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Experience of disused source management in Latin America – 8443

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ABSTRACT

The Centro de Desenvolvimento da Tecnologia Nuclear (Center for the Development of Nuclear Technology) – CDTN – has been actively engaged in cooperation programs for disused source management throughout the Latin American and the Caribbean region since 1996. The CDTN source conditioning team participated in the preparation of the technical procedures established for the different tasks involved in the radium sources conditioning operations, like preparation of the packaging for conditioning; sources conditioning; capsule welding; leak test in radium-containing capsule; and radiation protection planning for the conditioning of disused radium sources. The team also carried out twelve radium sources conditioning operation in the region, besides in-house operations, which resulted in a total conditioned activity of approximately 525 GBq, or 14,200 mg of radium. Additionally, one operation was carried out in Nicaragua to safely condition three Cobalt teletherapy heads stored under very precarious conditions in the premises of an old hospital. More recently, the team started its participation in an IAEA- and US State Department-sponsored program for the repatriation of disused or excess transuranic sources presently stored at users´ premises or under regulatory control in different countries in the region. In September 2007 the team attended a theoretical and practical training in transuranic sources management, including the participation in the conditioning of different neutron sources in certified packages. It is expected that the trained team will carry out similar operations in other Latin American countries. Finally, the team is expected be involved in the near future in the repatriation of US-origin teletherapy heads and industrial gauges.

INTRODUCTION

Disused sealed radioactive sources have been considered, especially since the last decade, one of the most urgent waste management issues to be tackled internationally. Several national governments and international organizations have been devoting considerable efforts in devising effective initiatives to minimize the safety and security hazards associated to this class of waste.

Brazil has been actively participating in this effort. Since 1996, the Brazilian nuclear research center CDTN has been carrying out source conditioning operations in Latin American and the Caribbean region in the scope of programs promoted by the International Atomic Energy Agency and the US Department of Energy. As a result of this cooperation, twelve operations have been carried out in the region to condition excess radium sources, one to condition old teletherapy cobalt heads and one to condition and repatriate transuranic sources. In another initiative unrelated to direct source conditioning, a course on the safety and security in radioactive sources handling was jointly organized by the CDTN, the IAEA and the US Department of Energy for the Brazilian first responders, nuclear regulators and implementers, customs and for the organization responsible for the air cargo control.

The next actions to be taken in the region are the safe conditioning in the respective countries or the repatriation to the supplying countries of the Class 1 and Class 2 sources stored in the region, notably the teletherapy heads and industrial irradiators.

DISUSED RADIUM SOURCES CONDITIONING

Old radium sources represent a particular safety problem because of the production of radon gas due to the radioactive decay of Ra^{226}. The resulting pressure increase in the interior of the sources often resulted in the appearance of cracks in the source cladding and in radioactive material leakage.

This problem was fully recognized in the decade of 1990, when a worldwide program to safely condition these sources was launched by the IAEA. Planned to be carried out on a regional basis, expert teams were selected to give hands-on assistance to countries in their own continents. The CDTN team operated from 1996 to 2005 in Latin American and the Caribbean region, having completed so far twelve missions abroad, which, added to the in-house operations, resulted in the conditioning of the radium activity of 525 GBq. The visited countries were Uruguay, Nicaragua, Guatemala, Ecuador, Paraguay, Costa Rica, Jamaica, Venezuela, Dominican Republic, Colombia, Barbados and El Salvador. Besides, CDTN sent the necessary shields and containment capsules to Chile, Peru and Cuba, whose local teams, under the supervision of IAEA officers, carried out the sources conditioning.

As a result of the operations conducted by the CDTN team, 26 packages suitable for transport and for long-term storage were produced. These packages are now under the control of the respective national authorities.

The operations were carried out according to an established Quality Assurance Program. Accordingly, the main steps of the operations are conducted following written procedures and the package components and materials are chosen or manufactured in order to guarantee an acceptable level of safety and security during the whole interim storage phase. The procedures relate to the following aspects:

- preparation of the packaging for conditioning;
- sources conditioning;

- capsule welding;
- leak test in radium-containing capsule and
- radiation protection planning for the conditioning of disused radium sources.

As a collaborative enterprise between the host country, the IAEA and the conditioning team, each side held its responsibilities.

The tasks under the host country's responsibility were:

- to gather the most accurate information about the inventory to be conditioned;
- to collect all sources and store them in the conditioning site;
- to prepare the site for the operation, which includes the removal of all equipment, consumables or trash possibly stored at the place, improving the electrical wiring and water supply system and setting up the items sent by the IAEA (items described below);
- to provide the necessary local personnel for radiation protection services and supporting tasks during the operation;
- to supply the locally available equipment and consumables (calibrated radiation monitors, cement vibrator, metallic drums, argon cylinder for TIG welding, chemicals for decontamination, raw material for concrete preparation – cement, sand and gravel) and
- to provide an adequate intermediate storage place for the long term storage of the packages generated.

