



DEPARTMENT OF STATE HEALTH SERVICES

**Industrial Radiography Investigation
Findings and Trends
Chris Moore**

Outline

- Radiography incidents/complaints
- Unannounced temporary job site inspections (Special Projects)
- Reporting requirements



What the heck!!!!

Radiography Operations



**Locked up
or
Eyes on the
camera**

Texas Radiography Facts

- 104 radiography licensees
 - 188 site locations
- 11 reciprocity companies
- Over 6,000 radiographers
 - RAM, X-Ray, both
 - trainees, technicians, trainers
 - Over 1000 reciprocity radiographers

Radiography Incidents (Last 4 years)

- 87 Incidents
- Most common incidents:
 - 49 Equipment failures
 - Source disconnects
 - Failure to retract source
 - 26 Overexposure
 - Badge only exposure (14 cases)
 - Radiographer overexposure (5 cases)
 - Radiographer below exposure limits (5 cases)
 - Public overexposure (2 cases)
 - 5 Stolen/Lost/Potential theft of camera
 - 3 Transportation accidents

Radiography Complaints (Last 4 years)

- 29 complaints.
- Most common complaints:
 - 11 cases of multiple regulatory violations.
 - 8 cases of improper 2 mrem in an hour boundary/exposure to public.
 - 4 radiographer concerns including qualification, driving, and drug use.

29 Complaint Results

- 16 no violations.
- 6 multiple violations issues.
- 5 unrelated violations issued, complaint not substantiated.
- 2 complaints still in investigation.

29 Complaint Lessons Learned

- Difficult to locate same crew if lack of detail is provided.
- The Agency will always spot check a crew and typically visit the site office.
- Often a current or disgruntled employee who was fired.
- Competing companies complain but often call in anonymous.
- Lack of understanding by public of radiation levels outside boundaries. Crews need to inform surrounding companies or public.

Incident Cases

Radiography Incident #1

Survey Meter Off

The radiographer failed to fully retract the source into the camera. The portable radiation meter was turned off and no radiation pagers alarmed. Both radiographers noted that their 0-200 millirem pocket dosimeters were off scale. They stopped work, fully retracted the source in the camera, and reported the incident to the RSO. The trainer had received 3.31 rem and the trainee had received 2.79 rem. The total exposure for the year for the trainer equaled 5.152 rem and he was removed from duty for 2011. The trainee had attempted to conduct a survey after cranking in the source but the meter was off for all three shots on the first weld and post use survey. Both radiographers stated they tested their electronic rate meters but the batteries appeared to be weak.

Radiography Incident #1

Survey Meter Off

- September 12, 2011
 - 67 curies Ir-192
 - 3.31 rem & 2.79 rem (dosimetry – badges)
- Administrative Penalty
 - Radiographer Trainer
 - \$1,000
 - Radiographer Trainee
 - \$0 (Trainee Status)
 - Company
 - \$1,625



