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MANAGEMENT OF DISUSED SEALED RADIOACTIVE SOURCES (DSRS) COLLECTED FROM PUNJAB, NWFP AND CAPITAL TERRITORY OF PAKISTAN

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Disused Sealed Radiation Sources (DSRSs) pose radiological threat and concern globally to both public and the environment. The sources may get mislaid or lost if not properly managed due to their small physical size and therefore, need to be managed with an adequate nuclear waste management infrastructure and legal framework. Management of such moieties from upper half of the country has been entrusted to Radioactive Waste Management Group of Health Physics Division at Pakistan Institute of Nuclear Science and Technology, Islamabad. Various types of DSRSs having a total activity of 91360 GBq have been collected from various end users such as nuclear medical centres and industries in the eastern and north-western parts of Pakistan. A conditioning procedure has been optimized and a few sources have been conditioned which are being studied. The procedure has yet to be approved from the regulatory authority. The results are promising. Satisfactory management parameters, reduced radiation risks and improved security of the sources have shown the viability of the procedure. The possibility of using DSRS as a radiological dispersal device, risk of improper handling, or loss of control, etc. has been reduced considerably and control over the spent SRS is facilitated. This paper briefly describes management parameters like legal infrastructure and control, collection, conditioning and on-site interim storage, radiation safety and contamination control, quality assurance, documentation and inventory of DSRS in the country.

Keywords : Sealed radioactive / radiation sources (SRS), Disused sealed radioactive / radiation sources (DSRS), Waste management, Interim storage, Radiation safety, SRS inventory

1. Introduction

A sealed radioactive/radiation source (SRS) is one whose structure is such as to prevent, under normal conditions of use, any dispersion of the radioactive substances into the environment. The use of sealed radioactive sources in industry, medicine, agriculture and research has become a common place worldover. According to IAEA, their number runs into millions. Nearly 500,000 SRSs have been supplied in the past 50 years to the operators in only 15 member states of European Union (EU). Of these, about 110,000 are currently in use [1,2]. However, the registered number is much smaller [3]. These sources when outlived their useful life and are no longer utilized for their intended purpose become spent or disused (DSRS) but they still may contain substantial amount of residual activity (of the order of mega- or gega-Becquerel) which merit their proper management under proper regulatory infrastructure. Improper control and storage of sources have caused many accidents around the world. Some of these accidents resulted in human deaths and/or contamination of large areas e.g. Brazil, Turkey and Thailand [3-6]. The sources at greater risk of being lost from regulatory control are those held in local storage at the user's premises, in particular, hospitals and universities may keep disused sources in storage to avoid the cost of consigning the source to an approved collection and storage facility for safe management. About 300,000 are estimated such sources throughout EU only [3]. Management of SRS presents a major problem owing to their small physical size and high specific activity in most developing countries and accidents involving sealed sources and loss of control on sources occur worldwide. Few unfortunate incidents have fortunately given impetus to the proper management of this special type of radioactive waste material. The problem of SRS arises in two different scenarios but with the same nature. In developed countries, from the larger number of such sources in use, whose small

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percentage can amount to a large number if lost, and in the developing countries, by the lack of expertise and of regulatory control either in practice or at times when sources were acquired. The IAEA along with the member states have taken steps to lower the risks associated with the growing number of disused radioactive sources and to hamper the likelihood of occurrence of such incidents/accidents. For the developing countries, the steps aim at collection, update information; formulations and distribution of management tools like transfer of technology and know-how etc. IAEA's program for the management of DSRSs addresses the areas like: a) Legal and regulatory framework, b) Technology, management and safety assessment practices and, c) international cooperation [3,7] and proposes a scheme for SRS management (Figure 1). This paper presents some of the management parameters of partial DSRS inventory (Table 1) of the country.

2. Management of DSRSs in Pakistan

2.1. National policy

A). Management of SRS

Sealed radiation sources containing long-lived isotopes (half life > one year with initial activity of 100 GBq or more) shall be purchased henceforth by the users with the undertaking from the manufacturer/supplier to accept the return of these sources when no longer useful for the intended purpose (i.e. spent sources). This condition shall be included as binding on the supplier in the purchase contract. The user is also required to provide copy of the shipping and other legal documents to regulatory authority when applying for import/export of the SRS.

