

**MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND
ENERGY**

MATERIALS MANAGEMENT DIVISION

IONIZING RADIATION RULES FOR RADIOACTIVE MATERIAL

(By authority conferred on the director of the department of environment, great lakes, and energy by section 13521 of 1978 PA 368, MCL 333.13521, Executive Reorganization Order No. 1996-1, MCL 330.33101, and Executive Reorganization Order No. 2019-6, MCL 324.99923)

PART 5. STANDARDS FOR PROTECTION AGAINST RADIATION

R 325.5201 Purpose and scope.

Rule 201. (1) This part establishes standards for protection against radiation hazards. Except as otherwise specifically provided this part applies to all licensees and registrants.

(2) In addition to complying with requirements in this part, every reasonable effort should be made to maintain radiation levels in unrestricted areas and releases of radioactive materials in effluents to unrestricted areas, as far below the limits specified in this part as practicable. The term "as far below the limits specified in this part as practicable" means as low as is practicably achievable, taking into account the state of technology, and the economics of improvements in relation to benefits to the public health and safety and in relation to the use of sources of radiation in the public interest.

History: 1979 AACCS; 2016 MR 10, Eff. May 25, 2016.

R 325.5202 Intentional exposure of humans.

Rule 202. (1) Nothing in these rules shall be construed as limiting the intentional exposure of patients to radiation for the purpose of medical diagnosis, medical therapy, or medical research conducted by licensed members of the healing arts.

(2) Intentional exposure of individuals to radiation or concentrations of radioactive material for diagnostic or therapeutic purposes shall be limited to supervision or prescriptions by licensed members of the healing arts.

History: 1979 AACCS; 2016 MR 10, Eff. May 25, 2016.

PERMISSIBLE DOSES, LEVELS AND CONCENTRATIONS

R 325.5203 Exposure of individuals to radiation.

Rule 203. (1) Except as provided in subrules (3),(4), and (6) of this rule, a licensee or registrant

shall not receive, possess, use, or transfer sources of radiation in a manner as to cause any individual to receive in any period from all sources of radiation in the licensee's or registrant's possession a dose in excess of the limits specified in table 1 of Rule 205. A licensee or registrant shall not be held liable for meeting the dose limit for fertile women (with respect to fetus) listed in table 1 until and unless the employee has submitted written notice to the licensee or registrant of the pregnant condition. Potential risk of exposure, if any, to the fetus before the written notice is received shall be assumed by the employee as a condition of employment as a radiation worker. Following receipt of written notice, the employee's dosimeter record shall be reviewed immediately and necessary steps shall be taken to meet the dose limit specified in table 1 of Rule 205.

(2) For determining the doses specified in Rules 203 to 215, a dose from x- or gamma rays up to 10 MeV may be assumed to be equivalent to the exposure measured by a properly calibrated appropriate instrument in air at or near the body surface of the region of the highest exposure rate.

(3) A licensee or registrant may permit an individual in a restricted area to receive a dose to the whole body greater than that permitted in subrule (1) of this rule, under any of the following conditions:

(a) The annual dose does not exceed 5 rems in any 1 year and during any calendar quarter the dose to the whole body from sources of radiation in the licensee's or registrant's possession does not exceed 3 rems.

(b) The dose to the whole body, when added to the accumulated occupational dose to the whole body, does not exceed 5 (N-18) rems where "N" equals the individual's age in years at his or her last birthday.

(c) The licensee or registrant has determined the individual's accumulated occupational dose to the whole body on Form RH-101, or on a clear and legible record containing all the information required in that form and has otherwise complied with the requirements of Rule 206.

(4) Upon application showing an operational need, the department may authorize radiation doses at a higher annual level than the limits set forth in subrule (1) of this rule, provided that the dose does not exceed 3 rems per quarter and that, based on the determination of the individual's prior radiation record, his or her accumulated occupational dose does not exceed 5 (N-18) rems where "N" equals the individual's age in years at his or her last birthday.

(5) As used in this part, "dose to the whole body" includes any dose to the whole body, gonads, active blood-forming organs, head and trunk, or lens of the eye.

(6) Nothing in this part shall be interpreted as limiting the exposure of members of emergency response teams to radiation under emergency circumstances for the purpose of minimizing danger to life or property. Teams may include police, fire, ambulance, and paramedical crews acting in the course of their assigned duties.

History: 1979 AACCS; 2016 MR 10, Eff. May 25, 2016.

R 325.5205 Dose limits.

Rule 205. Table 1

Maximum Permissible Dose Equivalent for Occupational Exposure	
Dose to the whole body*	1.25 rem per quarter
Skin of whole body	7.5 rems per quarter
Hands	18.75 rems per quarter
Fertile women (with respect to fetus)	0.5 rem in gestation period
Maximum Permissible Dose Equivalent for Non-Occupational Exposure	
Individual	0.5 rem in any one year
Population Dose Limits	
Genetic	0.17 rem average per year
Somatic	0.17 rem average per year

*If the dose distribution is not uniform the limiting dose shall be the highest dose received by any of the critical organs specified in subrule (5) of Rule 203.

History: 1979 AACS; 2016 MR 10, Eff. May 25, 2016.

R 325.5206 Determination of accumulated dose.

Rule 206. (1) This rule applies to licensees or registrants who propose, pursuant to Rule 203 (3) or (4), to permit individuals in a restricted area to receive radiation doses in excess of the limits specified in table 1 of Rule 205.

(2) Before permitting an individual in a restricted area to be exposed to radiation in excess of the limits specified in table 1 of Rule 205, each licensee or registrant shall do all of the following:

(a) Obtain a certificate on Form RH-101, or on a clear and legible record containing all the information required in that form, signed by the individual, showing each period of time after the individual attained the age of 18 in which the individual received an occupational dose of radiation.

(b) Calculate on Form RH-101, in accordance with the instructions appearing therein, or on a clear and legible record containing all the information required in that form, the previously accumulated occupational dose received by the individual and the additional dose allowed for the individual under Rule 203 (3) or (4).

(3) In the preparation of Form RH-101, or on a clear and legible record containing all the information required in that form, the licensee or registrant shall make a reasonable effort to obtain reports of the individual's previously accumulated occupational dose. For each period for which the licensee or registrant obtains these reports, he or she shall use the dose shown in the report in preparing the form. Where a licensee or registrant is unable to obtain reports of the individual's occupational dose for a previous complete calendar quarter, it is assumed that the individual has received the occupational dose specified in whichever of the following columns apply:

	<u>COLUMN 1</u> Assumed Dose in Rems for Calendar Quarters Before January 1, 1961	<u>COLUMN 2</u> Assumed Dose in Rems For Calendar Quarters Beginning on or After January 1, 1961
Part of Body		
Whole body, gonads, active blood-forming organs, head and trunk, lens of the eye	3.75	1.25

(4) The licensee or registrant shall retain and preserve records used in preparing Form RH-101. If calculation of the individual's accumulated occupational dose for all periods before January 1, 1961 yields a result higher than the applicable accumulated dose value for the individual as of that date, as specified in Rule 205, the excess may be disregarded.

History: 1979 AACs; 2016 MR 10, Eff. May 25, 2016.

R 325.5208 Exposure of individuals to radioactive material in restricted areas.

Rule 208. (1) A licensee shall not receive, acquire, possess, use, or transfer radioactive material in such a manner as to cause an individual in a restricted area to be exposed to airborne radioactive material in an average concentration in excess of the limits specified in table I of appendix A in Rules 261 to 270. "Expose," as used in this rule, means that the individual is present in a region where an airborne concentration exist. An allowance shall not be made for the use of protective clothing or equipment, or particle size, except as authorized by the department pursuant to subrule (3) or (4) of this rule.

(2) The limits given in table I of appendix A in Rules 261 to 270, are based upon an individual being exposed to the specified concentrations for the reference period of 40 hours in any 7 consecutive days. In any such period where an individual has been exposed for less than the 40 hours, the limits specified may be increased proportionately. In any such period where an individual has been exposed for more than 40 hours, the limits specified in the table shall be decreased proportionately.

(3) The department may authorize a licensee to expose an individual in a restricted area to airborne concentrations in excess of the limits specified in table I of appendix A in Rules 261 to 270, upon receipt of an application demonstrating that the concentration is composed in whole or in part of particles of such size that the particles are not respirable and that the individual will not inhale the concentrations in excess of the limits established in the table. An application submitted pursuant to this subrule shall include an analysis of particle sizes in the concentrations and description of the methods used in determining the particle sizes.

(4) The department may authorize a licensee to expose an individual in a restricted area to airborne concentrations in excess of the limits specified in table I of appendix A in Rules 261 to 270, upon receipt of an application demonstrating that the individual will wear appropriate protective equipment and that the individual will not inhale, ingest, or absorb quantities of radioactive material in excess of those which might otherwise be permitted under this part for individuals in restricted areas during a 40-hour week. An application submitted pursuant to this subrule shall contain all of the following information:

(a) A description of the protective equipment to be employed, including the efficiency of the

equipment for the material involved.

(b) Procedures for the fitting, maintenance, and cleaning of the protective equipment.

(c) Procedures governing the use of the protective equipment, including supervisory procedures and length of the time the equipment will be used by the individuals in each work week. The proposed periods for use of the equipment by any individual should not be of such duration as would discourage observance by the individual of the proposed procedures.

(d) The average concentrations present in the areas occupied by individuals.

(e) Procedures for bio-assay evaluation of the effectiveness of the proposed protective safeguards.

History: 1979 AACS; 2016 MR 10, Eff. May 25, 2016.

R 325.5209 Orders requiring furnishing of bio-assay services.

Rule 209. Where necessary or desirable in order to aid in determining the extent to which an individual was or may be exposed to concentrations of radioactive material, the department may incorporate license provisions or issue an order requiring a licensee or registrant to make available to the individual appropriate bio-assay services and to furnish a copy of the reports of such services to the department.

History: 1979 AACS..

R 325.5210 Exposure of minors.

Rule 210. (1) A licensee or registrant shall not receive, acquire, possess, use, or transfer sources of radiation in a manner as to cause an individual who is under 18 years of age, to receive in any period of 1 calendar quarter from all sources of radiation in the licensee's or registrant's possession, a dose in excess of 10% of the quarterly occupational limit specified in Rule 205 (e.g. 125 mrems whole body).

(2) A licensee shall not receive, acquire, possess, use, or transfer radioactive material in such a manner as to cause any individual in a restricted area, who is under 18 years of age, to be exposed to airborne radioactive material in an average concentration in excess of the limits specified in table II of appendix A in Rules 261 to 270. For purposes of this subrule, concentrations may be averaged over periods not greater than 1 week (7 consecutive days).

(3) Rule 208 (1) shall apply where an individual is exposed subject to subrule (2) of this rule.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5211 Radiation levels from external sources in unrestricted areas.

Rule 211. (1) Except as authorized by the department pursuant to subrule (2) of this rule, a licensee or registrant shall not receive, acquire, possess, use, or transfer sources of radiation in such a manner as to result in an individual in an unrestricted area receiving a dose in excess of the following:

(a) Two millirems in any 1 hour.

(b) One hundred millirems in any 7 consecutive days.

(c) Five hundred millirems in any 1 year.

(2) A person may apply to the department for proposed limits upon levels of radiation in unrestricted areas in excess of those specified in subrule (1) of this rule resulting from the applicant's possession or use of sources of radiation. The application shall include information as to anticipated average radiation levels and anticipated occupancy times for each unrestricted area involved. The department shall approve the proposed limits if the applicant demonstrates to the satisfaction of the department that the proposed limits are not likely to cause any individual to receive a dose to the whole body in any period of 1 calendar year in excess of 0.5 rem.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5212 Concentrations in effluents to unrestricted areas.

Rule 212. (1) A licensee shall not receive, acquire, possess, use, or transfer licensed material so as to release to an unrestricted area radioactive material in concentrations that exceed the limits specified in table II of appendix A in Rules 261 to 270, except as authorized pursuant to subrule (2) of this rule or Rule 238. For purposes of this rule, concentrations may be averaged over a period not greater than 1 year.

(2) An application for a license or amendment may include proposed limits higher than those specified in subrule (1) of this rule. The department shall approve the proposed limits if the applicant demonstrates both of the following:

(a) The applicant has made a reasonable effort to minimize the radioactivity contained in effluents to unrestricted areas.

(b) It is not likely that radioactive material discharged in the effluent would result in the exposure of an individual to concentrations of radioactive material in air or water exceeding the limits specified in table II of appendix A in Rules 261 to 270.

(3) An application for higher limits pursuant to subrule (2) of this rule shall include information demonstrating that the applicant has made a reasonable effort to minimize the radioactivity discharged in effluents to unrestricted areas, and shall include, as pertinent, the following:

(a) Information as to flow rates, total volume of effluent, peak concentration of each radionuclide in the effluent, and concentration of each radionuclide in the effluent averaged over a period of 1 year at the point where the effluent leaves a stack, tube, pipe, or similar conduit.

