



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

July 1, 1993

MEMORANDUM FOR: Those on Attached List

FROM: Richard E. Cunningham, Director  
Division of Industrial and  
Medical Nuclear Safety, NMSS

SUBJECT: REPORTING OF DAMAGED PORTABLE GAUGES

In the fall of 1992, the Office of Enforcement (OE) asked for our view as to whether a licensee must report a damaged moisture-density gauge to NRC and, if so, on what basis. We conducted a detailed analysis of the reporting requirements and recently responded to OE. The purpose of this memorandum is to provide you with our analysis of the requirements.

Whether or not licensees must report damaged moisture-density gauges depends on the extent of damage to the gauge. The requirement to report also depends on the level of radiation in an unrestricted area or doses to individuals resulting from the damaged gauge. The applicable reporting requirements are given in 10 CFR 20.405(a)(1), 20.2203(a), and 30.50(b). The enclosure provides our detailed analysis of the reporting requirements. In summary, reporting is required in most incidents when damage to the gauge results in one of several conditions:

- (1) the protective housing (shielding) is damaged such that the source is not fully shielded, or cannot be moved into the shielded position (10 CFR 30.50);
- (2) the source is left exposed in an unrestricted area such that the radiation levels exceed 20 mrem in any one hour (10 times the limit of 2 mrem in any one hour) (10 CFR 20.405 and 20.2203); or
- (3) the incident results in doses in excess of limits in Part 20 or in the license (10 CFR 20.405 and 20.2203).

Please note that the method of reporting and the associated time for the licensee to make the report are different for conditions (1), (2), and (3) above.

In a more serious case involving a broken sealed source that leads to contamination, reporting within 24 hours is required (10 CFR 30.50(b)(1)). Likewise, in a case involving a sealed source that causes, or threatens to cause, serious overexposures, immediate notification or 24-hour notification and subsequent written reporting may be required (20.403, 20.2202, and 20.2203). However, these situations are beyond the scope of most damaged gauge incidents and will not be discussed here. Finally, immediate telephonic reporting of loss or theft of a moisture-density gauge is required in most cases, and a written report within 30 days is required in nearly all cases.

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We hope that this clarifies the reporting requirements and their applicability to damaged moisture-density gauges. We are filing this memorandum and enclosure in the Public Document Room and will mail it to several major gauge manufacturers. We also will enter it into the Health Physics Positions database. If you have any questions, please call Scott Moore at 301-504-2514 or Cynthia Jones at 301-504-2629.

Signed by Carl J. Paperiello

Richard E. Cunningham, Director  
Office of Industrial and  
Medical Nuclear Safety, NMSS

Enclosure: As stated

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REPORTING REQUIREMENTS FOR DAMAGED MOISTURE-DENSITY GAUGES

A. Requirements Based On Radiation Levels:

20.405(a)(1)(v): . . . each licensee shall make a report in writing concerning any one of the following types of incidents within 30 days of its occurrence: . . . Levels of radiation or concentrations of radioactive material (whether or not involving excessive exposure of any individual) in an unrestricted area in excess of ten times any applicable limit set forth in this part or in the license.

20.2203(a)(3)(ii): . . . each licensee shall submit a written report within 30 days after learning of any of the following occurrences: . . . Levels of radiation or concentrations of radioactive material in . . . An unrestricted area in excess of 10 times any applicable limit set forth in this part or in the license (whether or not involving exposure of any individual in excess of the limits in 20.1301) . . .

[NOTE: 10 CFR 20.105(b)(1) and 20.1301(a)(2) limit doses in unrestricted areas to not exceed 2 mrem in any one hour.]

If a gauge is damaged such that it causes dose levels in an unrestricted area to exceed 20 mrem in any one hour, then the incident must be reported (see sections referenced above). Portable moisture-density gauges often contain up to 10 millicuries of cesium-137 (Cs-137). The specific gamma emission factor for Cs-137 is 0.33 R/hr at 1 m/Ci. For a 10 mCi Cs-137 source:

$$3.3 \text{ mR/hr @ 1 m} = 37 \text{ mR/hr @ 30 cm} = 0.61 \text{ mR/min @ 30 cm}$$

Thus, if the source was left in the unshielded position in an unrestricted area for over 33 minutes, the dose levels would exceed 20 mrem in an hour, and a written report would be required within 30 days.

Issues regarding what is a restricted area and what is an unrestricted area with regards to the damaged gauge are not so clear. A restricted area is an area to which access is controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials. If a gauge user was in immediate control of the undamaged gauge (i.e., standing near the gauge and restricting access to it) so that he or she could, at all times, prevent damage to or misuse of the gauge, then we could consider the area to be restricted. However, if a gauge user is not in immediate control of the gauge, then we could consider the area to be unrestricted, because the user is not controlling access to the area (also note that the licensee is in violation of 20.207(b) if the licensed material is not under immediate control). In most circumstances, if a gauge is damaged on a construction site, then the user was not in immediate control of the device.

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If the licensee took prompt action to limit the dose rate in the unrestricted area (such as returning the source to the shielded position, shielding the source with some other material, and/or identifying the area as a restricted area and fulfilling all associated requirements regarding a restricted area), then the licensee would not have to file a written report.

