

**RADIOLOGICAL CONTROL MANUAL**

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**CHAPTER 4, RADIOACTIVE MATERIALS****Part 1, Radioactive Material Identification, Storage, and Control****Article 411, General**

1. Materials in contamination, high contamination, or airborne radioactivity areas shall be considered contaminated until they are surveyed and released [see 10 CFR 835.1101(a)]. Any equipment or system component removed from a process that may have had contact with radioactive material will be considered contaminated until it is disassembled to the extent required to perform an adequate survey, surveyed, and shown to be free of contamination at levels exceeding the Table 2-2 values. These survey and release provisions do not apply to airborne radioactivity areas where only gaseous, short-lived radionuclides (with a half-life of 1 hour or less) are present. Detailed provisions for the release of materials from radiological areas to controlled and uncontrolled areas are provided in Article 421 and 422.
2. Radioactive material located within contamination, high contamination, or airborne radioactivity areas does not require specific labeling or packaging if sufficient information is provided to allow individuals to take appropriate protective actions [see 10 CFR 835.606(a)]. The information may be provided by means of postings, pre-job briefings, training, or other appropriate means.
3. The Radiological Control organization will develop response and notification requirements associated with a loss of radioactive material, including searches, internal investigations, documentation, and reporting. The Radiological Control organization will be notified in case of a loss of radioactive material.

**Article 412, Radioactive Material Labeling**

1. The regulations in 10 CFR 835 require labeling of individual containers of radioactive material and radioactive items except under certain specified conditions in which existing postings and control measures provide adequate warning [see 10 CFR 835.601(a) and 835.606(a)].
2. Postings and access control requirements for radiological areas generally provide sufficient personnel protection to negate the need for individual container or item labeling; however, items having removable contamination in excess of the Table 2-2 values will be labeled when used, handled, or stored in areas other than contamination, high contamination, or airborne radioactivity areas.
3. Required labels shall include the standard radiological warning trefoil and the words "CAUTION" or "DANGER" and "RADIOACTIVE MATERIAL" [see 10 CFR 835.605]. The "DANGER" label will be used when an individual exposed to, using, or handling the material could receive a dose equivalent exceeding any applicable administrative control level in 1 hour. The radiation-warning trefoil shall be black or magenta and imposed on a yellow background [see 10 CFR 835.601(a)].
4. Required labels shall provide sufficient information to permit individuals handling, using, or working in the vicinity of the labeled material to take appropriate actions to control

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exposures [see 10 CFR 835.605]. The following information should be included on radioactive material labels to the extent appropriate to the radiological hazard created by the material and the education, training, and skills of the individuals who may be exposed to the hazards:

- a. Radionuclide(s).
  - b. Nature of material (e.g., a sealed radioactive source, a contaminated component, or an activated target).
  - c. Radiological hazard information (e.g., radiation and contamination levels).
  - d. Total quantity of radioactive material (in subunits or multiple units of curies).
  - e. Required precautions.
  - f. Name of surveyor.
  - g. Date of survey.
5. If an item is too small to be labeled with all of the desired information, the label should be applied to the device or storage location with sufficient information available to trace the item to the appropriate label.
  6. If a label is applied to packaged radioactive material, the label should be applied to the outside of the package or should be visible through the package.
  7. Radioactive materials and containers should be labeled in accordance with Table 4-1.
  8. Items and containers may be exempted from labeling requirements under the conditions listed in Table 4-2.

Table 4-1 Radioactive material labeling.

| Material or Item   | Required Labeling                                 | Supplemental Labeling   |
|--|---|---|
| Equipment, components, and other items that are radioactive or potentially radioactive, or have been exposed to radioactive contamination or activation sources. | Standard radiation warning trefoil,<br>and        | “CONTAMINATED” or<br>“POTENTIALLY<br>CONTAMINATED”                      |
| Sealed and unsealed radioactive sources or associated storage containers.  | “CAUTION” or “DANGER”                             |   |
| Equipment, components, and other items with actual or potential internal contamination.  | and   | “INTERNAL<br>CONTAMINATION” or<br>“POTENTIAL INTERNAL<br>CONTAMINATION” |
| Components, equipment, or other items with fixed contamination.  | “RADIOACTIVE<br>MATERIAL”<br>[see 10 CFR 835.605] | “FIXED<br>CONTAMINATION”  |
| CFR = Code of Federal Regulations  |   |   |

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Table 4-2. Exceptions from radioactive material labeling requirements.

