

Sustaining the Security of Radioactive Sources Through Compliance with Regulatory Requirements

By

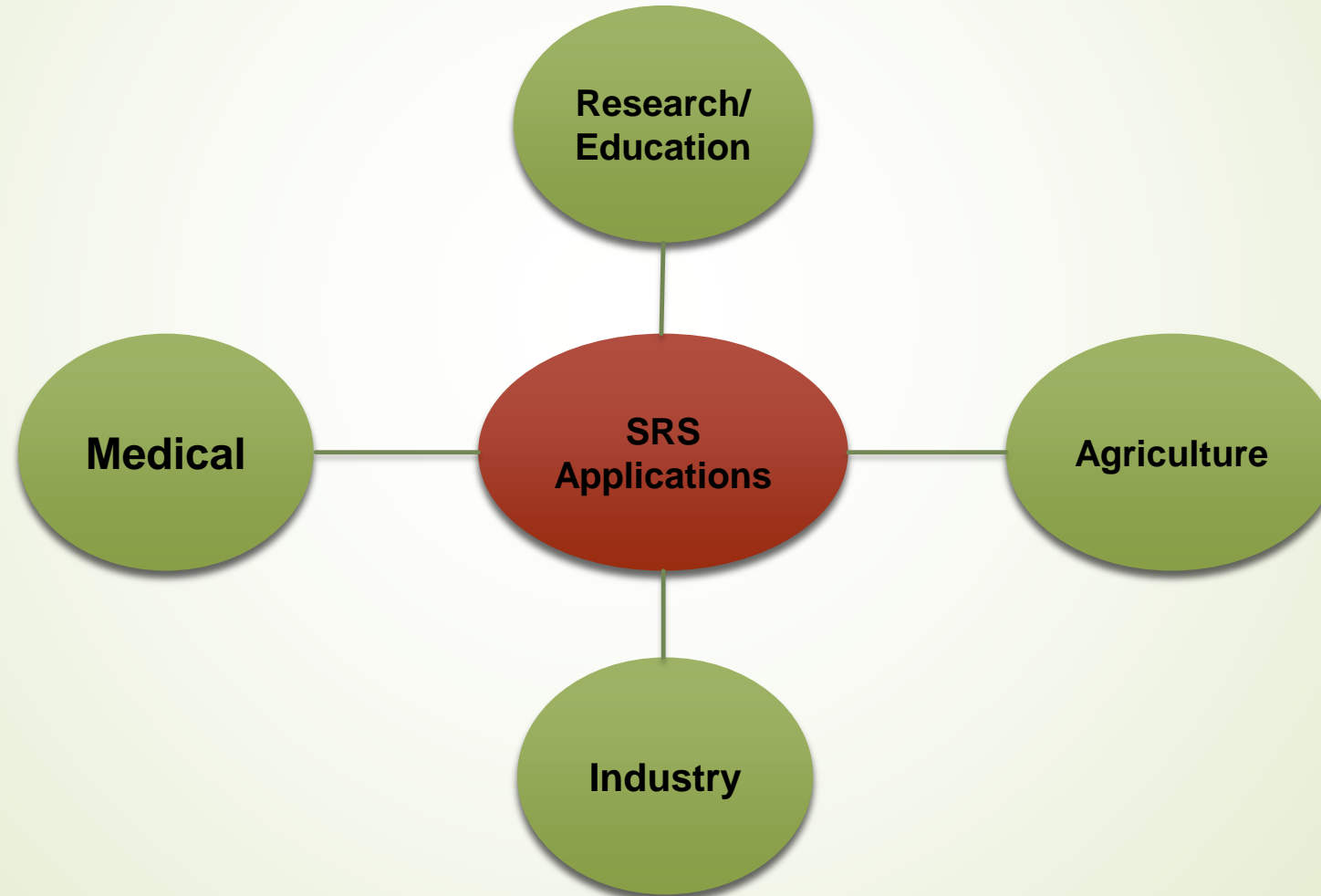
Javed Iqbal

Pakistan Atomic Energy Commission

Outlines

- Application of Sealed radioactive Sources (SRS) in Pakistan
- Basis for Implementation of Security of Radioactive Sources
- Accountability and Control Program for SRS
 - ❑ Categorization System and Security Levels for SRS
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 - ❑ Corporate Oversight and Sustainability
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- Management of Disused SRS
- Conclusion