B) Management of spent/disused sealed radiation sources

Spent sealed sources maintained in the inventory of the user(s) for disposal and those not covered in 'A' above "shall be transported by the users, to a national disposal facility under intimation to PNRA, to"

i. KANUPP for the users belonging to Sindh and Balochistan provinces,
ii. PINSTECH for the users belonging to Punjab province, NWFP and capital territory.

2.2. DSRS management activities

Like other developing countries, SRSs have been in use in Pakistan in industry, health and agriculture in the government as well as private sector. Many of the early sources particularly Radium sources were acquired in the country around 1958. Some of them were commissioned in then East Pakistan. Another portion of the remaining radium sources was recently conditioned and managed with the help of IAEA at Karachi Nuclear Power Plant (KANUPP) site while some of the sources are still in operation or in the custody of the end users. All the sources are registered and their inventory has been kept with PNRA, the Pakistan Nuclear Regulatory Authority. It is planned that a centralized waste processing facility will be developed for processing/ conditioning of the DSRSs of high activity and high radiological concern lying with the end users. As no international consensus exists on a palatable disposal regime for DSRSs, the 'best available technology' recommended for developing countries, rests on cementation of the sources; which is cost effective and can deliver acceptable results if properly amalgamated.

As per national policy the country is divided into two zones, the south eastern areas of Sindh and the south western Baluchistan province comprise the lower zone and the north western Punjab, north western frontier province (NWFP) and territories under Capital administration in the upper zone. The radioactive waste management group (RWMG) of Health Physics Division (HPD) at Pakistan Institute of Nuclear Science and Technology (PINSTECH) Islamabad is responsible for the upper zone whereas a similar group at KANUPP has been established to deal with the sources collected from the lower zone. Because these radiation sources have implied risk of being used as radiological dispersal devices (RDD), it is important to have a proper infrastructure for their safe management in the country. Appropriate means should be developed to know lucidly the location of the sources at all times and to avoid its loss, theft or misuse. Besides, administrative instruments be there to avoid abandonment of the sources or any laxity in their management.

Due to a particular type of waste it needs special attention for its disposal as well as pre-disposal management. However some issues specific to SRSs are also ratified e.g. all parties involved in the management of SRSs are required to be clearly identified and their responsibilities delineated, identification of existing and anticipated spent SRS; establishing a safety regime inclusive of radiological and environmental protection