| Exception Criteria  | Items Typically Excepted <sup>a</sup>   |
|---|---|
| Material that is used, handled, or stored in radiological areas or radioactive material areas [see 10 CFR 835.606(a)(1)].   | All radioactive material in radiological areas and radioactive material areas.<br><br>This exception will not be applied to items (a) with removable contamination exceeding the Table 2-2 values and (b) stored outside of contamination, high contamination, or airborne radioactivity areas. |
| Material having a total quantity of radioactive material below one-tenth of the 10 CFR 835, Appendix E, values [see 10 CFR 835.606(a)(2)].  | Items having extremely low levels of radioactive material content such as low-activity sealed radioactive sources, laundered personal protective equipment, and tools and equipment having low levels of fixed contamination.   |
| Material that has been packaged, labeled, and marked in accordance with the applicable (e.g., DOE or the Department of Transportation) radioactive material transportation requirements [see 10 CFR 835.606(a)(3)].   | Radioactive material packages awaiting shipment.  |
| Material that is inaccessible, or accessible only to individuals authorized to handle or use them, or to work in the vicinity [see 10 CFR 835.606(a)(4)].   | Material stored in locked areas or areas having strict physical and administrative entry controls that preclude unauthorized entry, or radioactive samples being handled or transported by authorized personnel.  |
| Material that is installed in manufacturing, process, or other equipment [see 10 CFR 835.606(a)(5)].  | Equipment or material such as piping, tanks, valves, instrument sensors, and test sources that are installed in immobile systems.   |
| Material that consists solely of nuclear weapons or their components [see 10 CFR 835.606(a)(6)].  | Nuclear weapons components.   |
| <p>CFR = Code of Federal Regulations<br/>DOE = Department of Energy<br/>a. Caution must be exercised to ensure that the listed items actually meet the criteria established in the first column.</p> <p><b>Note:</b> Caution also should be exercised to ensure that other applicable requirements (e.g., member of the public dose limits [see Table 2-1], training provisions [see Table 3-2], as low as reasonably achievable [ALARA] requirements [see Article 117], controlled area dose expectation [see Article 232]) will be met in the absence of radioactive material labels.</p> |   |

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**Article 413, Radioactive Material Packaging**

1. Radioactive material that is outside contamination, high contamination, or airborne radioactivity areas and is confirmed or suspected of having removable radioactive contamination levels greater than Table 2-2 values should be securely wrapped in plastic or placed in a closed container.
2. Radioactive material with sharp edges or projections should be taped or additionally protected to ensure package integrity.
3. Radioactive material with removable or potentially removable contamination levels in excess of 100 times Table 2-2 values should have additional packaging controls such as double-wrapping or the use of plastic bags inside containers.
4. Yellow plastic wrapping material (or plastic wrapping materials emblazoned with yellow markings) should be used for packaging radioactive material and will not be used for nonradiological purposes. Translucent or clear plastic bags clearly marked with yellow stripes on both sides and the standard radiation symbol also may be used to package radioactive material.
5. The amount of combustible material used in packaging should be minimized.

**Article 414, Radioactive Material Storage**

1. Radioactive material in quantities exceeding the applicable 10 CFR 835, Appendix E, quantities shall be used, handled, and stored in a radioactive material area or other area posted in accordance with Articles 234, 235, or 236, as appropriate [see 10 CFR 835.2(a), radioactive material area, and 10 CFR 835.603 and 604].
2. Decontamination or disposal of radioactive material is the preferred alternative to long-term storage.
3. Each radioactive material area will be approved by the Radiological Control director or designee.
4. A custodian will be assigned responsibility for each radioactive material area. A custodian may have responsibility for more than one storage area.
5. The custodian should conduct walk-throughs of radioactive material areas monthly to check integrity of containers and wrapping materials.
6. The custodian will conduct annual or more frequent reviews of each radioactive material area, with emphasis on treatment, decontamination, movement of material to long-term storage locations, and disposal of unneeded material.
7. Storage of nonradioactive material in a radioactive material area is discouraged.
8. Outdoor storage of radioactive material is discouraged. In cases where outdoor storage is necessary, the integrity of containers or wrapping materials used should be ensured to prevent degradation from weathering and subsequent release of radioactive material.

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Material with high-integrity packaging such as the dry storage fuel casks and Type A drums do not require coverings for outside storage, nor do items with fixed contamination.

9. Radioactive material should be stored in a manner that reduces combustible loading. The use of cardboard containers for storage is discouraged.
10. Flammable or combustible materials should not be stored adjacent to radioactive material areas.
11. Fire protection measures such as smoke detectors, water sprinklers, and fire extinguishers should be considered when establishing a radioactive material area.
12. The area within a 2,000-ft radius of the Radiological and Environmental Sciences Laboratory (CFA-690) should, as far as practicable, be a low background-radiation area. New programs, projects and facilities requiring or using radioactive or fissile materials in excess of the quantities listed in 10 CFR 835, Appendix E, should not be located in this area. Existing usage of radioactive materials in this portion of the Central Facilities Area should not be increased, and additional radioactive materials will not be introduced into this area, except with the specific written approval of the Radiological and Environmental Sciences Laboratory director.