Application of Sealed Radioactive Sources (SRS) in Pakistan



Commonly used Sealed Radioactive Sources (SRS) in Pakistan

- Co-60, Ir-192, Cs-137
- Activity Range: few KBq – TBq
- Co-60 is used for radiotherapy
- Ir-192 is used for Brachytherapy, radiography
- Around 31% sources are being used in Industry (for Gamma Radiography, well-logging, level gauges, moisture gauges etc.)



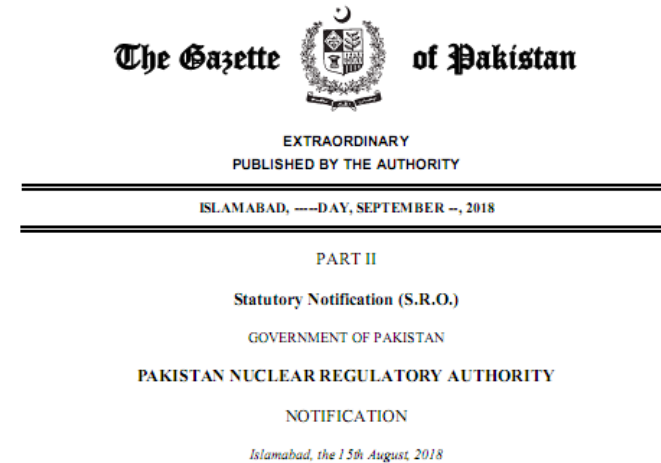
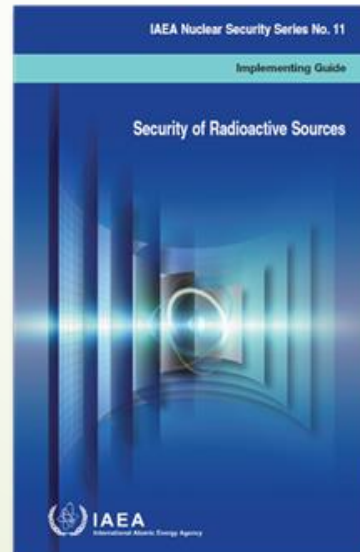
Co-60 Teletherapy Machine



Industrial radiography of pipes using Iridium-192

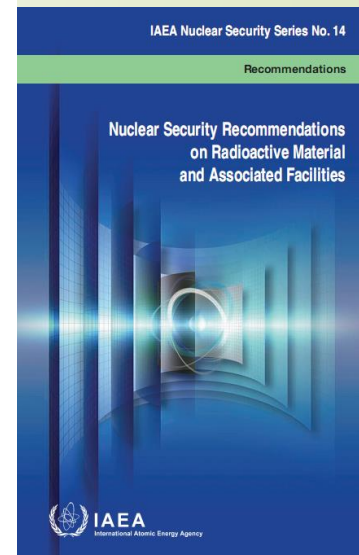
Basis for Implementation of Security Measures for Radioactive Sources

- ❑ IAEA code of Conduct – INFCIRC/663
- ❑ IAEA nuclear Security Recommendations (NSS14)
- ❑ IAEA Nuclear Security Implementing Guide (NSS-11)
- ❑ PNRA Regulations on “Security of Radioactive Source(s)-PAK/926”

