

APPENDIX A

U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 030-30175/90-004

Docket No. 030-30175

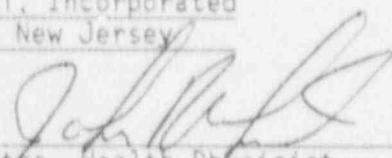
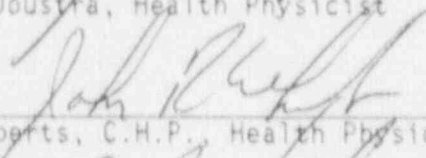
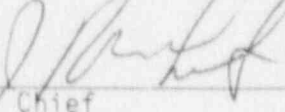
License No. 42-26900-01 Priority 1 Category C1 Program Code 3320

Licensee: Western Stress, Inc.
11011 Richmond Avenue, Suite 800
Houston, Texas 77042

Inspection Conducted: October 5-6 and 11, 1990

Facility Name: Western Stress, Inc.
1602 Hylton Road
Pennsauken, New Jersey 08110

Inspection At: Circuit Foil, Incorporated
Bordentown, New Jersey

Inspectors:  10/22/90
Judith A. Jousra, Health Physicist date
 10/22/90
Mark C. Roberts, C.H.P., Health Physicist date
Approved by:  10/22/90
John R. White, Chief date
Nuclear Materials Safety Section C

Inspection Summary: Reactive Inspection conducted October 5 and 6, 1990.
(Inspection Report No. 030-30175/90-004).

Areas Inspected: Description of incident, recovery of source and evaluation of doses.

Results: Four apparent violations were observed: failure to wear radiation dosimetry during radiographic operations (Section 3); failure to perform appropriate radiation survey (Section 3); whole body occupational radiation dose in excess of regulatory limits (Section 6) and extremity occupational radiation dose in excess of regulatory limits (Section 6).

DETAILS1. Persons Contacted

Roland Dellarciprete, Radiographer, Western Stress, Inc.,
Pennsauken, New Jersey
Fred Goodson, Assistant Radiographer, Western Stress, Inc.,
Pennsauken, New Jersey
Peter Rogers, District Manager, Western Stress, Inc.,
Pennsauken, New Jersey
Fred Frongillo, Corporate Radiation Safety Officer, Western Stress,
Inc., Houston, Texas
Robert L. Kelly, Manufacturer's Technical Representative, Amersham
Alan Cain, Manufacturer's Technical Representative, Amersham
Rob Miller, Water Treatment Plant Supervisor, Circuit Foil, Inc.,
Bordentown, New Jersey
Michael Mundress, Reverse Osmosis Supervisor, Circuit Foil, Inc.,
Bordentown, New Jersey
Julian Toneatto, Environmental Consultant to AFEC (new facility owner)
Patrick Nocera, Consultant, Square D Company

2. NRC Region I Notification

On October 5, 1990, at about 8:00 p.m., the NRC Headquarters Operation Center notified Region I of an incident involving a disconnect of a radiography source. The incident involved Pennsauken, New Jersey field office of a NRC Region IV licensed radiography company, Western Stress, Incorporated, (WSI) Houston, Texas. The incident occurred at a field site at the Circuit Foil Company, Bordentown, New Jersey.

Upon notification, NRC Region I management elected to dispatch two Health Physicist to the scene of the event to assure that proper radiological controls were maintained until the source was recovered, and interview involved personnel. Upon their arrival at the Circuit Foil facility in Bordentown, New Jersey, at about 12:00 p.m. the inspectors confirmed that proper radiological controls were in place and that public health and safety was not compromised.

3. Description of the Incident

The following narrative is based on a description of the sequence of the incident as provided to the NRC inspectors by the WSI radiographer on October 6, 1990, at about 1:00 a.m.; and information provided to NRC Region I in a meeting with WSI's Corporate Radiation Safety Officer on October 11, 1990.

A Western Stress, Incorporated radiographer and his assistant were performing a series of radiographic exposures on a recently repaired 300,000 gallon waste water storage tank at the Circuit Foil Company, Bordentown, New Jersey (Attachment 1). The WSI radiographer was also the Radiation Safety Officer for the company's field office in Pennsauken, New Jersey.

The area on the tank being radiographed was the perimeter of a welded plate, approximately 10 feet high and 12 feet wide, at the base of the tank. The radiographic apparatus being used was a Tech-Ops Model 920 camera with a 14-foot source guide tube. The source in the radiographic camera was 80.5 curies of Ir-192 (manufacturer's activity, 99.8 curies on September 12, 1990). A tungsten collimator was positioned on the source guide tube end-cap, which provided about 95% attenuation. The source guide tube end-cap and attached collimator was clamped to a stand that was magnetically mounted to the exterior surface of the tank wall. The stand was moved along the weld for each successive exposure. The radiographic camera remained on the concrete pad for each of the exposures. A second stand and clamp was used for the exposures at the top of the weld. The middle section of the source guide tube was clamped to this stand so that the weight of the source guide tube itself would not pull the magnetic stand off the side of the tank. The drive cable and crank was extended around the perimeter of an adjacent tank. Thirty-five exposures were planned with each exposure approximately 45 seconds in duration.