## **Part 2, Release and Transportation of Radioactive Material and Equipment**

### **Article 421, Release to Controlled Areas**

Once materials and equipment have been brought into radiological areas controlled for surface contamination or airborne radioactivity, comprehensive and time-consuming evaluations of the potential for contamination are required prior to releasing the material or equipment to a controlled area. Likewise, exposure of certain materials and equipment to a beam of neutrons or other particles produced in a nuclear reactor or particle accelerator may activate that material or equipment, resulting in the creation of radioactive material requiring controlled use, storage, and disposal. The necessity to evaluate the radiological characteristics of these materials and equipment and to implement appropriate controls provides substantial impetus to limit the amount of material and equipment brought into radiological areas and to prevent contamination or activation of materials and equipment that do enter these areas.

1. Accessible surfaces of material or equipment that has entered contamination, high contamination, or airborne radioactivity areas shall be surveyed prior to release from these areas to controlled areas [see 10 CFR 835.1101(a)]. Guidance for conducting these surveys is provided in the footnotes to Table 2-2.

Survey types and methods used are based on technical evaluations, including an analysis of radionuclides of concern. Radiological buffer area surveys may be used as the release survey provided that the survey meets the radiological criteria described in DOE O 5400.5 for unconditional release.

2. If an assessment of the prior use of the material or equipment indicates that inaccessible surfaces are not likely to be contaminated in excess of applicable limits, a complete

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- survey of accessible surfaces and documentation of the assessment may be an appropriate basis to release materials to the controlled area [see 10 CFR 835.1101(a)(2)].
3. If an assessment of the prior use of the material or equipment indicates that inaccessible surfaces are likely to be contaminated to levels in excess of the Table 2-2 values, then the material shall not be released from the radiological area, except as permitted under Article 421.5 or 421.6 [see 10 CFR 835.1101(a)(2)]. If it is necessary to release the material or equipment from the radiological area, the material or equipment will be disassembled to the extent necessary to perform adequate surveys.
  4. Removable contamination levels shall be less than Table 2-2 values prior to releasing material and equipment for unrestricted use in controlled areas [see 10 CFR 835.1101(a)(1) and (a)(2)].
  5. Material and equipment with fixed contamination levels that exceed the total contamination values specified in Table 2-2 and removable contamination levels less than the Table 2-2 values may be released for restricted use in controlled areas outside of radiological areas [see 10 CFR 835.1101(c) and (c)(1)]. The material or equipment shall be monitored routinely and clearly marked or labeled to alert individuals to the contaminated status [see 10 CFR 835.1101(c)(2)]. Written procedures should be developed to establish requirements for monitoring of the material or equipment and surrounding areas, control of access to these areas, authorized uses of the material or equipment, and contingency plans for the spread of radioactive contamination.
  6. Material and equipment with total or removable contamination levels exceeding Table 2-2 values may be moved on-Site from one radiological area to another if appropriate monitoring is performed and appropriate controls are established and implemented [see 10 CFR 835.1101(b)]. These controls should include provisions for containment to the extent practicable, labeling in accordance with Article 412, monitoring and control of the transfer route and participating individuals, and control of spills.
  7. The requirements of 10 CFR 835.1101 apply only to material and equipment that are radioactive as a result of the deposition of radioactive contamination. Although DOE has not established any specific controls over the release of other radioactive materials (e.g., activated materials, materials that are naturally radioactive, and volumes-contaminated substances) to controlled areas, the release of these materials is subject to other requirements of 10 CFR 835. The following regulatory requirements and guidance are applicable to the release of this type of material and equipment.
    - a. Controls shall be adequate to ensure compliance with the radiation safety training requirements of 10 CFR 835.901. Release of material and equipment to controlled areas may result in occupational or nonoccupational exposure of individuals to radiation. Chapter 6 contains provisions for implementing an appropriate training program.
    - b. Controls shall be adequate to ensure compliance with the 100 mrem in ~~1~~<sup>4</sup>a year controlled area maximum TEDE [see 10 CFR 835.602]. Site-specific criteria

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ensures that radioactive material and equipment released to the controlled area, in combination with other sources of radiation in the controlled area, will not result in any individual exceeding this dose expectation.

