

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS  
WASHINGTON, D.C. 20555

March 26, 1991

NRC INFORMATION NOTICE NO. 91-23: ACCIDENTAL RADIATION OVEREXPOSURES TO  
PERSONNEL DUE TO INDUSTRIAL RADIOGRAPHY  
ACCESSORY EQUIPMENT MALFUNCTIONS

Addressees:

All Nuclear Regulatory Commission (NRC) licensees authorized to use sealed sources for industrial radiography.

Purpose:

This information notice is being issued to alert licensees to recent radiography incidents involving both extremity and whole body overexposures of radiographers. These occurred during industrial radiographic operations as a result of: (1) not surveying a radiographic exposure device and source guide tube after each exposure; or (2) using either a magnetic or non-magnetic stand for applications that applied stresses exceeding the limits of the stand. It is expected that licensees will review this notice, distribute it to responsible staff, and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice do not constitute any new NRC requirements, and no written response is required.

Description of Circumstances:

The following cases are recent events reported to NRC that have resulted in radiation overexposures to radiographers and radiography assistants as a result of improper handling of radioactive sealed sources and inattention to radiation safety procedures.

Case 1: A radiographer had been performing exposures of welds at the base of a 300,000 gallon waste storage tank, with a radiography camera equipped with a 14-foot guide tube. A tungsten collimator had been positioned on the end of a guide tube that was clamped to a stand that was magnetically attached to the tank wall. After cranking out the 80-curie iridium-192 (Ir-192) source for an exposure approximately 10 feet above the base of the tank, the radiographer heard the collimator fall. After straightening out the guide tube, the radiographer fully retracted the cable, and consequently thought that the source was in the shielded position of the camera. Subsequently, the radiographer removed his dosimetry, picked up a survey instrument, walked up to the end of the source guide tube and removed the collimator, without observing the meter reading. As he was unscrewing the nozzle of the guide tube, the source fell to the ground. The radiographer immediately left the area, and notified the proper authorities. Exposure estimates to the radiographer, based on source activity and exposure time estimates, are 8.9 rem whole body, and 1070 rem to the right hand.

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Case 2: A radiographer and his assistant were performing radiographic exposures of welds on a 48-inch diameter tank. After the sixth exposure, the radiographer left the immediate area to load film in a belt. While the radiographer was away, the assistant set up the seventh exposure and cranked out the source. The assistant had turned the crank about two or three times when he saw that the magnetically mounted stand, that held the guide tube near the exterior of the tank, had fallen. When the stand fell, the assistant's personnel dosimeter (chirper) began to alarm, so he quickly cranked the source back into the shielded position. Because his chirper stopped alarming, he thought that the source was in the shielded position, so he did not survey the area (the licensee later reported that the chirper was found to be malfunctioning due to a shorted ground wire). Instead, he walked over to the tank, repositioned the magnetic stand and source guide tube with his right hand, and returned to the camera to proceed with the exposure. When he cranked out the 50-curie Ir-192 source, he noted that his chirper did not alarm, so he looked at his pocket dosimeter and noticed that it was off scale high. When the radiographer returned, 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 he had received an overexposure, 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 hands showed clinical signs of radiation injury. From reenactments, clinical observations, and calculations, the overexposure to the assistant radiographer's hand was estimated to be between 1500 and 3000 rem. The attending physician stated that amputation of one or more fingers could be necessary. The whole body dose to the assistant, as measured by his TLD, was 365 millirem.

Case 3: This radiographic operation involved the use of an 80-curie Ir-192 source. After completing two radiographs of a pipe weld, an assistant radiographer disassembled the equipment in order to move the exposure device to another location. While doing this, he removed the source guide tube and draped it around his neck so that his hands would be free to carry the remaining equipment approximately 50 feet. As he removed the guide tube from around his neck, he noticed that the sealed source fell from the tube to the ground. The assistant notified the radiographer, who telephoned the company owner and, following his direction, successfully retrieved the source to a shielded position within the exposure device. The radiographer's film badge was immediately sent for processing (the assistant radiographer was not wearing a dosimeter and was immediately sent to a hospital for a medical examination). The cytogenetic studies revealed equivalent whole body doses of 17 rem for the radiographer and 24 rem for the assistant. The assistant developed an area of redness 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 physician determined that the observed effect corresponded to an overexposure to the skin of 5000-7000 rem. There were no medical effects observed for the radiographer.

Discussion:

All licensees are reminded of the importance of ensuring the safe performance of licensed activities, in accordance with NRC regulations, requirements of their licenses, and accepted health physics practices. The aforementioned cases illustrate: the lack of radiation surveys following the retraction of a sealed source; failure to wear a direct reading pocket dosimeter and either a film badge or TLD; failure to personally supervise an assistant radiographer while using radiographic exposure devices; the improper use of a magnetic or non-magnetic stand that cannot hold the weight of the intended equipment (such as a 12-pound collimator); the necessity of consistently following standard operating and, when necessary, emergency procedures; and the need to understand the significance of radiation doses that result from the misuse of large radiographic sources. Sealed sources for radiography are capable of delivering significant unintended exposures to radiographers, assistants, and members of the general public, when source management procedures are not followed.

Although it might seem obvious that common sense would prevent radiation workers from picking up highly radioactive sources or guide tubes that might inadvertently contain a dislodged radiographic source, the number of unplanned radiation exposures of this type indicates that "common sense" cannot be counted on, in such a situation. Licensees are responsible for ensuring the safe performance of licensed activities in accordance with NRC regulations and the terms of their licenses. In so doing, licensees should not only provide adequate training, but should also exercise close supervision over their employees, to ensure compliance with procedures and with NRC or any other applicable requirements. All workers should understand the consequences of improperly handling a radiographic source containing large quantities of Ir-192. Such improper handling can cause a significant, undesired, radiation dose to both the whole body and extremities, and can easily result in the amputation of several fingers, the development of a tumor, or death.

