



# REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

## REGULATORY GUIDE 4.20

(Draft issued as DG-8016)

### CONSTRAINT ON RELEASES OF AIRBORNE RADIOACTIVE MATERIALS TO THE ENVIRONMENT FOR LICENSEES OTHER THAN POWER REACTORS

#### A. INTRODUCTION

In 10 CFR Part 20, "Standards for Protection Against Radiation," § 20.1302(b) requires that:

A licensee shall show compliance with the annual dose limit in § 20.1301 by (1) Demonstrating by measurement or calculation that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed operation does not exceed the annual dose limit; or (2) Demonstrating that (i) The annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the values specified in Table 2 of Appendix B to Part 20; and (ii) If an individual were continuously present in an unrestricted area, the dose from external sources would not exceed 0.002 rem (0.02 mSv) in an hour and 0.05 rem (0.5 mSv) in a year.

In addition, 10 CFR 20.1101(d) requires that:

To implement the ALARA [as low as is reasonably achievable] requirements of § 20.1101(b), and notwithstanding the requirements in § 20.1301 of this part, a constraint on air emissions of radioactive material to the environment, excluding radon-222 and its daughters, shall be established by licensees other

than those subject to 10 CFR 50.34a, such that the individual member of the public likely to receive the highest dose will not be expected to receive a total effective dose equivalent in excess of 10 mrem (0.1 mSv) per year from these emissions. If a licensee subject to this requirement exceeds this dose constraint, the licensee shall report the exceedance as provided in 10 CFR 20.2203 and promptly take appropriate corrective action to ensure against recurrence.

This regulatory guide provides guidance on methods acceptable to the NRC staff for compliance with the constraint on air emissions to the environment. If additional significant comments are received in the first year following its issuance, the staff will revise the guide as appropriate. Guidance on ALARA programs can be found in other regulatory guides. Although these guides deal primarily with occupational exposure and may be specific to one type of licensee, they contain programmatic information that may be useful to all licensees. These guides are:

- Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable." This guide delineates the components of an ALARA program.

#### USNRC REGULATORY GUIDES

Regulatory Guides are issued to describe and make available to the public such information as methods acceptable to the NRC staff for implementing specific parts of the Commission's regulations, techniques used by the staff in evaluating specific problems or postulated accidents, and data needed by the NRC staff in its review of applications for permits and licenses. Regulatory guides are not substitutes for regulations, and compliance with them is not required. Methods and solutions different from those set out in the guides will be acceptable if they provide a basis for the findings requisite to the issuance or continuance of a permit or license by the Commission.

This guide was issued after consideration of comments received from the public. Comments and suggestions for improvements in these guides are encouraged at all times, and guides will be revised, as appropriate, to accommodate comments and to reflect new information or experience.

Written comments may be submitted to the Rules Review and Directives Branch, DFIPS, ADM, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

The guides are issued in the following ten broad divisions:

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| 1. Power Reactors                 | 6. Products                       |
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Issued guides may also be purchased from the National Technical Information Service on a standing order basis. Details on this service may be obtained by writing NTIS, 5285 Port Royal Road, Springfield, VA 22161.

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- Regulatory Guide 8.18, "Information Relevant to Ensuring that Occupational Radiation Exposures at Medical Institutions Will Be As Low As Reasonably Achievable."
- Regulatory Guide 8.31, "Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Mills Will Be As Low As Is Reasonably Achievable."
- Regulatory Guide 8.37, "ALARA Levels for Effluents from Materials Facilities."
- Regulatory Guide 10.8, "Guide for the Preparation of Applications for Medical Use Programs." Section 1.3 and Appendix G deal specifically with ALARA programs for medical facilities.

In addition, further information can be found in Revision 1 to NUREG-0267, "Principles and Practices for Keeping Occupational Radiation Exposures As Low As Reasonably Achievable" (October 1982).<sup>1</sup>

The information collections contained in this regulatory guide are covered by the requirements of 10 CFR Part 20, which were approved by the Office of Management and Budget, approval number 3150-0014. The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

## B. DISCUSSION

The dose limits in 10 CFR Part 20 are based on limiting dose to an acceptably low level of risk to the exposed individual. However, any radiation exposure may carry some risk. Thus, the NRC requires licensees to take actions, to the extent practicable, utilizing procedures and engineering controls to further reduce risk below the levels implicit in the dose limits in keeping with the principle that exposures should be as low as is reasonably achievable. This is the goal and purpose for radiation protection programs. In order to achieve this goal, licensees must control the way radioactive material is handled from receipt through disposal.

## ALARA

Components of an effective radiation protection program, as required by 10 CFR 20.1101, include radiation exposure control, written procedures and policies, control of radioactive materials, radioactive contamination control, radioactive waste management, training, program reviews, and audits.

