

Rule 1. General Provisions

410 IAC 5-1-1 Scope of rule

Sec. 1. Pursuant to the authority found in IC 13-1-2-9 providing for the granting, suspending, revoking, or amending general or specific licenses for radioactive materials and the registration of radiation sources. Nothing in 410 IAC 5 shall apply to any person to the extent such person is subject to regulation by the U.S. Nuclear Regulatory Commission.

410 IAC 5-1-2 Definitions

Sec. 2. As used in 410 IAC 5, these terms have the definitions set forth below. Additional definitions used only in a certain part will be found in that part.

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

"Act" means the Radiation Control Act of Indiana, IC 13-1-2, Indiana General Assembly.

"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. 689).

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

"Airborne radioactivity area" means (1) any room, enclosure, or operating area in which airborne radioactive material exists in concentrations in excess of the amounts specified in Table I, Column 1 of 410 IAC 5-4-27; or (2) any room, enclosure, or operating area in which airborne radioactive material exists in concentrations which, averaged over the number of hours in any week during which individuals are in the area, exceed 25 percent of the amounts specified in Table I, Column 1 of 410 IAC 5-4-27.

"Board" means executive board of the Indiana state board of health or its duly authorized representatives.

"Byproduct material" means 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.

"Calendar quarter" means not less than 12 consecutive weeks nor more than 14 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 him of determining calendar quarters for purposes of 410 IAC 5 except at the beginning of a calendar year.

"Calibration" means the determination of (1) the response or reading of an instrument relative to a series of known radiation values over the range of the instrument, or (2) the strength of a source of radiation relative to a standard.

"CFR" means Code of Federal Regulations (1982 Edition).

"Controlled area" see "Restricted area."

"Curie" means a unit of quantity of radioactivity. One curie (Ci) is that quantity of radioactive material which decays at the rate of 3.7×10^{10} transformations per second (tps). Commonly used submultiples of the curie are the millicurie and the microcurie. One millicurie (mCi) = 0.001 curie = 3.7×10^7 tps. One microcurie (μ Ci) = 0.000001 curie = 3.7×10^4 tps. (See 410 IAC 5-1-10.5 for SI equivalent becquerel.)

"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.

"Dose" as used in 410 IAC 5 shall mean absorbed dose or dose equivalent as appropriate.

"Absorbed dose" is the energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest. The special unit of absorbed dose is the rad. (See rad.) (See 410 IAC 5-1-10.5 for SI equivalent gray.)

"Dose equivalent" is a quantity that expresses on a common scale for all radiation a measure of the postulated effect on a given organ. It is defined as the absorbed dose in rads times certain modifying factors. The unit of dose equivalent is the rem. (See rem.) (See 410 IAC 5-1-10.5 for SI equivalent sievert.)

"Dose commitment" means the total radiation dose to a part of the body that will result from retention in the body of radioactive material. For purposes of estimating the dose commitment, it is assumed that from the time of intake, the period of exposure to retained material will not exceed 50 years.

*"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 special unit of exposure is the roentgen (R).) (See 410 IAC 5-1-10.5 for SI equivalent coulomb per kilogram).

*(When not indicated as above or indicated as "exposure (X)," the term "exposure" has a more general meaning in 410 IAC

5.)

"Exposure rate" means the exposure per unit of time, such as R/min, mR/h etc.

"Former U.S. Atomic Energy Commission (AEC) or U.S. Nuclear Regulatory Commission (NRC) licensed facilities" means nuclear reactors, nuclear fuel reprocessing plants, uranium enrichment plants or critical mass experimental facilities where AEC or NRC licenses have been terminated.

"Healing arts" includes any system, treatment, operation, diagnosis, prescription or practice for the ascertainment, cure, relief, palliation, adjustment or correction of any human or animal disease, ailment, deformity, injury or unhealthy or abnormal physical or mental condition.

"High radiation area" means any area, accessible to individuals, in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose in excess of 100 millirems.

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

"Individual" means any human being.

"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 board.

"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.