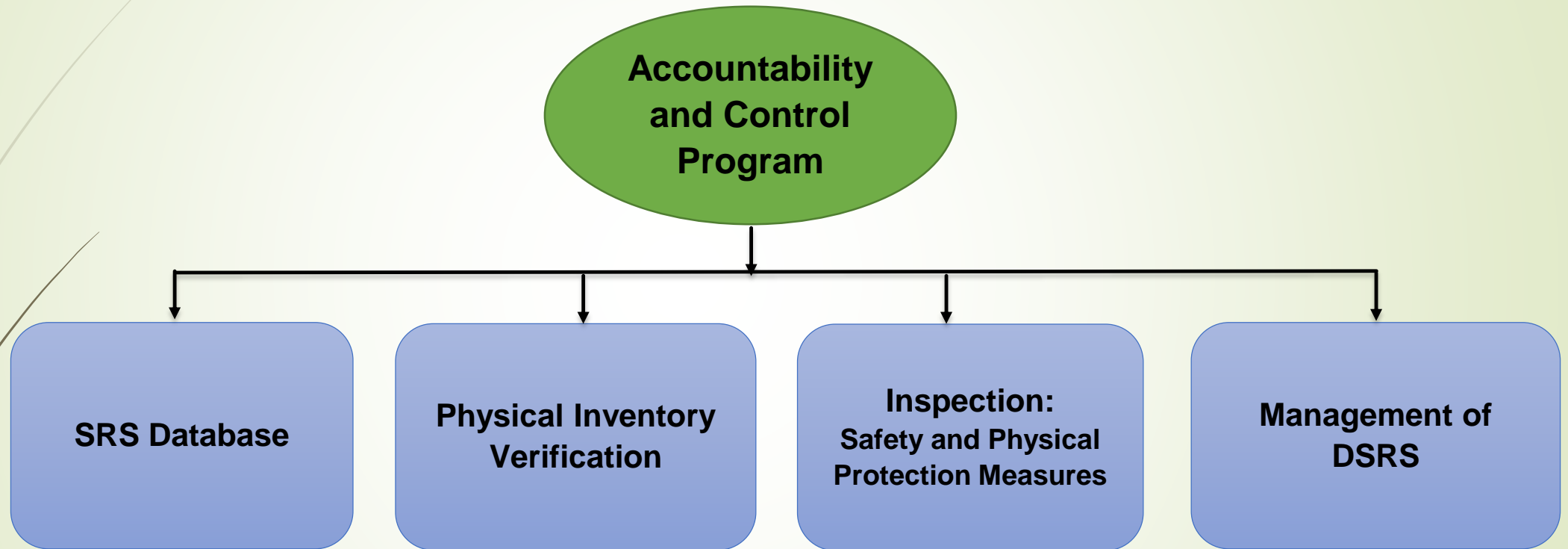


S.R.O. ----(I)/2018. — In exercise of the powers conferred by Section 16(2)(a) read with Section 56 of the Pakistan Nuclear Regulatory Authority Ordinance, 2001 (III of 2001), the Pakistan Nuclear Regulatory Authority is pleased to make and promulgate the following regulations:—

1. **Short Title, Extent, Applicability and Commencement.**— (1) These regulations may be called the “Regulations on Security of Radioactive Sources - (PAK/926)”.
 - (2) These regulations shall extend to the whole of Pakistan.
 - (3) These regulations shall be applicable for the security of radioactive sources.
 - (4) These regulations shall come into force at once.
2. **Definitions.**— In these regulations, unless there is anything repugnant in the subject or context,
 - (a) “*Authority*” means the Pakistan Nuclear Regulatory Authority established under section 3 of Pakistan Nuclear Regulatory Authority Ordinance, 2001;
 - (b) “*background checks*” means a process which include confirmation of identity, financial/criminal record, moral conduct, motivation, verification of references, and employment history to determine the integrity, character and reliability of an individual;



Accountability and Control Program for SRS



Categorization and Security Level for SRS

Category	Practices ^(a)	A/D ^{(b)(c)}	Security Level
1	Irradiators, Teletherapy	$A/D \geq 1000$	A
2	Industrial radiography, High/medium dose rate Brachytherapy	$1000 > A/D \geq 10$	B
3	Fixed industrial gauges that incorporate high activity sources, Well logging gauges	$10 > A/D \geq 1$	C
4	Low dose rate (LDR) Brachytherapy, Industrial gauges that incorporate low activity sources, Bone densitometers, Static eliminators	$1 > A/D \geq 0.01$	D
5	LDR Brachytherapy eye plaques and permanent implant sources, X-ray fluorescence devices containing sources, Electron capture devices, Mossbauer spectrometry, check sources.	$0.01 > A/D$ and $A >$ exempt	