Radiography Incident #2

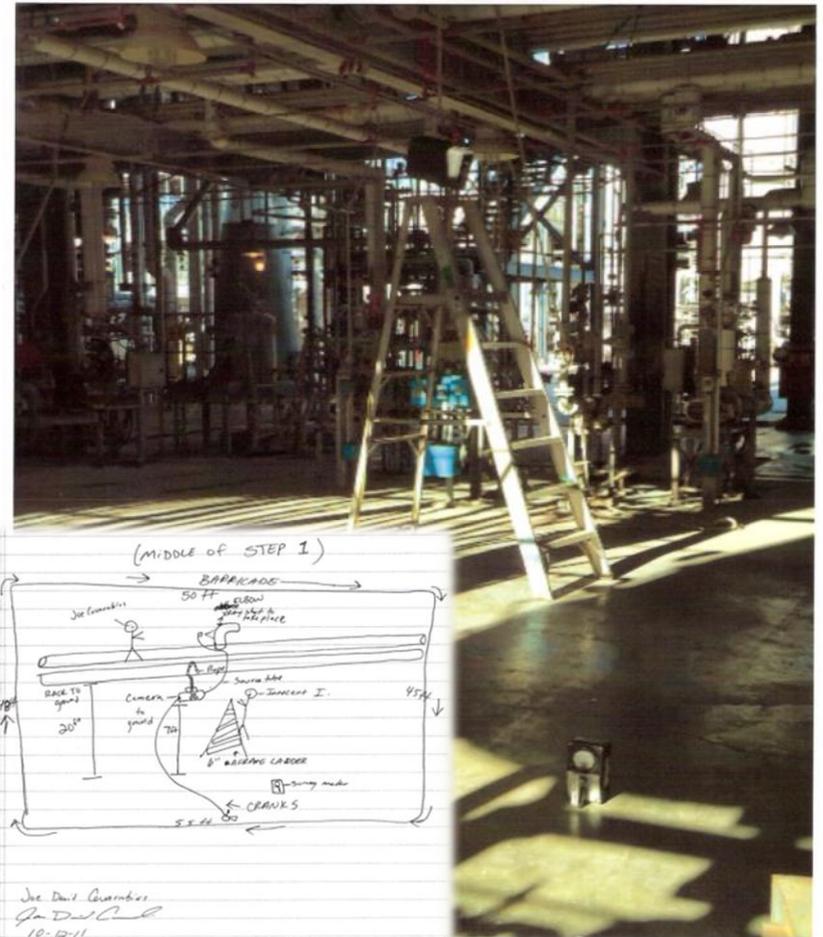
Camera on a Rope

On October 17, 2011, the Agency was notified by a licensee that a radiographer had climbed a ladder to remove the guide tube from a QSA Model 880 radiography camera containing a 49.3 curie iridium-192 source that was suspended by a rope. As he was trying to disconnect the guide tube, another employee observed the radiographer's survey meter was indicating that the camera's source was not in the shielded position. The radiographer climbed down the ladder and cranked the source back into the camera. The radiographer's badge was sent for processing and the badge had a total effective dose equivalent reading of 4,192 mrem. The radiographer was unable to ascertain where the source had been in the guide tube. The whole body dose from the incident caused the radiographer to exceed the annual occupational dose limit of 5,000 mrem.

Radiography Incident #2

Camera on a Rope

- October 17, 2011
 - 49.3 curies Ir-192
 - Badge processed:
 - 4,192 mrem TEDE
 - 58.15 rem to hand (estimated)
- Administrative Penalty
 - Radiographer
 - \$1,000
 - Company
 - \$3,250
 - + \$2,000 probated 1 yr



Radiography Incident #3

Cell Phone

A radiographer was working in a bay using a radiography camera containing a 37 curie iridium-192 source. She was on her cell phone when she entered the bay to set up the next shot. Her head was about 12 inches beneath the collimator for about 2.5 minutes. She exited the bay and attempted to crank out the source but realized the camera was unlocked and the source was still out and in the collimator. She did not perform a proper survey of the camera between shots. The bay is equipped with an audible and visual alarm to indicate when a radioactive source is exposed. Another worker had opened a breaker that turned off ventilation fans in the building which also supplied power to the alarms. Based on two reenactments, she received 8.116 rem to the head.

Radiography Incident #3

Cell Phone

- February 17, 2012
 - 37 curies Ir-192
 - 2.5 minutes (estimated)
 - 8.116 rem to head (estimated)
- Administrative Penalty:
 - Radiographer
 - \$1,000
 - Company
 - \$6,750

Radiography Incident #4

Guide Tube Necklace

A radiography team had experienced a disconnect of a 65 curie iridium-192 source on a QSA Delta 880 radiography camera at a temporary work site in Pasadena, Texas. The crank out drive cable had broken at the pigtail and the source had disconnected. After an authorized individual performed the source retrieval, the licensee's RSO learned that the radiographer trainer disconnected the source guide tube from the camera and had carried the source guide tube around his neck while he climbed down the ladder of the scaffold. The source was still in the source guide tube at this time. When the radiographer trainer reached the platform he removed the source tube from his neck and laid it on the platform. The licensee and the Agency conducted an investigation into the event. The licensee performed dose assessment calculations and estimated the radiographer received 29.32 rem (whole body, deep dose equivalent) during this event.

