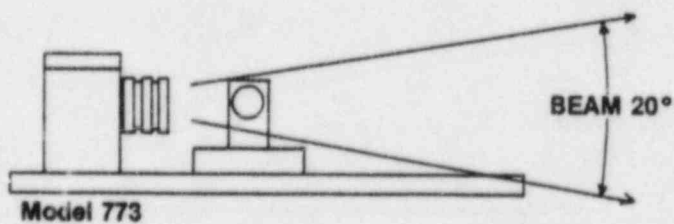


FIGURE 2

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

SURVEY INSTRUMENT CALIBRATION

PROC. REF.
B-VII SUPP

PAGE

10

CONT.
ON
PAGE

11

Figure 3

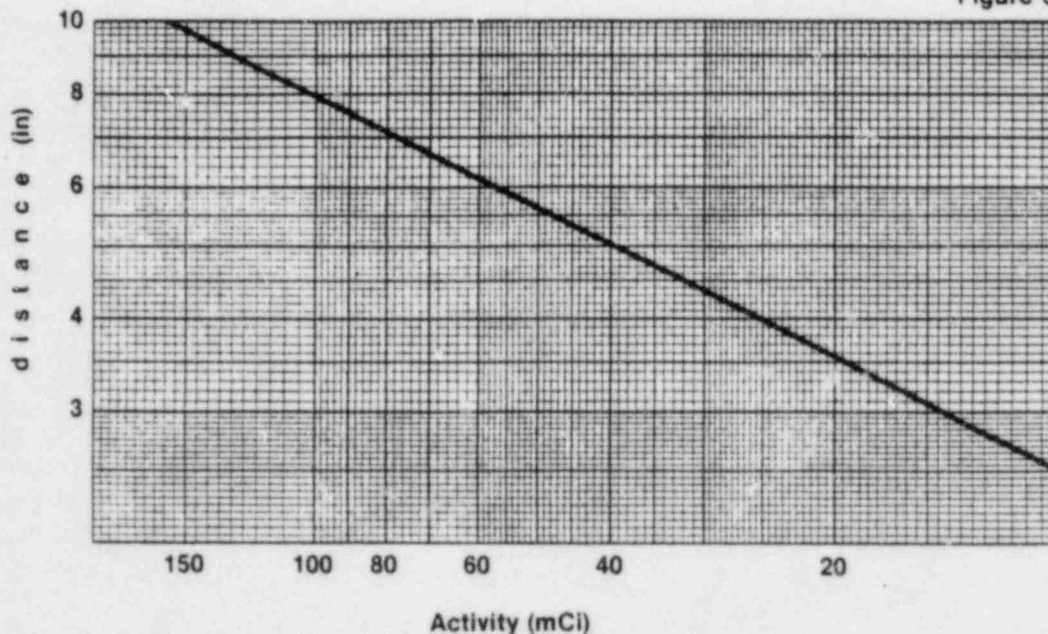
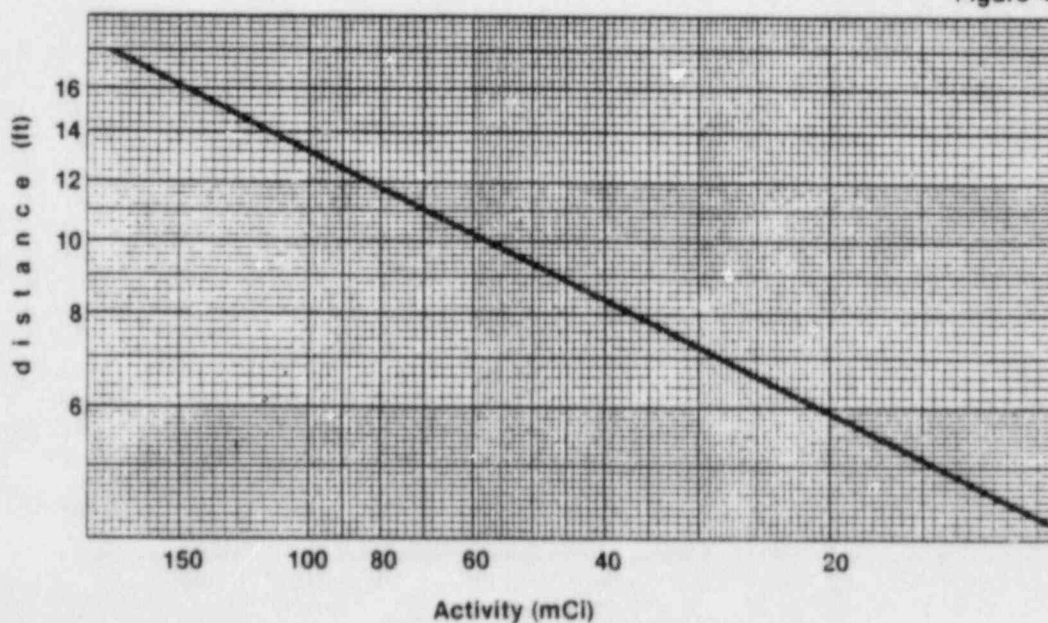


Figure 4



REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
B-VII SUPP

PAGE

11

CONT.
ON
PAGE

12

SURVEY INSTRUMENT CALIBRATION



Kellogg Rust Constructors

Calibration Date: _____

Calibration Due: _____

Calibration Performed by:

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-VII SUPP

PAGE

12

CONT.
ON
PAGE

SURVEY INSTRUMENT CALIBRATION

CERTIFICATE OF CALIBRATION

Location: _____

Job No.: _____

Instrument: _____

Serial No.: _____

Calibration Source: _____

Source Strength: _____

RANGE	CALIBRATION	POINT	READING
X1	_____	MR/HR	_____ MR/HR
X1	_____	MR/HR	_____ MR/HR
X10	_____	MR/HR	_____ MR/HR
X10	_____	MR/HR	_____ MR/HR
X100	_____	MR/HR	_____ MR/HR
X100	_____	MR/HR	_____ MR/HR

This is to certify the above named Instrument has been calibrated in accordance with the KRC Survey Instrument Calibration Procedure.

DATE _____ CALIBRATED BY: _____

SIGNATURE: _____

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							

460615



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-VIII

PAGE

CONT.
ON
PAGE

RADIATION AREA CONTROL

1

2

100 RESTRICTED AREA

100.1 Definition

This is the maximum area it is the Radiographer's obligation to control the access to for the purposes of protection of individuals from exposure to radiation.

100.2 Radiation Level

The radiation level outside the Restricted Area MUST NOT exceed 2 millirems/hour.

100.3 Determination

To establish limits the Radiographer should survey with his meter so as to "approach" the radiation from all directions, not only in the plane as if the source were to be used near the ground but also up and down when necessary due to the location of the source in regard to where other personnel might be working.

100.4 Control

The Radiographer shall string ropes, post light, and otherwise restrict access to the Restricted Area. Use of stairways, ladders and other means of access to the Restricted Area should be limited to persons who must by necessity make such use and such use should be limited, if at all possible, to "through passage" use and outside of the "Radiation Area: and, in any event, outside of the "High Radiation Area" described below.

100.5 Posting

While no posting is required, TO BE SAFE, post the "Radiation Area" signs described in Radiation Area - Posting, below.

100.6 Personnel Monitoring

(See 2.6 Radiation Area, Personnel Monitoring, below.)

100.7 Surveillance

Constant surveillance of the whole Restricted Area is not required and in many cases not possible. Therefore, the quality of your physical control and warning is very important. Emphasize the word "Restrict" in Restricted Area; plan to shut traffic away from your area; obtain aid from the construction superintendent if necessary - THINK AND PLAN!

REVISION	0	1	2	3	4	5	6	7
BY	A.BURGE							
DATE	10 APR 85							
APPROVED	K.KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-VIII

PAGE

2

CONT.
ON
PAGE

3

RADIATION AREA CONTROL

101 RADIATION AREA

101.1 Definition

(See Radiation Level, below.)

101.2 Radiation Level

"Radiation Area" means any area, accessible to personnel, in which there exists radiation, originating in whole or in part within licensed material, at such levels that a major portion of the body could receive in any one hour a dose in excess of 5 millirem, or in any 5 consecutive days a dose in excess of 100 millirems.

101.3 Determination

(See 100.3 Restricted Area Determination, above.)

101.4 Control

The Radiographer should string ropes and post lights to the limits of the Radiation Area with the intent to prevent access, not merely to restrict access.

101.5 Posting

Posting of this area is required. The Radiographer shall post at the limits of this area the radiation symbol sign reading "Caution (or Danger) Radiation Area".

101.6 Personnel Monitoring

For your obligations to yourself and others acting as a Radiographer or Radiographer's Assistant, see PROC. REF. B-IX PERSONNEL MONITORING EQUIPMENT, USE AND RECORDS. Third persons not Radiographers or their assistants in either Restricted Areas or Radiation Areas must be issued personnel monitoring equipment as soon as it is likely that they will receive (in case of those 18 years or over) a dose in excess of 25% of 1 1/4 rems/calendar quarter. Thus, you are to follow the RULE. All persons of whatever age who are doing anything more in a Restricted Area (which includes by definition a "Radiation Area") than "passing through" are to be issued at least (0-200 mr) dosimeters and badges, and records further described in PROC. REF. B-IX PERSONNEL MONITORING EQUIPMENT, USE AND RECORDS are to be kept as outlined there and, in any event, monitoring equipment is to be issued when the above exposure limits are likely to be exceeded.

REVISION	0	1	2	3	4	5	6	7
BY	A.BURGE							
DATE	10APR85							
APPROVED	K.KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
B-VIII

PAGE

CONT
ON
PAGE

RADIATION AREA CONTROL

3

4

101.7 Surveillance

Every attempt should be made to keep this area under constant surveillance. No loitering of any kind should be permitted. No other work of any kind other than radiography should be allowed within this area.

102 HIGH RADIATION AREA

102.1 Definition

(See Radiation Level, below.)

102.2 Radiation Level

"High Radiation Area" means any area, accessible to personnel, in which there exists radiation originating in whole or in part within licensed material at such levels that a major portion of the body could receive in any one hour a dose in excess of 100 millirems.

102.3 Determination

This should always be estimated by experience or calculations. Do not purposely survey to determine as it results in unnecessary exposure to the surveyor.

102.4 Control

No High Radiation Area shall be created unless the Radiographer or his assistant is personally in attendance to control the Area for the entire time it is in existence. Thus, any time a source is exposed, i.e. not in its projector at "safe" or in its shipping container, absolute control and surveillance is required to protect against unauthorized entry in the High Radiation Area.

102.5 Posting

Posting is required. The Radiographer shall post at the limits of this area the radiation symbol sign reading: "Caution (or Danger) High Radiation Area."

102.6 Personnel Monitoring Equipment

Every person without exception who enters a High Radiation Area must be equipped with the two types of dosimeters worn by the Radiographer and a film badge. The dosage rate condition for Restricted or Radiation Area does not apply.

REVISION	0	1	2	3	4	5	6	7
BY	A.BURGE							
DATE	10APR85							
APPROVED	K.KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
B-VIII

PAGE

4

CONT.
ON
PAGE

RADIATION AREA CONTROL

102.7 Surveillance

Direct surveillance is required to protect against unauthorized entry,
(See also discussion under 102.4, Control, above.)

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-IX

PERSONNEL MONITORING EQUIPMENT USE AND RECORDS

PAGE

1

CONT.
ON
PAGE

2

100 DOSIMETERS AND CHARGERS

100.1 Type

The Radiographer shall use in his work two dosimeters; one with a range of 0-200mr, Landsverk Model L-50 or Victoreen 541/A, 541/S, 541/R or W.H. Henken Model 862 and one with a range of 0-5r, Landsverk Model L-51 or Dosimeter Corporation of America Model 611 or Bendix Model 1200-5. Dosimeter chargers are to be Landsverk Model L-24 or Victoreen 2000A or Victoreen 750-5.

100.2 Procurement and Return

The Radiographer shall arrange with the Radiation Protection Officer in Houston to supply a minimum of two of each type of dosimeter for each Radiographer and/or Radiographer's Assistant on the job, together with an adequate number of Chargers, plus such extra dosimeters as he feels are necessary under the circumstances, keeping in mind that a person cannot perform radiography without wearing one of each. All defective or suspected defective dosimeters are to be returned to the RPO for replacement, marked "no good", together with remarks concerning apparent defect or damage.

100.3 Calibration Requirements

100.3.1 No 0-200 Mr Dosimeter shall be accepted for use or used by a Radiographer unless it has been calibrated within one (1) year of date of delivery or of use as the case may be.

100.3.2 0-5R Dosimeters do not require periodic calibration as they are used only as a general indicator of large doses of radiation should the 0-200 MR Dosimeter go off scale.

100.3.3 Upon receipt of Dosimeter, the radiographer shall check the Dosimeter Calibration Log Sheet against the serial number on each 0-200 MR Dosimeter received. The Radiographer shall immediately notify the Radiation Protection Officer if any of the required calibrations are not recorded.