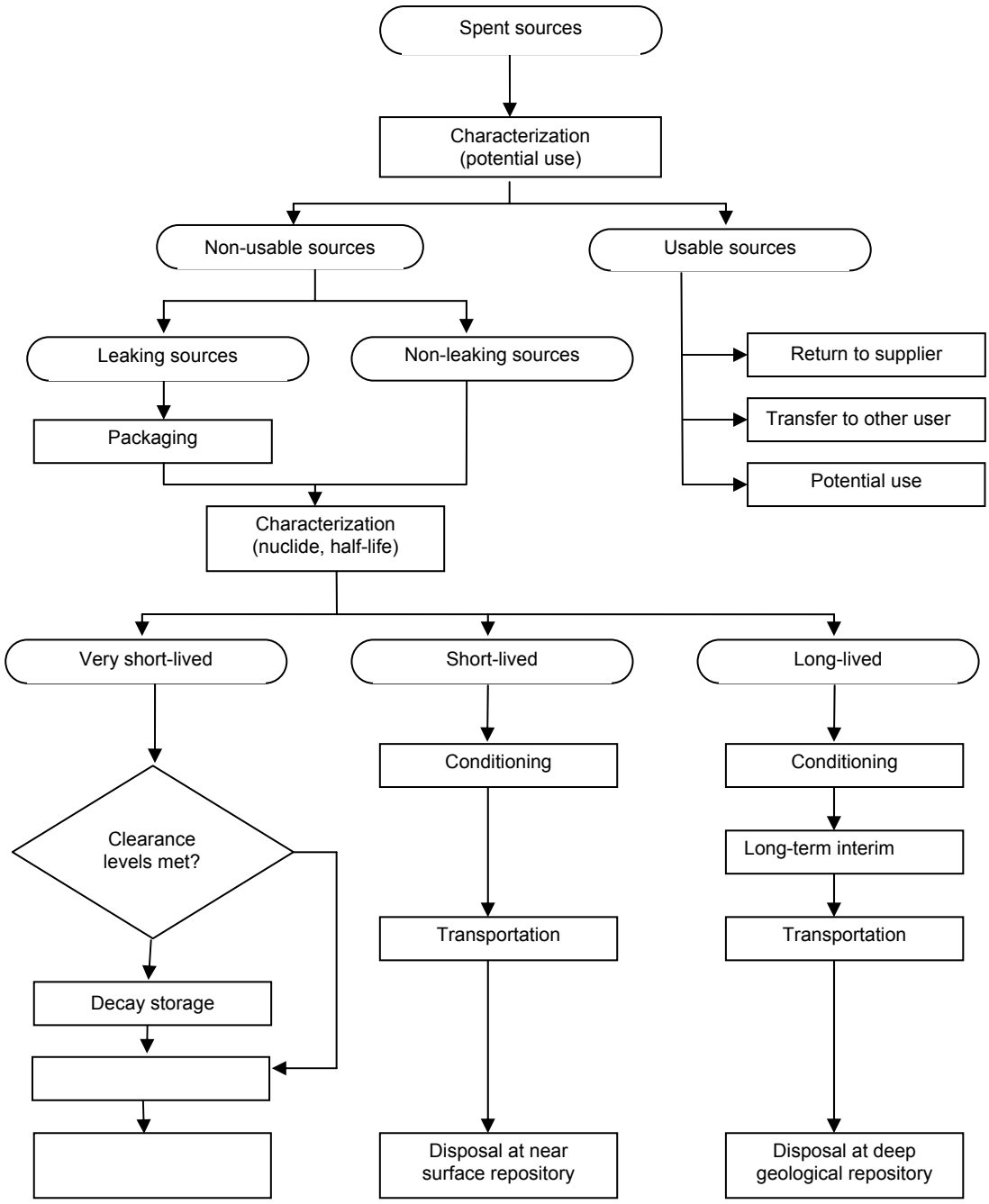

Figure 1. Schematic diagram of SRS management proposed by IAEA [16].

objectives and identification of available methods and facilities for the management of spent sources. All general requirements for radioactive waste management described in IAEA Safety Standards [8,9] are applicable to the management of SRS as one category of radioactive waste material.

Under the national policy when sealed radiation source(s) remains no longer in use, it is obligatory for the user to request RWMG, PINSTECH for management and disposal of the source(s).

The disused sealed radiation sources decayed to activity level below the exemption levels can be removed from regulatory control with the approval of PNRA and intimation to Waste Management Division (WMD). While exercising this operation, proper documentation is required to be maintained

Table 1. Inventory of DSRSs at RWMG facilities of PINSTECH, Islamabad.