- c. Controls shall be adequate to ensure that the ALARA process is properly implemented [see 10 CFR 835.101 and 10 CFR 835.1001 through 1003]. Given the low levels of radioactivity that are likely to be present in material and equipment being considered for release to controlled areas, the controls should not be burdensome. Options that should be considered include retention in radiological areas, placement in specified areas with appropriate access restrictions and usage controls, posting, labeling or color-coding, storage for decay, removal of radioactive components, and disposal as radioactive waste.
8. When radioactive materials are moved outside of radiological areas, controls will be established to ensure that no unmonitored individual is likely to exceed a dose equivalent that would require monitoring in accordance with Articles 511 and 521.
9. Records for release of materials will describe the property, the survey date, the identity of the individual who performed the survey, the type and identification number of the survey instruments used, and the survey results. For small items and packages of similar items (such as boxes of tools or boxes of fasteners), creating a separate survey record for each item is not necessary. However, the survey record or log entry should provide traceability to the individual removing the item from the radiological area.

**Article 422, Release to Uncontrolled Areas**

1. Radiological criteria for releasing material to uncontrolled areas are described in DOE O 5400.5.

The survey that is required prior to release to uncontrolled areas may be a release survey from radiological buffer areas established for contamination control.

2. Guidance will be obtained from DOE O 5400.5 for getting approvals, on a case-by-case basis, for releasing material that has been contaminated in depth or volume, such as activated material or smelted contaminated material.
3. The criteria for unrestricted release of materials established in DOE O 5400.5 may be more stringent than those established in [the RCM this manual](#) for release to controlled areas.

Note: Such releases normally will be conducted in accordance with Table 2-2 and employ a documented technical basis when appropriate.

4. Material not immediately released after it is surveyed should be controlled to prevent contamination while awaiting release.
5. Radiological labeling should be removed from or defaced on material prior to release for unrestricted use.

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**Article 423, Transportation of Radioactive Material**

1. Requirements are established in 49 CFR 171, “General Information, Regulations, and Definitions”; 172, “Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements”; and 173, “Shippers—General Requirements for Shipments and Packagings”; and 175, “Carriage by Aircraft”; 176, “Carriage by Vessel”; 177, “Carriage by Public Highway”; and 178, “Specifications for Packagings”; for inspecting and surveying packages, containers, and transport conveyances prior to transport via the public transportation system. These regulations apply to radioactive material transportation in commerce.
2. Two DOE orders, DOE O 460.1B, “Packaging and Transportation Safety,” and DOE O 460.2, “Departmental Materials Transportation and Packaging Management,” ~~shall be~~ used as the basis for providing requirements that conform with 49 CFR, “Transportation,” requirements for transportation of radioactive material using any conveyance. Radioactive material transportation activities performed in accordance with applicable transportation requirements (e.g., Department of Transportation or DOE requirements) are excluded, by 10 CFR 835.1(b)(4), from the requirements of 10 CFR 835. However, radioactive material transportation (as defined in 10 CFR 835) does not include preparation of materials for shipment, packaging and labeling, or performance of radiological monitoring required for occupational radiation protection. Therefore, these activities shall be conducted in accordance with 10 CFR 835 [see 10 CFR 835.2(a), radioactive material transportation, and 10 CFR 835.1(b)] and will be conducted in accordance with ~~the RCM~~this manual.
3. When radioactive material exceeding a Type A quantity (as defined in 10 CFR 71, “Packaging and Transportation of Radioactive Material”) is received, radiation and contamination monitoring of the received packages shall be performed if the package is labeled in accordance with applicable transportation requirements (e.g., a Radioactive White I, Yellow II, or III label) [see 835.405(b)(1)] or the package has been transported as low specific activity material on an exclusive-use vehicle [see 835.405(b)(2)].
  - a. The external surfaces of all packages received from transportation should be monitored to determine the external radiation and contamination levels, unless the packaged materials are not capable of creating an external radiation or contamination hazard. These surveys are used to demonstrate compliance with Department of Transportation regulations and applicable DOE orders and to identify appropriate postings and access control measures. These measures will be established as soon as practicable after receipt.
  - b. Monitoring for radiation and contamination shall be performed when a received package containing greater than a Type A quantity of radioactive material shows evidence of degradation, such as packages that are crushed, wet, or damaged [see 835.405(b)(3)].
  - c. Monitoring for radiation and contamination of received packages of radioactive material shall be performed as soon as practicable following receipt, but no later

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than 8 hours following the beginning of the working day following the receipt of the package [see 835.405(d)].