Radiography Incident #4

Guide Tube Necklace

- March 24, 2012
 - 65 curies Ir-192
 - 29.32 rem (estimated)



Work area

Male Coupling

Drive Cable

- Administrative Penalty
 - Radiographer
 - \$600
 - 12 Mo. Suspension
 - Company
 - \$2,500

Dose rate Instrument in Off



Radiography Incident #5

Trainee Radiation Burn

Report of a radiography trainee (RTT) may have received an overexposure to his right hand and was seeking medical attention in a Houston, Texas hospital.

The Agency contacted the RTT in the hospital. The RTT stated that he was performing radiography using a camera containing 73 curies of iridium - 192. He stated that the last shot had been completed and he was removing the guide tube to move the camera. He stated that when he removed the guide tube, he saw the source sticking out of the front of the camera about 2 inches. He stated that he immediately retracted the source to its fully retracted and locked position. Three days later, his right thumb, index finger, and middle finger began to swell and turn yellow. At this point he began to seek medical attention ending up in the hospital in Houston, Texas.

Estimate that his hand was near the source for 10 seconds



Several days to weeks Later Sep 2011

-Night of incident swelling started and blisters formed in three days



Dec 2012



Early 2013



Radiography Incident #5

Trainee Radiation Burn

- 73 curies Ir-192
- 2703 rem to the fingers
(estimated)
- Administrative Penalty
 - Radiographer
 - Licensed Revoked
 - notified additional states
 - Company
 - \$16,500

Commonalities of Incidents

Incident #	Root Cause	Contributing Factor	Contributing Factor
8884	Failure to perform proper post exposure survey	Failure to fully retract source	Inattention to detail
8886	Failure to perform proper post exposure survey	Failure to fully retract source	Inattention to detail
8894	Failure to perform proper post exposure survey	Failure to fully retract source	Inattention to detail
8934	Failure to perform proper post exposure survey	Failure to fully retract source	Inattention to detail
8942	Failure to perform proper post exposure survey	Failure to perform routine maintenance	Failure to perform inspection prior to use

Actions

- DSHS
 - Letter distributed to licensees
 - Start Special Project inspections
- NRC
 - IN-2012-23:
“Recent Radiography Events Resulting In Exposures Exceeding Regulatory Limits”





TEXAS DEPARTMENT OF STATE HEALTH SERVICES

“...overexposure could have been prevented if proper radiological surveys and pre-use inspections of radiographic equipment had been performed.”

P.O. Box 149347
Austin, Texas 78714-9347
1-888-963-7111
TTY: 1-800-735-2989
www.dshs.state.tx.us

DAVID L. LAKEY, M.D.
COMMISSIONER

“In all cases, a proper radiation survey of the guide tube following an exposure would have indicated that the source was not properly shielded.”

June 15, 2012

To: The Radiation Safety Officer

“...an individual who is in physical contact with an iridium-192 source would receive a dose causing adverse physical effects in just a few seconds.”

The Department of State Health Services (DSHS) Nuclear Medicine (NMED) Regulatory Commission. Of these 55 events, 21 have occurred in the State of Texas. Included in the NMED events were 12 source disconnects of which nine occurred in Texas. ...occurring in the events Database cameras have been

Enforcement Changes

- Post Exposure Survey

Surveys performed to verify the sealed source has been returned to its fully shielded position after each radiographic exposure, before exchanging film, repositioning the head, or dismantling equipment.

- Originally Severity Level II only

- Still used – no overexposure

- Added Severity Level I

- Root cause for overexposure

Licensee & Radiographer Response

- Licensee
 - Read letter at safety meetings
 - “We’re telling them how important it is”
- Radiographer
 - “We’ll be in big trouble with the State”



Radiography
Truck Accidents
(Radiation Meter
Required)



Special Projects

The Agency sent a letter to all licensed radiography companies in Texas. The letter stated in part:

The Agency has noted an increase of events occurring in the industrial radiography industry. An Agency review of the Nuclear Material Events Database (NMED) found from January 2011 to June 2012, 53 events involving radiography cameras have been reported to the Nuclear Regulatory Commission. Of these 53 events, 21 have occurred in the State of Texas. Included in the NMED events were 12 source disconnects of which nine occurred in Texas.