(b) A description of the properties of the effluents, including the following:

(i) Chemical composition.

(ii) Physical characteristics, including suspended solids content in liquid effluents, and nature of gas or aerosol for air effluents.

(iii) The hydrogen ion concentrations (pH) of liquid effluents.

(iv) The size range of particulates in effluents released into air.

(c) A description of the anticipated human occupancy in the unrestricted areas where the highest concentration of radioactive material from the effluent is expected, and, in the case of a river or stream, a description of water uses downstream from the point of release of the effluent.

(d) Information as to the highest concentration of each radionuclide in an unrestricted area, including anticipated concentrations averaged over a period of 1 year in the following:

(i) In air at any point of human occupancy.

(ii) In water at points of use downstream from the point of release of the effluent.

(e) The background concentration of radionuclides in the receiving river or stream before the release of liquid effluent.

(f) A description of the environmental monitoring equipment, including sensitivity of the system, and procedures and calculations to determine concentration of radionuclides in the unrestricted area and possible reconcentrating of radionuclides.

(g) A description of the waste treatment facilities and procedures used to reduce the concentration of radionuclides in effluents before their release.

(4) For the purposes of this rule, the concentration limits in table II of appendix A in Rules 261 to 270 apply at the boundary of the restricted area. The concentration of radioactive material discharged through a stack, pipe, or similar conduit may be determined with respect to the point where the material leaves the conduit. If the conduit discharges within the restricted area, the concentration at the boundary may be determined by applying appropriate factors for dilution, dispersion, or decay between the point of discharge and the boundary.

(5) In addition to limiting concentrations in effluent streams, the department may limit quantities of radioactive materials released in air or water during a specified period of time if it appears that the daily intake of radioactive material from air, water, and food by a suitable sample of an exposed population group, averaged over a period not exceeding 1 year, would otherwise exceed the daily intake resulting from continuous exposure to air or water containing 1/3 the concentration of radioactive materials specified in table II of appendix A in Rules 261 to 270.

(6) This rule does not apply to disposal of radioactive material into sanitary sewerage systems, which is governed by Rule 239.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

NOTICES, INSTRUCTIONS, AND REPORTS TO WORKERS; INSPECTIONS

R 325.5213 General information.

Rule 213. Rules 214 to 220 apply to the following:

(a) Establish requirements for notices, instructions and reports by licensees or registrants to individuals engaged in work under a license or registration.

(b) Explain options available to individuals in connection with department investigations of licensees or registrants to ascertain compliance with the act, these rules or orders, licenses or registration certificates issued regarding radiological working conditions. Department investigations include investigations of complaints and routine inspections or compliance investigations.

(c) Apply to all persons who own, receive, acquire, possess, use, or transfer sources licensed by or registered with the department pursuant to part 2.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5214 Posting of notices to workers.

Rule 214. (1) A licensee or registrant shall post current copies of the following documents:

(a) The regulations in this part.

(b) The license, certificate of registration and conditions or documents incorporated by reference and amendments thereto.

(c) The operating procedures applicable to work under the license or registration.

(d) Any notice of violation involving radiological working conditions, proposed imposition of civil penalty, or order issued pursuant to part 1, and any response from the licensee or registrant.

(2) If posting of a document specified in subrule (1)(a), (b) or (c) of this rule is not practicable, the licensee or registrant may post a notice which describes the document and states where it may be examined.

(3) Form RH-100 "Notice to Employees" shall be posted by each licensee or registrant wherever individuals work in or frequent any portion of a restricted area.

(4) Documents, notices, or forms posted pursuant to this rule shall appear in a sufficient number of places to permit individuals engaged in work under the license or registration to observe them on the way to or from any particular work location to which the document applies, shall be conspicuous, and shall be replaced if defaced or altered.

(5) Department documents posted pursuant to subrule(1)(d) of this rule shall be posted within 2 working days after receipt of the documents from the department. The licensee's or registrant's response, if any, shall be posted within 2 working days after dispatch from the licensee or registrant. The documents shall remain posted for a minimum of 5 working days or until action correcting the violation has been completed, whichever is later.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5215 Instructions to workers.

Rule 215. (1) A licensee or registrant shall do the following:

(a) Inform individuals working in or frequenting any portion of a restricted area of the occurrence of radiation or sources of radiation in those portions of the restricted area.

(b) Instruct workers in the following:

(i) The health protection problems associated with exposure to the sources of radiation and in precautions or procedures to minimize exposure.

(ii) The purposes and functions of protective devices employed.

(iii) Appropriate responses to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radiation or radioactive material.

(c) Instruct workers to observe, to the extent within the workers' control, the applicable rules and license or registration conditions for the protection of personnel from exposures to radiation or radioactive material.

(d) Advise workers of reports of radiation dose that they may request pursuant to Rule 216.

(e) Inform workers of their responsibility to report promptly to licensee or registrant any condition which may lead to or cause the following:

(i) A violation of department rules, licenses, or registration certificates.

(ii) Unnecessary exposure to radiation or radioactive material.

(2) The extent of instructions required by this rule shall be commensurate with potential radiological health protection problems in the restricted area.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5216 Notifications and reports to individuals.

Rule 216. (1) Radiation exposure data for an individual and the results of any measurements, analyses, and calculations of radioactive material deposited or retained in the body of an individual shall be reported to the individual as specified in this rule. The information reported shall include data and results obtained pursuant to rules or orders, or license or registration conditions, as shown in records maintained by the licensee or registrant pursuant to rules. Each notification and report shall meet the following requirements:

(a) Be in writing.

(b) Include appropriate identifying data such as the name of the licensee or registrant, the name of the individual, and the individual's social security number.

(c) Include the individual's exposure information.

(d) Contain the following statement:

"This report is furnished to you under the provisions of Part 5 of the Michigan Department of Environmental Quality rules entitled 'Standards for Protection Against Radiation'. You should preserve this report for future reference."

(2) At the request of any worker, employed by or associated with him or her, a licensee or registrant shall advise the worker annually of the worker's exposure to radiation or radioactive material as shown in records maintained by the licensee or registrant pursuant to Rule 245.

(3) At the request of a worker formerly engaged in work controlled by the licensee or the registrant, a licensee or registrant shall furnish to the worker a report of the worker's exposure to radiation or radioactive material. The report shall meet the following requirements:

(a) Be furnished within 30 days from the time the request is made, or within 30 days after the exposure of the individual has been determined by the licensee or registrant, whichever is later.

(b) Cover, within the period of time specified in the request, each calendar quarter in which the worker's activities involved exposure to radiation from radioactive material licensed by, or registered with, the department.

(c) Include the dates and locations of work under the license or registration certificate in which the worker participated during this period.

(4) When a licensee or registrant is required pursuant to Rule 250 to report to the department any exposure of an individual to radiation or radioactive material, the licensee or the registrant shall also provide the individual a report on his or her exposure data included therein. Reports shall be transmitted at a time not later than the transmittal to the department.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5217 Presence of representatives of licensees or registrants and workers during investigations.

Rule 217. (1) A licensee or registrant shall afford opportunity to a department representative, at all reasonable times, to inspect or investigate materials, machines, activities, facilities, premises, and records pursuant to these rules.

(2) A licensee or registrant, or his or her authorized representative, may accompany a department representative during all phases of an investigation except during consultation with workers as specified in Rule 218.

(3) If, at the time of investigation, an individual has been authorized by the workers to represent them during department investigations, the licensee or registrant shall notify the department representative of such authorization and shall give the workers' representative an opportunity to accompany the department representative during the investigation of physical working conditions.

(4) Each worker's representative shall be routinely engaged in work under control of the licensee or registrant and shall have received instructions as specified in Rule 215.

(5) Different representatives of licensees or registrants and workers may accompany the department representative during different phases of an investigation if there is no resulting interference with the conduct of the investigation. However, only 1 workers' representative at a time may accompany the department representative.

(6) With the approval of the licensee or registrant and the worker's representative, an individual who is not routinely engaged in work under control of the licensee or registrant, for example a consultant to the licensee or registrant or to the workers' representative, shall be afforded the opportunity to accompany the department representative during the investigation of physical working conditions.

(7) Notwithstanding the other provisions of this rule, a department representative may refuse to permit accompaniment by any individual who deliberately interferes with a fair and orderly investigation. With regard to any area containing proprietary information, the workers' representative for that area shall be an individual previously authorized by the licensee or registrant to enter that area.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5218 Consultation with workers during investigations.

Rule 218. (1) A department representative may consult privately with workers concerning matters of occupational radiation protection and other matters related to applicable provisions of rules and licenses to the extent the department representative deems necessary for the conduct of an effective and thorough investigation.

(2) During an investigation, a worker or authorized representative may bring privately to the attention of the department representative, either orally or in writing, any past or present condition that he or she has reason to believe may have contributed to or caused the following:

(a) A violation of the act, these rules or license or registration conditions.

(b) An unnecessary exposure of an individual to radiation from radioactive material under the licensee's or registrant's control.

(3) A written notice presented pursuant to subrule (2) of this rule shall comply with requirements of Rule 219(1).

(4) The provisions of subrule (2) of this rule shall not be interpreted as authorization to disregard instructions provided pursuant to Rule 215.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5219 Requests by workers for investigations.

Rule 219. (1) A worker or representative of workers who believes that a violation of the act, these rules, or license or registration conditions exists or has occurred in work under a license or registration with regard to radiological working conditions in which the worker is engaged, may request an investigation by giving notice of the alleged violation to the department. Any notice shall be in writing, shall set forth the specific grounds for the notice, and shall be signed by the worker or representative of the workers. A copy shall be provided to the licensee or registrant by the department no later than at the time of investigation except that, upon the request of the worker giving notice, his or her name and the name of individuals referred to therein shall not appear in such copy or on any record published, released, or made available by the department, except for good cause shown.

(2) If, upon receipt of notice, the department determines that the complaint meets the requirements in subrule (1) of this rule and that there are reasonable grounds to believe that the alleged violations exists or has occurred, the department shall investigate as soon as practicable, to determine if such alleged violation exists or has occurred. An investigation pursuant to this rule need not be limited to matters referred to in the complaint.

(3) A licensee or registrant shall not discharge or in any manner discriminate against a worker because a worker has filed a complaint or instituted or caused to be instituted any proceeding under these rules or has testified, or is about to testify, in any proceeding or because of the exercise by a worker on behalf of himself or herself or others of any option afforded by this part.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5220 Investigation not warranted; informal review.

Rule 220. (1) If the department determines, with respect to a complaint under Rule 219, that an investigation is not warranted because there are no reasonable grounds to believe that a violation exists or has occurred, the complainant shall be notified in writing of such determination. The complainant may obtain review of such determination by submitting a written statement of position with the director of the department who shall provide the licensee or registrant with a copy of the statement by registered mail, excluding, at the request of the complainant, the name of the complainant. The licensee or registrant may submit an opposing written statement of position with the director of the department who will provide the complainant with a copy of the statement by registered mail. Upon the request of the complainant, the department may hold an informal conference in which the complainant and the licensee or registrant may orally present his or her views. An informal conference may also be held at the request of the licensee or registrant, but disclosure of the identity of the complainant shall be made only following receipt of written authorization from the complainant. After considering all written or oral views presented, the director of the department, or his or her designated representative, shall affirm, modify, or reverse the determination of the department and furnish the complainant and the licensee or registrant a written notification of his or her decision and the reason.

(2) If the department determines that an investigation is not warranted because the requirements of Rule 219 (1) have not been met, the department shall notify the complainant in writing of the determination. The determination shall be without prejudice to the filing of a new complaint meeting the requirements of Rule 219 (1).

(3) If the decision resulting from informal review is contested, the department shall proceed

pursuant to Rule 2 (2).

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

PRECAUTIONARY PROCEDURES

R 325.5221 Surveys.

Rule 221. (1) As used in this rule, "survey" means a critical evaluation of a facility or area incident to the production, use, release, disposal, or presence of sources of radiation under a specific set of conditions to determine actual or potential radiation hazards. When appropriate, the evaluation includes tests, physical examination, source inventory and accountability, and measurements of levels of radiation or concentration of radioactive material present.

(2) Each licensee or registrant shall make or cause to be made surveys as may be necessary to establish compliance with these rules.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5222 Personnel monitoring.

Rule 222. (1) Each licensee or registrant shall supply appropriate personnel monitoring equipment to, shall require the use of such equipment by, and shall demonstrate compliance pursuant to this rule for the following:

(a) Each individual under such circumstances that he or she receives, or is likely to receive, a dose in any calendar quarter in excess of 25% of the quarterly occupational limit specified in Rule 205, (e.g. 300 mrems whole body).

(b) Each individual under 18 years of age under such circumstances that he or she receives, or is likely to receive, a dose in any calendar quarter in excess of 5% of the quarterly occupational limit specified in Rule 205, (e.g. 60 mrems whole body).