"License" means a license issued by the board in accordance with 410 IAC 5 and IC 13-1-2.

"Licensee" means any person who is licensed by the board in accordance with 410 IAC 5 and IC 13-1-2.

"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.

"Major processor" means a user processing, handling, or manufacturing radioactive material exceeding Type A quantities as unsealed sources or material, or exceeding 4 times Type B quantities as sealed sources, but does not include nuclear medicine programs, universities, industrial radiographers, or small industrial programs. Type A and B quantities are defined in Section 71.4 of 10 CFR Part 71.

"NARM" means any naturally-occurring or accelerator-produced radioactive material. It does not include byproduct, source or special nuclear material.

"Natural radioactivity" means radioactivity of naturally-occurring nuclides.

"Occupational dose" means exposure of an individual to radiation (1) in a restricted area or (2) in the course of employment in which the individual's duties involve exposure to radiation provided that occupational dose shall not be deemed to include any exposure of an individual to radiation for the purpose of diagnosis or therapy of such individual.

"Particle 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 1 MeV.

"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.

"Personnel monitoring equipment" means devices (e.g. film badges, pocket dosimeters, and thermoluminescent dosimeters) designed to be worn or carried by an individual for the purpose of estimating the dose received by the individual.

"Pharmacist" means an individual licensed by the state of Indiana to compound and dispense drugs, prescriptions, and poisons.

"Physician" means an individual licensed by the state of Indiana to dispense drugs in the practice of medicine.

"Rad" means the special unit of absorbed dose. One rad equals one hundredth of a joule per kilogram of material; for example, if tissue is the material of interest, then 1 rad equals 100 ergs per gram of tissue.

"Radiation" means ionizing radiation; i.e., gamma rays and x-rays, alpha and beta particles, high speed electrons, neutrons, high speed protons, and other nuclear particles.

"Radiation area" means any area, accessible to individuals, in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose in excess of 5 millirems, or in any 5 consecutive days a dose in excess of 100 millirems.

"Radiation machine" means any device capable of producing radiation except those which produce radiation only from radioactive material.

"Radiation safety officer" means one who has the knowledge and responsibility to apply appropriate radiation protection regulations.

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

"Radioactivity" means the transformation of unstable atomic nuclei by the emission of radiation.

"Registrant" means any person who is registered with the board and is legally obligated to register with the board as

required by 410 IAC 5 and IC 13-1-2.

"Registration" means registration with the board in accordance with 410 IAC 5.

"Regulations of the U.S. Department of Transportation" means the regulations in 49 CFR Parts 100-189.

"Rem" means a special unit of dose equivalent. (One millirem (mrem) = 0.001 rem.) For the purpose of 410 IAC 5, any of the following is considered to be equal to one rem:

- (1) An exposure of 1 roentgen of x or gamma radiation;
- (2) An absorbed dose of 1 rad due to x, gamma or beta radiation;
- (3) An absorbed dose of 0.05 rad due to particles heavier than protons and with sufficient energy to reach the lens of the eye;
- (4) An absorbed dose of 0.1 rad due to neutrons or high energy protons.^{1/} (See 410 IAC 5-1-10.5 for SI equivalent sievert.)

^{1/} If it is more convenient to measure the neutron flux or equivalent than to determine the neutron absorbed dose in rads, one rem of neutron radiation may, for purposes of 410 IAC 5, be assumed to be equivalent to 14 million neutrons per square centimeter incident upon the body; or if there exists sufficient information to estimate with reasonable accuracy the approximate distribution in energy of the neutrons, the incident number of neutrons per square centimeter equivalent to one rem may be estimated from the following table:

