Frequency of Medical Examinations for Use of Respiratory Protection Equipment - Part 20 (60 FR 7900)		
NRC Regulation Section	**State Regulation Section**	**Comments**
20.1703	33-10-04.1-11, subsection 3	

Law Implemented: NDCC 23-20.1-03, 23-20.1-04

33-10-04.1-11. Respiratory protection and controls to restrict internal exposure in restricted areas.

1. **Use of process or other engineering controls.** The licensee or registrant shall use, to the extent ~~practicable~~ practical, process or other engineering controls, such as, containment or ventilation, to control the concentrations of radioactive material in air.

2. **Use of other controls.** When it is not ~~practicable~~ practical to apply process or other engineering controls to control the concentrations of radioactive material in air to values below those that define an airborne radioactivity area, the licensee or registrant, consistent with maintaining the total effective dose equivalent as low as is reasonably achievable (ALARA), shall increase monitoring and limit intakes by one or more of the following means:

   a. Control of access;

   b. Limitation of exposure times;

   c. Use of respiratory protection equipment; or

   d. Other controls.

3. **Use of individual respiratory protection equipment.**

   a. If the licensee or registrant uses respiratory protection equipment to limit intakes pursuant to subsection 2:

      (1) Except as provided in paragraph 2, the licensee or registrant shall use only respiratory protection equipment that is tested and certified or had certification extended by the national institute for occupational safety and health and the mine safety and health administration.

      (2) The licensee or registrant may use respiratory protection equipment that has not been tested

or certified by the national institute for occupational safety and health and the mine safety and health administration, has not had certification extended by the national institute for occupational safety and health and the mine safety and health administration, or for which there is no schedule for testing or certification, provided the licensee or registrant has submitted to the department and the department has approved an application for authorized use of that respiratory protection equipment, including a demonstration by testing, or a demonstration on the basis of test information, that the material and performance characteristics of the respiratory protection equipment are capable of providing the proposed degree of protection under anticipated conditions of use.

(3) The licensee or registrant shall implement and maintain a respiratory protection program that includes:

(a) Air sampling sufficient to identify the potential hazard, permit proper respiratory protection equipment selection, and estimate exposures;

(b) Surveys and bioassays, as appropriate, to evaluate actual intakes;

(c) Testing of ~~respirators~~ respiratory protection equipment for operability immediately prior to each use;

(d) Written procedures regarding selection, fitting, issuance, maintenance, and testing of ~~respirators~~ respiratory protection equipment, including testing for operability immediately prior to each use; supervision and training of personnel; monitoring, including air sampling and bioassays; and recordkeeping; and

(e) Determination by a physician prior to the initial fitting of ~~respirators~~

respiratory protection equipment, and ~~at least~~ either every twelve months thereafter or periodically at a frequency determined by a physician, that the individual user is ~~physically able~~ medically fit to use the respiratory protection equipment.

(4) The licensee or registrant shall issue a written policy statement on ~~respirator~~ respiratory protection equipment usage covering:

(a) The use of process or other engineering controls, instead of ~~respirators~~ respiratory protection equipment;

(b) The routine, nonroutine, and emergency use of ~~respirators~~ respiratory protection equipment; and

(c) The length of periods of ~~respirator~~ respiratory protection equipment use and relief from ~~respirator~~ respiratory protection equipment use.

(5) The licensee or registrant shall advise each ~~respirator~~ respiratory protection equipment user that the user may leave the area at any time for relief from ~~respirator~~ respiratory protection equipment use in the event of equipment malfunction, physical or psychological distress, procedural or communication failure, significant deterioration of operating conditions, or any other conditions that might require such relief.

(6) The licensee or registrant shall use respiratory protection equipment within the equipment manufacturer's expressed limitations for type and mode of use and shall provide proper visual, communication, and other special capabilities, such as adequate skin protection, when needed.

Low-Level Waste Shipment Manifest Information and Reporting - Parts 20, 61 (60 FR 15649 and 60 FR 25983)		
NRC Regulation Section	**State Regulation Section**	**Comments**
20.2006	33-10-04.1-14, subsection 6	
20.2101	33-10-04.1-15, subsection 1	
Appendix G to 10 CFR Part 20	Appendix G to Chapter 33-10-04.1	
Amendments to Part 61	None	We do not have an equivalent to Part 61 in our regulations because we do not have any land disposal of radioactive waste in North Dakota.

33-10-04.1-14, subsection 6

6. **Transfer for disposal and manifests.**

a. The requirements of this subsection and appendix D and appendix G are designed to control transfers of low-level radioactive waste ~~intended for disposal at~~ by any waste generator, waste collector, or waste processor licensee, as defined in appendix G, who ships low-level waste either directly, or indirectly through a waste collector or waste processor, to a licensed low-level radioactive waste disposal facility, establish a manifest

tracking system, and supplement existing requirements concerning transfers and recordkeeping for those wastes.

b. Beginning March 1, 1998, all affected licensees must use appendix G. Prior to March 1, 1998, a low-level radioactive waste disposal facility operator or its regulatory authority may require the shipper to use appendix D or appendix G. Licensees using appendix D shall comply with paragraph 1 of subdivision b of this subsection. Licensees using appendix G shall comply with paragraph 2 of subdivision b of this subsection.

~~b.~~ (1) Each shipment of radioactive waste ~~designated~~ intended for disposal at a licensed low-level radioactive waste disposal facility shall be accompanied by a shipment manifest as specified in section I of appendix D.

(2) Any licensee shipping radioactive waste intended for ultimate disposal at a licensed land disposal facility must document the information required on the uniform low-level radioactive waste manifest and transfer this recorded manifest information to the intended consignee in accordance with appendix G.

c. Each shipment manifest shall include a certification by the waste generator as specified in section II of appendix D or appendix G, as appropriate.

d. Each person involved in the transfer of waste for disposal or in the disposal of waste, including the waste generator, waste collector, waste processor, and disposal facility operator, shall comply with the requirements specified in section III of appendix D or appendix G, as appropriate.

33-10-04.1-15, subsection 1

33-10-04.1-15. Records.

1. **General provisions.**

   a. Each licensee or registrant shall use the international system units becquerel, gray, sievert, and coulomb per kilogram, or the special units curie, rad, rem, and roentgen, including multiples and subdivisions, and shall clearly indicate the units of all quantities on records required by this chapter.

   b. Not withstanding the requirements of subdivision a of subsection 1 of section 33-10-04.1-15, when recording information on shipment manifests, as required in paragraph 2 of subdivision b of subsection 6 of section 33-10-04.1-14, information must be recorded in the international system of units or in the international system of units and units as specified in subdivision a of subsection 1 of section 33-10-04.1-15.

   ~~b~~c. The licensee or registrant shall make a clear distinction among the quantities entered on the records required by this chapter, such as, total effective dose equivalent, total organ dose equivalent, shallow dose equivalent, eye dose equivalent, deep dose equivalent, or committed effective dose equivalent.

2. **Records of radiation protection programs.**

   a. Each licensee or registrant shall maintain records of the radiation protection program, including:

      (1) The provisions of the program; and

      (2) Audits and other reviews of program content and implementation.

Appendix G to Chapter 33-10-04.1

APPENDIX G
REQUIREMENTS FOR TRANSFERS OF LOW-LEVEL RADIOACTIVE WASTE INTENDED FOR DISPOSAL AT LICENSED LAND DISPOSAL FACILITIES AND MANIFESTS

I. Manifest

A waste generator, collector, or processor who transports, or offers for transportation, low-level radioactive waste intended for ultimate disposal at a licensed low-level radioactive waste land disposal facility must prepare a Manifest (Federal OMB Control Numbers 3150-0164, -0165, and -0166) reflecting information requested on applicable U.S. Nuclear Regulatory Commission (NRC) Forms 540 (Uniform Low-Level Radioactive Waste Manifest (Shipping Paper)) and 541 (Uniform Low-Level Radioactive Waste Manifest (Container and Waste Description)) and, if necessary, on an applicable NRC Form 542 (Uniform Low-Level Radioactive Waste Manifest (manifest Index and Regional Compact Tabulation)). NRC Forms 540 and 540A must be completed and must physically accompany the pertinent low-level waste shipment. Upon agreement between shipper and consignee, NRC Forms 541 and 541A and 542 and 542A may be completed, transmitted, and stored in electronic media with the capability for producing legible, accurate, and complete records on the respective forms. Licensees are not required by the department to comply with the manifesting requirements of this part when they ship:

(a) LLW for processing and expect its return (i.e., for storage under their license) prior to disposal at a licensed land disposal facility;
(b) LLW that is being returned to the licensee who is the ``waste generator'' or ``generator,'' as defined in this part; or
(c) Radioactively contaminated material to a ``waste processor'' that becomes the processor's ``residual waste.''

For guidance in completing these forms, refer to the instructions that accompany the forms. Copies of manifests required by this appendix may be legible carbon copies, photocopies, or computer printouts that reproduce the data in the format of the uniform manifest. NRC Forms 540, 540A, 541, 541A, 542 and 542A, and the accompanying instructions, in hard copy, may be obtained from the Information and Records Management Branch, Office of Information Resources Management, U S. Nuclear Regulatory Commission, Washington, DC 20555, telephone (301) 415-7232.

This appendix includes information requirements of the Department of Transportation, as codified in 49 CFR part 172. Information on hazardous, medical, or other waste, required to meet Environmental Protection Agency regulations, as codified in 40 CFR parts 259, 261 or elsewhere, is not addressed in this section, and must be provided on the required EPA forms. However, the required EPA forms must accompany the Uniform Low-Level Radioactive Waste Manifest required by this chapter.

As used in this appendix, the following definitions apply:

Chelating agent has the same meaning as that given in Chapter 33-10-01.

Chemical description means a description of the principal chemical characteristics of a low-level radioactive waste.

Computer-readable medium means that the regulatory agency's computer can transfer the information from the medium into its memory and process the data.

Consignee means the designated receiver of the shipment of low-level radioactive waste.

Decontamination facility means a facility operating under a Commission or Agreement State license whose principal purpose is decontamination of equipment or materials to accomplish recycle, reuse, or other waste management objectives, and, for purposes of this part, is not considered to be a consignee for LLW shipments.

Disposal container means a container principally used to confine low-level radioactive waste during disposal operations at a land disposal facility (also see ``high integrity container''). Note that for some shipments, the disposal container may be the transport package.

EPA identification number means the number received by a transporter following application to the Administrator of EPA as required by 40 CFR part 263.

Generator means a licensee operating under a Commission or Agreement State license who (1) is a waste generator as defined in this chapter, or (2) is the licensee to whom waste can be attributed within the context of the Low-Level Radioactive Waste Policy Amendments Act of 1985 (e.g., waste generated as a result of decontamination or recycle activities).

High integrity container (HIC) means a container commonly designed to meet the structural stability requirements of the U.S. Nuclear Regulatory Commission Requirements in 10 CFR part 61 section 56, and to meet Department of Transportation requirements for a Type A package.

Land disposal facility means the land, buildings and structures, and equipment which are intended to be used for the disposal of radioactive waste. For purposes of this chapter, a "geologic repository" as defined in 10 CFR part 60 is not considered a "land disposal facility"

NRC Forms 540, 540A, 541, 541A, 542, and 542A are official NRC Forms referenced in this appendix. Licensees need not use originals of these NRC Forms as long as any substitute forms are equivalent to the original documentation in respect to content, clarity, size, and location of information. Upon agreement between the shipper and consignee, NRC Forms 541 (and 541A) and NRC Forms 542 (and 542A) may be completed, transmitted, and

stored in electronic media. The electronic media must have the capability for producing legible, accurate, and complete records in the format of the uniform manifest.

Package has the same meaning as that given in Chapter 33-10-01.

Physical description means the items called for on NRC Form 541 to describe a low-level radioactive waste.

Residual waste means low-level radioactive waste resulting from processing or decontamination activities that cannot be easily separated into distinct batches attributable to specific waste generators. This waste is attributable to the processor or decontamination facility, as applicable.

Shipper means the licensed entity (i.e., the waste generator, waste collector, or waste processor) who offers low-level radioactive waste for transportation, typically consigning this type of waste to a licensed waste collector, waste processor, or land disposal facility operator.

Shipping paper means NRC Form 540 and, if required, NRC Form 540A which includes the information required by DOT in 49 CFR part 172.

Source material has the same meaning as that given in Chapter 33-10-01.

Special nuclear material has the same meaning as that given in Chapter 33-10-01.

Uniform Low-Level Radioactive Waste Manifest or uniform manifest means the combination of NRC Forms 540, 541, and, if necessary, 542, and their respective continuation sheets as needed, or equivalent.

Waste collector means an entity, operating under a Commission or Agreement State license, whose principal purpose is to collect and consolidate waste generated by others, and to transfer this waste, without processing or repackaging the collected waste, to another licensed waste collector, licensed waste processor, or licensed land disposal facility

Waste description means the physical, chemical and radiological description of a low-level radioactive waste as called for on NRC Form 541.

Waste generator means an entity, operating under a Commission or Agreement State license, who (1) possesses any material or component that contains radioactivity or is radioactively contaminated for which the licensee foresees no further use, and (2) transfers this material or component to a licensed land disposal facility or to a licensed waste collector or processor for handling or treatment prior to disposal. A licensee performing processing or decontamination services may be a ``waste generator'' if the transfer of low-level radioactive waste from its facility is defined as ``residual waste.''

Waste processor means an entity, operating under a Commission or Agreement State license, whose principal purpose is to process, repackage, or otherwise treat low-level radioactive material or waste generated by others prior to eventual transfer of waste to a licensed low-level radioactive waste land disposal facility.

Waste type means a waste within a disposal container having a unique physical description (i.e., a specific waste descriptor code or description; or a waste sorbed on or solidified in a specifically defined media).

Information Requirements

A. General Information

The shipper of the radioactive waste, shall provide the following information on the uniform manifest:

1. The name, facility address, and telephone number of the licensee shipping the waste;

2. An explicit declaration indicating whether the shipper is acting as a waste generator, collector, processor, or a combination of these identifiers for purposes of the manifested shipment; and

3 The name, address, and telephone number, or the name and EPA identification number for the carrier transporting the waste.

B. Shipment Information

The shipper of the radioactive waste shall provide the following information regarding the waste shipment on the uniform manifest:

1. The date of the waste shipment;

2. The total number of packages/disposal containers;

3 The total disposal volume and disposal weight in the shipment;

4 The total radionuclide activity in the shipment;

5. The activity of each of the radionuclides H-3, C-14, Tc-99, and I-129 contained in the shipment; and

6. The total masses of U-233, U-235, and plutonium in special nuclear material, and the total mass of uranium and thorium in source material.

C Disposal Container and Waste Information

The shipper of the radioactive waste shall provide the following information on the uniform manifest regarding the waste and each disposal container of waste in the shipment:

1. An alphabetic or numeric identification that uniquely identifies each disposal container in the shipment;

2. A physical description of the disposal container, including the manufacturer and model of any high integrity container;

3. The volume displaced by the disposal container;

4. The gross weight of the disposal container, including the waste;

5. For waste consigned to a disposal facility, the maximum radiation level at the surface of each disposal container;

6. A physical and chemical description of the waste;

7. The total weight percentage of chelating agent for any waste containing more than 0.1% chelating agent by weight, plus the identity of the principal chelating agent;

8. The approximate volume of waste within a container;

9. The sorbing or solidification media, if any, and the identity of the solidification media vendor and brand name;

10. The identities and activities of individual radionuclides contained in each container, the masses of U-233, U-235, and plutonium in special nuclear material, and the masses of uranium and thorium in source material. For discrete waste types (i.e., activated materials, contaminated equipment, mechanical filters, sealed source/devices, and wastes in solidification/stabilization media), the identities and activities of individual radionuclides associated with or contained in these waste types within a disposal container shall be reported;

11. The total radioactivity within each container; and

12. For wastes consigned to a disposal facility, the classification of the waste pursuant to 10 CFR part 61 section 55. Waste not meeting the structural stability requirements of 10 CFR par 61 section 56 subsection (b) must be identified.

D. Uncontainerized Waste Information

The shipper of the radioactive waste shall provide the following information on the uniform manifest regarding a waste shipment delivered without a disposal container:

1. The approximate volume and weight of the waste;

2. A physical and chemical description of the waste;

3. The total weight percentage of chelating agent if the chelating agent exceeds 0.1% by weight, plus the identity of the principal chelating agent;

4. For waste consigned to a disposal facility, the classification of the waste pursuant to 10 CFR part 61 section 55. Waste not meeting the structural stability requirements of 10 CFR part 61 section 56 subsection (b) must be identified;

5. The identities and activities of individual radionuclides contained in the waste, the masses of U-233, U-235, and plutonium in special nuclear material, and the masses of uranium and thorium in source material; and

6. For wastes consigned to a disposal facility, the maximum radiation levels at the surface of the waste

E. Multi-Generator Disposal Container Information

This section applies to disposal containers enclosing mixtures of waste originating from different generators. (Note: The origin of the LLW resulting from a processor's activities may be attributable to one or more ``generators'' (including ``waste generators'') as defined in this part). It also applies to mixtures of wastes shipped in an uncontainerized form, for which portions of the mixture within the shipment originate from different generators.

1. For homogeneous mixtures of waste, such as incinerator ash, provide the waste description applicable to the mixture and the volume of the waste attributed to each generator.

2. For heterogeneous mixtures of waste, such as the combined products from a large compactor, identify each generator contributing waste to the disposal container, and, for discrete waste types (i.e., activated materials, contaminated equipment, mechanical filters, sealed source/devices, and wastes in solidification/stabilization media), the identities and activities of individual radionuclides contained in these waste types within the disposal container. For each generator, provide the following:

   (a) The volume of waste within the disposal container;

   (b) A physical and chemical description of the waste, including the solidification agent, if any;

(c) The total weight percentage of chelating agents for any disposal container containing more than 0.1% chelating agent by weight, plus the identity of the principal chelating agent;

(d) The sorbing or solidification media, if any, and the identity of the solidification media vendor and brand name if the media is claimed to meet stability requirements in 10 CFR part 61 section 56 subsection (b); and

(e) Radionuclide identities and activities contained in the waste, the masses of U-233, U-235, and plutonium in special nuclear material, and the masses of uranium and thorium in source material if contained in the waste.

II. Certification

An authorized representative of the waste generator, processor, or collector shall certify by signing and dating the shipment manifest that the transported materials are properly classified, described, packaged, marked, and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation and the Commission. A collector in signing the certification is certifying that nothing has been done to the collected waste which would invalidate the waste generator's certification.

III. Control and Tracking

1. Any licensee who transfers radioactive waste to a land disposal facility or a licensed waste collector shall comply with the requirements in paragraphs A.1 through 9 of this section. Any licensee who transfers waste to a licensed waste processor for waste treatment or repackaging shall comply with the requirements of paragraphs A.4 through 9 of this section. A licensee shall:

(a) Prepare all wastes so that the waste is classified according to 10 CFR part 61 section 55 and meets the waste characteristics requirements in 10 CFR part 61 section 56.

(b) Label each disposal container (or transport package if potential radiation hazards preclude labeling of the individual disposal container) of waste to identify whether it is Class A waste, Class B waste, Class C waste, or greater then Class C waste, in accordance with 10 CFR part 61 section 55;

(c) Conduct a quality assurance program to assure compliance with 10 CFR part 61 section 55 and 10 CFR part 61 section 56 (the program must include management evaluation of audits);

(d) Prepare the NRC Uniform Low-Level Radioactive Waste Manifest as required by this appendix;

(e) Forward a copy or electronically transfer the Uniform Low-Level Radioactive Waste Manifest to the intended consignee so that either (I) receipt of the manifest precedes the LLW shipment or (ii) the manifest is delivered to the consignee with the waste at the time the waste is transferred to the consignee. Using both (I) and (ii) is also acceptable;

(f) Include NRC Form 540 (and NRC Form 540A, if required) with the shipment regardless of the option chosen in paragraph A.5 of this section;

(g) Receive acknowledgment of the receipt of the shipment in the form of a signed copy of NRC Form 540;

(h) Retain a copy of or electronically store the Uniform Low-Level Radioactive Waste Manifest and documentation of acknowledgment of receipt as the record of transfer of licensed material as required by 10 CFR Parts 30, 40, and 70; and

(i) For any shipments or any part of a shipment for which acknowledgment of receipt has not been received within the times set forth in this appendix, conduct an investigation in accordance with paragraph E of this appendix.

B. Any waste collector licensee who handles only prepackaged waste shall:

(a) Acknowledge receipt of the waste from the shipper within one week of receipt by returning a signed copy of NRC Form 540;

(b) Prepare a new manifest to reflect consolidated shipments that meet the requirements of this appendix. The waste collector shall ensure that, for each container of waste in the shipment, the manifest identifies the generator of that container of waste;

(c) Forward a copy or electronically transfer the Uniform Low-Level Radioactive Waste Manifest to the intended consignee so that either:

(1) Receipt of the manifest precedes the LLW shipment or

(2) The manifest is delivered to the consignee with the waste at the time the waste is transferred to the consignee. Using both (i) and (ii) is also acceptable;

(d) Include NRC Form 540 (and NRC Form 540A, if required) with the shipment regardless of the option chosen in paragraph B.3 of this section;

(e) Receive acknowledgment of the receipt of the shipment in the form of a signed copy of NRC Form 540;

(f) Retain a copy of or electronically store the Uniform Low-Level Radioactive Waste Manifest and documentation of acknowledgment of receipt as the record of transfer of licensed material as required by 10 CFR parts 30, 40, and 70;

(g) For any shipments or any part of a shipment for which acknowledgment of receipt has not been received within the times set forth in this appendix, conduct an investigation in accordance with paragraph E of this appendix; and

(h) Notify the shipper and the Administrator of the nearest Commission Regional Office when any shipment, or part of a shipment, has not arrived within 60 days after receipt of an advance manifest, unless notified by the shipper that the shipment has been canceled.

C. Any licensed waste processor who treats or repackages waste shall:

(a) Acknowledge receipt of the waste from the shipper within one week of receipt by returning a signed copy of NRC Form 540;

(b) Prepare a new manifest that meets the requirements of this appendix. Preparation of the new manifest reflects that the processor is responsible for meeting these requirements. For each container of waste in the shipment, the manifest shall identify the waste generators, the preprocessed waste volume, and the other information as required in paragraph I.E. of this appendix;

(c) Prepare all wastes so that the waste is classified according to 10 CFR part 61 section 55 and meets the waste characteristics requirements in 10 CFR part 61 section 56;

(d) Label each package of waste to identify whether it is Class A waste, Class B waste, or Class C waste, in accordance with 10 CFR part 61 section 55 and 10 CFR part 61 section 57;

(e) Conduct a quality assurance program to assure compliance with 10 CFR part 61 section 55 and 10 CFR part 61 section 56 (the program shall include management evaluation of audits);

(f) Forward a copy or electronically transfer the Uniform Low-Level Radioactive Waste Manifest to the intended consignee so that either: (I) Receipt of the manifest precedes the LLW shipment or (ii) the manifest is delivered to the consignee with the waste at the time the waste is transferred to the consignee. Using both (I) and (ii) is also acceptable;

(g) Include NRC Form 540 (and NRC Form 540A, if required) with the shipment regardless of the option chosen in paragraph C.6 of this section;

(h) Receive acknowledgment of the receipt of the shipment in the form of a signed copy of NRC Form 540;

(i) Retain a copy of or electronically store the Uniform Low-Level Radioactive Waste Manifest and documentation of acknowledgment of receipt as the record of transfer of licensed material as required by 10 CFR parts 30, 40, and 70;

(j) For any shipment or any part of a shipment for which acknowledgment of receipt has not been received within the times set forth in this appendix, conduct an investigation in accordance with paragraph E of this appendix; and

(k) Notify the shipper and the Administrator of the nearest Commission Regional Office when any shipment, or part of a shipment, has not arrived within 60 days after receipt of an advance manifest, unless notified by the shipper that the shipment has been canceled.

D. The land disposal facility operator shall:

(a) Acknowledge receipt of the waste within one week of receipt by returning, as a minimum, a signed copy of NRC Form 540 to the shipper. The shipper to be notified is the licensee who last possessed the waste and transferred the waste to the operator. If any discrepancy exists between materials listed on the Uniform Low-Level Radioactive Waste Manifest and materials received, copies or electronic transfer of the affected forms must be returned indicating the discrepancy;

(b) Maintain copies of all completed manifests and electronically store the information required by 10 CFR part 61 section 80 subsection (l) until the Commission terminates the license; and

(c) Notify the shipper and the Administrator of the nearest Commission Regional Office when any shipment, or part of a shipment, has not arrived within 60 days after receipt of an

advance manifest, unless notified by the shipper that the shipment has been canceled.

E. Any shipment or part of a shipment for which acknowledgment is not received within the times set forth in this section must:

(a) Be investigated by the shipper if the shipper has not received notification or receipt within twenty days after transfer; and

(b) Be traced and reported. The investigation shall include tracing the shipment and filing a report with the nearest commission regional office. Each licensee who conducts a trace investigation shall file a written report with the appropriate nuclear regulatory commission regional office within two weeks of completion of the investigation.

Performance Requirements for Radiography Equipment - Part 34 (60 FR 28323)		
NRC Regulation Section	**State Regulation Section**	**Comments**
34.20	33-10-05-04, subsection 1	

33-10-05-04, subsection 1

1. Performance requirements for radiography equipment. Equipment used in industrial radiographic operations must meet the following minimum criteria:

   a. Each radiographic exposure device and all associated equipment must meet the requirements specified in American national standards institute (ANSI) N432-1980 "radiological safety for the design and construction of apparatus for gamma radiography", (published in NBS handbook 136, issued January 1981). Engineering analysis may be submitted by an applicant or licensee to demonstrate the applicability of previously performed testing on similar individual radiography equipment components. Upon review, the department may find this an acceptable alternative to actual testing of the component pursuant to the standard.

   b. In addition to the requirements specified in subdivision a, the following requirements apply to radiographic exposure devices and associated equipment.

      (1) Each radiographic exposure device must have attached to it by the user, a durable, legible, clearly visible label bearing the:

         (a) Chemical symbol and mass number of the radionuclide in the device;

         (b) Activity and the date on which this activity was last measured;

         (c) Model number and serial number of the sealed source;

         (d) Manufacturer of the sealed source; and

         (e) Licensee's name, address, and telephone number.

      (2) Radiographic exposure devices intended for use as type B transport containers must meet the applicable requirements of 10 CFR part 71.

      (3) Modification of any exposure devices and associated equipment is prohibited unless the design of any replacement component, including source holder,

33-10-05-04, subsection 1 (continued)

source assembly, controls, or guide tubes would nc compromise the design safety features of the system

c. In addition to the requirements specified in subdivisions a and b, the following requirements apply to radiographic exposure devices and associated equipment that allow the source to be moved out of the device for routine operation.

(1) The coupling between the source assembly and the control cable must be designed in such a manner that the source assembly will not become disconnected if cranked outside the guide tube. The coupling must be such that it cannot be unintentionally disconnected under normal and reasonably foreseeable abnormal conditions.

(2) The device must automatically secure the source assembly when it is cranked back into the fully shielded position within the device. This securing system may only be released by means of a deliberate operation on the exposure device.

(3) The outlet fittings, lockbox, and drive cable fittings on each radiographic exposure device must be equipped with safety plugs or covers which must be installed during storage and transportation to protect the source assembly from water, mud, sand, or other foreign matter.

(4) Each sealed source or source assembly must have attached to it or engraved in it, a durable, legible, visible label with the words: "DANGER RADIOACTIVE". The label must not interfere with the safe operation of the exposure device or associated equipment.

(5) The guide tube must have passed the crushing tests for the control tube as specified in American national standards institute N432-1980 and a kinking resistance test that closely approximates the kinking forces likely to be encountered during use.

(6) Guide tubes must be used when moving the source ou of the device.

33-10-05-04, subsection 1 (continued)

(7) An exposure head or similar device designed to prevent the source assembly from passing out of the end of the guide tube must be attached to the outermost end of the guide tube during radiographic operations.

(8) The guide tube exposure head connection must be able to withstand the tensile test for control units specified in American national standards institute N432-1980.

(9) Source changers must provide a system for assuring that the source will not be accidentally withdrawn from the changer when connecting or disconnecting the drive cable to or from a source assembly.

~~d. All newly manufactured radiographic exposure devices and associated equipment acquired by licensees after January 10, 1992, must comply with the requirements of this section.~~

~~e. All radiographic exposure devices and associated equipment in use after January 10, 1996, must comply with the requirements of this section.~~

d. Notwithstanding subdivision a, equipment used in industrial radiographic operations need not comply with section 8.9.2(c) of the endurance test in American national standards institute N432-1980, if the prototype equipment has been tested using a torque value representative of the torque that an individual using the radiography equipment can realistically exert on the lever or crankshaft of the drive mechanism.

