

Radionuclide Identification Devices with Gamma Imagery	 IAEA International Atomic Energy Agency	IAEA Specification Dated 2022-12-10
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SPECIFICATION

Radionuclide Identification Devices with Gamma Imagery

1. Scope

This specification describes the requirements for a lightweight handheld, high resolution, Radionuclide Identification Device (RID), hereinafter referred to as the “RID”, used to identify the radionuclides present in radioactive materials and sources with gamma radiation imagery. The specification is written primarily for an RID that would be used by a Front Line Officer (FLO) in nuclear security applications such as border monitoring. Typically, the RID would be used as a secondary inspection tool once a source of radiation has been detected by a gross counting instrument such as a Radiation Portal Monitor (RPM) or personal radiation detector (PRD). The specifications describe the design and functioning criteria of the RID to identify the radionuclides present and for indication of the ambient dose equivalent rate.

The specification has minimum requirements for photon detection and identification. The detection of neutrons is a desired, but not required, feature and specifications for neutron detection are included herein if a neutron detector option is offered.

2. Applicable Documents

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

“Radiation protection instrumentation – Hand-held instruments for the detection and identification of radionuclides and for the indication of ambient dose equivalent rate from photon radiation,”
International Standard, IEC 62327, First edition, 2006-02.

Additionally, any standards or references, including any tests therein, incorporated as essential elements of the IEC Standard above shall also be applicable.

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

3. Definitions, Acronyms, and Abbreviations

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

PRD: Personal Radiation Detector

RID: Radionuclide Identification Device

RPM: Radiation Portal Monitor

4. Essential features

The RID *shall* have the following features:

- (a) User friendly controls for single-handed RID operation, even with protective gloves.



- (b) At least two operating modes: (1) for routine operation where search and identification capabilities are available to the user, and (2) for expert mode which is restricted access and allows settings to be adjusted.
- (c) Gamma detection and identification capability using internal detectors and without external cables and connectors;
- (d) Internal processor to perform isotope identification within the device;
- (e) User selectable dose rate and count rate and safety alarm levels;
- (f) Ability to store internally at least 100 spectra.
- (g) Each stored spectrum shall also have the following information:
 - Time and date
 - Identified radionuclides and associated confidence levels
 - Indicated ambient gamma dose equivalent rate
- (h) Time-counter mode for gamma channels to enhance detection sensitivity for weak sources, including re-settable dose indication;
- (i) Rugged and designed for outdoor use in a wide range of temperature and humidity, including rainy conditions;
- (j) Multilanguage user interface, including English and Russian;
- (k) Sufficient battery life for at least 8 hours of continuous operation;
- (l) Automatic (“easy”) and manual (“expert”) modes of operation, including password protected switching between modes;
- (m) Computer link and computer support software;
- (n) The location of internal detectors shall be marked on the RID housing;
- (o) The display of the RID shall meet the following requirements:
 - (i) Adequate display size and good readability under all field conditions including strong daylight. The display shall be illuminated and shall have manual contrast adjustment;
 - (ii) Dose rate indication shall be in units, and subunits, of Sv/h excluding nSv/h;
 - (iii) Graphic indication, such as a bar graph with auto scaling of logarithmic dose rate, strip chart for search mode with auto scaling of count rate, and gamma spectrum in expert mode;
 - (iv) Over range indication for dose rates of more than 10 mSv/h with visual and acoustic alarms;
 - (v) Indication of remaining battery voltage, life or available charge; and
- (p) User configurable audio and visual alarm functions - vibration alarm desirable.

For RIDs that are proposed, can be as an option, with the ability to support an external probe for alpha and beta radiation, the RID shall meet the following requirement:

- (q) Plug and play indications to use the external alpha/beta contamination monitor.

5. Detailed specifications of main functions

5.1. Start up and shutdown

The RID shall have the following start-up and shutdown characteristics:

- (a) The startup and shutdown keys shall be protected against non-intentional operation;
- (b) A fully automated start-up process, with system self test;
- (c) If recalibration not automatically done, allowance for manual re-calibration of the RID, based on a specified energy line of a supplied exempted calibration source;
- (d) Display indication of the hardware/software version and the date/time; and
- (e) Ability to store the energy calibration data so as to shorten startup time.

