# Guidance for the Use of Exempt Quantities of Radioactive Materials in the Secondary School

**Health Physics Society Science Support Committee, August 2010**

## Introduction

Middle or high school teachers may wish to use radioactive sources as aids to teach students about radioactivity and radiation. The Health Physics Society provides sources and instruments for use in education programs. Unless a school has a specific radioactive materials license, schools can only possess radioactive materials that are exempt from Nuclear Regulatory Commission (NRC) and Agreement State regulations. The NRC and Agreement States regard "exempt quantities" safe for use by the general public. See Attachment A for the NRC definition of exempt quantity sources and health concerns.

## Exempt Quantity Radioactive Sources

Exempt quantities of radioactive sources fall into two categories: sealed sources and liquid sources. One source of radioactivity, an isogenerator, is a sealed source that produces a liquid source when a solution passes through it. For teaching purposes, sealed sources, isogenerators, natural radioactivity (potassium, radon, pitchblende, etc.), and consumer products (lantern mantles, Fiestaware, thoriated welding rods, etc.) may be used. All these sources produce minimal radiation dose and, when handled properly, do not pose a risk of contamination.

## General Handling Procedures

Although the radiation from exempt quantity sources is not hazardous, the basic principle of minimizing radiation dose should be followed:

- No eating, drinking, or applying cosmetics while handling the sources.
- Do not hold sources unless necessary.
- Only hold edges of disk. Avoid touching the unlabeled flat side of disk.
- Place sources away from living organisms with labeling facing up when not in use.
- Wash hands after handling sources.
- Sources must be accounted for. Take an inventory before and after each class period.
- Sources must be locked up at the end of each day.

When the sources are used by a class, stress to the class that these sources, although not hazardous, should be handled with respect. Students should not put any sources in their pockets or hold them in their hands when not necessary. See Attachment B for precautions, disposal concerns, and a summary of necessary actions.

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# Attachment A

## Nuclear Regulatory Commission Definition of Exempt Quantities (from the Introduction to Exempt Consumer Product Uses, NRC 10 CFR 30):

Consumer products containing byproduct material that are used by the general public are exempted from licensing requirements only if the Commission determines that the products or types of uses do not constitute an unreasonable risk to the common defense or security or to public health and safety and the environment. Radiation-safety features are built into the sealed source or device, or the amount of radioactive material that can initially be distributed in such a device is restricted. The Rules of General Applicability to Domestic Licensing of Byproduct Material (10 CFR Part 30) exempts members of the public from the requirements for an NRC license when they receive, possess, use, transfer, own, or acquire byproduct material in products such as silicon chips, electron tubes, check sources, gun sights, and smoke detectors. NRC applies its regulatory control on the transfer of these products, placing specific requirements on distributions, as defined in Subpart A, 10 CFR Part 32.

Generally, distribution of byproduct material to persons exempt from regulatory authority (the general public) can only be made by persons who have a specific license from the Commission authorizing the distribution of their products to persons exempt from the requirements for an NRC license. Manufacturers and distributors of these products must be licensed in order to initially transfer or distribute them to persons exempt from licensing. The licensed distributor is required to satisfy the Commission that all products are manufactured, tested, and distributed in accordance with the regulations and specifications provided in its license application. These specific licenses are issued by the Commission and are referred to as "exempt distribution" or "E" licenses.

## Normal Radiation Exposure

Radiation has the potential to affect the health of those exposed to it. Health effects only occur from very large doses of radiation. The radiation doses received from the use of exempt quantities of radioactive materials are extremely low compared to the doses that cause adverse health effects. It is safe for teachers and students to handle these sources. The dose from handling the sources is much less than the radiation we are exposed to from natural background radiation in one day.

# Attachment B

## Precautions for Exempt Quantity Sealed Sources

Gamma: These sources are quite rugged, so gamma sources can be handled with minimum regard to safety.

Beta: These sources require a bit more care than gamma sources. They should be picked up by the sides; i.e., do not put a finger on the top of the source. Although the cover should be sturdy enough to protect the source from handling damage, very sharp fingernails could penetrate the cover. To minimize dose, a beta source can be placed upside down on the table when not in use.

Alpha: Because alpha radiation is absorbed by a thin layer of material (a piece of paper or a dead layer of skin stops alpha radiation), these sources have the radioactive material electroplated to a metal surface. Although electroplat-

ing assures that the radioactive material is firmly attached to the metal surface, it is possible that a small fraction of the material may rub off. Therefore, never touch the top of the source; handle it by the sides only. To minimize dose, an alpha source can be placed upside down on the table when not in use; however, even if right side up the alpha radiation will not reach any living tissue.

## Special Precautions for Isogenerators

Isogenerators typically contain cesium-137, which is radioactive and decays to barium-137, which is also radioactive. Barium-137 has a half-life of 2.5 minutes, emitting gamma radiation, and then becomes stable. When an eluting solution flows through the cesium, barium attaches to the eluting solution and the liquid leaving the solution then contains some radioactive barium. Because of the short half-life, the barium activity decreases to less than one percent of its original activity in a little more than 15 minutes.

When using an isogenerator:

- Be certain that the eluting solution enters the proper side of the isogenerator so that cesium-137 is not eluted in addition to barium-137.
- Do not let anyone ingest any of the liquid.
- Wipe up spills with a paper towel and dispose of it in the trash.
- If any liquid solution splashes onto clothes, use a damp cloth to wipe off as much as possible. The remaining radioactivity in the solution will decay rapidly, thus producing minimal radiation exposure.
- Wipe sample holders with a paper towel after use and dispose of towels in the trash.
- Wash hands after handling.

## Disposal

Radioactive material decays away with a characteristic half-life. Therefore, some sources lose enough of their radioactivity that they become useless for teaching demonstrations. If you have borrowed sources from somebody, the owner will handle the disposal when the source becomes invaluable for any purpose. If you own an exempt quantity source that has become useless, you may dispose of it in the regular trash. You must remove labels and other identifying marks prior to disposal to avoid any confusion if found by someone else.

## Summary of Necessary Actions for Exempt Sources

- Obtain concurrence for use of radioactive sources from supervision.
- Provide a copy of “General Handling Procedures” to students.
- Handle all sources with care:
    - Pick up sources by the sides.
    - Do not touch the top of alpha and beta sources.
    - Place sources “label side up” when not in use.
- Lock up all sources when not in use.
- Take an inventory:
    - After every class.
    - At the end of each semester.