100.3.4 All calibrations will be performed by the Radiation Protection Officer or the Assistant Radiation Protection Officer in Houston. Thus, the radiographer must anticipate the need for calibrated dosimeter in time to request them without interference in the work schedule.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							

460615



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
B-IXPERSONNEL MONITORING EQUIPMENT
USE AND RECORDS

PAGE

2

CONT.
ON
PAGE

3

100.4 Dosimeter Calibration Procedure

100.4.1 Dosimeters shall be calibrated using the Victoreen Dosimeter Calibrator Model 541-205 or The Dosimeter Corp. of America Model No. 3060.

100.4.2 Dosimeters shall be checked by inserting them into holes that are drilled in the calibrator concentrically about a 10 U Ci OR less cesium - 137 radioactive source, which is sealed in a well in the center of the calibrator.

100.4.3 Typically, a dosimeter shall be zero adjusted using a dosimeter charger and exposed for 7 - 8 hours to read 100 MR using an approximate activity of 10 U Ci of Cesium - 137.

100.4.4 To be acceptably accurate, the Dosimeter must measure within $\pm 30\%$ the amount of radiation exposure occurring during the test.

100.5 Documentation of Calibration

A Dosimeter Calibration Log Sheet indicating Dosimeter type and serial number, date of calibration, what radiation exposures were used and what exposure the Dosimeter indicated, shall be filled out by the person performing the calibration. One copy of Dosimeter Calibration Log Sheet shall be sent to the jobsite with the Calibrated Dosimeters. The original shall be kept by the RPO in the Houston Office.

100.6 Defective Dosimeters

Any Dosimeter that does not meet accuracy requirements will be returned to the supplier for repair or it will be discarded.

100.7 Use

100.7.1 No Radiographer or his assistant is to be engaged in radiography unless he is wearing one operable dosimeter each of the (0-200 mr) and (0-5r) working range.

100.7.2 All dosimeters shall be charged and zeroed at the beginning of each day and more frequently if need be. Inability to be zeroed is to be considered a defect.

100.7.3 Pocket dosimeters shall be checked by the wearer thereof no less than 4 times in the course of each 8 hours and immediately after any potentially hazardous occurrence. If at any time a check by the wearer indicates a reading of thirty (30) milliroentgens or more, all radiogra-

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
B-IX

PAGE

3

CONT.
ON
PAGE

4

PERSONNEL MONITORING EQUIPMENT USE AND RECORDS

phy shall cease and a check made to eliminate the unnecessary radiation hazard.

100.8 Recordation of Daily Readings

Pocket dosimeter readings shall be recorded daily (K-24)

101 FILM BADGES

101.1 Type and Procurement

The radiographer shall arrange for bi-weekly film badge and control badge service for his assistants and himself from:

- (a) Atomic Energy Industrial Laboratories of the Southwest, Inc.
- (b) Radiation Detection Company.
- (c) R.S. Landauer, Jr. and Co.

He shall specify that he is to receive "telegraphic" notification of overexposures and that the originals of all reports shall be sent to the Radiation Protection Officer, Kellogg Rust Constructors, Three Greenway Plaza, P. O. Box 27723, Houston, Texas 77027, with a copy to be sent to him. The radiographer shall also order such additional badges as may be required for visitors and other third parties whose exposure may require such be provided (For further discussion concerning third parties' need for monitoring equipment, see PROC. REF. B-VIII RADIOGRAPHIC AREA CONTROL, 101.6 and 102.6).

101.2 Film Badge Use

101.2.1 A film badge shall be assigned to and worn by only one (1) person and the name of the person to whom the badge is assigned shall be transmitted to the film badge supplier at the time of the return of the badge.

101.2.2 No one shall act as a Radiographer or Radiographer's Assistant unless wearing a film badge.

101.2.3 The Radiographer is responsible for the care and keeping of the "control badge" and the return to the supplier of the biweekly badge.

101.2.4 A film badge shall be IMMEDIATELY processed if a (0-200 mr) dosimeter is discharged beyond its range.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10APR85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-IXPERSONNEL MONITORING EQUIPMENT
USE AND RECORDS

PAGE

4

CONT.
ON
PAGE

5

101.3 Recordation

Film badge readings are to be recorded biweekly (File reports of film badge supplier).

102 RECORDS

102.1 Whom

The Radiographer is responsible for the keeping of a record showing the radiation exposure of all individuals for whom personnel monitoring equipment is required. Thus, he must keep a record not only for himself and his fellow Radiographers but also for third parties to whom monitoring equipment is required to be issued. (For further discussion concerning third parties' need for monitoring equipment, see PROC. REF. B-VIII RADIOGRAPHIC AREA CONTROL, 101.6 and 102.6.)

102.2 Form

The Radiographer shall keep the radiation exposure record for individuals concerned, utilizing Form K-24 "INDIVIDUAL WHOLE BODY RADIATION DOSAGE RECORD" on a monthly basis and totaled on a quarterly basis:

1st Quarter: Jan. 1 to March 31
2nd Quarter: April 1 to June 30
3rd Quarter: July 1 to Sept. 30
4th Quarter: Oct. 1 to Dec. 31

Inasmuch as the permissible quarterly dosage is to be 1 1/4 rems, there is no need to carry forward a reading from a previous quarter, BUT ALL EXPOSURE WITHIN THE CURRENT QUARTER MUST BE CARRIED AS A RUNNING TOTAL. Thus, the line "Subtotal this Quarter" is to show all exposure in the quarter, INCLUDING the month in question.

102.3 Distribution

The K-24 form is to be filled out for each individual. A copy of the form is to be sent to the Radiation Protection Officer at the end of the month or at the completion of an assignment, whichever first occurs, in the case of Radiographers or their assistants. However, in the case of visitors or other third parties, a copy is to be transmitted as soon as the film badge reports of the third parties have been received. One copy is to be retained by the Radiographer in the field. In all cases in which an individual receives exposure in excess of 96 millirems in any day or week, the Radiographer will immediately transmit a copy of the form, together with an explanation and action taken to prevent a recurrence.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
B-IXPERSONNEL MONITORING EQUIPMENT
USE AND RECORDS

PAGE

5

CONT.
ON
PAGE

103 PHYSICAL EXAMINATION

Each Radiographer or assistant must have had a blood count by a physician before the start of any radiographic project. It is the responsibility of the Radiographer or the Radiographer's Assistant to have this done and to send the reports to the Radiation Protection Officer.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							

DOSIMETER CALIBRATION LOG SHEET

	Dosimeter Type & Mod. No.	Dosimeter Serial No.	Radiation Exposure	Dosimeter Reading
1	_____	_____	_____	_____
2	_____	_____	_____	_____
3	_____	_____	_____	_____
4	_____	_____	_____	_____
5	_____	_____	_____	_____
6	_____	_____	_____	_____
7	_____	_____	_____	_____
8	_____	_____	_____	_____
9	_____	_____	_____	_____
10	_____	_____	_____	_____
11	_____	_____	_____	_____
12	_____	_____	_____	_____
13	_____	_____	_____	_____
14	_____	_____	_____	_____
15	_____	_____	_____	_____

CALIBRATION DATE _____

CALIBRATION DUE _____

CALIBRATED BY _____



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-X

PAGE

CONT.
ON
PAGE

1

REQUIRED DOCUMENTS

100 REQUIRED DOCUMENTS

No Radiography shall be performed unless and until the Radiographer shall:

100.1 have POSTED copies of form N.R.C.-3 "Notice to Employees" or the equivalent Agreement State notice.

100.2 have AVAILABLE at the jobsite a copy of:

- (a) KRC OPERATING & EMERGENCY PROCEDURES FOR RADIOGRAPHERS,
- (b) a copy of the KRC RADIOGRAPHY LICENSE,
- (c) a copy of current N.R.C. or Agreement State regulations.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-XI

PAGE

CONT.
ON
PAGE

1

RECORDS AND INSTRUCTIONS

100 RECORDS

The Radiographer shall keep such records as are specified in these KRC Operating and Emergency Procedures and other such records as the Radiation Protection Officer may from time to time require.

101 INSTRUCTIONS

The Radiographer and his assistants, as the case may be, may receive from time to time such written Instructions under these KRC Operating and Emergency Procedures as the Radiation Protection Officer may deem necessary.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
B-XII

PAGE

CCNT.
ON
PAGE

INSPECTION AND MAINTENANCE PROCEDURES

1

2

100 GENERAL

100.1 Order

All inspection shall be sequential and all defects shall be corrected before using the device.

100.2 Survey

Before beginning inspection or maintenance the exposure device shall be surveyed for excessive radiation levels (more than 50 mr/hr at a distance of six inches from device). If the radiation level is excessive, follow the Emergency and Accident Procedure, etc. B-XIV, 101. Do not proceed with the inspection and maintenance if the radiation level is excessive.

101 DAILY IF USED (K-31)

101.1 Applicable Models

Technical Operations' Model numbers 660, 680, 683, 684, 741, 900, 910, 920.

101.1.1 Inspect the control cables for cuts, breaks, and broken fittings.

101.1.2 Inspect the source tube for cuts, crushing, and broken fittings.

101.1.3 Inspect the source switch or source stop for damage or loose parts.

101.1.4 Inspect the shield for damage to the fittings, lock, fasteners, and labels.

101.1.5 Inspect the crank for damage and loose hardware.

101.1.6 Inspect the operation of the cable connection except T/O 683 which has none. All defects must be corrected before proceeding to the next step.

101.1.7 Check the operation of the control for freedom of source movement.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
B-XII

INSPECTION AND MAINTENANCE PROCEDURES

PAGE

2

CONT.
ON
PAGE

3

102 QUARTERLY (K-30)

102.1 Applicable Models

Technical Operation's Model numbers 660, 680, 684, 741, 900, 910, 920.

102.1.1 Control Cable Housing. Visually inspect the control cable housing for cuts and breaks by flexing the cable and inspect the fittings. If slight cuts are evidenced on the housing these may be corrected by taping with plastic electrical tape. Deeper cuts, breaks, and defective fittings must be corrected by replacement of the equipment.

102.1.2 Control Cable. Eject three to four feet of the control cable onto a clean surface. Examine the cable for kinks, fraying, broken wires, rust, and cleanliness of the lubricant. If the cable has sharp bends, frayed or broken wires, or heavy rust it must be replaced.

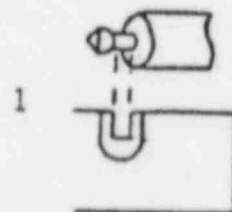
102.1.3 Connectors. Examine the connectors (male and female) for straightness and evidence of looseness. Check the connectors with the Tech-Ops Model 550 Connector Gauge (Fig. 1) for wear.

This gauge checks the critical areas of the Tech-Ops source connector for excessive wear. All positions are NO-GO and connectors should NOT PASS THRU the gauge. DO NOT FORCE. Connectors that fail this test MUST be replaced.

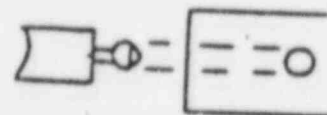
MALE DRIVE CABLE CONNECTOR

Position No. 1 - Male Ball Shank Dia.

Position No. 2 - Male Ball Dia.



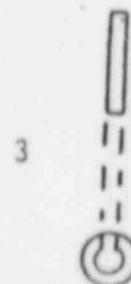
2



FEMALE SOURCE CABLE CONNECTOR

Position No. 3 - Female Slot Width

Fig. 1 Use of Tech Ops 550 connector gauge
Tech Ops Drawing No. A550H-2



REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-XII

PAGE

CONT.
ON
PAGE

INSPECTION AND MAINTENANCE PROCEDURES

3

4

102.1.4 Source Guide Tubes. Visually inspect the source tubes for cuts and dents by flexing the tubes. Slight cuts without flexible metallic tube damage may be wrapped with plastic electrical tape to stiffen and seal. Inspect for broken or loose source tube fittings. Check the tubes for free passage of the source by holding the tubes vertical and dropping a dummy source assembly through the tubes. If the dummy does not slide through freely, check for foreign material in the source tube, and if present, remove. Source tubes which contain dents, defective fittings or which do not allow free passage of the dummy source assembly shall be replaced. If a source tube is multiple section, remove the defective section(s), and use the projector with the remaining section(s).

102.1.5 Shield Assembly. Inspect the shield for damage to the fittings, lock, fasteners and labels. The source exit fitting should rotate freely without excessive looseness. If the fittings, lock or fasteners are damaged they must be replaced or repaired. Order replacements for damaged labels and replace with temporary labels.

102.1.6 Crank Assembly. Inspect the crank for damage and loose hardware. Loose hardware may be tightened using the proper tool. Damaged cranks must be replaced.

102.1.7 Operation Check. Check the operation of the control for freedom of source movement by cranking the source out to the exposure position and returning the source to the safe position. If binding occurs during the crank out, return the source to the shield and make a survey. Check for kinks and sharp bends in the control cable and source tube. Recheck the operation.

102.1.8 Source Position Indicator System. The source position indicator system may be checked during the operation check. This system consists of an odometer. The odometer has a screwdriver adjustment control which may be adjusted when the odometer does not indicate "000" when the crank is in its full retract position. If the system needs repairs which require parts not readily available or require the manufacturer's representative to perform, the projector may be used with normal systems i.e. survey meter.

