

SPECIFICATION

Unmanned Airborne Vehicle (UAV) based Gamma Ray Spectrometer

1. Scope

- 1.1. This specification describes the requirements for an Unmanned Airborne Vehicle (UAV) and compatible lightweight Gamma Ray Spectrometer (hereinafter referred to as “the System”) for low altitude aerial radiation survey and mapping in real time during routine, targeted and emergency response monitoring, to be provided to the Agency of Nuclear and Radiation Safety (ANRS), in Tbilisi, Georgia (hereinafter referred to as the “End-User”).
- 1.2. The System is to be provided through the IAEA Project GEO9016 “Improving Regulatory Oversight and Response Capabilities”.

2. Definitions, Acronyms, and Abbreviations

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

- 2.1. ASCII – American Standard Code for Information Interchange;
- 2.2. CSV – Coma Separated Values;
- 2.3. CPS – Counts per Second;
- 2.4. DSP – Digital Signal processing;
- 2.5. GNSS: Global Navigation Satellite System;
- 2.6. KML/KMZ – Keyhole Mark-up Language (Zipped);
- 2.7. MCA – Multichannel Analyser;
- 2.8. MTOW – Maximum Take Off Weight;
- 2.9. UAV – Unmanned Aerial Vehicle
- 2.10. HD Camera – High Definition Camera

3. Requirements

- 3.1. **The System shall meet the following general functional and performance requirements:**
 - 3.2.1. The System shall be designed based on combination of UAV with Gamma Ray Spectrometer and HD camera as a payload;
 - 3.2.2. The UAV platform shall provide autonomous deployment and mission capability and capacity for operation with the gamma ray spectrometer and HD camera.
 - 3.2.3. The System shall have HD camera that is additional to built-in aerial camera;
 - 3.2.4. The System shall perform radiological mapping in environmental and radiation protection applications;
 - 3.2.5. The UAV platform shall be designed on multirotor platform equipped by anti-collision beacon;

- 3.2.6. The System shall provide proper operation of the gamma ray spectrometer, HD camera as well as compatibility to control the peripherals. The compatibility of all components shall be assured; and
- 3.2.7. The System shall operate in the following environmental conditions: Temperature from -10°C to +40°C; humidity from 40% to 95%.

3.2. The System shall meet the following technical requirements:

- 3.2.8. The System shall communicate with ground station: UAV Flight Control Systems and computer (laptop) or tablet for receiving and displaying transmitted radiation data.
- 3.2.9. The frequency range for the System communication and data transmission shall meet requirements of Georgian legislation (Order No.58 of Director of Civil Aviation Agency, from 1 May 2017, for the operation of UAV can be used all frequencies, different from aviation frequency range);
- 3.2.10. The System shall include auxiliary (supporting) sensors for: fix the position by multi GNSS, measurement of altitude above ground (laser or radar altimeter), real time clock synchronized with GNSS time, and optionally measurement of temperature, humidity and pressure;
- 3.2.11. The System shall record and transmit at least following data to the ground station in real-time of flight: spectra, counts per second (CPS), Dose Rate, GNSS data (Lat, Lon, altitude, date/time, and number of received satellites) as well as altitude above the ground with a period 1 sec; and
- 3.2.12. The System shall include the software for data acquisition and data post-processing with capability for data and spectra visualization, data presentation on the map, data export to ASCII or MS Excel format (CSV) and KMZ or KML format.

UAV platform shall have the following or better parameters:

- 3.2.13. MTOW: up to 20 kg;
- 3.2.14. Effective flight duration: min. 40 min on one battery set (without payload);
- 3.2.15. Wind resistance: up to 10 m/s;
- 3.2.16. Remote operation control range: ≥ 3 km;
- 3.2.17. Operation frequencies: according to Georgian legislation (see 3.2.9);
- 3.2.18. Aerial preview camera: built-in;
- 3.2.19. UAV Flight Control Systems: Type RF, remote controller with antenna, powered by battery (for frequency see 3.2.9);
- 3.2.20. Power supply: Rechargeable batteries and battery charger based on 220-240 VAC, 50-60 Hz and 12 VDC with car connector.
- 3.2.21. 6 spare batteries (the same parameters as standard one from UAV platform);
- 3.2.22. Two sets of spare propellers;
- 3.2.23. Transport case for all components of UAV platform; and
- 3.2.24. Software package for diagnostic and UAV setup, survey preparation, UAV flight control with telemetry and video transmitting, flight data recording. A permanent licence is required;



HD Camera for Photogrammetry shall have the following or better parameters:

- 3.2.25. High resolution HD camera suitable for Photogrammetry: type optical, photos resolution ≥ 20 MP, zoom option, video resolution $\geq 5K$, field of view ≥ 70 degree, supported formats JPEG, MOV, MP4, DNG and with 3-axis mechanical gimbal stabilization;
- 3.2.26. Photogrammetry SW (permanent licence) for processing of photos from high resolution camera (specified above), orthophoto map creation, 3D model preparation and picture format converting;

Gamma Ray Spectrometer shall have the following or better parameters:

- 3.2.27. Detection type: scintillation NaI(Tl) or equivalent, (temperature stabilized);
- 3.2.28. Detector size: $\geq 1.5 \times 1.5$ inch;
- 3.2.29. Energy Range: 50 keV – 3 MeV;
- 3.2.30. Energy resolution: ≤ 7.5 % at 662 keV of Cs-137;
- 3.2.31. Number of Channels: min 1024 (256/512/1024 adjustable);
- 3.2.32. Sampling rate: 1 sec (data recording);
- 3.2.33. DSP Pulse throughput: min. 50 kcps;
- 3.2.34. Altitude above the ground measurement: 0-50m (laser or radar altimeter);
- 3.2.35. Ground station laptop or tablet for transmitted radiation data receiving and visualization;
- 3.2.36. SW package for Radiological Mapping, real time radiation data receiving and display, data post processing, export, and QC. A permanent licence is required;
- 3.2.37. Tripod supporting ground station.

4. Marking and Packing

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

5. Quality Requirements

- 5.1. The System shall be manufactured and installed in accordance with the Contractor's ISO quality assurance system or an equivalent quality assurance system.
- 5.2. The System, prior to shipment, shall be tested for conformance with manufacturer's performance specifications and the minimum requirements specified herein.
- 5.3. 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, and the report submitted to the IAEA Technical Officer.

6. Installation and Training

- 6.1. The Contractor shall provide on-site system assembling and support to initial operation, at the End-User's location.



- 6.2. The Contractor shall provide on-site five (5) days end-user staff training for:
- UAV piloting,
 - Operation of radiation detector, resp. Gamma Ray Spectrometer and related SW for Radiological Mapping;
 - Utilization of Photogrammetry SW;
 - System maintenance.
- 6.3. The Contractor shall provide ongoing remote support and service, for one year from conclusion of the training.
- 6.4. 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 English language.