

TUMBLEWEED X-RAY COMPANY

P.O. Box 1592
Weatherford, Oklahoma 73096
405-772-2554

Otho G. Jones
Owner

August 29, 1983

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Mr. Joseph C. Wang
Material Licensing Branch
Division of Fuel Cycle & Material Safety
U. S. Nuclear Regulatory Commission
Mail Stop 396SS
Washington, D. C. 20555

RE: Mail Control Number 15317

Dear Mr. Wang:

In response to your recent letter requesting clarification of certain items in our license application for a byproduct material license in Industrial Radiography, we submit the following, item by item, for your information:

- ✓ 1. Tumbleweed X-Ray Company (a sole proprietorship).
- ✓ 2. Application to read: "All States Regulated by the United States Nuclear Regulatory Commission".
- ✓ 3. (a) Permanent Storage Facilities: Steel, lead-lined storage containers permanently affixed to the mobil darkroom vehicle and locked for security.

(b) Office Facility where inspection of equipment, records and operations may be performed: Kendall House Trailer Park, Lot 8-South, Junction I-40 and State Highway 54, Custer County, Oklahoma. If there is a change in this location, you will be notified prior to such change.
4. Attached are copies of Supplements 1, 2 and 3 which were originally submitted with the license application on July 12, 1983.
- ✓ 5. Pocket dosimeters will be returned to the manufacturer (Dosimeter Corporation of America) for calibration at lease once a year or more frequent if found to be malfunctioning.

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U. S. Nuclear Regulatory Commission
August 29, 1983

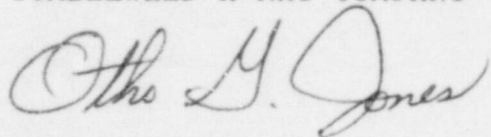
6. Attached are copies of tests and answers, as requested.
7. See License Application Attachment, Item 6(f), Training Program, Page 2, Paragraph 5. Also to be covered in the annual review will be the areas in which deficiencies were found in the periodic "Radiographers Performance Review", outlined in Attachment Item 6(g), Internal Inspection and Management Controls, Paragraph 3.
8. Paragraph A, Page 10 of our "Operating and Emergency Procedures Manual has been revised and is attached.

We sincerely hope that this information will clarify any areas in questions.

We wish to stress again that we are very anxious for approval of this application as we have customers that require immediate service in this area. Therefore, your prompt attention will be greatly appreciated.

Respectfully submitted,

TUMBLEWEED X-RAY COMPANY



Otho G. Jones
Owner

OGJ/jj

Enclosures

4. SEALED SOURCES TO BE USED IN RADIOGRAPHY

	<u>BYPRODUCT MATERIAL</u>	<u>SOURCE MODEL NUMBER</u>	<u>MANUFACTURER</u>	<u>MAX. ACTIVITY PER SOURCE</u>	<u>NO. OF SOURCES</u>
A.	Iridium 192	A-424-9	Technical Operations	100 Curies	5
B.	Iridium 192	A-424-1	Technical Operations	100 Curies	1
C.	Iridium 192	A-58101-8	Technical Operations	200 Curies	1
D.	Iridium 192	G-3	Source Production & Equipment Company	100 Curies	2
E.	Iridium 192	G-23	Source Production & Equipment Company	100 Curies	1
F.	Iridium 192	G-1	Source Production & Equipment Company	100 Curies	1
G.	Iridium 192	T-3-T	Gamma Industries	100 Curies	5
H.	Iridium 192	T-1-T	Gamma Industries	100 Curies	1
I.	Iridium 192	A-2-A	Gamma Industries	100 Curies	1
J.	Cobalt 60	A-424-3	Technical Operations	20 Curies	1

Per Jelfs, OK. Jan 9/8/63
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 Jan

5(a). RADIOGRAPHIC EXPOSURE DEVICESMODEL
NUMBERMANUFACTURER

A. Tech/Ops 660

Technical Operations, Inc. ↗

B. Tech/Ops 533

Technical Operations, Inc.

C. Tech/Ops 616

Technical Operations, Inc.

D. Spec 2-T

Source Production & Equipment Company ↗

E. Pipeliner I

Gamma Industries, Inc.

F. Century-S

Gamma Industries, Inc.

G. GI 35-S

Gamma Industries, Inc.

H. Century-SA

Gamma Industries, Inc.