S. No.	Source(s) collected from	Date of collection	Radionuclide	Activity (MBq) at collection time	No of sources collected
1	Industrial Unit, Joharabad	20-06-1999	Co-60	111.0	01
2	do.	20-06-1999	Co-60	12.58	01
3	Medical Centre, Peshawar	07-07-1999	Co-60	21.534×10^6	01
4	do.	02-07-2005	Co-60	1.670	01
5	do.	02-07-2005	Cs-137	20.934×10^3	78
6	do.	02-07-2005	Cs-137	17.458×10^3	10
7	do.	02-07-2005	Sr-90	259.96	05
8	Industrial Unit, Haripur	20-11-1999	Pm-147	12.950×10^3	01
9	Industrial Unit, Lahore	02-10-2000	Ir-192	17.390×10^3	09
10	do.	08-05-2004	Ir-192	65.310	09
11	do.	08-05-2004	Ir-192	51.800	09
12	do.	08-05-2004	Ir-192	49.250	09
13	Industrial Unit, Lahore	20-11-2000	Ir-192	15.355×10^4	05
14	do.	12-06-2001	Ir-192	16.200×10^3	05
15	do.	21.06.2003	Ir-192	1.62×10^4	05
16	Industrial Unit, Sadiqabad	12-09-2001	Ir-192	27.010	03
17	do.	11-11-2003	Ir-192	804.75	03
18	Medical Centre, Lahore	15-11-2003	Ir-192	128.02	4221
19	Medical Centre, Lahore	09-10-2004	Cs-137	65.120×10^2	12
20	do.	09-10-2004	Cs-137	538.350	32
21	do.	09-10-2004	Co-60	39.350×10^6	01
22	do.	27-09-2003	Sr-90	17.020	01
23	Scientific/Technical Centre, Islamabad	13-07-2004	Ir-192	20.730×10^2	04
24	do.	13-07-2004	Co-60	25.500×10^4	01
25	Scientific/Technical Centre, Islamabad	22-02-2000	Co-60	18.500×10^6	01
26	Industrial Unit, Jhelum	26-05-2005	Sr-90	18.870×10^2	03
27	Scientific/Technical Centre, Islamabad	25-05-1974	Na-22	0.110	05
28	Medical Centre, Islamabad	29-03-2001	Co-57	(61.20 Bq, to be cleared)	01
29	Medical Centre, Multan	27-09-2003	Co-57 Sr-90	(387.8 Bq, to be cleared)	17
30	Orphan	07-09-1991	Co-60	11.47×10^6	01
31	do.	do.	Co-60	2.934	01
32	do.	do.	Ra-226	3.700	01
33	Industrial Unit, Khewra	27-04-05	Cs-137	462.5	01
34	Utility organization, Lahore	01-08-05	Cs-137	10.658	01

for this purpose by the local waste management facility operators in consultations with the end users. Sources within a practice may be exempted from regulatory control subject to condition that the activity of the source is less then the exemption level specified by the PNRA.

2.3. Legal control / legal infrastructure

The radiological safety associated with the nuclear facilities and practices is backed by regulatory control. Like many other countries, in Pakistan also, there is usually no SRS/DSRS specific legislation dealing with the management of spent SRS and it is usually included under radiation protection or waste management legislature [10]. However, such sources are managed with an adequate waste management infrastructure and legal framework to control any radiation hazard to the public and environment. The existing regulations for the conduct of radiation and radioactive waste management work are based on the Pakistan Nuclear Safety and Radiation Protection (PNS&RP) Regulations 1990

(revised 1999), which derive guidance from Publication ICRP-60 [11]. These national regulations have also been adopted at PINSTECH and a code of practice for conducting radiation work at the Institute in step with the PNRA ordinance, 2001 are being followed at Radioactive Waste Management Group.

2.4. Management infrastructure

Outlined as IAEA has [12-14], the principal parties involved in the management of spent SRS are the PNRA, the regulatory body; the WMD as a centralized radioactive waste operating body; the RWMG, as the local waste management structure and the user/owner (registrants/licensees, users only in most of the cases). These closely coordinating bodies bear the responsibility to manage all spent SRSs from different users in the country and take all necessary actions to ensure the safety of the sources unless the responsibility has been transferred over to else other as approved by the regulatory body.

WMD, as the centralized radioactive waste operating organization (*CRWOO* as IAEA calls it) in coordination with RWMG/PINSTECH as local waste management body (LWMB) is designated to manage or to coordinate the management of the source when it becomes spent or if the license is vanished. The WMD will take the responsibility for the management of the source, if requested by the regulatory body (PNRA). The PNRA cooperates with the IAEA at one end and with LWMB at the local end through the WMD and the directorate of safety (DOS) as centralized and mediating structures. RWMG as local waste management setup undertakes the collection/transportation, management operations, safety of radioactive sources. security of radioactive material, quality assurance and record keeping etc. The group comprises qualified health physicists and other technical staff and is running an interim storage facility, source conditioning and decontamination facilities, engineered trenches for disposal and record/housekeeping cell. A centralized waste processing facility is planned.

