

# Physics Division ESH Bulletin 03-4

## Radioactive Material Inventory Guideline

If a facility contains [radioactive materials](#), there are four issues which must be considered: 1) the radioactive material inventory, which defines whether the facility is a nuclear facility or not, 2) if the radioactive material includes any [nuclear materials](#), safeguards and security issues become involved, 3) if any of the nuclear materials are classed as [fissionable materials](#), criticality safety issues become involved, and 4) if the radioactive material inventory includes [sealed radioactive sources](#), radioactive source control issues are involved. In this document, radioactive materials include materials declared as excess or waste but still in a facility, but does not include waste material in a DOT Type B shipping container with Certificates of Compliance for the container and contents.

The first issue to be considered is whether there are any [radioactive materials](#) in a facility. If there are, the inventory of those materials by isotope shall be compared with inventory limits given in Attachment 1, Table A-1 of [DOE-STD-1027-92](#). This document lists radioactive isotope inventory threshold limits (below which the facility is not a nuclear facility), and threshold limits for Category 3 and Category 2 nuclear facilities. The limits are given both in grams and curies for many isotopes. Note that at the end of the list of isotopes, [tables](#) from LANL are available if your needed isotope is not in 1027-92. To determine the radiological material categorization of a facility, the facility inventory is divided by the Category 3 threshold for each isotope present in the facility, and the resulting ratios are summed. (Note that sealed radioactive sources that are engineered to pass the special form testing specified by the Department of Transportation (DOT) in 49 CFR 173.463 or testing specified by ANSI N43.6 "Sealed Radioactive Sources, Categorization," may be excluded from summation of a facility's radioactive inventory. The facility must have documentation that the source or prototypes of the source have been tested and passed the tests specified by DOT or ANSI). If the sum is less than 1.0, the facility is not a nuclear facility but rather is classed as a radiological facility. If the sum is greater than or equal to 1.0, the facility is a [nuclear facility](#), and the facility inventory must be divided by the Category 2 threshold for each isotope present in the facility and the resulting ratios

summed. If the sum is less than 1.0, the facility is a Category 3 nuclear facility. If the sum is greater than or equal to 1.0, the facility is a Category 2 nuclear facility. It is important to note that there are significant regulatory differences between requirements for radiological and nuclear facilities. Also note that there is an SBMS requirement to retain the analysis used to determine the Category of a facility.

Secondly, if it is determined that a facility contains radioactive isotopes and is thus a radiological or nuclear facility, the inventory of a class of isotopes known as [nuclear materials](#) becomes important because of safeguards and security issues. The list of nuclear materials is given at the end of this guideline. A subgroup of Nuclear Materials called Special Nuclear Materials (SNM) consists of  $^{233,235}\text{U}$  and  $^{238,239/241,242}\text{Pu}$ . SNM have additional safeguards and security requirements. If a facility contains nuclear materials, it will have a Material Balance Area (MBA) assigned, and there will be an assigned MBA Coordinator (and Alternate Coordinator) who is responsible for any transfers of nuclear materials to or from the MBA. A MBA can include several facilities and/or buildings. When isotopes classed as nuclear materials are transferred to or from a facility, paperwork forms and signature approvals are required prior to any transfer. In other words, nuclear materials cannot be moved in or out of facilities without special attention. This oversight work is performed by the [Nuclear Material Control and Accountability](#) (NMC&A) organization, and their staff work closely with the MBA Coordinators to ensure that the distribution of nuclear materials among MBAs at ORNL is accurately known at any given time. In addition, NMC&A staff work with the MBA Coordinator to perform formal inventories of MBAs on a regular basis. MBAs are assigned as Category I-IV (IV having the fewest regulatory requirements), depending on the inventory and “attractiveness level” of the nuclear materials contained in the facility. Physics Division has one MBA, which is classed as Category IV. This could change (go higher than IV), based on information contained in paperwork required when nuclear materials are transferred into the MBA. It is to our advantage to remain a Category IV MBA, and transfer of nuclear material to the MBA which may raise the Category level needs to be carefully considered by the MBA Coordinator during experiment reviews.

Third, if the MBA contains a subset of [nuclear materials](#) known as [fissionable materials](#), additional issues related to criticality must be considered. Fissionable materials are listed at the end of this guideline. For minimum criticality safety regulatory requirements, the nuclear material inventory in any particular facility

(building) must contain less than 250 grams of fissile-equivalent <sup>235</sup>U. To determine this number, individual isotopic inventories of the fissionable materials are multiplied by conversion factors to convert them to a fissile-equivalent amount of <sup>235</sup>U, and the converted amounts are summed. The sum must remain below 250 grams so a Nuclear Criticality Safety Approval form is not required. Further information related to this subject is available from the [Nuclear Criticality Safety](#) site. NMC&A accountability records may not provide the specific isotopic information required for criticality safety inventory purposes. For example, NMC&A records for plutonium provide the combined mass of Pu-239 and Pu-241, but do not provide individual isotope mass values for Pu-239, Pu-241, or other fissionable plutonium isotopes which may be present.

Finally, if any of the radioactive materials in an inventory are classified as [sealed radioactive sources](#), requirements for radioactive source inventory and usage must be followed. Radioactive Source Inventory is maintained by the Source Inventory Group, and facilities often have their own requirements for usage of radioactive sources. Contact the [Division Radiological Control Officer](#) for source usage information, or go to the SBMS www site and search for “source control.”

## **Nuclear Materials**

Americium-241	Plutonium-239/241
Americium-243	Plutonium 242
Berkelium-249	Thorium
Californium-252	Tritium
Curium-246	Uranium-233
Deuterium	Uranium enriched in 235
Lithium enriched in Li-6	Uranium (depleted)
Neptunium-237	Uranium (natural)
Plutonium-238	

## **Fissionable Materials**

Uranium-233	Americum-241
Uranium-235	Americum-242m
Neptunium-236	Americum-243
Neptunium-237	Curium-243
Plutonium-238	Curium-244
Plutonium-239	Curium-245
Plutonium-240	Curium-247
Plutonium-241	Californium-249

Plutonium-242

Californium-251

## **Nuclear Facility**

A facility in which activities or operations are carried out that involve radioactive and/or fissionable materials in such form and quantity that a nuclear hazard potentially exists to the employees or the general public.

Duane Larson

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