I. GI 35-SA

Gamma Industries, Inc.

J. Century

Gamma Industries, Inc. ↗

K. GI 35

Gamma Industries, Inc.

L. Tech/Ops 491

Technical Operations, Inc.

5(b). RADIOGRAPHIC SOURCE CHANGERSMODEL
NUMBERMANUFACTURER

A. Tech/Ops 650	Technical Operations, Inc.
B. Spec C-1	Source Production and Equipment Company
C. GI C-10	Gamma Industries, Inc.

TUMBLEWEED X-RAY COMPANY

SNT-TC-IA LEVEL II EXAMINATION FOR INDUSTRIAL RADIOGRAPHERS

NAME _____ DATE _____

EXAMINER _____ GRADE _____

INSTRUCTIONS TO EXAMINERS: This is a typical test having 80 questions divided into 5 groups of 16 questions. Each group covers a specific area of instruction which the candidate has received, in accordance with the requirements outlined in U.S.N.R.C. Title 10, Part 34. Each test shall consist of 40 questions, with the examiner randomly selecting 8 questions from each group. The full set of 80 questions will be given to each candidate with the 40 questions which each is to answer being circled. Tests will be varied as much as possible to prevent answers from becoming common knowledge and under no circumstances shall a group of candidates be given identical sets of questions at the same time.

Each question carries a 2.5 value. An 80% accuracy on this test is required to PASS; provided that no more than two wrong answers are given in any of the 5 categories. In that event, the candidate shall be given a minimum of one hour additional instruction in each deficient category and retested, using a different set of questions. In any event, the examiner will review and discuss each incorrect answer with the candidate.

GROUP A - CHARACTERISTICS OF GAMMA RADIATION & FUNDAMENTALS OF RADIATION SAFETY.

1. What parts of the body are regarded as most sensitive to radiation? *WHOLE BODY, HEAD & TRUNK, BLOOD FORMING ORGANS, LENS OF EYES & GONADS.*
2. When an isotope has gone through 3 half lives, what fraction of its initial strength is left? *1/8*
3. What is an isotope? *A VARIATION OF AN ELEMENT WHICH HAS THE SAME ATOMIC NUMBER & CHEMICAL CHARACTERISTICS AS THE ELEMENT, BUT DIFFERS IN ATOMIC WEIGHT, MAKING IT UNSTABLE.*

4. How is the number of disintegrations per second taking place in a given radioactive source expressed?

CURIES

5. Explain the difference between radiation dose rate and radiation dose.

DOSE RATE - IS THE INTENSITY AT WHICH THE DOSE IS RECEIVED.

DOSE - TOTAL DOSE RECEIVED IN A GIVEN LENGTH OF TIME.

6. What is the unit of measurement for the ionizing effect of penetrating radiation on air?

ROENTGEN

7. Does the energy level of radiation emitted by a given isotope decrease as the curie strength of the isotope decreases?

NO - IT REMAINS CONSTANT

8. What is the unit of measurement for the effect of any type of radiation on man that is the equivalent of the effect of one roentgen of gamma radiation to man?

REM

9. Why does radiation produce greater biological effects on minors than on adults?

CELL DIVISION IS MORE RAPID IN EARLY YEARS, AND THEY ARE MORE SUSCEPTIBLE TO DAMAGE FROM RADIATION.

10. Define the half life of an isotope.

LENGTH OF TIME IT TAKES FOR AN ISOTOPE TO LOSE ONE HALF OF ITS STRENGTH, AS MEASURED FROM ANY GIVEN TIME.

11. Would a single exposure of 600 r to only one hand be fatal? Explain your answer.

NO. HANDS ARE LESS SENSITIVE TO RADIATION THAN OTHER PARTS OF BODY.

12. What effect would a single, whole body exposure of 600 r have on a human?

PROBABLY DEATH

13. Calculate the dose received from a 10 curie Cobalt 60 source in ten minutes at a point two feet from the source after the radiation has been attenuated by one HVL of lead.

APPROX 3,021 MR

14. What is the HVL thickness of lead for Iridium 192?
For Cobalt 60? *IR 192 - .20"*
CO 60 - .50"
15. If the radiation intensity from a source is 10 r/hr at a distance of two feet, how much would it be at the following distances?
- | | |
|-----------------|--------------------------|
| (a) Four feet | <u><i>2 1/2 R/HR</i></u> |
| (b) Ten feet | <u><i>400 MR/HR</i></u> |
| (c) Twenty feet | <u><i>100 MR/HR</i></u> |
| (d) One foot | <u><i>40 R/HR</i></u> |
16. What parts of the body are regarded as the least sensitive to radiation?
HANDS, FOREARMS, FEET & ANKLES.

