Australian Government
Australian Radiation Protection and Nuclear Safety Agency

**Fact Sheet 6**

# Radioactivity in Domestic Smoke Alarms

## The small amount of radioactive material in some smoke alarms is not a health hazard.

### Introduction

The radiation dose to the occupants of a house from a domestic smoke alarm is minute compared to natural background radiation.

Individual (or small numbers of) smoke alarms can be safely disposed of in domestic rubbish.

The ability of domestic smoke alarms to save life and property has been shown in many house fires.

There are two types of smoke alarm commonly available.

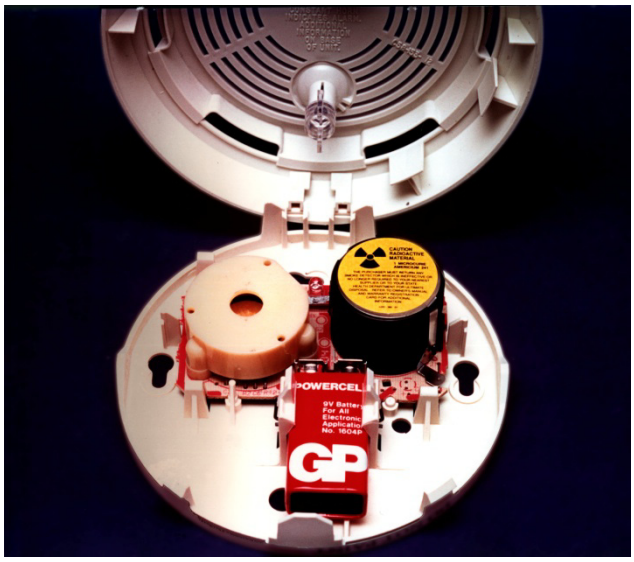
- One type uses the radiation from a small amount of radioactive material to detect smoke or heat sources. These are the most popular type, because they are inexpensive and sensitive to a wider range of fire conditions.
- The other type does not contain radioactive material – it uses a photoelectric sensor to detect the change in light level caused by smoke.

Due to the small amount of material used and the secure means of its encapsulation, these smoke alarms are completely safe under all normal conditions it may encounter, including during a fire. Read on for more information.

### How smoke alarms work

Smoke alarms that use radioactive material incorporated in an ionisation chamber are called "ion chamber smoke alarms". The radioactive material used, Americium-241, emits alpha particles and low energy gamma rays. The alpha particles are absorbed inside the alarm but most of the gamma rays escape. The radiation health consequences of this are discussed later.

The alpha particles collide with the air in the ionisation chamber to produce charged particles called ions. A low-level electric voltage is applied to the chamber to collect these ions, causing a steady electric current to flow. Smoke or hot air entering the chamber changes the rate of ionisation and the electric current level, triggering an alarm.




### Alarm standards

The Australian Standard AS3786-1993 *Smoke Alarms* requires domestic smoke alarms to be labelled with:

- The words "WARNING - RADIOACTIVE MATERIAL" or equivalent;
- The radiation warning (trefoil) symbol (right); and
- The identity and amount of radioactive material in the source.

AS3786 also sets down various requirements for the radiation source itself including the type and activity of the source that can be used. The CSIRO's ActivFire Scheme (see **www.activfire.gov.au/default.asp**) tests the ability of smoke alarms to detect smoke, in accordance with AS3786.


619 Lower Plenty Road, Yallambie VIC 3085
Telephone: +61 3 9433 2211
Fax: + 61 3 9432 1835

## Radiation Safety

Radiation from natural sources is always present in the environment. It comes from cosmic radiation and radioactive materials in the ground, building materials, food, water, the atmosphere and even our own bodies. We are continuously and unavoidably exposed to this background radiation.

Besides the radioactive materials that occur naturally in our environment, there are man-made radioactive materials. Americium-241 is one such material. In a smoke alarm, the radiation source comprises americium-241 dioxide in a gold matrix covered by a silver foil. The foil is thin enough to allow the alpha particles to escape into the ionisation chamber. The alpha particles travel only a few centimetres in air before they are absorbed and hence will not escape from the smoke alarm. They do not have sufficient energy even to penetrate the dead layer of human skin, which is approximately 70 micrometres thick.

The gamma ray dose rate from a domestic smoke alarm at a distance of one metre is less than one thousandth of that from background radiation, which in Australia is on average 1.5 millisievert per year. At greater distances, the dose rate is much lower.

The dose rate to the hands when holding a smoke alarm would be higher but would still be less than one tenth that from background radiation. As the hands are very much less sensitive to radiation than internal organs and the time of exposure is likely to be less than a few hours per year, no significant radiation exposure would occur.

The radioactive source in a smoke alarm is extremely insoluble and, if swallowed, would not be absorbed into the body but would pass through the digestive system.

In a house fire, temperatures are unlikely to exceed 1200°C. While such a fire temperature might be sufficient to melt the source it would not be enough to vaporise it and create an inhalation hazard. So, there would be no inhalation hazard during the fire or afterwards.

## Safe Disposal

In its November 2001 statement, the Radiation Health Committee recommended that the preferred method of disposal for small numbers of smoke alarms is to include them in the domestic rubbish (see www.arpansa.gov.au/pubs/rhc/sd_rhc_01.pdf). The Committee considered this action acceptable because:

- the amount of radioactive material in each smoke alarm is extremely small and, from environmental and public health perspectives, the disposal of individual smoke alarms with domestic rubbish does not represent any hazard
- the radioactive material is securely bound in a metal foil within the smoke alarm
- the amount of naturally-occurring alpha-emitting radioactivity in normal soils is equivalent to a dozen or more smoke alarms in every cubic metre. The dispersal of smoke alarms, even in large numbers, through refuse land-fill sites is therefore not significant in comparison.

When more than ten smoke alarms (or more particularly, the americium-241 sources) are collected together for bulk disposal however, they must be treated as radioactive waste, and the requirements of the National Health and Medical Research Council's *Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia (1992)* (RHS35) must be met. Contact your state or territory radiation control authority for advice. RHS 35 and contact details for radiation control authorities are available on ARPANSA's website at www.arpansa.gov.au