(c) Each individual, except a patient being intentionally irradiated, who enters a high radiation area.

(d) Each individual who is likely to receive a dose in excess of 100 millirems in any 5 consecutive days while in a room or area occupied by a patient while the patient is receiving therapy from any gamma-emitting radioactive material.

(e) Each individual for whom personnel monitoring is specifically required under other parts of these rules pertaining to specific uses of sources of radiation.

(2) Monitoring devices used to estimate whole body exposure shall normally be worn on the chest or abdomen. The dosimeter assigned for monitoring the trunk of the body shall not be used for any other purposes. If monitoring of other areas of the body (e.g. lens of the eye, extremity) is required by these rules or requested by the radiation worker because of the nature of exposure, a separate dosimeter shall be assigned for this purpose. The separate dosimeter shall be designated as an auxiliary dosimeter and the radiation record shall specify the specific area monitored.

(3) If auxiliary dosimeters are assigned in accordance with subrule (2) of this rule, the specific body area shall be monitored for a minimum 13 consecutive weeks. If this monitoring results in recorded exposures in excess of 25% of the applicable specified quarterly limit in Rule 205 (e.g. 300

mrems lens of the eye, 6.25 rems hands), the auxiliary dosimeter shall be permanently assigned to monitor that area.

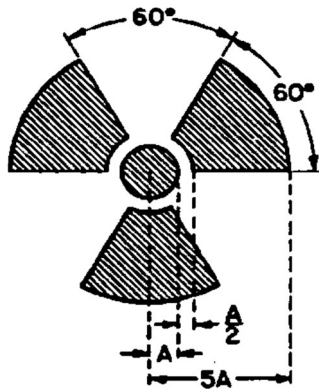
History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5224 Caution signs, labels, and signals.

Rule 224. (1) Except as otherwise authorized by the department, symbols prescribed by Rules 224 to 231 shall use the conventional radiation caution colors (magenta or purple on yellow background). The symbol prescribed is the conventional three-bladed design as follows:

RADIATION SYMBOL

1. Cross-hatched area is to be magenta or purple.
2. Background is to be yellow.



(2) In addition to the contents of signs and labels prescribed in Rules 224 to 231, a licensee or registrant may provide on or near these signs and labels any additional information which may be appropriate in aiding individuals to minimize being exposed to radiation.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5225 Radiation area signs.

Rule 225. Each radiation area shall be conspicuously posted with 1 or more signs bearing the radiation caution symbol and the following words:

History: 1979 AACS; 2016 MR 10, Eff. May 25, 2016.

CAUTION: RADIATION AREA

R 325.5226 High radiation area signs.

Rule 226. Each high radiation area shall be conspicuously posted with 1 or more signs bearing the radiation caution symbol and the following words:

History: 1979 AACS; 2016 MR 10, Eff. May 25, 2016.

CAUTION: HIGH RADIATION AREA

R 325.5227 Controls for access to high radiation areas.

Rule 227. (1) Each entrance or access point to a high radiation area shall be equipped with a control device that complies with 1 of the following:

(a) It causes that level of radiation to be reduced below that at which an individual might receive a dose of 100 millirems in 1 hour upon entry into the area.

(b) It energizes a conspicuous visible and audible alarm signal in such a manner that the individual entering the high radiation area and the licensee, registrant, or a supervisor of the activity are made aware of the entry.

(c) It is locked, except during periods when access to the area is required, with positive control over each individual entry.

(2) Controls shall be established in such a way that an individual will not be prevented from leaving a high radiation area.

(3) The controls required by subrule (1) (a) of this rule shall be constructed in such a manner that the primary radiation cannot be reactivated until all entrances have been secured, and the radiation on-off control is reset at the control panel.

(4) The controls required by subrule (1) (b) of this rule shall be constructed in such a manner that when the warning device is activated, it is necessary to shut off or secure the source of radiation and secure all tripped entrances before being able to inactivate the alarm system.

(5) In the case of a high radiation area established for a period of 30 days or less, direct surveillance to prevent unauthorized entry may be substituted for the controls required by this rule.

(6) A licensee, registrant, or applicant for a license or registration, may apply to the department for approval of methods not included in subrules (1) and (5) of this rule for controlling access to high radiation areas. The department may approve the proposed alternatives if the licensee, registrant, or applicant demonstrates that the alternative methods of control will prevent unauthorized entry into a high radiation area, and that the requirement of subrule (2) of this rule is met.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5228 Airborne radioactivity area signs.

Rule 228. (1) As used in this rule, “airborne radioactivity area” means a room, enclosure, or operating area in which airborne radioactive material exists in concentrations in excess of the amounts specified in column 1, table I of Rules 261 to 269 or a room, enclosure, or operating area in which airborne radioactive material exists in concentrations which, averaged over the number of hours in any week during which individuals are in the area, exceed 25% of the amounts specified in column 1, table I of Rules 261 to 269.

(2) Each airborne radioactivity area shall be conspicuously posted with 1 or more signs bearing the radiation caution symbol and the following words:

**CAUTION
AIRBORNE RADIOACTIVITY AREA**

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5229 Area and room signs.

Rule 229. (1) Each area or room in which any radioactive material, other than natural uranium or thorium, is used or stored in an amount exceeding 10 times the quantity of radioactive material specified in Rule 271 shall be conspicuously posted with 1 or more signs bearing the radiation caution symbol and the following words:

**CAUTION
RADIOACTIVE MATERIAL**

(2) Each area or room in which natural uranium or thorium is used or stored in an amount exceeding 100 times the quantity specified in Rule 271 shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the following words:

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5230 Container labels.

Rule 230. (1) Except as provided in subrule (3) of this rule each container of radioactive material shall bear a durable, clearly visible label identifying the radioactive contents.

(2) The label required shall bear the radiation caution symbol and the following words:

**CAUTION
RADIOACTIVE MATERIAL**

It shall also provide sufficient information (including as appropriate, radiation levels, kinds of material, estimate of activity, date for which activity is estimated, and the like) to permit individuals handling or using the containers, or working in their vicinity to take precautions to avoid or minimize being exposed.

(3) Notwithstanding subrule (1) of this rule, labeling is not required for the following:

(a) Containers that do not contain radioactive materials in quantities greater than the applicable quantities listed in Rule 271.

(b) Containers that contain only natural uranium or thorium in quantities no greater than 10 times the applicable quantities listed in Rule 271.

(c) Containers that do not contain radioactive materials in concentrations greater than the applicable concentrations listed in column 2, table I, of appendix A in Rules 261 to 269.

(d) Containers that are attended by an individual who takes the precautions necessary to prevent any individual from being exposed to radiation or radioactive materials in excess of the limits established by this part.

(e) Containers that are in transport and packaged and labeled in accordance with regulations published by the United States Department of Transportation.

(f) Containers that are accessible only to individuals authorized to handle or use them (for example, containers in locations such as water-filled canals, storage vaults, or hot cells) or to work in the vicinity thereof, if the contents are identified to such individuals by a readily available

written record.

(g) Manufacturing and process equipment such as nuclear reactors, reactor components piping, and tanks.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5231 Alternate wording for warning signs.

Rule 231. The word DANGER may be used instead of CAUTION in a warning sign required by Rules 225, 226, 228, 229, and 230.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5232 Rescinded.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5233 Exemptions from posting and labeling requirements.

Rule 233. Notwithstanding Rules 225 to 230, the following apply:

(a) A room or other area containing radioactive material for periods of less than 8 hours is not required to be posted with a caution sign if either of the following apply:

(i) The material is constantly attended during these periods by an individual who shall take the precautions necessary to prevent any individual from being exposed to radiation or radioactive material in excess of the limits established in this part.

(ii) The room or area is subject to the licensee's or registrant's control.

(b) A room or other area is not required to be posted with a caution sign, and control is not required for each entrance or access point to a room or other area that is a high radiation area, solely because of the presence of radioactive material prepared for transport and packaged and labeled in accordance with regulations of the United States Department of Transportation.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5236 Storage of sources and procedures for receiving and opening of packages.

Rule 236. (1) Sources of radiation shall be secured against unauthorized removal from the place of storage.

(2) A licensee shall establish and maintain procedures for safely opening packages in which licensed material is received, and the licensee shall assure that such procedures are followed and due consideration is given to special instructions for the type of package being opened.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5237 Surface contamination.

Rule 237. (1) Pursuant to Rule 221, a licensee or registrant shall conduct surveys and

measurements of radioactive surface contamination of facilities, equipment, and other property that may be contaminated. With regard to radioactive surface contamination, the philosophy and goal stated in Rule 201(2) may be considered presently satisfied by following the guidance in Rule 272.

(2) A facility, installation, equipment, or other property shall not be assigned, sold, leased, or transferred to an unlicensed person unless the property has been decontaminated below the applicable limits specified in Rule 272.

(3) The guidance in Rule 272 may be modified at the discretion of the department in any specific situation involving a specific radionuclide.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5238 Disposal of radioactive material.

Rule 238. (1) A licensee shall not dispose of any radioactive material except for either of the following:

(a) By transfer to an authorized recipient as provided in Rule 123.

(b) As authorized pursuant to subrule (2) of this rule or Rule 212, 239, or 240.

(2) A person may apply to the department for approval of proposed procedures to dispose of radioactive material in a manner not otherwise authorized in this part. The application shall include a description of the radioactive material, including the quantities and kinds of radioactive material and the levels of radioactivity involved, and the proposed manner and conditions of disposal. The application, where appropriate, should also include an analysis and evaluation of pertinent information as to the nature of the environment, including topographical, geological, meteorological, and hydrological characteristics; usage of ground and surface waters in the general area; the nature and location of other potentially affected facilities; and procedures to be observed to minimize the risk of unexpected or hazardous exposures.

(3) The department shall not approve an application for a license to receive radioactive material from other persons for disposal on land not owned by a state or the federal government.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5239 Disposal by release into sanitary sewerage systems.

Rule 239. (1) A licensee shall not discharge radioactive material into a sanitary sewerage system unless all of the following conditions exist:

(a) It is readily soluble or dispersible in water.

(b) The quantity of any radioactive material released into the system by the licensee in any 1 day does not exceed the larger of the following:

(i) The quantity which, if diluted by the average daily quantity of sewage released into the sewer by the licensee, will result in an average concentration not greater than the limits specified in column 2, table I, of Rules 261 to 269.

(ii) Ten times the quantity of such material specified in Rule 271.

(c) The quantity of any radioactive material released in any 1 month, if diluted by the average monthly quantity of water released by the licensee, will not result in an average concentration exceeding the limits specified in column 2, table I, of Rules 261 to 269.

(d) The gross quantity of radioactive material released into the sewerage system by the licensee does not exceed 1 curie per year.

(2) Excreta from individuals undergoing medical diagnosis or therapy with radioactive material shall be exempt from any limitations contained in this rule.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5240 Disposal by burial in soil or incineration.

Rule 240. (1) Burial sites shall be licensed by the department upon application submitted in accordance with Rules 101 and 102. Burial shall be in a controlled area.

(2) A licensee shall not incinerate radioactive material for the purpose of disposal or preparation for disposal except as specifically approved by the department pursuant to Rules 212 and 238.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5241 Use of safety equipment.

Rule 241. (1) Requirements for safety interlocks, protective enclosures, protective clothing, precautionary labels, or any other safety equipment presumes the proper use of such equipment. Unauthorized override of safety interlocks or other intentional misuse or non-use of required safety equipment shall be considered willful violation of these rules.

(2) The radiation supervisor shall request, in writing, from the department, authorization to override safety interlocks. The request shall include justification, precautionary procedures during override, and statement of immediate supervision by the radiation protection supervisor or his or her authorized representative. Prior approval by the department is required. Approval may be granted by written condition on the specific license or registration certificate or by telephone followed by written confirmation from the department.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

RECORDS, REPORTS AND NOTIFICATION

R 325.5245 Records of surveys, radiation monitoring, disposal, and tests.

Rules 245. (1) A licensee or registrant shall maintain records showing the radiation doses of all individuals for whom personnel monitoring is required under Rule 222. Records shall be kept on department Form RH-102, in accordance with the instructions contained in that form, or on clear and legible records containing all the information required by Form RH-102. The doses entered on the forms or records shall be for periods of time not exceeding 1 calendar quarter.

(2) A licensee or registrant shall maintain records in the same units used in this part, showing the results of surveys required in Rule 221, disposals made under Rules 238 to 240, and surveys required by other parts of these rules.

(3) Records of individual exposure to radiation and to radioactive material that is maintained

pursuant to subrule (1) of this rule and records of bio-assays, including results of whole body counting examinations, made pursuant to Rule 209 shall be preserved indefinitely or until the department authorizes their disposal.

(4) The discontinuance or curtailment of activities does not relieve the licensee or registrant of responsibility for retaining all records required by this rule. A licensee or registrant may, however, request the department to accept such records. The acceptance of the records by the department relieves the licensee or registrant of subsequent responsibility only in respect to its preservation as required by this rule.