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5.2. Dose rate

The RID shall have the performance characteristics as listed below.

5.2.1. Range of the gamma dose rate indication

The RID shall be capable of indicating the gamma dose rate ranging from normal background up to at least 10 mSv/h, over the energy range from 60 keV up to 3.0 MeV with a relative uncertainty of less than $\pm 50\%$.

5.2.2. Response at high gamma dose rates

The RID shall have the following responses to high gamma dose rates:

- When the dose rate of an isotopic gamma field is increased in less than 3 sec from $100 \mu\text{Sv}\cdot\text{h}^{-1}$ to more than 1 mSv/h the RID shall not indicate zero dose rate for more than 1 s when switching from the scintillation detector based dose rate reading to the high dose rate detector based reading. If the dose rate is derived from the internal high dose rate detector, this shall be indicated on the display;
- If the high dose rate condition is suddenly removed, the normal operation of the RID for gamma spectrometer and isotope identification shall resume in 1 minute or less time; and
- At the transition point there shall not be a significant variance, i.e. less than $\pm 50\%$, between dose rate values measured with the spectrometric detector and measured with the high dose rate detector of the RID.
- The RID, if there is a gamma dose rate overload of more than 10 mSv/h, shall have a clear and permanent visual and audio over dose rate indication;
- The RID overload indication shall never break down in the situation described in point 2.2(a) and the dose rate indication shall be “greater than 10 mSv/h” or shall be “ $> 10 \text{ mSv/h}$ ”.

5.2.3. False Alarm Rate (FAR)

At standard gamma and neutron background*, the false alarm rate in search mode of the RID shall be less than one per minute for gamma alarms and shall be less than one per hour for neutron alarms at 0.95 confidence level.

The FAR due to RID problems (noise, interferences, EMI, microphonics) shall be negligible compared to the FAR determined by the RID counting statistics. The FAR requirements shall be met with standard equipment settings fulfilling the dynamic sensitivity requirements as given below.

5.2.4. Sensitivity to gamma radiation in search mode

The RID shall have the following response characteristics in ‘search’ mode:

- Over the gamma energy range of 0.06 MeV to 1.5 MeV; the gamma alarm shall be triggered by an increase in dose rate at the face of the detector for a duration of 1 second at a standard background of $0.1 \mu\text{Sv/h}$ for the following:
 - For Am-241 at 50 nSv/h ;
 - For Cs-137 at 100 nSv/h ;
 - For Co-60 at 150 nSv/h .
- The gamma alarm indication originating under the conditions specified in (a) above, shall disappear within 1 sec after the removal of the gamma signal originating from a gamma ray source.

* As specified in NSS1: standard gamma ray background is $0.1 \mu\text{Sv/h} \pm 50\%$ in the energy range from 30 keV to 3.0 MeV, standard neutron background is $0.015 \text{ n}\cdot\text{cm}^{-2}\cdot\text{s}^{-1}$.

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6. Sensitivity to neutron radiation (If this optional detection capability is offered)

6.1. For RIDs supplied with a neutron detector, the RID shall meet the following requirements with regard to neutron sensitivity:

- The RID shall alarm within 10 second of the exposure to an unmoderated Cf-252 source of 0.01ug (emitting not more than 20,000 n/s) with the source placed no less than 25 cm from the instrument's reference point.
- The sensitivity specified in point 6.1(a) above, shall be achieved with a neutron false alarm rate of less then one per one hour; and
- The RID shall use an efficient internal neutron moderator.

There are some applications where a RID may be required with a high sensitivity neutron detector. Additional consideration shall be given to RIDs that meet the following requirements with regard to neutron sensitivity:

- Absolute detection efficiency to fission spectrum neutrons shall not be less than 4 counts/s per 1 n·cm⁻²·s⁻¹ (4 cm²). This is equivalent to 0,4 counts/s (background subtracted) when the Cf-252 standard neutron test source of 12 000 n/s intensity is located at a one-meter distance from the reference point of the sensitive detector surface with the reference point of the instrument pointing towards the source. The RID shall trigger an alarm when exposed to a Cf-252 source with an emission rate of 12 000 n/s, moving with a speed of 0.5 m/s at the distance of closest approach of 1 m.

