



SPECIFICATION: Gamma Spectrometer With High Purity Germanium (HPGe) Detector

1. Scope

- 1.1. This specification describes the requirements for a high resolution gamma spectrometer (hereinafter referred to as “the System”) for the verification and determination of gamma emitting radionuclides in different sources and materials. The system is going to be used in the analysis of environmental (soil, water, air filter, etc.) and radioactive waste characterization (solid or liquid) samples in different geometries such as Marinelli-Beaker (500mL or 1000 mL), filter, disk and cylindrically shaped sources and in variable (low to high) count-rate.
- 1.2. The System shall be supplied to the Analysis Laboratory of Iran Radioactive Waste Management (IRWA) Co. in Tehran (Islamic Republic of Iran) (hereinafter referred to as “the End-User”) under IAEA Technical Cooperation project IRA9023. Required Language: English.
- 1.3. The Contractor may propose alternatives that differ from this Specification, but are intended to produce the same or better results for this application. In such cases, these must be clearly stated and justified in the proposal.
- 1.4. Any assumptions made in your Quotation (e.g., facilities, standards, equipment already possessed by End-User) must be clearly identified.
- 1.5. Quotations are to show the total cost to meet this specification, broken down to separately show equipment and in-country services (installation, training): then sufficient technical information to provide assurance of compliance with this Specification.

2. Applicable Documents

The Equipment shall not violate IEC 61508 (*Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems*).

3. Definitions, Acronyms, and Abbreviations

The following definitions, acronyms, and abbreviations shall apply throughout this Specification unless defined otherwise hereinafter:

Cd–Cadmium
Cu–Copper
DSP–Digital Signal Processing
IEC–International Electrotechnical Commission
ISO–International Standard Organization
KeV–Kilo electron volt
L–Litre
LN2–Liquid nitrogen
MCA–Multichannel analyzer
MeV–Mega electron volt
ML–millilitre



PC–Personal computer
IAEA–International Atomic Energy Agency
Sn–Tin

4. Requirements

4.1. The System shall meet the technical requirements in Schedule 1.

The System shall include the following equipment and functionality:

- 4.2. P-Type Closed-End Coaxial Ge detector (technical requirements in Schedule 1);
- 4.3. Cooling system to be liquid nitrogen with vertical geometry of cryostat, and automatic shutdown of detector high voltage in case of detector warm-up;
- 4.4. Detector shielding to be graded shield of lead, thickness 10 cm, with Sn (or Cd) and Cu sheets to prevent interference by lead X-rays, or other with equivalent performance;
- 4.5. Integrated desktop MCA, preamplifier, DSP and high voltage power supply, pole zero adjustment option (According to Preamplifier Type), communication interface to the equipment PC;
- 4.6. Gamma Spectrometry Software with all needed components to control the equipment setup, the MCA, spectrum acquisition and analysis, reporting results and Energy-Efficiency calibration;
- 4.7. Efficiency calculation application for High Purity Germanium detectors and common containers such as Point Source, Marinelli, filter paper, disk, charcoal cartridge, and bottles based on the concept of efficiency transfer;
Software interface and operation manual in the English language;
- 4.8. Dewar vessel (35L), Liquid Nitrogen Level Monitor/Controller, storage vessel and transportation system for liquid nitrogen, with the needed tubes and fittings; and
- 4.9. All required connecting cables and adapters.

5. Marking and Packing

- 5.1. The System shall have all safety markings in the English language; and
- 5.2. The System, for the shipment by air to the End-User, shall be packed in accordance with international standards that are applicable for the shipment by air of this kind of equipment.

6. Quality Requirements

- 6.1. The System shall be manufactured, shipped and installed in accordance with the Contractor's ISO quality assurance system or an equivalent quality assurance system. The Contractor shall retain documents demonstrating compliance, and provide them only if specifically requested;
- 6.2. The System, prior to shipment, shall be tested for conformance of the System with manufacturer's performance specifications and the minimum requirements specified herein; and
- 6.3. The System, 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.

7. Installation and Training

- 7.1. The Contractor shall install the System in the location specified in 1.2;
- 7.2. The Contractor shall provide five days training for up to three staff of the End-User in the operation and maintenance of the System at the End-User's location immediately after the installation of the System; and
- 7.3. On completion of installation, testing, and training the Contractor shall obtain acceptance from the End-User, and forward this to the IAEA to enable payment.

8. Deliverable Data Items

The Contractor shall provide two complete sets of operation and servicing manuals and technical drawings in the English language.

9. Support

- 9.1. The System shall be supplied with a comprehensive warranty, valid for one (1) year from date of installation;
- 9.2. Contractor to identify a support plan appropriate for the End-User, with full contact details. Note that in-country or regional support is preferred; and
- 9.3. Please note consumables required, any routine or preventative maintenance that is recommended, and components where replacement is expected within a typical ten year life span.

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10. Optional Requirements

Contractor to quote for the following ‘options’, clearly separated from the main quotation, to be considered by IAEA or End-User:

- 10.1. Four (4) years’ service contract, for additional years of fully comprehensive maintenance and support services (including costs of labour and parts) following the initial one (1) year full warranty. Full details of the service contract plans must be provided with the offer, including detailed maintenance schedule options and costs; and
 - 10.2. Please indicate if any additional items are suggested for installation, calibration, and operation (such as, reference sources).
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**Schedule 1 – Technical parameters**

Description		Value	Notes
Energy Range	Minimum	40 keV	
	Maximum	10 MeV	
Detector relative efficiency	Minimum	50%	
Energy resolution Full Width Half Maximum (FWHM)	Maximum	1.1 keV	@ 122keV
	Maximum	2.0 keV	@ 1333keV
FWTM/FWHM	Maximum	1.9	
FWFM/FWHM	Maximum	2.5	
Peak-to-Campton Ratio	Minimum	62:1	
Cryostat LN2 capacity	Minimum	35L	