102.2 Technical Operations Model 683

102.2.1 Control Cable Housing. Visually inspect the control cable housing for cuts and breaks by flexing the cable and inspect the fittings. If slight cuts are evidenced on the housing these may be corrected by taping with plastic electrical tape. Deeper cuts, breaks, and defective fittings must be corrected by replacement of the equipment.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-XII

PAGE

CONT.
ON
PAGE

INSPECTION AND MAINTENANCE PROCEDURES

4

5

102.2.2 Source Guide Tubes. Visually inspect the source tubes for cuts and dents by flexing the tubes. Slight cuts without flexible metallic tube damage may be wrapped with plastic electrical tape to stiffen and seal. Inspect for broken or loose source tube fittings. Check the tubes for free passage of the source by holding the tubes vertical and dropping a dummy source assembly through the tube. If the dummy source does not slide through freely, check for foreign material in the source tube, and if present, remove. Source tubes which contain dents, defective fittings or which do not allow free passage of the dummy source assembly shall be replaced. If a source tube is multiple section, remove the defective section(s), and use the projector with the remaining section(s).

102.2.3 Shield Assembly. Inspect the shield for damage to the fittings, lock, fasteners and labels. The source exit fitting should rotate freely without excessive looseness. If the fittings, lock or fasteners are damaged they must be replaced or repaired. Order replacements for damaged labels and replace with temporary labels.

102.2.4 Crank Assembly. Inspect the crank for damage and loose hardware. Loose hardware may be tightened using the proper tool. Damaged cranks must be replaced.

102.2.5 Operation Check. Check the operation of the control for freedom of source movement by cranking the source out to the exposure position and returning the source to the safe position. If binding occurs during the crank out, return the source to the safe position. If binding occurs during the crank out, return the source to the shield and make a survey. Check for kinks and sharp bends in the control cable and source tube. Recheck the operation.

102.2.6 Source Position Indicator System. The source position indicator system may be checked during the operation check. This system consists of an odometer with pistol grip control T/O 693 (Not with T/O 692). The odometer has a screwdriver adjustment control which may be adjusted when the odometer does not indicate "000" when the crank is in its full retract position. If the system needs repairs which require parts not readily available or require the manufacturer's representative to perform, the projector may be used with normal systems (Geiger Counter).

103 NON-ROUTINE-AFTER POSSIBLE DAMAGE (K-32)

If there is any reason to suspect damage to an exposure device the daily inspection shall be performed. A report shall be made to the Radiation Protection Officer which includes:

103.1 The cause of the possible damage.

REVISION	0	1	2	3	4	5	6	7
BY	A.BURGE							
DATE	10APR85							
APPROVED	K.KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
B-XII

PAGE

CONT.
ON
PAGE

INSPECTION AND MAINTENANCE PROCEDURES

5

103.2 The date of the occurrence.

103.3 The identification of the device i.e. Model, serial number, source model number and source serial number, etc.

103.4 The corrective action taken to prevent recurrence.

103.5 The defects (in any) uncovered in the inspection.

103.6 The action taken to correct defects uncovered during the inspection.

103.7 The survey readings taken at 6 inches from the top, bottom, front, back, left side, and right side.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10APR85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
B-XIII

PAGE

CONT
ON
PAGE

OPERATING PROCEDURES

1

2

100 OPERATING PROCEDURES

100.1 Calculate exposure times.

100.2 Attach film badge to clothing or place in pocket.

100.3 Recharge pocket dosimeters (0-200 Mr and 0-5R) and place in pocket of clothing. During operations read and interpret in accord with PROC. REF. B-IX, Section 100.7.

100.4 Check that survey meter(s) are operable and calibrated.

100.5 Perform physical radiation survey of projector and record.

100.6 Transport exposure device to working area (See PROC. REF. B-IV).

100.7 perform daily inspection and maintenance in accordance with procedures.

100.8 Transport and position exposure device near exposure site.

100.9 Position source tube end stop using jig or other attachment device (tape, surgical rubber tubing, etc.) where exposure is to be made.

100.10 Attach film, markers, and identification.

100.11 Position source tube so movement of source through tube will be free and easy.

100.12 Layout control cable and control unit such that it will be as far from the exposure point as possible or behind shielding and such that control cable will move free and easy.

100.13 Estimate by calculation and/or experience the dimensions of the Restricted Area (2 mr/hr.) and High Radiation Area.

100.14 Establish and post the Restricted Area and High Radiation Area (PROC. REF. B-VIII).

100.15 Unlock exposure device.

100.16 Rotate the handle on control unit in the "expose" direction until the source contacts the source stop. Do not use undue force. If the source tube or control cable binds or offers unusual resistance reverse direction and return to safe position. Survey projector to assure source is in safe position. Check control cable and source tube for kinks, sharp bends, or twisting.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
B-XIII

PAGE

2

CONT.
ON
PAGE

OPERATING PROCEDURES

100.17 Start exposure timing when source reaches end stop.

100.18 Survey perimeter of restricted area to assure that it is at 2 mr/hr.

100.19 Maintain a constant surveillance of the area to assure that no persons enter the area.

100.20 When the exposure is completed rotate the handle on the control unit in the "retract" direction until the source is returned to the safe position.

100.21 Approach the exposure device with the survey meter while reading it to assure that the source is returned to the safe position.

100.22 Rotate securing mechanism to locking positions.

100.23 Survey the entire circumference, the exposure device and the source tube to assure that the source is in the safe position.

100.24 Repeat steps 100.9 through 100.23 as necessary to make exposures which do not require movement of the projector.

100.25 When the last exposure which can be made safely without movement of the projector is completed, secure and lock the projector.

100.26 For additional exposures repeat steps 100.8 through 100.25.

100.27 Transport exposure device to storage area and perform physical radiation survey of exposure device and record.

100.28 Perform radiation survey around storage area to assure that unrestricted area does not exceed 2 mr/hr. or 0.6 mr/hr. (See PROC. REF. B-III, Paragraph 101.4).

100.29 Lock storage area and remove key.

100.30 Remove film badges and store with control badge.

100.31 Read and record dosimeter readings and complete form K-24.

100.32 Minimize the dose received by (1) Minimizing the handling time of projectors in safe position. (2) Placement of the shielding between the source and position of personnel. (3) Limiting the time in High Radiation Areas (over 100 mr per hour) and Radiation Areas (5mr/hr. through 100 mr/hr.) (4) Staying in an area below 2 mr/hr. during exposures.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							

460615



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

EMERGENCY AND ACCIDENT PROCEDURE,
INCLUDING ILLNESS OR ABSENCE OF
RADIOGRAPHER

PROC. REF
B-XIV

PAGE

1

CONT.
ON
PAGE

2

100 DEFINITION

ANY UNUSUAL SITUATION that may develop during the course of ordinary operation is to be considered an emergency which shall include but not be limited to the following:

- 100.1 Broken, dented or eroded Capsule Container.
- 100.2 Source fall out of Projector.
- 100.3 Source is stuck in flexible source cable.
- 100.4 Source falls into construction equipment.
- 100.5 Lost or stolen equipment or possible product defects.
- 100.6 Equipment is jarred, crushed, buried or involved in fires, earthquakes, explosions or other Acts of God.
- 100.7 N.R.C. "Rules and Regulations" - Part 20, Paragraph 20.403, or in applicable Agreement State Regulations.
- 100.8 Dosimeter readings in excess of 96 Mr per day or week.
- 100.9 Telegraphic report of film badge overexposure.
- 100.10 If there is any doubt that a given situation is an emergency it shall be considered one until proven otherwise and emergency procedures shall be followed.

101 PROCEDURE

- 101.1 Evacuate all unnecessary personnel from area.
- 101.2 Immediately survey area with calibrated survey meter(s) to establish a Restricted Area (2 mr/hr.), erect warning signs and if possible erect barriers to prevent persons from entering.
- 101.3 Maintain a constant surveillance of the area to assure that persons do not enter the area. If possible post persons around the Restricted Area to prevent persons entering.
- 101.4 Establish Radiation Area and High Radiation Area as necessary to maintain control.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10APR85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

EMERGENCY AND ACCIDENT PROCEDURE,
INCLUDING ILLNESS OR ABSENCE OF
RADIOGRAPHER

PROC. REF
B-XIV

PAGE

2

CONT.
ON
PAGE

3

101.5 Notification

101.5.1 Each Radiographer and Radiographer's Assistant are issued a wallet card with the emergency phone numbers as follows:

NRC Region IV.

Agreement States.

Radiation Protection Officer - Office and home plus home address.

Assistant Radiation Protection Officer - office and home.

These personnel shall retain the card on their person at all times. All helpers shall be notified by the Radiographer of where the card is.

101.5.2 All emergencies are to be reported IMMEDIATELY to the Radiation Protection Officer, wherever he may be. Do not leave the area unattended to perform notification. Send someone else with written instructions, if necessary. In the event that the Radiation Protection Officer cannot be contacted immediately, the Radiographer shall notify the Assistant Radiation Protection Officer. If he cannot be located immediately, call the NRC or applicable Agreement State for assistance. Transmit a report to the RPO by telex or telegram to the Houston Office and another by telegram addressed to the RPO's home. Inform the telegrapher that you want immediate delivery and that you will pay the extra fee. AND in cases of theft or loss of licensed material or of radiation incidents, N.R.C. Rules and Regulation (10 CFR) Part 20, Paragraph 20.402, or in applicable Agreement State Regulations, make the specified notifications to the applicable United States Nuclear Regulatory Commission Office listed in Appendix D of the N.R.C. Rules and Regulations (10 CFR) - Part 20, or to the applicable Agreement State authority.

101.5.3 In all emergencies involving malfunctioning of the equipment, the Radiographer shall also notify the nearest office of the contractor supplying the equipment or any other office authorized by the N.R.C. or Agreement State authority to service the equipment in question.

101.5.4 Any time the Radiographer has reason to believe that any projector, source changer, meter calibrator or part thereof contains defects which could create a substantial safety hazard, he shall immediately notify the RPO. The RPO will immediately notify the NRC if his evaluation supports the radiographers.

102 ILLNESS OR ABSENCE OF RADIOGRAPHER

102.1 No radiography shall be performed except in the presence of the Radiographer.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
B-XIV

EMERGENCY AND ACCIDENT PROCEDURE,
INCLUDING ILLNESS OR ABSENCE OF
RADIOGRAPHER

PAGE

3

CONT.
ON
PAGE

102.2 In the case of absence, illness, or other incapacity of the Radiographer, all Shipping Containers and Projectors shall be returned to and/or remain in storage at the jobsite. In case of the incapacity of the Radiographer, his Assistant may take charge of the return to storage.

102.3 In case of illness, or other incapacity of the Radiographer, the Radiation Protection Officer is to be notified immediately.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							

SUPPLEMENTARY SHEET NO. 1 TO NRC FORM 313

5 (a) Byproduct Material	5 (b) Source Model (1) (2)	5 (c) Maximum Activity Source at any one time.	6 Projectors (3) or capsule containers	7 Storage (Shipping) Containers (3)
Cs 137	Tech/Ops Model 77302	165 millicuries	Technical Operations Model 773 Survey Instrument Calibrator	
Ir 192	Tech/Ops Model 90003	100 curies	Technical Operations Projector, Model 900	Technical Operations Source Changer, Model 850
	Tech/Ops Model 91003	25 curies	Technical Operations Projector, Model 910	Technical Operations Source Changer, Model 850
	Tech/Ops Model 90003	200 curies	Technical Operations Projector, Model 920	Technical Operations Source Changer, Model 850
	Tech/Ops Model A424-9	100 curies	Technical Operations Projector, Model 660	Technical Operations Source Changer, Model 650
	Tech/Ops Model 68309	100 curies	Technical Operations Projector, Model 683	
Co60	Tech/Ops Model A424-15	10 curies	Technical Operations Model 684	
	Tech/Ops Model A424-18	30 curies	Technical Operations Projector, Model 741	
	Tech/Ops Model A424-14	100 curies	Technical Operations Projector, Model 680	

(1) All sealed sources are cobalt or iridium metal form.

(2) All sealed sources are encapsulated by Technical Operations Inc.

(3) All Storage Containers and Projectors are supplied by Technical Operations, Inc.
All Projectors are also Storage Containers.

PART B

Supplemental Sheet No. 2 Dated April 10, 1985.

In accordance with NRC Form 313 for: Kenneth L. Kluge

FORMAL EDUCATION

B.S. Metallurgical Engineering

California State Polytechnic College

RADIATION SAFETY RELATED EXPERIENCE

1959 - 1961 -U.S. Army - Radiation Survey and Decontamination Team

1963 - 1968 -California State Polytechnic College - X-Ray of Metals

1968 - Present-Kellogg Rust Constructors Inc. - Isotope Radiography
of Metals. Successfully completed Kellogg Rust
Constructors Inc. Radiation Safety Program.

EXPERIENCE WITH ISOTOPES

ISOTOPE	MAX. CURIES	DATES	COMPANY
IR 192	105	since 1968	Kellogg Rust Construc- tors Inc.
Co 60	5	since 1969	Kellogg Rust Construc- tors Inc.

ALAN J. BURGE

RADIATION PRODUCING DEVICES RESUME

I. Training

Date: August, 1975 to May, 1977

School: Hutchinson Area Vocational Technical Institute
Hutchinson, Minnesota. Degree in Nondestructive
Testing Technology.