| Neutron energy (MeV) | Number of neutrons per square centimeter for a dose equivalent to 1 rem (neutrons/cm ²) | Average flux density to deliver 100 millirems in 40 hours (neutrons/cm ² per second) |
|----------------------|---|---|
| Thermal..... | 970 x 10 ⁶ | 670 |
| 0.0001..... | 720 x 10 ⁶ | 500 |
| 0.005..... | 820 x 10 ⁶ | 570 |
| 0.02..... | 400 x 10 ⁶ | 280 |
| 0.1..... | 120 x 10 ⁶ | 80 |
| 0.5..... | 43 x 10 ⁶ | 30 |
| 1.0..... | 26 x 10 ⁶ | 18 |
| 2.5..... | 29 x 10 ⁶ | 20 |
| 5.0..... | 26 x 10 ⁶ | 18 |
| 7.5..... | 24 x 10 ⁶ | 17 |
| 10.0..... | 24 x 10 ⁶ | 17 |
| 10 to 30..... | 14 x 10 ⁶ | 10 |

"Research and development" means: (1) theoretical analysis, exploration, or experimentation or (2) 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.

"Restricted area" (controlled area) means any area access to which is controlled by the licensee or registrant for purposes of protection of individuals from exposure to radiation and radioactive material. "Restricted area" shall not include any areas used for residential quarters although a separate room or rooms in a residential building may be set apart as a restricted area.

"Roentgen" (R) means the special unit of exposure. One roentgen equals 2.58 x 10⁻⁴ coulombs/kilogram of air (see

"Exposure").

"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.

"Source material" means: (1) uranium or thorium, or any combination thereof, in any physical or chemical form or (2) ores which contain by weight one-twentieth of one percent (0.05 percent) or more of (i) uranium, (ii) thorium or (iii) any combination thereof. Source material does not include special nuclear material.

"Source material milling" means any activity that results in the production of byproduct material as defined by definition (2) of source material.

"Source of radiation" means any radioactive material or any device or equipment emitting or capable of producing radiation.

"Special form" means any of the following physical forms of licensed material of any transport group:

- (1) The material is in solid form having no dimension less than 0.5 millimeter or at least one dimension greater than five (5) millimeters; does not melt, sublime or ignite in air at a temperature of 1000° F (538° C); will not shatter or crumble if subjected to the percussion test described in Appendix B, 410 IAC 5-1-12; and is not dissolved or converted into dispersible form to the extent of more than 0.005 percent by weight by immersion for 1 week in water at 68° F (20° C) or in air at 86° F (30° C); or
- (2) The material is securely contained in a capsule having no dimension less than 0.5 millimeter or at least one dimension greater than five (5) millimeters, which will retain its contents if subjected to the tests prescribed in Appendix B, 410 IAC

5-1-12; and which is constructed of materials which do not melt, sublime or ignite in air at 1475° F (802° C), and do not dissolve or convert into dispersible form to the extent of more than 0.005 percent by weight by immersion for 1 week in water at 68° F (20° C) or in air at 86° F (30° C).

"Special nuclear material in quantities not sufficient to form a critical mass" means uranium enriched in the isotope U-235 in quantities not exceeding 350 grams of contained U-235, U-233 in quantities not exceeding 200 grams; plutonium in quantities not exceeding 200 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:

$$\frac{176 \text{ (grams contained U - 235)}}{350} + \frac{50 \text{ (grams U - 233)}}{200} + \frac{50 \text{ (grams Pu)}}{200} = 1$$

"Survey" means an evaluation of the production, use, release, disposal, and/or presence of sources of radiation under a specific set of conditions to determine actual or potential radiation hazards. When appropriate, such evaluation includes but is not limited to tests, physical examination and measurements of levels of radiation or concentration of radioactive material present.

"Test" means the process of verifying compliance with the applicable sections of 410 IAC 5.

"Transport group" means any one of seven groups into which radionuclides in normal form are classified according to their toxicity and their relative potential hazard in transport (see Appendix A, 410 IAC 5-1-11).

