



## SPECIFICATION

### **Segmented gamma scanner and handling equipment for characterization of radioactive materials and waste**

#### 1 Scope

This specification describes the requirements for a segmented gamma scanner and auxiliary handling equipment (hereinafter referred to as the “Equipment”) for characterization of radioactive materials and waste at Armenian Nuclear Power Plant (hereinafter referred to as the “End-User”).

The Equipment is required to improve the radioactive materials and waste characterization system at End-User through the establishment of the capacities and capabilities in radiological characterizations, and handling of packages with materials and waste in the characterization process.

The materials and waste subject to radiological characterization at End-User’s site, as well as conditions at measurement locations are provided in Annex 1. The drawings on the type of containers are provided in Annex 2.

#### 2 Applicable Documents:

The following documents shall be applicable for this Specification to the extent specified hereinafter:

- 2.1 SSR-6 “Regulations for the Safe Transport of Radioactive Material”, IAEA, 2012; [http://www-pub.iaea.org/MTCD/publications/PDF/Pub1570\\_web.pdf](http://www-pub.iaea.org/MTCD/publications/PDF/Pub1570_web.pdf); and
- 2.2 Government Decree Nr. 1367 of 27 November 2014 “On amendments and addenda to the Republic of Armenia Government Decrees №1219-Nand №1489-Nof 18 August 2006 “On approval of Radiation Safety Standards” (Please refer to Annex 3).

In the event of conflict between the documents listed above and the content of this Specification, the content of this Specification shall take precedence to the extent of the conflict.

#### 3 Requirements

##### 3.1 Functional and Performance Requirements:

The Equipment to be provided by the Contractor shall meet the following functional and performance requirements:



### 3.1.1 Segmented Gamma Scanner

- 3.1.1.1 Shall enable qualitative and quantitative assays on gamma emitting nuclides typical for waste streams at Nuclear Power Plants with Pressurized Water Reactors (PWR) including fission and activation products;
- 3.1.1.2 Shall provide for characterization of low and intermediate level waste;
- 3.1.1.3 Shall use transmission source or radiation source in the matrix to take into account the density variations in the waste matrix in the individual measurement segments;
- 3.1.1.4 Shall provide for measurements for clearance (ref. document in para 2.2 for clearance levels in the Republic of Armenia);
- 3.1.1.5 Shall be modular design to support easy assembling/disassembling and connecting/disconnecting for transport (relocation) within the End-User's site;
- 3.1.1.6 Shall be HPGe based liquid nitrogen cooled segmented assay system optimized for measurement of radioactive materials and waste having different densities in packages of cylindrical geometry;
- 3.1.1.7 Shall ensure gamma activity measurement range: at least 3.7 kBq to 0.74 TBq per package;
- 3.1.1.8 Assay time (measurement for clearance) shall be up to approx. 30 minutes per package;
- 3.1.1.9 Shall include shielded detector housing;
- 3.1.1.10 Shall include computer based IT component (built on Windows compatible software with perpetual license) which shall enable multiple matrix correction, archiving, QA and reporting capabilities, including user editable report templates; and
- 3.1.1.11 Shall include automatic weighing system with measurement range at least 50 kg to 850 kg.

### 3.1.2 Auxiliary Handling Equipment

- 3.1.2.1 Shall provide for handling and transport of packages with radioactive materials and waste at the location of Segmented Gamma Scanner; and
- 3.1.2.2 Shall be integral solution of the handling and characterization scheme enabling safe and reliable feed and removal of packages to and from the Segmented Gamma Scanner measurement position.

## 3.2 Technical Requirements



The Equipment shall meet the following technical requirements:

3.2.1 Segmented Gamma Scanner:

3.2.1.1 Shall be compatible with electric power supply network 220 V, 50 Hz; and

3.2.1.2 Maximum mass of a single component for transportation shall not exceed 1500 kg.

3.2.2 Auxiliary Handling Equipment:

3.2.2.1 Shall include roll-gang type transporter of package to and from measurement position;

3.2.2.2 Shall include fork lift truck:

3.2.2.2.1 type – electric driven 4 wheel counterbalanced truck;

3.2.2.2.2 lifting capacity - 1800 kg minimum;

3.2.2.2.3 lifting height –2.1 m minimum;

3.2.2.2.4 power source – rechargeable Li-Ion battery(ies);

3.2.2.2.5 continuous operation time before recharging the battery(ies) – minimum 4 hours at maximum load; and

3.2.2.2.6 electric hydraulic steering.

4 Calibration sources

The Contractor shall at the discretion of the IAEA supply the required calibration sources for the Equipment as per Section 3 above.

5 Marking

The Equipment shall have all safety markings in English or Russian.

