

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

March 2, 1994

NRC INFORMATION NOTICE NO. 94-15: RADIATION EXPOSURES DURING AN EVENT
INVOLVING A FIXED NUCLEAR GAUGE

Addressees

All U.S. Nuclear Regulatory Commission licensees authorized to possess, use, manufacture, or distribute industrial nuclear gauges.

Purpose

NRC is issuing this information notice to alert addressees to events, involving industrial gauges, that resulted, or may have resulted, in unnecessary radiation exposure to members of the public and licensee personnel. It is expected that recipients will review the information for applicability to their operation and consider action, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not new NRC requirements; therefore, no specific action nor written response is required.

Description of Circumstances

A recent incident occurred at a glass factory where a level gauge with approximately 185 gigabecquerels (5 curies) of cesium-137 was subjected to a severe heat environment that resulted in the loss of lead shielding, producing a high radiation dose rate near the source housing. Licensees were alerted to similar incidents in Information Notice No. 81-37 (see Attachment 1).

The glass manufacturing company (an NRC licensee) informed NRC on August 23, 1993, that lead shielding melted from one of the level gauges that was mounted on the exterior surface of a glass furnace. The licensee believed that the damage occurred when it lost electrical power for approximately 3 hours on Saturday, August 21, 1993, and the glass furnaces were operated using natural gas, which caused higher than normal temperatures. During the outage, an employee noticed that some lead had melted and accumulated on a mounting bracket adjacent to a level-measuring nuclear gauge; however, the employee did not notify the facility Radiation Safety Officer (RSO) at that time. The following Monday, the same employee noticed more lead on the mounting bracket and other adjacent areas. The RSO was then notified, who restricted access to the area.

The lead melt was apparently caused by intense heat emanating through refractory board covering an opening in the furnace wall adjacent to the source housing. It was later determined that this opening had been in the furnace wall for some time, to be used for another type of measuring device. However, on this occasion when the device was not in use, the opening was

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covered with refractory board instead of being closed with the original refractory brick. Radiation surveys performed by the licensee and a manufacturer's representative revealed an exposure rate of 1.29×10^{-5} C/(kg-hr) at 2.44 meters (50 mR/hr at 8 feet) and 5.16×10^{-5} C/(kg-hr) at 1.22 meters (200 mR/hr at 4 feet) from the source housing. The representative estimated the highest exposure rate at the surface of the source housing to be 7.74×10^{-4} C/(kg-hr) (3000 mR/hr). He indicated that the shutter block of this device might be melted, and that half of the lead might no longer be contained in the source housing. This particular device contained a nominal 185 gigabecquerels (5 curies) of cesium-137, and between 86 and 91 kilograms (190 and 200 pounds) of lead shielding. Although there was no facility or personnel contamination, since the cesium-137 source did not leak, dose equivalent calculations indicated that one individual may have received approximately 2 mSv (200 mrem) to the whole body. Other individuals working in the vicinity (about 34 people) received lower doses.

The major causes of the incident were: 1) the licensee did not take into consideration the effect of extreme heat on the source housing before removing the refractory brick; and 2) the licensee failed to follow its emergency procedures by not immediately notifying the RSO when the leaking lead was first discovered. This contributed to delays in establishing appropriate radiological controls to minimize radiation exposure to personnel.

Discussion

Under normal working conditions, these gauges are designed and can be operated without problems related to radiological safety. Operational history has shown that many devices will also survive severe conditions such as fires and explosions, but there are limitations on the source housing. A common factor in incidents described in this information notice and within IN 81-37 is the impact that modification of a gauge's environment has on its safety and integrity. It is important that licensees consider the effects on nuclear gauges when changes are made to the gauge's environment. Individuals working near a nuclear gauge should be aware of the potential hazard. Any changes in gauge surroundings, or the gauge itself, need to be reviewed by radiation safety personnel, and compared with the manufacturer's design criteria, so that inadvertent exposure can be avoided.

This information notice requires no specific action nor written response. If you have any questions about the information in this notice, please contact one of the technical contacts below, or the appropriate regional office.



Carl J. Paperiello, Director
Division of Industrial and
Medical Nuclear Safety
Office of Nuclear Material Safety
and Safeguards

Technical contacts: Judith A. Joustra, RI
215) 337-5257

Joseph E. DeCicco, NMSS
(301) 504-2067

Attachments:

1. Excerpts from Information Notice No. 81-37
2. List of Recently Issued NMSS Information Notices
3. List of Recently Issued NRC Information Notices

Excerpts from Information Notice 81-37: UNNECESSARY RADIATION EXPOSURES TO THE PUBLIC AND WORKERS DURING EVENTS INVOLVING THICKNESS AND LEVEL MEASURING DEVICES, dated December 15, 1981.

Case 1: An NRC licensee was closing a facility in Oklahoma City, Oklahoma, and had sold a trailer containing a mounted measuring device (Tube Wall caliper) for determining pipe wall thickness. Since the device contained a 55.5-gigabecquerel (1.5-curie) cesium-137 source and the new owner had not yet obtained a license to possess the radioactive source, the licensee removed the device from the trailer before the new owner took possession. During removal of the device (which was performed by an unauthorized user), the radioactive source was inadvertently released from its shielded position in the device and fell to the trailer floor. The dismounting of the device was performed without benefit of a survey meter or personnel monitoring equipment. The radiation dose to the individual may have been as high as 6 mSv (600 mrem). Subsequently, the new owner had the trailer towed to Houston, Texas, with an interim stop for tow truck engine repair in Norman, Oklahoma. The driver, who was not aware of the presence of the radioactive source, waited near the trailer for approximately 4 hours. He may have received a radiation dose as high as 0.014 Sv (1.4 rem). The next day, the licensee found that the source was missing from the measuring device. Local health authorities performed a search using radiation detection equipment along the highway route between Oklahoma City and Houston. The source was found lodged on a bridge support structure near Lewisville, Texas.