GROUP B - RADIATION DETECTION AND INSTRUMENTATION

1. Suppose your survey meter was found to be broken or badly out of adjustment on a field trip. What would you do? *SHUT DOWN JOB, OBTAIN ANOTHER SURVEY METER THAT WAS OPERATABLE & HAD BEEN CALIBRATED WITHIN THE PAST 3 MONTHS, BEFORE TRANSPORTING OR USING RADIOGRAPHIC EQUIPMENT.*
2. Why do most film badges contain two films of different speeds? *INCREASE DIAGNOSTIC RANGE*
3. Why is it so important to survey your exposure device after each exposure is made?
TO ASSURE THAT THE SOURCE IS SECURED IN A SAFE, STORED POSITION.
4. Pocket dosimeters are designed to measure:
- (a) Gamma rays and x-rays only
 - (b) Gamma rays, x-rays and beta particles
 - (c) Gamma rays, alpha and beta particles
 - (d) Alpha and beta particles only

5. Why can't film badges be transferred from one user to another? *THERE WOULD BE NO WAY OF DETERMINING WHAT PERCENT OF THE TOTAL MEASURED DOSE WAS RECEIVED BY EACH WEARER.*
6. How often must radiation survey meters be calibrated?
AT 3 MONTH INTERVALS
7. What minimum and maximum ranges are required for a survey meter?
2 mr/hr - 1 R/hr
8. When performing radiography, when must physical radiation surveys be made? *PRIOR TO MAKING EXPOSURES TO DETERMINE RESTRICTED AREA, AFTER EACH EXPOSURE, & PRIOR TO SECURING THE EXPOSURE DEVICE.*
9. List the radiation levels indicated on a survey meter when range switch is set on:
- | | |
|-----------------------|--------------------|
| 100 - meters reads 25 | <u>2,500</u> mr/hr |
| 1 - meter reads 65 | <u>65</u> mr/hr |
| 10 - meter reads 8 | <u>80</u> mr/hr |
10. Why aren't you permitted to use a survey meter which has no date of expiration? *REGULATIONS REQUIRE THAT A CALIBRATION DATE BE AFFIXED TO ALL SURVEY METERS IN USE.*
11. Does a film badge measure dose or dose rate?
DOSE
12. Does a survey meter measure dose or dose rate?
DOSE RATE
13. Does a pocket dosimeter measure dose or dose rate?
DOSE
14. How do survey meters and pocket dosimeters differ in the way they measure radiation?
*SURVEY METER MEASURES DOSE RATE.
DOSIMETER MEASURES TOTAL DOSE RECEIVED.*
15. What personnel monitoring devices must a Radiographer's Assistant wear? *FILM BADGE & DOSIMETER*

16. When performing radiography, what physical surveys must have the results recorded?

THE SURVEY MADE PRIOR TO SECURING THE EXPOSURE DEVICE.

GROUP C - RADIATION EQUIPMENT AND ITS USE AND MAINTENANCE

1. If a leak test of a gamma ray source shows excessive leakage, what must be done? *AFTER YOU HAVE SECURED & LOCKED THE SOURCE, PUT CONTAMINATED DEVICE & ATTACHMENTS IN A PLASTIC BAG & PLACE IN A LOCKED CONTAINER. NOTIFY THE RADIATION SAFETY OFFICER.*
2. How often must a sealed source be leak tested?
6 MONTH INTERVALS
3. Why are exposure devices which are made from depleted uranium lighter than those made of lead?
LEAD HAS LESS DENSITY AND ABSORPTION EFFICIENCY THAN URANIUM.
4. A Gamma Industries Model 35 exposure device has a capacity of 35 curies of Iridium 192. Why can't you use this same camera for 10 curies of Cobalt 60?
COBALT REQUIRES MORE SHIELDING
5. What is the maximum strength of the source of Iridium 192 you are allowed to use in a Tech/Ops Model 660 exposure device?
100 CURIES
6. What is a collimator and why is it used? *A PORTED SHIELDING METAL ATTACHMENT USED TO REDUCE SCATTER & CONFINE THE PRIMARY BEAM OF RADIATION TO THE AREA BEING EXAMINED.*
7. If a radiographic exposure device measures 5 inches from the sealed source storage position to the exterior surface of the device, what is the maximum allowable dose rate at the surface?
200 MR/HR

8. What is the maximum allowable dose rate at 6 inches from the exterior surface of an exposure device that measures 3 inches from the sealed source storage position to any exterior surface on the device?