(1) Any radionuclide not specifically listed in one of the groups in Appendix A, 410 IAC 5-1-11 shall be assigned to one of the groups in accordance with the following table:

| Radionuclide | Radioactive half-life | | |
|---------------------------|-----------------------|------------------------------------|----------------------------|
| | 0 to 1000 days | 1000 days to 10 ⁶ years | Over 10 ⁶ years |
| Atomic number 1-81 | Group III | Group II | Group III |
| Atomic number 82 and over | Group I | Group I | Group III |

(2) For mixtures of radionuclides the following shall apply:

(i) If the identity and respective activity of each radionuclide are known, the permissible activity of each radionuclide shall be such that the sum for all groups present of the ratio between the total activity for each group to the permissible activity for each group will not be greater than unity.

(ii) If the groups of the radionuclides are known but the amount in each group cannot be reasonably determined, the mixture shall be assigned to the most

restrictive group present.

(iii) If the identity of all or some of the radionuclides cannot be reasonably determined, each of those unidentified radionuclides shall be considered as belonging to the most restrictive group which cannot be positively excluded.

(iv) Mixtures consisting of a single radioactive decay chain where the radionuclides are in the naturally-occurring proportions shall be considered as consisting of a single radionuclide. The group and activity shall be that of the first member present in the chain, except that if a radionuclide "X" has a half-life longer than that of the first member and an activity greater than that of any other member, including the first, at any time during transportation, the transport group of the nuclide "X" and the activity of the mixture shall be the maximum activity of that nuclide "X" during transportation.

"U.S. Department of Energy" means the Department of Energy established by Public Law 95-91, August 4, 1977, 91 Stat. 565, 42 U.S.C. 7101 et seq., to the extent that the department exercises functions formerly vested in the U.S. Atomic Energy Commission, its chairman, members, officers, and components and transferred to the U.S. Energy Research and Development Administration and to the administrator thereof pursuant to sections 104(b), (c), and (d) of the Energy Reorganization Act of 1974 (Public Law 93-438, October 11, 1974, 88 Stat. 1233 at 1237, effective January 19, 1975) and retransferred to the Secretary of Energy pursuant to section 301(a) of the Department of Energy Organization Act (Public Law 95-91, August 4, 1977, 91 Stat. 565 at 577-578, 42 U.S.C. 7151, effective October 1, 1977).

"Uncontrolled area" see "Unrestricted area."

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

"Unrestricted area" (uncontrolled area) means any area access to which is not controlled by the licensee or registrant for

purposes of protection of individuals from exposure to radiation and radioactive material and any area used for residential quarters.

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

"Worker" means any individual engaged in work under a license or registration issued by the board and controlled by a licensee or registrant but does not include the licensee or registrant.

410 IAC 5-1-3 Exemptions from rule

Sec. 3. (a) General Provision. The board may, upon application therefore or upon its own initiative, grant such exemptions or exceptions from the requirements of 410 IAC 5 as it determines are authorized by law and will not result in undue hazard to public health and safety or property.

(b) Carriers. Common and contract carriers, freight forwarders, and warehousemen, who are subject to the rules and regulations of the U.S. Department of Transportation or the U.S. Postal Service are exempt from 410 IAC 5 to the extent that they transport or store sources of radiation in the regular course of their carriage for another or storage incident thereto. Private carriers who are subject to the rules and regulations of the U.S. Department of Transportation are exempted from 410 IAC 5 to the extent that they transport sources of radiation. Common, contract, and private carriers who are not subject to the rules and regulations of the U.S. Department of Transportation or the U.S. Postal Service are subject to applicable sections of 410 IAC 5.

(c) U.S. Department of Energy Contractors and U.S. Nuclear Regulatory Commission Contractors. Any U.S. Department of Energy contractor or subcontractor and any U.S. Nuclear Regulatory Commission contractor or subcontractor of the following categories operating within the state of Indiana is exempt from 410 IAC 5 to the extent that such contractor or subcontractor under his contract receives, possesses, uses, transfers or acquires sources of radiation:

- (1) Prime contractors performing work for the U.S. Department of Energy at U.S. Government-owned or -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;
- (2) Prime contractors of the U.S. Department of Energy performing research in, or development, manufacture, storage, testing or transportation of, atomic weapons or components thereof;
- (3) Prime contractors of the U.S. Department of Energy using or operating nuclear reactors or other nuclear devices in a United States Government-owned vehicle or vessel; and
- (4) Any other prime contractor or subcontractor of the U.S. Department of Energy or of the U.S. Nuclear Regulatory Commission when the state of Indiana and the U.S. Nuclear Regulatory Commission jointly determine:
 - (i) that the exemption of the prime contractor or subcontractor is authorized by law; and
 - (ii) that under the terms of the contract or subcontract, there is adequate assurance that the work thereunder can be accomplished without undue risk to the public health and safety.