Courses: Basic and advanced industrial radiography
120 class hours 210 laboratory hours.

Subjects covered: Theory and nature of penetrating radiation,
radiation safety, operation of gamma ray and
x-ray equipment, care and maintenance of equip-
ment, radiographic field and laboratory exposure
techniques, regulations for safe handling of radio-
active material, preparation of safety records and
reports.

II. Employment Using Radiation Producing Devices

Date: February, 1983 - Present

Employer: Kellogg Rust Constructors Inc.
Houston, Texas

Duties: Serves as Corporate Level III, NDE. Plan and implement
NDE activities.

Date: January, 1982 - Present

Employer: San Jacinto College, Central Campus, Pasadena, Texas

Duties: Part time instructor in the Welding-Quality Inspection
Department. Responsible for training approximately 15-20
students per semester in radiographic inspection. Course
content includes: origin of penetrating radiation, radiation
safety and operation of gamma ray and x-ray equipment,
maintenance of radiation dosage records and survey records.

ALAN J. BURGE - RADIATION PRODUCING DEVICES RESUME (Cont'd) Page 2

Date: June, 1979 - February, 1983

Employer: Northrop Services Inc., Johnson Space Center,
Houston, Texas.

Duties: Performed all radiographic examinations required by NASA
at the Johnson Space Center. Support included inspection
of spacecraft components at in-lab and field sites using
140 KV and 200 KV x-ray generators.

Date: July, 1977 - May, 1979

Employer: Metils Inc., Houston, Texas

Duties: Performed industrial radiographic inspection of petrochemical
piping, power piping and structural steel articles at various
field site locations throughout the Houston area.

KELLOGG RUST CONSTRUCTORS

RADIOGRAPHY PROGRAM

PART C

EXPLANATION OF FORMS FOR INTERNAL

AUDIT BY ASSISTANT RADIATION PROTECTION OFFICER



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
C-(K-10)

PAGE

1

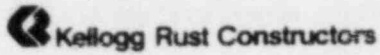
CONT.
ON
PAGEEXPLANATION OF FORM: K-10

"QUALIFICATION CARD"

The Technician shall be qualified in accordance with the American Society for Nondestructive Testing. There are three classifications, Level I - shall be an assistant, Level II - shall be a technician and Level III - a senior technician. KRC Field Technicians shall be qualified as Level II.

To be qualified as a Level II Technician in Radiography, the Technician must pass the A.S.N.T. Qualification Test and the KRC N.R.C. Radiation Safety Examination.

REVISION	0	1	2	3	4	5	6	7
BY	A. Burge							
DATE	10Apr85							
APPROVED	K. Kluge							



NDT CERTIFICATE OF QUALIFICATION

Name Kenneth L. Dorsett

Employee No. 11553

This is to certify that the above named person is employed by Kellogg Rust Constructors Inc. as a qualified NDT Technician. He is qualified in accordance with SNT-TC-1A and/or the Kellogg Rust Constructors Inc. Radiography Program to perform the duties listed on the back of this card. This certificate becomes void automatically on termination of employment.

James E. Turner
Manager of Quality Control
or NDT Level III
James E. Turner

K-10-1 (4-81)

ACTIVITY	LEVEL	DATE ISSUED	EXP. DATE	CERTIFYING OFFICER
Radiographic Technician	II	5/80	5/83	J. Turner
Liquid Penetrant Technician				
Magnetic Particle Technician				
Ultrasonic Technician				
NRC Radiographer	Rad.	5/80	5/83	J. Turner
NRC Assistant Radiographer				

K-10-2 (4-81) BACK



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

 PROC. REF.
C-(K-24)

PAGE

1

 CONT.
ON
PAGE

 EXPLANATION OF FORM: K-24

"FIELD RADIOGRAPHIC TECHNICIAN INDIVIDUAL WHOLE BODY RADIATION DOSAGE RECORD"

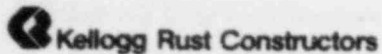
The form shall be filled out daily by each Radiographer and mailed to the Radiation Protection Officer the last day of the month. The field Radiographer keeps one copy.

The Assistant Radiation Protection Officer shall check the following:

- Daily Dosimeter Readings do not exceed 96 MR in any one day or 96 MR in any one week.
- Record - Monthly total of daily Dosimeter Readings, on form K-28 "Current Occupational External Radiation Exposure."
- Maximum radiation level at perimeter in MR does not exceed 2 MR/hr.
- Results of surveys in MR/hr do not exceed 50 MR/hr.
- File the form by the Radiographer's name.

REVISION	0	1	2	3	4	5	6	7
BY	A. Burge							
DATE	10 Apr 85							
APPROVED	K. Kluge							

460615



**FIELD RADIOGRAPHIC TECHNICIAN
INDIVIDUAL WHOLE BODY RADIATION DOSAGE RECORD**

EXAMPLE

NAME Tommy D. Lang
(PRINT) FIRST MIDDLE LAST
DATE OF BIRTH 11 26 45
MONTH DAY YEAR
SOCIAL SECURITY NUMBER 460-28-3135
JOB NUMBER 5113
JOB LOCATION Catoosa, Oklahoma
ACTING RADIOGRAPHER Kenneth L. Dorsett
FILM BADGE NUMBER 72311-0003

MONTH OF July 19 80
CAPACITY (CHECK ONE)
RADIOGRAPHER ☐
RADIOGRAPHER ASSISTANT ☐
HELPER ☒
OTHER (SPECIFY) _____
0-200 MR DOSIMETER SERIAL NO. 511722
0-5R DOSIMETER SERIAL NO. 01526
TOTAL DOSIMETER READING THIS QUARTER IN MR. 31

DAY	DOSIMETER READINGS IN MILLIREMS	DEVICE				SURVEY METER		MAXIMUM RADIATION LEVEL AT PERIMETER IN MR/HR	RESULTS OF SURVEYS-MR/HR	
		ISOTOPE	MODEL NUMBER	SERIAL NUMBER	CURIES	MANUFACTURER/ MODEL NUMBER	SERIAL NUMBER		SURVEY A	SURVEY B
1	2	IR192	660	845	50	Ludlum/4	4536	2	6.5	6.5
2										
3	4	IR192	660	845	48	Ludlum/4	4536	2	6.0	6.0
4										
5										
6										
7	8	IR192	660	845	46	Ludlum/4	4536	1.5	6.5	6.5
8	3	IR192	660	845	46	Ludlum/4	4536	2	6.5	6.5
9	6	IR192	660	845	45	Ludlum/4	4536	2	5.5	5.5
10										
11										
12	4	IR192	660	845	44	Ludlum/4	4536	2	5.5	5.5
13										
14	5	IR192	660	845	44	Ludlum/4	4536	1.5	5.0	5.0
15										
16										
17										
18										
19										
20	10	IR192	660	845	42	Ludlum/4	4536	2	4.5	4.5
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
31										
TOTAL 42		DOSIMETER READINGS ON THIS RECORD ARE FROM GAMMA RADIATION.								

I CERTIFY THAT:

- 1) PHYSICAL RADIATION SURVEY OF DEVICE WAS PERFORMED AFTER COMPLETION OF EACH EXPOSURE.
- 2) PHYSICAL RADIATION SURVEY WAS PERFORMED AND SOURCE WAS FOUND TO BE SECURE IN DEVICE PRIOR TO ITS STORAGE.
- 3) THE DEVICE WAS SECURED IN STORAGE AREA.

Kenneth L. Dorsett
RADIOGRAPHER SIGNATURE



INSTRUCTIONS:

THE MAXIMUM RADIATION LEVEL AT PERIMETER IS: THE LEVEL OF RADIATION IN MR/HR AT THE RADIATION AREA LINE IT SHALL NOT EXCEED 2MR/HR.

SURVEY A IS: THE LEVEL OF RADIATION IN MR/HR MEASURED 6 INCHES FROM THE TOP OF PROJECTOR, BEFORE REMOVING THE PROJECTOR FROM STORAGE AREA.

SURVEY B IS: THE LEVEL OF RADIATION IN MR/HR MEASURED 6 INCHES FROM THE TOP OF PROJECTOR, AFTER PROJECTOR HAS BEEN RETURNED TO STORAGE AREA.

IF ANY EXPOSURE IN EXCESS OF 96 MR IN ANY ONE DAY, or 96 MR IN ANY ONE WEEK, IS RECORDED, SEND 2 COPIES OF THIS FORM TO THE RADIATION PROTECTION OFFICER IMMEDIATELY WITH AN EXPLANATION ON A SEPARATE SHEET, OF ACTION TAKEN TO PREVENT RECURRENCE.

THIS FORM IS TO BE KEPT UP-TO-DATE AT ALL TIMES. IT IS TO BE SUBMITTED TO THE RADIATION PROTECTION OFFICER ON THE LAST DAY OF EACH MONTH. A FORM SHALL BE SUBMITTED FOR EACH INDIVIDUAL REQUIRED TO CARRY PERSONNEL MONITORING EQUIPMENT BY THE N.R.C., STATE OR LOCAL RADIATION SAFETY RULES AND REGULATIONS.

ONE PERSONAL COPY IS TO BE KEPT BY THE RADIOGRAPHER IN CHARGE OF THE PROJECT, FOR EACH INDIVIDUAL WEARING POCKET DOSIMETERS, SO THAT IT CAN BE PRODUCED ON CALL BY VISITING REPRESENTATIVES OF THE N.R.C., STATE OF LOCAL AGENCIES.

KELLOGG RUST CONSTRUCTORS INC. IS ON A CALENDAR QUARTER BASIS AS FOLLOWS:

JANUARY 1 TO MARCH 31	—	1ST QUARTER
APRIL 1 TO JUNE 30	—	2ND QUARTER
JULY 1 TO SEPT. 30	—	3RD QUARTER
OCTOBER 1 TO DEC. 30	—	4TH QUARTER



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
C-(K-25)

PAGE

1

CONT.
ON
PAGE

EXPLANATION OF FORM: K-25

"RADIOGRAPHY EQUIPMENT RUNNING INVENTORY CONTROL AND QUARTERLY PHYSICAL INVENTORY"

The form shall be filled out quarterly and when shipping or receiving a sealed source, by the field radiographers and mailed to the Radiation Protection Officer. The field radiographer keeps one copy. This form shall be accompanied with a copy of the leak test record.

The Assistant Radiation Protection Officer shall check the following:

- A leak test has been performed within the last 6 months.
- Source strength is not more than the KRC license limits us to for a given type of projector.
- Radiation level check does not exceed 50 mr/hr at 6 inches from the projector.
- KRC license covers the projector at the job.
- Record - Information on a "Radiographic Equipment Quarterly Inventory Summary" K-29 only on a quarterly basis.
- Record - Information on a "Radiographic Equipment Running Inventory Summary" K-27 is recorded only when a new projector is received or returned.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							



RADIOGRAPHY EQUIPMENT RUNNING INVENTORY CONTROL AND QUARTERLY PHYSICAL INVENTORY

RADIOGRAPHER Kenneth L. DorsettTYPE OF INVENTORY
(CHECK ONE)RUNNING ☒JOB NO. 5113 LOCATION Catoosa, OklahomaQUARTERLY ☐

PROJECTOR		SOURCE		ISOTOPE		DATE OF SOURCE STRENGTH	DATE OF LAST LEAK TEST	DATE	
MODEL NO.	SERIAL NO.	MODEL NO.	SERIAL NO.	TYPE	CURIAGE			RECEIVED	RETURNED
660	898	A424-9	2935	IR-192	52	2-13-80	2-13-80	2-17-80	5-14-80
660	1020	A424-9	3176	IR-192	100	5-10-80	5-10-80	5-14-80	

RADIATION LEVEL CHECK

PROJECTOR MODEL NO.	FRONT	LEFT SIDE	RIGHT SIDE	BACK	TOP	BOTTOM
660/898	4.5	5	5	6.5	4.5	4
660/1020	9	7	7	6.5	6	6.5

UNIT OF MEASUREMENT: MR/HR, MEASURED AT 6 INCHES FROM PROJECTOR

NOTE: THIS FORM IS TO BE USED FOR EACH PROJECTOR EVERY TIME ONE IS RECEIVED OR RETURNED, OR THE SOURCE THEREIN IS REPLACED.
THIS FORM IS TO BE USED TO REPORT THE EQUIPMENT PRESENT AT THE JOB AT THE END OF EACH CALENDAR QUARTER.

KELLOGG RUST CONSTRUCTORS INC. IS ON A CALENDAR QUARTER BASIS AS FOLLOWS: 1ST QUARTER - JAN. 1 TO MARCH 31;
2ND QUARTER - APRIL 1 TO JUNE 30;
3RD QUARTER - JULY 1 TO SEPTEMBER 30;
4TH QUARTER - OCTOBER 1 TO DECEMBER 31.