Radiation Protection Requirements: Amended Definitions and Criteria - Parts 19 and 20 (60 FR 36038)		
NRC Regulation Section	**State Regulation Section**	**Comments**
19.12	33-10-10-02, subsection 2	
20.1003	33-10-01-04, subsections 65, 72, and 82	
20.2104(a)	33-10-04.1-06, subsection 5, subdivision a	
20.2205	33-10-04.1-16, subsection 7, subdivision b	

33-10-10-02, subsection 2

2. **Instructions to workers.**

a. All individuals who in the course of employment are ~~engaged in licensed activities which involve exposure to radiation or to radioactive material, or both~~ likely to receive in a year an occupational dose in excess of one millisievert [100 millirem]:

33-10-10-02, subsection 2 (continued)

(1) Must be kept informed of the storage, transfer, or use of ~~radioactive material or of~~ sources of radiation ~~in the licensee's facility~~.

(2) Must be instructed in the health protection problems associated with exposure to ~~such~~ radiation or radioactive material to the individual and potential offspring, in precautions or procedures to minimize exposure, and in the purposes and functions of protective devices employed.

(3) Must be instructed in, and ~~instructed~~ required to observe, to the extent within the worker's control, the applicable provisions of this article and licenses for the protection of personnel from exposures to radiation or radioactive material

(4) Must be instructed of their responsibility to report promptly to the licensee or registrant any condition which may constitute, lead to, or cause a violation of North Dakota Century Code chapter 23-20.1, this article, and licenses or unnecessary exposure to radiation or radioactive material.

(5) Must be instructed in the appropriate response to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radiation or radioactive material.

(6) Must be advised as to the radiation exposure reports which workers must be furnished pursuant to subsection 3.

b. In determining those individuals subject to the requirements of subdivision a , licensees and registrants must take into consideration assigned activities during normal and abnormal situations involving exposure to radiation or radioactive material which can reasonably be expected to occur during the life of a licensed or registered facility. The extent of these instructions must be

33-10-10-02, subsection 2 (continued)

commensurate with potential radiological health protection problems present in the workplace.

33-10-01-04, subsection 65

medicine programs, universities, industrial radiographers, or small industrial programs. The terms "type A quantity" and "type B quantity" are defined in chapter 33-10-13.

64. "Medical use" means the intentional internal or external administration of radioactive material or the radiation therefrom to patients or human research subjects under the supervision of an authorized user as defined in chapter 33-10-07.

~~61~~65. "Member of the public" means any individual except when that individual is receiving an occupational dose.

~~62~~66. "Minor" means an individual less than eighteen years of age.

~~63~~67. "Monitoring" means the measurement of radiation, radioactive material concentrations, surface area activities or quantities of radioactive material, and the use of the results of these measurements to evaluate potential exposures and doses. For purposes of these rules, "radiation monitoring" and "radiation protection monitoring" are equivalent terms.

~~64~~68. "NARM" means any naturally occurring or accelerator-produced radioactive material. It does not include byproduct, source, or special nuclear material. (Note: For the purpose of meeting the definition of a licensing state by the conference of radiation control program directors, incorporated., naturally occurring or accelerator-produced radioactive material refers only to discrete sources of naturally occurring or accelerator-produced radioactive material. Diffuse sources of naturally occurring or accelerator-produced radioactive material are excluded from consideration by the conference of radiation control program directors, incorporated. for licensing state designation purposes.)

~~65~~69. "Natural radioactivity" means radioactivity of naturally occurring nuclides.

70. "Natural thorium" means thorium with the naturally occurring distribution of thorium isotopes (essentially 100 weight percent thorium-232).

~~66~~71. "Nuclear regulatory commission (NRC)" means the United States nuclear regulatory commission or its duly authorized representatives.

33-10-01-04, subsection 72

~~67~~72. "Occupational dose" means the dose received by an individual in the course of employment~~, while engaged in activities licensed or registered by the department,~~ in which the individual's assigned duties involve exposure to sources of radiation, whether or not the sources are in the possession of the licensee, registrant, or other person. Occupational dose does not include dose received: from background radiation, ~~as a patient~~ from any medical ~~practices, administration~~ the individual has received, from exposure to individuals administered radioactive material and released in accordance with subsection 12 of section 33-10-07-05, from voluntary participation in medical research programs, or as a member of the public.

~~68~~73. "Ore refineries" means all processors of a radioactive material ore.

~~69~~74. "Package" means the packaging together with its radioactive contents as presented for transport.

75. "Packaging" means the assembly of components necessary to ensure compliance with the packaging requirements of this article. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle, tie-down system, and auxiliary equipment may be designated as part of the packaging.

~~70~~76. "Particle accelerator" (see "accelerator").

~~71~~77. "Person" means any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, agency, political subdivision of this state, any other state or political subdivision or agency thereof, and any legal successor, representative, agent, or agency of the foregoing, other than the commission, or any successor thereto and other than federal government agencies licensed by the commission or any successor thereto.

~~72~~78. "Personnel monitoring equipment" (see "individual monitoring devices").

~~73~~79. "Pharmacist" means an individual licensed by this state to compound and dispense drugs, prescriptions, and poisons.

33-10-01-04, subsection 82

~~74~~80. "Physician" means an individual licensed by this state to dispense drugs in the practice of medicine.

~~75~~81. "Principal activities" means activities authorized by the license which are essential to achieving the purpose(s) for which the license was issued or amended. Storage during which no licensed material is accessed for use or disposal and activities incidental to decontamination or decommissioning are not principal activities.

~~76~~82. "Public dose" means the dose received by a member of the public from sources of radiation from a licensed or registered operation. ~~It~~ Public dose does not include occupational dose, or doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with subsection 12 of section 33-10-07-05 ~~dose received as a patient from medical practices~~, or ~~dose~~ from voluntary participation in medical research programs.

~~77~~83. "Pyrophoric material" means any liquid that ignites spontaneously in dry or moist air at or below one hundred thirty degrees Fahrenheit [54.4 degrees Celsius] or any solid material, other than one classed as an explosive, which under normal conditions is liable to cause fires through friction, retained heat from manufacturing or processing, or which can be ignited readily and, when ignited, burns so vigorously and persistently as to create a serious transportation, handling, or disposal hazard. Included are spontaneously combustible and water-reactive materials.

~~78~~84. "Quality factor" (Q) means the modifying factor, listed in tables I and II of section 33-10-01-14, that is used to derive dose equivalent from absorbed dose.

~~79~~85. "Rad" means the special unit of absorbed dose. One rad is equal to an absorbed dose of one hundred erg per gram or one one-hundredths joule per kilogram (0.01 gray).

~~80~~86. "Radiation" means alpha particles, beta particles, gamma rays, x-rays, neutrons, high speed electrons, high speed protons, and other particles capable of producing ions. For purposes of these rules, ionizing radiation is an equivalent term. Radiation, as used in these rules, does not include

33-10-04.1-06, subsection 5, subdivision a

5. **Determination of prior occupational dose.**

a. For each individual who is likely to receive, in a year, an occupational dose requiring monitoring

pursuant to subsection 2 of section 33-10-04.1-09, the licensee or registrant shall:

(1) Determine the occupational radiation dose received during the current year; and

(2) Attempt to obtain the records of cumulative occupational radiation dose.

b. Prior to permitting an individual to participate in a planned special exposure, the licensee or registrant shall determine:

(1) The internal and external doses from all previous planned special exposures;

(2) All doses in excess of the limits, including doses received during accidents and emergencies, received during the lifetime of the individual; and

(3) All lifetime cumulative occupational radiation dose.

c. In complying with the requirements of subdivision a of subsection 5, a licensee or registrant may:

(1) Accept, as a record of the occupational dose that the individual received during the current year, a written signed statement from the individual, or from the individual's most recent employer for work involving radiation exposure, that discloses the nature and the amount of any occupational dose that the individual received during the current year;

(2) Accept, as the record of cumulative radiation dose, an up-to-date department's occupational radiation exposure history form (SFN 19443) or equivalent, signed by the individual and countersigned by an appropriate official of the most recent employer for work involving radiation exposure, or the individual's current employer, if the individual is not employed by the licensee or registrant; and

33-10-04.1-16, subsection 7, subdivision b

7. **Notifications and reports to individuals.**

   a. Requirements for notification and reports to individuals of exposure to radiation or radioactive material are specified in subsection 3 of section 33-10-10-02.

   b. When a licensee or registrant is required pursuant to ~~subsection 3~~ this section to report to the department any exposure of an individual to radiation or radioactive material, the licensee or registrant shall also ~~notify~~ provide the individual a copy of the report submitted to the department. Such ~~notice~~ reports shall be transmitted at a time not later than the transmittal to the department~~, and shall comply with the provisions of subdivision a of subsection 3 of section 33-10-10-02~~.

8. **Reports of leaking or contaminated sealed sources.** The licensee or registrant shall file a report within five days with the department if the test for leakage or contamination required pursuant to subsection 1 of section 33-10-04.1-08 indicates a sealed source is leaking or contaminated. The report shall include the equipment involved, the test results, and the corrective action taken.

History: Effective March 1, 1994; amended effective July 1, 1995.
General Authority: NDCC 23-20.1-04

Clarification of Decommissioning Funding Requirements - Parts 30, 40, 70 (60 FR 38235)		
NRC Regulation Section	**State Regulation Section**	**Comments**
30.35	33-10-03-05, subsection 14	
30.36	33-10-03-05, subsection 8	

33-10-03-05, subsection 14

14. **Financial assurance and recordkeeping for decommissioning.**

a. Each applicant for a specific license authorizing the possession and use of unsealed radioactive material of half-life greater than one hundred twenty days and in quantities exceeding one hundred thousand times the applicable quantities set forth in Schedule F of this chapter shall submit a decommissioning funding plan as described in subdivision e. The decommissioning funding plan must also be submitted when a combination of isotopes is involved if R divided by one hundred thousand is greater than one (unity rule), where R is defined here as the sum of the ratios of the quantity of each isotope to the applicable value in schedule F of this chapter.

b. Each applicant for a specific license authorizing possession and use of radioactive material of half-life greater than one hundred twenty days and in quantities specified in subdivision d shall either:

(1) Submit a decommissioning funding plan as described in subdivision e; or

(2) Submit a certification that financial assurance for decommissioning has been provided in the amount prescribed by subdivision d using one of the methods described in subdivision f. For an applicant, this certification may state that the appropriate assurance will be obtained after the application has been approved and the license issued but ~~prior to~~ before the receipt of licensed material. ~~As part of the certification, a copy of the financial instrument obtained to satisfy th requirements of subdivision f is to be submitted to the~~

~~department.~~ If the applicant defers execution of the financial instrument until after the license has been issued, a signed original of the financial instrument obtained to satisfy the requirements of subdivision f must be submitted to the department before receipt of licensed material. If the applicant does not defer execution of the financial instrument, the applicant shall supply to the department, as part of the certification, a signed original of the financial instrument obtained to satisfy the requirements of subdivision f.

c. (1) Each holder of a specific license ~~issued on or after January 1, 1994,~~ which is of a type described in subdivision a or b, shall provide financial assurance for decommissioning in accordance with the criteria set forth in this subsection.

(2) Each holder of a specific license ~~issued before January 1, 1994, and~~ of a type described in subdivision a shall submit~~, on or before January 1, 1994,~~ a decommissioning funding plan as described in subdivision e or a certification of financial assurance for decommissioning in an amount at least equal to seven hundred fifty thousand dollars in accordance with the criteria set forth in this subsection. If the licensee submits the certification of financial assurance rather than a decommissioning funding plan ~~at this time~~, the licensee shall include a decommissioning funding plan in any application for license renewal.

(3) Each holder of a specific license ~~issued before January 1, 1994, and~~ of a type described in subdivision b shall submit~~, on or before January 1, 1994,~~ a decommissioning funding plan as described in subdivision e or a certification of financial assurance for decommissioning ~~or a decommissioning funding plan~~ in accordance with the criteria set forth in this subsection.

d. Table of required amounts of financial assurance for decommissioning by quantity of material.

Greater than ten thousand but less than or equal to one hundred	

thousand times the applicable quantities of Schedule F in unsealed form. (For a combination of isotopes, if R, as defined in subdivision a, divided by ten thousand is greater than one but R divided by one hundred thousand is less than or equal to one) $750,000

Greater than one thousand but less than or equal to ten thousand times the applicable quantities of Schedule F in unsealed form. (For a combination of isotopes, if R, as defined in subdivision a, divided by one thousand is greater than one but R divided by ten thousand is less than or equal to one) $150,000

Greater than ten billion times the applicable quantities of Schedule F in sealed sources or plated foils. (For a combination of isotopes, if R, as defined in subdivision a, divided by ten billion is greater than one) $75,000

e. Each decommissioning funding plan must contain a cost estimate for decommissioning and a description of the method of assuring funds for decommissioning from subdivision f, including means of adjusting cost estimates and associated funding levels periodically over the life of the facility. The decommissioning funding plan must also contain a certification by the licensee that financial assurance for decommissioning has been provided in the amount of the cost estimate for decommissioning and a signed original of the financial instrument obtained to satisfy the requirements of subdivision f.

f. Financial assurance for decommissioning must be provided by one or more of the following methods:

(1) Prepayment. Prepayment is the deposit prior to the start of operation into an account segregated from licensee assets and outside the licensee's administrative control

of cash or liquid assets such that the amount of funds would be sufficient to pay decommissioning costs. Prepayment may be in the form of a trust, escrow account, government fund, certificate of deposit, or deposit of government securities.

(2) A surety method, insurance, or other guarantee method. These methods guarantee that decommissioning costs will be paid. A surety method may be in the form of a surety bond, letter of credit, or line of credit. A parent company guarantee of funds for decommissioning costs based on a financial test may be used if the guarantee and test are as contained in Schedule G. A parent company guarantee may not be used in combination with other financial methods to satisfy the requirements of this subsection. A guarantee of funds by the applicant or licensee for decommissioning costs based on a financial test may be used if the guarantee and test are as contained in schedule H. A guarantee by the applicant or licensee may not be used in combination with any other financial methods to satisfy the requirements of this subsection or in any situation where the applicant or licensee has a parent company holding majority control of the voting stock of the company. Any surety method or insurance used to provide financial assurance for decommissioning must contain the following conditions:

(a) The surety method or insurance must be open-ended or, if written for a specified term, such as five years, must be renewed automatically unless ninety days or more prior to the renewal date, the issuer notifies the department, the beneficiary, and the licensee of its intention not to renew. The surety method or insurance must also provide that the full face amount be paid to the beneficiary automatically prior to the expiration without proof of forfeiture if the licensee fails to provide a replacement acceptable to the department within thirty days after receipt of notification of cancellation.

(b) The surety method or insurance must be payable to a trust established for decommissioning costs. The trustee and trust must be acceptable to the department. An acceptable trustee includes an

appropriate state or federal government agency or an entity which has the authority to act as a trustee and whose trust operations are regulated and examined by a federal or state agency.

(c) The surety method or insurance must remain in effect until the department has terminated the license.

(3) An external sinking fund in which deposits are made at least annually, coupled with a surety method or insurance, the value of which may decrease by the amount being accumulated in the sinking fund. An external sinking fund is a fund established and maintained by setting aside funds periodically in an account segregated from licensee assets and outside the licensee's administrative control in which the total amount of funds would be sufficient to pay decommissioning costs at the time termination of operation is expected. An external sinking fund may be in the form of a trust, escrow account, government fund, certificate of deposit, or deposit of government securities. The surety or insurance provisions must be as stated in paragraph 2 of subdivision f.

(4) In the case of state or local government licensees, a statement of intent containing a cost estimate for decommissioning or an amount based on the table in subdivision d, and indicating that funds for decommissioning will be obtained when necessary.

(5) When a governmental agency is assuming custody and ownership of a site, an arrangement that is deemed acceptable by such governmental agency.

g. Each person licensed shall keep records of information important to the ~~safe and effective~~ decommissioning of ~~the~~ a facility in an identified location until the ~~license is terminated by the department~~ site is released for unrestricted use. Before licensed activities are transferred or assigned in accordance with subdivision b of subsection 7 of section 33-10-03-05, licensees shall transfer all records described in this subdivision to the new licensee. In this case, the new licensee shall maintain these records until the license is terminated. If records ~~of relevant information~~ important to

the decommissioning of a facility are kept for other purposes, reference to these records and their locations may be used. Information the department considers important to decommissioning consists of:

(1) Records of spills or other unusual occurrences involving the spread of contamination in and around the facility, equipment, or site. These records may be limited to instances when contamination remains after any cleanup procedures or when there is reasonable likelihood that contaminants may have spread to inaccessible areas as in the case of possible seepage into porous materials such as concrete. These records must include any known information on identification of involved nuclides, quantities, forms, and concentrations.

(2) As-built drawings and modifications of structures and equipment in restricted areas where radioactive materials are used or stored, and of locations of possible inaccessible contamination such as buried pipes which may be subject to contamination. If required drawings are referenced, each relevant document need not be indexed individually. If drawings are not available, the licensee shall substitute appropriate records of available information concerning these areas and locations.

(3) Except for areas containing only sealed sources (provided the sources have not leaked or no contamination remains after any leak) or radioactive materials having only half-lives of less than sixty-five days, a list contained in a single document and updated every two years, of the following:

(a) All areas designated and formerly designated as restricted areas as defined in section 33-10-01-04;

(b) All areas outside of restricted areas that require documentation under paragraph 1 of subdivision g;

(c) All areas outside of restricted areas where current and previous wastes have been buried as documented under subsection 9 of section 33-10-04.1-15; and

33-10-03-05, subsection 14 (continued)

(d) All areas outside of restricted areas which contain material such that, if the license expired, the licensee would be required to either decontaminate the area to ~~unrestricted release levels~~ meet the criteria for decommissioning in section 18 of chapter 33-10-04.1 or apply for approval for disposal under subsection 2 of section 33-10-04.1-14.

(4) Records of the cost estimate performed for the decommissioning funding plan or of the amount certified for decommissioning, and records of the funding method used for assuring funds if either a funding plan or certification is used.

History: Amended effective October 1, 1982, June 1, 1986; June 1, 1992; March 1, 1994; July 1, 1995
General Authority: NDCC 23-20.1-04, 23-20.1-04.1, 23-20.1-04.2, 23-20.1-04.5
Law Implemented: NDCC 23-20.1-03, 23-20.1-04, 23-20.1-04.1, 23-20.1-04.2, 23-20.1-04.5

33-10-03-05, subsection 8

8. **Expiration and termination of licenses and decommissioning of sites and separate buildings or outdoor areas.**

a. Each specific license expires at the end of the day on the expiration date stated in the license unless the licensee has filed an application for renewal under subsection 9 not less than thirty days before the expiration date stated in the existing license. If an application for renewal has been filed at least thirty days prior to the expiration date stated in the existing license, the existing license shall not expire until final action is taken on the renewal application by the department, or shall expire at the end of the day on which the department makes a final determination to deny the renewal application or, if the determination states an expiration date, the expiration date stated in the determination.

b. Each specific license revoked by the department expires at the end of the day on the date of the department's final determination to revoke the license, or on the expiration date stated in the determination, or as otherwise provided by department order.

33-10-03-05, subsection 8 (continued)

c. Each specific license continues in effect, beyond the expiration date if necessary, with respect to possession or radioactive material until the department notifies the licensee in writing that the license is terminated. During this time, the licensee shall:

(1) Limit actions involving radioactive material to those related to decommissioning; and

(2) Continue to control entry to restricted areas until they are suitable for release in accordance with requirements in article 33-10.

d. Within sixty days of the occurrence of any of the following, consistent with the administrative directions in section 33-10-01-13, each licensee shall provide notification to the department in writing of such occurrence, and either begin decommissioning its site, or any separate building or outdoor area that contains residual radioactivity so that the building or outdoor area is suitable for release in accordance with requirements in article 33-10, or submit within twelve months of notification a decommissioning plan, if required by paragraph 1 of subdivision ~~f~~g, and begin decommissioning upon approval of that plan if:

(1) The license has expired pursuant to subdivision a or b;

(2) The licensee has decided to permanently cease principal activities, as defined in section 33-10-01-04, at the entire site or in any separate building or outdoor area that contains residual radioactivity such that the building or outdoor area is unsuitable for release in accordance with requirements in article 33-10;

(3) No principal activities under the license have been conducted for a period of twenty-four months; or

(4) No principal activities have been conducted for a period of twenty-four months in any separate building or outdoor area that contains residual radioactivity such that the building or outdoor area is unsuitable for release in accordance with requirements in article 33-10.

e. Coincident with the notification required by subdivision d, the licensee shall maintain in effect all decommissioning

financial assurances established by the licensee pursuant to subsection 14 in conjunction with a license issuance or renewal or as required by this subsection. The amount of the financial assurance must be increased, or may be decreased, as appropriate, to cover the detailed cost estimate for decommissioning established pursuant to subparagraph e of paragraph 4 of subdivision g.

(1) Any licensee who has not provided financial assurance to cover the detailed cost estimate submitted with the decommissioning plan shall do so.

(2) Following approval of the decommissioning plan, a licensee may reduce the amount of the financial assurance as decommissioning proceeds and radiological contamination is reduced at the site with the approval of the department.

~~e~~f. The department may grant a request to extend the time periods established in subdivision d if the department determines that this relief is not detrimental to the public health and safety and is otherwise in the public interest. The request must be submitted no later than thirty days before notification pursuant to subdivision d. The schedule for decommissioning set forth in subdivision d may not commence until the department has made a determination on the request.

~~f~~g. (1) A decommissioning plan must be submitted if required by license condition or if the procedures and activities necessary to carry out decommissioning of the site or separate building or outdoor area have not been previously approved by the department and these procedures could increase potential health and safety impacts to workers or to the public, such as in any of the following cases:

(a) Procedures would involve techniques not applied routinely during cleanup or maintenance operations;

(b) Workers would be entering areas not normally occupied where surface contamination and radiation levels are significantly higher than routinely encountered during operation;

33-10-03-05, subsection 8 (continued)

(c) Procedures could result in significantly greater airborne concentrations of radioactive materials than are present during operation; or

(d) Procedures could result in significantly greater releases of radioactive material to the environment than those associated with operation.

(2) The department may approve an alternate schedule for submittal of a decommissioning plan required pursuant to subdivision d if the department determines that the alternative schedule is necessary to the effective conduct of decommissioning operations and presents no undue risk from radiation to the public health and safety and is otherwise in the public interest.

(3) Procedures such as those listed in paragraph 1 of subdivision ~~f~~g with potential health and safety impacts may not be carried out prior to approval of the decommissioning plan.

(4) The proposed decommissioning plan for the site or separate building or outdoor area must include:

(a) A description of the conditions of the site or separate building or outdoor area sufficient to evaluate the acceptability of the plan;

(b) A description of planned decommissioning activities;

(c) A description of methods used to ensure protection of workers and the environment against radiation hazards during decommissioning;

(d) A description of the planned final radiation survey; and

(e) An updated detailed cost estimate for decommissioning, comparison of that estimate with present funds set aside for decommissioning, and a plan for assuring the availability of adequate funds for completion of decommissioning.

(f) For decommissioning plans calling for completion of decommissioning later than twenty-four months after plan approval, the plan must include a justification for the delay based on the criteria in subdivision ~~h~~i.

(5) The proposed decommissioning plan will be approved by the department if the information therein demonstrates that the decommissioning will be completed as soon as ~~practicable~~ practical and that the health and safety of workers and the public will be adequately protected.

~~g~~h. (1) Except as provided in subdivision ~~h~~i, licensees shall complete decommissioning of the site or separate building or outdoor area as soon as ~~practicable~~ practical but no later than twenty-four months following the initiation of decommissioning.

(2) Except as provided in subdivision ~~h~~i, when decommissioning involves the entire site, the licensee shall request license termination as soon as ~~practicable~~ practical but no later than twenty-four months following the initiation of decommissioning.

~~h~~i. The department may approve a request for an alternative schedule for completion of decommissioning of the site or separate building or outdoor area, and license termination if appropriate, if the department determines that the alternative is warranted by consideration of the following:

(1) Whether it is technically feasible to complete decommissioning within the allotted twenty-four month period;

(2) Whether sufficient waste disposal capacity is available to allow completion of decommissioning within the allotted twenty-four month period;

(3) Whether a significant volume reduction in wastes requiring disposal will be achieved by allowing short-lived radionuclides to decay;

(4) Whether a significant reduction in radiation exposure to workers can be achieved by allowing short-lived radionuclides to decay; and

33-10-03-05, subsection 8 (continued)

(5) Other site-specific factors which the department may consider appropriate on a case-by-case basis, such as the regulatory requirements of other government agencies, lawsuits, ground-water treatment activities, monitored natural ground-water restoration, actions that could result in more environmental harm than deferred cleanup, and other factors beyond the control of the licensee.

~~i~~j. As the final step in decommissioning, the licensee shall:

(1) Certify the disposition of all licensed material, including accumulated wastes, by submitting a completed radiation control program form 1 or equivalent information; and

(2) Conduct a radiation survey of the premises where the licensed activities were carried out and submit a report of the results of this survey unless the licensee demonstrates ~~that the premises are suitable for release~~ that the premises are suitable for release in accordance with the criteria for decommissioning in section 18 of chapter 33-10-04.1 in some other manner. The licensee shall, as appropriate:

(a) Report levels of gamma radiation in units of millisieverts (millirem) per hour at one meter from surfaces, and report levels of radioactivity, including alpha and beta, in units of megabecquerels (disintegrations per minute or microcuries) per one hundred square centimeters, removable and fixed, for surfaces, megabecquerels (microcuries) per milliliter for water, and becquerels (picocuries) per gram for solids such as soils or concrete; and

(b) Specify the survey instruments used and certify that each instrument is properly calibrated and tested.

~~j~~k. Specific licenses, including expired licenses, will be terminated by written notice to the licensee when the department determines that:

(1) Radioactive material has been properly disposed;

33-10-03-05, subsection 8 (continued)

(2) Reasonable effort has been made to eliminate residual radioactive contamination, if present; and

(3) (a) A radiation survey has been performed which demonstrates that the premises are suitable for release in accordance with ~~requirements in article 33-10~~ the criteria for decommissioning in section 18 of chapter 33-10-04.1;

(b) Other information submitted by the licensee is sufficient to demonstrate that the premises are suitable for release in accordance with ~~requirements in article 33-10~~ the criteria for decommissioning in section 18 of chapter 33-10-04.1.

(4) Records required by subsection 14 of section 33-10-03-05 and sections 14 and 15 of chapter 33-10-04.1 have been received.

Medical Administration of Radiation and Radioactive Materials - Parts 20, 35 (60 FR 48623)		
NRC Regulation Section	**State Regulation Section**	**Comments**
20.1002	33-10-04.1-02	
20.1003	33-10-01-04, subsections 72 and 82	
20.1301(a)(1)	33-10-04.1-07.1.a(1)	
35.2	33-10-07-01.1, subsection 10	
35.33	33-10-07-04, subsection 8	

33-10-04.1-02

33-10-04.1-02. Scope. This chapter applies to persons licensed or registered by the department to receive, possess, use, transfer, or dispose of sources of radiation. The limits in this chapter do not apply to doses due to background radiation, to ~~exposure of patients to radiation for the purpose of~~ any medical ~~diagnosis or therapy~~ administration or therapy the individual has received, to exposure from individuals administered radioactive material and released in accordance with subsection 12 of section 33-10-07-05, or to voluntary participation in medical research programs.

History: Effective March 1, 1994.
General Authority: NDCC 23-20.1-04
Law Implemented: NDCC 23-20.1-03, 23-20.1-04

33-10-04.1-03. Definitions. As used in this chapter:

1. "Annual limit on intake" (ALL) means the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. Annual limit on intake is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of five-hundredths savored [5 rem] or a committed dose equivalent of five-tenths savored [50 rem] to any individual organ or tissue. Annual limit on intake values for intake by ingestion and by inhalation of selected radionuclides are given in table I, columns 1 and 2, of appendix B.

2. "Class" means a classification scheme for inhaled material according to its rate of clearance from the pulmonary region of the lung. Materials are classified as D, W, or Y, which applies to a range of clearance half-times: for class D, days, of less than ten days, for class W, weeks, from ten to one hundred days, and for

33-10-01-04, subsection 72

~~67~~72. "Occupational dose" means the dose received by an individual in the course of employment~~, while engaged in activities licensed or registered by the department,~~ in which the individual's assigned duties involve exposure to sources of radiation, whether or not the sources are in the possession of the licensee, registrant, or other person. Occupational dose does not include dose received: from background radiation, ~~as a patient~~ from any medical ~~practices, administration~~ the individual has received, from exposure to individuals administered radioactive material and released in accordance with subsection 12 of section 33-10-07-05, from voluntary participation in medical research programs, or as a member of the public.

~~68~~73. "Ore refineries" means all processors of a radioactive material ore.

~~69~~74. "Package" means the packaging together with its radioactive contents as presented for transport.

75. "Packaging" means the assembly of components necessary to ensure compliance with the packaging requirements of this article. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle, tie-down system, and auxiliary equipment may be designated as part of the packaging.

~~70~~76. "Particle accelerator" (see "accelerator").

~~71~~77. "Person" means any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, agency, political subdivision of this state, any other state or political subdivision or agency thereof, and any legal successor, representative, agent, or agency of the foregoing, other than the commission, or any successor thereto and other than federal government agencies licensed by the commission or any successor thereto.

