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DOMESTIC SMOKE DETECTORS USING RADIOACTIVE MATERIAL

Increasing numbers of technical and consumer products incorporating radioactive material are becoming available to the Australian public. One consumer device of this type coming into common use is the domestic smoke detector that uses a radioactive material in detecting smoke. This device has obvious life-saving and property-saving advantages and is attractive in that it is self-contained, battery-powered and needs little maintenance.

The National Health and Medical Research Council in October 1978 recommended conditions for the licensing of suppliers of smoke detectors using radioactive material. These conditions, which are listed on page 3 of this Information Bulletin, are intended to ensure that radiation safety is preserved. They provide for the testing and approval of all models of domestic smoke detectors using radioactive material. The National Health and Medical Research Council stated that provided these conditions are applied it had no objection to the sale of these detectors by retailers.

TYPES OF DOMESTIC SMOKE DETECTOR

For many years various kinds of smoke detectors have been used as fire-warning devices in large buildings such as factories, office blocks and airports. Smoke detectors using radioactive material incorporate an "ion chamber" and are called "ion chamber smoke detectors". The radioactive material in the ion chamber of the smoke detector produces many electric ions in the air in the chamber. A low electric voltage, continuously applied to the chamber, causes a steady electric current through it. Smoke entering the chamber alters the electric current and operates the alarm.

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RADIOACTIVITY AND SAFETY

Radiation from natural causes is always present in the environment. It arises from cosmic radiation from outer space and from naturally-occurring radioactive materials. Many other radioactive materials can be made by man. One such material is americium-241, which is used in domestic ion chamber smoke detectors. Americium-241 emits short range alpha particles (which are used for detecting smoke in an ion chamber smoke detector) and also emit gamma rays of low intensity that mostly pass out of the smoke detector and are lost in the surrounding space.

Americium-241 has a long life and the americium-241 used in an ion chamber smoke detector will be little different in amount after the device has reached the end of its useful life. Conditions for the safe disposal of the radioactive material in these smoke detectors have therefore been included in the recommendation of the National Health and Medical Research Council.

A radioactive substance is more likely to cause harm if it enters the body than if it remains outside. It is even more likely to cause harm if the radioactivity is not sealed in a tight enclosure; part of the radioactivity may then become fixed, temporarily or permanently, in particular parts of the body and over a long period the radiation emitted may lead to radiation injury. It is therefore necessary to ensure that the amounts of radioactivity swallowed or inhaled in addition to natural radioactivity are kept as low as possible.

The amounts of americium-241 needed to operate domestic ion chamber smoke detectors are so small that only long term radiation effects need be considered when setting out conditions for radiation safety. (These effects would be to induce some forms of cancer). However, provided that the radioactive material is sealed and remains attached to the ion chamber smoke detector, there is no possibility of anyone swallowing or inhaling any of the americium. The only remaining radiation hazard to users of ion chamber smoke detectors is that due to the gamma rays from the americium-241. This radiation is of low intensity and the intensity decreases with increasing distance from the source. As ion chamber smoke detectors are installed well above floor level they are at an adequate distance from the users to ensure radiation safety from this source.

BENEFITS AND RISKS

The organization for Economic Co-operation and Development (OECD)⁽¹⁾ has considered the benefits and radiation risks of ion chamber smoke detectors. This study led to the conclusion that the benefits obtained from the use of domestic ion chamber smoke detectors considerably outweigh the risks due to all radiation exposure that may result from their use, misuse and disposal.

CONDITIONS FOR TESTING DOMESTIC ION CHAMBER SMOKE DETECTORS

The best way to ensure that ion chamber smoke detectors are well built and retain their radioactive material is to test samples of detectors by prescribed destructive testing. A well based test program has been laid down by the National Radiation Protection Board in the United Kingdom⁽²⁾. This program includes heating, cooling, overpressure, impact, drop, puncture, vibration, corrosion, humidity and fire tests. The recommendation of the National Health and Medical Research Council requires a supplier of ion chamber smoke detectors to show that the devices he proposes to sell conform to these testing requirements or to other similar approved requirements.

NATIONAL HEALTH AND MEDICAL RESEARCH COUNCIL RECOMMENDED CONDITIONS FOR LICENSING SUPPLIERS

The National Health and Medical Research Council has adopted⁽³⁾ the following

RECOMMENDATION

Council considered a proposal to market single station (domestic) ionization chamber smoke detectors through retail outlets.

It had no objection to the proposal provided each supplier was licensed and that when applying for a licence, the supplier demonstrated that each device conformed to the requirements of a recognized testing authority such as the National Radiological Protection Board (UK), the Underwriters Laboratory, Inc. (USA) or other organizations recognized by the Statutory Authority in the States or Territories.

Council recommended that the States and Territories adopt the following conditions for the licensing of suppliers of ionization chamber smoke detectors (ICSD):

- the radionuclide used should be americium-241;
- the nominal activity of americium-241 in each ICSD shall not exceed one microcurie;
- if a radionuclide other than americium-241 be used the quantity used shall be such that the risk due to radiation exposure will not be greater than that from the use of one microcurie of americium-241;
- the radioactive material used in the ICSD shall be a sealed source;
- the location of the sealed source shall be clearly indicated;
- the package in which the ICSD is to be sold to the public shall be clearly labelled on the outside with the following statement:

"This device contains a small quantity of radioactive material";

- when the cover of the ICSD is removed the following information shall be clearly visible on a permanently affixed label:
 - (a) the statement "Caution — radioactive material";
 - (b) the standard radiation warning (trefoil) symbol;
 - (c) the type and activity of the radionuclide present; and
 - (d) a statement that when the device is no longer wanted it shall be disposed of by returning it to the supplier or the State Department of Health;
- the licensee shall maintain an inventory of the numbers and types of ICSD received and of the numbers held on the premises;
- with each ICSD the licensee shall provide written instructions for the installation and maintenance of the device. These shall include directions for changing the batteries, cleaning the device, its disposal when no longer wanted and a warning against tampering with the sealed source; and
- the licensee shall not offer for sale any ICSD not approved for sale by the relevant Statutory Authority.'

SUMMARY

1. Domestic ion chamber smoke detectors give a life-saving and property-saving benefit that has been demonstrated to outweigh their possible radiation risks.
2. Conditions for controlling the sale of domestic ion chamber smoke detectors have been recommended by the National Health and Medical Research Council for uniform application throughout Australia.
3. A high standard of design and integrity of domestic ion chamber smoke detectors has been encouraged by the recommendation of the National Health and Medical Research Council that acceptance be based on ability to pass strict tests.
4. Conditions recommended by the National Health and Medical Research Council provide for the safe disposal of domestic ion chamber smoke detectors that are no longer required by users.

It is concluded that domestic ion chamber smoke detectors are an acceptable consumer product in Australia provided that the conditions of sale, disposal and testing recommended by the National Health and Medical Research Council are met.

REFERENCES

- (1) Recommendations for ionization chamber smoke detectors in implementation of radiation protection standards. Organization for Economic Co-operation and Development, Paris, 1977.
- (2) Radiological protection tests for products which can lead to exposure of the public to ionizing radiation. Hill, Marion D., Wrixon A.D. and Wilkins W.T. Technical Report R42. National Radiological Protection Board, United Kingdom, 1976.
- (3) National Health and Medical Research Council of Australia. Report of 86th Session, October, 1978. (In Press.)

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