EXAMPLE



RADIOGRAPHY EQUIPMENT RUNNING INVENTORY CONTROL AND QUARTERLY PHYSICAL INVENTORY

RADIOGRAPHER Kenneth L. DorsettTYPE OF INVENTORY
(CHECK ONE)RUNNING ☐JOB NO. 5113 LOCATION Catoosa, OklahomaQUARTERLY ☒

PROJECTOR		SOURCE		ISOTOPE		DATE OF SOURCE STRENGTH	DATE OF LAST LEAK TEST	DATE	
MODEL NO.	SERIAL NO.	MODEL NO.	SERIAL NO.	TYPE	CURIAGE			RECEIVED	RETURNED
660	1020	A424-9	3176	IR-192	68	6-30-80	5-10-80	5-14-76	

RADIATION LEVEL CHECK

PROJECTOR MODEL NO.	FRONT	LEFT SIDE	RIGHT SIDE	BACK	TOP	BOTTOM
660/1020	7	6	6	5	5.5	5.5

UNIT OF MEASUREMENT: MR/HR, MEASURED AT 6 INCHES FROM PROJECTOR

NOTE: THIS FORM IS TO BE USED FOR EACH PROJECTOR EVERY TIME ONE IS RECEIVED OR RETURNED, OR THE SOURCE THEREIN IS REPLACED.

THIS FORM IS TO BE USED TO REPORT THE EQUIPMENT PRESENT AT THE JOB AT THE END OF EACH CALENDAR QUARTER.

KELLOGG RUST CONSTRUCTORS INC. IS ON A CALENDAR QUARTER BASIS AS FOLLOWS:

1ST QUARTER - JAN 1 TO MARCH 31;
2ND QUARTER - APRIL 1 TO JUNE 30; **1980**
 3RD QUARTER - JULY 1 TO SEPTEMBER 30;
 4TH QUARTER - OCTOBER 1 TO DECEMBER 31.



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
C-(K-26)

PAGE

1

CONT.
ON
PAGEEXPLANATION OF FORM: K-26

"SURVEY OF STORAGE AREA"

This form shall be completed whenever a new isotope is placed in the storage area or when there is reason to believe that the radiation level at any exterior surface has increased.

Send original immediately to RPO. The field radiographer shall retain one copy.

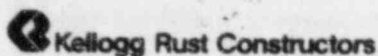
RPO will review and file.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10 APR 85							
APPROVED	K. KLUGE							

SURVEY OF STORAGE AREA

JOB NO. 5113

LOCATION Catoosa, OK



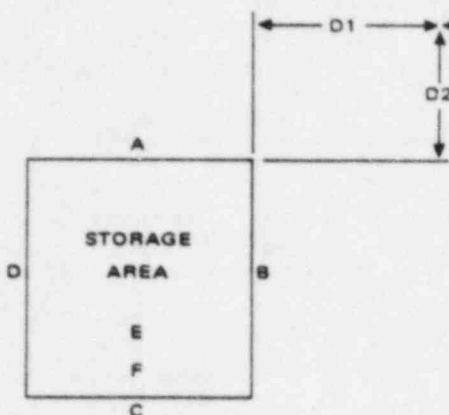
CIRCLE DIRECTION:

East

West

North

South



FIXED POINT: 105-D Centerline

EXAMPLE

D1 = 132 FT.

D2 = 75 FT.

SURVEY

MR/HOUR

A (side)

0

B (side)

0

C (side)

0

D (side)

0

E (Top if accessible)

0

F (Bottom if accessible)

-

SEE BACK OF FORM FOR
MAXIMUM PERMISSIBLE
RADIATION LEVEL.

SURVEY INSTRUMENT USED

Manufacturer (Brand) Ludlum

Model No. 4

Serial No. 3236

Date of Calibration 5-14-80

SOURCE STRENGTH IN STORAGE AREA

100 Curies of Iridium 192 (Total)

Curies of Cobalt 60 (Total)

Date of survey 5-22-80

Name of surveyor (Radiographer) K.L. Dorsett

Signature of surveyor (Radiographer) K.L. DORSETT

SURVEY OF STORAGE AREA



INSTRUCTIONS:

Fixed point is a vessel, column, or building, etc., which will remain fixed for the duration of job. Identify on lines provided, e.g. 105D centerline.

Surveys are made at exterior surface of storage area.

The maximum permissible radiation level is 0.6 mr/hr. except if the storage area is located a distance equal to or greater than the largest dimension (diameter or side) of the storage area from any area occupied by a person more than 50 hours in any seven (7) consecutive days, in which case the maximum permissible radiation level may be 2 mr/hr.

This form is to be completed whenever a new isotope is placed in the storage area or there is reason to believe that the radiation level has increased.

The original of this form is to be sent immediately to the Radiation Protection Officer. A copy is to be kept by the radiographer with the Radiography Records.



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
C-(K-27)

PAGE

1

CONT.
ON
PAGE

EXPLANATION OF FORM: K-27

"RADIOGRAPHIC EQUIPMENT RUNNING INVENTORY SUMMARY"

The form shall be filled out by the Assistant Radiation Protection Officer whenever a projector is received or returned by the field radiographer. The information shall be transferred from Form K-25 "Radiography Equipment Running Inventory Control and Quarterly Physical Inventory" to K-27 by the Assistant Radiation Protection Officer. This is to provide on one form for all sites the information required by 10 CFR 34.27.

REVISION	0	1	2	3	4	5	6	7
BY	A. BURGE							
DATE	10APR85							
APPROVED	K. KLUGE							

460615

FROM Jan. 1980

TO_

RADIOGRAPHIC EQUIPMENT RUNNING INVENTORY SUMMARY

[illegible]



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
C-(K-28)

PAGE

1

CONT.
ON
PAGE

EXPLANATION OF FORM: K-28

"CURRENT OCCUPATIONAL EXTERNAL RADIATION EXPOSURE"

This form shall be completed by the Assistant Radiation Protection Officer on or around the last day of the month.

This form shall be the basis for the information required by 10 CFR 20.407 "Personnel Exposure and Monitoring Reports". The Assistant Radiation Officer shall, within the first quarter of each calendar year, submit to the Director of Regulation, U.S. Nuclear Regulatory Commission, Washington, D.C. 20545, a report of the total number of individuals for whom personnel monitoring was required in the previous calendar year.

The bottom of the form "Lifetime Accumulated Dose" shall be the basis for the information required by 10 CFR 20.408 "Reports of Personnel Exposure on Termination of Employment or Work". When termination occurs, the Assistant Radiation Protection Officer shall prepare a report of the individuals' exposure to radiation incurred during the period of employment. This report is submitted to the employee and the Director of Regulation, U.S. Nuclear Regulatory Commission, Washington, D.C. 20545.

REVISION	0	1	2	3	4	5	6	7
BY	A. Burge							
DATE	10Apr85							
APPROVED	K. Kluge							

CURRENT OCCUPATIONAL EXTERNAL RADIATION EXPOSURE

NAME Kenneth L. Dorsett

SOCIAL SECURITY NO. 338-39-4256

DATE OF BIRTH Jan 29, 1933

DOSIMETER NO. 402915101777

AGE IN FULL YEARS (N) 47

FILM BADGE NO. 72311-2

[illegible][illegible]

DOSIMETER AND FILM BADGE READINGS ARE FROM GAMMA RADIATION

LIFETIME ACCUMULATED DOSE

PREVIOUS TOTAL 3.671 REM

TOTAL ACCUMULATED DOSE _____ REM

TOTAL DOSE RECORDED ON THIS SHEET _____ REM.

PERM. ACC. DOSE 5 (N-18) 145 REM

PRIVACY ACT STATEMENT

Pursuant to 5 U.S.C. 552a(e) (3), enacted into law by section 3 of the Privacy Act of 1974 (Public Law 93-579), the following statement is furnished to individuals who supply information to the Nuclear Regulatory Commission on form K-28-1 (4181). This information is maintained in a system of records designated as NRC-27 and described at 40 Federal Register 45344 (October 1, 1975).

1. **AUTHORITY** Sections 53, 63, 65, 81, 103, 104, 161(b), and 161(o) of the Atomic Energy Act of 1954, as amended (42 U.S.C. 2073, 2903, 2095, 2111, 2133, 2134, 2201(b), and 2201(0)). The authority for soliciting the social security number is 10 CFR Part 20.
2. **PRINCIPAL PURPOSE(S)** The information is used by the NRC in its evaluation of the risk of radiation exposure associated with the licensed activity and in exercising its statutory responsibility to monitor and regulate the safety and health practices of its licensees. The data permits a meaningful comparison of both current and long-term exposure experience among types of licenses and among licensees within each type. Data on your exposure to radiation is available to you upon your request.
3. **ROUTINE USES** The information may be used to provide data to other Federal and State agencies involved in monitoring and/or evaluating radiation exposure by individuals employed as radiation workers on a permanent or temporary basis and exposure received by monitored visitors. The information may also be disclosed to an appropriate Federal, State, or local agency in the event the information indicates a violation or potential violation of law and in the course of an administrative or judicial proceeding.
4. **WHETHER DISCLOSURE IS MANDATORY OR VOLUNTARY AND EFFECT ON INDIVIDUAL OF NOT PROVIDING INFORMATION** It is voluntary that you furnish the requested information, including social security number; however, the licensee must complete form K-28-1 (4/81) on each individual for whom personnel monitoring is required under 10 CFR 20.202. Failure to do so may subject the licensee to enforcement action in accordance with 10 CFR 20.601. The social security number is used to assure that NRC has an accurate identifier not subject to the coincidence of similar names or birthdates among the large number of persons on whom data is maintained.
5. **SYSTEM MANAGER(S) AND ADDRESS** Director, Office of Management Information and Program Control, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

 PROC. REF.
C-(K-29)

PAGE

 CONT.
ON
PAGE

1

 EXPLANATION OF FORM: K-29

"RADIOGRAPHIC EQUIPMENT QUARTERLY INVENTORY SUMMARY"

This form shall be filled out quarterly by the Assistant Radiation Protection Officer, on or around the last day of each calendar year (March 31, June 30, September 30 and December 31). The Assistant Radiation Protection Officer shall mail out two copies of Form K-25 "Radiography Equipment Running Inventory Control and Quarterly Physical Inventory", to the Field Radiographers with instructions to fill it out and mail back to the Assistant R.P.O. as soon as possible, the Field Radiographer keeps one copy.

The Assistant R.P.O. will then transfer the information to the "Radiographer Equipment Quarterly Inventory Summary Form."

REVISION	0	1	2	3	4	5	6	7
BY	A. Burge							
DATE	10 Apr 85							
APPROVED	K. Kluge							



RADIOGRAPHIC EQUIPMENT QUARTERLY INVENTORY SUMMARY

YEAR 1980

QUARTER	ISOTOPE		PROJECTOR MODEL NO.	JOB LOCATION	RADIOGRAPHER
	TYPE	CURIAGE			
1st QUARTER JANUARY 1 to MARCH 31	IR-192	58	T/O-660	Catoosa, Okla.	K.L. Dorsett
2nd QUARTER APRIL 1 to JUNE 30	IR-192	75	T/O-660	Catoosa, Okla.	K.L. Dorsett
3rd QUARTER JULY 1 to SEPTEMBER 30					
4th QUARTER OCTOBER 1 to DECEMBER 31					



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
C-(K-30)

PAGE

1

CONT.
ON
PAGEEXPLANATION OF FORM: K-30

"QUARTERLY INSPECTION AND MAINTENANCE"

This form shall be filled out by the Radiographer on a quarterly basis for each projector. Each projector begins its quarter on the date received. A copy shall be sent to the Radiation Protection Officer immediately when quarterly inspection and maintenance is performed.

The Assistant Radiation Protection Officer shall check the following:

- Defective equipment was not used.
- Inspection and maintenance was timely performed.
- Indications of repetitive defects.

REVISION	0	1	2	3	4	5	6	7
BY	A. Burge							
DATE	10 Apr 85							
APPROVED	K. Kluge							

460615

[illegible]

Abstract

INSPECTION OK

D

DEFECTIVE

R

REPAIRED



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
C-(K-31)

PAGE

1

CONT.
ON
PAGE

EXPLANATION OF FORM: K-31

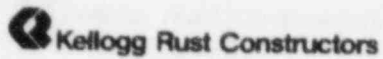
"DAILY INSPECTION AND MAINTENANCE"

This form shall be filled out daily by the Radiographer when the projector is used and mailed to the Radiation Protection Officer the first working day following the last day of the month. The field Radiographer shall keep one copy in his file.

The Assistant Radiation Protection Officer shall check the following:

- Defective projectors were not used.
- Maintenance was performed each day the projector was used.

REVISION	0	1	2	3	4	5	6	7
BY	A. Burge							
DATE	10Apr85							
APPROVED	K. Kluge							



DAILY INSPECTION AND MAINTENANCE

JOB NUMBER 5113
 JOB LOCATION Catoosa, Oklahoma
 RADIOGRAPHER Kenneth L. Dorsett

MONTH OF April 19 80
 MODEL NO. 660
 SERIAL NO. 1002

		<input type="checkbox"/> = INSPECTION OK							<input checked="" type="checkbox"/> = DEFECTIVE								<input checked="" type="checkbox"/> = REPAIRED				
DAY	TECHNICAL OPERATIONS							GAMMA INDUSTRIES												INITIAL	
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	8						
1	/	/	/	/	/	/	/														
2	/	/	/	/	/	/	/														
3	/	/	/	/	/	/	/														
4	/	/	/	/	/	/	/														
5	/	/	/	/	/	/	/														
6	/	/	/	/	/	/	/														
7	/	/	/	/	/	/	/														
8	/	/	/	/	/	/	/														
9	/	R	/	/	/	/	/														
10	/	/	/	/	/	/	/														
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
19																					
20																					
21																					
22																					
23																					
24																					
25																					
26																					
27																					
28																					
29																					
30																					
31																					

The source tube
 was replaced on the
 9th as it was defec-
 tive. This explanation
 need not be written out.