No written response is required by this information notice. If you have any questions about this matter, please contact the appropriate regional office or this office.

*Richard E. Cunningham*

Richard E. Cunningham, Director  
Division of Industrial and  
Medical Nuclear Safety  
Office of Nuclear Material Safety  
and Safeguards

Technical Contact: Cynthia G. Jones, NMSS  
(301) 492-0629

Attachments:

1. List of Recent NMSS Information Notices
2. List of Recent NRR Information Notices

LIST OF RECENTLY ISSUED  
NMSS INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
91-16	Unmonitored Release Pathways from Slightly Contaminated Recycle and Recirculation Water Systems At A Fuel Facility	03/06/91	All fuel cycle facilities.
91-14	Recent Safety-Related Incidents at Large Irradiators	03/05/91	All Nuclear Regulatory Commission (NRC) licensees authorized to possess and use sealed sources at large irradiators.
91-03	Management of Wastes Contaminated with Radioactive Materials ("Red Bag" Waste and Ordinary Trash)	01/07/91	All medical licensees.
91-02	Brachytherapy Source Management	01/07/91	All Nuclear Regulatory Commission (NRC) medical licensees authorized to use byproduct material for medical purposes.
90-82	Requirements for Use of Nuclear Regulatory Commission-(NRC-)Approved Transport Packages for Shipment of Type A Quantities of Radioactive Materials.	12/31/90	All registered users of NRC-approved packages.
90-81	Fitness for Duty	12/24/90	All U.S. Nuclear Regulatory Commission (NRC) and non-power reactor licensees.
90-75	Denial of Access to Current Low-Level Radioactive Waste Disposal Facilities	12/5/90	All Michigan holders of NRC licenses.
90-71	Effective Use of Radiation Safety Committees to Exercise Control Over Medical Use Programs	11/6/90	All NRC licensees authorized to use byproduct material for medical purposes.

LIST OF RECENTLY ISSUED  
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Information Notice No.	Subject	Date of Issuance	Issued to
91-22	Four Plant Outage Events Involving Loss of AC Power or Coolant Spills	03/19/91	All holders of OLs or CPs for nuclear power reactors.
91-21	Inadequate Quality Assurance Program of Vendor Supplying Safety-Related Equipment	03/19/91	All holders of OLs or CPs for nuclear power reactors and all recipients of NUREG-0040 "Licensee Contractor and Vendor Inspection Status Report" (White Book).
91-20	Electrical Wire Insulation Degradation Caused Failure in A Safety-Related Motor Control Center	03/19/91	All holders of OLs or CPs for nuclear power reactors.
90-43, Supp. 1	Mechanical Interference with Thermal Trip Function in GE Molded-Case Circuit Breakers	03/13/91	All holders of OLs or CPs for nuclear power reactors.
91-19	Steam Generator Feedwater Distribution Piping Damage	03/12/91	All holders of OLs or CPs for pressurized water reactors (PWRs).
91-18	High-Energy Piping Failures Caused by Wall Thinning	03/12/91	All holders of OLs or CPs for nuclear power reactors.
90-25, Supp. 1	Loss of Vital AC Power with Subsequent Reactor Coolant System Heat-Up	03/11/91	All holders of OLs or CPs for nuclear power reactors.
91-17	Fire Safety of Temporary Installations or Services	03/11/91	All holders of OLs or CPs for nuclear power reactors.
91-16	Unmonitored Release Pathways from Slightly Contaminated Recycle and Recirculation Water Systems at A Fuel Facility	03/06/91	All fuel cycle facilities.

OL = Operating License  
 CP = Construction Permit

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Although it might seem obvious that common sense would prevent radiation workers from picking up highly radioactive sources or guide tubes that might inadvertently contain a dislodged radiographic source, the number of unplanned radiation exposures of this type indicates that "common sense" cannot be counted on, in such a situation. Licensees are responsible for ensuring the safe performance of licensed activities in accordance with NRC regulations and the terms of their licenses. In so doing, licensees should not only provide adequate training, but should also exercise close supervision over their employees, to ensure compliance with procedures and with NRC or any other applicable requirements. All workers should understand the consequences of improperly handling a radiographic source containing large quantities of Ir-192. Such improper handling can cause a significant, undesired, radiation dose to both the whole body and extremities, and can easily result in the amputation of several fingers, the development of a tumor, or death.

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Editor/NMSS  
EKraus  
3/06/91

\*See previous concurrence

OFC	: IMOB*	: IMOB *	: IMOB *	: IMAB *	: IMNS	: IMNS
NAME	: CJones/cj/11	: CTrottier	: JHickey	: JGlenn	: GSjoblom	: RECunningham:
DATE	: 3/05/91	: 3/11/91	: 3/14/91	: 3/15/91	: 3/19/91	: 3/19/91

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OFFICIAL RECORD COPY  
INRADIO

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Although it may appear obvious that common sense should prevent radiation workers from picking up highly radioactive sources or guide tubes that may inadvertently contain a dislodged radiographic source, the number of unplanned radiation exposures of this type indicates that "common sense" has not been effective. Licensees are responsible for ensuring the safe performance of licensed activities in accordance with NRC regulations and the terms of their licenses. In so doing, licensees should not only provide adequate training, but should also exercise close supervision over their employees to ensure compliance with procedures and with NRC or any other applicable requirements. All workers should have a clear understanding of the significance of improperly handling a radiographic source containing large quantities of Ir-192. Consequently, the potential for causing a significant, undesired radiation dose to both whole body and extremities are great, and can easily result in severe radiation consequences: the amputation of several fingers, the development of a tumor, or death.

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