2.5. Management parameters

Three parameters, the most important amongst others are considered i.e. information on existence, collection and conditioning of source(s); contamination control, decontamination if needed; and storage. Information on the existence are continually being gathered through postal communication from the inherent users who might have acquired source(s) before the regulations were enacted or those who might have escaped registration immediately after acquiring the sources or lost the documents in due course of time when the regulations were not fully implemented in their early days. All the known users are registered and their possessions are well documented. Besides, the potential users and the leading industrial, agricultural and medical units of the country are from time to time contacted by sending them a questionnaire. This has helped not only in the management of SRSs but also in arousing awareness in the public/users regarding radiation hazards.

The RWMG, in coordination with WMD as IAEA's *CRWOO*, in this particular instance is responsible for a): storing the collected short-lived spent SRS for decay, b): discharging of the short lived spent SRS which have decayed to clearance levels; conditioning of DSRS and their storage until a centralized disposal facility is available, and c): establishing and maintaining a record keeping for all DSRS at the facility.

2.5.1. Collection

Lack of information and a well established traceability of the sources from its manufacturer until its final recovery by the operator responsible for its recycling and disposal has been a prime cause of loss of control, causing accidents or incidents. All users are required to request HPD, PINSTECH for the management of their SRSs. User is requested to submit a return reply of a questionnaire as shown at Figure 3 for this purpose. Request for management of a source is initiated at the user end and routed through PNRA, the regulatory authority. For storage/disposal, the sources are transported to RWMG facilities at PINSTECH in accordance with the national regulations and IAEA's guidelines for the transport of radioactive material [15]. SRSs are prepared for transportation to the LWMB (RWMG) in accordance with the national transport regulations. At present no specialized transport vehicle is available and proper arrangements are made in a cargo vehicle acquired from public sector or from within PAEC establishments.

Authorization for safe transport from a qualified health physicist/radiation protection officer is required before starting transportation. As the required formalities are completed, the sources are collected and transported from the user's site to RWMG facilities. During transportation external

Table 2. Dose rate allowed during transportation of DSRSs to RWMG, PINSTECH from various sites.

Consignment No.	Radionuclide	Dose rate μSv/h at	
		surface	1 meter
1	^{60}Co	7.0	2.0
2	^{60}Co	15.0	3.5
3	^{60}Co	10.0	2.0
4	^{147}Pm	5.0	1.0
5	^{192}Ir	35.0	4.8
6	^{192}Ir	200.0	21.0
7	^{57}Co	8.0	0.5
8	^{192}Ir	92.0	10.0
9	^{192}Ir	37.0	1.0
10	^{192}Ir	45.0	3.0
11	^{57}Co ^{90}Sr	2.0 –	0.05 –
12	^{192}Ir	7.3	0.67
13	^{192}Ir	48.0	0.65

Table 3: Disused ^{60}Co and ^{90}Sr sources conditioned in 200 L MS drums.

Package No.	Radio-nuclide	Decay energy (keV)	Half Life	Activity MBq	Dose factor		Package dose rate (μSv/h) at	
					Ingestion (μSv/Bq)	Inhalation (μSv/Bq)	Surface	1 meter
SRS/C-1	^{60}Co	γ(1173, 1333) $\beta_{max.}$(218)	5.3 a	333	3.4×10^{-3}	1.7×10^{-2}	0.7	negligible
SRS/C-2	^{60}Co	γ(1173, 1333) $\beta_{max.}$(218)	5.3 a	37	3.4×10^{-3}	1.7×10^{-2}	0.75 0.05	–
SRS/C-3	^{90}Sr	$\beta_{max.}$(196)	29.0 a	17.02	2.8×10^{-2}	7.7×10^{-2}	0.5 0.01	–

and internal radiation exposures of the workers are kept as low as reasonably achievable (Table 2). Workers are properly instructed and all necessary precautions are taken. After transportation to RWMG facilities, these sources are safely emplaced in interim store as per PNRA guidelines. Various types of DSRSs having a total activity of 91832 GBq (2473.56 Ci) have so far been collected and conditioned at the facilities. Three orphan sources from within the institute were also identified and are now being characterized and documented.