The IAEA was expected:

- to identify candidate countries and get permission of the local authorities for the operation;
- to fund the operation, including the expert team's travel expenses and the needed equipment and consumables (e.g. HEPA filtration system, lead barriers and package components);
- to send an expert to follow the operations in situ.

The expert team should:

- carry out a pre-mission to a) select the operation site and instruct the counterpart on the necessary site improvements; b) to gather as much information as possible about the country's radioactive sources inventory; c) to examine the prevailing sources storage conditions, identifying any improvements required from the safety and security points of view; d) to check the local available support infra-structure and e) prepare, discuss, and agree on a detailed work plan for the sources conditioning operation;

- manufacture or subcontract the manufacturing and ship to the host country the required number of conditioning packages. The main package components are: stainless steel capsules, lead shielding device; 200L metallic drum with internal concrete shield; locking bars and hooks;

- carry out the sources conditioning operation according to the established QA Program;

- record the whole operation in a final report.

Figure 1 shows a loaded shielding device and Figure 2 the device being inserted into the external drum cavity.

Figure 1. A loaded shielding device (the sources are inside the protruding capsules).

Figure 2. A locked and labeled lead shield being inserted into the shielded 200L drum.

TELETHERAPY HEADS CONDITIONING

In order to solve the problem of three old cobalt teletherapy heads stored under unacceptable conditions in Nicaragua, the Government of this country first requested the aid of the Pan-American Health Organization – PAHO. This organization, in turn, requested in 1993 technical assistance from the Mexican Institute ININ, which recommended the immobilization of the heads in cement matrix inside a vault to be constructed in an appropriate site.

This proposition was never implemented and a few years later the nuclear authorities of Nicaragua requested assistance from the IAEA regarding the same problem. The Agency then contracted the expert team of CDTN to travel to the country and condition the heads.

The approach chosen this time was to lodge the heads in portable units, rather than immobilizing them in a fixed structure, so that at any moment in the future the sources could be retrieved and treated or disposed of accordingly. The operation was carried out in the premises of the former El Retiro Hospital in Managua, from 20 May to 02 June 1999.

The available information about the heads is presented in Table 1 below.

Table 1. Cobalt teletherapy heads conditioned in Nicaragua

Head Nr.	Manufacturer	Activity		Remarks
		Ci	Date	
1	Neutron Products Inc.	4,140	Feb. 1984	Donated by Organization of the American States
2	Westinghouse	180	1984	Installed in 1963, use discontinued in 1993
3	N/A	20	1994	Buried 2m deep for long period

Each head was conditioned individually in one container (Figure 3). The containers consist of internal and external stainless steel cylinders, the void space filled with concrete. The external cylinder is provided with four lifting eyebolts and two reinforcement rings. To avoid unintentional or unauthorized removal of the cobalt head, the internal cavity is locked after loading by two steel bars cross-welded upon the cavity. The container's lid and body are fixed together by welding.

Figure 3. The cobalt heads were stored in individual packages.

TRANSURANIC SOURCES REPATRIATION PROGRAM

The security of spent high activity sealed sources and high toxicity sources has been the subject of increasing concern by the nuclear community.

In line with this reality, the Brazilian Nuclear Energy Commission and the IAEA have been conducting since June 2007 a cooperation agreement aiming at the repatriation of the disused transuranic sources presently stored in Brazil and other Latin American countries. Due to the previous experience gathered in the conditioning of disused radium sources, CDTN has been chosen to be the implementer of this program.

In the first phase of the program, the Brazilian source inventory was conditioned for repatriation to the United States. The sources and source-containing gauges had being kept in intermediate storage buildings at CDTN, in Belo Horizonte, and IPEN, another Brazilian nuclear institute in São Paulo. The national inventory consisted of 85 Am241-Be moisture gauges, 14 Am241Be-Cs137 moisture/density gauges, six Ra226-Be moisture/density gauges, three Pu239-Be and six Cf252 sources, one Pu238 pacemaker and three other Pu238 sources. Figure 4 illustrates the moment that a source-laden Plexiglas holder is loaded into an appropriate package. The used packages are certified for the transportation of Type A Fissile material.

Figure 4. Transuranic sources conditioned in a certified package.

As a result of this operation, 17 packages were generated, as detailed in Table 2. The packages were conditioned in an ISO container and shipped to the United States.

Table 2. Packages generated during the transuranic sources conditioning

Radionuclide	Number of packages	Total Activity (GBq)
Am241-Be	10	5,368
Pu239-Be	01	185
Pu238	01	95
Ra226-Be	01	6.5
Cf-252	01	5.4
Am241-Be-Cs137	03	33,674 (Am241) / 6,290 (Cs137)

PLANNED ACTIVITIES

The transuranic sources repatriation program will continue from now on with the involvement of other Latin American countries. Venezuela, Colombia, Uruguay and Argentina have already been contacted and are either immediately interested in participating or evaluating the proper timing for joining the program.

CNEN and the US National Nuclear Security Agency are also considering starting cooperation for the repatriation of American-origin teletherapy heads and industrial gauges containing Categories 1 and 2 sources.