(5) Records that are maintained pursuant to this part may be maintained in the form of microfilms.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5246 Reports of theft or loss of sources of radiation.

Rule 246. A licensee or registrant shall report by telephone and facsimile to the department the theft or loss of any source of radiation immediately after such occurrence becomes known to the licensee or registrant.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5247 Notification of incidents.

Rule 247. (1) A licensee or registrant shall immediately notify the department by telephone and facsimile if any incident involving any source of radiation possessed by him or her and that may have caused or threatens to cause any of the following:

(a) A dose to the whole body of any individual of 25 rems or more of radiation; a dose to the skin of the whole body of any individual of 150 rems or more of radiation; or a dose to the feet, ankles, hands, or forearms of any individual of 375 rems or more of radiation.

(b) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 5,000 times the limits specified for such materials in table II of Rules 261 to 269.

(c) A loss of 1 working week or more of the operation of any facilities affected due to contamination or other potential hazard from radioactive material.

(d) Damage to property in excess of \$100,000.00.

(2) A licensee or registrant shall within 24 hours notify the department by telephone and facsimile of any incident involving any source of radiation possessed by him or her and that may have caused or threatens to cause any of the following:

(a) A dose to the whole body of any individual of 5 rems or more of radiation; a dose to the skin of the whole body of any individual of 30 rems or more of radiation; or a dose to the feet, ankles, hands or forearms of 75 rems or more of radiation.

(b) The release of radioactive material in concentrations that, if averaged over a period of 24 hours, would exceed 500 times the limits specified for such materials in table II of Rules 261 to 269.

(c) A loss of 1 day or more of the operation of any facilities affected or damage to property in excess of \$1,000.00 due to contamination or other potential hazard from radioactive material.

(3) A report filed with the department pursuant to this rule shall be prepared in such a manner that names of individuals who have received exposure to radiation are stated in a separate part of the report.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5250 Reports of overdose and excessive levels and concentrations.

Rule 250. (1) In addition to any notification required by Rule 247 a licensee or registrant shall report all of the following in writing within 30 days to the department:

(a) Each radiation dose received by an individual or concentrations of radioactive material in excess of any applicable limit as set forth in this part or as otherwise approved by the department.

(b) Each incident for which notification is required by Rule 247.

(c) Levels of radiation or concentrations of radioactive material (not involving excessive exposure of any individual) in an unrestricted area in excess of 10 times any applicable limit as set forth in this part or as otherwise approved by the department.

(2) A report required in subrule (1) of this rule shall describe the extent of radiation dose received by individuals or exposure to radioactive material, including estimates of each individual's dose as required by subrule (3) of this rule; levels of radiation and concentrations of radioactive material involved; the cause of exposure, levels, or concentrations; and corrective steps taken or planned to assure against a recurrence.

(3) A report filed with the department pursuant to subrule (1) of this rule shall include for each individual exposed the name, social security number, and date of birth, and an estimate of the individual's dose. The report shall be prepared so that this information is stated in a separate part of the report.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5253 Vacating premises.

Rule 253. A specific licensee, not less than 20 days before vacating or relinquishing possession or control of premises that may have been contaminated with radioactive material as a result of his or her activities, shall notify the department in writing of intent to vacate. When deemed necessary by the department, the licensee shall decontaminate or have decontaminated the premises in a manner required by the department.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

TRANSPORTATION

R 325.5255 Intrastate transportation of radioactive materials.

Rule 255. (1) A licensee shall not transport any radioactive material outside of the confines of his or her plant or other authorized location of use, or deliver any radioactive material to a carrier

for transportation, unless the licensee complies with 10 CFR Parts 20, 71; 14 CFR Part 103; 46 CFR Part 146; and 49 CFR Parts 173-179 to the same extent as if the transportation were subject to the rules and regulations of that agency.

(2) This rule applies to both of the following:

(a) The transportation of radioactive material.

(b) The delivery of radioactive material to a carrier for transportation that is not subject to the rules and regulations of the United States Department of Transportation and other agencies of the United States.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5256 Rescinded.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5261 Appendix A1. Concentrations in air and water above natural background.

Elements A and B.

Rule 261. (See notes in Rule 270.)

Element (atomic number)	Radionuclide*		TABLE I		TABLE II	
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)
Actinium (89)	Ac-227	S	2×10^{-12}	6×10^{-5}	8×10^{-14}	2×10^{-6}
		I	3×10^{-11}	9×10^{-3}	9×10^{-13}	3×10^{-4}
	Ac-228	S	8×10^{-8}	3×10^{-3}	3×10^{-9}	9×10^{-5}
		I	2×10^{-8}	3×10^{-3}	6×10^{-10}	9×10^{-5}
Americium (95)	Am-241	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	Am-242m	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		I	3×10^{-10}	3×10^{-3}	9×10^{-12}	9×10^{-5}
	Am-242	S	4×10^{-8}	4×10^{-3}	1×10^{-9}	1×10^{-4}
		I	5×10^{-8}	4×10^{-3}	2×10^{-9}	1×10^{-4}
	Am-243	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	Am-244	S	4×10^{-6}	1×10^{-1}	1×10^{-7}	5×10^{-3}
		I	2×10^{-5}	1×10^{-1}	8×10^{-7}	5×10^{-3}
Antimony (51)	Sb-122	S	2×10^{-7}	8×10^{-4}	6×10^{-9}	3×10^{-5}
		I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
	Sb-124	S	2×10^{-7}	7×10^{-4}	5×10^{-9}	2×10^{-5}
		I	2×10^{-8}	7×10^{-4}	7×10^{-10}	2×10^{-5}
	Sb-125	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	3×10^{-8}	3×10^{-3}	9×10^{-10}	1×10^{-4}
Argon (18)	A-37	Sub**	6×10^{-3}	-----	1×10^{-4}	-----
	A-41	Sub	2×10^{-6}	-----	4×10^{-8}	-----

Element (atomic number)	Radionuclide*		TABLE I		TABLE II	
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)
Arsenic (33)	As-73	S	2×10^{-6}	1×10^{-2}	7×10^{-8}	5×10^{-4}
		I	4×10^{-7}	1×10^{-2}	1×10^{-8}	5×10^{-4}
	As-74	S	3×10^{-7}	2×10^{-3}	1×10^{-8}	5×10^{-5}
		I	1×10^{-7}	2×10^{-3}	4×10^{-9}	5×10^{-5}
	As-76	S	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
		I	1×10^{-7}	6×10^{-4}	3×10^{-9}	2×10^{-5}
As-77	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}	
	I	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}	
Astatine (85)	At-211	S	7×10^{-9}	5×10^{-5}	2×10^{-10}	2×10^{-6}
		I	3×10^{-8}	2×10^{-3}	1×10^{-9}	7×10^{-5}
Barium (56)	Ba-131	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
		I	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-4}
	Ba-140	S	1×10^{-7}	8×10^{-4}	4×10^{-9}	3×10^{-5}
		I	4×10^{-8}	7×10^{-4}	1×10^{-9}	2×10^{-5}
Berkelium (97)	Bk-249	S	9×10^{-10}	2×10^{-2}	3×10^{-11}	6×10^{-4}
		I	1×10^{-7}	2×10^{-2}	4×10^{-9}	6×10^{-4}
	Bk-250	S	1×10^{-7}	6×10^{-3}	5×10^{-9}	2×10^{-4}
		I	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}
Beryllium (4)	Be-7	S	6×10^{-6}	5×10^{-2}	2×10^{-7}	2×10^{-3}
		I	1×10^{-6}	5×10^{-2}	4×10^{-8}	2×10^{-3}
Bismuth (83)	Bi-206	S	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
		I	1×10^{-7}	1×10^{-3}	5×10^{-9}	4×10^{-5}
	Bi-207	S	2×10^{-7}	2×10^{-3}	6×10^{-9}	6×10^{-5}
		I	1×10^{-8}	2×10^{-3}	5×10^{-10}	6×10^{-5}
	Bi-210	S	6×10^{-9}	1×10^{-3}	2×10^{-10}	4×10^{-5}
		I	6×10^{-9}	1×10^{-3}	2×10^{-10}	4×10^{-5}
	Bi-212	S	1×10^{-7}	1×10^{-2}	3×10^{-9}	4×10^{-4}
		I	2×10^{-7}	1×10^{-2}	7×10^{-9}	4×10^{-4}
Bromine (35)	Br-82	S	1×10^{-6}	8×10^{-3}	4×10^{-8}	3×10^{-4}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

**R 325.5262 Appendix A2. Concentrations in air and water above natural background.
Elements C.**

Rule 262. (See notes in Rule 270.)

Element (atomic number)	Radionuclide*		TABLE I		TABLE II	
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)
Cadmium (48)	Cd-109	S	5×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
		I	7×10^{-8}	5×10^{-3}	3×10^{-9}	2×10^{-4}
	Cd-115m	S	4×10^{-8}	7×10^{-4}	1×10^{-9}	3×10^{-5}
		I	4×10^{-8}	7×10^{-4}	1×10^{-9}	3×10^{-5}

Element (atomic number)	Radionuclide*		TABLE I		TABLE II		
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	
	Cd-115	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	3×10^{-5}	
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}	
Calcium (20)	Ca-45	S	3×10^{-8}	3×10^{-4}	1×10^{-9}	9×10^{-6}	
		I	1×10^{-7}	5×10^{-3}	4×10^{-9}	2×10^{-4}	
	Ca-47	S	2×10^{-7}	1×10^{-3}	6×10^{-9}	5×10^{-5}	
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	3×10^{-5}	
Californium (98)	Cf-249	S	2×10^{-12}	1×10^{-4}	5×10^{-14}	4×10^{-6}	
		I	1×10^{-10}	7×10^{-4}	3×10^{-12}	2×10^{-5}	
	Cf-250	S	5×10^{-12}	4×10^{-4}	2×10^{-13}	1×10^{-5}	
		I	1×10^{-10}	7×10^{-4}	3×10^{-12}	3×10^{-5}	
	Cf-251	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	4×10^{-6}	
		I	1×10^{-10}	8×10^{-4}	3×10^{-12}	3×10^{-5}	
	Cf-252	S	6×10^{-12}	2×10^{-4}	2×10^{-13}	7×10^{-6}	
		I	3×10^{-11}	2×10^{-4}	1×10^{-12}	7×10^{-6}	
	Cf-253	S	8×10^{-10}	4×10^{-3}	3×10^{-11}	1×10^{-4}	
		I	8×10^{-10}	4×10^{-3}	3×10^{-11}	1×10^{-4}	
	Cf-254	S	5×10^{-12}	4×10^{-6}	2×10^{-13}	1×10^{-7}	
		I	5×10^{-12}	4×10^{-6}	2×10^{-13}	1×10^{-7}	
Carbon (6)	C-14	S	4×10^{-6}	2×10^{-2}	1×10^{-7}	8×10^{-4}	
	(CO ₂)	Sub**	5×10^{-5}	-----	1×10^{-6}	-----	
Cerium (58)	Ce-141	S	4×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}	
		I	2×10^{-7}	3×10^{-3}	5×10^{-9}	9×10^{-5}	
	Ce-143	S	3×10^{-7}	1×10^{-3}	9×10^{-9}	4×10^{-5}	
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}	
	Ce-144	S	1×10^{-8}	3×10^{-4}	3×10^{-10}	1×10^{-5}	
		I	6×10^{-9}	3×10^{-4}	2×10^{-10}	1×10^{-5}	
Cesium (55)	Cs-131	S	1×10^{-5}	7×10^{-2}	4×10^{-7}	2×10^{-3}	
		I	3×10^{-6}	3×10^{-2}	1×10^{-7}	9×10^{-4}	
	Cs-134m	S	4×10^{-5}	2×10^{-1}	1×10^{-6}	6×10^{-3}	
		I	6×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-3}	
	Cs-134	S	4×10^{-8}	3×10^{-4}	1×10^{-9}	9×10^{-6}	
		I	1×10^{-8}	1×10^{-3}	4×10^{-10}	4×10^{-5}	
	Cs-135	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}	
		I	9×10^{-8}	7×10^{-3}	3×10^{-9}	2×10^{-4}	
	Cs-136	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	9×10^{-5}	
		I	2×10^{-7}	2×10^{-3}	6×10^{-9}	6×10^{-5}	
	Cs-137	S	6×10^{-8}	4×10^{-4}	2×10^{-9}	2×10^{-5}	
		I	1×10^{-8}	1×10^{-3}	5×10^{-10}	4×10^{-5}	
	Chlorine (17)	Cl-36	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
			I	2×10^{-8}	2×10^{-3}	8×10^{-10}	6×10^{-5}
Cl-38		S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}	
		I	2×10^{-6}	1×10^{-2}	7×10^{-8}	4×10^{-4}	
Chromium (24)	Cr-51	S	1×10^{-5}	5×10^{-2}	4×10^{-7}	2×10^{-3}	
		I	2×10^{-6}	5×10^{-2}	8×10^{-8}	2×10^{-3}	
Cobalt (27)	Co-57	S	3×10^{-6}	2×10^{-2}	1×10^{-7}	5×10^{-4}	