4. The removable ~~and other~~ contamination ~~values limits~~ in Table 2-2 are more ~~limiting conservative~~ than the 49 CFR 173.443, "Contamination control," requirements and should be used as ~~the~~ controlling ~~values limits~~ for on-Site and off-Site transportation when using a conveyance that is owned by DOE. However, when a shipment is received from an off-Site destination, by a non-DOE conveyance, the 49 CFR 173.443 contamination values will be applied to all subsequent on-Site transfers to the ultimate on-Site destination.
5. Only the removable contamination ~~values limits~~ in Table 2-2 apply to shipping requirements. However, surveys ~~should shall~~ be conducted for both fixed and removable contamination [see 10 CFR 835, Appendix D]. ~~because F~~fixed contamination may be masked by direct radiation from the container or the contents of the shipping container. The shipment will be labeled as required to identify direct radiation hazards.
6. On-Site transfers over nonpublic thoroughfares will be performed in accordance with written procedures adhering to pre-approved routes. The procedures or other measures should include requirements to ensure appropriate monitoring and control of the radioactive material and should be approved by the Radiological Control organization. Radioactive material should not be carried through designated food preparation, serving, or eating areas.
7. On-Site transfers over public thoroughfares by non-DOE conveyance ~~shall will~~ be performed in accordance with Department of Transportation, state, and local shipping requirements and pre-approved agreements. On-Site transfers over public thoroughfares by DOE conveyance should be performed in accordance with DOE G 460.1-1, "Packaging and Transportation Safety," and other applicable DOE orders and will conform to state and local shipping requirements and pre-approved agreements.
8. Before shipment and upon receipt of a radioactive material shipment, a visual inspection of packages should be performed to ensure that packages are not damaged. The inspection should identify dents, flaking paint, debris, package orientation, and any indication of leakage.
9. Before shipment and upon receipt of a radioactive material shipment, packages should be inventoried against the shipping manifest to ensure accountability.
10. Transport conveyances should be inspected visually prior to loading to ensure the trailers are acceptable for the intended use.
11. Transport conveyances should be radiologically surveyed before loading, especially when using commercial carriers specializing in radioactive transport. The surveys should be adequate to identify any contamination remaining on the vehicle from previous radioactive material transport evolutions, so that neither DOE nor the Site contractor would be held liable.

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12. Transport of large volumes of radioactive material by non-DOE motor vehicles should be “exclusive use” to prevent commingling of DOE and other commercial shipments.
13. The Site emergency plan should describe appropriate responses for potential on-Site radioactive material transportation accidents.
14. Drivers of DOE and non-DOE motor vehicles should have a copy of their emergency response plan, or the emergency response information required by 49 CFR 172.600, “Applicability and general requirements,” during transport on-Site or during off-Site transportation.
15. ~~Specific arrangements shall be made for receiving packages containing radioactive material, regardless of the means of conveyance, in excess of Type A quantities as defined in 10 CFR 71.4, “Definitions” [see 10 CFR 835.405(a)]. These arrangements shall include ensuring that packages are received upon delivery or to receive notification of delivery, which expedites receipt of packages. If packages containing quantities of radioactive material in excess of a Type A quantity (as defined at 10 CFR 71.4) are expected to be received from radioactive material transportation, arrangements shall be made to either take possession of the package when the carrier offers it for delivery or receive notification as soon as practicable after arrival of the package at the carrier’s terminal and to take possession of the package expeditiously after receiving such notification.~~ [see 10 CFR 835.405(a)].
16. Written procedures for safely opening packages will be developed and maintained. These procedures should include due consideration of the type of package and potential hazards present.

### **Part 3, Sealed Radioactive Source Controls**

#### **Article 431, Sealed Radioactive Source Controls**

Sealed radioactive sources having activities equal to or exceeding the values specified in 10 CFR 835, Appendix E [see 10 CFR 835.2(a)], are considered accountable sealed radioactive sources.

1. Written procedures should be established and implemented to control accountable sealed radioactive sources. These procedures should establish requirements for source acquisition, receipt, storage, transfer, inventory, leak testing, usage, and disposal of sources when no longer needed.
2. Accountable sealed sources and all other sealed radioactive sources having activities exceeding one-tenth of the 10 CFR 835, Appendix E, values, or their storage containers, shall be labeled with the radiation symbol and “CAUTION” or “DANGER” and “RADIOACTIVE MATERIAL” [see 10 CFR 835.605]. The label also shall provide sufficient information to control exposures [see 10 CFR 835.605]. Because of the wide variety of labels that manufacturers affix to sealed radioactive sources, these labels are excepted from the normal color scheme of magenta or black on yellow [see 10 CFR 835.606(b)]. If the size or configuration of the source precludes application of a suitable label, the label should be attached to the source container or mechanism.