~~72~~78. "Personnel monitoring equipment" (see "individual monitoring devices").

~~73~~79. "Pharmacist" means an individual licensed by this state to compound and dispense drugs, prescriptions, and poisons.

33-10-01-04, subsection 82

~~74~~80. "Physician" means an individual licensed by this state to dispense drugs in the practice of medicine.

~~75~~81. "Principal activities" means activities authorized by the license which are essential to achieving the purpose(s) for which the license was issued or amended. Storage during which no licensed material is accessed for use or disposal and activities incidental to decontamination or decommissioning are not principal activities.

~~76~~82. "Public dose" means the dose received by a member of the public from sources of radiation from a licensed or registered operation. ~~It~~ Public dose does not include occupational dose, or doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with subsection 12 of section 33-10-07-05 ~~dose received as a patient from medical practices~~, or ~~dose~~ from voluntary participation in medical research programs.

~~77~~83. "Pyrophoric material" means any liquid that ignites spontaneously in dry or moist air at or below one hundred thirty degrees Fahrenheit [54.4 degrees Celsius] or any solid material, other than one classed as an explosive, which under normal conditions is liable to cause fires through friction, retained heat from manufacturing or processing, or which can be ignited readily and, when ignited, burns so vigorously and persistently as to create a serious transportation, handling, or disposal hazard. Included are spontaneously combustible and water-reactive materials.

~~78~~84. "Quality factor" (Q) means the modifying factor, listed in tables I and II of section 33-10-01-14, that is used to derive dose equivalent from absorbed dose.

~~79~~85. "Rad" means the special unit of absorbed dose. One rad is equal to an absorbed dose of one hundred erg per gram or one one-hundredths joule per kilogram (0.01 gray).

~~80~~86. "Radiation" means alpha particles, beta particles, gamma rays, x-rays, neutrons, high speed electrons, high speed protons, and other particles capable of producing ions. For purposes of these rules, ionizing radiation is an equivalent term. Radiation, as used in these rules, does not include

33-10-04.1-07.1.a(1)

33-10-04.1-07. Radiation dose limits for individual members of the public.

1. Dose limits for individual members of the public.

a. Each licensee or registrant shall conduct operations so that:

(1) The total effective dose equivalent to individual members of the public from the licensed or registered operation does not exceed one millisievert [0.1 rem] in a year, exclusive of the dose contribution from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with subsection 12 of section 33-10-07-05, voluntary participation in medical research programs, and the licensee's or registrant's disposal of radioactive material into sanitary sewerage in accordance with subsection 3 of section 33-10-04.1-14. Retrofit shall not be required for locations within facilities where only radiation machines existed prior to January 1, 1994, and met the previous requirements of five millisievert [0.5 rem] in a year; and

(2) The dose in any unrestricted area from external sources exclusive of the dose contributions from patients administered radioactive material and released in accordance with subsection 12 of section 33-

33-10-07-01.1, subsection 10

10. "Misadministration" means the administration of:

a. A radiopharmaceutical dosage greater than ~~thirty microcuries [1110 kilobecquerels]~~ one thousand one hundred ten kilobecquerels [30 microcuries] of either sodium iodide I-125 or I-131:

(1) Involving the wrong ~~patient~~ individual or wrong radiopharmaceutical; or

(2) When both the administered dosage differs from the prescribed dosage by more than twenty percent of the prescribed dosage and the difference between the administered dosage and prescribed dosage exceeds ~~thirty microcuries [1110 kilobecquerels]~~ one thousand one hundred ten kilobecquerels [30 microcuries].

b. A therapeutic radiopharmaceutical dosage, other than sodium iodide I-125 or I-131:

(1) Involving the wrong ~~patient~~ individual, wrong radiopharmaceutical, or wrong route of administration; or

(2) When the administered dosage differs from the prescribed dosage by more than twenty percent of the prescribed dosage.

c. A gamma stereotactic radiosurgery radiation dose:

(1) Involving the wrong ~~patient~~ individual or wrong treatment site; or

(2) When the calculated total administered dose differs from the total prescribed dose by more than ten percent of the total prescribed dose.

d. A teletherapy radiation dose:

(1) Involving the wrong ~~patient~~ individual, wrong mode of treatment, or wrong treatment site;

(2) When the treatment consists of three or fewer fractions and the calculated total administered dose differs from the total prescribed dose by more than ten percent of the total prescribed dose;

(3) When the calculated weekly administered dose ~~is~~ exceeds the weekly prescribed dose by thirty percent ~~greater than~~ or more of the weekly prescribed dose; or

(4) When the calculated total administered dose differs from the total prescribed dose by more than twenty percent of the total prescribed dose.

e. A brachytherapy radiation dose:

(1) Involving the wrong ~~patient~~ individual, wrong radioisotope, or wrong treatment site (excluding, for permanent implants, seeds that were implanted in the correct site but migrated outside the treatment site);

(2) Involving a sealed source that is leaking;

(3) When, for a temporary implant, one or more sealed sources are not removed upon completion of the procedure; or

(4) When the calculated administered dose differs from the prescribed dose by more than twenty percent of the prescribed dose.

f. A diagnostic radiopharmaceutical dosage, other than quantities greater than ~~thirty microcuries [1110 kilobecquerels]~~ one thousand one hundred ten kilobecquerels [30 microcuries] of either sodium iodide I-125 or I-131, both:

(1) Involving the wrong ~~patient~~ individual, wrong radiopharmaceutical, wrong route of administration, or when the administered dosage differs from the prescribed dosage; and

(2) When the dose to the ~~patient~~ individual exceeds ~~five rems [50 millisieverts]~~ fifty millisieverts [5 rems] effective dose equivalent or ~~fifty rems [500 millisieverts]~~ five hundred millisieverts [50 rems] dose equivalent to any individual organ.

33-10-07-04, subsection 8

~~9~~8. **Notifications, reports, and records of misadministrations.**

a. For a misadministration:

(1) The licensee shall notify the department by telephone no later than the next working day after discovery of the misadministration.

(2) The licensee shall submit a written report to the department within fifteen days after discovery of the misadministration. The written report must include the licensee's name; the prescribing physician's name; a brief description of the event; why the event occurred; the effect on the ~~patient~~ individual who received the misadministration; what improvements are needed to prevent recurrence; actions taken to prevent recurrence; whether the licensee notified the ~~patient~~ individual, or the ~~patient's~~ individual's responsible relative or guardian ~~(this person will be subsequently referred to as "the patient" in this subsection)~~, and if not, why not~~,~~; and if ~~the patient~~ there was ~~notified~~ notification, what information was provided ~~to the patient~~. The report must not include the ~~patient's~~ individual's name or other information that could lead to identification of the ~~patient~~ individual. To meet the requirements of this subsection, the notification of the individual receiving the misadministration may be made instead to that individual's responsible relative or guardian, when appropriate.

(3) The licensee shall notify the referring physician and also notify the ~~patient~~ individual receiving the misadministration of the misadministration no later than twenty-four hours after its discovery, unless the referring physician personally informs the licensee either that the referring physician will inform the ~~patient~~ individual or that, based on medical judgment, telling the ~~patient~~ individual would be harmful. The licensee is not required to notify the ~~patient~~ individual without first consulting the referring physician. If the referring physician or ~~patient~~ individual receiving the misadministration cannot be reached within twenty-four hours, the licensee shall notify the ~~patient~~ individual as soon as possible thereafter. The licensee may not delay any appropriate medical care for the ~~patient~~ individual, including any necessary remedial care as a result of the misadministration, because of any delay in notification.

(4) If the ~~patient~~ individual who received the misadministration was notified, the licensee shall also furnish, within fifteen days after discovery of the misadministration, a written report to the ~~patient~~ individual by sending either:

(a) A copy of the report that was submitted to the department; or

(b) A brief description of both the event and the consequences as they may affect the ~~patient~~ individual, provided a statement is included that the report submitted to the department can be obtained from the licensee.

b. Each licensee shall retain a record of each misadministration for five years. The record must contain the names of all individuals involved (including the prescribing physician, allied health personnel, the ~~patient~~ individual who received the

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misadministration, and ~~the patient's~~ that individual's referring physician if applicable), the ~~patient's~~ individual's social security number or other identification number if one has been assigned, a brief description of the misadministration, why it occurred, the effect on the ~~patient~~ individual, what improvements are needed to prevent recurrence, and the actions taken to prevent recurrence.

c. Aside from the notification requirement, nothing in this subsection affects any rights or duties of licensees and physicians in relation to each other, ~~patients~~ to individuals receiving misadministrations, or ~~the patient's~~ to that individual's responsible relatives or guardians.

10 CFR Part 71: Compatibility With The International Atomic Energy Agency (60 FR 50248, 61 FR 28724)		
NRC Regulation Section	**State Regulation Section**	**Comments**
71.0	33-10-13-01	
71.3	33-10-13-03	
71.4	33-10-01-04 & 33-10-13-02	Definitions
71.5	33-10-13-05	
71.10	33-10-13-04	
71.12	33-10-13-07	
71.13	33-10-13-08	
71.14	33-10-13-09	
71.16	33-10-13-10	
71.18	33-10-13-11	
71.20	33-10-13-12	
71.81	33-10-13-01 is roughly equivalent to 10 CFR 71.81	
71.85	33-10-13-14	
71.87	33-10-13-15	
71.88	33-10-13-16	
71.89	33-10-13-05.1.b	
71.91	33-10-13-17	
71.95	33-10-13-18	
71.97	33-10-13-19	
Appendix A to Part 71	Appendix A to Chapter 33-10-13	

33-10-01-04 (pages 1-3 through 1-22)

33-10-01-04. Definitions. As used in this article, these terms have the definitions set forth below. Additional definitions used only in a certain section will be found in that section. Terms not defined in this article shall have the meaning given them in North Dakota Century Code chapter 23-20.1.

1. "A_1" means the maximum activity of special form radioactive material permitted in a Type A package. "A_2" means the maximum activity of radioactive material, other than special form, low specific activity (LSA), and surface contaminated object (SCO) ~~radioactive~~ material, permitted in a Type A package. These values are either listed in chapter 33-10-13, appendix A, table I, or may be derived in accordance with the procedure prescribed in chapter 33-10-13 appendix A.

2. "Absorbed dose" means the energy imparted by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the gray (Gy) and the rad.

3. "Accelerator" means any machine capable of accelerating electrons, protons, deuterons, or other charged particles in a vacuum and of discharging the resultant particulate or other radiation into a medium at energies usually in excess of one megaelectronvolt. For purposes of this definition, "particle accelerator" is an equivalent term.

4. "Accelerator produced material" means any material made radioactive by exposing it in a particle accelerator.

5. "Act" means North Dakota Century Code chapter 23-20.1.

6. "Activity" means the rate of disintegration or transformation or decay of radioactive material. The units of activity are the becquerel (Bq) and the curie (Ci).

7. "Adult" means an individual eighteen or more years of age.

8. "Agreement state" means any state with which the United States nuclear regulatory commission has entered into an effective agreement under section 274(b) of the Atomic Energy Act of 1954, as amended [73 Stat. 688; 42 U.S.C. 2021].

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9. "Airborne radioactive material" means any radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases.

10. "Airborne radioactivity area" means a room, enclosure, or area in which airborne radioactive materials exist in concentrations:

    a. In excess of the derived air concentrations (DACs) specified in appendix B, table I of chapter 33-10-04.1, or

    b. To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of six tenths percent of the annual limit on intake (ALI) or twelve derived air concentrations-hours.

11. "Alert" means events may occur, are in progress, or have occurred that could lead to a release of radioactive material but that the release is not expected to require a response by an offsite response organization to protect persons offsite.

12. "As low as is reasonably achievable" (ALARA) means making every reasonable effort to maintain exposures to radiation as far below the dose limits in these rules as is practical, consistent with the purpose for which the licensed or registered activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed or registered sources of radiation in the public interest.

13. "Background radiation" means radiation from cosmic sources; naturally occurring radioactive materials, including radon, except as a decay product of source or special nuclear material, and including global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. "Background radiation" does not include sources of radiation from radioactive materials regulated by the department.

14. "Becquerel" (Bq) means the SI unit of activity. One becquerel is equal to one disintegration or transformation per second (dps or tps).

15. "Bioassay" means the determination of kinds, quantities or concentrations, and, in some cases, the locations of radioactive material in the human body, whether by direct measurement, in vivo counting, or by analysis and evaluation of materials excreted or removed from the human body. For purposes of these rules, "radiobioassay" is an equivalent term.

16. "Brachytherapy" means a method of radiation therapy in which sealed sources are utilized to deliver a radiation dose at a distance of up to a few centimeters, by surface, intracavitary, or interstitial application.

17. "Byproduct material" means:

    a. Any radioactive material, except special nuclear material, yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material; and

    b. The tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium or thorium solution extraction processes. Underground ore bodies depleted by these solution extraction operations do not constitute "byproduct material" within this definition.

18. "Calendar quarter" means not less than twelve consecutive weeks nor more than fourteen consecutive weeks. The first calendar quarter of each year shall begin in January and subsequent calendar quarters shall be so arranged such that no day is included in more than one calendar quarter and no day in any one year is omitted from inclusion within a calendar quarter. No licensee or registrant shall change the method observed by the licensee or registrant of determining calendar quarters for purposes of this article except at the beginning of a year.

19. "Calibration" means the determination of:

    a. The response or reading of an instrument relative to a series of known radiation values over the range of the instrument; or

b. The strength of a source of radiation relative to a standard.

20. "CFR" means Code of Federal Regulations.

21. "Chelating agent" means amine polycarboxylic acids (e.g., EDTA, DTPA), hydroxycarboxylic acids, ~~gluconic acid,~~ and polycarboxylic acids (e.g., citric acid, carbolic acid, and gluconic acid).

22. "Collective dose" means the sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation.

23. "Committed dose equivalent" ($H_{T,50}$) means the dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the fifty-year period following the intake.

24. "Committed effective dose equivalent" ($H_{E,50}$) is the sum of the products of the weighing factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to each of these organs or tissues ($H_{E,50} = \sum W_T, H_{T,50}$).

25. "Constraint" (dose constraint) means a value above which specified licensee actions are required.

26. "Critical group" means the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.

~~25~~27. "Curie" means a unit of measurement of activity. One curie (Ci) is that quantity of radioactive material which decays at the rate of 3.7×10^{10} disintegrations or transformations per second (dps or tps).

~~26~~28. "Decommission" means to remove ~~(as a facility)~~ a facility or site safely from service and reduce residual radioactivity to a level that permits:

a. ~~r~~Release of the property for unrestricted use and termination of license~~.~~ ; or

b. Release of the property under restricted conditions and termination of the license.

~~27~~29. "Deep dose equivalent" (H_d), which applies to external whole body exposure means the dose equivalent at a tissue depth of one centimeter (or a density thickness of 1000 mg/cm^2). This assumes a tissue density of one gram per cubic centimeter.

~~28~~30. "Department" means the North Dakota department of health.

~~29. "Depleted uranium" means the source material uranium in which the isotope uranium 235 is less than 0.711 weight percent of the total uranium present. Depleted uranium does not include special nuclear material.~~

31. "Distinguishable from background" means that the detectable concentration of a radionuclide is statistically different from the background concentration of that radionuclide in the vicinity of the site or, in the case of structures, in similar materials using adequate measurement technology, survey, and statistical techniques.

~~30~~32. "Dose" is a generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, total organ dose equivalent, or total effective dose equivalent. For purposes of these rules, "radiation dose" is an equivalent term.

~~31~~33. "Dose equivalent (H_T)" means the product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the sievert (Sv) and rem.

~~32~~34. "Dose limits" means the permissible upper bounds of radiation doses established in accordance with these rules. For purposes of these rules, "limits" is an equivalent term.

~~33~~35. "Effective dose equivalent (H_E)" means the sum of the products of the dose equivalent to each organ or tissue (H_T) and the weighting factor (W_T) applicable to each of the body organs or tissues that are irradiated ($H_E = \sum W_T H_T$).

~~34~~36. "Embryo/fetus" means the developing human organism from conception until the time of birth.

~~35~~37. "Entrance or access point" means any opening through which an individual or extremity of an individual could gain access to

radiation areas or to licensed or registered radioactive materials. This includes entry or exit portals of sufficient size to permit human entry, irrespective of their intended use.

~~36~~38. "Explosive material" means any chemical compound, mixture, or device which produces a substantial instantaneous release of gas and heat spontaneously or by contact with sparks or flame.

~~37~~39. "Exposure" means being exposed to ionizing radiation or to radioactive material.

~~38~~40. "External dose" means that portion of the dose equivalent received from any source of radiation outside the body.

~~39~~41. "Extremity" means hand, elbow, arm below the elbow, foot, knee, and leg below the knee.

~~40~~42. "Eye dose equivalent" means the external dose equivalent to the lens of the eye at a tissue depth of three tenths centimeter (or a density thickness of 300 mg/cm^2). This assumes a tissue density of one gram per cubic centimeter.

~~41~~43. "Former United States atomic energy commission or United States nuclear regulatory commission licensed facilities" means nuclear reactors, nuclear fuel reprocessing plants, uranium enrichment plants, or critical mass experimental facilities where their atomic energy commission or nuclear regulatory commission licenses have been terminated.

~~42~~44. "Generally applicable environmental radiation standards" means standards issued by the United States environmental protection agency under the authority of the Atomic Energy Act of 1954, as amended, that impose limits on radiation exposures or levels, or concentrations or quantities of radioactive material, in the general environment outside the boundaries of locations under the control of persons possessing or using radioactive material.

~~43~~45. "Gray" (Gy) means the SI unit of absorbed dose. One gray is equal to an absorbed dose of one joule per kilogram [100 rad].

~~44~~46. "Hazardous waste" means those wastes designated as hazardous by United States environmental protection agency regulations

in 40 CFR part 261 and article 33-24 of the North Dakota Administrative Code.

~~45~~47. "Healing arts" means diagnostic or healing treatment of human and animal maladies including, but not limited to, the following which are duly licensed by the state of North Dakota for the lawful practice of: medicine and its associated specialties, dentistry, veterinary medicine, osteopathy, chiropractic, and podiatry.

~~46~~48. "High radiation area" means any area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of one hundred millirems [1 millisievert] in one hour at thirty centimeters from any source of radiation or from any surface that the radiation penetrates.

~~47~~49. "Human use" means the internal or external administration of radiation or radioactive material to human beings.

~~48~~50. "Individual" means any human being.

~~49~~51. "Individual monitoring" means the assessment of:

a. Dose equivalent by the use of individual monitoring devices or by the use of survey data; or

b. Committed effective dose equivalent by bioassay or by determination of the time-weighted air concentrations to which an individual has been exposed, that is, derived air concentration-hours. (See the definition of derived air concentration-hours in chapter 33-10-04.1).

~~50~~52. "Individual monitoring devices" means devices designed to be worn by a single individual for the assessment of dose equivalent. For purposes of these rules, "personnel dosimeter" and "dosimeter" are equivalent terms. Examples of individual monitoring devices are film badges, thermoluminescent dosimeters (TLDs), pocket ionization chambers, and personal air sampling devices.

~~51~~53. "Inspection" means an official examination or observation including, but not limited to, tests, surveys, and monitoring to determine compliance with rules, regulations, orders, requirements, and conditions of the department.

~~52~~54. "Interlock" means a device arranged or connected such that the occurrence of an event or condition is required before a second event or condition can occur or continue to occur.

~~53~~55. "Internal dose" means that portion of the dose equivalent received from radioactive material taken into the body.

~~54~~56. "License" means a general or specific license issued by the department in accordance with the regulations adopted by the department.

~~55~~57. "Licensed material" means radioactive material received, possessed, used, transferred, or disposed of under a general or specific license issued by the department.

~~56~~58. "Licensee" means any person who is licensed by the department in accordance with this article and North Dakota Century Code chapter 23-20.1.

~~57~~59. "Licensing state" means any state with regulations equivalent to the Suggested State Regulations for Control of Radiation relating to, and an effective program for, the regulatory control of NARM and which has been granted final designation by the conference of radiation control program directors, inc.

~~58~~60. "Limits" (see "dose limits").

~~59~~61. "Lost or missing licensed (or registered) source of radiation" means licensed (or registered) source of radiation whose location is unknown. This definition includes licensed (or registered) material that has been shipped but has not reached its planned destination and whose location cannot be readily traced in the transportation system.

62. "Low toxicity alpha emitters" means natural uranium, depleted uranium, natural thorium; uranium-235, uranium-238, thorium-232, thorium-228 or thorium-230 when contained in ores or physical or chemical concentrates or tailings; or alpha emitters with a half-life of less than 10 days.

~~60~~63. "Major processor" means a user processing, handling, or manufacturing radioactive material exceeding type A quantities as unsealed sources or material, or exceeding four times type B quantities as sealed sources, but does not include nuclear

medicine programs, universities, industrial radiographers, or small industrial programs. The terms "type A quantity" and "type B quantity" are defined in chapter 33-10-13.

64. "Medical use" means the intentional internal or external administration of radioactive material or the radiation therefrom to patients or human research subjects under the supervision of an authorized user as defined in chapter 33-10-07.

~~61~~65. "Member of the public" means any individual except when that individual is receiving an occupational dose.

~~62~~66. "Minor" means an individual less than eighteen years of age.

~~63~~67. "Monitoring" means the measurement of radiation, radioactive material concentrations, surface area activities or quantities of radioactive material, and the use of the results of these measurements to evaluate potential exposures and doses. For purposes of these rules, "radiation monitoring" and "radiation protection monitoring" are equivalent terms.

~~64~~68. "NARM" means any naturally occurring or accelerator-produced radioactive material. It does not include byproduct, source, or special nuclear material. (Note: For the purpose of meeting the definition of a licensing state by the conference of radiation control program directors, incorporated., naturally occurring or accelerator-produced radioactive material refers only to discrete sources of naturally occurring or accelerator-produced radioactive material. Diffuse sources of naturally occurring or accelerator-produced radioactive material are excluded from consideration by the conference of radiation control program directors, incorporated. for licensing state designation purposes.)

~~65~~69. "Natural radioactivity" means radioactivity of naturally occurring nuclides.

70. "Natural thorium" means thorium with the naturally occurring distribution of thorium isotopes (essentially 100 weight percent thorium-232).

~~66~~71. "Nuclear regulatory commission (NRC)" means the United States nuclear regulatory commission or its duly authorized representatives.

~~67~~72. "Occupational dose" means the dose received by an individual in the course of employment~~, while engaged in activities licensed or registered by the department,~~ in which the individual's assigned duties involve exposure to sources of radiation, whether or not the sources are in the possession of the licensee, registrant, or other person. Occupational dose does not include dose received: from background radiation, ~~as a patient~~ from any medical ~~practices, administration~~ the individual has received, from exposure to individuals administered radioactive material and released in accordance with subsection 12 of section 33-10-07-05, from voluntary participation in medical research programs, or as a member of the public.

~~68~~73. "Ore refineries" means all processors of a radioactive material ore.

~~69~~74. "Package" means the packaging together with its radioactive contents as presented for transport.

75. "Packaging" means the assembly of components necessary to ensure compliance with the packaging requirements of this article. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle, tie-down system, and auxiliary equipment may be designated as part of the packaging.

~~70~~76. "Particle accelerator" (see "accelerator").

~~71~~77. "Person" means any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, agency, political subdivision of this state, any other state or political subdivision or agency thereof, and any legal successor, representative, agent, or agency of the foregoing, other than the commission, or any successor thereto and other than federal government agencies licensed by the commission or any successor thereto.

~~72~~78. "Personnel monitoring equipment" (see "individual monitoring devices").

~~73~~79. "Pharmacist" means an individual licensed by this state to compound and dispense drugs, prescriptions, and poisons.

~~74~~80. "Physician" means an individual licensed by this state to dispense drugs in the practice of medicine.

~~75~~81. "Principal activities" means activities authorized by the license which are essential to achieving the purpose(s) for which the license was issued or amended. Storage during which no licensed material is accessed for use or disposal and activities incidental to decontamination or decommissioning are not principal activities.

~~76~~82. "Public dose" means the dose received by a member of the public from sources of radiation from a licensed or registered operation. ~~It~~ Public dose does not include occupational dose, or doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with subsection 12 of section 33-10-07-05 ~~dose received as a patient from medical practices~~, or ~~dose~~ from voluntary participation in medical research programs.

~~77~~83. "Pyrophoric material" means any liquid that ignites spontaneously in dry or moist air at or below one hundred thirty degrees Fahrenheit [54.4 degrees Celsius] or any solid material, other than one classed as an explosive, which under normal conditions is liable to cause fires through friction, retained heat from manufacturing or processing, or which can be ignited readily and, when ignited, burns so vigorously and persistently as to create a serious transportation, handling, or disposal hazard. Included are spontaneously combustible and water-reactive materials.

~~78~~84. "Quality factor" (Q) means the modifying factor, listed in tables I and II of section 33-10-01-14, that is used to derive dose equivalent from absorbed dose.

~~79~~85. "Rad" means the special unit of absorbed dose. One rad is equal to an absorbed dose of one hundred erg per gram or one one-hundredths joule per kilogram (0.01 gray).

~~80~~86. "Radiation" means alpha particles, beta particles, gamma rays, x-rays, neutrons, high speed electrons, high speed protons, and other particles capable of producing ions. For purposes of these rules, ionizing radiation is an equivalent term. Radiation, as used in these rules, does not include

nonionizing radiation, such as radiowaves or microwaves, visible, infrared, or ultraviolet light.

~~81~~87. "Radiation area" means any area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of five millirems [0.05 millisievert] in one hour at thirty centimeters from the source of radiation or from any surface that the radiation penetrates.

~~82~~88. "Radiation dose" (see "dose").

~~83~~89. "Radiation exposure" means the quotient of dQ by dm where "dQ" is the absolute value of the total charge of the ions of one sign produced in air when all the electrons (negatrons and positrons) liberated by photons in a volume element of air having mass "dm" are completely stopped in air. The SI unit of radiation exposure is the coulomb per kilogram (C/kg). (See section 33-10-01-14 units of exposure, dose, and activity for the special unit equivalent "roentgen" (R).)

~~84~~90. "Radiation exposure rate" means the radiation exposure per unit of time, such as R/min, mR/h, etc.

~~85~~91. "Radiation machine" means any device capable of producing radiation except, those devices with radioactive material as the only source of radiation.

~~86~~92. "Radiation safety officer" means an individual who has the knowledge and responsibility to apply appropriate radiation protection regulations.

~~87~~93. "Radioactive material" means any material (solid, liquid, or gas) which emits radiation spontaneously.

~~88~~94. "Radioactivity" means the disintegration of unstable atomic nuclei by the emission of radiation.

~~89~~95. "Radiobioassay" (see "bioassay").

~~90~~96. "Registrant" means any person who is registered with the department and is legally obligated to register with the department pursuant to this article and North Dakota Century Code chapter 23-20.1.

~~91~~97. "Registration" means the notification of the department of possession of a source of radiation and the furnishing of information with respect thereto, in accordance with North Dakota Century Code chapter 23-20.

~~92~~98. "Regulations of the United States department of transportation" means the regulations in 49 CFR, 100-189.

~~93~~99. "Rem" means the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rad multiplied by the quality factor (1 rem = 0.01 sievert (Sv)).

~~94~~100. "Research and development" means (a) theoretical analysis, exploration, or experimentation; or (b) the extension of investigative findings and theories of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of models, devices, equipment, materials, and processes. Research and development does not include the internal or external administration of radiation or radioactive material to human beings.

101. "Residual radioactivity" means radioactivity in structures, materials, soils, groundwater, and other media at a site resulting from activities under the licensee's control. This includes radioactivity from all licensed and unlicensed sources used by the licensee, but excludes background radiation. It also includes radioactive materials remaining at the site as a result of routine or accidental releases of radioactive material at the site and previous burials at the site, even if those burials were made in accordance with the provisions of this article.

~~95~~102. "Restricted area" means an area, access to which is limited by the licensee or registrant for the purpose of protecting individuals against undue risks from exposure to sources of radiation radioactive material. "Restricted area" does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

~~96~~103. "Roentgen" (R) means the special unit of exposure. One roentgen equals ~~2.58 x 10^{-4}~~ two hundred fifty-eight millionths of a coulomb~~s~~ per kilogram of air (see "Exposure").

~~97~~104. "Sealed source" means radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent release and dispersal of the radioactive material under the most severe conditions which are likely to be encountered in normal use and handling.

~~98~~105. "Shallow dose equivalent" (H_s), which applies to the external exposure of the skin or an extremity, means the dose equivalent at a tissue depth of seven one-thousandths centimeter [7 mg/cm^2] averaged over an area of one square centimeter.

~~99~~106. "SI" means the abbreviation for the international system of units.

~~100~~107. "Sievert" means the SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sievert is equal to the absorbed dose in gray multiplied by the quality factor (1 Sv = 100 rem).

~~101~~108. "Site area emergency" means events may occur, are in progress, or have occurred that could lead to a significant release of radioactive material and that could require a response by offsite response organizations to protect persons offsite.

~~102~~109. "Site boundary" means that line beyond which the land or property is not owned, leased, or otherwise controlled by the licensee or registrant.