In the same 18 months, the Nuclear Regulatory Commission has received 14 reports from entities licensed in the United States involving individuals who have received exposure to radiation that exceeded an annual limit. Five of these events occurred in the State of Texas and all of these were to industrial radiographers.

In response to the Agency's concern over the increase of these events, the letter was to the Radiation Safety Officer for each radiography company licensed in the State of Texas so that the information may be shared with their radiographers.

Increase in Radiography

-Why the increase?

-Over 185 licensees for field operations and more than 15 licensees in shooting bays.

-How many cameras in use?

-Contacted two of our largest radiography companies. They estimated (together) they used well over a million pieces of film in a year.

-How many shots is this?

Texas Oil and Gas Industry

- Texas oil production represents roughly 34.5% of the total US output from 15% a few years ago.
- Production has increased rapidly to 3.4 million barrels a day and increasing.
- Texas will rank 6th on a list of all nations oil production and above all OPEC countries except Saudi Arabia by late 2014.
- Texas gas production represents 30% of all US production.
- Texas Railroad Commission issued 2,419 drilling permits in July 2014.
- 900 active rigs in Texas (47% of U.S. total).

Texas Oil and Gas Industry

- Majority of all operations are in:
 - Eagle Ford Shale area in South Texas (1.5 million/day).
 - Permian Basin in West Texas (1.7 million/day).
 - Barnett Basin North Texas (31% of Texas Nat Gas Prod).
 - Major pipelines being built toward Houston/Pasadena area.
- Result is a significant increase in radiography operations at temporary job sites and pipe manufacturing facilities.

- On May 14, 2013, the Agency decided that based on the number of recent events involving radiographers, discretionary inspections were warranted.
- Large workload on radiography companies.
- Large increase in radiographer trainees.

Jun 25-27, 2013

- Incident Investigation commences first Special Projects – Operation Eagle Eye.
- Four Investigators and two inspectors conducted 11 temporary job site inspections in 3 days in Karnes and surrounding counties in Eagle Ford Shale area.
- You can sit at a corner in Kenedy, Tx and radiographer trucks will drive by all day.



Additional inspections

- August 15 – Two in Kenedy.
- August 14-16 – Three west of Fort Worth.
- August 29-30 – Four near Midland/Odessa.
- September 18 – Two near Midland.
- October 18-19 Three in Odessa.
- 6 RAM Inspectors have assisted in Inspections.

Inspection History and Plans

- 42 Inspections completed.
- 6 RAM Inspectors have assisted in Inspections.
- Teams of two best for unannounced surveillance.
- IIP will request more Inspector support as needed.







Summary #1 Findings

The inspectors observed multiple exposures by the radiographers. The inspectors noted **surveys were not performed to verify that the sealed source had been returned to its fully shielded position after each radiographic exposure.** They also found that the radiographers were **not carrying their credentials** on them at the job site. The licensee and the radiographer were cited for multiple violations.

Summary #2 Findings

Investigators observed the radiography team set up. The radiographers **did not post the** area as a radiation area. The **trainee performed 4 to 5 shots while the trainer sat inside the front of their truck.** The radiographers **did not perform a boundary survey during the first exposure nor was any survey performed following each exposure** to ensure the source had been returned to its shielded position. **The trainer's direct reading pocket dosimeter was in the cab of the truck** and not on the trunk of his body during operations as required and it had not been charged (zeroed) that day.

Summary #2 Continued

The trainee had also **failed to charge (zero) his pocket dosimeter** before beginning the day's work. The radiographers appeared to be in compliance with all other requirements for a temporary work site. When asked to demonstrate the **alarm** on the vehicle worked, the trainer stated it had **broken** that morning and showed the broken wire. The radiographer trainer assured Agency investigators it would be repaired that day. The trainer and licensee were cited for Five violations.