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Note: Consumer product exempt sources marked as radioactive by the manufacturer normally should be considered to meet 10 CFR 835.605 labeling requirements.

3. Each accountable sealed radioactive source shall be inventoried at intervals not to exceed 6 months [see 10 CFR 835.1202(a)]. This inventory shall:
  - a. Establish the physical location of each accountable sealed radioactive source.
  - b. Verify that the associated posting and labeling are adequate.
  - c. Establish that storage locations, containers, and devices are adequate.
4. Each accountable sealed radioactive source shall be subject to a source leak test upon receipt, when damage is suspected and at intervals not to exceed 6 months [see 10 CFR 835.1202(b)]. Source leak tests shall be capable of detecting radioactive material leakage equal to or exceeding 0.005  $\mu\text{Ci}$  (as indicated by the presence of 0.005  $\mu\text{Ci}$  or more activity on the leak test sample) [see 10 CFR 835.1202(b)].
5. Periodic leak tests need not be performed if the source has been documented as removed from service. Such sources shall be stored in a controlled location and subject to periodic inventory in accordance with Article 431.3 and subject to leak testing prior to being returned to service [see 10 CFR 835.1202(c)].
6. As allowed by 10 CFR 835.1202(d), if a source is located in an area that is unsafe for human entry or is otherwise inaccessible (such as resulting from operational or environmental constraints), then periodic inventories and leak tests need not be performed. When the conditions that restrict access to the area have been terminated, the inventory and integrity test should be performed before allowing uncontrolled access to the area.
7. If an accountable sealed radioactive source is found to be leaking radioactive material, then controls shall be established to prevent the escape of radioactive material to the workplace [see 10 CFR 835.1202(e)]. These controls should include wrapping or containing the source, applying appropriate labels, and removing the source from service.
8. Both accountable and nonaccountable sealed radioactive sources shall be used, handled, and stored in a manner commensurate with the hazards associated with the operations involving the sources [see 10 CFR 835.1201].
9. Sealed radioactive sources having activities below one-tenth of 10 CFR 835, Appendix E, values should be labeled consistent with Article 412 and should be controlled to ensure their retention and proper use and storage.
10. Procurement of radioactive sources should be coordinated with the Radiological Control organization.
11. Receipt surveys of radioactive material shipments should be performed by the Radiological Control organization in accordance with Articles ~~552 and 554~~ [423](#).
12. Sealed radioactive sources, including radiography sources, should not be brought on-Site by external organizations without the prior knowledge and approval of the Radiological Control organization.

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13. A custodian should be appointed to coordinate sealed radioactive source procurement, issue, inventory, leak testing, disposal, and other aspects of the sealed radioactive source control program.
14. Exempt sources may be controlled using the processes established to meet 10 CFR 835.1202 to reduce the need for redundant administrative processes. However, they will not be ~~required to be~~ subjected to the leak testing and inventory activities.

## **Part 4, Solid Radioactive Waste Management**

### **Article 441, Requirements**

1. DOE O 435.1, "Radioactive Waste Management"; DOE M 435.1-1, "Radioactive Waste Management Manual"; and the DOE G 435.1-1 series describes how solid radioactive waste is treated, packaged, stored, transported, and disposed of.
- ~~3.2.~~ Radiological operations generating radioactive waste shall be designed and developed to promote minimization and permit segregation, monitoring, treatment, storage, and disposal [see DOE O 435.1 and DOE M 435.1].
- ~~4.3.~~ Radioactive waste minimization goals and practices shall be developed and implemented [see DOE O 435.1 and DOE M 435.1].

### **Article 442, Waste Minimization**

A radioactive waste minimization program shall be in effect to reduce the generation of radioactive waste and the spread of contamination from contamination, high contamination, or airborne radioactivity areas [see DOE O 435.1 and DOE M 435.1]. The following practices should be evaluated and instituted as appropriate to support waste minimization:

1. Restrict material entering radiological buffer areas and other areas surrounding radiological areas to only that required to perform work.
2. Restrict quantities of hazardous materials such as paints, solvents, chemicals, cleaners, and fuels entering radiological buffer areas and other areas surrounding radiological areas and implement measures to prevent inadvertent radioactive contamination of these materials.
3. Substitute recyclable or burnable items in place of disposable ones and reuse equipment, chemicals, solvents, and cleaners when practical.
4. Select consumable materials such as protective coverings and clothing that are compatible with waste-processing systems, volume reduction, and waste-form acceptance criteria.
5. Reserve an assortment of tools primarily for use in contamination, high contamination, or airborne radioactivity areas. Tools should be maintained in a designated storage or distribution area or a contaminated tool crib. Controls should be established for tool issuance and use.
6. Survey potentially contaminated material from radiological areas to separate uncontaminated from contaminated materials.