~~103~~110. "Source material" means: (a) uranium or thorium, or any combination thereof, in any physical or chemical form; or (b) ores that contain by weight one-twentieth of one percent (0.05 percent) or more of uranium, thorium, or any combination of uranium and thorium. Source material does not include special nuclear material.

~~104~~111. "Source material milling" means any activity that results in the production of byproduct material as defined in subdivision b of subsection 17.

~~105~~112. "Source of radiation" means any radioactive material, or any device or equipment emitting or capable of producing radiation.

~~106~~113. "Special form radioactive material" means radioactive material that satisfies the following conditions:

a. It is either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule.

b. The piece or capsule has at least one dimension not less than five millimeters [0.2 inch].

c. It satisfies the test requirements specified by the United States nuclear regulatory commission. A special form encapsulation designed in accordance with the United States nuclear regulatory commission requirements in effect on June 30, 1983, and constructed prior to July 1, 1985, and a special form encapsulation designed in accordance with the United States nuclear regulatory commission requirements in effect on March 31, 1996, and constructed prior to April 1, 1998 may continue to be used. A special form encapsulation ~~either~~ designed ~~or constructed~~ after ~~June 30, 1985,~~ March 31, 1996, or constructed after April 1, 1998, must meet requirements of this definition applicable at the time of its design or construction.

~~107~~114. "Special nuclear material" means"

a. Plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope 235, and any other material that the United States nuclear regulatory commission, pursuant to the provisions of section 51 of the Atomic Energy Act of 1954, as amended, determined to be special nuclear material, but does not include source material; or

b. Any material artificially enriched by any of the foregoing but does not include source material.

~~108~~115. "Special nuclear material in quantities not sufficient to form a critical mass" means uranium enriched in the isotope U-235 in quantities not exceeding three hundred fifty grams of contained U-235, uranium-233 in quantities not exceeding two hundred grams; plutonium in quantities not exceeding two hundred grams; or any combination of them in accordance with the following formula: For each kind of special nuclear material, determine the ratio between the quantity of that special nuclear material and the quantity specified above for

the same kind of special nuclear material. The sum of such ratios for all of the kinds of special nuclear material in combination shall not exceed "1", i.e., unity. For example, the following quantities in combination would not exceed the limitation and are within the formula:

$$\frac{175 \text{ (grams contained U-235)}}{350} + \frac{50 \text{ (grams U-233)}}{200} + \frac{50 \text{ (grams Pu)}}{200} = 1$$

~~109~~116. "Surface Contaminated Object" (SCO) means a solid object that is not itself classed as radioactive material, but which has radioactive material distributed on any of its surfaces. Surface contaminated objects must be in one of two groups with surface activity not exceeding the following limits:

a. Surface contaminated object-I (SCO-I): A solid object on which:

(1) The non-fixed contamination on the accessible surface averaged over three hundred square centimeters (or the area of the surface if less than three hundred square centimeters) does not exceed four becquerels per square centimeter (0.0001 microcurie/cm²) for beta and gamma and low toxicity alpha emitters, or four-tenths becquerel per square centimeter (0.00001 microcurie/cm²) for all other alpha emitters;

(2) The fixed contamination on the accessible surface averaged over three hundred square centimeters (or the area of the surface if less than 300 cm²) does not exceed forty thousand becquerels per square centimeter (1.0 microcurie/cm²) for beta and gamma and low toxicity alpha emitters, or four thousand becquerels per square centimeter (0.1 microcurie/cm²) for all other alpha emitters; and

(3) The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over three hundred square centimeters (or the area of the surface if less than 300 cm²) does not exceed forty thousand becquerels per square centimeter (1.0 microcurie/cm²) for beta and gamma and low toxicity alpha emitters, or four thousand becquerel per square centimeter (0.1 microcurie/cm²) for all other alpha emitters.

b. Surface contaminated object-II (SCO-II): A solid object on which the limits for surface contaminated object-I (SCO-I) are exceeded and on which:

(1) The non-fixed contamination on the accessible surface averaged over three hundred square centimeters (or the area of the surface if less than 300 cm^2) does not exceed four hundred becquerels per square centimeter (0.01 microcurie/cm^2) for beta and gamma and low toxicity alpha emitters or forty becquerels per square centimeter (0.001 microcurie/cm^2) for all other alpha emitters;

(2) The fixed contamination on the accessible surface averaged over three hundred square centimeters (or the area of the surface if less than 300 cm^2) does not exceed eight hundred thousand becquerels per square centimeter (20 microcuries/cm^2) for beta and gamma and low toxicity alpha emitters, or eighty thousand becquerels per square centimeter (2 microcuries/cm^2) for all other alpha emitters; and

(3) The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over three hundred square centimeters (or the area of the surface if less than 300 cm^2) does not exceed eight hundred thousand becquerels per square centimeter (20 microcuries/cm^2) for beta and gamma and low toxicity alpha emitters, or eighty thousand becquerels per square centimeter (2 microcuries/cm^2) for all other alpha emitters.

~~109~~117. "Survey" means an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of sources of radiation. When appropriate, such evaluation includes tests, physical examination, and measurements of levels of radiation or concentration of radioactive material present.

~~110~~118. "Test" means a method for determining the characteristics or condition of sources of radiation or components thereof. "Test" may also mean the process of verifying compliance with this article.

~~111~~119. "These rules" means all parts of this article and any subsequent changes or additions thereto.

~~112~~120. "Total effective dose equivalent" (TEDE) means the sum of the deep dose equivalent for external exposures and the committed effective dose equivalent for internal exposures.

~~113~~121. "Total organ dose equivalent" (TODE) means the sum of the deep dose equivalent and the committed dose equivalent to the organ receiving the highest dose as described in chapter 33-10-04.1 of these rules.

~~114~~122. "United States department of energy" means the department of energy established by Pub. L. 95-91, [91 Stat. 565, 42 U.S.C. 7101 et seq.] to the extent that the department exercises functions formerly vested in the United States atomic energy commission, its chairman, members, officers, and components and transferred to the United States energy research and development administration and to the administrators thereof pursuant to sections 104(b), (c) and (d) of the Energy Reorganization Act of 1974 (Pub. L. 93-438; 88 Stat. 1237; 42 U.S.C. 5814, effective January 19, 1975) and transferred to the secretary of energy pursuant to subsection 301(a) of the Department of Energy Organization Act (Pub. L. 95-91); 91 Stat. 577-578, 42 U.S.C. 7151, effective October 1, 1977).

~~115~~123. "Unrefined and unprocessed ore" means ore in its natural form prior to any processing, such as grinding, roasting, beneficiating, or refining.

~~116~~124. "Unrestricted area" means an area, access to which is neither limited nor controlled by the licensee or registrant.

125. "Uranium" natural, depleted, enriched:

a. "Natural uranium" means uranium with the naturally occurring distribution of uranium isotopes (approximately 0.711 percent by weight uranium-235, and the remainder by weight essentially uranium-238).

b. "Depleted uranium" means uranium containing less uranium-235 than the naturally occurring distribution of uranium isotopes. Depleted uranium does not include special nuclear material.

c. "Enriched uranium" means uranium containing more uranium-235 than the naturally occurring distribution of uranium isotopes.

~~117~~126. "Waste" means those low-level radioactive wastes that are acceptable for disposal in a land disposal facility. For the purposes of this definition, low-level waste has the same meaning as in the Low-Level Radioactive Waste Policy Act [Pub. L. 96-573; 94 Stat. 3347; 42 U.S.C. 2021b-2021j], as amended by Pub. L. 99-240 [99 Stat. 1842; 42 U.S.C. 2021b-2021j], effective January 15, 1986; that is, radioactive waste:

a. Not classified as high-level radioactive waste, spent nuclear fuel, or byproduct material as defined in section 11e(2) of the Atomic Energy Act [Pub. L. 95-604; 92 Stat. 3033; 42 U.S.C. 2014(e)(2)] (uranium or thorium tailings and waste); and

b. Classified as low-level radioactive waste consistent with existing law and in accordance with subdivision a by the United States nuclear regulatory commission.

~~118~~127. "Waste handling licensees" means persons licensed to receive and store radioactive wastes prior to disposal and/or persons licensed to dispose of radioactive waste.

~~119~~128. "Week" means seven consecutive days starting on Sunday.

~~120~~129. "Whole body" means, for purposes of external exposure, head, trunk including male gonads, arms above the elbow, or legs above the knee.

~~121~~130. "Worker" means an individual engaged in work under a license or registration issued by the department and controlled by a licensee or registrant.

~~122~~131. "Working level" (WL) means any combination of short-lived radon daughters in one liter of air that will result in the ultimate emission of ~~1.3E+5~~ one hundred thirty thousand megaelectronvolt of potential alpha particle energy. The short-lived radon daughters are - for radon-222: polonium-218, lead-214, bismuth-214, and polonium-214; and for radon-220: polonium-216, lead-212, bismuth-212, and polonium-212.

~~123~~132. "Working level month" (WLM) means an exposure to one working level for one hundred seventy hours - two thousand working hours per year divided by twelve months per year is approximately equal to one hundred seventy hours per month.

~~124~~133. "Year" means the period of time beginning in January used to determine compliance with the provisions of these rules. The licensee or registrant may change the starting date of the year used to determine compliance by the licensee or registrant provided that the change is made at the beginning of the year and that no day is omitted or duplicated in consecutive years.

History: Amended effective October 1, 1982; June 1, 1986; June 1, 1992; March 1, 1994; July 1, 1995.
General Authority: NDCC 28-32-02, 23-20.1-04
Law Implemented: NDCC 23-20.1-03, 23-20.1-04

33-10-01-05. Exemptions.

1. General provision. The department may, upon application therefore or upon its own initiative, grant such exemptions or exceptions from the requirements of this article as it determines are authorized by law and will not result in undue hazard to public health and safety or property.

2. United States department of energy contractors and United States nuclear regulatory commission contractors. Any United States department of energy contractor or subcontractor and any United States nuclear regulatory commission contractor or subcontractor of the following categories operating within this state is exempt from this article to the extent that such contractor or subcontractor under the contractor's or subcontractor's contract receives, possesses, uses, transfers, or acquires sources of radiation:

   a. Prime contractors performing work for the United States department of energy at United States government-owned or government-controlled sites, including the transportation of sources of radiation to or from such sites and the performance of contract services during temporary interruptions of such transportation.

   b. Prime contractors of the United States department of energy performing research in, or development, manufacture, storage, testing, or transportation of, atomic weapons or components thereof.

CHAPTER 33-10-13
TRANSPORTATION OF RADIOACTIVE MATERIAL

33-10-13-01. Purpose and scope. The rules in this chapter establish requirements for packaging, preparation for shipment, and transportation of radioactive material and apply to any person who transports radioactive material or delivers radioactive material to a carrier for transport. To ensure compatibility with international transportation standards, all limits in this chapter are given in terms of dual units: The International System of Units (SI) followed by United States customary units. The United States customary units are not exact equivalents, but are rounded to a convenient value, providing a functionally equivalent unit. For the purpose of this chapter, either unit may be used.

History: Effective June 1, 1992.
General Authority: NDCC 28-32-02
Law Implemented: NDCC 28-32-02

33-10-13-02. Definitions. As used in this chapter, the following definitions apply:

1. "Carrier" means any person engaged in the transportation of passengers or property by land or water as a common, contract, or private carrier, or by civil aircraft.

2. "Certificate holder" means a person who has been issued a certificate of compliance or other package approval by the United States nuclear regulatory commission.

3. "Close reflection by water" means immediate contact by water of sufficient thickness for maximum reflection of neutrons.

~~2~~4. "Closed transport vehicle" means a transport vehicle equipped with a securely attached exterior enclosure that during normal transportation restricts the access of unauthorized individuals to the cargo space containing the radioactive material. The enclosure may be either temporary or permanent but must limit access from top, sides, and ends. In the case of packaged materials, it may be of the "see-through" type.

5. "Containment system" means the assembly of components of the packaging intended to retain the radioactive material during transport.

6. "Conveyance" means:

   a. For transport by public highway or rail: any transport vehicle or large freight container;

   b. For transport by water: any vessel, or any hold, compartment, or defined deck area of a vessel including any transport vehicle on board the vessel; and

   c. For transport by aircraft: any aircraft.

~~37~~. "Exclusive use" means the sole use of a conveyance by a single consignor and for which all initial, intermediate, and final loading and unloading are carried out in accordance with the direction of the consignor or consignee. ~~The term "exclusive use" is used interchangeably with the terms "sole use" or "full load" in other regulations, such as title 49 of the Code of Federal Regulations.~~ The consignor and the carrier must ensure that any loading or unloading is performed by personnel having radiological training and resources appropriate for safe handling of the consignment. The cosigner must issue specific instructions, in writing, for maintenance or exclusive use shipment controls, and include them with the shipping paper information provided to the carrier by the cosigner.

~~48~~. "Fissile material" means any ~~special nuclear material consisting of, or containing one or more fissile radionuclides. Fissile radionuclides are plutonium 238, plutonium 239, plutonium 241, uranium 233, and uranium 235. Neither natural nor depleted uranium is fissile material.~~ plutonium-238, plutonium-239, plutonium-241, uranium-233, uranium-235, or any combination of these radionuclides. Unirradiated natural uranium and depleted uranium, and natural uranium or depleted uranium that has been irradiated in thermal reactors only are not included in this definition. Department jurisdiction extends only to special nuclear material if quantities are not sufficient to form a critical mass as defined in chapter 33-10-01 of this article.

~~a. Fissile Class I: A package which may be transported in unlimited numbers and in any arrangement, and which requires no nuclear criticality safety controls during transportation. A transport index is not assigned for purposes of nuclear criticality safety but may be required because of external radiation levels.~~

~~b. Fissile Class II: A package which may be transported together with other packages in any arrangement but, for criticality control, in numbers which do not exceed an aggregate transport index of fifty. These shipments require no other nuclear criticality safety control during~~

~~transportation. Individual packages may have a transport index not less than one tenth and not more than ten.~~

9. "Fissile material package" means a fissile material packaging together with its fissile material contents.

~~5~~10. "Low specific activity (LSA) material" means ~~any of the following:~~

~~a. Uranium or thorium ores and physical or chemical concentrates of those ores.~~

~~b. Unirradiated natural or depleted uranium or unirradiated natural thorium.~~

~~c. Tritium oxide in aqueous solutions provided the concentration does not exceed five millicuries (185 megabecquerels) per milliliter.~~

~~d. Material in which the radioactivity is essentially uniformly distributed and in which the estimated average concentration per gram of contents does not exceed:~~

~~(1) 0.0001 millicurie [3.7 kilobecquerels] of radionuclides for which the A_2 quantity in Appendix A of this chapter is not more than five hundredths curie [1.85 gigabecquerels];~~

~~(2) 0.005 millicurie [185 kilobecquerels] of radionuclides for which the A_2 quantity in appendix A of this chapter is more than five hundredths curie [1.85 gigabecquerels] but not more than one curie [37 gigabecquerels]; or~~

~~(3) 0.3 millicurie [11.1 megabecquerels] of radionuclides for which the A_2 quantity in appendix A of this chapter is more than one curie [37 gigabecquerels].~~

~~e. Objects of nonradioactive material externally contaminated with radioactive material, provided that the radioactive material is not readily~~

~~dispersible, and the surface contamination, when averaged over an area of one square meter, does not exceed 0.0001 millicurie per square centimeter [3.7 kilobecquerels per centimeter^2] of radionuclides for which the A_2 quantity in Appendix A of this chapter is not more than 0.05 curie [1.85 gigabecquerels] or 0.001 millicurie per square centimeter [37 kilobecquerels per centimeter^2] for other radionuclides.~~

radioactive material with limited specific activity that satisfies the descriptions and limits set forth below. Shielding materials surrounding the low specific activity material may not be considered in determining the estimated average specific activity of the package contents. Low specific activity material must be in one of three groups:

a. Low specific activity-I (LSA-I).

(1) Ores containing only naturally occurring radionuclides (e.g., uranium, thorium) and uranium or thorium concentrates of such ores; or

(2) Solid unirradiated natural uranium or depleted uranium or natural thorium or their solid or liquid compounds or mixtures; or

(3) Radioactive material, other than fissile material, for which the A_2 value is unlimited; or

(4) Mill tailings, contaminated earth, concrete, rubble, other debris, and activated material in which the radioactive material is essentially uniformly distributed, and the average specific activity does not exceed one millionth of the A_2 per gram.

b. Low specific activity-II (LSA-II).

(1) Water with tritium concentration up to eight tenths of a terabecquerel per liter (20.0 curies/liter); or

(2) Material in which the radioactive material is distributed throughout, and the average specific activity does not exceed one ten thousandths of an A_2 per gram for solids and gases, and one hundred thousandths of an A_2 per gram for liquids.

c. Low specific activity-III (LSA-III). Solids (e.g., consolidated wastes, activated materials) in which:

(1) The radioactive material is distributed throughout a solid or a collection of solid objects, or is essentially uniformly distributed in a solid compact binding agent (such as concrete, bitumen, ceramic, etc.);

(2) The radioactive material is relatively insoluble, or it is intrinsically contained in a relatively insoluble material, so that, even under loss of packaging, the loss of radioactive material per package by leaching, when placed in water for seven days, would not exceed one tenth of an A_2; and

(3) The average specific activity of the solid does not exceed two thousandths of an A_2 per gram.

11. "Maximum normal operating pressure" means the maximum gauge pressure that would develop in the containment system in a period of one year under the heat condition specified in 10 CFR 71.71(c)(1), in the absence of venting, external cooling by an ancillary system, or operational controls during transport.

~~6~~12. "Normal form radioactive material" means radioactive material which has not been demonstrated to qualify as special form radioactive material.

13. "Optimum interspersed hydrogenous moderation" means the presence of hydrogenous material between packages to such an extent that the maximum nuclear reactivity results.

~~7. "Packaging" means the assembly of components necessary to ensure compliance with the packaging requirements of this~~

~~chapter. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle, tie down system, and auxiliary equipment may be designated as part of the packaging.~~

~~8~~14. "Rules of the United States department of transportation" means the regulations in 49 CFR parts 100-189.

~~9~~15. "Specific activity" of a radionuclide means the radioactivity of a radionuclide per unit mass of that nuclide. The specific activity of a material in which the radionuclide is essentially uniformly distributed is the radioactivity per unit mass of the material.

~~10~~16. "Transport index" means the dimensionless number, rounded up to the first decimal place, placed on the label of a package to designate the degree of control to be exercised by the carrier during transportation. The transport index is ~~the number expressing the maximum radiation level in millirem per hour at one meter from the external surface of the package.~~ determined as follows:

a. For non-fissile material packages, the number determined by multiplying the maximum radiation level in millisievert (mSv) per hour at one meter (3.3 ft) from the external surface of the package by one hundred (equivalent to the maximum radiation level in millirem per hour at one meter (3.3 ft)); or

b. For fissile material packages, the number determined by multiplying the maximum radiation level in millisievert per hour at one meter (3.3 ft) from the external surface of the package by one hundred (equivalent to the maximum radiation level in millirem per hour at one meter (3.3 ft)), or, for criticality control purposes, the number obtained as described in 10 CFR 71.59, whichever is larger.

~~11~~17. "Type A quantity" means a quantity of radioactive material, the aggregate radioactivity of which does not exceed A_1 for special form radioactive material or A_2 for normal form radioactive material, where A_1 and A_2 are given in appendix A of this chapter or may be determined by procedures described in appendix A of this chapter.

~~12~~18. "Type B package" means a Type B packaging together with its radioactive contents. A Type B package design is designated as B(U) or B(M). B(U) refers to the need for unilateral approval of international shipments; B(M) refers to the need for multilateral approval. There is no distinction made in how packages with these designations may be used in domestic transportation. To determine their distinction for international transportation, refer to 49 CFR part 173. A Type B package approved prior to September 6, 1983 was designated only as Type B. Limitations on its use are specified in section 33-10-13-08.

~~13~~19. "Type B packaging" means a packaging designed to retain the integrity of containment and shielding when subjected to the normal conditions of transport and hypothetical accident test conditions set forth in 10 CFR part 71.

~~14~~20. "Type B quantity" means a quantity of radioactive material greater than a Type A quantity.

History: Effective June 1, 1992.
General Authority: NDCC 28-32-02
Law Implemented: NDCC 28-32-02

33-10-13-03. Requirement for license. No individual may transport radioactive material or deliver radioactive material to a carrier for transport except as authorized in a general or specific license issued by the department or as exempted in section 33-10-13-04.

History: Effective June 1, 1992.
General Authority: NDCC 23-20.1-04, 28-32-02

Law Implemented: NDCC 23-20.1-03, 23-20.1-04, 28-32-02

33-10-13-04. Exemptions.

1. Common and contract carriers, freight forwarders, and warehousemen which are subject to the requirements of the United States department of transportation in 49 CFR 170 through 189 or the United States postal service in the postal service manual (Domestic Mail Manual), section 124.3 incorporated by reference, 39 CFR 111.11 (1974), and the United States postal service are exempt from the requirements of this chapter to the extent that they transport or store radioactive material in the regular course of their carriage for others or storage incident thereto. Common and contract carriers who are not subject to the requirements of the United States department of transportation or United States postal service are subject to section 33-10-13-03 and other applicable requirements of this article.

2. Any licensee is exempt from the requirements of this chapter ~~to the extent that the licensee delivers to a carrier for transport~~ with respect to shipment or carriage of a package containing radioactive material having a specific activity not greater than seventy becquerels per gram (0.002 microcurie per gram) ~~[74 becquerels per gram]~~.

3. With the exception of sections 33-10-13-05 and 33-10-13-16, a licensee is exempt from all requirements of this chapter, with respect to shipment or carriage of the following packages provided the packages contain no fissile material or meet the fissile material exemption standards in 10 CFR 71.53:

   a. A package containing no more than a Type A quantity of radioactive material ~~if the package contains no fissile material, or~~

   b. Packages transported between locations within the United States which contain only americium or plutonium in special form with an aggregate radioactivity not to exceed seven hundred forty

gigabecquerels (twenty curies) ~~[740 gigabecquerels]~~.

c. A package in which the only radioactive material is low specific activity (LSA) material or surface contaminated objects (SCO), provided the external radiation level at three meters from the unshielded material or objects does not exceed ten millisieverts per hour (1 rem/hour); or

d. A licensee is exempt from all requirements of this part, other than 33-10-13-05 and 33-10-13-16, with respect to shipment or carriage of low specific activity (LSA) material in group LSA-I, or surface contaminated objects (SCOs) in group SCO-I.

History: Effective June 1, 1992.
General Authority: NDCC 23-20.1-04, 28-32-02
Law Implemented: NDCC 23-20.1-04, 28-32-02

33-10-13-05. Transportation of licensed material.

1. Each licensee who transports licensed material outside of the confines of the licensee's plant or other place of use, or who delivers licensed material to a carrier for transport, shall:

   a. Comply with the applicable requirements, appropriate to the mode of transport, of the regulations of the United States department of transportation; and

      (1) The licensee shall particularly note United States department of transportation regulations in the following areas:

         (a) Packaging--49 CFR part 173: subparts A and B and I.

         (b) Marking and labeling--49 CFR part 172: subparts D and E.

(c) Placarding--49 CFR part 172: subpart F, especially sections 172.500 through 172.519, 172.556, and appendices B and C.

(d) Accident reporting--49 CFR part 171: sections 171.15 and 171.16.

(e) Shipping papers and emergency information--49 CFR part 172: subparts C and G.

(f) Hazardous material employee training--49 CFR part 172: subpart H.

(g) Hazardous material shipper/carrier registration--49 CFR part 107: subpart G.

(h) Radiation protection program--49 CFR part 172: subpart I.

(2) The licensee shall also note United States department of transportation regulations pertaining to the following modes of transportation:

(a) Rail--49 CFR part 174: subparts A through D and K.

(b) Air--49 CFR part 175.

(c) Vessel--49 CFR part 176: subparts A through F and M.

(d) Public Highway--49 CFR part 177 and parts 390 through 397.

b. Assure that any special instructions needed to safely open the package are sent to or have been made available to the consignee.

2. If, for any reason, the regulations of the United States department of transportation are not applicable to a shipment of licensed material, the licensee shall conform to the standards and requirements of those regulations to

the same extent as if the shipment was subject to the regulations.

History: Effective June 1, 1992.
General Authority: NDCC 23-20.1-04, 28-32-02
Law Implemented: NDCC 23-20.1-03, 23-20.1-04, 28-32-02

33-10-13-06. General licenses for carriers.

1. A general license is hereby issued to any common or contract carrier not exempt under section 33-10-13-04 to receive, possess, transport, and store radioactive material in the regular course of their carriage for others or storage incident thereto, provided the transportation and storage is in accordance with the applicable requirements, appropriate to the mode of transport, of the United States department of transportation insofar as such requirements relate to the loading and storage of packages, placarding of the transporting vehicle, and incident reporting. Any notification of incidents referred to in those United States department of transportation requirements must be filed with, or made to, the department.

2. A general license is hereby issued to any private carrier to transport radioactive material, provided the transportation is in accordance with the applicable requirements, appropriate to the mode of transport, of the United States department of transportation insofar as such requirements relate to the loading and storage of packages, placarding of the transporting vehicle, and incident reporting. Any notification of incidents referred to in those United States department of transportation requirements must be filed with, or made to, the department.

3. Individuals who transport radioactive material pursuant to the general licenses in subsection 1 or 2 are exempt from the requirements of chapters 33-10-04 and 33-10-10 to the extent that they transport radioactive material.

History: Effective June 1, 1992.
General Authority: NDCC 23-20.1-04, 28-32-02

Law Implemented: NDCC 23-20.1-03, 23-20.1-04, 28-32-02

33-10-13-07. General license - Approved packages.

1. A general license is hereby issued to any licensee of the department to transport, or to deliver to a carrier for transport, licensed material in a package for which a license, certificate of compliance, or other approval has been issued by the United States nuclear regulatory commission.

2. This general license applies only to a licensee who:

   a. Has a copy of the specific license, certificate of compliance, or other approval of the package and has the drawings and other documents referenced in the approval relating to the use and maintenance of the packaging and to the actions to be taken prior to shipment;

   b. Complies with the terms and conditions of the license, certificate, or other approval, as applicable, and the applicable requirements of this chapter;

   c. Prior to the licensee's first use of the package, has registered with the United States nuclear regulatory commission; and

   d. Has a quality assurance program ~~required by section 33-10-13-20~~ that meets the applicable requirements of 10 CFR 71, subpart H and is approved by the department or the United States nuclear regulatory commission.

3. The general license in subsection 1 applies only when the package approval authorizes use of the package under this general license.

4. For previously approved Type B packages which are not designated as either B(U) or B(M) in the certificate of compliance, this general license is subject to additional restrictions of section 33-10-13-08.

History: Effective June 1, 1992.
General Authority: NDCC 23-20.1-04, 28-32-02
Law Implemented: NDCC 23-20.1-04, 28-32-02

33-10-13-08. General license - Previously approved Type B packages.

1. A Type B package previously approved by the United States nuclear regulatory commission, but not designated as B(U) or B(M) in the certificate of compliance, may be used under the general license of section 33-10-13-07 with the following additional ~~limitations~~ conditions:

   a. Fabrication of the packaging was satisfactorily completed before August 31, 1986, as demonstrated by application of its model number in accordance with United States nuclear regulatory commission regulations; and

   b. ~~The package may not be used for a shipment to a location outside the United States after August 31, 1986, except approved under special arrangement in accordance with 49 CFR 173.471.~~ A package used for a shipment to a location outside the United States is subject to multilateral approval, as defined in 49 CFR 173.403; and

   c. A serial number that uniquely identifies each packaging which conforms to the approved design is assigned to, and legibly and durably marked on, the outside of each packaging.

2. A Type B(U) package, a Type B(M) package, a low specific activity (LSA) material package or a fissile material package, previously approved by the United States nuclear regulatory commission but without the designation "-85" in the identification number of the United States nuclear regulatory commission certificate of compliance, may be used under the general license of section 33-10-13-07 with the following additional conditions:

   a. Fabrication of the package is satisfactorily completed by April 1, 1999 as demonstrated by

application of its model number in accordance with subsection 4 of section 33-10-13-14;

b. A package used for a shipment to a location outside the United States is subject to multilateral approval as defined in 49 CFR 173.403; and

c. A serial number that uniquely identifies each packaging which conforms to the approved design is assigned to, and legibly and durably marked on, the outside of each packaging.

History: Effective June 1, 1992.
General Authority: NDCC 23-20.1-04, 28-32-02
Law Implemented: NDCC 23-20.1-04, 28-32-02

33-10-13-09. General license - Specification container.

1. A general license is issued to any licensee of the department to transport, or to deliver to a carrier for transport, licensed material in a specification container for a Type B quantity of radioactive material as specified in 49 CFR parts 173 and 178.

2. This general license applies only to a licensee who has a quality assurance program ~~required by section 33-10-13-20~~ that meets the applicable requirements of 10 CFR 71, subpart H and is approved by the department or the United States nuclear regulatory commission.

3. This general license applies only to a licensee who:

   a. Has a copy of the specification; and

   b. Complies with the terms and conditions of the specification and the applicable requirements of this chapter.

