

Republic of the Philippines
PHILIPPINE NUCLEAR RESEARCH INSTITUTE
Department of Science and Technology
Address: Commonwealth Avenue Tel. No.: 97-60-11 to 15
Diliman, Quezon City Fax No.: 95-16-46

NRLSD BULLETIN NO. 93-01

**INFORMATION BULLETIN TO
INDUSTRIAL RADIOGRAPHY LICENSEES
ABOUT INCIDENTS REPORTED IN
USNRC PUBLICATIONS WHICH MAY
HAVE SIGNIFICANT TO THEIR
ACTIVITIES**

A. ADDRESSEES

All holders of industrial radiography licenses.

B. PURPOSE

The purpose of this information bulletin is to provide guidance/information to industrial radiography licensees about incidents reported in USNRC publications which may have significance to their activities. Concerned licensees are expected to review this bulletin to avoid similar problems in their facility, and to institute corrective measures as may be appropriate.

C. BACKGROUND

PNRI regulations in the use of radioactive material in industrial radiography do not differ from US-NRC regulations. As such, standards and criteria applied in the practice are the same. US-NRC reports involving incidents in industrial radiography may serve as lessons for PNRI licensees to preclude occurrence of similar incidents in their respective licensed activities.

1. Radiographer's Assistant Wraps Source Around Neck.

On the evening of April 6, 1990, Barnett Industrial X-ray of Stillwater, Oklahoma, notified the NRC that an incident had occurred that evening, while a radiographer and his assistant were working at a temporary job site in Ardmore, Okla. The radiographic operation involved the use of a radiography device containing an Iridium-192 sealed source of approximately 80 curies of radioactivity. The licensee reported that the source had become disconnected from its drive cable and had remained in the source guide tube.

Failing to conduct a radiation survey of the exposure device, and thus being unaware that the source had remained in the tube, the assistant, having disconnected the source guide tube from the radiography device, wrapped the source guide around his neck while he moved equipment at the work site. The licensee's initial estimate was that the assistant received an exposure of 4,000 rems to the exposed area of his neck.

Both the assistant and radiographer were referred to a radiation oncologist for examination and blood samples were obtained. The cytogenetic studies revealed equivalent whole-body doses of 17 rems for the radiographer and 24 rems for the assistant. The assistant developed erythema, or reddening, on the left side of his neck, which later showed signs of more significant damage to skin tissue, in an area approximately 10 centimeters in diameter. The oncologist determined that the observed effect corresponded to a local skin dose of 5,000-to-7,000 rems. As of June 1990, the skin tissue in the individual's neck had regenerated, and the physician did not predict any long term effects as a result of this exposure. The assistant remains under the physician's care. There were no medical effects observed for the radiographer.

The NRC issued an Order prohibiting the radiographer and assistant from participating in licensed activity. The Order was later relaxed, after the licensee implemented corrective actions. The NRC staff proposed imposition of a civil penalty in the amount of \$ 7,500.

2. Radiographer Removes Dosimeters to Conceal Overexposure.

During the evening of October 5, 1990, Western Stress, Inc. of Houston, Texas, notified the NRC that an incident had occurred earlier that evening while a radiographer and his assistant were working at a temporary job site in Bordentown, N.J. The radiographic operation involved the use of a radiography device containing an 80.5-curie, Iridium-192 sealed source. The licensee reported that the source had become disconnected from the drive cable and remained in the guide tube.

Operations to perform 35 exposures of welds on a tank were planned. After cranking out the source for the sixth exposure, the radiographer heard a crash and saw that a magnetically mounted stand had fallen and was lying on the concrete pad. The source guide tube end-cap, with the collimator, had been approximately 10 feet above the concrete pad for this exposure.

The radiographer attempted to crank the source back into the camera but found that the drive cable could only be retracted a short distance because the guide tube was looped. The radiographer dragged the camera back by pulling on the drive cable housing to straighten out the guide tube. After straightening the guide tube, the radiographer retracted the cable fully, and hence, thought that the source was in the camera. The radiographer removed his two self-reading pocket dosimeters and his thermoluminescent dosimeter badge. The radiographer later admitted that he did this to conceal the radiation exposure he would later receive.