2.5.2. Conditioning

The approach of conditioning of DSRS at our facility relies on the principal of rendering the sources inaccessible to the human environment and to isolate them for very long time periods provided some safe and plausible mechanism is implied for planned retrieval of the source for purposes like further conditioning etc. The tested and recommended methods to achieve this goal are rather simple and quite adequate. The intended source within the working shield is lifted and positioned in a small mild steel (MS) container

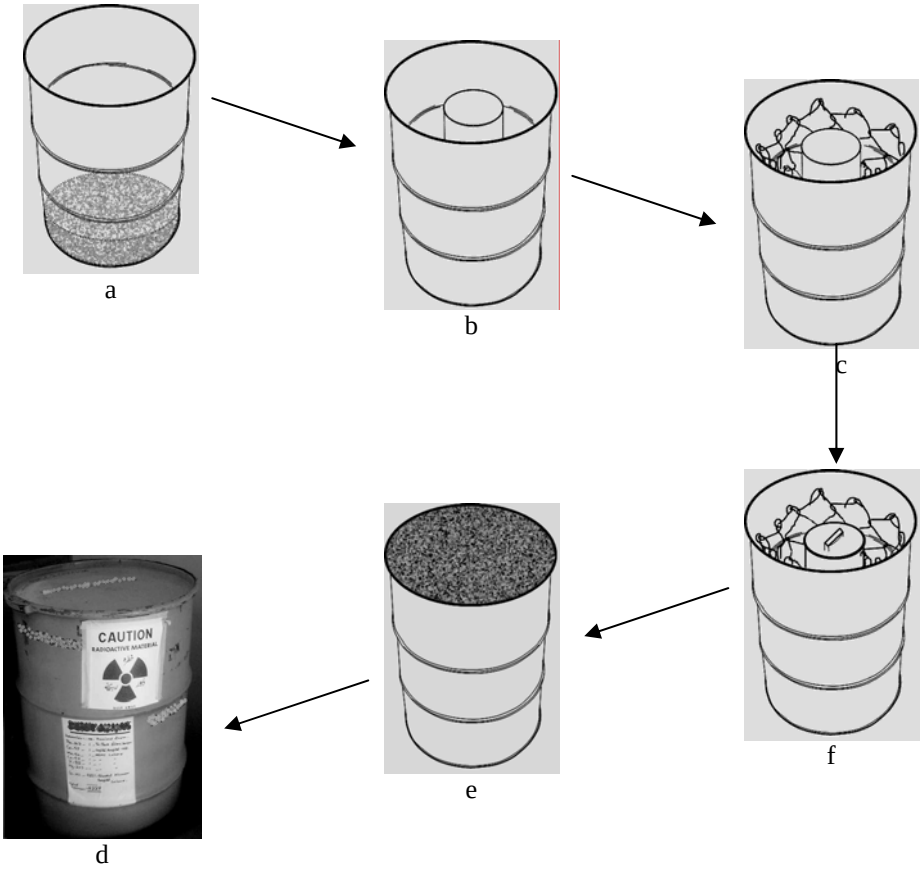

Figure 2. Different steps of DSRS conditioning till the finished package – (a) RCC bottom plug, (b) Inner 4-6 mm MS drum inserted, (c) ϕ3-4 mm galvanized steel net inserted amid outer and inner drums, (d) DSRS package inserted and covered into inner drum, (e) Concrete poured into the assembly with on-top RCC plug, (f) Finished package with engraved as well as painted markings ready for Interim storage.

emplaced in the center of a standard 200L MS drum and surrounded by cement mortar. The embodying concrete is reinforced by a steel-bar net (Figure 2). The concrete plugging the outer drum atop provides in a way the mechanism for planned retrieval while at the same time, integrity of the conditioned package is secured. If the physical volume, activity, and resulting surface dose rate permit, more than one sources are conditioned in the same drum. Later, the container is covered with the lid and positively fastened/secured by screwing to prevent unintentional and unauthorized opening. Closing and securing the container concludes the conditioning process. The source is kept retrievable nevertheless it is stored safely with regard to irradiation, contamination and physical safety. The dose rate at different positions of the so far conditioned drums (Table 3) has been well below the recommended value of 2 mSv/h [15]. High activity gamma sources, contained in heavy shielding structures, may not render themselves suitable for similar conditioning [16]. Such sources are retained with their shielding devices and the on-going practice is to store them as such.