4. The general license in subsection 1 is subject to the limitation that the specification container may not be used for a shipment to a location outside the United States, ~~after August 31, 1986 except approved under special arrangements in accordance with 49 CFR 173.472~~

except by multilateral approval, as defined in 49 CFR 173.403.

History: Effective June 1, 1992.
General Authority: NDCC 23-20.1-04, 28-32-02
Law Implemented: NDCC 23-20.1-04, 28-32-02

33-10-13-10. General license - use of foreign approved package.

1. A general license is issued to any licensee of the department to transport, or to deliver to a carrier for transport, licensed material in a package the design of which has been approved in a foreign national competent authority certificate which has been revalidated by the United States department of transportation as meeting the applicable requirements of 49 CFR 171.12.

2. This general license applies only to international shipments.

3. Except as otherwise provided in this section, the general license applies only to a licensee who has a quality assurance program that meets the applicable requirements of 10 CFR 71, subpart H and is approved by the department or the United States nuclear regulatory commission.

~~3~~4. This general license applies only to a licensee who:

   a. Has a copy of the applicable certificate, the revalidation, and the drawings and other documents referenced in the certificate relating to the use and maintenance of the packaging and to the actions to be taken prior to shipment; and

   b. Complies with the terms and conditions of the certificate and revalidation and with the applicable requirements of this chapter. With respect to the quality assurance provisions of 10 CFR 71, subpart H, the licensee is exempt from design, construction and fabrication considerations.

History: Effective June 1, 1992.

General Authority: NDCC 23-20.1-04, 28-32-02
Law Implemented: NDCC 23-20.1-04, 28-32-02

33-10-13-11. General license - ~~Type A f~~Fissile ~~class II~~ material, limited quantity per package.

1. A general license is hereby issued to any licensee to transport fissile material, or to deliver fissile material to a carrier for transport, if the material is shipped ~~as a fissile class II package~~ in accordance with this section.

2. This general license applies only to a licensee who has a quality assurance program that meets the applicable requirements of 10 CFR 71 subpart H and is approved by the department or the United States nuclear regulatory commission.

~~2~~3. This general license applies only when a package contains no more than a Type A quantity of radioactive material, including only one of the following:

   a. Up to forty grams of uranium-235;

   b. Up to thirty grams of uranium-233;

   c. Up to twenty-five grams of the fissile radionuclides of plutonium, except that for encapsulated plutonium-beryllium neutron sources in special form, an A_1 quantity of plutonium may be present; or

   d. A combination of fissile radionuclides in which the sum of the ratios of the amount of each radionuclide to the corresponding maximum amounts in subdivisions a, b and c of this subsection does not exceed unity.

~~3~~4. a. Except as specified in subdivision b of this subsection this general license applies only when a package containing more than fifteen grams of fissile radionuclides is labeled with a transport

index not less than the number given by the following equation:

$$\text{Minimum Transport Index} = (0.4x + 0.67y + z)\left(1 - \frac{15}{x+y+z}\right)$$

where the package contains x grams of uranium-235, y grams of uranium-233, and z grams of the fissile radionuclides of plutonium.

b. For a package in which the only fissile material is in the form of encapsulated plutonium-beryllium neutron sources in special form, the transport index based on criticality considerations may be taken as 0.026 times the number of grams of the fissile radionuclides of plutonium in excess of fifteen grams.

c. In all cases, the transport index must be rounded up to one decimal place and may not exceed ten.

History: Effective June 1, 1992.
General Authority: NDCC 23-20.1-04, 28-32-02
Law Implemented: NDCC 23-20.1-04, 28-32-02

33-10-13-12. General license - ~~Restricted, f~~Fissile ~~class II~~ material, limited moderator per package.

1. A general license is ~~hereby~~ issued to any licensee to transport fissile material, or to deliver fissile material to a carrier for transport, if the material is shipped ~~as a fissile class II package~~ in accordance with this section.

2. This general license applies only to a licensee who has a quality assurance program that meets the applicable requirements of 10 CFR 71, subpart H and is approved by the department or the United States nuclear regulatory commission.

~~2~~3. This general license applies only when all of the following requirements are met.

a. The package contains no more than a Type A quantity of radioactive material.

b. Neither beryllium nor hydrogenous material enriched in deuterium is present.

c. The total mass of graphite present does not exceed ~~one hundred fifty~~ seven and seven tenths times the total mass of uranium-235 plus plutonium.

d. Substances having a higher hydrogen density than water are not present, except that polyethylene may be used for packing or wrapping.

e. Uranium-233 is not present, and the amount of plutonium does not exceed one percent of the amount of uranium-235.

f. The amount of uranium-235 is limited as follows:

(1) If the fissile radionuclides are not uniformly distributed, the maximum amount of uranium-235 per package may not exceed the value given in the following table:

Table 1

Uranium enrichment in weight percent of uranium-235 not exceeding	Permissible maximum grams of uranium-235 per package
24	40
20	42
15	45
11	48
10	51
9.5	52
9	54
8.5	55
8	57
7.5	59
7	60
6.5	62
6	65

5.5	68
5	72
4.5	76
4	80
3.5	88
3	100
2.5	120
2	164
1.5	272
1.35	320
1	680*
0.92	1200*

*Pursuant to the department's agreement with the United States nuclear regulatory commission, jurisdiction extends only to three hundred fifty grams of uranium-235.

(2) If the fissile radionuclides are distributed uniformly, the maximum amount of uranium-235 per package may not exceed the value given in the following table:

Table 2

Uranium enrichment in weight percent of uranium-235 not exceeding	Permissible maximum grams of uranium-235 per package
4	84
3.5	92
3	112
2.5	148
2	240
1.5	560*
1.35	800*

*Pursuant to the department's agreement with the United States nuclear regulatory commission, jurisdiction extends only to three hundred fifty grams of uranium-235.

g. The transport index of each package based on criticality considerations is taken as ten times the number of grams of uranium-235 in the package divided by the maximum allowable number of grams per package in accordance with table 1 or 2 above as applicable.

History: Effective June 1, 1992.
General Authority: NDCC 23-20.1-04, 28-32-02
Law Implemented: NDCC 23-20.1-04, 28-32-02

33-10-13-13. Fissile material - Assumptions as to unknown properties. When the isotopic abundance, mass, concentration, degree of irradiation, degree of moderation, or other pertinent property of fissile material in any package is not known, the licensee shall package the fissile material as if the unknown properties had credible values that would cause the maximum nuclear reactivity.

History: Effective June 1, 1992.
General Authority: NDCC 23-20.1-04, 28-32-02
Law Implemented: NDCC 23-20.1-03, 23-20.1-04, 28-32-02

33-10-13-14. Preliminary determinations. Prior to the first use of any packaging for the shipment of radioactive material:

1. The licensee shall ascertain that there are no defects which could significantly reduce the effectiveness of the packaging;

2. Where the maximum normal operating pressure will exceed ~~thirty-four and three-tenths~~ thirty-five kilopascal (5 psi) gauge, the licensee shall test the containment system at an internal pressure at least fifty percent higher than the maximum normal operating pressure to verify the capability of that system to maintain its structural integrity at that pressure;

3. The licensee shall determine that the packaging has been fabricated in accordance with the design approved by the United States nuclear regulatory commission; and

4. The licensee shall conspicuously and durably mark the packaging with its model number, gross weight, and a package identification number assigned by the United States nuclear regulatory commission.

History: Effective June 1, 1992.
General Authority: NDCC 23-20.1-04, 28-32-02
Law Implemented: NDCC 23-20.1-03, 23-20.1-04, 28-32-02

33-10-13-15. Routine determinations. Prior to each shipment of licensed material, the licensee shall determine that:

1. The package is proper for the contents to be shipped;

2. The package is in unimpaired physical condition except for superficial defects such as marks or dents;

3. Each closure device of the packaging, including any required gasket, is properly installed and secured and free of defects;

4. Any system for containing liquid is adequately sealed and has adequate space or other specified provision for expansion of the liquid;

5. Any pressure relief device is operable and set in accordance with written procedures;

6. The package has been loaded and closed in accordance with written procedures;

7. Any structural part of the package which could be used to lift or tie down the package during transport is rendered inoperable for that purpose unless it satisfies design requirements specified by the United States nuclear regulatory commission;

8. ~~a.~~ The level of removable radioactive contamination on the external surfaces of each package offered for shipment is as low as reasonably achievable, and within the limits specified in 49 CFR 173.443. ~~The level of removable radioactive contamination may be determined by wiping an area of three hundred square centimeters of the surface concerned with an~~

~~absorbent material, using moderate pressure, and measuring the activity on the wiping material. Sufficient measurements must be taken in the most appropriate locations to yield a representative assessment of the removable contamination levels. Except as provided in subdivision b of this subsection, the amount of radioactivity measured on any single wiping material, when averaged over the surface wiped, must not exceed the limits given in table 3 below at any time during transport. Other methods of assessment of equal or greater efficiency may be used. When other methods are used, the detection efficiency of the method used must be taken into account and in no case may the removable contamination on the external surfaces of the package exceed ten times the limits listed in table 3.~~

~~Table 3~~

~~Removable External Radioactive Contamination Wipe Limits~~

~~Contaminant~~	~~Maximum Permissible Limits~~	
	~~*μCi/cm^2~~	~~dpm/cm^2~~
~~Beta-gamma-emitting radionuclides; all radionuclides with half-lives less than ten days; natural uranium; natural thorium; uranium 235; uranium 238; thorium 232; thorium 228 and thorium 230 when contained in ores or physical concentrates .....~~	~~10^{-5}~~	~~22~~
~~All other alpha emitting radionuclides .....~~	~~10^{-6}~~	~~2.2~~

~~*To convert microcuries (μCi) to SI units of megabecquerels, multiply the values by 0.037.~~

~~b. In the case of packages transported as exclusive use shipments by rail or highway only, the removable radioactive contamination at any time during transport must not exceed ten times the levels prescribed in subdivision a. The levels at the beginning of transport must not exceed the levels in subdivision a;~~

9. External radiation levels around the package and around the vehicle, if applicable, will not exceed two ~~hundred millirems~~ millisieverts per hour [200 ~~millisieverts~~ millirems per hour] at any point on the external surface of the package at any time during transportation. The transport index may not exceed ten;

10. For a package transported in exclusive use by rail, highway, or water, radiation levels external to the package may exceed the limits specified in subsection 9 but may not exceed any of the following:

    a. Two ~~hundred millirems~~ millisieverts per hour [200 ~~millisieverts~~ millirem per hour] on the accessible external surface of the package unless the following conditions are met, in which case the limit is ~~one thousand millirems~~ ten millisieverts per hour [1000 ~~millisieverts~~ millirems per hour];

        (1) The shipment is made in a closed transport vehicle,

        (2) Provisions are made to secure the package so that its position within the vehicle remains fixed during transportation, and

        (3) There are no loading or unloading operations between the beginning and end of the transportation.

    b. Two ~~hundred millirems~~ millisieverts per hour [200 ~~millisieverts~~ millirems per hour] at any point on the outer surface of the vehicle, including the upper and lower surfaces, or, in the case of a flatbed style vehicle, with a personnel barrier ~~(A flatbed style vehicle with a personnel barrier shall have radiation levels determined at vertical~~

~~planes. If no personnel barrier, the package cannot exceed 200 millirems per hour [2 millisieverts per hour] at the surface.),~~ at any point on the vertical planes projected from the outer edges of the vehicle, on the upper surface of the load [or enclosure, if used], and on the lower external surface of the vehicle~~,~~. If no personnel barrier, the package cannot exceed 2 millisieverts per hour [200 millirems per hour] at the surface.

c. One-t~~T~~enth ~~millirems~~ millisievert per hour [~~0.1 millisievert~~ 10 millirems per hour] at any point two meters from the vertical planes represented by the outer lateral surfaces of the vehicle, or, in the case of a flat-bed style vehicle, at any point two meters from the vertical planes projected from the outer edges of the vehicle; and

d. Two hundredths ~~millirems~~ millisieverts per hour [~~0.02 millisieverts~~ 2 millirems per hour] in any normally occupied positions of the vehicle, except that this provision does not apply to private motor carriers when individuals occupying these positions are provided with special health supervision, personnel radiation exposure monitoring devices, and training in accordance with subsection 2 of section 33-10-10-02 of this article; and

11. For shipments made under the provisions of subsection 10, the shipper shall provide specific written instructions to the carrier for maintenance of the exclusive use shipment controls. The instructions must be included with the shipping paper information.

12. The written instructions required for exclusive use shipments must be sufficient so that, when followed, they will cause the carrier to avoid actions that will unnecessarily delay delivery or unnecessarily result in increased radiation levels or radiation exposures to transport workers or members of the general public.

~~11~~13. A package must be prepared for transport so that in still air at thirty-eight degrees Celsius [100 ~~one hundred~~ degrees Fahrenheit ~~[38 degrees Celsius]~~ and in the shade, no accessible surface of a package

would have a temperature exceeding fifty degrees Celsius [122 ~~one hundred twenty two~~ degrees Fahrenheit ~~[50 degrees Celsius]~~ in a nonexclusive use shipment or ~~one hundred eighty degrees Fahrenheit [82 degrees Celsius]~~ eighty-two degrees Celsius [180 degrees Fahrenheit] in an exclusive use shipment. Accessible package surface temperatures may not exceed these limits at any time during transportation.

History: Effective June 1, 1992; amended effective July 1, 1995.
General Authority: NDCC 23-20.1-04, 28-32-02
Law Implemented: NDCC 23-20.1-04, 28-32-02

33-10-13-16. Air transport of plutonium.

1. Notwithstanding the provisions of any general licenses and notwithstanding any exemptions stated directly in this chapter or included indirectly by citation of the United States department of transportation regulations, as may be applicable, the licensee shall assure that plutonium in any form is not transported by air, or delivered to a carrier for air transport, unless:

   ~~1~~a. The plutonium is contained in a medical device designed for individual human application;

   ~~2~~b. The plutonium is contained in a material in which the specific activity is not greater than seventy becquerels per gram [~~two thousandths~~ 0.002 microcuries per gram ~~[74 becquerels per gram]~~ of material and in which the radioactivity is essentially uniformly distributed;

   ~~3~~c. The plutonium is shipped in a single package containing no more than an A_2 quantity of plutonium in any isotope or form and is shipped in accordance with section 33-10-13-05; or

   ~~4~~d. The plutonium is shipped in a package specifically authorized for the shipment of plutonium by air in the Certificate of Compliance for that package issued by the United States nuclear regulatory commission.

2. Nothing in subsection 1 is to be interpreted as removing or diminishing the requirements of section 33-10-13-11 of this chapter.

3. For a shipment of plutonium by air which is subject to subdivision d of subsection 1, the licensee shall, through special arrangement with the carrier, require compliance with 49 CFR 175.704, as applicable to the air transport of plutonium.

History: Effective June 1, 1992.
General Authority: NDCC 23-20.1-04, 28-32-02
Law Implemented: NDCC 23-20.1-04, 28-32-02

33-10-13-17. Shipment records. Each licensee shall maintain for a period of two years after shipment a record of each shipment of licensed material not exempt under section 33-10-13-04, showing, where applicable:

1. Identification of the packaging by model number;

2. Verification that there were no significant defects in the packaging, as shipped;

3. Volume and identification of coolant;

4. Type and quantity of licensed material in each package, and the total quantity of each shipment;

5. Date of the shipment;

6. Name and address of the transferee;

7. Address to which the shipment was made; and

8. Results of the determinations required by section 33-10-13-15.

History: Effective June 1, 1992.
General Authority: NDCC 23-20.1-04, 28-32-02
Law Implemented: NDCC 23-20.1-03, 23-20.1-04, 28-32-02

33-10-13-18. Reports. The licensee shall report to the department within thirty days:

1. Any instance in which there is significant reduction in the effectiveness of any authorized packaging during use; and

2. Details of any defects with safety significance in the packaging after first use, with the means employed to repair the defects and prevent their recurrence.

3. Instances in which the conditions of approval in the certificate of compliance were not observed in making a shipment.

History: Effective June 1, 1992.
General Authority: NDCC 23-20.1-04, 28-32-02
Law Implemented: NDCC 23-20.1-03, 23-20.1-04, 28-32-02

33-10-13-19. Advance notification of transport of irradiated reactor fuel and nuclear waste.

1. Prior to the transport of any irradiated reactor fuel or nuclear waste outside of the confines of the licensee's facility or other place of use or storage, or prior to the delivery of any irradiated reactor fuel or nuclear waste to a carrier for transport, each licensee shall provide advance notification of such transport to the governor, or governor's designee ~~(A list of the mailing addresses of the governors and governors' designees is available upon request from the director, office of state programs, Office of governmental and public affairs, United States nuclear regulatory commission, Washington, D.C. 20555-0001.)~~, of each state through which the irradiated reactor fuel or nuclear waste will be transported. A list of the mailing addresses of the governors and governors' designees is available upon request from the director, office of state programs, office of governmental and public affairs, United States nuclear regulatory commission, Washington, D.C. 20555-0001.

2. Advance notification is required only when:

a. The irradiated reactor fuel or nuclear waste is required to be in Type B packaging for transportation;

b. The irradiated reactor fuel or nuclear waste is being transported to, through, or across state boundaries to a disposal site or to a collection point for transport to a disposal site; and

c. The quantity of licensed material in a single package exceeds~~,~~ any of the following:

~~(1) Five thousand curies [185 terabecquerels] of special form radionuclides;~~

~~(2) Five thousand curies [185 terabecquerels] of uncompressed gases of argon 41, krypton 85m, krypton 87, xenon 131m, or xenon 135;~~

~~(3) Fifty thousand curies [1.85 petabecquerels] of argon 37, or of uncompressed gases of krypton 85 or xenon 133, or of hydrogen 3 as a gas, as luminous paint, or absorbed on solid material;~~

~~(4) Twenty curies [740 gigabecquerels] of other nonspecial form radionuclides for which A_2 is less than or equal to four curies [148 gigabecquerels]; or~~

~~(5) Two hundred curies [7.4 terabecquerels] of other nonspecial form radionuclides for which A_2 is greater than four curies [148 gigabecquerels].~~

~~3. Each advance notification required by subsection 1 must contain the following information:~~

~~a. The name, address, and telephone number of the shipper, carrier, and receiver of the shipment;~~

~~b. A description of the nuclear waste contained in the shipment as required by 49 CFR 172.202 and 172.203(d);~~

c. The point of origin of the shipment and the seven-day period during which departure of the shipment is estimated to occur;

d. The seven day period during which arrival of the shipment at state boundaries is estimated to occur;

e. The destination of the shipment, and the seven day period during which arrival of the shipment is estimated to occur; and

f. A point of contact with a telephone number for current shipment information.

4. The notification required by subsection 1 must be made in writing to the office of each appropriate governor, or governor's designee, and to the department. A notification delivered by mail must be postmarked at least seven days before the beginning of the seven day period during which departure of the shipment is estimated to occur. A notification delivered by messenger must reach the office of the governor, or governor's designee, at least four days before the beginning of the seven day period during which departure of the shipment is estimated to occur. A copy of the notification must be retained by the licensee for one year.

5. The licensee shall notify each appropriate governor, or governor's designee, and the department of any changes to schedule information provided pursuant to subsection 1. Such notification must be by telephone to a responsible individual in the office of the governor, or governor's designee, of the appropriate state or states. The licensee shall maintain for one year a record of the name of the individual contacted.

6. Each licensee who cancels a nuclear waste shipment, for which advance notification has been sent, shall send a cancellation notice to the governor, or governor's designee, of each appropriate state and to the department. A copy of the notice must be retained by the licensee for one year.

(1) Three thousand times the A_1 value of the radionuclides as specified in appendix A, for special form radioactive material;

(2) Three thousand times the A_2 value of the radionuclides as specified in appendix A, for normal form radioactive material; or

(3) One thousand terabecquerels (27,000 Ci).

3. Procedures for submitting advance notification.

a. The notification must be made in writing to the office of each appropriate governor or governor's designee and to the department.

b. A notification delivered by mail must be postmarked at least seven days before the beginning of the seven-day period during which departure of the shipment is estimated to occur.

c. A notification delivered by messenger must reach the office of the governor or of the governor's designee at least four days before the beginning of the seven-day period during which departure of the shipment is estimated to occur.

d. The licensee shall retain a copy of the notification as a record for three years.

4. Information to be furnished in advance notification of shipment. Each advance notification of shipment of irradiated reactor fuel or nuclear waste must contain the following information:

a. The name, address, and telephone number of the shipper, carrier, and receiver of the irradiated reactor fuel or nuclear waste shipment;

b. A description of the irradiated reactor fuel or nuclear waste contained in the shipment, as specified in 49 CFR 172.202 and 172.203(d);

c. The point of origin of the shipment and the seven-day period during which departure of the shipment is estimated to occur;

d. The seven-day period during which arrival of the shipment at State boundaries is estimated to occur;

e. The destination of the shipment, and the seven-day period during which arrival of the shipment is estimated to occur; and

f. A point of contact, with a telephone number, for current shipment information.

5. Revision notice. A licensee who finds that schedule information previously furnished to a governor or governor's designee, in accordance with this section, will not be met, shall telephone a responsible individual in the office of the governor of the state or of the governor's designee and inform that individual of the extent of the delay beyond the schedule originally reported. The licensee shall maintain a record of the name of the individual contacted for three years.

6. Cancellation notice.

a. Each licensee who cancels an irradiated reactor fuel or nuclear waste shipment for which advance notification has been sent shall send a cancellation notice to the governor of each State or to the governor's designee previously notified.

b. The licensee shall state in the notice that it is a cancellation and identify the advance notification that is being canceled. The licensee shall retain a copy of the notice as a record for three years.

History: Effective June 1, 1992.
General Authority: NDCC 23-20.1-04, 28-32-02
Law Implemented: NDCC 23-20.1-03, 23-20.1-04, 28-32-02

~~33-10-13-20. Quality assurance requirements.~~

~~1. Each licensee shall establish, maintain, and execute a quality assurance program to verify by procedures such as checking, auditing, and inspection that deficiencies, deviations, and defective material and equipment relating to the shipment of packages containing radioactive material are promptly identified and corrected.~~

~~2. The licensee shall identify the material and components to be covered by the quality assurance program.~~

~~3. Each licensee shall document the quality assurance program by written procedures or instructions and shall carry out the program in accordance with those procedures throughout the period during which packaging is used.~~

~~4. Prior to the use of any package for the shipment of radioactive material, each licensee shall obtain approval by the department of its quality assurance program.~~

~~5. The licensee shall maintain sufficient written records to demonstrate compliance with the quality assurance program. Records of quality assurance pertaining to the use of a package for shipment of radioactive material must be maintained for a period of two years after shipment.~~

History: Effective June 1, 1992.
General Authority: NDCC 23-20.1-04, 28-32-02
Law Implemented: NDCC 23-20.1-03, 23-20.1-04, 28-32-02

APPENDIX A

DETERMINATION OF A_1 AND A_2

1. Single radionuclides.

a. For a single radionuclide of known identity, the values of A_1 and A_2 are taken from table I if listed there. The values A_1 and A_2 in table I are also applicable for the radionuclide contained in (α,n) or (γ,n) neutron sources.

b. For any single radionuclide whose identity is known but which is not listed in table I, the value of A_1 and A_2 are determined according to the following procedure.

(1) If the radionuclide emits only one type of radiation, A_1 is determined according to the following method. For radionuclides emitting different kinds of radiation, A_1 is the most restrictive value of those determined for each kind of radiation. However, in either case, A_1 is restricted to a maximum of one thousand curies [37 terabecquerels]. If a parent nuclide decays into a shorter-lived daughter with a half-life not greater than ten days, A_1 is calculated for both the parent and the daughter, and the more limiting of the two values is assigned to the parent nuclide.

(a) For gamma emitters, A_1 is determined by the expression.

$$A_1 = \frac{9 \text{ curies}}{\Gamma}$$

where Γ is the gamma-ray constant, corresponding to the dose in roentgens per curie-hour at 1 meter, and the number 9 results from the choice of 1 rem per hour at a distance of 3 meters as the reference dose-equivalent rate.

(b) For x-ray emitters, A_1 is determined by the atomic number of the nuclide.

~~for $Z \leq 55$, $A_1 = 1000$ Ci [37 terabecquerels]; and~~

~~for $Z > 55$, $A_1 = 200$ Ci [7.4 terabecquerels]~~

~~where Z is the atomic number of the nuclide.~~

~~(c) For beta emitters, A_1 is determined by the maximum beta energy (E_{max}) according to Table II; and~~

~~(d) For alpha emitters, A_1 is determined by the expression:~~

~~$A_1 = 1000 A_3$~~

~~where A_3 is the value listed in table III;~~

~~(2) A_2 is the more restrictive of the following two values:~~

~~(a) The corresponding A_1; and~~

~~(b) The value A_3 obtained from table III.~~

~~c. For any single radionuclide whose identity is unknown, the value of A_1 is taken to be two curies [74 gigabecquerels] and the value of A_2 is taken to be two-thousandths curie [74 megabecquerels]. However, if the atomic number of the radionuclide is known to be less than eighty-two, the value of A_1 is taken to be ten curies [370 gigabecquerels] and the value of A_2 is taken to be four tenths curie [14.8 gigabecquerels].~~

~~2. Mixtures of Radionuclides, Including Radioactive Decay Chains.~~

~~a. For mixed fission products, the activity limit may be assumed if a detailed analysis of the mixture is not carried out,~~

~~$A_1 = 10$ Ci [370 gigabecquerels]~~

~~$A_2 = 0.4$ Ci [14.8 gigabecquerels]~~

b. A single radioactive decay chain is considered to be a single radionuclide when the radionuclides are present in their naturally occurring proportions and no daughter nuclide has a half life either longer than ten days or longer than that of the parent nuclide. The activity to be taken into account and the A_1 or A_2 value from table I to be applied are those corresponding to the parent nuclide of that chain. When calculating A_1 or A_2 values, radiation emitted by daughters must be considered. However, in the case of radioactive decay chains in which any daughter nuclide has a half life either longer than ten days or greater than that of the parent nuclide, the parent and daughter nuclides are considered to be mixtures of different nuclides.

c. In the case of a mixture of different radionuclides, where the identity and activity of each radionuclide are known, the permissible activity of each radionuclide R_1, R_2 . . . . R_n is such that $F_1 + F_2 + \ldots . F_n$ is not greater than unity, where:

$$F_1 = \frac{\text{Total activity of } R_1}{A_1(R_1)}$$

$$F_2 = \frac{\text{Total activity of } R_2}{A_1(R_2)}$$

$$F_n = \frac{\text{Total activity of } R_n}{A_1(R_n)} \text{ and}$$

$A_1 (R_1, R_2 \ldots . R_n)$ is the value of A_1 or A_2 as appropriate for the nuclide $R_1, R_2 \ldots . R_n$.

d. When the identity of each radionuclide is known but the individual activities of some of the radionuclides are not known, the formula given in paragraph 2.c is applied to establish the values of A_1 or A_2 as appropriate. All the radionuclides whose individual activities are not known (their total activity will, however, be known) are classed in a single group and the most restrictive value of A_1 and A_2 applicable to any one of them is used as the value of A_1 or A_2 in the denominator of the fraction.

e. Where the identity of each radionuclide is known but the individual activity of none of the radionuclides is

~~known, the most restrictive value of A_1 or A_2 applicable to any one of the radionuclides present is adopted as the applicable value.~~

~~f. When the identity of none of the nuclides is known, the value of A_1 is taken to be two curies [74 gigabecquerels] and the value of A_2 is taken to be two thousandths [74 megabecquerels]. However, if alpha emitters are known to be absent, the value of A_2 is taken to be four-tenths curie [14.8 gigabecquerels].~~

1. Values of A_1 and A_2 for individual radionuclides, which are the bases for many activity limits elsewhere in these rules are given in Table I. The curie (Ci) values specified are obtained by converting from the Terabecquerel (TBq) figure. The curie values are expressed to three significant figures to assure that the difference in the TBq and Ci quantities is one tenth of one percent or less. Where values of A_1 or A_2 are unlimited, it is for radiation control purposes only. For nuclear criticality safety, some materials are subject to controls placed on fissile material.

2. For individual radionuclides whose identities are known, but which are not listed in Table I, the determination of the values of A_1 and A_2 requires department approval, except that the values of A_1 and A_2 in Table II may be used without obtaining department approval.

3. In the calculations of A_1 and A_2 for a radionuclide not in Table I, a single radioactive decay chain, in which radionuclides are present in their naturally occurring proportions, and in which no daughter nuclide has a half-life either longer than 10 days, or longer than that of the parent nuclide, shall be considered as a single radionuclide, and the activity to be taken into account, and the A_1 or A_2 value to be applied shall be those corresponding to the parent nuclide of that chain. In the case of radioactive decay chains in which any daughter nuclide has a half-life either longer than 10 days, or greater than that of the parent nuclide, the parent and those daughter nuclides shall be considered as mixtures of different nuclides.