The radiographer walked up to the end of the source guide tube with his survey

meter in his hand but did not refer to the instrument. He grasped the end of the source guide tube with this left hand and removed the tape which held the collimator in place with his right hand. He then began to unscrew the source guide tube end-cap from the source guide tube to exchange the end-cap for a lighter one. As he removed the cap, the source chain containing the sealed source fell out of the end-cap assembly onto the concrete pad. The radiographer dropped the source guide tube and end-cap, and left.

Two NRC inspectors investigated the event at the job site. Based on interviews conducted with the radiographer and the Corporate Radiation Safety Officer, the NRC inspectors estimated rems and an extremity exposure of about 1,070 rems.

The NRC issued an Order prohibiting the radiographer from engaging in NRC-licensed activity on behalf of the licensee for a period of one year. A proposed civil penalty of \$ 15,000 was issued to the licensee, which has been paid.

3. Radiographer's Assistant Irradiated When "Chirper" Stops.

On November 26, 1990, Tumleweed X-Ray Company of Greenwood, Oklahoma, notified the NRC that on November 12, 1990, a radiographer's assistant may have sustained a possible radiation overexposure to his right hand at a temporary job site in Burns Flat, Oklahoma. The licensee stated that it was not informed of the incident by the radiographer until the morning of November 25, 1990, because the radiographer did not think an overexposure had occurred until the assistant radiographer's right hand became red and his fingers began to swell.

On the day of the incident, the radiographer and his assistant were working with a radiography device that contained a 49-curie, Iridium-192 sealed source. The radiographer and his assistant were performing radiographic exposure of welds on a 48-inch diameter tank at a fabrication shop. While the radiographer was away, the assistant set up an exposure and cranked out the source.

The assistant had turned the crank about two or three turns when he saw that the magnetically mounted stand that held the guide tube near the tank exterior had fallen. The assistant radiographer's alarming personnel dosimeter (chirper) had alarmed loudly when the guide tube had fallen. The assistant stated that he froze for about five seconds, and then cranked the source back to the shielded position. The assistant's chirper stopped alarming, so he thought the source was in the shielded position in the radiography device.

The assistant radiographer walked over to the tank and repositioned the magnetic stand and source guide tube. The assistant radiographer stated that he failed to pick up and use his survey instrument to survey the radiography and the source guide tube because his chirper was not alarming. The chirper had been dropped a couple of times that night and upon subsequent testing was found to be malfunctioning because of a shorted ground wire. After the assistant radiographer correctly positioned the guide tube with his right hand, he returned to the crank handle to proceed with the exposure.

As he performed this exposure, he noted that his chirper did not alarm when the source was cranked out. Because of that, he looked at his pocket dosimeter and noticed that it was off-scale (greater than 200 millirem). At about the same time, the radiographer returned and the assistant told him what had happened and that his pocket dosimeter had gone off scale. The assistant told the radiographer that he did not think that he received an exposure, but that he thought his pocket dosimeter was off scale because he had bumped it earlier. The radiographer and his assistant continued to work and did not inform the Radiation Safety Officer of the incident until the assistant's hand showed clinical signs of a radiation injury.

The radiation injuries that the assistant radiographer sustained to his indicated that he had grasped the guide tube with his thumb, index, and middle fingers, and that the source must have been directly beneath the point grasped. This information may indicate that the assistant radiographer mistakenly cranked the source out, instead of in, when the incident first occurred.

From re-enactments, clinical observations, and calculations, the dose to the assistant radiographer's hand was estimated by the NRC to be from 1,500-to-3,000 rems. The whole-body dose to the assistant, as measured by his thermoluminescent dosimeter, was 365 millirem. Blood samples were taken from the assistant for cytogenetic tests, the results indicating an equivalent whole-body exposure of less than 10 rems.

On November 29, 1990, the NRC inspector noted that the assistant's thumb, index and middle fingers were severely blistered and swollen. The assistant was admitted to a burn center in Oklahoma, City, Oklahoma, for medical care. The assistant remained in the hospital for approximately two weeks, during which time he had skin graft performed on his index fingers. On January 22, 1991, the physician contacted NRC and stated that the assistant's middle finger and thumb appeared to be healing and that the index finger was grafted as a result of lesions that were not healing. The physician also stated that the assistant would remain under his care.