**B. Requirements Based On Device Damage:**

- 30.50(b)(2): Twenty-four hour report. Each licensee shall notify the NRC within 24 hours after the discovery of any of the following events involving licensed material: . . . An event in which equipment is disabled or fails to function as designed when:
- (i) The equipment is required by regulation or license condition to . . . prevent exposures to radiation and radioactive materials exceeding regulatory limits, or to mitigate the consequences of an accident;
  - (ii) The equipment is required to be available and operable when it is disabled or fails to function; and
  - (iii) No redundant equipment is available and operable to perform the required safety function.

The shielding around the source and the source rod in a portable gauge can be considered to be safety equipment. If the shielding is damaged such that it cannot properly shield the source or the source rod is bent with the source in the exposed position, then the shield or source rod "fails to function as designed." In that case, the three criteria of 30.50(b)(2) apply: (i) the shield and source rod are required by license condition (i.e., model and type of gauge) to prevent exposures to radioactive materials exceeding regulatory limits, (ii) the shield and source rod are required to be operable when they fail to function, and (iii) no redundant shielding is available and operable.

**C. Reporting Based on Doses:**

- 20.405(a)(1): . . . each licensee shall make a report in writing concerning any one of the following types of incidents within 30 days of its occurrence:
- (i) Each exposure of an individual to radiation in excess of the applicable limits in 20.101 or 20.104(a) of this part, or the license;
  - (ii) Each exposure of an individual to radioactive material in excess of the applicable limits in 20.103(a)(1), 20.103(a)(2), or 20.104(b) of this part, or in the license;
- . . .

20.2203(a)(2): . . . each licensee shall submit a written report within 30 days after learning of any of the following occurrences: . . . Doses in excess of any of the following:

- (i) The occupational dose limits for adults in 20.1201; or
- (ii) The occupational dose limits for a minor in 20.1207; or
- (iii) The limits for an embryo/fetus of a declared pregnant woman in 20.1208; or
- (iv) The limits for an individual member of the public in 20.1301; or
- (v) Any applicable limit in the license . . .

If any incident involving a damaged portable gauge leads to a dose in excess of the respective Part 20 limits or applicable limits in the license, then the licensee is required to report within 30 days. In cases where the incident causes or threatens to cause a serious overexposure or where the dose limits will be exceeded within a 24-hour period, immediate notification or 24-hour notification may be required (see 20.403 and 20.2202). However, incidents of such severity are beyond the scope of most damaged portable gauge incidents.

#### D. Reporting Theft or Loss of a Moisture-Density Gauge

If the moisture-density gauge is lost or stolen, then licensees are required to report to NRC immediately, by telephone, as required by 10 CFR 20.402. In nearly all cases of loss or theft of a moisture-density gauge, the loss or theft of byproduct material would be of such quantities and under such circumstances that it would appear that "a substantial hazard may result to persons in unrestricted areas" (the conditions under which immediate reporting is required).

10 CFR 20.402 has specific requirements for the licensee to make a report, in writing and within 30 days, whenever a telephonic report of loss or theft of licensed material is made to NRC.

10 CFR 20.2201 of the revised Part 20 (effective January 1, 1994) contains different reporting requirements for loss or theft of licensed material. If the loss or theft involves 1000 times the quantity of material given in Appendix C to 10 CFR 20.1001-20.2401 "under such circumstances that it appears to the licensee that an exposure could result to persons in unrestricted areas," then the licensee is required to report immediately.

If the gauge contains more than 10 mCi of cesium-137 or 1 mCi of Am-241, then immediate reporting by telephone of the loss or theft is required (the Appendix C value for Cs-137 is 10 microcuries; for americium-241, (Am-241), 0.001 microcurie. 10 CFR 20.2201 also has a requirement for a follow-up written report within 30 days, whenever the licensee is required to make an immediate telephonic report. Since most moisture-gauges contain byproduct material in activities near or in excess of these reporting levels, licensees would be prudent to report all losses or thefts of licensed materials immediately by telephone to NRC.

10 CFR 20.2201 of the revised Part 20 also contains a requirement for reporting in writing loss or theft of licensed material in excess of 10 times the Appendix C value within 30 days after the occurrence. Because this reporting level equates to 100 microcuries of Cs-137 or 0.01 microcurie of Am-241, nearly all moisture-density gauges using these radionuclides would be required to report (a typical gauge may contain up to 10 mCi Cs-137 and 40 mCi Am-241).

In summation, under the revised Part 20, loss or theft of most moisture-density gauges would require immediate notification, and loss or theft of nearly all moisture-density gauges would require a written report within 30 days.

#### E. Other Requirements

If the moisture-density gauge is damaged such that the sealed source is broken open, resulting in contamination, the reporting is required within 24 hours under 10 CFR 30.50(b)(1). However, IMNS staff is not aware of any cases where encapsulation was breached as a result of an incident involving damage to the gauge.

If the moisture-density gauge is damaged with the source in the shielded position and the source remains in the shielded position without any loss of integrity of the shielding, then the incident is not reportable under 10 CFR 30.50. If the incident does not cause or threaten to cause excessive doses (i.e., doses in excess of the limits) or dose rates in excess of the limits for an unrestricted area, then the incident is not reportable under 10 CFR Part 20.

#### F. Violations of 10 CFR 20.207

The previous discussion applies to reporting of damage to gauges, not failure to control licensed material in unrestricted areas. The reporting requirements and the requirement to control licensed materials are independent. Licensees could have an incident where they failed to control licensed material (i.e., violated 20.207(b)) leading to damage to the gauge, but where the incident is not required to be reported. The reporting requirements must be determined separately from the requirements to keep the gauge "under the constant surveillance and immediate control of the licensee."