4. For mixtures of radionuclides whose identities and respective activities are known, the following conditions apply:

a. For special form radioactive material, the maximum quantity transported in a Type A package:

$$\sum_{I} \frac{B(i)}{A_1(i)} \leq 1$$

Where B(i) is the activity of radionuclide I and $A_1(i)$ is the A_1 value for radionuclide I.

b. For normal form radioactive material, the maximum quantity transported in a Type A package:

$$\sum_{I} \frac{B(i)}{A_2(i)} \leq 1$$

Where B(i) is the activity of radionuclide I and $A_2(i)$ is the A_2 value for radionuclide I.

c. An A_1 value for mixtures of special form material may be determined as follows:

$$A_1 \text{ for mixture} = \frac{1}{\sum_{I} \frac{f(i)}{A_1(i)}}$$

Where f(i) is the fraction of activity of nuclide I in the mixture and $A_1(i)$ is the appropriate A_1 value for nuclide I.

d. An A_2 value for mixtures of normal form material may be determined as follows:

$$A_2 \text{ for mixture} = \frac{1}{\sum_{I} \frac{f(i)}{A_2(i)}}$$

Where f(i) is the fraction of activity of nuclide I in the mixture and $A_2(i)$ is the appropriate A_2 value for nuclide I.

5. When the identity of each radionuclide is known, but the individual activities of some of the radionuclides are not known, the radionuclides may be grouped and the lowest A_1 or A_2 value, as appropriate, for the radionuclides in each group may be used in applying the formulas in subsection 4. Groups may be based on the total alpha activity and the total beta/gamma activity when these are known, using the lowest A_1 or A_2 values for the alpha emitters and beta/gamma emitters.

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General Authority: NDCC 28-32-02
Law Implemented: NDCC 28-32-02

~~Table I~~

~~A_1 and A_2 Values for Radionuclides~~

~~(See Footnotes at end of Table)~~

Symbol of radionuclide	Element and atomic number	A_1(Ci)	A_2(Ci)	Specific Activity (Ci/g)
Ac-227	Actinium (89)	1000	0.003	7.2×10^{1}
Ac-228		10	4	2.2×10^{6}
Ag-105	Silver (47)	40	40	3.1×10^{4}
Ag-110m		7	7	4.7×10^{3}
Ag-111		100	20	1.6×10^{5}
Am-241	Americium (95)	8	0.008	3.2
Am-243		8	0.008	1.9×10^{-1}
Ar-37 (compressed or uncompressed)*	Argon (18)	1000	1000	1.0×10^{5}
Ar-41 (uncompressed)*		20	20	4.3×10^{7}
Ar-41 (compressed)*		1	1	4.3×10^{7}
As-73	Arsenic (33)	1000	400	2.4×10^{4}
As-74		20	20	1.0×10^{5}
As-76		10	10	1.6×10^{6}
As-77		300	20	1.1×10^{6}
At-211	Astatine (85)	200	7	2.1×10^{6}
Au-193	Gold (79)	200	200	9.3×10^{5}
Au-196		30	30	1.2×10^{5}
Au-198		40	20	2.5×10^{5}

Au-199		200	25	2.1×10^5
Ba-131	Barium (56)	40	40	8.7×10^4
Ba-133		40	40	4.0×10^2
Ba-140		20	20	7.3×10^4
Be-7	Beryllium (4)	300	300	3.5×10^5

Table I (Continued 2)

Symbol of radionuclide	Element and atomic number	A_1(Ci)	A_2(Ci)	Specific Activity (Ci/g)
Bi-206	Bismuth (83)	5	5	9.9×10^4
Bi-207		10	10	2.2×10^2
Bi-210 (RaE)		100	4	1.2×10^5
Bi-212		6	6	1.5×10^7
Bk-249	Berkelium (97)	1000	1	1.8×10^3
Br-77	Bromine (35)	70	25	7.1×10^5
Br-82		6	6	1.1×10^6
C-11	Carbon (6)	20	20	8.4×10^8
C-14		1000	60	4.6
Ca-45	Calcium (20)	1000	25	1.9×10^4
Ca-47		20	20	5.9×10^5
Cd-109	Cadmium (48)	1000	70	2.6×10^3
Cd-115m		30	30	2.6×10^4
Cd-115		80	20	5.1×10^5
Ce-139	Cerium (58)	100	100	6.5×10^3
Ce-141		300	25	2.8×10^4
Ce-143		60	20	6.6×10^5
Ce-144		10	7	3.2×10^3
Cf-249	Californium (98)	2	0.002	3.1
Cf-250		7	0.007	1.3×10^2
Cf-252		2	0.009	6.5×10^2
Cl-36	Chlorine (17)	300	10	3.2×10^{-2}
Cl-38		10	10	1.3×10^8
Cm-242	Curium (96)	200	0.2	3.3×10^3
Cm-243		9	0.009	4.2×10^1

Table I (Continued 3)

Symbol of radionuclide	Element and atomic number	A_1(Ci)	A_2(Ci)	Specific Activity (Ci/g)
Cm-244		10	0.01	8.2×10^{1}
Cm-245		6	0.006	1.0×10^{-1}
Cm-246		6	0.006	3.6×10^{-1}
Co-56	Cobalt (27)	5	5	3.0×10^{4}
Co-57		90	90	8.5×10^{3}
Co-58m		1000	1000	5.9×10^{6}
Co-58		20	20	3.1×10^{4}
Co-60		7	7	1.1×10^{3}
Cr-51	Chromium (24)	600	600	9.2×10^{4}
Cs-129	Cesium (55)	40	40	7.6×10^{5}
Cs-131		1000	1000	1.0×10^{5}
Cs-134m		1000	10	7.4×10^{6}
Cs-134		10	10	1.2×10^{3}
Cs-135		1000	25	8.8×10^{-4}
Cs-136		7	7	7.4×10^{4}
Cs-137		30	10	9.8×10^{1}
Cu-64	Copper (29)	80	25	3.8×10^{6}
Cu-67		200	25	7.9×10^{5}
Dy-165	Dysprosium (66)	100	20	8.2×10^{6}
Dy-166		1000	200	2.3×10^{5}
Er-169	Erbium (68)	1000	25	8.2×10^{4}
Er-171		50	20	2.4×10^{6}
Eu-152m	Europium (63)	30	30	2.2×10^{6}
Eu-152		20	10	1.9×10^{2}
Eu-154		10	5	1.5×10^{3}

Table I (Continued 4)

Symbol of radionuclide	Element and atomic number	A_1(Ci)	A_2(Ci)	Specific Activity (Ci/g)
Eu-155		400	60	1.4×10^3
F-18	Fluorine (9)	20	20	9.3×10^7
Fe-52	Iron (26)	5	5	7.3×10^6
Fe-55		1000	1000	2.2×10^3
Fe-59		10	10	4.9×10^4
Ga-67	Gallium (31)	100	100	6.0×10^5
Ga-68		20	20	4.0×10^7
Ga-72		7	7	3.1×10^6
Gd-153	Gadolinium (64)	200	100	3.6×10^3
Gd-159		300	20	1.1×10^6
Ge-68	Germanium (32)	20	10	7.0×10^3
Ge-71		1000	1000	1.6×10^5
H-3	Hydrogen (1) see T Tritium			
Hf-181	Hafnium (72)	30	25	1.6×10^4
Hg-197m	Mercury (80)	200	200	6.6×10^5
Hg-197		200	200	2.5×10^5
Hg-203		80	25	1.4×10^4
Ho-166	Holmium (67)	30	30	6.9×10^5
I-123	Iodine (53)	50	50	1.9×10^6
I-125		1000	70	1.7×10^4
I-126		40	10	7.8×10^4
I-129		1000	2	1.6×10^{-4}
I-131		40	10	1.2×10^5
I-132		7	7	1.1×10^7
I-133		30	10	1.1×10^6

Table I (Continued 5)

Symbol of radionuclide	Element and atomic number	A_1 (Ci)	A_2 (Ci)	Specific Activity (Ci/g)
I-134		8	8	2.7×10^7
I-135		10	10	3.5×10^6
In-111	Indium (49)	30	25	4.2×10^5
In-113m		60	60	1.6×10^7
In-114m		30	20	2.3×10^4
In-115m		100	20	6.1×10^6
Ir-190	Iridium (77)	10	10	6.2×10^4
Ir-192		20	10	9.1×10^3
Ir-194		10	10	8.5×10^5
K-42	Potassium (19)	10	10	6.0×10^6
K-43		20	10	3.3×10^6
Kr-85m (uncompressed)*	Krypton (36)	100	100	8.4×10^6
Kr-85m (compressed)*		3	3	8.4×10^6
Kr-85 (uncompressed)*		1000	1000	4.0×10^2
Kr-85 (compressed)*		5	5	4.0×10^2
Kr-87 (uncompressed)*		20	20	2.8×10^7
Kr-87 (compressed)*		0.6	0.6	2.8×10^7
La-140	Lanthanum (57)	30	30	5.6×10^5
Lu-177	Lutetium (71)	300	25	1.1×10^5
MFP	Mixed Fission products	10	0.4	
Mg-28	Magnesium (12)	6	6	5.2×10^6
Mn-52	Manganese (25)	5	5	4.4×10^5
Mn-54		20	20	8.3×10^3
Mn-56		5	5	2.2×10^7
Mo-99	Molybdenum (42)	100	20	4.7×10^5

Table I (Continued 6)

Symbol of radionuclide	Element and atomic number	A_1(Ci)	A_2(Ci)	Specific Activity (Ci/g)
N-13	Nitrogen (7)	20	10	1.5×10^3
Na-22	Sodium (11)	8	8	6.3×10^3
Na-24		5	5	8.7×10^6
Nb-93m	Niobium (41)	1000	200	1.1×10^3
Nb-95		20	20	3.9×10^4
Nb-97		20	20	2.6×10^7
Nd-147	Neodymium (60)	100	20	8.0×10^4
Nd-149		30	20	1.1×10^7
Ni-59	Nickel (28)	1000	900	8.1×10^{-2}
Ni-63		1000	100	4.6×10^1
Ni-65		10	10	1.9×10^7
Np-237	Neptunium (93)	5	0.005	6.9×10^{-4}
Np-239		200	25	2.3×10^5
Os-185	Osmium (76)	20	20	7.3×10^3
Os-191		600	200	4.6×10^4
Os-191m		200	200	1.2×10^6
Os-193		100	20	5.3×10^5
P-32	Phosphorus (15)	30	30	2.9×10^5
Pa-230	Protactinium (91)	20	0.8	3.2×10^4
Pa-231		2	0.002	4.5×10^{-2}
Pa-233		100	100	2.1×10^4
Pb-201	Lead (82)	20	20	1.7×10^6
Pb-210		100	0.2	8.8×10^1
Pb-212		6	5	1.4×10^6
Pd-103	Palladium (46)	1000	700	7.5×10^4

Table I (Continued 7)

Symbol of radionuclide	Element and atomic number	A_1(Ci)	A_2(Ci)	Specific Activity (Ci/g)
Pd-109		100	20	2.1×10^{6}
Pm-147	Promethium (61)	1000	25	9.4×10^{2}
Pm-149		100	20	4.2×10^{5}
Po-210	Polonium (84)	200	0.2	4.5×10^{3}
Pr-142	Praseodymium (59)	10	10	1.2×10^{4}
Pr-143		300	20	6.6×10^{4}
Pt-191	Platinum (78)	100	100	2.3×10^{5}
Pt-193m		200	200	2.0×10^{5}
Pt-197m		300	20	1.2×10^{7}
Pt-197		300	20	8.8×10^{5}
Pu-238	Plutonium (94)	3	0.003	1.7×10^{1}
Pu-239		2	0.002	6.2×10^{-2}
Pu-240		2	0.002	2.3×10^{-1}
Pu-241		1000	0.1	1.1×10^{2}
Pu-242		3	0.003	3.9×10^{-3}
Ra-223	Radium (88)	50	0.2	5.0×10^{4}
Ra-224		6	0.5	1.6×10^{5}
Ra-226		10	0.05	1.0
Ra-228		10	0.05	2.3×10^{2}
Rb-81	Rubidium (37)	30	24	8.2×10^{6}
Rb-86		30	30	8.1×10^{4}
Rb-87		Unlimited	Unlimited	6.6×10^{-8}
Rb (natural)		Unlimited	Unlimited	1.8×10^{-8}
Re-186	Rhenium(75)	100	20	1.9×10^{5}
Re-187		Unlimited	Unlimited	3.8×10^{-8}
Re-188		10	10	1.0×10^{6}

Table I (Continued 8)

Symbol of radionuclide	Element and atomic number	A_1 (Ci)	A_2 (Ci)	Specific Activity (Ci/g)
Re (natural)		Unlimited	Unlimited	2.4×10^{-8}
Rh-103m	Rhodium (45)	1000	1000	3.2×10^{7}
Rh-105		200	25	8.2×10^{5}
Rn-222	Radon (86)	10	2	1.5×10^{5}
Ru-97	Ruthenium (44)	80	80	5.5×10^{5}
Ru-103		30	25	3.2×10^{4}
Ru-105		20	20	6.6×10^{6}
Ru-106		10	7	3.4×10^{3}
S-35	Sulphur (16)	1000	60	4.3×10^{4}
Sb-122	Antimony (51)	30	30	3.9×10^{5}
Sb-124		5	5	1.8×10^{4}
Sb-125		40	25	1.4×10^{3}
Sc-46	Scandium (21)	8	8	3.4×10^{4}
Sc-47		200	20	8.2×10^{5}
Sc-48		5	5	1.5×10^{6}
Se-75	Selenium (34)	40	40	1.4×10^{4}
Si-31	Silicon (14)	100	20	3.9×10^{7}
Sm-147	Samarium (62)	Unlimited	Unlimited	2.0×10^{-8}
Sm-151		1000	90	2.6×10^{1}
Sm-153		300	20	4.4×10^{5}
Sn-113	Tin (50)	60	60	1.0×10^{4}
Sn-119m		100	100	4.4×10^{3}
Sn-125		10	10	1.1×10^{5}
Sr-85m	Strontium (38)	80	80	3.2×10^{7}
Sr-85		30	30	2.4×10^{4}
Sr-85m		50	50	1.2×10^{7}

Table I (Continued 9)

Symbol of radionuclide	Element and atomic number	A_1(Ci)	A_2(Ci)	Specific Activity (Ci/g)
Sr-89		100	10	2.9×10^4
Sr-90		10	0.4	1.5×10^2
Sr-91		10	10	3.6×10^6
Sr-92		10	10	1.3×10^7
T (uncompressed)*	Tritium (1)	1000	1000	9.7×10^3
T (compressed)*		1000	1000	9.7×10^3
T (activated luminous paint)		1000	1000	9.7×10^3
T (adsorbed on solid carrier)		1000	1000	9.7×10^3
T (tritiated water)		1000	1000	9.7×10^3
T (other forms)		20	20	9.7×10^3
Ta-182	Tantalum (73)	20	20	6.2×10^3
Tb-160	Terbium (65)	20	10	1.1×10^4
Tc-96m	Technetium (43)	1000	1000	3.8×10^7
Tc-96		6	6	3.2×10^5
Tc-97m		1000	200	1.5×10^4
Tc-97		1000	400	1.4×10^{-3}
Tc-99m		100	100	5.2×10^6
Tc-99		1000	25	1.7×10^{-2}
Te-125m	Tellurium (52)	1000	100	1.8×10^4
Te-127m		300	20	4.0×10^4
Te-127		300	20	2.6×10^6
Te-129m		30	10	2.5×10^4
Te-129		100	20	2.0×10^7
Te-131m		10	10	8.0×10^5

Table I (Continued 10)

Symbol of radionuclide	Element and atomic number	A_1(Ci)	A_2(Ci)	Specific Activity (Ci/g)
Te-132		7	7	3.1×10^5
Th-227	Thorium (90)	200	0.2	3.2×10^4
Th-228		6	0.008	8.3×10^2
Th-230		3	0.003	1.9×10^{-2}
Th-231		1000	25	5.3×10^5
Th-232		Unlimited	Unlimited	1.1×10^{-7}
Th-234		10	10	2.3×10^4
Th (natural)		Unlimited	Unlimited	2.2×10^{-7}
Th (irradiated)**				
Tl-200	Thallium (81)	20	20	5.8×10^5
Tl-201		200	200	2.2×10^5
Tl-202		40	40	5.4×10^4
Tl-204		300	10	4.3×10^2
Tm-170	Thulium (69)	300	10	6.0×10^3
Tm-171		1000	100	1.1×10^3
U-230	Uranium (92)	100	0.1	2.7×10^4
U-232		30	0.03	2.1×10^3
U-233		100	0.1	9.5×10^{-3}
U-234		100	0.1	6.2×10^{-3}
U-235		100	0.2	2.1×10^{-6}
U-236		200	0.2	6.3×10^{-5}
U-238		Unlimited	Unlimited	3.3×10^{-7}
U (natural)		Unlimited	Unlimited	(see Table IV)
U (enriched) < 20%		Unlimited	Unlimited	(see Table IV)
	20% or greater	100	0.1	(see Table IV)

Table I (Continued 11)

Symbol of radionuclide	Element and atomic number	A_1 (Ci)	A_2 (Ci)	Specific Activity (Ci/g)
U (depleted)		Unlimited (see Table IV)		Unlimited
U (irradiated)***				
V-48	Vanadium (23)	6	6	1.7×10^5
W-181	Tungsten (74)	200	100	5.0×10^3
W-185		1000	25	9.7×10^{-3}
W-187		40	20	7.0×10^5
Xe-127 (uncompressed)*	Xenon (54)	70	70	2.8×10^4
Xe-127 (compressed)*		5	5	2.8×10^4
Xe-131m (compressed)*		10	10	1.0×10^5
Xe-131m (uncompressed)*		100	100	1.0×10^5
Xe-133 (uncompressed)*		1000	1000	1.9×10^5
Xe-133 (compressed)*		5	5	1.9×10^5
Xe-135 (uncompressed)*		70	70	2.5×10^5
Xe-135 (compressed)*		2	2	2.5×10^5
Y-87	Yttrium (39)	20	20	4.5×10^3
Y-90		10	10	2.5×10^5
Y-91m		30	30	4.1×10^7
Y-91		30	30	2.5×10^4
Y-92		10	10	9.5×10^6
Y-93		10	10	3.2×10^6
Yb-169	Ytterbium (70)	80	80	2.3×10^5
Yb-175		400	25	1.8×10^5
Zn-65	Zinc (30)	30	30	8.0×10^3
Zn-69m		40	20	3.3×10^6
Zn-69		300	20	5.3×10^7

Table I (Continued 12)

Symbol of radionuclide	Element and atomic number	A_1(Ci)	A_2(Ci)	Specific Activity (Ci/g)
Zr-93	Zirconium (40)	1000	200	3.5×10^{-3}
Zr-95		20	20	2.1×10^{4}
Zr-97		20	20	2.0×10^{6}

* For the purpose of table I, compressed gas means a gas at a pressure which exceeds the ambient atmospheric pressure at the location where the containment system was closed.

** The values of A_1 and A_2 must be calculated in accordance with the procedure specified in appendix A, paragraph c, taking into account the activity of the fission products and of the uranium 233 in addition to that of the thorium.

*** The values of A_1 and A_2 must be calculated in accordance with the procedure specified in appendix A, paragraph c, taking into account the activity of the fission products and plutonium isotopes in addition to that of the uranium.

ENTIRELY NEW TABLE I

TABLE I
A_1 and A_2 Values for Radionuclides
(See Footnotes at end of Table)

Symbol of Radionuclide	Element and Atomic Number	A_1(TBq)	A_1(Ci)	A_2(TBq)	A_2(Ci)	Specific Activity (TBq/g)	Specific Activity (Ci/g)
Ac-225	Actinium(89)	0.6	16.2	1E-2	0.270	2.1E3	5.8E4
Ac-227		40	1080	2E-5	5.41E-4	2.7	7.2E1
Ac-228		0.6	16.2	0.4	10.8	8.4E4	2.2E6
Ag-105	Silver(47)	2	54.1	2	54.1	1.1E3	3.0E4
Ag-108m		0.6	16.2	0.6	16.2	9.7E-1	2.6E1
Ag-110m		0.4	10.8	0.4	10.8	1.8E2	4.7E3
Ag-111		0.6	16.2	0.5	13.5	5.8E3	1.6E5
Al-26	Aluminum(13)	0.4	10.8	0.4	10.8	7.0E-4	1.9E-2
Am-241	Americium(95)	2	54.1	2E-4	5.41E-3	1.3E-1	3.4
Am-242m		2	54.1	2E-4	5.41E-3	3.6E-1	1.0E1
Am-243		2	54.1	2E-4	5.41E-3	7.4E-3	2.0E-1
Ar-37	Argon(18)	40	1080	40	1080	3.7E3	9.9E4
Ar-39		20	541	20	541	1.3	3.4E1
Ar-41		0.6	16.2	0.6	16.2	1.5E6	4.2E7
Ar-42		0.2	5.41	0.2	5.41	9.6	2.6E2
As-72	Arsenic(33)	0.2	5.41	0.2	5.41	6.2E4	1.7E6
As-73		40	1080	40	1080	8.2E2	2.2E4
As-74		1	27.0	0.5	13.5	3.7E3	9.9E4
As-76		0.2	5.41	0.2	5.41	5.8E4	1.6E6
As-77		20	541	0.5	13.5	3.9E4	1.0E6
At-211	Astatine(85)	30	811	2	54.1	7.6E4	2.1E6
Au-193	Gold(79)	6	162	6	162	3.4E4	9.2E5
Au-194		1	27.0	1	27.0	1.5E4	4.1E5
Au-195		10	270	10	270	1.4E2	3.7E3
Au-196		2	54.1	2	54.1	4.0E3	1.1E5
Au-198		3	81.1	0.5	13.5	9.0E3	2.4E5
Au-199		10	270	0.9	24.3	7.7E3	2.1E5

Symbol of Radionuclide	Element and Atomic Number	A_1(TBq)	A_1(Ci)	A_2(TBq)	A_2(Ci)	Specific Activity (TBq/g)	Specific Activity (Ci/g)
Ba-131	Barium(56)	2	54.1	2	54.1	3.1E3	8.4E4
Ba-133m		10	270	0.9	24.3	2.2E4	6.1E5
Ba-133		3	81.1	3	81.1	9.4	2.6E2
Ba-140		0.4	10.8	0.4	10.8	2.7E3	7.3E4
Be-7	Beryllium(4)	20	541	20	541	1.3E4	3.5E5
Be-10		20	541	0.5	13.5	8.3E-4	2.2E-2
Bi-205	Bismuth(83)	0.6	16.2	0.6	16.2	1.5E-3	4.2E4
Bi-206		0.3	8.11	0.3	8.11	3.8E3	1.0E5
Bi-207		0.7	18.9	0.7	18.9	1.9	5.2E1
Bi-210m		0.3	8.11	3E-2	0.811	2.1E-5	5.7E-4
Bi-210		0.6	16.2	0.5	13.5	4.6E3	1.2E5
Bi-212		0.3	8.11	0.3	8.11	5.4E5	1.5E7
Bk-247	Berkelium(97)	2	54.1	2E-4	5.41E-3	3.8E-2	1.0
Bk-249		40	1080	8E-2	2.16	6.1E1	1.6E3
Br-76	(Bromine)(35)	0.3	8.11	0.3	8.11	9.4E4	2.5E6
Br-77		3	81.1	3	81.1	2.6E4	7.1E5
Br-82		0.4	10.8	0.4	10.8	4.0E4	1.1E6
C-11	Carbon(6)	1	27.0	0.5	13.5	3.1E7	8.4E8
C-14		40	1080	2	54.1	1.6E-1	4.5
Ca-41	Calcium(20)	40	1080	40	1080	3.1E-3	8.5E-2
Ca-45		40	1080	0.9	24.3	6.6E2	1.8E4
Ca-47		0.9	24.3	0.5	13.5	2.3E4	6.1E5
Cd-109	Cadmium(48)	40	1080	1	27.0	9.6E1	2.6E3
Cd-113m		20	541	9E-2	2.43	8.3	2.2E2
Cd-115m		0.3	8.11	0.3	8.11	9.4E2	2.5E4
Cd-115		4	108	0.5	13.5	1.9E4	5.1E5
Ce-139	Cerium(58)	6	162	6	162	2.5E2	6.8E3
Ce-141		10	270	0.5	13.5	1.1E3	2.8E4
Ce-143		0.6	16.2	0.5	13.5	2.5E4	6.6E5
Ce-144		0.2	5.41	0.2	5.41	1.2E2	3.2E3
Cf-248	Californium(98)	30	811	3E-3	8.11E-2	5.8E1	1.6E3

Symbol of Radionuclide	Element and Atomic Number	A_1(TBq)	A_1(Ci)	A_2(TBq)	A_2(Ci)	Specific Activity (TBq/g)	Specific Activity (Ci/g)
Cf-249		2	54.1	2E-4	5.41E-3	1.5E-1	4.1
Cf-250		5	135	5E-4	1.35E-2	4.0	1.1E2
Cf-251		2	54.1	2E-4	5.41E-3	5.9E-2	1.6
Cf-252		0.1	2.70	1E-3	2.70E-2	2.0E1	5.4E2
Cf-253		40	1080	6E-2	1.62	1.1E3	2.9E4
Cf-254		3E-3	8.11E-2	6E-4	1.62E-2	3.1E2	8.5E3
Cl-36	Chlorine(17)	20	541	0.5	13.5	1.2E-3	3.3E-2
Cl-38		0.2	5.41	0.2	5.41	4.9E6	1.3E8
Cm-240	Curium(96)	40	1080	2E-2	0.541	7.5E2	2.0E4
Cm-241		2	54.1	0.9	24.3	6.1E2	1.7E4
Cm-242		40	1080	1E-2	0.270	1.2E2	3.3E3
Cm-243		3	81.1	3E-4	8.11E-3	1.9	5.2E1
Cm-244		4	108	4E-4	1.08E-2	3.0	8.1E1
Cm-245		2	54.1	2E-4	5.41E-3	6.4E-3	1.7E-1
Cm-246		2	54.1	2E-4	5.41E-3	1.1E-2	3.1E-1
Cm-247		2	54.1	2E-4	5.41E-3	3.4E-6	9.3E-5
Cm-248		4E-2	1.08	5E-5	1.35E-3	1.6E-4	4.2E-3
Co-55	Cobalt(27)	0.5	13.5	0.5	13.5	1.1E5	3.1E6
Co-56		0.3	8.11	0.3	8.11	1.1E3	3.0E4
Co-57		8	216	8	216	3.1E2	8.4E3
Co-58m		40	1080	40	1080	2.2E5	5.9E6
Co-58		1	27.0	1	27.0	1.2E3	3.2E4
Co-60		0.4	10.8	0.4	10.8	4.2E1	1.1E3
Cr-51	Chromium(24)	30	811	30	811	3.4E3	9.2E4
Cs-129	Cesium(55)	4	108	4	108	2.8E4	7.6E5
Cs-131		40	1080	40	1080	3.8E3	1.0E5
Cs-132		1	27.0	1	27.0	5.7E3	1.5E5
Cs-134m		40	1080	9	243	3.0E5	8.0E6
Cs-134		0.6	16.2	0.5	13.5	4.8E1	1.3E3
Cs-135		40	1080	0.9	24.3	4.3E-5	1.2E-3
Cs-136		0.5	13.5	0.5	13.5	2.7E3	7.3E4

Symbol of Radionuclide	Element and Atomic Number	A_1(TBq)	A_1(Ci)	A_2(TBq)	A_2(Ci)	Specific Activity (TBq/g)	Specific Activity (Ci/g)
Cs-137		2	54.1	0.5	13.5	3.2	8.7E1
Cu-64	Copper(29)	5	135	0.9	24.3	1.4E5	3.9E6
Cu-67		9	243	0.9	24.3	2.8E4	7.6E5
Dy-159	Dysprosium(66)	20	541	20	541	2.1E2	5.7E3
Dy-165		0.6	16.2	0.5	13.5	3.0E5	8.2E6
Dy-166		0.3	8.11	0.3	8.11	8.6E3	2.3E5
Er-169	Erbium(68)	40	1080	0.9	24.3	3.1E3	8.3E4
Er-171		0.6	16.2	0.5	13.5	9.0E4	2.4E6
Es-253	Einsteinium(99)*	200	5400	2E-2	5.41E-1		
Es-254		30	811	3E-3	8.11E-2		
Es-254m		0.6	16.2	0.4	10.8		
Es-255							
Eu-147	Europium(63)	2	54.1	2	54.1	1.4E3	3.7E4
Eu-148		0.5	13.5	0.5	13.5	6.0E2	1.6E4
Eu-149		20	541	20	541	3.5E2	9.4E3
Eu-150		0.7	18.9	0.7	18.9	6.1E4	1.6E6
Eu-152m		0.6	16.2	0.5	13.5	8.2E4	2.2E6
Eu-152		0.9	24.3	0.9	24.3	6.5	1.8E2
Eu-154		0.8	21.6	0.5	13 5	9.8	2.6E2
Eu-155		20	541	2	54.1	1.8E1	4.9E2
Eu-156		0.6	16.2	0.5	13.5	2.0E3	5.5E4
F-18	Fluorine(9)	1	27.0	0.5	13.5	3 5E6	9.5E7
Fe-52	Iron(26)	0.2	5.41	0.2	5.41	2.7E5	7.3E6
Fe-55		40	1080	40	1080	8.8E1	2.4E3
Fe-59		0.8	21.6	0.8	21.6	1.8E3	5.0E4
Fe-60		40	1080	0.2	5.41	7.4E-4	2.0E-2
Fm-255	Fermium(100)**	40	1080	0.8	21.6		
Fm-257		10	270	8E-3	2.16E-1		
Ga-67	Gallium(31)	6	162	6	162	2.2E4	6.0E5
Ga-68		0.3	8.11	0.3	8.11	1.5E6	4.1E7
Ga-72		0.4	10.8	0.4	10.8	1.1E5	3.1E6