- (a) Overriding priority for the categorization of radioactive sources shall be given to their use in a certain practice.
- (b) In case of radioactive sources is not listed in column 2 of the above table, then A/D ratio shall be used for their categorization
- (c) For the radioactive sources during manufacture and storage, their A/D value shall only be considered for categorization

Periodic SRS Inventory Status

- Periodic SRS data is acquired by Corporate level
 - Quarterly for Category 1
 - Bi-annually for remaining categories of SRS
- Approved SRS Accountability form (SRS-1 Form)
- Part-A of SRS-1 Form
 - Summary of inventory of SRS
 - Detail of each SRS
 - Status and application of SRS
 - SRS transfer information
 - Custodian

Periodic SRS Inventory Status

Cont...

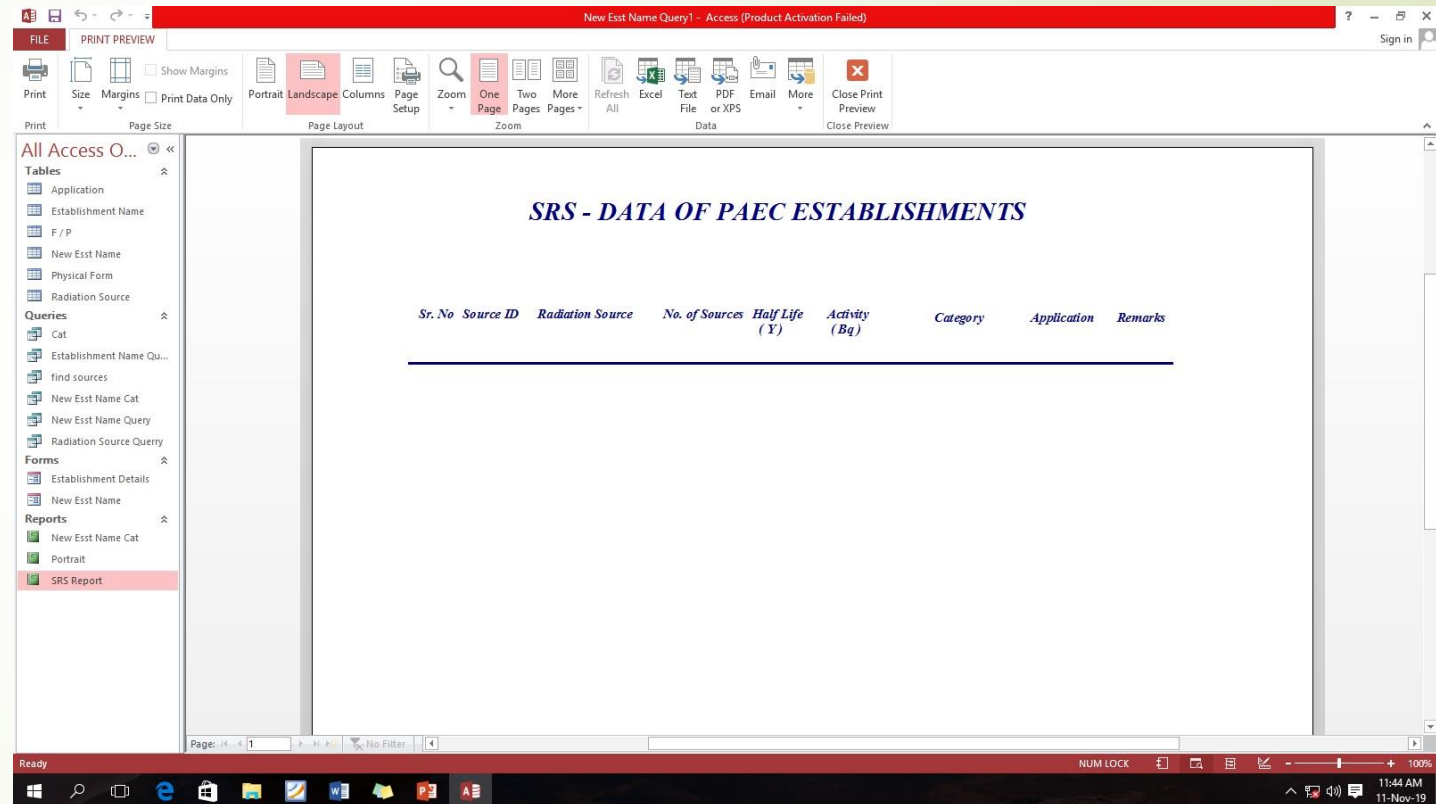
► Part-B of SRS-1 Form

- Questionnaire about onsite measures for secure handling of SRS
- Administrative physical protection measures
- SRS handling procedures
- Record keeping

SRS Database

Information Extracted from SRS-1 Form

- SRS ID
- SRS Name
- Half Life
- Number of SRS
- Activity
- Category of SRS
- Physical Form
- Application
- Remarks
 - In-use
 - Dis-used




The screenshot shows a Microsoft Access window titled "New Est Name Query1 - Access (Product Activation Failed)". The window is in "PRINT PREVIEW" mode. The report displayed is titled "SRS - DATA OF PAEC ESTABLISHMENTS". The report contains a table with the following columns: Sr. No, Source ID, Radiation Source, No. of Sources, Half Life (Y), Activity (Bq), Category, Application, and Remarks. The table is currently empty. The left-hand pane shows the "All Access Objects" list, with "SRS Report" selected under the "Reports" category. The Windows taskbar at the bottom shows the time as 11:44 AM on 11-Nov-19.

Corporate Oversight and Sustainability

- Physical Inventory Verification (PIV)
- Technical Security Measures
 - Detection