<sup>1</sup>Copies are available for purchase from the U.S. Government Printing Office, P.O. Box 37082, Washington, DC 20013-7082, telephone (202) 512-2249; or from the National Technical Information Service by writing NTIS at 5285 Port Royal Road, Springfield, VA 22161. Copies are available for inspection or copying for a fee from the NRC Public Document Room at 2120 L Street NW, Washington, DC; the PDR's mailing address is Mail Stop LL-6, Washington, DC 20555; telephone (202) 634-3273; fax (202) 634-3343.

The NRC staff examines licensee programs to determine whether they are in compliance with the requirements of 10 CFR Part 20. This guide addresses only a part of a licensee's overall radiation protection program. Specifically, it addresses methods for demonstrating compliance with the constraint on releases of airborne radioactive materials to the environment. In addition to controlling doses from the releases of airborne radioactive materials to the environment, licensees must implement a radiation protection program that controls liquid effluents and dose rates in unrestricted areas.

Many NRC licensees possess source, byproduct, or special nuclear material in a form that would not cause doses to members of the public from releases of airborne radioactive material to the environment. These licensees include radiographers, well loggers, and other users of sealed sources. These licensees need not take any actions to demonstrate compliance with the constraint on releases of airborne radioactive materials to the environment.

## CONSTRAINTS

A dose limit derived from a basic radiation protection standard is the upper acceptable bound of radiation dose and is needed to protect the health and safety of individuals; a limit is a value not to be exceeded. Such limits should be set with the assumption that effluent releases associated with licensed activities would result in doses to the public that are substantially below that value. Such limits are approached only under unusual circumstances, and only for a small fraction of the exposed population. A constraint is a dose value above which licensees are required to report to NRC and to take corrective actions to lower the dose below the constraint value. Enforcement action would only occur if a licensee fails to report an exceedance of the constraint or fails to take appropriate and timely corrective actions.

## C. REGULATORY POSITION

### 1. CONSTRAINT ON ENVIRONMENTAL AIR EMISSIONS

The following methods are acceptable to the NRC staff for determining the dose to members of the public from exposure to airborne radioactive material that has been released to the environment by NRC licensees other than power reactors. Licensees should choose a monitoring period (e.g., a year, month, or quarter) to demonstrate compliance with the airborne emissions constraint in accordance with 10 CFR 20.1101(d). For most licensees, the monitoring period will be one year.

**1.1** Licensees who (1) operate a nuclear power reactor subject to 10 CFR 50.34a or (2) possess and use radionuclides only in the form of sealed sources need not take any actions to demonstrate compliance with the constraint.

**1.2** Radioactive materials in sealed containers that remain unopened and have not leaked during the assessment period need not be included in the calculations. Examples of sealed containers would include radiopharmaceuticals in unopened manufacturers packages and materials in undamaged shipping containers. Independent spent fuel storage canisters that do not have vents to the atmosphere may also be considered sealed containers.

**1.3** Effluents from patients need not be included if compliance with the constraint is demonstrated by using an inventory approach. If compliance with the constraint is demonstrated by using measured or calculated concentrations of radioactive materials in the environment, the contribution from patients is considered insignificant and need not be considered.

**1.4** If it can be determined that some detected materials did not result from licensed activities of the licensee, only radioactive materials from the licensed activity need be considered. Materials that are windblown from other facilities need not be considered.

**1.5** In determining the member of the public likely to receive the highest dose from airborne radioactive material released from licensed operations to the environment, licensees need not consider nonresidents within the facility boundary.

## 2. CALCULATION OF DOSE TO THE MEMBER OF THE PUBLIC LIKELY TO RECEIVE THE HIGHEST DOSE FROM AIR EFFLUENTS

In demonstrating compliance with 10 CFR 20.1101(d), licensees should determine whether there have been any facility or design modifications, increases in radionuclide inventories, or operational changes; licensees should determine whether any of these factors resulted in variations to airborne emissions since the last monitoring period. If licensee operations have not changed, the review of licensed operations and demonstration of compliance with the constraint will be relatively straightforward.

Any of the following methods are acceptable for demonstrating compliance with 10 CFR 20.1101(d).

**2.1** The simplest screening technique is to assume that the air concentration at the receptor is equal to the air concentration measured at the point of release. This is analogous to using Appendix B to 10 CFR Part 20 to demonstrate compliance with the dose limits in Part 20.

**2.2** To demonstrate compliance with the constraint on air emissions, the licensee should demonstrate, by measurement or calculation, that the annual average concentration of airborne radioactive material released to the environment does not exceed 20% of the values in Column 1 of Table 2 in Appendix B to 10 CFR Part 20. The following formula demonstrates this technique.

$$C = \frac{fQ}{V}$$

Where:

$C$  = Average air concentration at the receptor (Ci/m<sup>3</sup> or  $\mu$ Ci/ml)

$f$  = Fraction of the time the wind blows toward the receptor of interest (dimensionless) (For a single "puff" release, the appropriate value is 1.)