Element (atomic number)	Radionuclide*		TABLE I		TABLE II		
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	
	Co-58m	I	2×10^{-7}	1×10^{-2}	6×10^{-9}	4×10^{-4}	
		S	2×10^{-5}	8×10^{-2}	6×10^{-7}	3×10^{-3}	
		I	9×10^{-6}	6×10^{-2}	3×10^{-7}	2×10^{-3}	
	Co-58	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}	
		I	5×10^{-8}	3×10^{-3}	2×10^{-9}	9×10^{-5}	
	Co-60	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	5×10^{-5}	
		I	9×10^{-9}	1×10^{-3}	3×10^{-10}	3×10^{-5}	
Copper (29)	Cu-64	S	2×10^{-6}	1×10^{-2}	7×10^{-8}	3×10^{-4}	
		I	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}	
Curium (96)	Cm-242	S	1×10^{-10}	7×10^{-4}	4×10^{-12}	2×10^{-5}	
		I	2×10^{-10}	7×10^{-4}	6×10^{-12}	2×10^{-5}	
	Cm-243	S	6×10^{-12}	1×10^{-4}	2×10^{-13}	5×10^{-6}	
		I	1×10^{-10}	7×10^{-4}	3×10^{-12}	2×10^{-5}	
	Cm-244	S	9×10^{-12}	2×10^{-4}	3×10^{-13}	7×10^{-6}	
		I	1×10^{-10}	8×10^{-4}	3×10^{-12}	3×10^{-5}	
	Cm-245	S	5×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}	
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}	
	Cm-246	S	5×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}	
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}	
	Cm-247	S	5×10^{-12}	1×10^{-4}	2×10^{-13}	4×10^{-6}	
		I	1×10^{-10}	6×10^{-4}	4×10^{-12}	2×10^{-5}	
		Cm-248	S	6×10^{-13}	1×10^{-5}	2×10^{-14}	4×10^{-7}
			I	1×10^{-11}	4×10^{-5}	4×10^{-13}	1×10^{-6}
Cm-249		S	1×10^{-5}	6×10^{-2}	4×10^{-7}	2×10^{-3}	
		I	1×10^{-5}	6×10^{-2}	4×10^{-7}	2×10^{-3}	

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5263 Appendix A3. Concentrations in air and water above natural background.

Elements D to H.

Rules 263. (See notes in Rule 270.)

Element (atomic number)	Radionuclide*		TABLE I		TABLE II	
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)
Dysprosium (66)	Dy-165	S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}
		I	2×10^{-6}	1×10^{-2}	7×10^{-8}	4×10^{-4}
	Dy-166	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}
Einsteinium (99)	Es-253	S	8×10^{-10}	7×10^{-4}	3×10^{-11}	2×10^{-5}
		I	6×10^{-10}	7×10^{-4}	2×10^{-11}	2×10^{-5}
	Es-254m	S	5×10^{-9}	5×10^{-4}	2×10^{-10}	2×10^{-5}

Element (atomic number)	Radionuclide*		TABLE I		TABLE II	
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)
	Es-254	I	6×10^{-9}	5×10^{-4}	2×10^{-10}	2×10^{-5}
		S	2×10^{-11}	4×10^{-4}	6×10^{-13}	1×10^{-5}
	Es-255	I	1×10^{-10}	4×10^{-4}	4×10^{-12}	1×10^{-5}
		S	5×10^{-10}	8×10^{-4}	2×10^{-11}	3×10^{-5}
		I	4×10^{-10}	8×10^{-4}	1×10^{-11}	3×10^{-5}
Erbium (68)	Er-169	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
		I	4×10^{-7}	3×10^{-3}	1×10^{-8}	9×10^{-5}
	Er-171	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Europium (63)	Eu-152 ($T_{1/2}=9.2$ hrs)	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	Eu-152 ($T_{1/2}=13$ yrs)	S	1×10^{-8}	2×10^{-3}	4×10^{-10}	8×10^{-5}
		I	2×10^{-8}	2×10^{-3}	6×10^{-10}	8×10^{-5}
	Eu-154	S	4×10^{-9}	6×10^{-4}	1×10^{-10}	2×10^{-5}
		I	7×10^{-9}	6×10^{-4}	2×10^{-10}	2×10^{-5}
	Eu-155	S	9×10^{-8}	6×10^{-3}	3×10^{-9}	2×10^{-4}
		I	7×10^{-8}	6×10^{-3}	3×10^{-9}	2×10^{-4}
Fermium (100)	Fm-254	S	6×10^{-8}	4×10^{-3}	2×10^{-9}	1×10^{-4}
		I	7×10^{-8}	4×10^{-3}	2×10^{-9}	1×10^{-4}
	Fm-255	S	2×10^{-8}	1×10^{-3}	6×10^{-10}	3×10^{-5}
		I	1×10^{-8}	1×10^{-3}	4×10^{-10}	3×10^{-5}
	Fm-256	S	3×10^{-9}	3×10^{-5}	1×10^{-10}	9×10^{-7}
		I	2×10^{-9}	3×10^{-5}	6×10^{-11}	9×10^{-7}
Fluorine (9)	F-18	S	5×10^{-6}	2×10^{-2}	2×10^{-7}	8×10^{-4}
		I	3×10^{-6}	1×10^{-2}	9×10^{-8}	5×10^{-4}
Gadolinium (64)	Gd-153	S	2×10^{-7}	6×10^{-3}	8×10^{-9}	2×10^{-4}
		I	9×10^{-8}	6×10^{-3}	3×10^{-9}	2×10^{-4}
	Gd-159	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}
Gallium (31)	Ga-72	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
Germanium (32)	Ge-71	S	1×10^{-5}	5×10^{-2}	4×10^{-7}	2×10^{-3}
		I	6×10^{-6}	5×10^{-2}	2×10^{-7}	2×10^{-3}
Gold (79)	Au-196	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
		I	6×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-4}
	Au-198	S	3×10^{-7}	2×10^{-3}	1×10^{-8}	5×10^{-5}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	5×10^{-5}
	Au-199	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
I		8×10^{-7}	4×10^{-3}	3×10^{-8}	2×10^{-4}	
Hafnium (72)	Hf-181	S	4×10^{-8}	2×10^{-3}	1×10^{-9}	7×10^{-5}
		I	7×10^{-8}	2×10^{-3}	3×10^{-9}	7×10^{-5}
Holmium (67)	Ho-166	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}

Element (atomic number)	Radionuclide*		TABLE I		TABLE II	
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)
		I	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-5}
Hydrogen (1)	H-3	S	5×10^{-6}	1×10^{-1}	2×10^{-7}	3×10^{-3}
		I	5×10^{-6}	1×10^{-1}	2×10^{-7}	3×10^{-3}
		Sub**	2×10^{-3}	-----	4×10^{-5}	-----

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

**R 325.5264 Appendix A4. Concentrations in air and water above natural background.
Elements I to L.**

Rule 264. (See notes in Rule 270.)

Element (atomic number)	Radionuclide*		TABLE I		TABLE II		
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	
Indium (49)	In-113m	S	8×10^{-6}	4×10^{-2}	3×10^{-7}	1×10^{-3}	
		I	7×10^{-6}	4×10^{-2}	2×10^{-7}	1×10^{-3}	
	In-114m	S	1×10^{-7}	5×10^{-4}	4×10^{-9}	2×10^{-5}	
		I	2×10^{-8}	5×10^{-4}	7×10^{-10}	2×10^{-5}	
	In-115m	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}	
		I	2×10^{-6}	1×10^{-2}	6×10^{-8}	4×10^{-4}	
	In-115	S	2×10^{-7}	3×10^{-3}	9×10^{-9}	9×10^{-5}	
		I	3×10^{-8}	3×10^{-3}	1×10^{-9}	9×10^{-5}	
Iodine (53)	I-125	S	5×10^{-9}	4×10^{-5}	8×10^{-11}	2×10^{-7}	
		I	2×10^{-7}	6×10^{-3}	6×10^{-9}	2×10^{-4}	
	I-126	S	8×10^{-9}	5×10^{-5}	9×10^{-11}	3×10^{-7}	
		I	3×10^{-7}	3×10^{-3}	1×10^{-8}	9×10^{-5}	
	I-129	S	2×10^{-9}	1×10^{-5}	2×10^{-11}	6×10^{-8}	
		I	7×10^{-8}	6×10^{-3}	2×10^{-9}	2×10^{-4}	
	I-131	S	9×10^{-9}	6×10^{-5}	1×10^{-10}	3×10^{-7}	
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}	
	I-132	S	2×10^{-7}	2×10^{-3}	3×10^{-9}	8×10^{-6}	
		I	9×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}	
	I-133	S	S	3×10^{-8}	2×10^{-4}	4×10^{-10}	1×10^{-6}
			I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}
		I-134	S	5×10^{-7}	4×10^{-3}	6×10^{-9}	2×10^{-5}
			I	3×10^{-6}	2×10^{-2}	1×10^{-7}	6×10^{-4}
I-135	S	1×10^{-7}	7×10^{-4}	1×10^{-9}	4×10^{-6}		
	I	4×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}		
Iridium (77)	Ir-190	S	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}	
		I	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-4}	
	Ir-192	S	1×10^{-7}	1×10^{-3}	4×10^{-9}	4×10^{-5}	
		I	3×10^{-8}	1×10^{-3}	9×10^{-10}	4×10^{-5}	
	Ir-194	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	3×10^{-5}	
		I	2×10^{-7}	9×10^{-4}	5×10^{-9}	3×10^{-5}	

Element (atomic number)	Radionuclide*		TABLE I		TABLE II	
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)
Iron (26)	Fe-55	S	9×10^{-7}	2×10^{-2}	3×10^{-8}	8×10^{-4}
		I	1×10^{-6}	7×10^{-2}	3×10^{-8}	2×10^{-3}
	Fe-59	S	1×10^{-7}	2×10^{-3}	5×10^{-9}	6×10^{-5}
		I	5×10^{-8}	2×10^{-3}	2×10^{-9}	5×10^{-5}
Krypton (36)	Kr-85m	Sub**	6×10^{-6}	-----	1×10^{-7}	-----
	Kr-85	Sub**	1×10^{-5}	-----	3×10^{-7}	-----
	Kr-87	Sub**	1×10^{-6}	-----	2×10^{-8}	-----
	Kr-88	Sub**	1×10^{-6}	-----	2×10^{-8}	-----
Lanthanum (57)	La-140	S	2×10^{-7}	7×10^{-4}	5×10^{-9}	2×10^{-5}
		I	1×10^{-7}	7×10^{-4}	4×10^{-9}	2×10^{-5}
Lead (82)	Pb-203	S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}
		I	2×10^{-6}	1×10^{-2}	6×10^{-8}	4×10^{-4}
	Pb-210	S	1×10^{-10}	4×10^{-6}	4×10^{-12}	1×10^{-7}
		I	2×10^{-10}	5×10^{-3}	8×10^{-12}	2×10^{-4}
	Pb-212	S	2×10^{-8}	6×10^{-4}	6×10^{-10}	2×10^{-5}
		I	2×10^{-8}	5×10^{-4}	7×10^{-10}	2×10^{-5}
Lutetium (71)	Lu-177	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

**R 325.5265 Appendix A5. Concentrations in air and water above natural background.
Elements M to O.**

Rule 265. (See notes in Rule 270.)