6 Packing

The Equipment, for the shipment by air or land to the End-User, shall be packed in accordance with international standards that are applicable for the shipment by air/land of this kind of equipment and goods.

All markings on the packaging shall be in English and Russian.



## 7 Quality Requirements

- 7.1 The Equipment shall be manufactured, shipped and installed in accordance with the requirements of the Contractor's ISO 9001 compliant quality management system or an equivalent quality assurance system.
- 7.2 The Contractor shall document the compliance with the quality assurance requirements.

## 8 Testing and Acceptance

The Equipment, prior to shipment, shall be tested for conformance with manufacturer's performance specifications and the minimum requirements specified herein.

The Equipment, after installation, shall be tested by the Contractor together with the End-User to demonstrate that the performance meets the manufacturer's performance specifications and the minimum requirements specified herein as defined by the IAEA and the End-User.

The results of the testing of the Equipment shall be documented by the Contractor in an Acceptance Document that shall be signed by the End-User.

## 9 Installation and Training

- 9.1 The Contractor shall install the Equipment at the End-User's site.
- 9.2 The Contractor shall provide two-day training for up to three staff of the End-User in the operation and maintenance of the Equipment at the End-User's location immediately after the installation of the Equipment.

## 10 Deliverable Data Items

The Contractor shall provide two (2) complete sets of Operation and Servicing Manuals and Technical Drawings in hard copies and one (1) in electronic version in the Russian and English language.



## ANNEX 1

### Details on the materials and waste that will be subject to radiological characterization at the ANPP

#### 1. Conditions at materials and waste characterization locations:

1.1.1 Temperature range +5°C to +40°C.

1.1.2 Humidity range 20% to 80%.

1.1.3 Radiation background:

1.1.3.1 measurement for clearance areas – dose rate up to 0.1  $\mu\text{Sv/h}$ ; and

1.1.3.2 low and intermediate<sup>1</sup> level waste measurement – dose rate up to 1.5  $\mu\text{Sv/h}$  and surface contamination up to 40 Bq/cm<sup>2</sup>.

#### 2. Composition and density of materials and waste subject to measurements:

2.1.1 Materials to be measured are steel, metals, filters, paper, glass, plastic/PVC/PPE, rubber and their mixture, and product of deep evaporation - “salt cake”.

2.1.2 Density of materials and waste:

2.1.2.2 vary in the range 1600 to 1900 kg/m<sup>3</sup> - most typical operational RAW stream “salt cake”;

2.1.2.3 vary in the range 300 to 2700 kg/m<sup>3</sup> – radioactive waste except “salt cake” and materials subject to measurement for clearance;

2.1.2.4 up to 8000 kg/m<sup>3</sup> – limited quantity of material as an inclusion of package with other waste and materials according to point 2.1.2.3.

#### 3. Types and characteristics of containers and overpacks:

3.1.1 Standard 200 L and 320 L drums will be used as overpacks for material subject to clearance and for low and intermediate level radioactive waste:

3.1.1.1 diameter – vary in the range 595 mm to 650 mm;

3.1.1.2 height – vary in the range 882 mm to 980 mm;

3.1.1.3 wall and lead/bottom thickness – vary in the range 1 mm to 1.5 mm;

3.1.1.4 mass netto – vary in the range 30 to 45 kg; and

3.1.1.5 total mass (with waste) – up to 500 kg.