410 IAC 5-1-4 Recordkeeping

Sec. 4. Each licensee and registrant shall maintain records showing the receipt, transfer, and disposal of all sources of radiation. Additional record requirements are specified elsewhere in 410 IAC 5.

410 IAC 5-1-5 Inspections of facilities and records

Sec. 5. (a) Each licensee and registrant shall afford the board at all reasonable times opportunity to inspect sources of radiation and the premises and facilities wherein such sources of radiation are used or stored.

(b) Each licensee and registrant shall make available to the board for inspection, upon reasonable notice, records maintained pursuant to 410 IAC 5.

410 IAC 5-1-6 Tests

Sec. 6. Each licensee and registrant shall perform upon instructions from the board, or shall permit the board to perform such reasonable tests as the board deems appropriate or necessary including, but not limited to, tests of:

- (a) sources of radiation;
- (b) facilities wherein sources of radiation are used or stored;
- (c) radiation detection and monitoring instruments; and
- (d) other equipment and devices used in connection with utilization or storage of licensed or registered sources of radiation.

410 IAC 5-1-7 Additional requirements

Sec. 7. The board may by rule, regulation, or order, impose upon any licensee or registrant such requirements in addition to

those established in 410 IAC 5 as it deems appropriate or necessary to minimize danger to public health and safety or property.

410 IAC 5-1-8 Violations

Sec. 8. Any person who willfully violates any provision of 410 IAC 5 or order issued thereunder will be subject to controls in IC 13-1-2-20 and IC 13-1-2-21.

410 IAC 5-1-9 Prohibited devices

- Sec. 9. (a) Hand-held fluoroscopic screens shall not be used.
- (b) Shoe-fitting fluoroscopic devices shall not be used.

410 IAC 5-1-10 Board address

Sec. 10. All communications and reports concerning 410 IAC 5, and applications filed thereunder, should be addressed to the board at its office located at the Indiana State Board of Health, 1330 West Michigan Street, Indianapolis, Indiana 46206.

410 IAC 5-1-10.5 International system of units

Sec. 10.5. The Metric Conversion Act of 1975 (PL 94-168) urged the increasing awareness and use of the International System of Units (SI). Where appropriate, schedules and appendices are provided with notes concerning conversion factors. The inclusion of the SI equivalent is for informational purposes only.

- (a) Absorbed dose. The unit of absorbed dose is the gray (Gy), which is equal to 1 joule per kilogram. One rad is equal to 1×10^{-2} gray. Sub-multiples included in this document are the milligray (mGy) and the microgray (μ Gy).
- (b) Dose equivalent. The unit of dose equivalent is the sievert (Sv) which is equal to 1 joule per kilogram. One rem is equal to 1×10^{-2} sievert. Sub-multiples included in this document are the millisievert (mSv) and the microsievert (μ Sv).
- (c) Exposure. The unit of exposure is the coulomb per kilogram (C/kg). One roentgen is equal to 2.58×10^{-4} coulomb per kilogram. Submultiples of this unit are the millicoulomb per kilogram (mC/kg) and the microcoulomb per kilogram (μ C/kg).
- (d) Radioactivity. The unit of measurement of radioactivity is the becquerel (Bq) and is equal to one transformation per second. One curie is equal to 3.7×10^{10} becquerels. Multiples included in this document are kilobecquerel (kBq), megabecquerel (MBq), gigabecquerel (GBq), and petabecquerel (PBq).

410 IAC 5-1-11 Transport grouping of radionuclides

Sec. 11.