Element (atomic number)	Radionuclide*		TABLE I		TABLE II	
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)
Manganese (25)	Mn-52	S	2×10^{-7}	1×10^{-3}	7×10^{-9}	3×10^{-5}
		I	1×10^{-7}	9×10^{-4}	5×10^{-9}	3×10^{-5}
	Mn-54	S	4×10^{-7}	4×10^{-3}	1×10^{-8}	1×10^{-4}
		I	4×10^{-8}	3×10^{-3}	1×10^{-9}	1×10^{-4}
	Mn-56	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
I		5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}	
Mercury (80)	Hg-197m	S	7×10^{-7}	6×10^{-3}	3×10^{-8}	2×10^{-4}
		I	8×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	Hg-197	S	1×10^{-6}	9×10^{-3}	4×10^{-8}	3×10^{-4}
		I	3×10^{-6}	1×10^{-2}	9×10^{-8}	5×10^{-4}
	Hg-203	S	7×10^{-8}	5×10^{-4}	2×10^{-9}	2×10^{-5}
		I	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
Molybdenum (42)	Mo-99	S	7×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
		I	2×10^{-7}	1×10^{-3}	7×10^{-9}	4×10^{-5}
Neodymium (60)	Nd-144	S	8×10^{-11}	2×10^{-3}	3×10^{-12}	7×10^{-5}
		I	3×10^{-10}	2×10^{-3}	1×10^{-11}	8×10^{-5}

Element (atomic number)	Radionuclide*		TABLE I		TABLE II	
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)
	Nd-147	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	2×10^{-7}	2×10^{-3}	8×10^{-9}	6×10^{-5}
	Nd-149	S	2×10^{-6}	8×10^{-3}	6×10^{-8}	3×10^{-4}
		I	1×10^{-6}	8×10^{-3}	5×10^{-8}	3×10^{-4}
Neptunium (93)	Np-237	S	4×10^{-12}	9×10^{-5}	1×10^{-13}	3×10^{-6}
		I	1×10^{-10}	9×10^{-4}	4×10^{-12}	3×10^{-5}
	Np-239	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	7×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-4}
Nickel (28)	Ni-59	S	5×10^{-7}	6×10^{-3}	2×10^{-8}	2×10^{-4}
		I	8×10^{-7}	6×10^{-2}	3×10^{-8}	2×10^{-3}
	Ni-63	S	6×10^{-8}	8×10^{-4}	2×10^{-9}	3×10^{-5}
		I	3×10^{-7}	2×10^{-2}	1×10^{-8}	7×10^{-4}
	Ni-65	S	9×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Niobium (41)	Nb-93m	S	1×10^{-7}	1×10^{-2}	4×10^{-9}	4×10^{-4}
		I	2×10^{-7}	1×10^{-2}	5×10^{-9}	4×10^{-4}
	Nb-95	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	1×10^{-7}	3×10^{-3}	3×10^{-9}	1×10^{-4}
	Nb-97	S	6×10^{-6}	3×10^{-2}	2×10^{-7}	9×10^{-4}
		I	5×10^{-6}	3×10^{-2}	2×10^{-7}	9×10^{-4}
Osmium (76)	Os-185	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
		I	5×10^{-8}	2×10^{-3}	2×10^{-9}	7×10^{-5}
	Os-191m	S	2×10^{-5}	7×10^{-2}	6×10^{-7}	3×10^{-3}
		I	9×10^{-6}	7×10^{-2}	3×10^{-7}	2×10^{-3}
	Os-191	S	1×10^{-6}	5×10^{-3}	4×10^{-8}	2×10^{-4}
		I	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-4}
	Os-193	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	3×10^{-7}	2×10^{-3}	9×10^{-9}	5×10^{-5}

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5266 Appendix A6. Concentrations in air and water above natural background.

Elements P.

Rule 266. (See notes in Rule 270.)

Element (atomic number)	Radionuclide*		TABLE I		TABLE II	
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)
Palladium (46)	Pd-103	S	1×10^{-6}	1×10^{-2}	5×10^{-8}	3×10^{-4}
		I	7×10^{-7}	8×10^{-3}	3×10^{-8}	3×10^{-4}
	Pd-109	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
		I	4×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
Phosphorus (15)	P-32	S	7×10^{-8}	5×10^{-4}	2×10^{-9}	2×10^{-5}
		I	8×10^{-8}	7×10^{-4}	3×10^{-9}	2×10^{-5}
Platinum (78)	Pt-191	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
	Pt-193m	S	7×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-3}
		I	5×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-3}
	Pt-193	S	1×10^{-6}	3×10^{-2}	4×10^{-8}	9×10^{-4}
		I	3×10^{-7}	5×10^{-2}	1×10^{-8}	2×10^{-3}
	Pt-197m	S	6×10^{-6}	3×10^{-2}	2×10^{-7}	1×10^{-3}
		I	5×10^{-6}	3×10^{-2}	2×10^{-7}	9×10^{-4}
	Pt-197	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Plutonium (94)	Pu-238	S	2×10^{-12}	1×10^{-4}	7×10^{-14}	5×10^{-6}
		I	3×10^{-11}	8×10^{-4}	1×10^{-12}	3×10^{-5}
	Pu-239	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	5×10^{-6}
		I	4×10^{-11}	8×10^{-4}	1×10^{-12}	3×10^{-5}
	Pu-240	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	5×10^{-6}
		I	4×10^{-11}	8×10^{-4}	1×10^{-12}	3×10^{-5}
	Pu-241	S	9×10^{-11}	7×10^{-3}	3×10^{-12}	2×10^{-4}
		I	4×10^{-8}	4×10^{-2}	1×10^{-9}	1×10^{-3}
	Pu-242	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	5×10^{-6}
		I	4×10^{-11}	9×10^{-4}	1×10^{-12}	3×10^{-5}
	Pu-243	S	2×10^{-6}	1×10^{-2}	6×10^{-8}	3×10^{-4}
		I	2×10^{-6}	1×10^{-2}	8×10^{-8}	3×10^{-4}
	Pu-244	S	2×10^{-12}	1×10^{-4}	6×10^{-14}	4×10^{-6}
		I	3×10^{-11}	3×10^{-4}	1×10^{-12}	1×10^{-5}
Polonium (84)	Po-210	S	5×10^{-10}	2×10^{-5}	2×10^{-11}	7×10^{-7}
		I	2×10^{-10}	8×10^{-4}	7×10^{-12}	3×10^{-5}
Potassium (19)	K-42	S	2×10^{-6}	9×10^{-3}	7×10^{-8}	3×10^{-4}
		I	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
Praseodymium (59)	Pr-142	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}
		I	2×10^{-7}	9×10^{-4}	5×10^{-9}	3×10^{-5}
	Pr-143	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	5×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	5×10^{-5}
Promethium (61)	Pm-147	S	6×10^{-8}	6×10^{-3}	2×10^{-9}	2×10^{-4}
		I	1×10^{-7}	6×10^{-3}	3×10^{-9}	2×10^{-4}
	Pm-149	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}

Element (atomic number)	Radionuclide*		TABLE I		TABLE II	
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)
Protactinium (91)	Pa-230	S	2×10^{-9}	7×10^{-3}	6×10^{-11}	2×10^{-4}
		I	8×10^{-10}	7×10^{-3}	3×10^{-11}	2×10^{-4}
	Pa-231	S	1×10^{-12}	3×10^{-3}	4×10^{-14}	9×10^{-7}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	2×10^{-5}
	Pa-233	S	6×10^{-7}	4×10^{-3}	2×10^{-8}	1×10^{-4}
		I	2×10^{-7}	3×10^{-3}	6×10^{-9}	1×10^{-4}

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

**R 325.5267 Appendix A7. Concentrations in air and water above natural background.
Elements R and S.**

Rule 267. (See notes in Rule 270.)

Element (atomic number)	Radionuclide*		TABLE I		TABLE II	
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)
Radium (88)	Ra-223	S	2×10^{-9}	2×10^{-5}	6×10^{-11}	7×10^{-7}
		I	2×10^{-10}	1×10^{-4}	8×10^{-12}	4×10^{-6}
	Ra-224	S	5×10^{-9}	7×10^{-5}	2×10^{-10}	2×10^{-6}
		I	7×10^{-10}	2×10^{-4}	2×10^{-11}	5×10^{-6}
	Ra-226	S	3×10^{-11}	4×10^{-7}	3×10^{-12}	3×10^{-8}
		I	5×10^{-11}	9×10^{-4}	2×10^{-12}	3×10^{-5}
Ra-228	S	7×10^{-11}	8×10^{-7}	2×10^{-12}	3×10^{-8}	
	I	4×10^{-11}	7×10^{-4}	1×10^{-12}	3×10^{-5}	
Radon (86)	Rn-220	S	3×10^{-7}	-----	1×10^{-8}	-----
		I	-----	-----	-----	-----
	Rn-222***	S	1×10^{-7}	-----	3×10^{-9}	-----
Rhenium (75)	Re-183	S	3×10^{-6}	2×10^{-2}	9×10^{-8}	6×10^{-4}
		I	2×10^{-7}	8×10^{-3}	5×10^{-9}	3×10^{-4}
	Re-186	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	5×10^{-5}
	Re-187	S	9×10^{-6}	7×10^{-2}	3×10^{-7}	3×10^{-3}
		I	5×10^{-7}	4×10^{-2}	2×10^{-8}	2×10^{-3}
Re-188	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}	
	I	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-5}	
Rhodium (45)	Rh-103m	S	8×10^{-5}	4×10^{-1}	3×10^{-6}	1×10^{-2}
		I	6×10^{-5}	3×10^{-1}	2×10^{-6}	1×10^{-2}
	Rh-105	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Rubidium (37)	Rb-86	S	3×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
		I	7×10^{-8}	7×10^{-4}	2×10^{-9}	2×10^{-5}
	Rb-87	S	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	7×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}

Element (atomic number)	Radionuclide*		TABLE I		TABLE II	
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)
Ruthenium (44)	Ru-97	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}
		I	2×10^{-6}	1×10^{-2}	6×10^{-8}	3×10^{-4}
	Ru-103	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}
		I	8×10^{-8}	2×10^{-3}	3×10^{-9}	8×10^{-5}
	Ru-105	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Ru-106	S	8×10^{-8}	4×10^{-4}	3×10^{-9}	1×10^{-5}	
	I	6×10^{-9}	3×10^{-4}	2×10^{-10}	1×10^{-5}	
Samarium (62)	Sm-147	S	7×10^{-11}	2×10^{-3}	2×10^{-12}	6×10^{-5}
		I	3×10^{-10}	2×10^{-3}	9×10^{-12}	7×10^{-5}
	Sm-151	S	6×10^{-8}	1×10^{-2}	2×10^{-9}	4×10^{-4}
		I	1×10^{-7}	1×10^{-2}	5×10^{-9}	4×10^{-4}
Sm-153	S	5×10^{-7}	2×10^{-3}	2×10^{-8}	8×10^{-5}	
	I	4×10^{-7}	2×10^{-3}	1×10^{-8}	8×10^{-5}	
Scandium (21)	Sc-46	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
		I	2×10^{-8}	1×10^{-3}	8×10^{-10}	4×10^{-5}
	Sc-47	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
		I	5×10^{-7}	3×10^{-3}	2×10^{-8}	9×10^{-5}
	Sc-48	S	2×10^{-7}	8×10^{-4}	6×10^{-9}	3×10^{-5}
		I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
Selenium (34)	Se-75	S	1×10^{-6}	9×10^{-3}	4×10^{-8}	3×10^{-4}
		I	1×10^{-7}	8×10^{-3}	4×10^{-9}	3×10^{-4}
Silicon (14)	Si-31	S	6×10^{-6}	3×10^{-2}	2×10^{-7}	9×10^{-4}
		I	1×10^{-6}	6×10^{-3}	3×10^{-8}	2×10^{-4}
Silver (47)	Ag-105	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	8×10^{-8}	3×10^{-3}	3×10^{-9}	1×10^{-4}
	Ag-110m	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}
		I	1×10^{-8}	9×10^{-4}	3×10^{-10}	3×10^{-5}
	Ag-111	S	3×10^{-7}	1×10^{-3}	1×10^{-8}	4×10^{-5}
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	4×10^{-5}
Sodium (11)	Na-22	S	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}
		I	9×10^{-9}	9×10^{-4}	3×10^{-10}	3×10^{-5}
	Na-24	S	1×10^{-6}	6×10^{-3}	4×10^{-8}	2×10^{-4}
		I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
Strontium (38)	Sr-85m	S	4×10^{-5}	2×10^{-1}	1×10^{-6}	7×10^{-3}
		I	3×10^{-5}	2×10^{-1}	1×10^{-6}	7×10^{-3}
	Sr-85	S	2×10^{-7}	3×10^{-3}	8×10^{-9}	1×10^{-4}
		I	1×10^{-7}	5×10^{-3}	4×10^{-9}	2×10^{-4}
	Sr-89	S	3×10^{-8}	3×10^{-4}	3×10^{-10}	3×10^{-6}
		I	4×10^{-8}	8×10^{-4}	1×10^{-9}	3×10^{-5}
	Sr-90	S	1×10^{-9}	1×10^{-5}	3×10^{-11}	3×10^{-7}
		I	5×10^{-9}	1×10^{-3}	2×10^{-10}	4×10^{-5}
	Sr-91	S	4×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
		I	3×10^{-7}	1×10^{-3}	9×10^{-9}	5×10^{-5}

Element (atomic number)	Radionuclide*		TABLE I		TABLE II	
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)
	Sr-92	S	4×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
Sulfur (16)	S-35	S	3×10^{-7}	2×10^{-3}	9×10^{-9}	6×10^{-5}
		I	3×10^{-7}	8×10^{-3}	9×10^{-9}	3×10^{-4}

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

**R 325.5268 Appendix A8. Concentrations in air and water above natural background.
Elements T.**

Rule 268. (See notes in Rule 270.)