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
C-(K-32)

PAGE

1

CONT.
ON
PAGE

EXPLANATION OF FORM: K-32

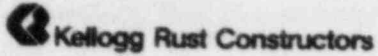
"INSPECTION AND MAINTENANCE NON-ROUTINE - AFTER POSSIBLE DAMAGE"

This form shall be completed by the Radiographer whenever there is reason to suspect damage to any exposure device. A copy shall be sent immediately to the Radiation Protection Officer.

The Assistant Radiation Officer shall:

- Compare survey readings with previous readings to determine that projector is undamaged.
- Review for corrective action.

REVISION	0	1	2	3	4	5	6	7
BY	A. Burge							
DATE	10Apr85							
APPROVED	K. Kluge							



INSPECTION AND MAINTENANCE
NON - ROUTINE - AFTER POSSIBLE DAMAGE

JOB NUMBER 5113 JOB LOCATION Catoosa, Okla.
 DATE April 12, 1980
 DEVICE MODEL 660 SERIAL NO. 1020
 SOURCE MODEL A424-9 SERIAL NO. 2164

COMPLETE THE FOLLOWING:

THE CAUSE OF POSSIBLE DAMAGE WAS Dropping the projector out of the pipe rack
 (15 feet) onto concrete foundation.

THE DEFECT(S) UNCOVERED IN THE INSPECTION IS ~~WAS~~ Damage to the hand crank assembly.

THE DEFECT(S) WAS ~~WAS~~ CORRECTED BY Replacing the crank assembly.

THE CORRECTIVE ACTION TAKEN TO PREVENT RECURRENCE WAS tying the projector in place with rope.

THE SURVEY READINGS IN MR/HR WERE

T °	BOTTOM	FRONT	BACK	LEFT SIDE	RIGHT SIDE
10	17	11	12	14	15

SEND COPY TO RADIATION PROTECTION OFFICER. KEEP ORIGINAL.

Kenneth L. Dorsett
SIGNATURE



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
C-(NRC TRNG.)

PAGE

1

CONT.
ON
PAGEEXPLANATION OF FORM: N.R.C. REFRESHER TRAINING RECORD

This form shall be filled out whenever a jobsite visit is made for the purpose of training by the Radiation Protection Officer or the Assistant Radiation Protection Officer.

This log will act as a guide for scheduling refresher training.

REVISION	0	1	2	3	4	5	6	7
BY	A. Burge							
DATE	10 Apr 55							
APPROVED	K. Kluge							

EXAMPLE

EMPLOYEE NO. 11522

[illegible]



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
NRC-RT 110 CFR 71 RADIOGRAPHY TRANSPORTATION
PACKAGE Q.A. PROGRAM

PAGE

1

CONT.
ON
PAGE

2

100 ORGANIZATION

The final responsibility for the radiography transportation package Quality Assurance Program to meet part 71 requirements rests with Kellogg Rust Constructors Inc. (KRC). Design and/or fabrication of radioactive material shipping packages shall not be conducted under this program.

100.2 The Quality Assurance Program is implemented using the following organization:

The "Radiation Protection Officer (RPO)", Kenneth L. Kluge, shall have the overall responsibility and authority for the 10 CFR 71 Q.A. Program, reporting in such capacity to L. J. Pucher, Vice President.

100.3 The Radiation Protection Officer is responsible for the following:

100.3.1 The safety of all personnel performing or coming in contact with the performance of radiography.

100.3.2 The training of all Radiographer's Assistants and Radiographers.

100.3.3 Reviewing radiation dosage records, survey records, inventory records, and personnel records.

100.3.4 The testing of all personnel performing radiography.

100.3.5 Disciplinary action when required.

100.3.6 Periodic inspections of performance and equipment.

100.3.7 Refresher training of personnel periodic and continuing.

100.3.8 Reviewing over with personnel any deficiency found and the required correction.

100.4 The radiographers are responsible to the Radiation Protection Officer for the conduct of the KRC Radiography program at each field jobsite including source handling, storing, shipping, inspection, tests, operating status and record keeping.

101 QUALITY ASSURANCE PROGRAM

REVISION	0	1	2	3	4	5	6	7
BY	K.Kluge							
DATE	23Apr85							
APPROVED	K.Kluge							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF
NRC-RT 110 CFR 71 RADIOGRAPHY TRANSPORTATION
PACKAGE Q.A. PROGRAM

PAGE

2

CONT.
ON
PAGE

3

101.1 The management of KRC has established and dictates the implementation of this Quality Assurance Program.

101.2 No person shall be permitted to act as a KRC Radiographer or Radiographers Assistant until such a person has been tested and certified as outlined in Part A of the KRC Radiography Program Manual.

101.3 Radiography Program revisions are made according to written procedures with the approval of Radiation Protection Officer and the appropriate regulatory agency.

101.4 The KRC Radiography program ensures that all manufacturer Q.C. procedures and specific provisions of the package design approval are satisfied. The transportation package Q.A. Program will emphasize control of the characteristics of the package which are critical to safety.

101.5 The Radiation Protection Officer shall assure that all radioactive material shipping packages used by KRC are designed and manufactured under a Quality Assurance Program approved by the Nuclear Regulatory Commission for all packages designed or fabricated after 1 July 1978. This requirement will be satisfied by receiving a certification to this effect from the manufacturer.

102 DOCUMENT CONTROL

102.1 All documents and forms related to a specific shipping package or container will be controlled through the use of written procedures that will be included in the KRC Radiography Program.

102.2 All document changes will be performed according to written procedures approved by the Radiation Protection Officer.

102.3 The Radiation Protection Officer shall insure that all transportation package Q.A. functions are conducted in accordance with the latest applicable changes to these documents.

103 HANDLING, STORAGE AND SHIPPING

103.1 Written safety procedures concerning the handling, storage and shipping of packages for certain special form material used by KRC will be followed as stated in part B, "Operating, Maintenance and Emergency Procedures" of the KRC Radiography Program.

103.2 Shipments of radioactive materials shall not be made unless all required test, certifications, acceptances and final inspections have been completed as called out in the KRC Radiography Program.

REVISION	0	1	2	3	4	5	6	7
BY	K.Kluge							
DATE	23Apr85							
APPROVED	K.Kluge							



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
NRC-RT 1

10 CFR 71 RADIOGRAPHY TRANSPORTATION
PACKAGE Q.A. PROGRAM

PAGE

3

CONT.
ON
PAGE

4

103.3 Work instructions are provided for handling, storage and shipping operations in Part B of the KRC Radiography Program.

103.4 Only radiographers shall perform the critical handling, storage and shipping operations.

104 INSPECTION, TESTS AND OPERATING STATUS

104.1 Inspection, tests and operating status of transportation packages for certain special form radioactive materials will be indicated and controlled as specified in Part B of the KRC Radiography Program.

104.2 Status will be documented by appropriate check list.

104.3 Status of nonconforming items will be positively maintained as required by Part B of the KRC Radiography Program.

105 QUALITY ASSURANCE RECORDS

105.1 Records of package approvals, including references and drawings, inspections, tests, operating records, audit results, personnel training and qualifications and records of shipments will be maintained in the Houston office.

105.2 Description of radiography equipment and written safety procedures are maintained in the KRC Radiography Program Manual.

105.3 All radiography records are identifiable and retrievable. A list of these records with their storage locations is maintained by the Radiation Protection Officer.

106 AUDITS

106.1 Established schedules of Audits of jobsite radiography projects will be performed using a written check list. Results are maintained and reported to management.

106.2 Audit reports are evaluated and deficient areas corrected.

106.3 Each jobsite radiography program is audited once every calendar quarter.

106.4 Audit reports are maintained as part of the Radiography Program records.

REVISION	0	1	2	3	4	5	6	7
BY	K.Kluge							
DATE	23Apr85							
APPROVED	K.Kluge							

460615



Kellogg Rust Constructors

RADIOGRAPHY PROGRAM

PROC. REF.
NRC-RT 110 CFR 71 RADIOGRAPHY TRANSPORTATION
PACKAGE Q.A. PROGRAM

PAGE

4

CONT.
ON
PAGE

106.5 Audits shall be conducted by either the Radiation Protection Officer or the Assistant Radiation Protection Officer.

106.6 Corporate audits of home office will be conducted on a yearly basis by the Manager of Construction Safety.

REVISION	0	1	2	3	4	5	6	7
BY	K. Kluge							
DATE	23Apr85							
APPROVED	K. Kluge							

N. R. C. RADIATION SAFETY EXAMINATION
RADIOGRAPHER'S ASSISTANT

NAME _____

DATE _____

1. Of the three types of radiation, namely Alpha, Beta, and Gamma, which is the most penetrating?

Ans: Gamma Radiation.

2. Can Gamma Radiation be detected by any of the Physical Senses?

Ans: Gamma radiation cannot be seen, heard, felt, smelled, or tasted.

3. In what direction do radioisotopes emit radiation?

Ans: Radioisotopes continuously emit radiation in all directions.

4. Why are scattered gammas more likely to be absorbed by the body than direct?

Ans: Scattered gammas are of lower energy.

5. Can gamma radiation damage body tissue?

Ans: Yes.

6. Do all Kellogg Construction Department Projectors also qualify as Storage Containers? Why?

Ans: Yes; because Kellogg Projectors meet the N.R.C. requirements of storage containers.

7. Name three fundamental principles which a Radiographer or Assistant must exercise in controlling exposure of the body to gamma radiation from external sources.

Ans: Time
Distance
Shielding

8. How is intensity of gamma radiation expressed?

Ans: Roentgens per hour (R/hr)
Milliroentgens per hour (MR/hr)

9. What is a Survey Meter?

Ans: A survey meter is a device used to determine radiation levels of any specific area.

10. How often must a Survey Meter be calibrated?

Ans: Every 3 months, if the meters performance is questionable or after servicing.

11. Is a Radiographer permitted to perform calibration of a Survey Meter?

Ans: No

12. The calibration tag attached to the Survey Meter should show what?

- Ans: 1. Where it was calibrated.
2. Date of calibration.
3. Show calibration at two points.

13. How is a survey instrument routinely checked before daily use at the job?

- Ans: 1. Battery Test.
2. Check the radiation level on the outside of the projector.

14. What is a film badge?

- Ans: A device used to measure ionizing radiation by the exposure of photographic film.

15. Is film badge exposure information available to Radiographers and their Assistant?

- Ans: Yes.

16. What is a Pocket Dosimeter?

- Ans: The pocket dosimeter is an ionization chamber with an electroscope which is used to directly read doses received.

17. What is the graduated scale of the Pocket Dosimeters employed by the Kellogg Construction Department?

- Ans: 0-200 MR
0-5 R

18. How often and by whom must a Pocket Dosimeter be checked?

Ans: Pocket dosimeters shall be checked by the wearer no less than four times in eight hours and immediately after any hazardous occurrence.

19. How often and by whom must a Pocket Dosimeter be charged?

Ans: Daily, by the radiographer.

20. If a check of your pocket dosimeter reads 30 milliroentgens or more, what do you do?

Ans: Cease operations; check for unnecessary hazards. If reading is 96 MR or more, notify the Radiation Protection Officer.

21. If the Radiographer is to be absent from work, what rule must be followed?

Ans: No radiography is to be done.

22. May the Radiographer's helper who acts as his equipment mover to carry the Projectors operate the Projector or otherwise perform radiography?

Ans: No.

23. Must the Radiographer post N.R.C. Form 3?

Ans: Yes.

24. In performing the daily maintenance on a T/o 660 it is discovered that the pigtail connector spring is functioning improperly. What must you do and why?

Ans: Take steps to ensure the source is not used for radiography and notify the radiation protection officer because malfunction of the pigtail connector spring could cause the source to disconnect during radiographic operations.

25. In performing the daily maintenance on a T/o 660 it is found that one of the 7 ft. source guide tubes is dented. May radiography still be performed? If so, how?

Ans: Yes. The dented tube must be replaced with a tube in operable condition.

This is to certify that questions with incorrect answers have been reviewed over with me by the Radiation Protection Officer.

Signature

Date

This is to certify that I have reviewed over questions with incorrect answers with the candidate.