APPENDIX A
TRANSPORT GROUPING OF RADIONUCLIDES

| Element ^{1/} | Radionuclide ² | Group |
|-----------------------|------------------------------------|-------|
| Actinium (89) | Ac-277 | I |
| | Ac-228 | I |
| Americium (95) | Am-241 | I |
| | Am-243 | I |
| Antimony (51) | Sb-122 | IV |
| | Sb-124 | III |
| | Sb-125 | III |
| Argon (18) | Ar-37 | VI |
| | Ar-41 | II |
| | Ar-41 (uncompressed) ^{3/} | V |
| Arsenic (33) | As-73 | IV |
| | As-74 | IV |
| | As-76 | IV |
| | As-77 | IV |
| Astatine (85) | At-211 | III |
| Barium (56) | Ba-131 | IV |
| | Ba-133 | II |
| | Ba-140 | III |
| Berkelium (97) | Bk-249 | I |
| Beryllium (4) | Be-7 | IV |

| | | |
|------------------|---------|-----|
| Bismuth (83) | Bi-206 | IV |
| | Bi-207 | III |
| | Bi-210 | II |
| | Bi-212 | III |
| Bromine (35) | Br-82 | IV |
| Cadmium (48) | Cd-109 | IV |
| | Cd-115m | III |
| | Cd-115 | IV |
| Calcium (20) | Ca-45 | IV |
| | Ca-47 | IV |
| Californium (98) | Cf-249 | I |
| | Cf-250 | I |
| | Cf-252 | I |
| Carbon (6) | C-14 | IV |
| Cerium (58) | Ce-141 | IV |
| | Ce-143 | IV |
| | Ce-144 | III |
| Cesium (55) | Cs-131 | IV |
| | Cs-134m | III |
| | Cs-134 | III |
| | Cs-135 | IV |
| | Cs-136 | IV |
| | Cs-137 | III |
| Chlorine (17) | Cl-36 | III |
| | Cl-38 | IV |
| Chromium (24) | Cr-51 | IV |
| Cobalt (27) | Co-56 | III |
| | Co-57 | IV |
| | Co-58m | IV |
| | Co-58 | IV |
| | Co-60 | III |
| Copper (29) | Cu-64 | IV |
| Curium (96) | Cm-242 | I |
| | Cm-243 | I |
| | Cm-244 | I |
| | Cm-245 | I |
| | Cm-246 | I |
| Dysprosium (66) | Dy-154 | III |
| | Dy-165 | IV |
| | Dy-166 | IV |
| Erbium (68) | Er-169 | IV |
| | Er-171 | IV |
| Europium (63) | Eu-150 | III |
| | Eu-152m | IV |
| | Eu-152 | III |
| | Eu-154 | II |
| | Eu-155 | IV |
| Fluorine (9) | F-18 | IV |
| Gadolinium (64) | Gd-153 | IV |
| | Gd-159 | IV |
| Gallium (31) | Ga-67 | III |

| | | |
|------------------------------|--------------------------------------|-----|
| | Ga-72 | IV |
| Germanium (32) | Ge-71 | IV |
| Gold (79) | Au-193 | III |
| | Au-194 | III |
| | Au-195 | III |
| | Au-196 | IV |
| | Au-198 | IV |
| | Au-199 | IV |
| Hafnium (72) | Hf-181 | IV |
| Holmium (67) | Ho-166 | IV |
| Hydrogen (1) | H-3 (see tritium) | |
| Indium (49) | In-113m | IV |
| | In-114m | III |
| | In-115m | IV |
| | In-115 | IV |
| Iodine (53) | I-124 | III |
| | I-125 | III |
| | I-126 | III |
| | I-129 | III |
| | I-131 | III |
| | I-132 | IV |
| | I-133 | III |
| | I-134 | IV |
| | I-135 | IV |
| Iridium (77) | Ir-190 | IV |
| | Ir-192 | III |
| | Ir-194 | IV |
| Iron (26) | Fe-55 | IV |
| | Fe-59 | IV |
| Krypton (36) | Kr-85m | III |
| | Kr-85m (uncompressed). ^{3/} | V |
| | Kr-85 | III |
| | Kr-85 (uncompressed). ^{3/} | VI |
| | Kr-87 | II |
| | Kr-87 (uncompressed). ^{3/} | V |
| Lanthanum (57) | La-140 | IV |
| Lead (82) | Pb-203 | IV |
| | Pb-210 | II |
| | Pb-212 | II |
| Lutetium (71) | Lu-172 | III |
| | Lu-177 | IV |
| Magnesium (12) | Mg-28 | III |
| Manganese (25) | Mn-52 | IV |
| | Mn-54 | IV |
| | Mn-56 | IV |
| Mercury (80) | Hg-197m | IV |
| | Hg-197 | IV |
| | Hg-203 | IV |
| Mixed fission products (MFP) | II | |
| Molybdenum (42) | Mo-99 | IV |