Element (atomic number)	Radionuclide*		TABLE I		TABLE II		
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	
Tantalum (73)	Ta-182	S	4×10^{-8}	1×10^{-3}	1×10^{-9}	4×10^{-5}	
		I	2×10^{-8}	1×10^{-3}	7×10^{-10}	4×10^{-5}	
Technetium (43)	Tc-96m	S	8×10^{-5}	4×10^{-1}	3×10^{-6}	1×10^{-2}	
		I	3×10^{-5}	3×10^{-1}	1×10^{-6}	1×10^{-2}	
	Tc-96	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}	
		I	2×10^{-7}	1×10^{-3}	8×10^{-9}	5×10^{-5}	
	Tc-97m	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}	
		I	2×10^{-7}	5×10^{-3}	5×10^{-9}	2×10^{-4}	
	Tc-97	S	1×10^{-5}	5×10^{-2}	4×10^{-7}	2×10^{-3}	
		I	3×10^{-7}	2×10^{-2}	1×10^{-8}	8×10^{-4}	
	Tc-99m	S	4×10^{-5}	2×10^{-1}	1×10^{-6}	6×10^{-3}	
		I	1×10^{-5}	8×10^{-2}	5×10^{-7}	3×10^{-3}	
	Tc-99	S	2×10^{-6}	1×10^{-2}	7×10^{-8}	3×10^{-4}	
		I	6×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}	
Tellurium (52)	Te-125m	S	4×10^{-7}	5×10^{-3}	1×10^{-8}	2×10^{-4}	
		I	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}	
	Te-127m	S	1×10^{-7}	2×10^{-3}	5×10^{-9}	6×10^{-5}	
		I	4×10^{-8}	2×10^{-3}	1×10^{-9}	5×10^{-5}	
	Te-127	S	2×10^{-6}	8×10^{-3}	6×10^{-8}	3×10^{-4}	
		I	9×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}	
	Te-129m	S	8×10^{-8}	1×10^{-3}	3×10^{-9}	3×10^{-5}	
		I	3×10^{-8}	6×10^{-4}	1×10^{-9}	2×10^{-5}	
	Te-129	S	5×10^{-6}	2×10^{-2}	2×10^{-7}	8×10^{-4}	
		I	4×10^{-6}	2×10^{-2}	1×10^{-7}	8×10^{-4}	
	Te-131m	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}	
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	4×10^{-5}	
	Te-132	S	2×10^{-7}	9×10^{-4}	7×10^{-9}	3×10^{-5}	
		I	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}	
	Terbium (65)	Tb-160	S	1×10^{-7}	1×10^{-3}	3×10^{-9}	4×10^{-5}
			I	3×10^{-8}	1×10^{-3}	1×10^{-9}	4×10^{-5}

Element (atomic number)	Radionuclide*		TABLE I		TABLE II	
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)
Thallium (81)	Tl-200	S	3×10^{-6}	1×10^{-2}	9×10^{-8}	4×10^{-4}
		I	1×10^{-6}	7×10^{-3}	4×10^{-8}	2×10^{-4}
	Tl-201	S	2×10^{-6}	9×10^{-3}	7×10^{-8}	3×10^{-4}
		I	9×10^{-7}	5×10^{-3}	3×10^{-8}	2×10^{-4}
	Tl-202	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	2×10^{-7}	2×10^{-3}	8×10^{-9}	7×10^{-5}
	Tl-204	S	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	3×10^{-8}	2×10^{-3}	9×10^{-10}	6×10^{-5}
Thorium (90)	Th-227	S	3×10^{-10}	5×10^{-4}	1×10^{-11}	2×10^{-5}
		I	2×10^{-10}	5×10^{-4}	6×10^{-12}	2×10^{-5}
	Th-228	S	9×10^{-12}	2×10^{-4}	3×10^{-13}	7×10^{-6}
		I	6×10^{-12}	4×10^{-4}	2×10^{-13}	1×10^{-5}
	Th-230	S	2×10^{-12}	5×10^{-5}	8×10^{-14}	2×10^{-6}
		I	1×10^{-11}	9×10^{-4}	3×10^{-13}	3×10^{-5}
	Th-231	S	1×10^{-6}	7×10^{-3}	5×10^{-8}	2×10^{-4}
		I	1×10^{-6}	7×10^{-3}	4×10^{-8}	2×10^{-4}
	Th-232	S	3×10^{-11}	5×10^{-5}	1×10^{-12}	2×10^{-6}
		I	3×10^{-11}	1×10^{-3}	1×10^{-12}	4×10^{-5}
	Th-natural	S	6×10^{-11}	6×10^{-5}	2×10^{-12}	2×10^{-6}
		I	6×10^{-11}	6×10^{-4}	2×10^{-12}	2×10^{-5}
Th-234	S	6×10^{-8}	5×10^{-4}	2×10^{-9}	2×10^{-5}	
	I	3×10^{-8}	5×10^{-4}	1×10^{-9}	2×10^{-5}	
Thulium (69)	Tm-170	S	4×10^{-8}	1×10^{-3}	1×10^{-9}	5×10^{-5}
		I	3×10^{-8}	1×10^{-3}	1×10^{-9}	5×10^{-5}
	Tm-171	S	1×10^{-7}	1×10^{-2}	4×10^{-9}	5×10^{-4}
		I	2×10^{-7}	1×10^{-2}	8×10^{-9}	5×10^{-4}
Tin (50)	Sn-113	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	9×10^{-5}
		I	5×10^{-8}	2×10^{-3}	2×10^{-9}	8×10^{-5}
	Sn-125	S	1×10^{-7}	5×10^{-4}	4×10^{-9}	2×10^{-5}
		I	8×10^{-8}	5×10^{-4}	3×10^{-9}	2×10^{-5}
Tungsten (74)	W-181	S	2×10^{-6}	1×10^{-2}	8×10^{-8}	4×10^{-4}
		I	1×10^{-7}	1×10^{-2}	4×10^{-9}	3×10^{-4}
	W-185	S	8×10^{-7}	4×10^{-3}	3×10^{-8}	1×10^{-4}
		I	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
	W-187	S	4×10^{-7}	2×10^{-3}	2×10^{-8}	7×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

**R 325.5269 Appendix A9. Concentrations in air and water above natural background.
Elements U to Z and certain unlisted radionuclides.**

Rule 269. (See notes in Rule 270.)

Element (atomic number)	Radionuclide*		TABLE I		TABLE II	
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)
Uranium (92)	U-230	S	3×10^{-10}	1×10^{-4}	1×10^{-11}	5×10^{-6}
		I	1×10^{-10}	1×10^{-4}	4×10^{-12}	5×10^{-6}
	U-232	S	1×10^{-10}	8×10^{-4}	3×10^{-12}	3×10^{-5}
		I	3×10^{-11}	8×10^{-4}	9×10^{-13}	3×10^{-5}
	U-233	S	5×10^{-10}	9×10^{-4}	2×10^{-11}	3×10^{-5}
		I	1×10^{-10}	9×10^{-4}	4×10^{-12}	3×10^{-5}
	U-234****	S	6×10^{-10}	9×10^{-4}	2×10^{-11}	3×10^{-5}
		I	1×10^{-10}	9×10^{-4}	4×10^{-12}	3×10^{-5}
	U-235****	S	5×10^{-10}	8×10^{-4}	2×10^{-11}	3×10^{-5}
		I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
	U-236	S	6×10^{-10}	1×10^{-3}	2×10^{-11}	3×10^{-5}
		I	1×10^{-10}	1×10^{-3}	4×10^{-12}	3×10^{-5}
	U-238****	S	7×10^{-11}	1×10^{-3}	3×10^{-12}	4×10^{-5}
		I	1×10^{-10}	1×10^{-3}	5×10^{-12}	4×10^{-5}
	U-240	S	2×10^{-7}	1×10^{-3}	8×10^{-9}	3×10^{-5}
		I	2×10^{-7}	1×10^{-3}	6×10^{-9}	3×10^{-5}
U-natural****	S	1×10^{-10}	1×10^{-3}	5×10^{-12}	3×10^{-5}	
	I	1×10^{-10}	1×10^{-3}	5×10^{-12}	3×10^{-5}	
Vanadium (23)	V-48	S	2×10^{-7}	9×10^{-4}	6×10^{-9}	3×10^{-5}
		I	6×10^{-8}	8×10^{-4}	2×10^{-9}	3×10^{-5}
Xenon (54)	Xe-131m	Sub**	2×10^{-5}	-----	4×10^{-7}	-----
	Xe-133m	Sub	1×10^{-5}	-----	3×10^{-7}	-----
	Xe-133	Sub	1×10^{-5}	-----	3×10^{-7}	-----
	Xe-135	Sub	4×10^{-6}	-----	1×10^{-7}	-----
Ytterbium (70)	Yb-175	S	7×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
		I	6×10^{-7}	3×10^{-3}	2×10^{-8}	1×10^{-4}
Yttrium (39)	Y-90	S	1×10^{-7}	6×10^{-4}	4×10^{-9}	2×10^{-5}
		I	1×10^{-7}	6×10^{-4}	3×10^{-9}	2×10^{-5}
	Y-91m	S	2×10^{-5}	1×10^{-1}	8×10^{-7}	3×10^{-3}
		I	2×10^{-5}	1×10^{-1}	6×10^{-7}	3×10^{-3}
	Y-91	S	4×10^{-8}	8×10^{-4}	1×10^{-9}	3×10^{-5}
		I	3×10^{-8}	8×10^{-4}	1×10^{-9}	3×10^{-5}
	Y-92	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	Y-93	S	2×10^{-7}	8×10^{-4}	6×10^{-9}	3×10^{-5}
		I	1×10^{-7}	8×10^{-4}	5×10^{-9}	3×10^{-5}
Zinc (30)	Zn-65	S	1×10^{-7}	3×10^{-3}	4×10^{-9}	1×10^{-4}
		I	6×10^{-8}	5×10^{-3}	2×10^{-9}	2×10^{-4}
	Zn-69m	S	4×10^{-7}	2×10^{-3}	1×10^{-8}	7×10^{-5}
		I	3×10^{-7}	2×10^{-3}	1×10^{-8}	6×10^{-5}
	Zn-69	S	7×10^{-6}	5×10^{-2}	2×10^{-7}	2×10^{-3}
		I	9×10^{-6}	5×10^{-2}	3×10^{-7}	2×10^{-3}

Element (atomic number)	Radionuclide*		TABLE I		TABLE II	
			Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)
Zirconium (40)	Zr-93	S	1×10^{-7}	2×10^{-2}	4×10^{-9}	8×10^{-4}
		I	3×10^{-7}	2×10^{-2}	1×10^{-8}	8×10^{-4}
	Zr-95	S	1×10^{-7}	2×10^{-3}	4×10^{-9}	6×10^{-5}
		I	3×10^{-8}	2×10^{-3}	1×10^{-9}	6×10^{-5}
	Zr-97	S	1×10^{-7}	5×10^{-4}	4×10^{-9}	2×10^{-5}
		I	9×10^{-8}	5×10^{-4}	3×10^{-9}	2×10^{-5}
Any single radionuclide not listed in Appendix A1 to A9 with decay mode other than alpha emission or spontaneous fission and with radioactive half-life less than 2 hours. Sub			1×10^{-6}	-----	3×10^{-8}	-----
Any single radionuclide not listed in Appendix A1 to A9 with decay mode other than alpha emission or spontaneous fission and with radioactive half-life greater than 2 hours.			3×10^{-9}	9×10^{-5}	1×10^{-10}	3×10^{-6}
Any single radionuclide not listed in Appendix A1 to A9 which decays by alpha emission or spontaneous fission.			6×10^{-13}	4×10^{-7}	2×10^{-14}	3×10^{-8}

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5270 Notes to Appendices A1 to A9.

Rule 270.

*Soluble (S): Insoluble (I).

**"Sub" means that values given are for submersion in a semi-spherical infinite cloud of airborne material.

***For purposes of these rules, it may be assumed that the daughter activity concentrations in the following table are equivalent to an air concentration of 10^{-7} microcuries of radon-222 per milliliter of air in equilibrium with the daughters polonium-218, lead-214, bismuth-214, and polonium-214:

Maximum Time Between Collection and Measurement (hours)*†	Alpha-Emitting Daughter Activity Collected per Milliliter of Air	
	Microcuries per milliliter	Total Alpha Disintegrations per minute per milliliter
0.5	7.2×10^{-8}	0.16
1.0	4.5×10^{-8}	0.10
2.0	1.3×10^{-8}	0.028
3.0	0.3×10^{-8}	0.0072

*†The duration of sample collection and the duration of measurement should be sufficiently short compared to the time between collection and measurement, as not to have a statistically significant effect upon the results.