50 mr/hr

9. Can the position of the source - fully exposed or fully retracted - be accurately determined by counting the number of hand crank revolutions? Explain.

NO, BECAUSE DRIVE CABLE SLIPPAGE CAN RESULT FROM WORN MECHANISMS AND REGULATIONS REQUIRE THAT A SURVEY METER BE USED FOR THIS PURPOSE.

10. For a 30 minute exposure in a restricted area, your "CAUTION-RADIATION AREA" signs should be placed where your survey meter reads 4 mr/hr.

11. Describe the procedure you would follow if your source should become uncoupled from the flexible cable while in the exposed position.

RESTRICT & POST THE AREA IN ACCORDANCE WITH THE OPERATING & EMERGENCY PROCEDURES MANUAL. NOTIFY THE NEAREST RADIATION SAFETY OFFICER. KEEP AREA UNDER CONSTANT PERSONAL SURVEILLANCE.

12. What can happen if you try to force the flexible control cable and source through the guide tube with the hand crank?

GUIDE TUBE CAN BE DAMAGED, SOURCE COULD BECOME UNCOUPLED FROM DRIVE CABLE, SOURCE COULD STICK IN GUIDE TUBE

13. Why are Cobalt 60 cameras so much heavier than Iridium 192 cameras?

BECAUSE OF THE GREAT DIFFERENCE IN ENERGY LEVEL & PENETRATING ABILITY.

14. How could you make a set of remote handling tongs in an emergency when you have only a kit of conventional hand tools available?

TAPE TWO HANDLES MADE FROM STICKS OR POLES TO THE HANDLES OF A PAIR OF PLIERS.

15. What portion of a crank operated, remotely controlled exposure device should be inspected most frequently to avoid creating a hazardous situation?

- (a) The locking mechanism on the camera
- (b) The control cable crank assembly
- (c) The hookup between the pigtail and control cable
- (d) All are of equal importance

16. When a sealed source is leak tested, what is the maximum allowable removable activity?

.005 MICROCURIES

GROUP D - U.S. NUCLEAR REGULATORY COMMISSION REGULATIONS

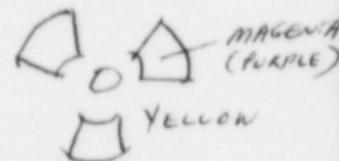
1. The Standards for Protection Against Radiation are set forth in Part 20 of the U.S.N.R.C. Title 10.
2. If special forms are maintained, a Radiographer may receive a radiation dose to the whole body of 3 rem per calendar quarter.
3. Regulations covering surveys are found in Paragraph 201 of Part 20 of U.S.N.R.C. Regulations, Title 10.
4. Unless special records are maintained, a Radiographer is not permitted to receive a radiation dose to the whole body in excess of 1.25 rem per calendar quarter.
5. Define a Radiation Area. *ANY AREA ACCESSIBLE TO PERSONNEL IN WHICH THERE EXIST 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.*
6. Why is a dose of one roentgen due to gamma or x-radiation considered to be the same as a dose of one rem? *THE BIOLOGICAL EFFECT OF OTHER RADIATION ON BODY TISSUE IS MEASURED RELATIVE TO A DOSE OF ONE ROENTGEN (R) OF X-RAYS & IS DEFINED AS A REM.*
7. What are the locking requirements on radiographic exposure devices? *THEY ARE TO BE LOCKED AT ALL TIMES EXCEPT WHEN UNDER THE DIRECT SURVEILLANCE OF THE RADIOGRAPHER OR RADIOGRAPHER'S ASSISTANT. THEY ARE TO BE LOOKED AFTER EACH EXPOSURE.*
8. Can you use a "CAUTION-RADIOACTIVE MATERIAL" sign to post a high radiation area? Explain.

NO. SIGN MUST READ "CAUTION - HIGH RADIATION AREA."