| | | |
|-------------------|------------|-----|
| Neodymium (60) | Nd-147 | IV |
| | Nd-149 | IV |
| Neptunium (93) | Np-237 | I |
| | Np-239 | I |
| Nickel (28) | Ni-56 | III |
| | Ni-59 | IV |
| | Ni-63 | IV |
| | Ni-65 | IV |
| Niobium (41) | Nb-93m | IV |
| | Nb-95 | IV |
| | Nb-97 | IV |
| Osmium (76) | Os-185 | IV |
| | Os-191m | IV |
| | Os-191 | IV |
| | Os-193 | IV |
| Palladium (46) | Pd-103 | V |
| | Pd-109 | IV |
| Phosphorus (15) | P-32 | IV |
| Platinum (78) | Pt-191 | IV |
| | Pt-193 | IV |
| | Pt-193m | IV |
| | Pt-197m | IV |
| | Pt-197 | IV |
| Plutonium (94) | Pu-238(F) | I |
| | Pu-239(F) | I |
| | Pu-240 | I |
| | Pu-241(F) | I |
| | Pu-242 | I |
| Polonium (84) | Po-210 | I |
| Potassium (19) | K-42 | IV |
| | K-43 | III |
| Praseodymium (59) | Pr-142 | IV |
| | Pr-143 | IV |
| Promethium (61) | Pm-147 | IV |
| | Pm-149 | IV |
| Protactinium (91) | Pa-230 | I |
| | Pa-231 | I |
| | Pa-233 | II |
| Radium (88) | Ra-223 | II |
| | Ra-224 | II |
| | Ra-226 | I |
| | Ra-228 | I |
| Radon (86) | Rn-220 | IV |
| | Rn-222 | II |
| Rhenium (75) | Re-183 | IV |
| | Re-186 | IV |
| | Re-187 | IV |
| | Re-188 | IV |
| | Re-Natural | IV |
| Rhodium (45) | Rh-103m | IV |
| | Rh-105 | IV |

| | | |
|-----------------|------------|-----|
| Rubidium (37) | Rb-86 | IV |
| | Rb-87 | IV |
| | Rb-Natural | IV |
| Ruthenium (44) | Ru-97 | IV |
| | Ru-103 | IV |
| | Ru-105 | IV |
| | Ru-106 | III |
| Samarium (62) | Sm-145 | III |
| | Sm-147 | III |
| | Sm-151 | IV |
| | Sm-153 | IV |
| Scandium (21) | Sc-46 | III |
| | Sc-47 | IV |
| | Sc-48 | IV |
| Selenium (34) | Se-75 | IV |
| Silicon (14) | Si-31 | IV |
| Silver (47) | Ag-105 | IV |
| | Ag-110m | III |
| | Ag-111 | IV |
| Sodium (11) | Na-22 | III |
| | Na-24 | IV |
| Strontium (38) | Sr-85m | IV |
| | Sr-85 | IV |
| | Sr-89 | III |
| | Sr-90 | II |
| | Sr-91 | III |
| | Sr-92 | IV |
| Sulfur (16) | S-35 | IV |
| Tantalum (73) | Ta-182 | III |
| Technetium (43) | Tc-96m | IV |
| | Tc-96 | IV |
| | Tc-97m | IV |
| | Tc-97 | IV |
| | Tc-99m | IV |
| | Tc-99 | IV |
| Tellurium (52) | Te-125m | IV |
| | Te-127m | IV |
| | Te-127 | IV |
| | Te-129m | III |
| | Te-129 | IV |
| | Te-131m | III |
| | Te-132 | IV |
| Terbium (65) | Tb-160 | III |
| Thallium (81) | Tl-200 | IV |
| | Tl-201 | IV |
| | Tl-202 | IV |
| | Tl-204 | III |
| Thorium (90) | Th-227 | II |
| | Th-228 | I |
| | Th-230 | I |
| | Th-231 | I |