Symbol of Radionuclide	Element and Atomic Number	A_1(TBq)	A_1(Ci)	A_2(TBq)	A_2(Ci)	Specific Activity (TBq/g)	Specific Activity (Ci/g)
Gd-146	Gadolinium(64)	0.4	10.8	0.4	10.8	6.9E2	1.9E4
Gd-148		3	81.1	3E-4	8.11E-3	1.2	3.2E1
Gd-153		10	270	5	135	1.3E2	3.5E3
Gd-159		4	108	0.5	13.5	3.9E4	1.1E6
Ge-68	Germanium(32)	0.3	8.11	0.3	8.11	2.6E2	7.1E3
Ge-71		40	1080	40	1080	5.8E3	1.6E5
Ge-77		0.3	8.11	0.3	8.11	1.3E5	3.6E6
H-3	Hydrogen(1)	See T-Tritium					
Hf-172	Hafnium(72)	0.5	13.5	0.3	8.11	4.1E1	1.1E3
Hf-175		3	81.1	3	81.1	3.9E2	1.1E4
Hf-181		2	54.1	0.9	24.3	6.3E2	1.7E4
Hf-182		4	108	3E-2	0.811	8.1E-6	2.2E-4
Hg-194	Mercury(80)	1	27.0	1	27.0	1.3E-1	3.5
Hg-195m		5	135	5	135	1.5E4	4.0E5
Hg-197m		10	270	0.9	24.3	2.5E4	6.7E5
Hg-197		10	270	10	270	9.2E3	2.5E5
Hg-203		4	108	0.9	24.3	5.1E2	1.4E4
Ho-163	Holmium(67)	40	1080	40	1080	2.7	7.6E1
Ho-166m		0.6	16.2	0.3	8.11	6.6E-2	1.8
Ho-166		0.3	8.11	0.3	8.11	2.6E4	7.0E5
I-123	Iodine(53)	6	162	6	162	7.1E4	1.9E6
I-124		0.9	24.3	0.9	24.3	9.3E3	2.5E5
I-125		20	541	2	54.1	6.4E2	1.7E4
I-126		2	54.1	0.9	24.3	2.9E3	8.0E4
I-129		Unlimited	Unlimited	Unlimited	Unlimited	6.5E-6	1.8E-4
I-131		3	81.1	0.5	13.5	4.6E3	1.2E5
I-132		0.4	10.8	0.4	10.8	3.8E5	1.0E7
I-133		0.6	16.2	0.5	13.5	4.2E4	1.1E6
I-134		0.3	8.11	0.3	8.11	9.9E5	2.7E7
I-135		0.6	16.2	0.5	13.5	1.3E5	3.5E6
In-111	Indium(49)	2	54.1	2	54.1	1.5E4	4.2E5

Symbol of Radionuclide	Element and Atomic Number	A_1(TBq)	A_1(Ci)	A_2(TBq)	A_2(Ci)	Specific Activity (TBq/g)	Specific Activity (Ci/g)
In-113m		4	108	4	108	6.2E5	1.7E7
In-114m		0.3	8.11	0.3	8.11	8.6E2	2.3E4
In-115m		6	162	0.9	24.3	2.2E5	6.1E6
Ir-189	Iridium(77)	10	270	10	270	1.9E3	5.2E4
Ir-190		0.7	18.9	0.7	18.9	2.3E3	6.2E4
Ir-192		1	27.0	0.5	13.5	3.4E2	9.2E3
Ir-193m		10	270	10	270	2.4E3	6.4E4
Ir-194		0.2	5.41	0.2	5.41	3.1E4	8.4E5
K-40	Potassium(19)	0.6	16.2	0.6	16.2	2.4E-7	6.4E-6
K-42		0.2	5.41	0.2	5.41	2.2E5	6.0E6
K-43		1.0	27.0	0.5	13.5	1.2E5	3.3E6
Kr-81	Krypton(36)	40	1080	40	1080	7.8E-4	2.1E-2
Kr-85m		6	162	6	162	3.0E5	8.2E6
Kr-85		20	541	10	270	1.5E1	3.9E2
Kr-87		0.2	5.41	0.2	5.41	1.0E6	2.8E7
La-137	Lanthanum(57)	40	1080	2	54.1	1.6E-3	4.4E-2
La-140		0.4	10.8	0.4	10.8	2.1E4	5.6E5
Lu-172	Lutetium(71)	0.5	13.5	0.5	13.5	4.2E3	1.1E5
Lu-173		8	216	8	216	5.6E1	1.5E3
Lu-174m		20	541	8	216	2.0E2	5.3E3
Lu-174		8	216	4	108	2.3E1	6.2E2
Lu-177		30	811	0.9	24.3	4.1E3	1.1E5
MFP	For mixed fission products, use formula for mixtures or Table II						
Mg-28	Magnesium(12)	0.2	5.41	0.2	5.41	2 0E5	5.4E6
Mn-52	Manganese(25)	0.3	8.11	0.3	8.11	1.6E4	4.4E5
Mn-53		Unlimited	Unlimited	Unlimited	Unlimited	6.8E-5	1.8E-3
Mn-54		1	27.0	1	27.0	2.9E2	7.7E3
Mn-56		0.2	5.41	0.2	5.41	8.0E5	2.2E7
Mo-93	Molybdenum(42)	40	1080	7	189	4.1E-2	1.1
Mo-99		0.6	16.2	0.5	13.5***	1.8E4	4.8E5
N-13	Nitrogen(7)	0.6	16.2	0.5	13.5	5.4E7	1.5E9

Symbol of Radionuclide	Element and Atomic Number	A_1 (TBq)	A_1 (Ci)	A_2 (TBq)	A_2 (Ci)	Specific Activity (TBq/g)	Specific Activity (Ci/g)
Na-22	Sodium(11)	0.5	13.5	0.5	13.5	2.3E2	6.3E3
Na-24		0.2	5.41	0.2	5.41	3.2E5	8.7E6
Nb-92m	Niobium(41)	0.7	18.9	0.7	18.9	5.2E3	1.4E5
Nb-93m		40	1080	6	162	8.8	2.4E2
Nb-94		0.6	16.2	0.6	16.2	6.9E-3	1.9E-1
Nb-95		1	27.0	1	27.0	1.5E3	3.9E4
Nb-97		0.6	16.2	0.5	13.5	9.9E5	2.7E7
Nd-147	Neodymium(60)	4	108	0.5	13.5	3.0E3	8.1E4
Nd-149		0.6	16.2	0.5	13.5	4.5E5	1.2E7
Ni-59	Nickel(28)	40	1080	40	1080	3.0E-3	8.0E-2
Ni-63		40	1080	30	811	2.1	5.7E1
Ni-65		0.3	8.11	0.3	8.11	7.1E5	1.9E7
Np-235	Neptunium(93)	40	1080	40	1080	5.2E1	1.4E3
Np-236		7	189	1E-3	2.70E-2	4.7E-4	1.3E-2
Np-237		2	54.1	2E-4	5.41E-3	2.6E-5	7.1E-4
Np-239		6	162	0.5	13.5	8.6E3	2.3E5
Os-185	Osmium(76)	1	27.0	1	27.0	2.8E2	7.5E3
Os-191m		40	1080	40	1080	4.6E4	1.3E6
Os-191		10	270	0.9	24.3	1.6E3	4.4E4
Os-193		0.6	16.2	0.5	13.5	2.0E4	5.3E5
Os-194		0.2	5.41	0.2	5.41	1.1E1	3.1E2
P-32	Phosphorus(15)	0.3	8.11	0.3	8.11	1.1E4	2.9E5
P-33		40	1080	0.9	24.3	5.8E3	1.6E5
Pa-230	Protactinium(91)	2	54.1	0.1	2.70	1.2E3	3.3E4
Pa-231		0.6	16.2	6E-5	1.62E-3	1.7E-3	4.7E-2
Pa-233		5	135	0.9	24.3	7.7E2	2.1E4
Pb-201	Lead(82)	1	27.0	1	27.0	6.2E4	1.7E6
Pb-202		40	1080	2	54.1	1.2E-4	3.4E-3
Pb-203		3	81.1	3	81.1	1.1E4	3.0E5
Pb-205		Unlimited	Unlimited	Unlimited	Unlimited	4.5E-6	1.2E-4
Pb-210		0.6	16.2	9E-3	0.243	2.8	7.6E1

Symbol of Radionuclide	Element and Atomic Number	A_1 (TBq)	A_1 (Ci)	A_2 (TBq)	A_2 (Ci)	Specific Activity (TBq/g)	Specific Activity (Ci/g)
Pb-212		0.3	8.11	0.3	8.11	5.1E4	1.4E6
Pd-103	Palladium(46)	40	1080	40	1080	2.8E3	7.5E4
Pd-107		Unlimited	Unlimited	Unlimited	Unlimited	1.9E-5	5.1E-4
Pd-109		0.6	16.2	0.5	13.5	7.9E4	2.1E6
Pm-143	Promethium(61)	3	81.1	3	81.1	1.3E2	3.4E3
Pm-144		0.6	16.2	0.6	16.2	9.2E1	2.5E3
Pm-145		30	811	7	189	5.2	1.4E2
Pm-147		40	1080	0.9	24.3	3.4E1	9.3E2
Pm-148m		0.5	13.5	0.5	13.5	7.9E2	2.1E4
Pm-149		0.6	16.2	0.5	13.5	1.5E4	4.0E5
Pm-151		3	81.1	0.5	13.5	2.7E4	7.3E5
Po-208	Polonium(84)	40	1080	2E-2	0.541	2.2E1	5.9E2
Po-209		40	1080	2E-2	0.541	6.2E-1	1.7E1
Po-210		40	1080	2E-2	0.541	1.7E2	4.5E3
Pr-142	Praseodymium(59)	0.2	5.41	0.2	5.41	4.3E4	1.2E6
Pr-143		4	108	0.5	13.5	2.5E3	6.7E4
Pt-188	Platinum(78)	0.6	16.2	0.6	16.2	2.5E3	6.8E4
Pt-191		3	81.1	3	81.1	8.7E3	2.4E5
Pt-193m		40	1080	9	243	5.8E3	1.6E5
Pt-193		40	1080	40	1080	1.4	3.7E1
Pt-195m		10	270	2	54.1	6.2E3	1.7E5
Pt-197m		10	270	0.9	24.3	3.7E5	1.0E7
Pt-197		20	541	0.5	13.5	3.2E4	8.7E5
Pu-236	Plutonium(94)	7	189	7E-4	1.89E-2	2.0E1	5.3E2
Pu-237		20	541	20	541	4.5E2	1.2E4
Pu-238		2	54.1	2E-4	5.41E-3	6.3E-1	1.7E1
Pu-239		2	54.1	2E-4	5.41E-3	2.3E-3	6.2E-2
Pu-240		2	54.1	2E-4	5.41E-3	8.4E-3	2.3E-1
Pu-241		40	1080	1E-2	0.270	3.8	1.0E2
Pu-242		2	54.1	2E-4	5.41E-3	1.5E-4	3.9E-3
Pu-244		0.3	8.11	2E-4	5.41E-3	6.7E-7	1.8E-5

Symbol of Radionuclide	Element and Atomic Number	A_1(TBq)	A_1(Ci)	A_2(TBq)	A_2(Ci)	Specific Activity (TBq/g)	Specific Activity (Ci/g)
Ra-223	Radium(88)	0.6	16.2	3E-2	0.811	1.9E3	5.1E4
Ra-224		0.3	8.11	6E-2	1.62	5.9E3	1.6E5
Ra-225		0.6	16.2	2E-2	0.541	1.5E3	3.9E4
Ra-226		0.3	8.11	2E-2	0.541	3.7E-2	1.0
Ra-228		0.6	16.2	4E-2	1.08	1.0E1	2.7E2
Rb-81	Rubidium(37)	2	54.1	0.9	24.3	3.1E5	8.4E6
Rb-83		2	54.1	2	54.1	6.8E2	1.8E4
Rb-84		1	27.0	0.9	24.3	1.8E3	4.7E4
Rb-86		0.3	8.11	0.3	8.11	3.0E3	8.1E4
Rb-87		Unlimited	Unlimited	Unlimited	Unlimited	3.2E-9	8.6E-8
Rb(natural)		Unlimited	Unlimited	Unlimited	Unlimited	6.7E6	1.8E8
Re-183	Rhenium(75)	5	135	5	135	3.8E2	1.0E4
Re-184m		3	81.1	3	81.1	1.6E2	4.3E3
Re-184		1	27.0	1	27.0	6.9E2	1.9E4
Re-186		4	108	0.5	13.5	6.9E3	1.9E5
Re-187		Unlimited	Unlimited	Unlimited	Unlimited	1.4E-9	3.8E-8
Re-188		0.2	5.41	0.2	5.41	3.6E4	9.8E5
Re-189		4	108	0.5	13.5	2.5E4	6.8E5
Re(natural)		Unlimited	Unlimited	Unlimited	Unlimited		2.4E-8
Rh-99	Rhodium(45)	2	54.1	2	54.1	3.0E3	8.2E4
Rh-101		4	108	4	108	4.1E1	1.1E3
Rh-102m		2	54.1	0.9	24.3	2.3E2	6.2E3
Rh-102		0.5	13.5	0.5	13.5	4.5E1	1.2E3
Rh-103m		40	1080	40	1080	1.2E6	3.3E7
Rh-105		10	270	0.9	24.3	3.1E4	8.4E5
Rn-222	Radon(86)	0.2	5.41	4E-3	0.108	5.7E3	1.5E5
Ru-97	Ruthenium(44)	4	108	4	108	1.7E4	4.6E5
Ru-103		2	54.1	0.9	24.3	1.2E3	3.2E4
Ru-105		0.6	16.2	0.5	13.5	2.5E5	6.7E6
Ru-106		0.2	5.41	0.2	5.41	1.2E2	3.3E3
S-35	Sulfur(16)	40	1080	2	54.1	1.6E3	4.3E4

Symbol of Radionuclide	Element and Atomic Number	A_1(TBq)	A_1(Ci)	A_2(TBq)	A_2(Ci)	Specific Activity (TBq/g)	(Ci/g)
Sb-122	Antimony(51)	0.3	8.11	0.3	8.11	1.5E4	4.0E5
Sb-124		0.6	16.2	0.5	13.5	6.5E2	1.7E4
Sb-125		2	54.1	0.9	24.3	3.9E1	1.0E3
Sb-126		0.4	10.8	0.4	10.8	3.1E3	8.4E4
Sc-44	Scandium(21)	0.5	13.5	0.5	13.5	6.7E5	1.8E7
Sc-46		0.5	13.5	0.5	13.5	1.3E3	3.4E4
Sc-47		9	243	0.9	24.3	3.1E4	8.3E5
Sc-48		0.3	8.11	0.3	8.11	5.5E4	1.5E6
Se-75	Selenium(34)	3	81.1	3	81.1	5.4E2	1.5E4
Se-79		40	1080	2	54.1	2.6E-3	7.0E-2
Si-31	Silicon(14)	0.6	16.2	0.5	13.5	1.4E6	3.9E7
Si-32		40	1080	0.2	5.41	3.9	1.1E2
Sm-145	Samarium(62)	20	541	20	541	9.8E1	2.6E3
Sm-147		Unlimited	Unlimited	Unlimited	Unlimited	8.5E-1	2.3E-8
Sm-151		40	1080	4	108	9.7E-1	2.6E1
Sm-153		4	108	0.5	13.5	1.6E4	4.4E5
Sn-113	Tin(50)	4	108	4	108	3.7E2	1.0E4
Sn-117m		6	162	2	54.1	3.0E3	8.2E4
Sn-119m		40	1080	40	1080	1.4E2	3.7E3
Sn-121m		40	1080	0.9	24.3	2.0	5.4E1
Sn-123		0.6	16.2	0.5	13.5	3.0E2	8.2E3
Sn-125		0.2	5.41	0.2	5.41	4.0E3	1.1E5
Sn-126		0.3	8.11	0.3	8.11	1.0E-3	2.8E-2
Sr-82	Strontium(38)	0.2	5.41	0.2	5.41	2.3E3	6.2E4
Sr-85m		5	135	5	135	1.2E6	3.3E7
Sr-85		2	54.1	2	54.1	8.8E2	2.4E4
Sr-87m		3	81.1	3	81.1	4.8E5	1.3E7
Sr-89		0.6	16.2	0 5	13.5	1.1E3	2.9E4
Sr-90		0.2	5.41	0.1	2.70	5.1	1.4E2
Sr-91		0.3	8.11	0.3	8.11	1.3E5	- 3.6E6
Sr-92		0.8	21.6	0.5	13.5	4.7E5	1.3E7

Symbol of Radionuclide	Element and Atomic Number	A_1(TBq)	A_1(Ci)	A_2(TBq)	A_2(Ci)	Specific Activity (TBq/g)	Specific Activity (Ci/g)
T	Tritium(1)	40	1080	40	1080	3.6E2	9.7E3
Ta-178	Tantalum(73)	1	27.0	1	27.0	4.2E6	1.1E8
Ta-179		30	811	30	811	4.1E1	1.1E3
Ta-182		0.8	21.6	0.5	13.5	2.3E2	6.2E3
Tb-157	Terbium(65)	40	1080	10	270	5.6E-1	1.5E1
Tb-158		1	27.0	0.7	18.9	5.6E-1	1.5E1
Tb-160		0.9	24.3	0.5	13.5	4.2E2	1.1E4
Tc-95m	Technetium(43)	2	54.1	2	54.1	8.3E2	2.2E4
Tc-96m		0.4	10.8	0.4	10.8	1.4E6	3.8E7
Tc-96		0.4	10.8	0.4	10.8	1.2E4	3.2E5
Tc-97m		40	1080	40	1080	5.6E2	1.5E4
Tc-97		Unlimited	Unlimited	Unlimited	Unlimited	5.2E-5	1.4E-3
Tc-98		0.7	18.9	0.7	18.9	3.2E-5	8.7E-4
Tc-99m		8	216	8	216	1.9E5	5.3E6
Tc-99		40	1080	0.9	24.3	6.3E-4	1.7E-2
Te-118	Tellurium(52)	0.2	5.41	0.2	5.41	6.8E3	1.8E5
Te-121m		5	135	5	135	2.6E2	7.0E3
Te-121		2	54.1	2	54.1	2.4E3	6.4E4
Te-123m		7	189	7	189	3.3E2	8.9E3
Te-125m		30	811	9	243	6.7E2	1.8E4
Te-127m		20	541	0.5	13.5	3.5E2	9.4E3
Te-127		20	541	0.5	13.5	9.8E4	2.6E6
Te-129m		0.6	16.2	0.5	13.5	1.1E3	3.0E4
Te-129		0.6	16.2	0.5	13.5	7.7E5	2.1E7
Te-131m		0.7	18.9	0.5	13.5	3.0E4	8.0E5
Te-132		0.4	10.8	0.4	10.8	1.1E4	3.0E5
Th-227	Thorium(90)	9	243	1E-2	0.270	1.1E3	3.1E4
Th-228		0.3	8.11	4E-4	1.08E-2	3.0E1	8.2E2
Th-229		0.3	8.11	3E-5	8.11E-4	7.9E-3	2.1E-1
Th-230		2	54.1	2E-4	5.41E-3	7.6E-4	2.1E-2
Th-231		40	1080	0.9	24.3	2.0E4	5.3E5

Symbol of Radionuclide	Element and Atomic Number	A_1(TBq)	A_1(Ci)	A_2(TBq)	A_2(Ci)	Specific Activity (TBq/g)	Specific Activity (Ci/g)
Th-232		Unlimited	Unlimited	Unlimited	Unlimited	4.0E-9	1.1E-7
Th-234		0.2	5.41	0.2	5.41	8.6E2	2.3E4
Th(natural)		Unlimited	Unlimited	Unlimited	Unlimited	8.1E-9	2.2E-7
Ti-44	Titanium(22)	0.5	13.5	0.2	5.41	6.4	1.7E2
Tl-200	Thallium(81.1)	0.8	21.6	0.8	21.6	2.2E4	6.0E5
Tl-201		10	270	10	270	7.9E3	2.1E5
Tl-202		2	54.1	2	54.1	2.0E3	5.3E4
Tl-204		4	108	0.5	13.5	1.7E1	4.6E2
Tm-167	Thulium(69)	7	189	7	189	3.1E3	8.5E4
Tm-168		0.8	21.6	0.8	21.6	3.1E2	8.3E3
Tm-170		4	108	0.5	13.5	2.2E2	6.0E3
Tm-171		40	1080	10	270	4.0E1	1.1E3
U-230	Uranium(92)	40	1080	1E-2	0.270	1.0E3	2.7E4
U-232		3	81.1	3E-4	8.11E-3	8.3E-1	2.2E1
U-233		10	270	1E-3	2.70E-2	3.6E-4	9.7E-3
U-234		10	270	1E-3	2.70E-2	2.3E-4	6.2E-3
U-235		Unlimited	Unlimited	Unlimited	Unlimited	8.0E-8	2.2E-6
U-236		10	270	1E-3	2.70E-2	2.4E-6	6.5E-5
U-238		Unlimited	Unlimited	Unlimited	Unlimited	1.2E-8	3.4E-7
U(natural)		Unlimited	Unlimited	Unlimited	Unlimited	2.6E-8	7.1E-7
U(enriched 5% or less)		Unlimited	Unlimited	Unlimited	Unlimited		(See Table A-3)
U(enriched more than 5%)			10	270	1E-3	2.70E-2	(See Table A-3)
U(depleted)		Unlimited	Unlimited	Unlimited	Unlimited		(See Table A-3)
V-48	Vanadium(23)	0.3	8.11	0.3	8.11	6.3E3	1.7E5
V-49		40	1080	40	1080	3.0E2	8.1E3
W-178	Tungsten(74)	1	27.0	1	27.0	1.3E3	3.4E4
W-181		30	811	30	811	2.2E2	6.0E3
W-185		40	1080	0.9	24.3	3.5E2	9.4E3

Symbol of Radionuclide	Element and Atomic Number	A_1(TBq)	A_1(Ci)	A_2(TBq)	A_2(Ci)	Specific Activity (TBq/g)	Specific Activity (Ci/g)
W-187		2	54.1	0.5	13.5	2.6E4	7.0E5
W-188		0.2	5.41	0.2	5.41	3.7E2	1.0E4
Xe-122	Xenon(54)	0.2	5.41	0.2	5.41	4.8E4	1.3E6
Xe-123		0.2	5.41	0.2	5.41	4.4E5	1.2E7
Xe-127		4	108	4	108	1.0E3	2.8E4
Xe-131m		40	1080	40	1080	3.1E3	8.4E4
Xe-133		20	541	20	541	6.9E3	1.9E5
Xe-135		4	108	4	108	9.5E4	2.6E6
Y-87	Yttrium(39)	2	54.1	2	54.1	1.7E4	4.5E5
Y-88		0.4	10.8	0.4	10.8	5.2E2	1.4E4
Y-90		0.2	5.41	0.2	5.41	2.0E4	5.4E5
Y-91m		2	54.1	2	54.1	1.5E6	4.2E7
Y-91		0.3	8.11	0.3	8.11	9.1E2	2.5E4
Y-92		0.2	5.41	0.2	5.41	3.6E5	9.6E6
Y-93		0.2	5.41	0.2	5.41	1.2E5	3.3E6
Yb-169	Ytterbium(70)	3	81.1	3	81.1	8.9E2	2.4E4
Yb-175		30	811	0.9	24.3	6.6E3	1.8E5
Zn-65	Zinc(30)	2	54.1	2	54.1	3.0E2	8.2E3
Zn-69m		2	54.1	0.5	13.5	1.2E5	3.3E6
Zn-69		4	108	0.5	13.5	1.8E6	4.9E7
Zr-88	Zirconium(40	3	81.1	3	81.1	6.6E2	1.8E4
Zr-93		40	1080	0.2	5.41	9.3E-5	2.5E-3
Zr-95		1	27.0	0.9	24.3	7.9E2	2.1E4
Zr-97		0.3	8.11	0.3	8.11	7.1E4	1.9E6

* International shipments of Einsteinium require multilateral approval of A_1 and A_2 values.
** International shipments of Fermium require multilateral approval of A_1 and A_2 values.
*** 20 Ci for Mo99 for domestic use.

~~Table II~~
~~Relationship Between A_1 and E_{max} for Beta Emitters~~

~~E_{max} (MeV)~~	~~A_1 (Ci)~~
~~< 0.5~~	~~1000~~
~~0.5 < 1.0~~	~~300~~
~~1.0 < 1.5~~	~~100~~
~~1.5 < 2.0~~	~~30~~
~~≥ 2.0~~	~~10~~

Table II
General Values for A_1 and A_2

Contents	A_1		A_2	
	(TBq)	(Ci)	(TBq)	(Ci)
Only beta- or gamma-emitting nuclides are known to be present	0.2	5	0.02	0.5
Alpha-emitting nuclides are known to be present, or no relevent data are available	0.10	2.70	2×10^{-5}	5.41×10^{-4}

~~Table III~~

~~Relationship Between A_3 and the Atomic Number of the Radionuclide~~

	A_3		
~~Atomic Number~~	~~Half life less than 1000 days~~	~~Half life greater than 1000 days to 10^6 years~~	~~Half life 1000 days than 10^6 years~~
~~1 to 81~~	~~3 Ci~~	~~0.05 Ci~~	~~3 Ci~~
~~82 and above~~	~~0.002 Ci~~	~~0.002 Ci~~	~~3 Ci~~

Table ~~IV~~ III
Activity-Mass Relationships for Uranium~~/Thorium~~

~~Thorium and Uranium Enrichment* wt % U-235 present~~	~~Special Activity~~	
	~~Ci/g~~	~~g/Ci~~
~~0.45~~	~~5.0×10^{-7}~~	~~2.0×10^{6}~~
~~0.72 (natural)~~	~~7.06×10^{-7}~~	~~1.42×10^{6}~~
~~1.0~~	~~7.6×10^{-7}~~	~~1.3×10^{6}~~
~~1.5~~	~~1.0×10^{-6}~~	~~1.0×10^{6}~~
~~5.0~~	~~2.7×10^{-6}~~	~~3.7×10^{5}~~
~~10.0~~	~~4.8×10^{-6}~~	~~2.1×10^{5}~~
~~20.0~~	~~1.0×10^{-5}~~	~~1.0×10^{5}~~
~~35.0~~	~~2.0×10^{-5}~~	~~5.0×10^{4}~~
~~50.0~~	~~2.5×10^{-5}~~	~~4.0×10^{4}~~
~~90.0~~	~~5.8×10^{-5}~~	~~1.7×10^{4}~~
~~93.0~~	~~7.0×10^{-5}~~	~~1.4×10^{4}~~
~~95.0~~	~~9.1×10^{-5}~~	~~1.1×10^{4}~~
~~Natural Thorium~~	~~2.2×10^{-7}~~	~~4.6×10^{6}~~

Uranium Enrichment* wt % U-235 present	Specific Activity	
	TBq/g	Ci/g
0.45	1.8×10^{-8}	5.0×10^{-7}
0.72 (natural)	2.6×10^{-8}	7.1×10^{-7}
1.0	2.8×10^{-8}	7.6×10^{-7}
1.5	3.7×10^{-8}	1.0×10^{-6}
5.0	1.0×10^{-7}	2.7×10^{-6}
10.0	1.8×10^{-7}	4.8×10^{-6}
20.0	3.7×10^{-7}	1.0×10^{-5}

35.0	7.4×10^{-7}	2.0×10^{-5}
50.0	9.3×10^{-7}	2.5×10^{-5}
90.0	2.2×10^{-6}	5.8×10^{-5}
93.0	2.6×10^{-6}	7.0×10^{-5}
95.0	3.4×10^{-6}	9.1×10^{-5}

*The figures for uranium include representative values for the activity of the uranium-234 which is concentrated during the enrichment process. ~~The activity for thorium includes the equilibrium concentration of thorium-228.~~

Termination or Transfer of Licensed Activities: Recordkeeping Requirements (61 FR 24669; May 16, 1996; Effective June 17, 1996)		
NRC Regulation Section	**State Regulation Section**	**Comments**
20.2108(b)	33-10-04.1-15.9.b	
30.35(g)	33-10-03-05.14.g	
30.36(k)(4)	33-10-03-05.8.k(4)	
30.51(d), (e), (f)	33-10-04.1-15, subsections 12, 13, & 14	

f. Upon termination of the license or registration, the licensee or registrant shall permanently store records on the department's occupational radiation exposure history form (SFN 19443) or equivalent, or shall make provision with the department for transfer to the department.