9. What is your responsibility as a worker (employee), as outlined in N.R.C. Form 3 "Notice to Employees"?

FAMILIARIZE YOURSELF WITH ALL PROVISIONS OF N.R.C. REGULATIONS AND THE O. & E. MANUAL. OBSERVE ALL PROVISIONS FOR YOUR PROTECTION & YOUR CO-WORKERS.

10. Make a drawing of the radiation symbol used on caution signs and indicate the colors which must be used for the symbol and its background.



11. Name two types of personnel monitoring equipment required by the N.R.C. regulations.

POCKET DOSIMETER & FILM BADGE

12. Fill in the maximum allowable exposures of individuals to radiation in a restricted area. (Rems per calendar quarter)

- (a) Whole body; head and trunk, active blood forming organs, lens of eyes or gonads 1.25 rems
(b) Hands and forearms, feet, ankles 18.75 rems
(c) Skin of whole body 7.50 rems

13. No person can act as a Radiographer until he has received copies of and instruction in the regulations covered in N.R.C. Title 10, Part 20 and Part 34.

14. Any radiographic area to which access is controlled by the licensee is called a RESTRICTED AREA.

15. Regulations covering licenses for radiography and radiation safety requirements for radiographic operations are set forth in Part 34 of N.R.C. Title 10.

16. What are the locking requirements for storage containers? THEY ARE TO BE LOCKED AT ALL TIMES EXCEPT WHEN UNDER DIRECT SURVEILLANCE OF RADIOGRAPHER OR RADIOGRAPHER'S ASSISTANT

GROUP E - OPERATING AND EMERGENCY PROCEDURES

1. Can a Radiographer's Assistant keep the jobsite under surveillance by himself? **YES**
2. When working at a customer's plant, what steps must be taken to advise customer personnel that you are working? **NOTIFY PLANT MANAGER OR SUPERVISOR & ASK HIM TO INFORM THEIR SAFETY DEPARTMENT. OBTAIN WORK PERMIT BEFORE STARTING RADIOGRAPHY.**
3. What is the requirement for surveillance of a radiographic exposure device when it is in use? **CONSTANT SURVEILLANCE DO NOT LEAVE DEVICE UNATTENDED.**
4. What company document must each Radiographer's Assistant have in his possession at all times? **O. & E. MANUAL**
5. List three documents that the company must make available to each Radiographer. **O. & E. MANUAL
N.R.C. LICENSE
TITLE 10, PARTS 19, 20 & 34**
6. How must you restrict each temporary radiographic area to control access? **ROPE OFF AREA AT 2 MR/HR PERIMETER, POST SIGNS AT 90°. CONSTANT SURVEILLANCE.**
7. When must a pocket dosimeter be recharged? **BEFORE YOU START WORK EACH DAY**
8. What would you do if your exposure device was lost or stolen? **NOTIFY CIVIL AUTHORITIES & NEAREST RADIATION SAFETY OFFICER.**
9. What reports must the Radiographer keep a copy of at the jobsite? **DAILY RADIATION REPORT**

10. You barricade a temporary radiographic area and the dose rate measured at the barricade is 2.5 mr/hr. How many signs must you use to post the area, where must they be placed and what words are on the signs?
"CAUTION - RADIATION AREA" - 4 SIGNS, ONE AT EACH 90° AROUND PERIMETER
11. What radiation dose rate is allowed at the outside of a truck used to transport a radioactive source?
2 MR/HR
12. What would you do if you checked your pocket dosimeter and found it had gone off scale? *SHOT DOWN JOB. SECURE EXPOSURE DEVICE. CONTACT NEAREST RADIATION SAFETY OFFICER.*
13. What would you do if you had a wreck with a truck carrying an exposure device containing a radioactive source?
FOLLOW PROCEDURE OUTLINED IN O. & E. MANUAL.
14. On a Radiation Report form, are the exposure device serial number and the source serial number the same?
NO
15. Suppose someone ignores your signs and barriers and insist on entering the radiation area. What steps would you take? *SHOT DOWN OPERATIONS. ASK TO LEAVE AREA. IF IGNORED, NOTIFY THEIR SUPERVISOR.*
16. What radiation dose rate is allowed at the driver's location in a truck used to transport a sealed source?
1 MR/HR

TUMBLEWEED X-RAY COMPANY

SNT-TC-1A LEVEL I EXAMINATION FOR RADIOGRAPHER'S ASSISTANT

NAME _____ DATE _____


EXAMINER _____ GRADE _____

INSTRUCTIONS TO EXAMINERS: Following are 2 group of questions consisting of 20 questions each. Group A covers specific areas of instruction in Radiation Safety. Group B covers specific and general areas of instruction in Radiographic Testing Methods, Equipment Usage and the Operating and Emergency Procedures, as required by U.S.N.R.C. Title 10, Part 34.