After cranking out the source for the sixth exposure, the radiographer heard a crash and saw that the magnetically mounted stand, which held the collimator and end-cap, had fallen from the side of the tank 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. He then looked around the tank and noticed the guide tube was looped. The radiographer then dragged the camera back by pulling on the drive cable housing in order to straighten out the guide tube. After straightening the guide tube, the radiographer was able to fully retract the cable, and consequently thought that the source was in the camera. Subsequently, the radiographer removed the chain around his neck that held his two 200 mR self-reading pocket dosimeters and his TLD badge; and laid the chain and dosimeters near the crank handle.

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 for any indication of radiation. At this time, he grasped the end of the source guide tube with his left hand. With his right hand, he removed the tape which held the collimator in place. Once removed, he cast the collimator aside. He then began to unscrew the source guide tube end cap from the source guide tube for the purpose of exchanging the end-cap for a lighter end-cap assembly. As he removed the cap, the source chain containing the 80.5 curie Ir-192 source fell out of the end-cap assembly onto the concrete pad. The radiographer then dropped the source guide tube and end-cap, and rapidly left the immediate area.

The assistant radiographer had been in the radiography truck developing films when the incident occurred. The truck was approximately 200 feet from the source and was outside the identified radiation area. The radiographer summoned the assistant, who then brought a second survey meter to the radiographer. The radiographer and his assistant controlled access to the area and performed a radiation survey to establish a restricted area boundary.

Since the radiography was being performed after routine day-shift work hours, there were very few plant workers in the general area. Approximately five plant workers were evacuated from adjacent areas as a precaution.

While the radiographer maintained control of the area, the radiographer's assistant contacted the Corporate Radiation Safety Officer (CRSO) in Houston, Texas in accordance with WSI's emergency procedures. Following, the CRSO reported the incident to the NRC Headquarters Operation Center. He also made arrangements with Amersham Corporation, Burlington, Massachusetts, the manufacturer of the radiographic camera, to send a source recovery team to the field site to perform source recovery operations.

The CRSO requested that the radiographer make an attempt to shield the source, as possible. Subsequently, the radiographer located a supply of lead shavings at the facility and filled two burlap bags with the material. Following, he ran up to the source with one of the bags and dropped the bag onto the source for shielding. A second bag was dropped on the source in a similar manner. According to the radiographer, at some time prior to placing the bags of lead on the exposed source, he replaced the chain holding his dosimetry around his neck.

The radiographer provided a written statement to the corporate RSO describing his recollection of the events of the incident. A copy of this statement was provided by the RSO to Region I and is included as Attachment 2.

The finding that the radiographer removed his TLD and direct reading pocket dosimeter during radiographic operations is an apparent violation of 10 CFR 34.33(a). The finding that the radiographer failed to perform a radiation survey of the guide tube on his approach is an apparent violation of 10 CFR 34.43(b).

4. Source Recovery

Two Amersham Corporation employees from the Burlington, Massachusetts office and their recovery equipment arrived at the field site shortly after the NRC inspectors. The lead recovery individual discussed the incident with the radiographer to determine the exact location of the source. The Amersham personnel, NRC inspectors and the radiographer then returned to the incident scene to evaluate the proposed recovery method.

Radiation levels were determined to be approximately 500 millirem (mR)/hour near contact with the bags of lead shavings and 0.5 mR/hour at approximately 20 feet from the bags. The radiographic camera was recovered and positioned in a staging area set up outside the immediate radiation area.

The Amersham personnel removed the guide tube and tested the radiographic camera with a dummy source chain to verify that the camera was still in proper working order and could be used for recovery of the source. A plan was devised to grasp the source with a long-handled tool and insert the source chain into the camera. A series of 2" x 4" boards were used to make a small stand for inclined placement of the radiographic camera so that the opening for the source chain was at an approximate forty-five degree angle. A 10-foot long pole was obtained for removal of the bags of lead from atop the source. The lead recovery technician placed a 200 mR self reading dosimeter on his collar and one on his waist to accompany his whole-body film badge. Film badges were placed on each wrist and ring dosimeters on either hand. Once the radiographic camera was positioned near the lead bags, the second Amersham technician moved the two lead bags with the pole. As soon as the source was uncovered, he backed away. The lead technician grabbed the source chain with a six-foot long remote handling tool and fed the source chain into the radiographic camera. The source was only exposed for approximately ten seconds during the recovery. The two recovery personnel received exposures of 72 mR and 2 mR for the entire recovery operation. The exposure rate was observed to be 16 mR/hour at about 60 feet from the source.