Summary #3 Findings

After observing several exposures, the inspectors noted the radiographer performing **the radiography was not carrying a radiation survey meter.** It was also noted that **the second radiographer was in the dark room and unable to monitor the actions** of the radiographer operating the exposure device. The inspectors interviewed the radiographers and determined the individual operating the exposure device was a trainee and the other radiographer was a trainer. Four violations were cited for the trainer and the licensee.

Summary #4 Findings

We pulled into the alley behind a facility and observed the radiographers taking three shots and noted they **failed to perform radiation surveys after an exposure while approaching the camera or at the camera.** After a few more exposures, we approached the radiographers. The trainee's self-reading dosimeter was reading 145 millirem, he stated **he had failed to zero it prior to starting work that day.** His alarming rate meter was in the dark room. **The radiography trainee did not have his trainee card. He was not wearing a self-reading dosimeter,** alarming rate meter, or personal dosimeter. His dosimetry was in the cab of the truck. When retrieved from the cab of the truck the self-reading dosimeter was reading 90 millirem. He had failed to zero the dosimeter prior to starting work. The licensee and radiographer were cited for multiple violations.

Violations 42 Special Projects Inspections

Special Projects Completed Through June 24, 2014.	First Exposure Survey	Post Exposure Survey	SRD Not Zeroed	IC Related Violation	Trainee Missing Card	Missing Required Records	Trainee Supervision	Radiographer/ Reciprocal Recognition	Not Wearing Dosimetry	Postings Missing	Radiographer Without Card/Reciprocity	Inaccurate Records	Improper Brace and Block	Device Labels	Vehicle Labeling	Inappropriate Crew Makeup	No Operable Personal Monitor/Rate Alarm		
Licensee	9	8	13	5	6	5	5	2	5	5	3	1	1	2	4	2	3	79	Total for Licensee
Radiographers	9	7	12	4	3	4	4	0	5	6	4	1	1	3	3	1	4	71	Total for Radiographers
	18	15	25	9	9	9	9	2	10	11	7	2	2	5	7	3	7	150	Total
Inspections With Violations	29																		
Inspections With No Violations	13																		
Total SP Inspections	42	69% of Special Projects have resulted in violations																	

Interesting Facts

- Many radiographers conducting work in South Texas are from site offices as far as Perryton, TX near Amarillo.
- Radiographers tend to rent houses or stay in hotels for extended times. The Agency is concerned about temporary storage at residences. Issue needs to be addressed.
- Radiographers are surprised by unannounced field visits.

Interesting Facts continued

- In one case a trainer reported working in the field six years in Texas and never being inspected. He was inspected weekly when he worked in Pennsylvania.
- Radiographers spread the word to other workers via Facebook that DSHS is conducting inspections. One group actually waved to us after we observed them without approaching them.

Reporting Requirements

Reporting Requirements

- Events in which equipment is disabled or fails to function as designed.
- Phone notifications – use the 24 hour Radiological Emergency Assistance Number (512) 458-7460.
- Leaving a message for a DSHS investigator or sending an email will not count for initial reporting requirements of state regulations.

§289.202(xx)(8)(A)

To the extent possible:

- (i) the caller's name and call back telephone number;
- (ii) a description of the event, including date and time;
- (iii) the exact location of the event;
- (iv) the isotopes, quantities, and chemical and physical form of the radioactive material involved; and
- (v) any personnel radiation exposure data available.

Follow-up Written Report

§289.202(xx)(8)(B)

Each licensee who makes a report required by paragraphs (6) and (7) of this subsection shall submit to the agency a written follow-up report within 30 days of the initial report.

- (i) a description of the event, including the probable cause and the manufacturer and model number (if applicable) of any equipment that failed or malfunctioned;
- (ii) the exact location of the event;
- (iii) the isotopes, quantities, and chemical and physical form of the radioactive material involved;
- (iv) date and time of the event;
- (v) corrective actions taken or planned and the results of any evaluations or assessments; and
- (vi) the extent of exposure of individuals to radioactive materials without identification of individuals by name.

Questions

Contact Information

Chris Moore

DSHS Incident Investigator

Texas Department of State Health Services

Office: (512) 834-6770 x2014

Chris.moore@dshs.state.tx.us