Signature (RPO)

Date

Written Test Grade _____

Oral Test Grade _____

Practical Test Satisfactory Or Unsatisfactory

NAME: _____

DATE: _____

S/S NO.: _____

RADIOGRAPHERS ASSISTANTS
PRACTICAL EXAMINATION

RADIATION SAFETY

	CORRECT	INCORRECT	
(1)	_____	_____	Attach film badge to clothing or place in pocket.
(2)	_____	_____	Recharge pocket dosimeters (0-200 Mr and 0.5R and place in pocket or clothing During operations read and interpret in accord with Paragraph B-IX-100.3.3.
(3)	_____	_____	Check that survey meter(s) are operable and calibrated. Radiographer verify.
(4)	_____	_____	Radiographer performs physical radiation survey of projector.
(5)	_____	_____	Transport exposure device to working area (See B-IV).
(6)	_____	_____	Radiographer performed and records daily inspection.
(7)	_____	_____	Transport and position exposure device near exposure site.
(8)	_____	_____	Position source tube end stop using jig or other attachment device (tape, surgical rubber tubing, etc.) where exposure is to be made. Attach film, markers, and identification.
(9)	_____	_____	Position source tube so movement of source through tube will be free and easy.
(10)	_____	_____	Layout control cable and control unit such that it will be as far from the exposure point as possible or behind shielding and such that control cable will move free and easy. Connect control cable to projector.
(11)	_____	_____	Radiographer checks projector connections.
(12)	_____	_____	Post the Restricted Area and High Radiation Area (B-VIII).
(13)	_____	_____	Unlock exposure device.

RADIOGRAPHERS ASSISTANTS PRACTICAL EXAMINATION/Cont'd.

	CORRECT	INCORRECT	
(14)	_____	_____	Rotate the handle on control unit in the "expose" direction until the source contacts the source stop. Do not use undue force. If the source tube or control cable binds or offers unusual resistance reverse direction and return to safe position. Survey projector to assure source is in safe position. Check control cable and source tube for kinks, sharp bends, or twisting.
(15)	_____	_____	Start exposure timing when source reaches end stop.
(16)	_____	_____	Radiographer shall survey perimeter of restricted area to assure that it is at 2 Mr/hr.
(17)	_____	_____	Radiographer shall maintain a constant surveillance of the area to assure that no persons enter the area.
(18)	_____	_____	When the exposure is completed rotate the handle on the control unit in the "retract" direction until the source is returned to the safe position.
(19)	_____	_____	Approach the exposure device with the survey meter while reading it to assure that the source is returned to the safe position.
(20)	_____	_____	Rotate securing mechanism to locking positions.
(21)	_____	_____	Survey the entire circumference, the exposure device and the source tube to assure that the source is in the safe position.
(22)	_____	_____	When the last exposure which can be made safely without movement of the projector is completed, secure and lock the projector. Radiographer shall verify before movement.
(23)	_____	_____	Transport exposure device to storage area and Radiographer shall perform physical radiation survey of exposure device and record. Place exposure device in storage area.
(24)	_____	_____	Radiographer shall perform radiation survey around storage area to assure that unrestricted area does not exceed 2 Mr/hr or 0.6 Mr/hr (See B-III-101.4.
(25)	_____	_____	Radiographer shall lock storage area and remove key.

RADIOGRAPHERS ASSISTANTS PRACTICAL EXAMINATION/Cont'd.

CORRECT INCORRECT

(26) _____ _____

Remove film badges and store with control badge.

(27) _____ _____

Read and record dosimeter readings and complete Form K-24.

SATISFACTORY _____

UNSATISFACTORY _____

Radiographers Assistant: _____

Date: _____

RPO: _____

Date: _____

N. R. C. RADIATION SAFETY
EXAMINATION

NAME _____

DATE _____

1. Of the three types of radiation, namely Alpha, Beta, and Gamma, which is the most penetrating?

Ans: Gamma Radiation

2. Of the three types of radiation, Alpha, Beta, or Gamma, which type is likely to be emitted from a sealed source?

Ans: Gamma

3. Can Gamma Radiation be detected by any of the Physical Senses?

Ans: Gamma radiation cannot be detected by any of the physical senses of the body, that is, it can be neither seen, heard, felt, smelled, or tasted.

4. In what direction do radioisotopes emit radiation?

Ans: Radioisotopes continuously emit radiation in all directions.

5. Why does the intensity decrease with distance?

Ans: Because the radiation has a greater surface area to cover.

6. Define the term "Half-Life"?

Ans: Radioactive half-life is the time it takes for $\frac{1}{2}$ of the atoms of a radioactive isotope to disintegrate; in other words, the time for a radioisotope to lose $\frac{1}{2}$ of its activity.

7. Define "The Inverse Square Law"?

Ans: Intensity varies inversely with the square of the distance from the source.

8. How is the inverse square law expressed algebraically?

Ans: $\frac{I_1}{I_2} = \frac{(d_2)^2}{(d_1)^2}$ or $I_1 d_1^2 = I_2 d_2^2$ Where: I_1 = Intensity at distance d_1
 I_2 = Intensity at distance d_2

Source d_1 d_2

9. How is the choice of shielding material related to atomic number?

Ans: The higher the atomic number the greater the shielding. This is because the photoelectric effect, compton effect, and pair production are all related to the atomic number.

10. Why are scattered gammas more likely to be absorbed by the body than direct?

Ans: Scattered gammas are of lower energy.

11. What are the permissible dosage limits from radioactive material for any individual in restricted areas in any period of one calendar quarter?

- Ans:
1. Whole body; head & trunk; active blood-forming organs; lens of eye; or gonads - $1\frac{1}{2}$ REMS per quarter.
 2. Hands & forearms; feet & ankles - $18\frac{3}{4}$ REMS per quarter.
 3. Skin of whole body - $7\frac{1}{2}$ REMS per quarter.

REF: 20.101

12. What is an isotope?

Ans: An isotope is a form of an element which is chemically identical but different in mass. The difference in mass is due to the difference in the number of neutrons in the nucleus of the element.

13. What is radioactivity?

Ans: Radioactivity is the spontaneous emittance of particles or electromagnetic energy. This disintegration results in a change to a lower energy state.

14. In what units is the strength of a radioactivity expressed?

Activity of a Radioisotope

Ans: Activity is expressed in curies, millicuries, microcuries, or disintegrations per second.

REF: 20.5, 30.4

15. What is a millicurie?

Ans: 1/1000 of a curie; $1\text{mCi} = 0.001\text{Ci}$

16. What is a roentgen?

Ans: A unit of measurement of x- and gamma rays absorbed in air and abbreviated (r). Specifically it is the quantity of radiation that will produce one electronstatic unit (esu) of charge in ICC of air at STP.

17. What is a milliroentgen?

Ans: 1/1000 of a Roentgen abbreviated (mr).

18. What is a definition of "Dose"?

Ans: Dose is the quantity of radiation absorbed per unit of mass by the body or by any portion of the body.

REF: 20.4

19. What do the letters in rem mean?

Ans: Roentgen equivalent man.

20. What is a rem?

Ans: A REM is a measure of the dose of any radiation to body tissue in terms of its estimated biological effect under consideration and upon the conditions of Irradiation.

REF: 20.4

21. What is the mrem?

Ans: 1/1000 of a REM.

22. How does the hazard vary with rate of dosage?

Ans: A radiation dose received over a long period of time will have less effect than a radiation dose received over a shorter period of time.

23. Can gamma radiation damage body tissue?

Ans: Yes; gamma radiation can not only damage body tissue but can also be fatal.

24. Enumerate some of the hazards of excessive exposure of radiation.

Ans: Excessive exposure of radiation can cause injury of the blood-forming organs, the skin, the lens of the eye and the gonads.

25. What is the maximum permissible radiation level in distance, in time and milliroentgens of a radiographic exposure device measuring a minimum of 4 inches from the sealed source storage position to any exterior surface of the device?

Ans: 200 mr/hr at any exterior surface and 10 mr/hr at one meter from an exterior surface.

REF: 34.21

26. If a Projector which is not a Storage Container has 3 1/2 inches of lead all about the source, but measures less than 4 inches from the source storage position to an exterior surface at one point, what is the maximum radiation level permitted at 1/2 foot from any exterior surface?

Ans: 50 mr/hr.

REF: 34.21

27. If a Projector which is not a Storage Container has 3 inches of uranium or mercury all about the source, but measures less than 4 inches of uranium or storage position to an exterior surface at one point, what is the maximum level of radiation permitted at 6 inches from any exterior surface?

Ans: 50 mr/hr.

28. If a projector in the "off" position has 4 1/2 inches of shielding material all around the source, what is the maximum level of radiation permitted in the physical survey of that Projector?

Ans: 200 mr/hr at any exterior surface and 10 mr/hr at one meter from an exterior surface.

REF: 34.21

29. For a Projector to be also a Storage Container, what radiation level must it meet?

Ans: Not in excess of 200 mr/hr at any exterior surface and not in excess of 10mr/hr at one meter from any exterior surface.

REF: 34.21

30. Do all Kellogg Construction Department Projectors also qualify as Storage Containers? Why?

Ans: Yes; because Kellogg Projectors meet the NRC requirements of storage containers.

31. What is the fundamental principle in radiation protection with respect to the use of shielding?

Ans: Do not rely on calculations concerning the effectiveness of shielding, but do rely on actual measurement of intensity.

32. Name the principle materials used in shielding against radiation?

Ans: Lead, steel, concrete.

33. Of the three materials lead, steel or concrete, which absorbs radiation to the greater degree?

Ans: Lead.

34. In shielding what is meant by half value layer (HVL) of thickness?

Ans: The half value layer of thickness is defined as that thickness of material required to reduce the intensity of radiation to one-half its previous value.

35. What is meant by the term tenth value layer?

Ans: The thickness of material which will reduce the intensity of radiation to 1/10 its previous value.

36. Express the formula for working distance in words?

Ans: The radiation intensity decreases in proportion to the square of the increased distance.

37. Name three fundamental principles which a Radiographer or Assistant must exercise in controlling exposure of the body to gamma radiation from external sources.

Ans: 1. Time.
2. Distance.
3. Shielding.

38. What is the fundamental principle in radiation protection with respect to time?

Ans: The amount of radiation absorbed by the human body is directly proportional to exposure time; i.e., the less time spent near the source the less radiation received.

39. How is intensity of gamma radiation expressed?

Ans: Roentgens per HOUR (r/hr) or milliroentgens per hour (mr/hr).

40. Assume an exposure takes 5 minutes and that the Radiographer remains 8 feet from a 1 curie Co 60 source which has a radiation rate of 230 mr per hour. The half value layer for lead for Co 60 is 0.49 inches. How many half inch thick lead shields must the radiographer use so that his exposure will not exceed 5 mrem?

Ans: (5 minutes) $\left(\frac{1\text{hr}}{60\text{min}}\right) = 1/12 \text{ hr}$

$(1/12\text{hr}) \left(\frac{230\text{mr}}{\text{hr}}\right) = \sim 19 \text{ mr received in 5 minutes}$
 $\frac{1}{2}" \text{ lead will reduce 19 to 9.5 mr}$
A second $\frac{1}{2}"$ will reduce 9.5 to 4.8 mr
USE 2- $\frac{1}{2}"$ lead shields

41. What origins of radiation must the Radiographer plan protection against in his radiographic set-up?

Ans: 1. Primary - Direct from source.
2. Secondary - Scattered radiation reflected from material on which radiation strikes.

42. If one curie of Ir 192 has a dose rate of 5900 mrem per hour at 1 foot, how many mrems will 10 curies have?

Ans: 1 ci @ 1 ft = 5900 mrem/hr
10 ci @ 1 ft = 10(5900) = 59000 mrem/hr

43. If one curie of Co 60 has a dose rate of 5900 mrem per hour at 1 foot and you double the distance not once but four times, then (a) how far away from the source is this and (b) what are the mrems/hr ?

Ans: (a) 16 Feet. Where $I_1 = 5900$ $d_1 = 1$
(b) $\frac{I_1}{I_2} = \frac{d_2^2}{d_1^2}$ $I_2 = ?$ $d_2 = 16$
 $I_2 = \sim 23$ mrem/hr

44. If 10 curies of unshielded Ir 192 emits 3687 mrem per hour at 4 feet, where the dose rate of one curie of Ir 192 is .548 rem per hour at 1 meter, then if one curie of Co 60 has a dose rate of 1.347 rem per hour at 1 meter, what will be the dose rate of 10 curies of Co 60 at 4 feet in mrem per hour?

Ans: Set up ratio - 1 ci Ir 192 @ 1 meter = .548 R/HR $\frac{1.347}{.548} = \frac{3687}{?}$
1 ci Co60 @ 1 meter = 1.347 R/HR
10 ci Co60 @ 4' = 9062 mrem/hr

45. If it is impossible to limit exposure by varying working distance or using shielding, how can a Radiographer, even so, control or reduce his exposure?

Ans: Radiographer can reduce time he is in the area.

46. If a T.O. Model 402 Projector has a surface leakance of 70 mr/hr. and it takes three minutes to unlock and to carefully remove the cables, seven minutes to carefully replace them, and lock the equipment all standing against the Projector, what is the dose received?

Ans: $3 + 7 = 10$ min Total Time

$$(10 \text{ min}) \left(\frac{\text{hr}}{60 \text{ min}} \right) \left(\frac{70 \text{ mr}}{\text{hr}} \right) \left(\frac{700}{60} \right) \approx 11.7 \text{ mr}$$

47. If a T.O. Model Projector with 10 curies of Co 60 with the source in the "On" position produces 55000 mr/hr at five feet, and the guide tube is 21 feet and the control cable is 25 feet, what is the intensity at the source control unit?