8. **Records of dose to individual members of the public.**

a. Each licensee or registrant shall maintain records sufficient to demonstrate compliance with the dose limit for individual members of the public. See subsection 1 of section 33-10-04.1-07.

b. The licensee or registrant shall retain the records required by subdivision a until the department terminates each pertinent license or registration requiring the record.

9. **Records of waste disposal.**

a. Each licensee or registrant shall maintain records of the disposal of licensed or registered materials made pursuant to subsection 2, 3, 4, or 5 of section 33-10-04.1-14, chapter 33-10-03, or disposal by burial in soil, including burials authorized before October 1, 1982.

b. The licensee or registrant shall retain the records required by subdivision a until the department terminates each pertinent license or registration requiring the record.

Requirements for disposition of these records, prior to license termination, are located in subsection 14 of section 33-10-03-05 and in sections 14 and 15 of chapter 33-10-04.1 for activities licensed or registered under this article.

10. **Records of testing entry control devices for very high radiation areas.**

a. Each licensee or registrant shall maintain records of tests made pursuant to paragraph 9 of subdivision b of subsection 3 of section 33-10-04.1-10 on entry control devices for very high

33-10-03-05.14.g

appropriate state or federal government agency or an entity which has the authority to act as a trustee and whose trust operations are regulated and examined by a federal or state agency.

(c) The surety method or insurance must remain in effect until the department has terminated the license.

(3) An external sinking fund in which deposits are made at least annually, coupled with a surety method or insurance, the value of which may decrease by the amount being accumulated in the sinking fund. An external sinking fund is a fund established and maintained by setting aside funds periodically in an account segregated from licensee assets and outside the licensee's administrative control in which the total amount of funds would be sufficient to pay decommissioning costs at the time termination of operation is expected. An external sinking fund may be in the form of a trust, escrow account, government fund, certificate of deposit, or deposit of government securities. The surety or insurance provisions must be as stated in paragraph 2 of subdivision f.

(4) In the case of state or local government licensees, a statement of intent containing a cost estimate for decommissioning or an amount based on the table in subdivision d, and indicating that funds for decommissioning will be obtained when necessary.

(5) When a governmental agency is assuming custody and ownership of a site, an arrangement that is deemed acceptable by such governmental agency.

g. Each person licensed shall keep records of information important to the ~~safe and effective~~ decommissioning of ~~the~~ a facility in an identified location until the ~~license is terminated by the department~~ site is released for unrestricted use. Before licensed activities are transferred or assigned in accordance with subdivision b of subsection 7 of section 33-10-03-05, licensees shall transfer all records described in this subdivision to the new licensee. In this case, the new licensee shall maintain these records until the license is terminated. If records ~~of relevant information~~ important to

the decommissioning of a facility are kept for other purposes, reference to these records and their locations may be used. Information the department considers important to decommissioning consists of:

(1) Records of spills or other unusual occurrences involving the spread of contamination in and around the facility, equipment, or site. These records may be limited to instances when contamination remains after any cleanup procedures or when there is reasonable likelihood that contaminants may have spread to inaccessible areas as in the case of possible seepage into porous materials such as concrete. These records must include any known information on identification of involved nuclides, quantities, forms, and concentrations.

(2) As-built drawings and modifications of structures and equipment in restricted areas where radioactive materials are used or stored, and of locations of possible inaccessible contamination such as buried pipes which may be subject to contamination. If required drawings are referenced, each relevant document need not be indexed individually. If drawings are not available, the licensee shall substitute appropriate records of available information concerning these areas and locations.

(3) Except for areas containing only sealed sources (provided the sources have not leaked or no contamination remains after any leak) or radioactive materials having only half-lives of less than sixty-five days, a list contained in a single document and updated every two years, of the following:

(a) All areas designated and formerly designated as restricted areas as defined in section 33-10-01-04;

(b) All areas outside of restricted areas that require documentation under paragraph 1 of subdivision g;

(c) All areas outside of restricted areas where current and previous wastes have been buried as documented under subsection 9 of section 33-10-04.1-15; and

(5) Other site-specific factors which the department may consider appropriate on a case-by-case basis, such as the regulatory requirements of other government agencies, lawsuits, ground-water treatment activities, monitored natural ground-water restoration, actions that could result in more environmental harm than deferred cleanup, and other factors beyond the control of the licensee.

~~i~~j. As the final step in decommissioning, the licensee shall:

(1) Certify the disposition of all licensed material, including accumulated wastes, by submitting a completed radiation control program form 1 or equivalent information; and

(2) Conduct a radiation survey of the premises where the licensed activities were carried out and submit a report of the results of this survey unless the licensee demonstrates ~~that the premises are suitable for release~~ that the premises are suitable for release in accordance with the criteria for decommissioning in section 18 of chapter 33-10-04.1 in some other manner. The licensee shall, as appropriate:

(a) Report levels of gamma radiation in units of millisieverts (millirem) per hour at one meter from surfaces, and report levels of radioactivity, including alpha and beta, in units of megabecquerels (disintegrations per minute or microcuries) per one hundred square centimeters, removable and fixed, for surfaces, megabecquerels (microcuries) per milliliter for water, and becquerels (picocuries) per gram for solids such as soils or concrete; and

(b) Specify the survey instruments used and certify that each instrument is properly calibrated and tested.

~~j~~k. Specific licenses, including expired licenses, will be terminated by written notice to the licensee when the department determines that:

(1) Radioactive material has been properly disposed;

(2) Reasonable effort has been made to eliminate residual radioactive contamination, if present; and

(3) (a) A radiation survey has been performed which demonstrates that the premises are suitable for release in accordance with ~~requirements in article 33-10~~ the criteria for decommissioning in section 18 of chapter 33-10-04.1;

(b) Other information submitted by the licensee is sufficient to demonstrate that the premises are suitable for release in accordance with ~~requirements in article 33-10~~ the criteria for decommissioning in section 18 of chapter 33-10-04.1.

(4) Records required by subsection 14 of section 33-10-03-05 and sections 14 and 15 of chapter 33-10-04.1 have been received.

9. **Renewal of licenses.** Applications for renewal of specific licenses shall be filed in accordance with subsection 1.

10. **Amendment of licenses at request of licensee.** Applications for amendment of a license shall be filed in accordance with subsection 1 and shall specify the respects in which the licensee desires the license to be amended and the grounds for such amendment.

11. **Department action on applications to renew or amend.** In considering an application by a licensee to renew or amend the license, the department will apply the criteria set forth in subsection 2, 3, 4, 5, or 14, and chapters 33-10-05, 33-10-07, or 33-10-12, as applicable.

12. **Transfer of material.**

a. No licensee shall transfer radioactive material except as authorized pursuant to this subsection.

b. Except as otherwise provided in one's license and subject to the provisions of subdivisions c and d, any licensee may transfer radioactive material:

33-10-04.1-15, Subsections 12, 13, and 14

radiation areas. These records must include the date, time, and results of each such test of function.

b. The licensee or registrant shall retain the records required by subdivision a for three years after the record is made.

11. **Form of records.** Each record required by this chapter shall be legible throughout the specified retention period. The record shall be the original or a reproduced copy or a microform, provided that the copy or microform is authenticated by authorized personnel and that the microform is capable of producing a clear copy throughout the required retention period or the record may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records, such as letters, drawings, and specifications, shall include all pertinent information, such as stamps, initials, and signatures. The licensee shall maintain adequate safeguards against tampering with and loss of records.

12. Prior to license termination, each licensee authorized to possess radioactive material with a half-life greater than 120 days, in an unsealed form, shall forward the following records to the department:

a. Records of disposal of licensed material made under subsection 2 of section 33-10-04.1-14 (including records of burials made before the effective date of this section), subsections 3, 4, 5 of section 33-10-04.1-14; and

b. Records required by paragraph 4 of subdivision b of subsection 3 of section 33-10-04.1-15.

13. If licensed activities are transferred or assigned in accordance with subdivision b of subsection 7 of section 33-10-03-05, each licensee authorized to possess radioactive material, with a half-life greater than one hundred twenty days, in an unsealed form, shall transfer the following records to the new licensee and the new licensee will be responsible for maintaining these records until the licensee is terminated:

33-10-04.1-15, Subsections 12, 13, and 14 (continued)

a. Records of disposal of licensed material made under subsection 2 of section 33-10-04.1-14 (including burials made before the effective date of this section), subsections 3, 4, 5 of section 33-10-04.1-14, and

b. Records required by paragraph 4 of subdivision b of subsection 3 of section 33-10-04.1-15.

14. Prior to license termination, each licensee shall forward the records required by subdivision g of subsection 14 of section 33-10-03-05 to the department.

History: Effective March 1, 1994.
General Authority: NDCC 23-20.1-04
Law Implemented: NDCC 23-20.1-03, 23-20.1-04, 23-20.1-09.1

33-10-04.1-16. Reports.

1. **Reports of stolen, lost, or missing licensed or registered sources of radiation.**

   a. Telephone reports. Each licensee or registrant shall report to the department by telephone as follows:

      (1) Immediately after its occurrence becomes known to the licensee or registrant, stolen, lost, or missing licensed or registered radioactive material in an aggregate quantity equal to or greater than one thousand times the quantity specified in appendix C under such circumstances that it appears to the licensee or registrant that an exposure could result to individuals in unrestricted areas; or

      (2) Within thirty days after its occurrence becomes known to the licensee or registrant, lost, stolen, or missing licensed or registered radioactive material in an aggregate quantity greater than ten times the quantity specified in appendix C that is still missing.

Resolution of Dual Regulation of Airborne Effluents of Radioactive Materials; Clean Air Act (61 FR 65119; Dec. 10, 1996; Effective Jan. 9, 1997)		
NRC Regulation Section	**State Regulation Section**	**Comments**
20.1003	33-10-01-04, subsection 25	
20.1101(d)	33-10-04.1-05, subsection 4	
20.2203(a)(2)(vi)	33-10-04.1-16.3.a(f)	
20.2203(b)(1)(iv)	33-10-04.1-16.3.b(1)(d)	
20.2203(b)(2)	33-10-04.1-16.3.b(2)	

33-10-01-04, subsection 25

b. The strength of a source of radiation relative to a standard.

20. "CFR" means Code of Federal Regulations.

21. "Chelating agent" means amine polycarboxylic acids (e.g., EDTA, DTPA), hydroxycarboxylic acids, ~~gluconic acid,~~ and polycarboxylic acids (e.g., citric acid, carbolic acid, and gluconic acid).

22. "Collective dose" means the sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation.

23. "Committed dose equivalent" ($H_{T,50}$) means the dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the fifty-year period following the intake.

24. "Committed effective dose equivalent" ($H_{E,50}$) is the sum of the products of the weighing factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to each of these organs or tissues ($H_{E,50} = \sum W_T H_{T,50}$).

25. "Constraint" (dose constraint) means a value above which specified licensee actions are required.

26. "Critical group" means the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.

~~25~~27. "Curie" means a unit of measurement of activity. One curie (Ci) is that quantity of radioactive material which decays at the rate of 3.7×10^{10} disintegrations or transformations per second (dps or tps).

~~26~~28. "Decommission" means to remove ~~(as a facility)~~ a facility or site safely from service and reduce residual radioactivity to a level that permits:

a. ~~r~~Release of the property for unrestricted use and termination of license~~.~~ ; or

b. Release of the property under restricted conditions and termination of the license.

Law Implemented: NDCC 23-20.1-03, 23-20.1-04

33-10-04.1-05, subsection 4

33-10-04.1-05. Radiation protection programs.

1. Each licensee or registrant shall develop, document, and implement a radiation protection program sufficient to ensure compliance with the provisions of this chapter. See subsection 2 of section 33-10-04.1-15 for recordkeeping requirements relating to these programs.

2. To the extent practicable, the licensee or registrant shall use procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and public doses that are as low as is reasonably achievable (ALARA).

3. At intervals not to exceed twelve months, the licensee or registrant shall review the radiation protection program content and implementation.

4. To implement the as low as is reasonably achievable (ALARA) requirements of subsection 2 of this section, and notwithstanding the requirements of subsection 1 of section 33-10-04.1-07, a constraint on air emissions of radioactive material to the environment, excluding radon-222 and its daughters, shall be established by licensees, such that the individual member of the public likely to receive the highest dose will not be expected to receive a total effective dose equivalent in excess of one-tenth millisieverts (10 mrem) per year from these emissions. If a licensee subject to this requirement exceeds this dose constraint, the licensee shall report the exceedance as provided in subsection 3 of section 33-10-04.1-16 and promptly take appropriate corrective action to ensure against recurrence.

History: Effective March 1, 1994.
General Authority: NDCC 23-20.1-04
Law Implemented: NDCC 23-20.1-03, 23-20.1-04

33-10-04.1-06. Occupational dose limits.

1. **Occupational dose limits for adults.**

   a. The licensee or registrant shall control the occupational dose to individual adults, except for

33-10-04.1-16, subsection 3

c. The licensee or registrant shall prepare each report filed with the department pursuant to this subsection so that names of individuals who have received exposure to sources of radiation are stated in a separate and detachable portion of the report.

d. Licensees or registrants shall make the reports required by subdivisions a and b to the department by telephone, telegram, mailgram, or facsimile to the department.

e. The provisions of this subsection do not apply to doses that result from planned special exposures, provided such doses are within the limits for planned special exposures and are reported pursuant to subsection 4.

3. **Reports of exposures, radiation levels, and concentrations of radioactive material exceeding the <u>constraints or</u> limits.**

33-10-04.1-16, subsection 3 (continued)

a. Reportable events. In addition to the notification required by subsection 2, each licensee or registrant shall submit a written report within thirty days after learning of any of the following occurrences:

(1) Incidents for which notification is required by subsection 2; or

(2) Doses in excess of any of the following:

(a) The occupational dose limits for adults in subsection 1 or section 33-10-04.1-06;

(b) The occupational dose limits for a minor in subsection 7; of section 33-10-04.1-06;

(c) The limits for an embryo or fetus of a declared pregnant woman in subsection 8 of section 33-10-04.1-06;

(d) The limits for an individual member of the public in subsection 1 of section 33-10-04.1-07; or

33-10-04.1-16.a(f)

(e) Any applicable limit in the license or registration; or

(f) The as low as is reasonably achievable (ALARA) constraints for air emissions established under subsection 2 of section 33-10-04.1-05.

(3) Levels of radiation or concentrations of radioactive material in:

(a) A restricted area in excess of applicable limits in the license or registration; or

(b) An unrestricted area in excess of ten times the applicable limit set forth in this chapter or in the license or registration, whether or not involving exposure of any individual in excess of the limits in subsection 1 of section 33-10-04.1-07; or

33-10-04.1-16, subsection 3 (continued)

(4) For licensees subject to the provisions of United States environmental protection agency's generally applicable environmental radiation standards in 40 CFR 190, levels of radiation or releases of radioactive material in excess of those standards, or of license conditions related to those standards.

b. Contents of reports.

(1) Each report required by subdivision a shall describe the extent of exposure of individuals to radiation and radioactive material, including, as appropriate:

(a) Estimates of each individual's dose;

(b) The levels of radiation and concentrations of radioactive material involved;

33-10-04.1-16.3.b(1)(d)

(c) The cause of the elevated exposures, dose rates, or concentrations; and

(d) Corrective steps taken or planned to ensure against a recurrence, including the schedule for achieving conformance with applicable limits, as low as is reasonably achievable (ALARA) constraints, generally applicable environmental standards, and associated license or registration conditions.

33-10-04.1-16.3.b(2)

(2) Each report filed pursuant to subdivision a shall include for each occupationally overexposed individual ~~exposed~~: the name, social security account number, and date of birth. With respect to the limit for the embryo or fetus in subsection 8 of section 33-10-04.1-06, the identifiers should be those of the declared pregnant woman. The report shall be prepared so that this information is stated in a separate and detachable portion of the report.

Criteria for the Release of Individuals Administered Radioactive Material (62 FR 4120; Jan. 29, 1997; Effective May 29, 1997)		
NRC Regulation Section	**State Regulation Section**	**Comments**
20.1002	33-10-04.1-02	
20.1003	33-10-01-04, subsections 72 and 82	
20.1301(a)	33-10-04.1-07.1.a	
20.1903	33-10-04.1-13.3.b	
35.8	Not Applicable	
35.75	33-10-07-05.13	
35.315	Deletion of the former 33-10-07-08.3.a(6)	
35.415(a)(1)	33-10-07-10.3.a and 3.a(1). Also, deletion of the former 33-10-07-10.3.a(5).	

33-10-04.1-02

33-10-04.1-02. Scope. This chapter applies to persons licensed or registered by the department to receive, possess, use, transfer, or dispose of sources of radiation. The limits in this chapter do not apply to doses due to background radiation, to ~~exposure of patients to radiation for the purpose of~~ any medical ~~diagnosis or therapy~~ administration or therapy the individual has received, to exposure from individuals administered radioactive material and released in accordance with subsection 12 of section 33-10-07-05, or to voluntary participation in medical research programs.

History: Effective March 1, 1994.
General Authority: NDCC 23-20.1-04
Law Implemented: NDCC 23-20.1-03, 23-20.1-04

33-10-04.1-03. Definitions. As used in this chapter:

1. "Annual limit on intake" (ALL) means the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. Annual limit on intake is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of five-hundredths savored [5 rem] or a committed dose equivalent of five-tenths savored [50 rem] to any individual organ or tissue. Annual limit on intake values for intake by ingestion and by inhalation of selected radionuclides are given in table I, columns 1 and 2, of appendix B.

2. "Class" means a classification scheme for inhaled material according to its rate of clearance from the pulmonary region of the lung. Materials are classified as D, W, or Y, which applies to a range of clearance half-times: for class D, days, of less than ten days, for class W, weeks, from ten to one hundred days, and for

33-10-01-04, subsection 72

~~67~~72. "Occupational dose" means the dose received by an individual in the course of employment~~, while engaged in activities licensed or registered by the department,~~ in which the individual's assigned duties involve exposure to sources of radiation, whether or not the sources are in the possession of the licensee, registrant, or other person. Occupational dose does not include dose received: from background radiation, ~~as a patient~~ from any medical ~~practices, administration~~ the individual has received, from exposure to individuals administered radioactive material and released in accordance with subsection 12 of section 33-10-07-05, from voluntary participation in medical research programs, or as a member of the public.

~~68~~73. "Ore refineries" means all processors of a radioactive material ore.

~~69~~74. "Package" means the packaging together with its radioactive contents as presented for transport.

75. "Packaging" means the assembly of components necessary to ensure compliance with the packaging requirements of this article. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle tie-down system, and auxiliary equipment may be designated as part of the packaging.

~~70~~76. "Particle accelerator" (see "accelerator").

~~71~~77. "Person" means any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, agency, political subdivision of this state, any other state or political subdivision or agency thereof, and any legal successor, representative, agent, or agency of the foregoing, other than the commission, or any successor thereto and other than federal government agencies licensed by the commission or any successor thereto.

~~72~~78. "Personnel monitoring equipment" (see "individual monitoring devices").

~~73~~79. "Pharmacist" means an individual licensed by this state to compound and dispense drugs, prescriptions, and poisons.

33-10-01-04, subsection 82

~~74~~80. "Physician" means an individual licensed by this state to dispense drugs in the practice of medicine.

~~75~~81. "Principal activities" means activities authorized by the license which are essential to achieving the purpose(s) for which the license was issued or amended. Storage during which no licensed material is accessed for use or disposal and activities incidental to decontamination or decommissioning are not principal activities.

~~76~~82. "Public dose" means the dose received by a member of the public from sources of radiation from a licensed or registered operation. ~~It~~ Public dose does not include occupational dose, or doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with subsection 12 of section 33-10-07-05 ~~dose received as a patient from medical practices~~, or ~~dose~~ from voluntary participation in medical research programs.

~~77~~83. "Pyrophoric material" means any liquid that ignites spontaneously in dry or moist air at or below one hundred thirty degrees Fahrenheit [54.4 degrees Celsius] or any solid material, other than one classed as an explosive, which under normal conditions is liable to cause fires through friction, retained heat from manufacturing or processing, or which can be ignited readily and, when ignited, burns so vigorously and persistently as to create a serious transportation, handling, or disposal hazard. Included are spontaneously combustible and water-reactive materials.

~~78~~84. "Quality factor" (Q) means the modifying factor, listed in tables I and II of section 33-10-01-14, that is used to derive dose equivalent from absorbed dose.

~~79~~85. "Rad" means the special unit of absorbed dose. One rad is equal to an absorbed dose of one hundred erg per gram or one one-hundredths joule per kilogram (0.01 gray).

~~80~~86. "Radiation" means alpha particles, beta particles, gamma rays, x-rays, neutrons, high speed electrons, high speed protons, and other particles capable of producing ions. For purposes of these rules, ionizing radiation is an equivalent term. Radiation as used in these rules does not include

33-10-04.1-07.1.a

33-10-04.1-07. Radiation dose limits for individual members of the public.

1. Dose limits for individual members of the public.

a. Each licensee or registrant shall conduct operations so that:

(1) The total effective dose equivalent to individual members of the public from the licensed or registered operation does not exceed one millisievert [0.1 rem] in a year, exclusive of the dose contribution from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with subsection 12 of section 33-10-07-05, voluntary participation in medical research programs, and the licensee's or registrant's disposal of radioactive material into sanitary sewerage in accordance with subsection 3 of section 33-10-04.1-14. Retrofit shall not be required for locations within facilities where only radiation machines existed prior to January 1, 1994, and met the previous requirements of five millisievert [0.5 rem] in a year; and

(2) The dose in any unrestricted area from external sources exclusive of the dose contributions from patients administered radioactive material and released in accordance with subsection 12 of section 33-

33-10-04.1-07.1. a (continued)

10-07-05 does not exceed two-hundredths millisievert [0.002 rem] in any one-hour.

b. If the licensee or registrant permits members of the public to have access to restricted areas, the limits for members of the public continue to apply to those individuals.

c. A licensee, registrant, or an applicant for a license or registration may apply for prior department authorization to operate up to an annual dose limit for an individual member of the public of five millisievert [0.5 rem]. This application shall include the following information:

(1) Demonstration of the need for and the expected duration of operations in excess of the limit in subdivision a;

(2) The licensee's or registrant's program to assess and control dose within the five millisievert [0.5 rem] annual limit; and

(3) The procedures to be followed to maintain the dose as low as reasonably achievable.

d. In addition to the requirements of this chapter a licensee or registrant subject to the provisions of the United States environmental protection agency's generally applicable environmental radiation standards in 40 CFR 190 shall comply with those standards.

e. The department may impose additional restrictions on radiation levels in unrestricted areas and on the total quantity of radionuclides that a licensee or registrant may release in effluents in order to restrict the collective dose.

2. **Compliance with dose limits for individual members of the public.**

a. The licensee or registrant shall make or cause to be made surveys of radiation levels in unrestricted areas and radioactive materials in effluents

33-10-04.1-13.3.b

3. **Exceptions to posting requirements.**

a. A licensee or registrant is not required to post caution signs in areas or rooms containing sources of radiation for periods of less than eight hours, if each of the following conditions is met:

(1) The sources of radiation are constantly attended during these periods by an individual who takes the precautions necessary to prevent the exposure of individuals to sources of radiation in excess of the limits established in this chapter; and

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

b. Rooms or other areas in hospitals that are occupied by patients are not required to be posted with caution signs pursuant to subsection 2 provided that the patient could be released from ~~confinement~~ control pursuant to subsection 12 of ~~chapter~~ section 33-10-07-05.

c. A room or area is not required to be posted with a caution sign because of the presence of a sealed source provided the radiation level at thirty centimeters from the surface of the sealed source container or housing does not exceed five hundredths millisievert [0.005 rem] per hour.

33-10-07-05.13

~~12~~13. **Release of ~~patients~~ individuals containing radiopharmaceuticals or permanent implants.**

~~a. A licensee may not authorize release from confinement for medical care any patient administered a radiopharmaceutical until either:~~

~~(1) The dose rate from the patient is less than five millirems [50 microsieverts] per hour at a distance of one meter; or~~

~~(2) The activity in the patient is less than thirty millicuries [1.11 gigabecquerels].~~

a. The licensee may authorize the release from its control of any individual who has been administered radiopharmaceuticals or permanent implants containing radioactive material if the total effective dose equivalent to any other individual from exposure to the released individual is not likely to exceed five millisieverts [0.5 rem].

b. The licensee shall provide the released individual with instructions, including written instructions, on actions recommended to maintain doses to other individuals as low as is reasonably achievable if the total effective dose equivalent to any other individual is likely to exceed one millisievert [0.1 rem]. If the dose to a breast-feeding infant or child could exceed one millisievert [0.1 rem]

33-10-07-05.13 (continued)

assuming there were no interruption of breast-feeding, the instructions shall also include:

(1) Guidance on the interruption or discontinuation of breast-feeding and

(2) Information on the consequences of failure to follow the guidance.

c. The licensee shall maintain a record of the basis for authorizing the release of an individual, for three years after the date of release, if the total effective dose equivalent is calculated by:

(1) Using the retained activity rather than the activity administered,

(2) Using an occupancy factor less than twenty-five hundredths at one meter,

(3) Using the biological or effective half-life, or

(4) Considering the shielding by tissue.

d. The licensee shall maintain a record, for three years after the date of release, that instructions were provided to a breast-feeding woman if the radiation dose to the infant or child from continued breast-feeding could result in a total effective dose equivalent exceeding five millisieverts [0.5 rem].

~~b. A licensee shall not authorize release from confinement for medical care any patient administered a permanent implant until the dose rate from the patient is less than five millirems [50 microsieverts] per hour at a distance of one meter.~~

Deletion of the Former 33-10-07-08.3.a(6)

3. **Safety precautions.**

a. For each patient or human research subject receiving radiopharmaceutical therapy and hospitalized for compliance with subsection ~~12~~13 of section 33-10-07-05, a licensee shall:

(1) Provide a private room with a private sanitary facility;

(2) Post the patient's or human research subject's door with a "Caution: Radioactive Material" sign and note on the door or on the patient's or human research subject's chart where and how long visitors may stay in the patient's or human research subject's room;

Deletion of the Former 33-10-07-08.3.a(6)

(3) Authorize visits by individuals under eighteen years of age only on a case-by-case basis with the approval of the authorized user after consultation with the radiation safety officer;

(4) Promptly after administration of the dosage, measure the dose rates in contiguous restricted and unrestricted areas with a radiation measurement survey instrument to demonstrate compliance with the requirements of chapter 33-10-04.1 and retain for ~~two~~ three years a record of each survey that includes the time and date of the survey, a plan of the area or list of points surveyed, the measured dose rate at several points expressed in millirems per hour, the instrument used to make the survey, and the initials of the individual who made the survey;

(5) Either monitor material and items removed from the patient's or human research subject's room to determine that any contamination cannot be distinguished from the natural background radiation level with a radiation detection survey instrument set on its most sensitive scale and with no interposed shielding, or handle these materials and items as radioactive waste;

~~(6) Provide the patient with radiation safety guidance that will help to keep radiation dose to household members and the public as low as reasonably achievable before authorizing release of the patient;~~

(~~7~~6) Survey the patient's or human research subject's room and private sanitary facility for removable contamination with a radiation detection survey instrument before assigning another patient or human research subject to the room. The room must not be reassigned until removable contamination is less than two hundred disintegrations per minute [3.33

33-10-07-10.3.a and 3.a(1)

3. **Safety precautions.**

a. For each patient or human research subject receiving implant therapy and not released from licensee control pursuant to subsection 13 of section 33-10-07-05, a licensee shall:

(1) Not place the patient or the human research subject in the same room with a patient or human research subject who is not receiving radiation therapy ~~unless the licensee can demonstrate compliance with the requirement of subdivision a of subsection 1 of section 33-10-04.1-07 at a distance of one meter from the implant~~;

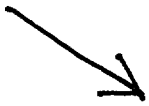
(2) Post the patient's or human research subject's door with a "Caution: Radioactive Materials" sign and note on the door or the patient's or human research subject's chart where and how long visitors may stay in the patient's or human research subject's room;

(continued on the next page)

Deletion of the Former 33-10-07-10.3.a(5)

(3) Authorize visits by individuals under eighteen years of age only on a case-by-case basis with the approval of the authorized user after consultation with the radiation safety officer;

(4) Promptly after implanting the sources, survey the dose rates in contiguous restricted and unrestricted areas with a radiation measurement survey instrument to demonstrate compliance with chapter 33-10-04.1 and retain for ~~two~~ three years a record of each survey that includes the time and date of the survey, a sketch of the area or list of points surveyed, the measured dose rate at several points expressed in ~~millirems [microsievert]~~ microsieverts [millirems] per hour, the instrument used to make the survey, and the initials of the individual who made the survey; and



~~(5) Provide the patient with radiation safety guidance that will help keep the radiation dose to household members and the public as low as reasonably achievable before releasing the patient if the patient was administered a permanent implant.~~

b. A licensee shall notify the radiation safety officer or authorized user immediately if the patient or the human research subject dies or has a medical emergency.