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7. Segregate known uncontaminated waste from potentially contaminated waste.
8. Segregate reusable items such as protective clothing, respirators, and tools at the step-off pad.
9. Minimize the number and size of radioactive material areas.
10. Emphasize training in waste reduction philosophies, techniques, and improved methods.

**Article 443, Mixed Waste**

Requirements specified in the Resource Conservation and Recovery Act ([42 USC 6901, 1976](#)) and Toxic Substances Control Act ([15 USC 2601, 1976](#)) apply to waste that contains both radioactive and hazardous materials.

1. Technical and administrative controls should be established to minimize the volume of mixed waste generated and the amount of radioactivity in such waste. Volume reduction methods include process optimization, materials substitution, and new technology development.
2. Materials suspected of being mixed waste should be identified and segregated as soon as practical in the generating process to avoid combining mixed waste with other waste forms.

**Part 5, Control of Radioactive Liquids and Airborne Radioactivity****Article 451, Minimization and Control of Radioactive Liquid Waste**

Criteria for minimizing the generation of radioactive liquid waste are provided in DOE O 435.1, DOE M 435.1-1, and the DOE G 435.1-1 series. Radioactive liquid waste discharge requirements are provided in DOE O 5400.5.

**Article 452, Control of Radioactive Drains**

Radioactive drain systems are designed to transport radioactive liquids. Improper use may cause an environmental release.

1. Radioactive drain systems should not discharge to the environment or be used to dispose of nonradioactive liquids. Drain systems that have been specifically approved by regulatory agencies, meet the intent of this requirement.
2. Existing radioactive drains should be evaluated to ensure the following:
  - a. Verification of the existing radioactive drain piping configuration.
  - b. Installation of flow-indicating devices in ~~leak-leak-off~~ lines.
  - c. Use of plugs to prevent nonradioactive input.
  - d. Consideration of alternative work controls before systems are drained for maintenance.
  - e. Controls prohibiting unauthorized use of drains.
3. Modifications to the design or operation of existing radioactive drain systems should be controlled to include:

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- a. Design considerations that prevent nonradioactive drain connections into radioactive drains.
- b. Procedural and design controls to prevent cross-connections of radioactive drains with nonradioactive systems.
- c. Management review of subsequent changes to the design of radioactive drain systems or radioactive drain controls.
- d. Management controls to restrict the introduction of hazardous waste into radioactive drain systems.

**Article 453, Control of Airborne Radioactivity**

1. The Radiological Control organization should be notified when engineering controls that prevent worker exposure to airborne radioactivity, such as barriers, gloveboxes, and glovebags, are compromised. An evaluation should be made of continuing operations with compromised engineering controls. The use of respiratory protection to continue activities under these conditions is not the preferred method of controlling worker exposures. Implementation of short-term engineering modifications that provide a commensurate level of worker protection is the preferred alternative.
2. Preventive maintenance and surveillance procedures should be established to ensure that equipment controls are maintained in an operable condition for containment of airborne radioactivity.

**Part 6, Support Activities****Article 461, Control and Monitoring of Personal Protective Equipment and Clothing**

1. Except for disposable, single-use items, protective clothing designated for radiological control use should be specifically identified by color, symbol, or appropriate labeling.
2. Protective clothing designated for radiological control use should not be used for nonradiological work.
3. Launderable items specifically designated for training purposes should be appropriately marked.
- 3.4. Personal protective equipment and clothing should not be stored with personal street clothing.
- 4.5. Cleaned personal protective equipment such as face shields and respirators that comes into contact with the wearer's face and company-issued clothing (other than protective clothing used for contamination control purposes) should be surveyed prior to use. Contamination levels should be below Table 2-2 contamination values prior to reuse. The use of statistically representative sampling is acceptable.
- 5.6. Laundered protective clothing should be surveyed and ~~should~~ will meet the following criteria prior to reuse:
  - a. ~~Emit~~ ~~b~~ Beta-gamma radioactivity less than 10,000 dpm/100 cm<sup>2</sup>.

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- b. ~~Emit a~~Alpha radioactivity less than 1,000 dpm/100 cm<sup>2</sup> for transuranics and other alpha emitters in the same Table 2-2 category, and less than 10,000 dpm/100 cm<sup>2</sup> for uranium.

~~6.7.~~ The Site contractor will work with the contracted laundry provider to continue efforts to reduce contamination levels on reusable personal protective equipment and clothing.