After recovery of the source, the Amersham personnel again ensured that the radiographic camera was operating properly so that the source could be safely transported. The connector end of the source chain was pulled through the radiographic camera and the red safety flag was observed to drop into place, securing the source chain in the camera. An examination of the connector end of the drive cable and the connector end of the source chain revealed that the connector ball had been sheared from the end of the drive cable. The connector ball was still lodged into the connector end of the source chain and was able to be recovered by the Amersham personnel. It appeared as though the fall caused the connector ball to break off. The recovered piece was returned to Amersham's offices for examination.

5. Routine Radiation Safety Requirements

Compliance with routine radiation safety requirements were also evaluated as a result of this reactive inspection.

A G. E. Smith & Associates Model GS2000 survey meter was being used by the radiographer for exposure measurements. This instrument has a range of 0-1000 mR/hr and was last calibrated on August 14, 1990 and was due for calibration November 14, 1990. The personnel dosimetry being used by the WSI personnel included a Landauer whole body TLD badge and two 0-200 mR self-reading pocket dosimeters. The radiation response of the two self-reading pocket dosimeters was last evaluated on June 12, 1990. A Landauer TLD badge was assigned to the radiographer and was routinely exchanged on the 5th of each month. The TLD being worn had been exchanged on or about October 3, 1990. The areas where radiography was being performed were conspicuously posted with radiation warning signs and ribbons. A survey at the exterior surface of the radiographic camera indicated an exposure rate of 24 mR/hour with the source installed.

No violations were identified.

6. Dose Evaluation

The primary exposure to the whole body and the extremities of the radiographer occurred during the time period in which he grasped the source guide tube end-cap, removed the collimator and unscrewed the end-cap, thus revealing the source. The NRC dose evaluation is limited to this time period.

Initial estimates for the length of time that the source was held and the length of time the radiographer was in the source vicinity indicated that a regulatory overexposure may have occurred. The initial time estimated for source handling was 45 seconds to 1 minute. The inspectors requested the radiographer to re-enact his action pertaining to the source guide tube end cap and collimator removal. In the re-enactment the radiographer rapidly removed the tape from the collimator and slid the collimator from the end cap and tossed it aside. He then unscrewed the end cap. The time estimate to unscrew the end-cap after removal of the collimator was approximately 10 seconds.

The activity of the Ir-192 source on October 5, 1990 was 80.5 curies. The specific Gamma constant for Ir-192 is 0.48 R/hour for a 1 curie source at a distance of 1 meter. The exposure rate from this source is thus 38.6 R/hour at 1 meter (Attachment 3). An inverse square correction for the exposure rates at various distances also appears in Attachment 4. An inverse square correction for the exposure rate at one centimeter yields 386,000 R/hour or 107 R/second.

The distance from the source to the whole body was estimated to be 11 centimeters based upon the re-enactment. The exposure rate at 11 centimeters is 3190 R/hour or 0.886 R/sec. Consequently, the exposure to the whole body is estimated to be 0.886 R/second times 10 seconds or 8.86 Rem.

The exposure to the extremities (right hand) is estimated to be 107 R/second times 10 seconds or 1070 R since the right hand was approximately 1 centimeter from the source. The one centimeter approximation is based on the observations during the re-enactment and a measurement of 0.7-1.0 centimeter for the radius of the source guide tube end cap.

Since the inverse square relationship may not hold true at close distances, this estimated exposure to the hand was compared to empirical TLD data from a similar dose evaluation performed by the NRC on November 23, 1976 involving the Pittsburgh-Des Moines Steel Company. In this case, TLDs had been placed at the end of a source guide and exposed to a 93.7 Curie Ir-192. The dose rate was measured to be from 4920 to 7590 Rad/minute; or from 4230 to 6530 Rad/minute, if corrected for an 80.5 Curie source. These dose rates correspond to an exposure rate between 70.5 and 109 Rad/second for a 80.5 Curie source. A ten second exposure would then yield doses of between 705 and 1090 Rads, which compares well with the estimated exposure of 1070 Rem.

The finding that the dose equivalent to the whole body of the radiographer exceeds 3 Rems per calendar quarter is an apparent violation of 10 CFR 20.101(b). The finding that the dose equivalent to the extremities (right hand) of the radiographer exceeds 18.75 Rem per calendar quarter is an apparent violation of 10 CFR 20.101(a).