All questions will be answered. Each question carries a 5 point value. An 80% accuracy on this test is required to PASS; provided that no more than 4 wrong answers are given in any of the two categories. In that event, the candidate shall be given a minimum of one hour additional instruction in the deficient category and retested. In any event, the examiner will review and discuss each incorrect answer with the candidate.

GROUP A - RADIATION SAFETY

1. What is the average yearly permissible exposure for a radiation worker?
5 REM
2. Define the following in terms of mr/hr:
 - (a) Unrestricted Area 2 mr/hr
 - (b) Radiation Area 5 mr/hr
 - (c) High Radiation Area 100 mr/hr
3. Records for radiation surveys to determine that each sealed source is returned to the shielded position prior to securing the camera shall be kept.
True X False _____
4. Name the three items that must be provided to the Radiographer's Assistant prior to allowing him to work.
FILM BADGE, DOSIMETER & C. & E MANUAL

5. Areas in which radiation levels are less than an average of 2 mr/hr or total dose of 100 mr in seven consecutive days, are designated as:
- (a) Radiation Area (c) Restricted Area
(b) Unrestricted Area (d) High Radiation Area
6. The limits defined by maximum permissible dose do not apply to medical exposures such as dental or chest x-rays.
- True X False _____
7. Radiation survey meters are required to be calibrated at 3 MONTH intervals.
8. Leak testing of sealed sources used in radiography is required at 6 MONTH intervals.
9. Why is it necessary to test radioactive sources for leakage? TO PREVENT CONTAMINATION
10. Direct surveillance of a radiation area is not required after posting the area with the required signs and barricades.
- True _____ False X
11. You can allow anyone to be a Radiographer's Assistant provided he is furnished with a survey meter, dosimeter and film badge.
- True _____ False X
12. Make a drawing of the radiation symbol, showing the colors of each part.
- 
13. What is the first thing to check when the source becomes stuck? SURVEY METER

14. Your radiation survey meter suddenly becomes inoperable during radiographic operations. What should you do?

STOP WORK OPERATIONS, GET ANOTHER SURVEY METER

15. How do you determine that your source has returned to the safe position in the camera?

SURVEY METER & LOCK

16. You regularly come up with a different film badge and dosimeter reading than the Radiographer. What action should be taken?

(a) Stop working

(b) Check how you wear your film badge and dosimeter relative to where the Radiographer wears his.

17. Describe how to check a Gamma Industries Model 250B survey meter prior to use. *TURN KNOB TO BATTERY POSITION, THEN TURN TO LOWEST SCALE & SURVEY EXPOSURE DEVICE AT 6". CHECK CALIBRATION STICKER.*

18. A general rule used to define the amount of radiation exposure that is excessive is?

(a) Any dose over 5 r per week is excessive

(b) Any dose which causes a mid-range reading on a survey meter is excessive

(c) Any unnecessary exposure to radiation is excessive

19. When should the dosimeter reading be recorded and on what form should it be recorded? *AT END OF WORK DAY & RECORDED ON RADIATION REPORT AND WEEKLY TIMESHEET.*

20. An exposure of 5 r of gamma or x-radiation equals

5 rem.

GROUP B - RADIOGRAPHIC TESTING METHODS, EQUIPMENT USAGE AND OPERATING PROCEDURES

1. Where would you find the operating instruction for a Tech/Ops Model 660 exposure device?
OPERATING & EMERGENCY PROCEDURES MANUAL
2. Radiographic film is least sensitive to
(a) Red light (b) Blue light (c) White light
3. As the temperature of the developer goes up, the development time must be decreased to maintain the same film density.
True X False _____
4. An x-ray machine should be warmed up gradually after it has been off for three or four hours even if the outside temperature is very warm.
True X False _____
5. The most common material used to provide protection against x-rays is
(a) High density brick (b) Tungsten (c) Lead
6. Three liquids which are essential to process exposed film properly are
(a) Stop bath, acetic acid and water
(b) Developer, fixer and water
(c) Acetic acid, fixer and stop bath
7. If you crimp a film while loading the film holder, the crimp will show up as a white mark on the film after it has been exposed and developed.
True X False _____

8. Excessive exposure of film to light prior to development of the film will most likely result in

(a) Foggy film (b) Streaks (c) Yellow stains

9. Why is film sponged off or dipped in a wetting solution before it is dried?

TO REMOVE WATER SPOTS

10. When using an Iridium 192 sealed source, a tungsten collimator will give more shielding than a lead collimator of the same thickness.