****For soluble mixtures of U-238, U-234, and U-235 in air, chemical toxicity may be the limiting factor. If the percent by weight (enrichment) of U-235 is less than 5, the concentration value for a 40-hour workweek, table I, is 0.2 milligrams uranium per cubic meter of air average. For any enrichment, the product of the average concentration and time of exposure during a 40-hour workweek shall not exceed 8×10^{-3} SA $\mu\text{Ci-hr/ml}$, where SA is the specific activity of the uranium inhaled. The concentration value for table II is 0.007 milligrams uranium per cubic meter of air. The specific activity for natural uranium is 6.77×10^{-7} curies per gram U. The specific activity for other mixtures of U-238, U-235, and U-234, if not known, shall be:

SA = 3.6×10^{-7} curies/gram U U-depleted

SA = $(0.4 + 0.38 E + 0.0034 E^2) 10^{-6} E \geq 0.72$ where E is the percentage by weight of U-235, expressed as percent.

NOTE: In any case where there is a mixture in air or water of more than 1 radionuclide, the limiting values for purposes of this appendix should be determined as follows:

1. If the identity and concentration of each radionuclide in the mixture are known, the limiting values should be derived as follows: Determine, for each radionuclide in the mixture, the ratio between the quantity present in the mixture and the limit otherwise established in Appendix "A" for the specific radionuclide when not in a mixture. The sum of such ratios for all the radionuclides in the mixture may not exceed "1" (i.e., "unity").

Example: If radionuclides a, b, and c are present in concentrations C_a , C_b , and C_c , and if the applicable Maximum Permissible Concentrations (MPC's) are MPC_a , MPC_b , and MPC_c respectively, then the concentrations shall be limited so that the following relationship exists:

$$\frac{C_a}{MPC_a} + \frac{C_b}{MPC_b} + \frac{C_c}{MPC_c} \leq 1$$

2. If either the identity or the concentration of any radionuclide in the mixture is not known, the limiting values for purposes of Appendix "A" shall be:

- a. For purposes of Table I, Column 1 6×10^{-13}
- b. For purposes of Table I, Column 2 4×10^{-7}
- c. For purposes of Table II, Column 1 2×10^{-14}
- d. For purposes of Table II, Column 2 3×10^{-8}

3. If any of the conditions specified hereinafter are met, the corresponding values specified there may be used in lieu of those specified in Paragraph 2 above.

a. If the identity of each radionuclide in the mixture is known but the concentration of one or more of the radionuclides in the mixture is not known, the concentration limit for the mixture is the limit specified in Appendix "A" for the radionuclide in the mixture having the lowest concentration limit; or,

b. If the identity of each radionuclide in the mixture is not known, but it is known that certain radionuclides specified in Appendix "A" are not present in the mixture, the concentration limit for the mixture is the lowest concentration limit specified in Appendix "A" for any radionuclide

that is not known to be absent from the mixture; or

c. Element (atomic number) and radionuclide	TABLE I		TABLE II	
	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)	Column 1 Air ($\mu\text{Ci/ml}$)	Column 2 Water ($\mu\text{Ci/ml}$)
If it is known that Sr-90, I-125, I-126, I-129, I-131, (I-133, Table II only), Pb-210, Po-210, At-211, Ra-223, Ra-224, Ra-226, Ac-227, Ra-228, Th-230, Pa-231, Th-232, Th-nat, Cm-248, Cf-254, and Fm-256 are not present	-----	9×10^{-5}	-----	3×10^{-6}
If it is known that Sr-90, I-125, I-126, I-129, I-131, (I-133, Table II only), Pb-210, Po-210, Ra-223, Ra-226, Ra-228, Pa-231, Th-nat, Cm-248, Cf-254, and Fm-256 are not present	-----	6×10^{-5}	-----	2×10^{-6}
If it is known that Sr-90, I-129, (I-125, I-126, I-131, Table II only), Pb-210, Ra-226, Ra-228, Cm-248, and Cf-254 are not present	-----	2×10^{-5}	-----	6×10^{-7}
If it is known that (I-129, Table II only), Ra-226, and Ra-228 are not present	-----	3×10^{-6}	-----	1×10^{-7}
If it is known that alpha-emitters and Sr-90, I-129, Pb-210, Ac-227, Ra-228, Pa-230, Pu-241, and Bk-249 are not present	3×10^{-9}	-----	1×10^{-10}	-----
If it is known that alpha-emitters and Pb-210, Ac-227, Ra-228, and Pu-241 are not present	3×10^{-10}	-----	1×10^{-11}	-----
If it is known that alpha-emitters and Ac-227 are not present	3×10^{-11}	-----	1×10^{-12}	-----
If it is known that Ac-227, Th-230, Pa-231, Pu-238, Pu-239, Pu-240, Pu-242, Pu-244, Cm-248, Cf-249 and Cf-251 are not present	3×10^{-12}	-----	1×10^{-13}	-----

4. If the mixture of radionuclides consists of uranium and its daughter products in ore dust before chemical processing of the uranium ore, the values specified below may be used in lieu of those determined in accordance with Paragraph 1 above or those specified in Paragraphs 2 and 3.

a. For purposes of Table I, Column 1, 1×10^{-10} $\mu\text{Ci/ml}$ gross alpha activity; or 5×10^{-11} $\mu\text{Ci/ml}$ natural uranium; or 75 micrograms per cubic meter of air natural uranium.

b. For purposes of Table II, Column 1, 3×10^{-12} $\mu\text{Ci/ml}$ gross alpha activity; or 2×10^{-12} $\mu\text{Ci/ml}$ natural uranium; or 3 micrograms per cubic meter of air natural uranium.

5. For purposes of this note, a radionuclide may be considered as not present in a mixture if (a) the ratio of the concentration of that radionuclide in the mixture (C_a) to the concentration limit

for that radionuclide specified in table II of Appendix “A” (MPC_a) does not exceed 1/10,

$$\left(\text{i.e., } \frac{C_a}{MPC_a} \leq 1/10\right)$$

and (b) the sum of such ratios for all radionuclides considered as not present in the mixture does not exceed 1/4, i.e.,

$$\left(\text{i.e., } \frac{C_a}{MPC_a} + \frac{C_b}{MPC_b} + \dots \leq 1/4\right)$$

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5271 Appendix B. Reference quantities for posting and disposal

Rule 271.

Radionuclide	Microcuries
Americium 241	.01
Antimony 122	100
Antimony 124	10
Antimony 125	10
Arsenic 73	100
Arsenic 74	10
Arsenic 76	10
Arsenic 77	100
Barium 131	10
Barium 133	10
Barium 140	10
Bismuth 210	1
Bromine 82	10
Cadmium 109	10
Cadmium 115m	10
Cadmium 115	100
Calcium 45	10
Calcium 47	10
Carbon 14	100
Cerium 141	100
Cerium 143	100
Cerium 144	1
Cesium 131	1,000
Cesium 134m	100
Cesium 134	1
Cesium 135	10
Cesium 136	10
Cesium 137	10

Radionuclide	Microcuries
Chlorine 36	10
Chlorine 38	10
Chromium 51	1,000
Cobalt 58m	10
Cobalt 58	10
Cobalt 60	1
Copper 64	100
Dysprosium 165	10
Dysprosium 166	100
Erbium 169	100
Erbium 171	100
Europium 152 (9.2h)	100
Europium 152 (13yr)	1
Europium 154	1
Europium 155	10
Fluorine 18	1,000
Gadolinium 153	10
Gadolinium 159	100
Gallium 72	10
Germanium 71	100
Gold 198	100
Gold 199	100
Hafnium 181	10
Holmium 166	100
Hydrogen 3	1,000
Indium 113m	100
Indium 114m	10
Indium 115m	100

Radionuclide	Microcuries
Indium 115	10
Iodine 125	1
Iodine 126	1
Iodine 129	0.1
Iodine 131	1
Iodine 132	10
Iodine 133	1
Iodine 134	10
Iodine 135	10
Iridium 192	10
Iridium 194	100
Iron 55	100
Iron 59	10
Krypton 85	100
Krypton 87	10
Lanthanum 140	10
Lutetium 177	100
Manganese 52	10
Manganese 54	10
Manganese 56	10
Mercury 197m	100
Mercury 197	100
Mercury 203	10
Molybdenum 99	100
Neodymium 147	100
Neodymium 149	100
Nickel 59	100
Nickel 63	10
Nickel 65	100
Niobium 93m	10
Niobium 95	10
Niobium 97	10
Osmium 185	10
Osmium 191m	100
Osmium 191	100
Osmium 193	100
Palladium 103	100
Palladium 109	100
Phosphorus 32	10
Platinum 191	100
Platinum 193m	100
Platinum 193	100

Radionuclide	Microcuries
Platinum 197m	100
Platinum 197	100
Plutonium 239	.01
Polonium 210	0.1
Potassium 42	10
Praseodymium 142	100
Praseodymium 143	100
Promethium 147	10
Promethium 149	10
Radium 226	.01
Radon 222	.01
Rhenium 186	100
Rhenium 188	100
Rhodium 103m	100
Rhodium 105	100
Rubidium 86	10
Rubidium 87	10
Ruthenium 97	100
Ruthenium 103	10
Ruthenium 105	10
Ruthenium 106	1
Samarium 151	10
Samarium 153	100
Scandium 46	10
Scandium 47	100
Scandium 48	10
Selenium 75	10
Silicon 31	100
Silver 105	10
Silver 110m	1
Silver 111	100
Sodium 24	10
Strontium 85	10
Strontium 89	1
Strontium 90	0.1
Strontium 91	10
Strontium 92	10
Sulfur 35	100
Tantalum 182	10
Technetium 96	10
Technetium 97m	100
Technetium 97	100

Radionuclide	Microcuries
Technetium 99m	100
Technetium 99	10
Tellurium 125m	10
Tellurium 127m	10
Tellurium 127	100
Tellurium 129m	10
Tellurium 129	100
Tellurium 131m	10
Tellurium 132	10
Terbium 160	10
Thallium 200	100
Thallium 201	100
Thallium 202	100
Thallium 204	10
Thorium (natural)	100*
Thulium 170	10
Thulium 171	10
Tin 113	10
Tin 125	10
Tungsten 181	10
Tungsten 185	10
Tungsten 187	100
Uranium (natural)	100**
Uranium 233	.01
Uranium 234 - 235	.01
Vanadium 48	10
Xenon 131m	1,000
Xenon 133	100
Xenon 135	100
Ytterbium 175	100
Yttrium 90	10
Yttrium 91	10
Yttrium 92	100
Yttrium 93	100
Zinc 65	10
Zinc 69m	100
Zinc 69	1,000
Zirconium 93	10
Zirconium 95	10
Zirconium 97	10

Radionuclide	Microcuries
Any alpha emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition	0.01
Any radionuclide other than alpha emitting radionuclides not listed above or mixtures of beta emitters of unknown composition	0.1

*Based on alpha disintegration rate of Th-232, Th-230 and their daughter products.

**Based on alpha disintegration rate of U-238, U-234 and U-235.

NOTE: For purposes of Rules 224 to 231, where there is involved a combination of nuclides in known amounts, the limit for the combination should be derived as follows: Determine, for each nuclide in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific nuclide when not in combination. The sum of such ratios for all the nuclides in the combination may not exceed “1” (i.e., “unity”).

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5272 Appendix C. Radioactive surface contamination guides.

Rule 272.

Application	Alpha (dpm/100 cm ²)		Beta/Gamma*	
	Total	Removable	Total (mR/hr)	Removable (dpm/100 cm ²)
Restricted Area				
Basic Guide	25,000 (max)	500	1.0	5,000
	5,000 (avg)			
Clean Area	1,000	100	0.5	1,000
Non-Restricted Area				
Skin, Personal Clothing	500	N.D.**	0.1	N.D.**
Release of Material or Facilities	2,500 (max)	100	0.2	1,000
	500 (avg)			

*Measured at 1 cm from the surface

**N.D. - non-detectable

NOTES TO APPENDIX C

It should be emphasized that because of the wide range of physical factors, no one value (of the few which can be incorporated in a standard) can relate health effects to contamination levels in all the diverse situations in which contamination is measured. Accordingly, standards for contamination levels must be used as guides (or decision levels). The above levels shall therefore be applied with the following guidance:

1. The levels are to be used as guides, and in practice professional judgment should be used by the health physicist to determine the acceptability of the actual contamination.
2. Although it is felt that the recommended values should not result in a health hazard, good radiation protection practice dictates that a reasonable effort be made to keep actual contamination levels below these values.
3. Compliance with contamination guides shall not be used as evidence that exposing persons to internal or external sources of radiation is within the prescribed standards. Biological sampling or whole body counting should be used to ascertain internal doses.
4. For release of material to the general public:
 - a. A reasonable effort shall be made to minimize the contamination (i.e. the application

of additional decontamination procedures have little effect on the contamination levels).

b. Surfaces of premises or equipment likely to be contaminated that are inaccessible for measurement shall be presumed to be contaminated in excess of the above limits and not released.

5. The levels adopted are for generally used isotopes of high toxicity, therefore lower levels may be appropriate for extremely toxic radionuclides and relaxations allowed for less toxic radionuclides.

History: 1979 AC.

R 325.5273 Rescinded.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.

R 325.5274 Rescinded.

History: 1979 AC; 2016 MR 10, Eff. May 25, 2016.