7. Exit Interview

An official exit interview was not held at the completion of the inspection. The inspectors discussed the event with the radiographer following recovery of the source. Further, the Corporate Radiation Safety Officer met with individuals from NRC Region I on October 11, 1990, at the Region I office to provide information obtained during his discussions with the radiographer. A transcription of the radiographer's statement to the RSO was provided to Region I at this time (Attachment 2).

An exit interview concerning this event was held with Fred Frongillo (Corporate Radiation Safety Officer) on October 23, 1990 via a telephone conference with John R. White (Region I) and Charles Cain (Region IV).

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Attachment 1

Plan View of Field Location
where Radiography was Conducted

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Attachment 2

Literal Transcription of
Roland Dellarciprete's Statement

Literal transcription of Roland Dellarciprete's statement.

Date: 10-5-90
Location: Yates RT130 Bordontown, NJ [Circuit Foil USA
Time: Approx. 1930 Hrs. 88 Rt. 130 South
Camera: S/N 49 Tech Ops Model 920 Bordertown, N.J 08505]
Source: S/N 1156 Iridium 192
Activity: 82 Curies

While performing radiographic operations at Yates Corp. Bordontown, NJ at approx. 1900 hrs I had a source disconnect incident. I was performing RT on an insert on a tank patch 8' high 10' wide using a magnetic stand. On the 6th exposure the stand failed to hold and fell. The control cables jerked around an adjacent tank which I was using as shielding. I looked around and saw that the source tube was on the ground and twisted, knowing that this was preventing me from securing the source in the camera I attempted to straighten the tube by pulling on the control cable moving the camera back therefore moving the source tube into a more straight position. I then cranked the source into the camera. Since I thought that the source was in a safe position, I approached the camera with my survey meter and through carelessness or fatigue failed to take note of meter readings. I then proceeded to change source tube tips on the tube since I felt the weight of the tip I was using was responsible for the magnetic stand failure. I proceeded to unscrew the tip after removing the collimator. When the tip was loose, the source chain assembly fell to the ground. I immediately left the area post-haste.

Sometime during and before I approached the disconnected source, I removed my dosimetry. Why? I really can not answer. It was a completely stupid act and there is no excuse or explanation I can give for this action.

I then sent my assistant (who was in the darkroom loading film for the next set of exposures) to report the incident to Fred Frongillo our Corporate Radiation Safety Officer. I noticed there was a building (R&D building) directly in the path of the radiation beam. I immediately surveyed the area and found I was getting a 4 mR/hr reading outside the building. There are several doors leading into the building. Trying one of these, I found it was open and entered. Finding the room empty, I went into the hallway and found a cleaning person there asking how many persons were in the building. He informed only himself, one man upstairs, and two men in a lab downstairs. I told him we had to evacuate the building and explained the reasons. He went upstairs to inform the man up there and I proceeded to the lab. (This all took place within 3 to 5 minutes after disconnect.) After arriving in the lab, I surveyed the area and found a 0.04 mR reading where the men were working. I asked them to leave explaining why. I then surveyed the rest of the lab finding a 1.4 mR reading in the room closest to the door. I placed the meter against the outside wall and noted a 4 mR/hr reading there. I then flagged the door with emergency radiation warning ribbon, checked the rest of the building. Finding it empty, I posted it as a restricted area. I then went outside and surveyed and posted my 2 mR/hr area. My assistant then returned and told me Mr. Frongillo wished to speak to me since he did not know

Yates Corp./E2A
10/05/90

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much about the incident. I then assigned him to finish posting the 2 mR/hr area and monitor the area and went to speak to Mr. Frongillo. I then informed him of the preceding information.

I then spoke to the plant manager and assured him none of his personnel were in danger. We spoke and he informed me he had lead chips in five-gallon containers. Taking these and filling three burlap bags with approximately 30 pounds of lead each. I approached and shielded the exposed source as best I could. I then surveyed the area again and found a reading of 0.04 mR 30 feet from source. I surveyed the R&D building and got a 0 mR/hr reading and allowed personnel back into the building. I called Mr. Frongillo to update him of the situation. He told me he had located a recovery team out of Boston and that they would be arriving at the Philadelphia airport at 2300 hours, and to keep the area under surveillance and remain calm.

The recovery team and NRC personnel arrived about 0030 hours (October 6, 1990). We went over the incident and my actions, the location of the source, and radiation readings.

The recovery team and NRC inspectors then proceeded to retrieve the source informing me I was not to enter the restricted area until the source was secured.

My assistant and I then secured operations and returned to our shop in Pennsauken, New Jersey.

I returned the source to the vault and tagged it out of service.

I got a call from Mr. Rogers (my boss, the district manager) to report to Cooper Hospital for blood tests, which I did and am now awaiting further developments.

Sunday, October 7, 1990
1100 hours

Roland Dellarciprete