 - Delay
 - Access Control
- Administrative Security Measures
- Sustainability
 - Maintenance and testing program
 - Adopting emerging technologies to enhance effectiveness of PPS
 - Policies and procedures

Physical Inventory Verification

- ❖ **Inventory and records**
 - SRS receipt and transfer record
 - SRS use/movement log
 - Periodic Inventory Verification by the custodian
 - SRS transportation and disposal record
 - SRS certificate and relevant documentation provided by the manufacturer

	Pakistan Atomic Energy Commission Checklist for Accountability & Control of SRS	Code	212(03.001)/
		Dated	

PART A: INVENTORY AND RECORDS
PART A1: INVENTORY VERIFICATION

Sr. No.	Check Point	Status	Remarks (if any)
1.	Total number of sources physically verified.		
2.	Total number of un-verified sources.		
3.	Total number of un-identified sources.		
4.	Total Number of Fixed Sources.		
5.	Total Number of portable sources.		
6.	Total number of sources transferred to any other facility.		
7.	Total number of sources borrowed from any other facility.		
8.	Total number of sources imported.		
9.	Total number of sources in-use.		
10.	Number of sources stored as back up sources.		
11.	Number of sources stored for disposal.		
12.	Number of sources disposed-off.		
13.	Number of sources returned to the manufacturer		
14.	Number of sources installed in device(s)/Equipment(s) (attach details installed location(s))		

Technical Security Measures

Physical Protection System

- ❖ Intrusion detection System
- ❖ Assessment of Detection (CCTV)
- ❖ Automatic Access Control System
- ❖ Physical Barriers (Robust doors, Secure containers and enclosures, Locks for doors)
- ❖ Strong room for sources storage
- ❖ Locked Shielded Containers

	Pakistan Atomic Energy Commission Checklist for Accountability & Control of SRS	Code	212(03.001/
		Dated	

PART B1: Security Measures for Category 1 Sealed Radioactive Sources – Security Level A