True X False _____

11. Why should screens be cleaned regularly?

TO MAINTAIN HIGHER QUALITY OF FILM

12. The small area in the x-ray tube from which the radiation emanates is called the

(a) Diaphragm (b) Focusing cup (c) Focal spot

13. When reference is made to a "source", we are usually referring to

(a) X-ray (b) Gamma ray (c) Neither

14. It is possible for lead numbers used as identification on film, to become radioactive when they are used many times in making Iridium 192 exposures.

True _____ False X

15. A Radiographer's Assistant is permitted to interpret radiographs for acceptance or rejection of the weld.

True _____ False X

16. A Radiographer's Assistant shall refer all questions concerning the results of the tests to the Radiographer in charge of the job.

True X False _____

17. A properly exposed radiograph that is developed in developer solution at temperature of 58° will be
(a) Overdeveloped ☒ (b) Underdeveloped (c) Fogged
18. A penetrameter is used to measure
(a) The density of the film
(b) The amount of film contrast
☒ (c) The quality of the radiographic technique
19. With all other conditions being equal, an Iridium 192 radiograph of a 3/8 inch thick weld will show greater detail than an x-ray radiograph of the same weld.
True _____ False X
20. Define "Radiographer's Assistant".
A PERSON, HAVING BEEN QUALIFIED, WORKS UNDER THE DIRECT PERSONAL SUPERVISION OF A RADIOGRAPHER USING RADIOGRAPHIC EXPOSURE DEVICES, SEALED SOURCES, SURVEY INSTRUMENTS AND OTHER EQUIPMENT IN RADIOGRAPHY.

TRAINING PROGRAM
(CONTINUED)

THE TRAINING AND REVIEW SESSIONS FOR TUMBLEWEED X-RAY COMPANY WILL BE CONDUCTED BY OTHO G. JONES, WHO IS QUALIFIED AND CERTIFIED AS A SNT-TC-1A LEVEL II IN RADIOGRAPHIC TESTING, DYE PENETRANT TESTING AND MAGNETIC PARTICLE TESTING, AND CURRENTLY ACTING IN THE CAPACITY OF ASSISTANT RADIATION SAFETY OFFICER. ASSISTING IN THE ADMINISTRATION OF THESE TESTS WILL BE JEANNE A. JONES. (COPIES OF PAST CERTIFICATIONS AND DOCUMENTATION OF TRAINING COURSES SATISFACTORILY COMPLETED ARE ATTACHED.)

IN THE EVENT TUMBLEWEED X-RAY COMPANY EMPLOYS INEXPERIENCED PERSONNEL, THEY WILL BE REQUIRED TO SATISFACTORILY COMPLETE THE "RADIATION SAFETY PROGRAM" CONDUCTED BY "SOURCE PRODUCTION AND EQUIPMENT COMPANY", KENNER, LOUISIANA. (AN OUTLINE OF THEIR COURSE IS ATTACHED.)

UPON COMPLETION OF THE ABOVE, THE TRAINEE WILL RECEIVE INSTRUCTION IN THE USE AND MAINTENANCE OF THE EQUIPMENT, REVIEW THE "OPERATING AND EMERGENCY PROCEDURES" OF TUMBLEWEED X-RAY COMPANY AND COMPLETE THE REQUIRED TEST. (A COPY OF THE RADIOGRAPHER'S ASSISTANT TEST IS ATTACHED.)

UPON SATISFACTORILY COMPLETING THIS TEST (80% REQUIRED TO PASS), THE TRAINEE WILL BE ASSIGNED TO A RADIOGRAPHER FOR ON-THE-JOB TRAINING. HE WILL WORK ONLY UNDER THE DIRECT PERSONAL SUPERVISION OF THE RADIOGRAPHER.