The NRC issued an Order prohibiting the radiographer and assistant from participating in licensed activity. Later, the NRC issued an Order suspending the licensee's General License, and its NRC materials license was terminated at the licensee's request.

4. Unshielded Source Causes Exposure; Rain Causes Survey Meter Malfunction.

During radiography operations, a radiographer employed by Big State X-Ray of Eastland, Texas, received an estimated exposure of 35 rems to his right thigh from a radioactive source that was not locked in its shielded position. The event occurred at pride Refinery in Abilene, Texas.

On November 7, 1990, two licensee radiographers were performing radiography

outside the pride refinery when it started to rain. They moved their operations inside a building so they could continue working. At the completion of the first series of radiographs, radiographer A proceeded to move the camera to the next weld for the next series of exposure. He stated that he surveyed the camera, got "no reading", locked the camera (but did not remove the key from the lock), and then moved the camera. He moved to the next weld by picking up and carrying the camera, survey meter, and other equipment, dragging the crank-out cables behind him. He stepped over some obstacles and believes the key turned in the lock and released the source, which we allowed to move outside the shield by the crank-out.

Upon arriving at the next weld, he resurveyed the camera and proceeded to set-up the next exposure. (It was later determined that the survey meter was not operating correctly because of the moisture from the rain). After completing the set-up, he noticed that the camera was unlocked and checked his pocket dosimeter. It was off-scale. He went to the crank-out handle and retracted the source about one and one-half turns. He then notified radiographer B of the incident and he stopped operations and had Radiographer A's film badge sent in for immediate processing. However, the film was damaged during shipment and could not be processed. Therefore, his exposure was established by a reenactment of the event and calculations; these indicated he received a 35-rem exposure to the right thigh.

The primary cause of this incident was the failure of the radiographer to properly lock the source in the camera and remove the key prior to moving the camera. The radiographer also failed to determine whether his survey meter was operating correctly after it became wet in the rain.

The state Agency cited the licensee for the overexposure and the improper procedure.

5. Overexposure of Non-radiation Worker.

During radiography operations, an unmonitored, non-radiation worker employed by the Exxon Corporation received a whole-body exposure estimated to be between 1.8 and 3.9 rems from a radioactive source that was not properly shielded. The dose exceeds the abnormal occurrence reporting threshold of 0.5 rem in one calendar year for a member of the general public. In addition, a radiographer working at an Exxon site received a whole-body exposure of about 7.7 rems, on June 14, 1990, during operations by the H & G Inspection Company, Inc., of Houston, Texas; the event occurred on a barge at Sabine Pass near Port Arthur, Texas.

On July 14, 1990, two licensee radiographers were performing routine radiography of welds at Exxon's Texas Well No. 1, located in Sabine Lake, using a Gulf Nuclear Model 20V camera containing 60 curies of Iridium-192. At the completion of a radiograph, the lead radiographer (Radiographer A) cranked in the source, approached and surveyed the camera and guide tube, and locked the camera. He removed the exposed film and took it to the darkroom. Radiographer A returned to the weld to set up for the next exposure. During this procedure, an Exxon employee

approached the radiographer camera inside the restricted area to discuss the next shot with Radiographer A. Radiographer A had problems setting up the next shot and obtained Radiographer B's assistance. The Exxon employee left the area at this time.

The two radiographers completed the set up and were leaving to make the radiograph when Radiographer B noticed that the lead radiographer's survey meter was off-scale on the high side. This indicated that the source was not in the shielded position. They moved away from the camera and tried to return the source to the shielded position; they were not successful in this attempt.

They then unlocked the camera and retracted the crank-out handle one-half turn. The camera was relocked and pocket dosimeters were checked. The dosimeters were off-scale. The Radiation Safety Officer was notified of the incident, and the employees were ordered to return to the shop. Their thermo- luminescent dosimeters (TLDs) were mailed in for immediate processing.

The TLDs indicated that Radiographers A and B received about 7.7 rems and 1.3 rems, respectively. Because the non-radiation worker was not wearing any radiation dosimetry, his exposure was estimated by a re-enactment of the event and subsequent calculation. This indicated that he had received a whole-body exposure between 1.8 and 3.9 rems.