Conditioning process is optimized on the philosophy that the packages will be emplaced in an interim storage in a planned retrievable fashion for any further conditioning without undue cost. Safety and security of the source is improved through conditioning and immobilization of these sources by cement grouting; incidental exposures are reduced since the dose rate of conditioned packages at surface and at one meter distance have significantly reduced. Conditioning with multi-barrier approach for containment imparts substantial strength to the packages and that future waste acceptance criteria will be met. There are three barriers, first the inner container, second the cement mortar and the third outer M.S. drum.

Radioactive Waste Management Group
HPD, PINSTECH

Request for a quotation to dispose off spent sealed radiation source(s)

Please ensure that you provide an answer to all the questions listed here.

1. It is important that the information you provide is accurate as this will avoid unnecessary delays or subsequent complications, which may incure additional unexpected costs.

2. Please provide drawings/photographs where possible

Name of the source(s)			
Number of the source(s)			
Source No. / identification mark			
Date of purchase			
Owner of the source			
NOC No. and Date (Please attach copy of NOC)			
Activity at the time of purchase (Bq/Ci)			
Residual activity (with date)			
Name of source manufacturer			
Application of the source			
Dimensions of the source Length (mm) x Width (mm) x Height (mm)			
Source Containment			
Is the source in a container?			
Is the source loose in its container?			
Is the source in an instrument or gauge?			
Size and weight of source containment Length (mm) x Width (mm) x Height (mm) Weight (kg)			
Radiation level i) At surface of container	μSv/hr		
ii) At one meter from surface of container	μSv/hr		
Contamination Level, Direct	Alpha (cps)	Beta/Gamma	(cps)
Smear	Alpha (cps)	Beta/Gamma	(cps)
Date of last wipe testing Pass/Fail?			
Has source(s) been removed from operational location? (Yes/No)			
Reason for disposal			

Figure 3. A sample copy of the questionnaire.

Thus the possibility of migration and/or leakage of sealed sources is reduced to a greater extent. Bulk weight of the intact conditioned package safeguards against theft or misuse. The risk of improper handling and theft decreases and control over the spent SRS is facilitated. A conditioned source in this manner should not be perceived as 100% risk free, yet, the process adapted meets the general international radiation safety and waste management requirements.

2.5.3. On-site interim storage

High activity and long life sources require conditioning followed by interim storage. For short-lived sources like ^{32}P, ^{131}I, ^{192}Ir, ^{210}Po etc., having low activity however, a 3–5 year time is considered

reasonable for application of storage for decay option. The interim storage facility constructed at RWMG serves these requirements. High activity gamma sources, contained in heavy working shields are also accommodated. They are retained in their shielding devices and interim-stored pending further management options. The facility is located in a designated controlled area away from working area. It is an engineered civil structure above the ground level, a concrete body as an earth-covered mound enclosing an underground L-shape trench ~1 meter deep with adequate concrete slabs shielding from the top. The facility conforms to as suggested by IAEA (Figure 1) for ^{192}Ir sources [8]. Safeguard measures are being taken for the source security. The sources are kept in a building with a multi-tier security. Regular contamination and radiation surveys of the storage area are conducted during the storage period to confirm that radiological conditions remain satisfactory. In addition, airborne activity is monitored by sampling air of interim storage facility. Ambient radiation level is monitored periodically by thermoluminscent dosimeters installed in the interim store [17].

2.5.4. Radiation safety / contamination control

The use of radiation sources and operations with these entities are subject to certain standards of safety. Adequate protection and safeguard measures are therefore being taken during and after the discharge of these operations. Prior to the transportation of the DSRS from the user point to the radioactive waste management facility at PINSTECH, radiation levels at the surface of the container and at 1 meter distance are recorded. Physical condition of the source is checked and the source status verified by a qualified health physicist. Contamination if any or probable during any operation is assessed. Proper transportation arrangements are made.