| | | |
|----------------|--|-----|
| | Th-232 | III |
| | Th-234 | II |
| | Th-Natural | III |
| Thulium (69) | Tm-168 | III |
| | Tm-170 | III |
| | Tm-171 | IV |
| Tin (50) | Sn-113 | IV |
| | Sn-117m | III |
| | Sn-121 | III |
| | Sn-125 | IV |
| Tritium (1) | H-3 | IV |
| | H-3 (as a gas, as luminous paint, or adsorbed on solid material). | VII |
| Tungsten (74) | W-181 | IV |
| | W-185 | IV |
| | W-187 | IV |
| Uranium (92) | U-230 | II |
| | U-232 | I |
| | U-233 (F) | II |
| | U-234 | II |
| | U-235(F) | III |
| | U-236 | II |
| | U-238 | III |
| | U-Natural | III |
| | U-Enriched (F) | III |
| | U-Depleted | III |
| Vandium (23) | V-48 | IV |
| | V-49 | III |
| Xenon (54) | Xe-125 | III |
| | Xe-131m | III |
| | Xe-131m (uncompressed). ^{3/} | V |
| | Xe-133 | III |
| | Xe-133 (uncompressed). ^{3/} | VI |
| | Xe-135 | II |
| | Xe-135 (uncompressed). ^{3/} | V |
| Ytterbium (70) | Yb-175 | IV |
| Yttrium (39) | Y-88 | III |
| | Y-90 | IV |
| | Y-91m | III |
| | Y-91 | III |
| | Y-92 | IV |
| | Y-93 | IV |
| Zinc (30) | Zn-65 | IV |
| | Zn-69m | IV |
| | Zn-69 | IV |
| Zirconium (40) | Zr-93 | IV |
| | Zr-95 | III |
| | Zr-97 | IV |

^{1/} Atomic number shown in parentheses.

^{2/} Atomic mass number shown after the element symbol.

^{3/} Uncompressed means at a pressure not exceeding one atmosphere.

m Metastable state.

(F) Fissile material.

For any radionuclide not specifically listed or for mixtures of radionuclides, refer to the definition of "transport group" in 410 IAC 5-1-2.

410 IAC 5-1-12 Tests for special form licensed material

Sec. 12.

APPENDIX B TESTS FOR SPECIAL
FORM LICENSED MATERIAL

(1) Free Drop A free drop through a distance of 30 feet (9.14 meters) onto a flat essentially unyielding horizontal surface, striking the surface in such a position as to suffer maximum damage.

(2) Percussion Impact of the flat circular end of a 1 inch (2.54 centimeters) diameter steel rod weighing 3 pounds (1.36 kilograms), dropped through a distance of 40 inches (1.02 meters). The capsule or material shall be placed on a sheet of lead, of hardness number 3.5 to 4.5 on the Vickers scale, and not more than 1 inch (2.54 centimeters) thick, supported by a smooth essentially unyielding surface.

(3) Heating Heating in air to a temperature of 1475° F (801.67° C) and remaining at that temperature for a period of 10 minutes.

(4) Immersion Immersion for 24 hours in water at room temperature. The water shall be at pH 6-pH 8, with a maximum conductivity of 10 micromhos per centimeter.