Sr. No.	Check Point	Yes/No	Remarks (If Any)
1.	Is immediate detection of any unauthorized access to the secured area being carried out by the use of electronic intrusion detection system?		
2.	Is continuous surveillance being ensured when IDS intentionally bypassed by the operating personnel?		
3.	Does immediate detection of any attempted unauthorized removal of the sources in place by the use of electronic tamper detection device?		
4.	Is the continuous surveillance/assessment of detection of the Radioactive Sources Storage Room (RSSR) being carried out through CCTV?		
5.	Is the remote video monitoring of the source room being carried out at Control Room?		
6.	Is there any means in place for immediate assessment of the cause of the alarm by the facility/response personnel?		
7.	Is there any procedure in place to immediately respond to the alarm by the facility/response personnel?		
8.	Have the facility (response personnel / operator) rapid dependable and diverse (at least two) means of communication to respond immediately following an unauthorized removal or access?		
9.	Is immediate detection of any unauthorized access to the secured area being carried out by the use of electronic intrusion detection system?		
10.	Does operator verify physically the presence of radioactive sources through fortnightly check(s)?		
11.	Does the system comprising at least two layers of delay barriers to prevent unauthorized access to radioactive source?		
12.	Is Two Person rule implemented for access to secured area?		

Security Measures for Source(s)

Security Function	Security Measures		
	Category-1 (Security Level A)	Category-2 (Security Level B)	Category-3 (Security Level C)
Goal	To prevent unauthorized removal	To Minimize likelihood of unauthorized removal	To reduce likelihood of unauthorized removal
Detection	IDS and/or continuous surveillance	IDS and/or continuous surveillance	-
	Electronic Temper detection	Temper detection or periodic checks by operating personnel	Temper detection or daily checks by operating personnel
	Immediate assessment of detection: CCTV or by operating personnel	Immediate assessment of detection: CCTV or by operating personnel	Immediate Assessment by operating personnel
	Physical Verification: Fortnightly	Physical Verification: Fortnightly	Physical Verification: Monthly

Security Measures for Source(s)

Security Function	Security Measures		
	Category-1 (Security Level A)	Category-2 (Security Level B)	Category-3 (Security Level C)
Delay	Two Layers of Delay Barriers (at least)	Two Layers of Delay Barriers (at least)	Single Barrier or surveillance by security personnel
Access Control	Provision of identification and verification	Identification measure	Identification measure
Response	Rapid, dependable and diverse means of communication;	Rapid and reliable means of communication	Appropriate actions in accordance with Physical Protection Plan
	Interrupt and neutralize adversary as per Physical Protection Plan	Interrupt and neutralize adversary as per Physical Protection Plan	Appropriate response actions in accordance with Physical Protection Plan

Administrative Security Measures

- Physical Protection Plan
- Security Event Reporting
- Reliability and Trustworthiness of Personnel
- Operating Procedures
 - Access Control Procedures
 - SRS handling and storage procedure
 - Key control procedures
 - Alarm assessment and response procedures
 - SRS disposal procedures
- Training of Personnel
- Security Culture

Event Reporting Mechanism

Required Actions	Timeline
Remedial measures and inform local law enforcement agencies	Immediate
Notify to Authority	24 Hours
Submit a preliminary report to the Authority	72 Hours
Submit to the Authority a detailed report on the causes of the event, its circumstances and consequences, and on the corrective actions taken or to be taken.	60 Days

Management of Disused SRS

Return to manufacturer

- Regulatory requirement as per PAK/915
- Applicable to SRS with initial activity > 100 GBq and Half-life > 1 year
- SRS shall be returned to country of origin as part of contract with supplier
- Mandatory condition for “**NO Objection Certificate**” from PNRA

Interim Storage

- **PPRWMF** (PINSTECH Predisposal Radioactive Waste Management Facility) Islamabad
 - Covers two provinces (i.e. Punjab, KPK) and Capital territory
- **RAWSA** (Radioactive Waste Storage Area) KANUPP, Karachi
 - Covers Provinces Sindh and Balochistan

Conclusion

- Sealed Radioactive Sources are being used in Medicine, Agriculture, Industry, Research and Education in Pakistan
- Relevant Regulations for Safety and Security of SRS are in place for Safe and Secure use/ handling, storage and transport of radioactive sources
- All radioactive sources are under strict regulatory control from cradle to grave

Thank you