During handling and management of spent/disused sealed radiation sources all appropriate personal protective measures are taken. Suitable calibrated instruments are used for surveillance of radioactive contamination and radiation levels. Only qualified, trained and authorized workers are allowed to carry out handling operations on the sources. The personnel exposure is not allowed to exceed annual dose limits and efforts are made to keep the exposure of individuals as low as reasonably achievable. Special precautions have to be taken to prevent inhalation of airborne contamination if leaking spent SRSs are to be handled. Since the risk that a source may be damaged during the work is always there, appropriate instruments and equipment are made available during all operations. All persons engaged in the work are provided with personal dosimeters. Occasionally, alarm monitors are also provided when handling high activity source assemblies. Proximity exposures are monitored and managed. Contamination monitoring is carried out during and after every step of the work. The exposure of all workers is documented and in case of any over exposure it is required to be investigated and intimated to PNRA.

To limit or eliminate contamination, surveys are carried out at and around the source before hand. Smear tests are carried out on the source to check for any leakage from the source. Proper handling of a leaking source is a challenging operation since it may result in the spread of contamination therefore; only qualified and experienced personnel are required to perform the operation where leaking source(s) will be involved. So far no leaking sources have been encountered, however, it is anticipated that a leaking source would be over packed and the areas where leaking sources would be manipulated should be covered e.g. by a plastic sheet in order to limit contamination and facilitate decontamination.

2.6. Quality assurance

Waste acceptance criteria for disposal are met when the source is intended for disposal. All records and required information are retained and can be retrieved and comprehended for any future reference. Other set of data, defining the characteristics of each conditioned package is registered and kept before this package is stored for long time periods. Data for documentation includes: package identification number, activity content and reference date, number of sources conditioned, surface dose rate, dost rate at 1 meter, date and place of conditioning and conditioning method.

Users/owners are required to establish a record-keeping system in such a manner as to ease identification, characterization, collection and storage of all SRS (in use and spent). The information is reliably stored and archived both manually and through a computerized database. Advisory and/or technical services in this regard are provided jointly by PNRA and LWMB (RWMG) on payment. However a discount or subsidy is

provided to encourage users/owners to follow proper management routes and routines besides law enforcement schedules. It is also imperative to iterate/assure, as per IAEA's recommendations that a competent radioactive material coordinator (RMC) has to be provided by user/owner [9]; which facility is also extended to the users by RWMG on nominal charges.

An authorization/reporting system that aims at controlled and managed access through lock & key and a logbook into the interim store is adapted to ensure that radiation sources are under the control of competent authorities.

Radiation safety: All handling operations are planned, tested if needed, and are implemented under the supervision of qualified health physicist/radiation protection personnel. While transporting a source, it is ensured that radiation contamination and activity levels are in accordance with the transport index for radioactive material.

Before the conduct of actual source handling operations, the nature and extent of all risks involved is fully assessed and the personnel of the management team are adequately made conversant of these steps involved or planned and the potential hazards associated with during these steps.

Persistent radiation monitoring is being conducted throughout handling operations and is conducted in the controlled area designated for the management of solid waste of the Institute. Radiation protection principles in accordance with the *ALARA* principle are regarded. Personnel are protected and are facilitated for safer conduct of the operations. Compliance with the mandatory radiation protection requirements is ensured.

Contamination checks are also included in the plan to conduct the operations, should a need arise for it. In the management of large sources (sources that are to be managed alongwith their working container and auxillary attachments) radiation as well as industrial safety aspects are observed.

2.7. Documentation and inventory of SRS

The record-keeping for disused sealed sources is established and maintained. End users and LWMB are required to keep these information. The information is reliably stored both manually and electronically and include: source model, identification numbers (source and container), radionuclide activity with reference date, manufacturer, former user, place of storage, date of import, activity at the time of purchase and residual activity with last date of leak testing. This information is gathered by supplementary measurements and consulting documents.

The characteristics of each conditioned package is registered and kept before this package is subject to long term storage. Data for documentation includes: package identification number, activity content and reference date, number of sources conditioned, conditioning method, surface dose rate and dose rate at 1 meter distance etc.

An updated inventory of all DSRSs is kept at RWMG facilities. The radioisotopes of high radiological concern will be dealt with accordingly during their use, transportation, conditioning/storage and disposal. A national database of SRS and DSRS is being developed which will help in efficient control of these sources, particularly high risk sources, to help prevent their improper handling and movement.

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