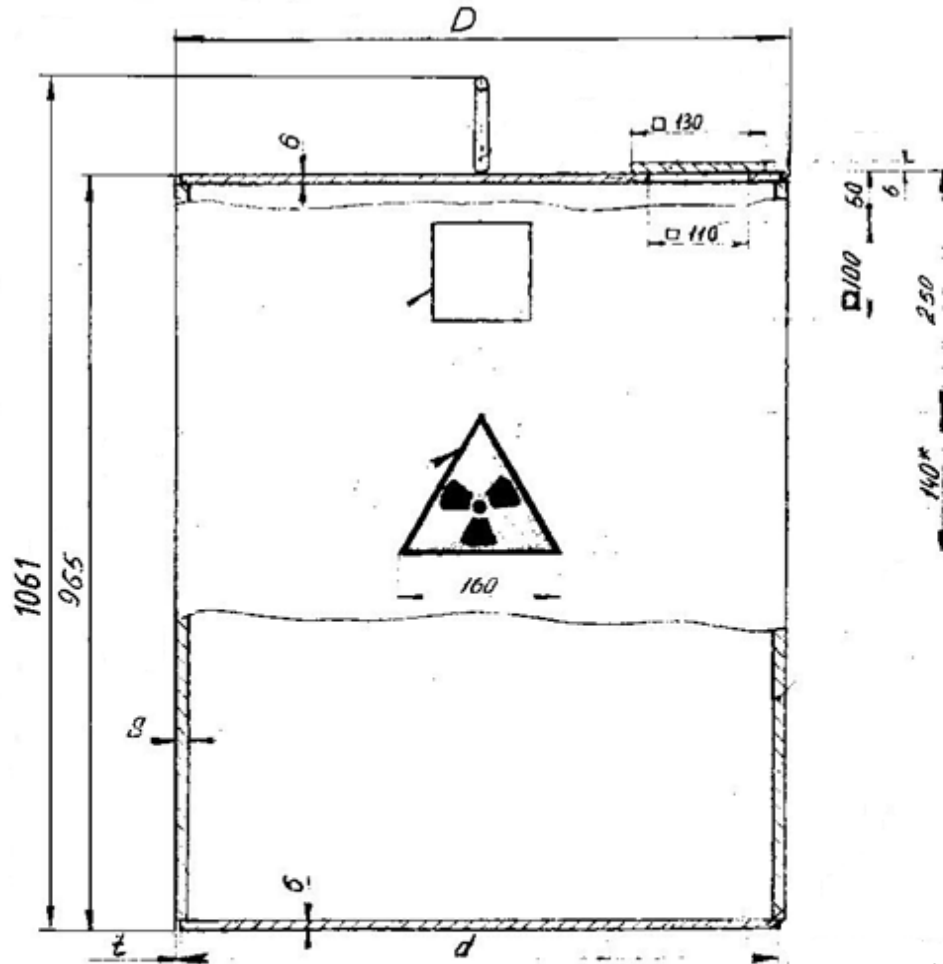
<sup>1</sup> Surface dose rate of packages with intermediate level waste can be up to 2 mSv/h



- 3.1.2 Cylindrical shape Type I and Type II containers (ref. Figures 1 and 2 in Annex) containers for “salt cake”:
- 3.1.2.1 material – carbon steel;
  - 3.1.2.2 wall and top/bottom thickness – 3 mm to 9 mm;
  - 3.1.2.3 diameter - vary in the range 426 mm to 790 mm;
  - 3.1.2.4 maximum height - up to 1063 mm (with hook);
  - 3.1.2.5 mass netto – vary in the range 75 kg to 150 kg; and
  - 3.1.2.6 total mass (with waste) – up to 830 kg.
- 3.1.3 Container MK-0.2 (ref. Figure 3 in Annex) to be used as a container for “salt cake”:
- 3.1.3.1 material – carbon steel;
  - 3.1.3.2 diameter – up to 565 mm;
  - 3.1.3.3 height – up to 916 mm (with T-hook on top);
  - 3.1.3.4 wall and lead/bottom thickness – 2.5 mm;
  - 3.1.3.5 mass netto – up to 78 kg; and
  - 3.1.3.6 total mass (with waste) – up to 456 kg.

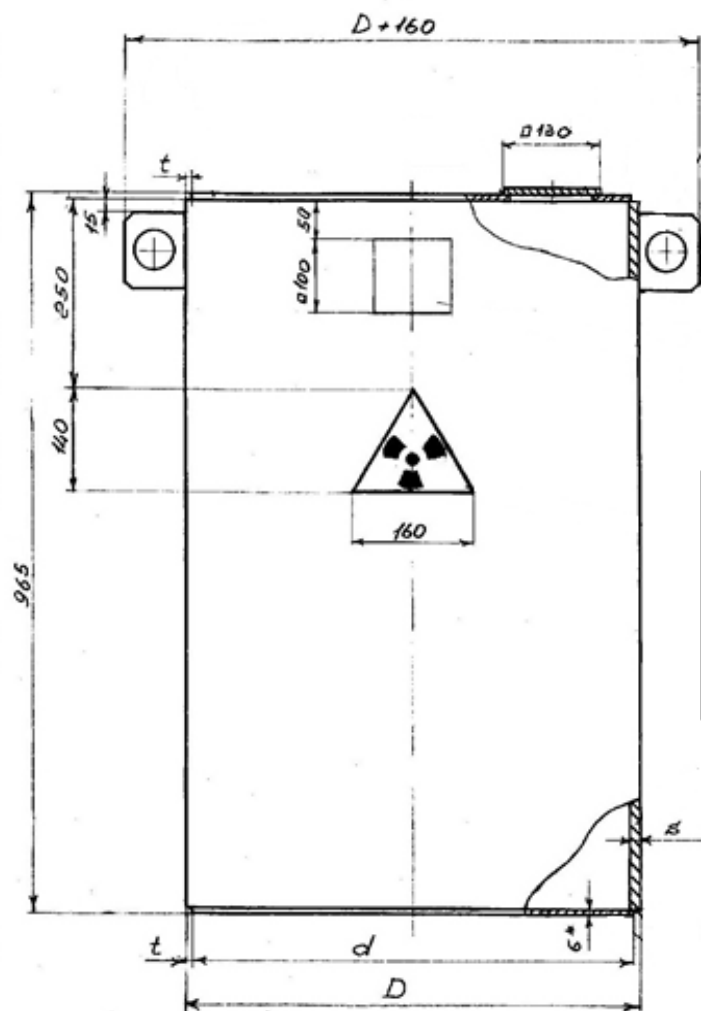
## ANNEX 2 Drawings on the type of containers