Ans: $\frac{I_1}{I_2} = \frac{d_2^2}{d_1^2}$ Where $I_1 = 55000 \text{ mr/hr}$ $d_1 = 5 \text{ ft.}$
 $I_2 = ?$ $d_2 = 46 \text{ ft.}$

$$\frac{55000}{I_2} = \frac{46^2}{5^2} \quad I_2 = 650 \text{ mr/hr}$$

48. With the T.O. Model 490 100 curie Ir 192 Projector, if the source in the "On" position produces 9.2 mr per hour at 25 feet per curie, what is the distance from the source to the 2 mr/hr level of intensity?

Ans: $\left(\frac{9.2 \text{ mr}}{\text{ci-hr}} \right) (100 \text{ ci}) = 920 \text{ mr/hr}$
 $\frac{I_1}{I_2} = \frac{d_2^2}{d_1^2}$ Where $I_1 = 920 \text{ mr/hr}$ $\frac{920}{2} = \frac{d_2^2}{25^2}$ $d_2 = 537'$
 $I_2 = 2 \text{ mr/hr}$
 $d_1 = 25 \text{ ft.}$
 $d_2 = ?$

49. What will be the strength of a 9 curie Ir 192 source after 3 half lives?

Ans: Each half-life reduces activity by $\frac{1}{2}$.

1. End of first half-life $9/2 = 4.5$
2. End of 2nd half-life $4.5/2 = 2.25$
3. End of 3rd half-life $2.25/2 = 1.125$

50. If two Co 60 600 mc sources were of two sizes, which would have the highest specific activity?

Ans: The source with the smallest volume.

51. How long per week can a Radiographer work in a field of 5 mr per hour if the limitation is 95 mr per week?

Ans: $(95\text{mr}) \left(\frac{\text{hr}}{5\text{mr}}\right) = 19 \text{ hr}$

52. If the Radiographer found that he was in a radiation field of 8 mr/hr at 10 feet during one radiation set-up, at what distance would he be in a field of 2 mr/hr?

Ans: $\frac{I_1}{I_2} = \frac{d_2^2}{d_1^2}$ $I_1 = 8 \text{ mr/hr}$ $d_2 = ?$
 $\frac{8}{2} = \frac{d_2^2}{10^2}$ $I_2 = 2 \text{ mr/hr}$ $d_1 = 10 \text{ ft.}$
 $d_2 = 20 \text{ ft.}$

53. What is a Survey Meter?

Ans: A survey meter is a device used to determine radiation levels of any specific area.

54. How often must a Survey Meter be calibrated?

Ans: Every 3 months, if survey meters performance is questionable, or after servicing.

REF: 34.24

55. Is a Radiographer permitted to perform calibration of a Survey Meter?

Ans: No.

56. Who is permitted to perform calibration of a Survey Meter?

Ans: Persons specifically authorized to do so by the agency or any agreement state.

57. The calibration tag attached to the Survey Meter should show what?

- Ans: 1. Where it was calibrated.
2. Date of calibration.
3. Show calibration at two points.

58. Your Assistant Radiographer drops the Survey Meter and you suspect it is damaged, your spare will not arrive for 1 more day, what must you do?

Ans: Stop radiography and secure exposure device.

59. Where should a Kellogg Radiographer place the Restricted Area signs?

Ans: At the point where the survey meter reads 2 mr/hr or less.

60. When a Projector has been positioned for an exposure, what does one do with the Survey Meter to establish the boundaries for the Radiation Area?

Ans: One walks around the radiation area marking the proper dosage boundary.

61. How is a survey instrument routinely checked before daily use at the job?

- Ans: 1. Battery Test.
2. Check the radiation level on the outside of the projector.

62. What survey records are required?

- Ans: 1. Before source is removed from vault.
2. Before each move in the field.
3. After return to vault.

REF: 34.43

63. What is a film badge?

Ans: A device used to measure ionizing radiation by use of photographic film.

64. How are film bages identified?

Ans: By identification stamped on the film pack - name & number.

65. How long is a film badge worn?

Ans: Two weeks.

66. Where are film badges kept at the end of the working shift?

Ans: With the control badge.

67. In what manner are dosages tabulated?

Ans: By comparing the developed film badge to a similar film strip and comparing densities.

68. How is the information reported?

Ans: It is reported in REMS.

69. Is film badge exposure information available to Radiographers and their Assistant?

Ans: . Yes.

70. In case of accidental breakage or wetting of the film badge what procedure must be followed?

Ans: The Radiation Protection Officer and the Film Badge Service Company should be informed and a spare film badge should be used for subsequent work.

71. What is the purpose of the control film badge?

Ans: To record radiation not received in the radiation area while the radiographer is not using the badge.

72. If the limitation is 1250 mr per calendar quarter, how much is permitted per week on a 13 week quarter?

Ans: $\frac{1250 \text{ mr}}{13 \text{ wks}} = 96.3 \text{ mr}$

73. A (0-200mr) Dosimeter is discharged beyond its range, what is to happen to the wearer's film badge?

Ans: It should be sent in to be developed immediately.

74. What is a Pocket Dosimeter?

Ans: The pocket dosimeter is an ionization chamber with an electroscope which is used to directly read doses received.

75. What is the graduated scale of the Pocket Dosimeters employed by the Kellogg Construction Department?

Ans: 0-200 mr & 0-5 mr.

76. How often and by whom must a Pocket Dosimeter be checked?

Ans: Pocket dosimeters shall be checked by the wearer no less than four times in eight hours and immediately after any hazardous occurrence.

77. How often and by whom must a Pocket Dosimeter be charged?

Ans: Daily by the radiographer or more often if needed.

78. How often shall a licensee conduct a physical inventory of sealed sources received and possessed under his license?

Ans: Quarterly.

REF: 34.26

79. What record must be maintained?

Ans: A utilization log and a record of all sources on hand and all sources transferred.

REF: 34.26

80. What is the maximum allowable body dosage for a person 18 years of age or over, in a calendar quarter?

Ans: Three REMS provided it does not exceed $5(N-18)$ REMS cumulative.
N = Age at last birthday.

REF: 20.101

81. In the field, you calculate shielding and place warning lights and signs etc., at 20 feet from the Projector. While making an exposure, your survey meter reads $2\frac{1}{2}$ millirems/hr at 20 feet. What must you do and why?

Ans: All signs, lights, etc. must be moved back to the two millirems/hr line as this is the permissible dose rate which an unrestricted area must be below.

82. At a job site, you move the Projector into a closet during lunch period and eat your lunch in front of it, need you post a caution sign?

Ans: No.

83. At a job site you finish for the night and store the Projector in the tool supply room which has a lock but to which other have also the key. You also label and post caution signs. Are you in compliance with N.R.C. Regulations? Why?

Ans: Yes, because it is locked and signs are posted.

84. At a job site, another worker unknown to you has been seated for one hour next to a Projector leaking 50 rems/hr. Upon learning of this you should do what?

Ans: Call the Radiation Protection Officer immediately, and if he cannot be contacted, notify the NRC by telephone and telegraph.

REF: 20.403(a)

85. At a job site, you must leave Projector to go to men's room. What is the first thing you must do?

Ans: Lock the exposure device.

86. At a job site, you receive by mail a Leak Test Kit and are instructed to perform a leak test on a Projector. What do you do? Why?

Ans: Call an authorized agent to perform the leak test; the leak test must be performed by licensed personnel.

REF: 34.25

87. At a job site you receive a Projector which when surveyed appears to be in good order but a Leak Test Certificate is missing. Upon calling supplier, you are told it was leak tested within last six months and that a certificate will be sent. May you use Projector?

Ans: No.

REF: 34.25 (b)

88. At a field site, your work on actual location will take about 3 hours of work; why must you post warning signs if you will be in constant attendance?

Ans: Regulations require warning signs whatever the length of time is.

REF: 20.203

89. Define "Restricted Area".

Ans: Restricted area is any area in which access is controlled, by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials.

REF: 20.3 (a,14)

90. Define "Radiation Area"?

Ans: Radiation area is any area, accessible to personnel, in which radiation exists such that a major portion of the body could receive in any one hour a dose in excess of 5 millirem, or in any five consecutive days a dose in excess of 100 millirems.

REF: 20.202 (b,2)

91. Define "High Radiation Area"?

Ans: High radiation area is any area, accessible to personnel, in which there exists radiation originating in whole or in part within licensed material at such levels that a major portion of the body could receive in any one hour a dose in excess of 100 millirems.

REF: 20.202 (b3)

92. At a job site should you have two (2) survey meters available at all times?

Why?

Ans: Yes; to check one against the other and as a safety precaution if one is damaged.

93. If a check of your pocket dosimeter reads 30 milliroentgens or more, what do you do?

Ans: Cease operations; check for unnecessary hazard if reading is 96 mr or more, and notify the Radiation Protection Officer.

94. In field work where do you record your dosimeter reading?

Ans: On form construction K-24 to be kept and filled out by radiographer.

95. At a jobsite, you for safety reasons request that a certain area be used as the Projector Storage Area. The Kellogg Construction Superintendent offers you an alternate place which you feel you should refuse to use for safety reasons and which you explain to the Kellogg Construction Superintendent. If he refuses to modify his position, you should do what?

Ans: Notify Radiation Protection Officer.

96. If the Radiographer is to be absent from work, what rule must be followed?

Ans: No radiography is to be done.

97. May the Radiographer's helper who acts as his equipment mover to carry the Projectors operate the Projector or otherwise perform radiography?

Ans: No.

98. What shall be done in case of malfunction of the Projector?

Ans: 1. Take precautions to minimize the hazard to persons.
2. Notify the agency by telephone & telegraph.
3. Contact licensed source handler to correct malfunction.

99. What shall be done if by-product material is missing?

Ans: The agency must be informed immediately by telephone and telegraph of the missing source.

REF: 20.402

100. Must the Radiographer post N.R.C. Form 3?

Ans: Yes.

This is to certify that questions with incorrect answers have been reviewed over with me by the Radiation Protection Officer.

Signature

Date

This is to certify that I have reviewed over questions with incorrect answers with the candidate.

Signature(RPO)

Date

Written Test Grade _____

Oral Test Grade _____

Practical Test Satisfactory Or Unsatisfactory

NAME: _____

DATE _____

S/S NO.: _____

RADIOGRAPHERS PRACTICAL EXAMINATION

RADIATION SAFETY

	CORRECT	INCORRECT	
(1)	_____	_____	Calculate Exposure Time.
(2)	_____	_____	Attach Film Badge to Clothing.
(3)	_____	_____	Recharge Pocket Dosimeters (0-200MR and 0-5R). Check Calibration on (0-200MR) and place both dosimeters in pocket of clothing where the film badge is attached. During operations read and interpret in accord with paragraph B-IX-100.3.3.
(4)	_____	_____	Check that survey meters are operable and calibrated.
(5)	_____	_____	Perform physical radiation survey of projector and record.
(6)	_____	_____	Transport exposure device to working area in accordance with (B-IV).
(7)	_____	_____	Perform daily inspection and maintenance in accordance with procedures and record.
(8)	_____	_____	Position exposure device near exposure site.
(9)	_____	_____	Position source tube end stop where exposure is to be made using collimator if possible.
(10)	_____	_____	Attach film, markers and identification.
(11)	_____	_____	Position source tube so movement of source through tube will be free and easy.
(12)	_____	_____	Layout control cable and control unit such that it will be as far from the exposure point as possible or behind shielding and connect to projector.
(13)	_____	_____	Estimate the dimensions of the restricted area and high radiation area.

	CORRECT	INCORRECT	
(14)	_____	_____	Establish and post the restricted area and high radiation area (B-VIII).
(15)	_____	_____	Unlock Exposure Device.
(16)	_____	_____	Rotate the handle on control unit in the "Exposure" direction until the source contacts the source stop.
(17)	_____	_____	Start exposure timing when source reaches end stop.
(18)	_____	_____	Survey perimeter of the restricted area to verify 2 MR/HR Level.
(19)	_____	_____	Maintain a constant surveillance of the area to assure that no persons enter the area.
(20)	_____	_____	When the exposure is completed rotate the handle on the control unit in the "Retract" direction until the source is returned to the safe position.
(21)	_____	_____	Approach the exposure device with the survey meter while reading it to assure that the source is returned to the safe position.
(22)	_____	_____	Rotate the securing mechanism to the lock position.
(23)	_____	_____	Survey the entire circumference of the exposure device and the source tube to assure that the source is in the safe position.
(24)	_____	_____	Make remaining exposures which do not require movement of the projector.
(25)	_____	_____	Exposure device was surveyed, secured and locked before movement.
(26)	_____	_____	Exposure device was transported to storage area and a physical radiation survey of exposure device was performed and recorded.
(27)	_____	_____	Exposure device was placed in storage area and the storage area was surveyed and locked. (B-III-101.4).
(28)	_____	_____	Personnel removed film badges and stored with control badge.

CORRECT INCORRECT

(29) _____

Read dosimeter and record readings on Form K-24.

(30) _____

Turn off and store survey instruments.

SATISFACTORY _____

UNSATISFACTORY _____

RADIOGRAPHER: _____

DATE: _____

RPO: _____

DATE: _____