There were three root causes identified for the event. The first was the locking of the camera with the source in the unshielded position. (The licensee stated that there is a design flaw in the lock box and that what had occurred is not unusual with the Gulf Nuclear Model 20V camera. The manufacturer of this camera is no longer in business). The second cause was the failure of the radiographer to perform an adequate survey to determine whether the source was in the shielded position. Apparently, the radiographer went through the motions of performing the survey, was complacent about reading the meter, and failed to apprehend what his meter was indicating. The third cause was inadequate procedures regarding unmonitored personnel entering a restricted area.

The State agency was considering escalated enforcement action, at the close of the report period.

6. Extremity Overexposure of Radiation Worker.

While extracting a 10-curie, Cesium-137 source from its housing, a radiation worker at the Rosemount, Inc., Kay-Ray/Sensall Division, Mt. Prospect, Illinois, received an overexposure to his left hand. The actual exposure was not precisely known but was considered to most likely fall between 200-and-714 rems. Because the higher value, which was indicated by the worker's dosimetry, could not be disproved, 714 rems to the left hand was entered into the worker's radiation record. The event was investigated by the Illinois Department of Nuclear Safety.

On July 10, 1990, the worker was removing the source from a Model 7064P source housing so that the source could be transferred to a Model 7067 housing for resale to a customer. The worker had approximately three years experience in source loading, although this was the first time that he had removed a 10-curie source. Operating on this particular source holder (Constructed of stainless and holding a larger than usual activity of Cesium-137) required precautions, including direct observation and timing of operations by the worker's supervisor. The removal of the source housing was routinely accomplished. Following that action, The source/source holder assembly was moved, by the use of tongs, to an area behind a lead-shielded work station and clamped into place.

Extraction of the source from the source holder then began. This procedure involves physical peeling back the crimp on top of the source holder, using a pair of side cutter hand tools. This effort proved unusually difficult, because the material was stainless steel rather than aluminum. With about 25 percent of the crimp peeled back, the cylinder in which the source was contained separated from the base of the source holder. Using a pair of channel-locks in his right hand, the worker retrieved the cylinder containing the source and continued the extraction process, using the channel-locks to hold the source/source holder assembly in place. Following the uncrimping of the broken source holder, the worker twice tried to extract the source, being successful on his second attempt. The source was then placed in a lead pig for eventual loading into the new device. The total time reported by the worker's supervisor for the entire procedure was four minutes and 45 seconds.

Previous recorded extremity doses to employees involved with the source changes on 10-curie Cesium-137 sources from stainless steel source holders were reported to be approximately 3 to 4 rems to the hand holding the side cutters. However, because source manipulation was unusually difficult in this case, the supervisor suggested that the worker's ring thermoluminescent dosimeter (TLD) be processed. On July 12, 1990, the results indicated an exposure of 714 rems to the left hand.

The worker was examined by the physician on the evening of July 12, 1990. The examination included a physical inspection of his hand as well as a blood test. Aside from a slightly elevated white blood count, because of the presence of a virus, no unusual results were reported by the physician. The worker showed no visible signs of acute radiation overexposure to his left hand. He stated that there was no discomfort, reddening, swelling or other ill effects suffered as a result of this event. On July 20, 1990, after further blood tests and physical examination, an oncologist/hematologist informed the worker that all tests were normal and that he could find no sign of damage to the worker's hands or forearms. Based on these findings, the doctor believed that the worker had not been exposed to the high level of radiation reported.

The ring TLD had only been worn for two days. On July 9, the worker prepared source capsules for disposal, an activity which usually results in minimal exposure. On July 10, the worker only performed the 10-curie source extraction. When not in use, the ring TLD was stored in a drawer at his desk in the stock room, and a survey of this

storage area, performed by the State inspectors, revealed no evidence of any reading in excess of natural background.

The State agency witnessed a re-enactment of the event and concluded that an overexposure occurred but was likely considering less than the 714 rems indicated by the TLD. The license was amended to include the licensee's corrective actions. The licensee was also cited for the overexposure.