KEEPING SEALED RADIOACTIVE SOURCES SAFE AND SECURE

The hot cell and all the equipment needed to erect, use and dismantle it, fits into two shipping containers.
(Photo: P. Pavlicek/IAEA)

A Mobile Hot Cell in Action

Radioactive sources are used in a wide variety of devices in medical, industrial, agricultural and research facilities worldwide. These sources, such as cobalt-60 and caesium-137, emit high levels of ionizing radiation, which can treat cancer, measure materials used in industry and sterilize food and medical appliances.

Problems may arise when these sources are no longer needed, or if they are damaged or decayed. If these sources are not properly stored they can be a threat to human health and the environment and pose a security risk.

Procedures to secure these spent or 'disused' sources are often highly expensive and need specialized assistance. The IAEA helps its States find long term solutions for the safe and secure storage of disused sealed radioactive sources (DSRSs).

Vilmos Friedrich is a radioactive waste expert in the IAEA's Department of Nuclear Energy. Louise Potterton spoke to him during a source conditioning mission at the Philippine Nuclear Research Institute in Manila.

What is a sealed radioactive source?

It's a small capsule which contains a very high concentration of radioactive material. The encapsulation ensures that the radioactive material is not dispersed into the environment under normal operating conditions. These high activity sources, which are usually a few centimetres in dimension, are put in various, large devices depending on the purpose for which they will be used. These devices provide the shielding that protects the operators, but allows the radiation beam to leave the device and enter the targeted area or object.

When does a sealed radioactive source become 'disused' or spent?

There are various reasons. The most common is that the radioactive material is decaying, its activity is decreasing and it's no longer usable for the original purpose. Or there could be a newer technology that replaces the use of the device containing the source, for example an X-ray machine that has no radioactive material inside. Another reason could be that some natural disaster or impact has damaged the device. There are also cases in which a company, following bankruptcy, can no longer take care of the machines it owned that contain radioactive sources.

The team successfully extracts the source from the medical device.
(Photo: P. Pavlicek/IAEA)

Why did the IAEA develop the hot cell?

The IAEA wished to assist countries by constructing a mobile facility, which could be used on-site to make disused sources safe and secure. The conceptual design was developed at the IAEA. Necsa — the South African Nuclear Energy Corporation — was contracted to undertake the detailed design and construction.

The IAEA has a special arrangement with Necsa that allows it to use the hot cell up to three times a year. Funds from the IAEA's Nuclear Security Fund were made available to develop and manufacture the mobile unit and it was ready in 2007. Since then the mobile hot cell has been used in Sudan, United Republic of Tanzania and Uruguay and two more mobile hot cells are now also in operation.

How does the hot cell process work?

Once the sources have been removed they are placed into protective capsules within the hot cell.
(Photo: L. Potterton/IAEA)

All the parts needed to erect and operate it are loaded into two containers. These are shipped from South Africa to the part of the world where the hot cell is needed. The individual devices are lifted by crane into the hot cell. Once inside, the radioactive sources are removed from these units using remote manipulators that the operators control outside of the cell. The sources cannot be removed outside of the hot cell because the high radioactivity would cause severe health damage to the operators. Once the source has been removed it's put into a protective capsule, which is welded.

Eventually these capsules are consolidated into a long term storage container that provides shielding and can accommodate many sources. These containers are then placed into an additional metal container, secured further with a metal cage, locked and then placed in a long term storage facility.

How does the protective shielding of the hot cell work?

The walls of the hot cell must provide adequate shielding to protect the operators from the ionizing radiation emitted by the bare high activity sources after they have been removed from the shielded devices. High density materials such as lead or heavy concrete are typically used for shielding purposes in stationary facilities. However, for a mobile unit it's not feasible to transport tens of tonnes of lead or concrete blocks.

The mobile hot cell walls therefore have a sandwich structure. Outside and inside there are relatively thin steel plates, which can easily be transported to the site. The gap of 1.5 m between the plates is filled with sand that is available in any country. It's this thick sand layer that provides adequate shielding.

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