PERIODIC TRAINING AND REVIEW WILL BE CONDUCTED BY TUMBLEWEED X-RAY COMPANY AT LEAST ANNUALLY. THIS WILL COVER A REVIEW OF "RADIATION SAFETY PROCEDURES", ANY NEW REGULATIONS OR COMPANY POLICIES, DEMONSTRATION OF NEW EQUIPMENT AND ITS MAINTENANCE PROCEDURES. EACH REVIEW WILL BE DOCUMENTED AND PLACED IN THE EMPLOYEE'S PERSONNEL FILE.

ITEM 7

6(g). INTERNAL INSPECTION AND MANAGEMENT CONTROLS:

1. Each Radiographer will be assigned an exposure device containing radioactive material. Upon receiving the exposure device, the Radiographer will complete the RADIOACTIVE MATERIAL RECEIVING REPORT (Attached) and this report will be placed in the Source File along with the Decay Curve and Leak Test Certificate.
2. Each Radiographer will complete the RADIATION REPORT (Attached) each day for the source in his possession. This report will be forwarded to the office with his daily work log.
3. At intervals not to exceed three (3) months, each Radiographer will be subjected to a RADIOGRAPHER'S PERFORMANCE REVIEW in compliance with Paragraph 34.11(d) of 10 CFR 34. This review will cover U.S.N.R.C. Regulations and license provisions. (Copy of the review form is attached.) The review shall be conducted on an announced and unannounced basis at the discretion of the Radiation Safety Officer. He shall observe an actual radiographic operation.

If the Radiographer cannot demonstrate thorough understanding of the items listed on the review form, he shall be disqualified from working with radioactive material until he shall:

- (a) Completes additional training in the deficient areas.
- (b) Depending on the severity of the deficiency, be terminated.

Upon completion of the RADIOGRAPHER'S PERFORMANCE REVIEW, the review form will be placed in the individual Radiographer's personnel file and will be retained for a period of two years.

ITEM 7

VI. RESTRICTING & CONTROLLING ACCESS TO RADIOGRAPHIC AREAS

A. EXCEPT AS SPECIFIED IN PARAGRAPH D OF THIS SECTION, EACH RADIOGRAPHIC AREA MUST BE ROPED OFF OR OTHERWISE BARRICADED AND POSTED WITH A MINIMUM OF FOUR SIGNS, ONE AT EACH 90 DEGREES AT THE PERIMETER (2 MR/HR), READING "CAUTION - RADIATION AREA". THE HIGH RADIATION AREA SHALL BE CONSPICUOUSLY POSTED WITH "CAUTION - HIGH RADIATION AREA" SIGNS AT THE PERIMETER (100 MR/HR). (SEE SECTION III, G AND H FOR DEFINITIONS OF RADIATION AND HIGH RADIATION AREAS.) BEFORE OPERATIONS (EXPOSURES), THE PERIMETER OF THE RESTRICTED AREA WILL BE CALCULATED USING THE INVERSE SQUARE LAW (SEE EXAMPLE). A RADIATION SURVEY FOR THE 2 MR/HR LEVEL SHALL BE MADE AS SOON AS THE SOURCE IS EXPOSED. THE BOUNDARIES SHALL THEN BE ADJUSTED, IF REQUIRED, SO THAT THE DOSE IN ONE HOUR WILL NOT EXCEED 2 MR AT THE BARRIER.

EXAMPLE:

$$D_2 = \sqrt{\frac{I_1 \times D_1^2}{I_2}}$$

B. THE RADIOGRAPHER OR RADIOGRAPHER'S ASSISTANT SHALL KEEP THE AREA UNDER CONSTANT SURVEILLANCE TO PREVENT UNAUTHORIZED ENTRY.

C. THE RADIOGRAPHER SHALL COMPLETE A "RADIATION REPORT FORM" (SEE APPENDIX B) EACH TIME A TEMPORARY RADIOGRAPHIC AREA IS ESTABLISHED.

D. FOR CROSS-COUNTRY PIPELINE INSPECTION, WHEREIN THE WORK PROGRESS IS IN A FORWARD DIRECTION CONSTANTLY CHANGING WITH EACH RADIOGRAPH, THE RADIOGRAPHER SHALL:

1. MAKE A SURVEY TO DETERMINE THE PERIMETER OF THE 2 MR/HR AREA.