The major causes of the event were: (1) the licensee failed to employ an authorized user to remove the device; and (2) the unauthorized user failed to make a radiation survey.

Case 2: A cooler in an iron ore pellet plant was shut down for repairs on March 30, 1981. On that day, the shutter mechanism of a level control device, which contained a nominal 370-gigabecquerel (10-curie) cesium-137 sealed source, was locked in the closed position. Radiation surveys performed at that time indicated that the source appeared to be properly shielded. After a cooldown period, workmen entered the cooler on April 3, 1981, to replace refractory material on the cooler walls. On April 7, licensee personnel discovered that there were radiation levels in excess of 100 millirem per hour within the cooler (later determined to be as high as 0.022 Sv (2.2 rem) per hour, where the radiation beam entered the cooler). It was determined that several individuals had been exposed to a radiation beam from the source during the working days between April 3 and 7, 1981. The device source holder was removed from its mounting, and licensee personnel found that the lead shielding in the shutter had melted and drained from the shielded location. This rendered the shielding integrity of the shutter useless.

Investigation showed that 17 licensee personnel and 14 contractor personnel had entered the cooler between April 3 and 7, 1981. The calculated radiation exposures received ranged from 1.4 to 30 mSv (140 to 3000 mrem). During the repairs, the pellet cooler area was considered an unrestricted area. It is estimated that 14 of the 31 individuals exposed may have received whole-body dose equivalent in excess of 5 mSv (500 mrem). No health effects were observed or would be expected from these exposures.

The event occurred because a hole had been cut in the side of the cooler to reduce shielding and allow more effective operation of the cesium-137 source in the device. During recent efforts to increase production, the pressure of the air forced into the cooler had been increased as a means of accelerating the cooling of the pellets. As a result, hot gases may have been forced out of the aperture in the cooler wall at the location of the source holder. The temperature of the pellets entering the cooler is about 1300 °C (2400 °F), considerably higher than the melting point of lead. The heat reaching the device was sufficient to melt the aluminum alloy dust cover over the device shutter mechanism and the lead in the shutter, thereby allowing a radiation beam to escape the device. In addition, the licensee's survey failed to determine that the radioactive source was not safely shielded.

LIST OF RECENTLY ISSUED
NMSS INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
94-09	Release of Patients with Residual Radioactivity from Medical Treatment and Control of Areas due to Presence of Patients Containing Radioactivity Following Implementation of Revised 10 CFR Part 20	02/03/94	All U.S. Nuclear Regulatory Commission medical licensees.
94-07	Solubility Criteria for Liquid Effluent Releases to Sanitary Sewerage under the Revised 10 CFR Part 20	01/28/94	All byproduct material and fuel cycle licensees with the exception of licensees authorized solely for sealed sources.
93-100	Reporting Requirements for Bankruptcy	12/22/93	All U.S. Nuclear Regulatory Commission licensees.
93-80	Implementation of the Revised 10 CFR Part 20	10/08/93	All byproduct, source, and special nuclear material licensees.
93-77	Human Errors that Result in Inadvertent Transfers of Special Nuclear Material at Fuel Cycle Facilities	10/04/93	All nuclear fuel cycle licensees.
93-69	Radiography Events at Operating Power Reactors	09/02/93	All holders of OLs or CPs for nuclear power reactors and all radiography licensees.
93-60	Reporting Fuel Cycle and Materials Events to the NRC Operations Center	08/04/93	All fuel cycle and materials licensees.
93-50	Extended Storage of Sealed Sources	07/08/93	All licensees authorized to possess sealed sources.

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
94-14	Failure to Implement Requirements for Biennial Medical Examinations and Notification to the NRC of Changes in Licensed Operator Medical Conditions	02/24/94	All holders of OLs or CPs for nuclear power and non-power reactors and all licensed reactor operators and senior reactor operators.
92-36, Supp. 1	Intersystem LOCA Outside Containment	02/22/94	All holders of OLs or CPs for nuclear power reactors.
94-13	Unanticipated and Unintended Movement of Fuel Assemblies and Other Components due to Improper Operation of Refueling Equipment	02/22/94	All holders of OLs or CPs for nuclear power reactors.
94-12	Insights Gained from Resolving Generic Issue 57: Effects of Fire Protection System Actuation on Safety-Related Equipment	02/09/94	All holders of OLs or CPs for nuclear power reactors.
94-11	Turbine Overspeed and Reactor Cooldown during Shutdown Evolution	02/08/94	All holders of OLs or CPs for nuclear power reactors.
94-10	Failure of Motor-Operated Valve Electric Power Train due to Sheared or Dislodged Motor Pinion Gear Key	02/04/94	All holders of OLs or CPs for nuclear power reactors.
94-09	Release of Patients with Residual Radioactivity from Medical Treatment and Control of Areas due to Presence of Patients Containing Radioactivity Following Implementation of Revised 10 CFR Part 20	02/03/94	All U.S. Nuclear Regulatory Commission medical licensees.

OL = Operating License
CP = Construction Permit

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