The drawings below are property of the Armenian Nuclear Power Plant.



Designation	Capacity L	D mm	S mm	d mm	t mm	Weight, kg	
						empty	filled
604-020	120	426	9	417	4.5	105	340
- 01	200	530	6	524	3	100	470
- 02	285	630		624		120	635
- 03	290	630	3	627	1.5	75	600

Figure 1. Type I container with hook on the top



Designation	Capacity L	D mm	S mm	d mm	t mm	Weight, kg	
						empty	filled
20/06-12.00.00	120	426	9	417	4.5	105	340
- 01	200	530	6	524	3	100	470
- 02	285	630		624		120	635
- 03	290	630	3	626	1.5	75	600

Figure 2.Type II container with hooks on the lateral part



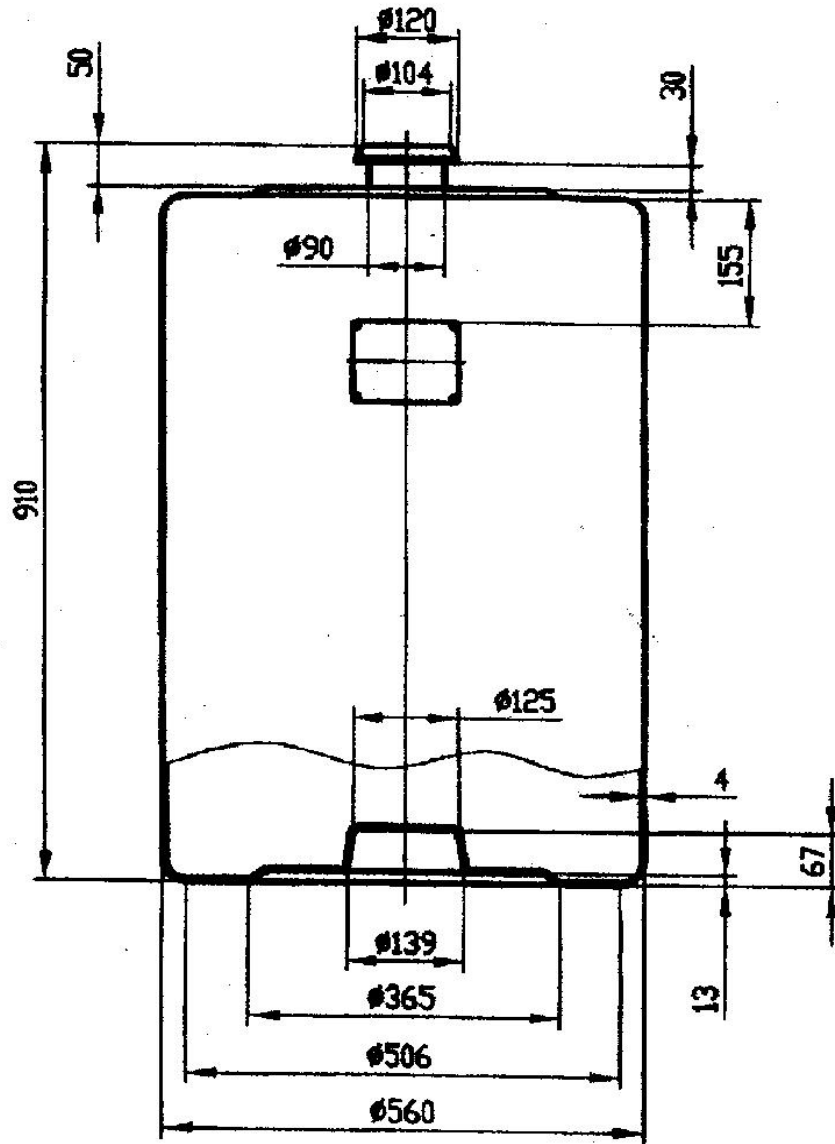


Figure 3. Container MK-0.2 with "T" hook on the top