~~7.8.~~ Cleaned personal protective equipment and laundered protective clothing should be inspected prior to use. Clothing should be free of tears, separated seams, deterioration, and damage or repaired in a manner that provides the original level of protection.

**Article 462, Laundry**

Laundry service ~~is subcontracted~~ at the Site ~~is subcontracted, and includes~~†The following specifications ~~of various requirements apply~~:- Therefore, only the following items are addressed in the RCM:

1. Clothing and equipment should be laundered according to facility, color, type, and level of contamination.
2. Clothing and equipment should be screened before laundering to segregate those that are damaged, present special handling problems, or require disposal.

**Article 463, Decontamination**

1. All RWPs and technical work documents should include provisions to control contamination at the source to minimize the amount of decontamination required.
2. Work preplanning should include consideration of the handling, temporary storage, and decontamination of materials, tools, and equipment.
3. Decontamination activities should be controlled to prevent the spread of contamination.
4. Water and steam are the preferred decontamination agents. Other cleaning agents should be selected based on their effectiveness, hazardous properties, amount of waste generated, and ease of disposal.
5. Facility line management should be responsible for directing decontamination efforts.
6. Efforts should be made to reduce the level of contamination and the number and size of contaminated areas that cannot be eliminated.

**Article 464, Vacuum Cleaners and Portable Air-Handling Equipment**

Improper use of vacuum cleaners and portable air-handling equipment may result in the generation of airborne radioactivity, removable contamination, and high dose rates.

1. Vacuum cleaners and portable air-handling equipment used in areas established to control removable surface contamination or airborne radioactivity (except areas where only tritium is present) should be equipped with high-efficiency particulate air (HEPA) filters.
- ~~2.~~ All HEPA filters used in vacuum cleaners and portable air-handling equipment should meet the applicable efficiency and construction requirements for the devices in which

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they are installed. The maximum flow rate of the device should not exceed the flow rate at which the HEPA filter was efficiency tested.

3. In addition, the device should be tested prior to initial use, when units have undergone any type of service that may compromise the integrity of the HEPA filter or its sealing surfaces, and annually. The filter integrity test is an in-place test that consists of injecting a challenge aerosol upstream from the HEPA filter. A challenge aerosol is a synthetic hydrocarbon used for in-place HEPA-filter integrity testing because of its wide range of particulate sizes and preponderance of particulate 0.3 ~~µ~~micron in diameter, the smallest particulate a HEPA filter is designed to filter. ~~The DOE recommended challenge aerosol for in-place HEPA filter testing is poly-alpha-olefin (PAO) (Butler 2002).~~ Upstream and downstream challenge aerosol concentrations are measured. The ratio of downstream-to-upstream concentrations represents the HEPA filter leak rate. The maximum allowable HEPA filter leak rate is 0.03% unless a different value has been established by a technical basis.
4. Maintenance on the equipment should be conducted in accordance with the manufacturer's instructions.
- 2.5. Appropriate standards for system design, construction, maintenance, and testing are provided in ASME N509-2002, "Nuclear Power Plant Air-Cleaning Units and Components"; ASME N510-1989, "Testing of Nuclear Air Treatment Systems"; and ASME AG-1-1997, "Code on Nuclear Air and Gas Treatment." Several of the DOE 3020 series of technical standards (e.g., DOE-STD-3020-97, "Specification for HEPA Filters Used by DOE Contractors"; DOE-STD-3022-98, "DOE HEPA Filter Test Program"; DOE-STD-3025-99, "Quality Assurance Inspection and Testing of HEPA Filters"; and DOE-STD-3026-99, "Filters Test Facility Quality Program Plan") provide additional information applicable to HEPA-filtered systems.
- 3.6. Vacuum cleaners used for radiological work will be checked before use to verify that they are:
  - a. Marked and labeled in accordance with Article 412 and with the testing expiration date.
  - b. Controlled by written work authorizations for other than low-risk routine cleanup.
  - c. Controlled to prevent use in nonradiological applications.
  - d. Designed to ensure HEPA-filter integrity under the conditions specified for use.
  - e. Constructed and controlled to prevent unauthorized or accidental access to the inner surfaces of the vacuum.
- 4.7. Radiation and contamination surveys should be performed periodically for vacuum cleaners in use and labels on these units will be updated. The frequency of radiation surveys should depend on the specific use of the vacuum cleaner.
- 5.8. Airborne radioactivity levels should be monitored when a vacuum cleaner is used in a high contamination area.

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6.9. A ~~nuclear safety review~~criticality safety evaluation should be performed and documented prior to the use of a vacuum cleaner for fissile material.