$Q$  = Effluent release rate (Ci/s)

$V$  = Volumetric flow rate at the point of release (m<sup>3</sup>/s)

The "sum of the fractions" technique should be used to assess compliance for effluents containing multiple radionuclides. With this technique, if radionuclides "a," "b," and "c" are present in concentrations  $C_a$ ,  $C_b$ , and  $C_c$ , and if the applicable effluent concentrations in Column 1 of Table 2 in Appendix B to 10 CFR Part 20 are  $EC_a$ ,  $EC_b$ , and  $EC_c$  respectively, satisfying the following inequality is sufficient to demonstrate compliance with the constraint.

$$\frac{C_a}{EC_a} + \frac{C_b}{EC_b} + \frac{C_c}{EC_c} < 0.2$$

**2.3** Additional methods acceptable to the NRC staff for demonstrating compliance with 10 CFR 20.1101(d) can be found in the worksheets contained in either NCRP Commentary No. 3, "Screening Techniques for Determining Compliance with Environmental Standards,"<sup>2</sup> or EPA 520/1-89-002, "A Guide for Determining Compliance with the Clean Air Act Standards for Radionuclide Emissions from NRC-Licensed and Non-DOE Federal Facilities" (Revision 2).<sup>3</sup>

**2.4** Another method that is acceptable to the NRC staff for demonstrating compliance with 10 CFR 20.1101(d) is the use of the computer code COMPLY. COMPLY was developed by the EPA to assess doses by using site-specific information in the determination of dose. COMPLY has four screening levels. In Level 1, the simplest level, only the quantity of radioactive material possessed during the monitoring period is entered. The calculations are based on generic parameters. Level 4 produces a more representative dose estimate by providing for more complete treatment of air dispersion by requiring site-specific information. It is expected that all

<sup>2</sup>NCRP Commentary No. 3 was published in January 1989 and the addendum was published in October 1989. Copies may be purchased from the National Council on Radiation Protection and Measurements, NCRP Publications, 7910 Woodmont Avenue, Bethesda, MD 20814.

<sup>3</sup>Copies may be obtained from the U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, 401 M Street SW, Washington, DC 20460.

NRC licensees will be able to demonstrate compliance at one of the four levels. The basis for the compliance measures in COMPLY are contained in "Background Information Document: Procedures Approved for Demonstrating Compliance with 40 CFR Part 61, Subpart I" (EPA 520/1-89-001, October 1989).<sup>4</sup>

If a computer code other than those listed above is used to demonstrate compliance with the constraint, the licensee should be prepared to demonstrate that the code has undergone verification and validation (V & V). For more information on software quality assurance including V & V, licensees may refer to NUREG/BR-0167, "Software Quality Assurance Program and Guidelines." This document can be purchased from the U.S. Government Printing Office, P.O. Box 37082, Washington, DC 20402-9328.

### 3. REPORTS TO NRC IF CONSTRAINT HAS BEEN EXCEEDED

If the constraint of 10 mrem (0.1 mSv) per year to the member of the public likely to receive the highest dose has been exceeded as determined by measurement or calculation, 10 CFR 20.2203(a)(2)(vi) requires licensees to send a report to the NRC within 30 days after

learning of the dose in excess of the constraint, and 10 CFR 20.2203(b)(1) requires licensees to describe the extent of exposure. The report should include the following information.

- An estimate of the dose
- The concentrations of the radioactive material released
- The cause of the elevated concentrations in effluents
- The corrective steps taken or planned to ensure against a recurrence
- A schedule for completing the corrective steps. The report should contain enough information to allow the NRC staff to verify the calculations.

The report should be sent to the U.S. Nuclear Regulatory Commission, Document Control Desk, Washington, DC 20555-0001, with a copy to the appropriate NRC Regional Office listed in Appendix D to 10 CFR Part 20.

### D. IMPLEMENTATION

The purpose of this section is to provide information to applicants and licensees regarding the NRC staff's plans for using this guide.

Except in those cases in which an applicant proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the methods described in this guide will be used in the evaluation of applications for new licenses, license renewals, or license amendments and for evaluating compliance with 10 CFR Part 20.

<sup>4</sup>Copies of the EPA Background Information Document and the COMPLY computer code with its Users Guide may be obtained by writing to the Center for Federal Guidance and Air Standards (6602J), Office of Radiation and Indoor Air, Environmental Protection Agency, Washington, DC 20460. It can also be downloaded from the Technology Transfer Network (TTN) Electronic Bulletin Board under the Office of Radiation and Indoor Air technical information area. The number for the TTN is (919)541-5742. In addition, EPA has pages on the World Wide Web as another mechanism to provide computer codes to licensees. The addresses are [ttnftp.rtpnc.epa.gov](mailto:ttnftp.rtpnc.epa.gov) and [ttnwww.rtpnc.epa.gov](http://ttnwww.rtpnc.epa.gov).



## REGULATORY ANALYSIS

A separate regulatory analysis was not prepared for this regulatory guide. The regulatory analysis prepared for the amendments to 10 CFR Part 20, "Standards for Protection Against Radiation," provides the regulatory basis for this guide. A copy of this regulatory analysis is available, as an enclosure to SECY-95-133, for inspection or copying for a fee at the NRC Public Document Room, 2120 L Street NW., Washington, DC.



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