The measurement of the sensitivity has to be done in low albedo environment, i.e. where the processes of neutron scattering from the source vicinity are negligibly small (outdoor at 2 m above ground).

6.2. Gamma sensitivity of Neutron detector (If this optional detection capability is offered)

The RID shall not trigger a neutron alarm when exposed to a Co-60 gamma ray source producing a dose rate at the neutron detector of not less than 100 µSv/h (±30%). This test shall be done with the neutron threshold set to meet the FAR and sensitivity requirement specified in Section 6.1

7. Minimum requirements for isotope identification

The RID shall meet the minimum requirement specified below.

7.1. List of isotopes and test conditions

With a dose rate at the detector of 0.5 µSv/h above background, the RID shall be capable of identifying all radionuclides listed in Table 1 below.

Table 1 – Minimum scope of the radionuclide's library (bare material)

Category	Radionuclide	Special Indication Requirements
Nuclear Materials	- U-233, U-235, U-238 ((covering HEU, LEU, NU, DU); - Np-237; - Pu-239 (covering low and high burn up Pu).	All to be indicated as uranium in easy mode; Neptunium; All to be indicated as plutonium in easy mode.

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Medical radioisotopes	PET source (e.g., F-18), Ga-67, Tc-99m, In-111, I-123, I-131, Xe-133, Tl-201.	For the isotope F-18 and other pure positron emitters, the RID display shall also indicate “annihilation radiation” or 511 keV
Industrial radioisotopes	Co-57, Co-60, Ba-133, Cs-137, Ir-192, Eu-152, Am-241, Se-75, Sr-90 (Bremsstrahlung)	SR-90 indicated as “Bremsstrahlung”
Naturally occurring radioactive materials (NORM)	K-40 (e.g. fertilizer, tiles, ceramics), Ra-226, Th-232s and daughter isotopes; The high energy gamma line of Th-232 and Th-228 at 2614 keV, which are an attribute of recycled uranium.	A differentiation by peak area between the 2614 keV background gamma line of Tl-208 originating from Th-232 decay and that from U-233 or U-232 of the sample decay is desirable.

In addition to the above, the RID shall be capable of displaying the isotopes in Table 2 below under the conditions indicated.

Table 2 – Minimum scope of the radionuclide’s library (shielded material)

Condition	Isotopes
Behind 5 mm steel shielding	K-40, Co-57, Co-60, Ga-67, Tc-99m, desirable I-125 and I-127, I-131, Ba-133, Cs-137, Ir-192, Tl-201, Ra-226, Th-232, U-233, U-235, U-238, Pu, Am-241
Behind 10 mm lead shielding	Low and high burn up Pu, LEU (<20% U-235), Co-60, I-131, Cs-137, Ir-192, Ra-226

The measurement time of the RID for unshielded sources shall be less than 1 min with a dose rate at the detector of 0.5 $\mu\text{Sv/h}$ above background.

The measurement time of the RID for a steel shielded source is to be within 2 minutes and with a lead shielded source within 10 minutes. For NORM an appropriate extension of the measurement time, depending on the dose rate at the detector, is allowed.

7.1.1 Mixtures

The following mixtures shall be identifiable by the RID within two minutes (unshielded, Pu filtered with 2 mm of Cd) with each isotope contributing $0.5 \mu\text{Sv.h}^{-1}$ ($\pm 30\%$) above background measured at the detector reference point from each radionuclide:

- (i) Cs-137+ U (natural and HEU);
- (ii) I-131 + U (natural and HEU);
- (iii) I-131 + Low and high burn-up Pu;
- (iv) Co-57 + U (natural and HEU);
- (v) Ba-133 + Low and high burn-up Pu; and
- (vi) Ra-226 + Th-232.

Sr-90 (Bremsstrahlung) shall not be misidentified as gamma radiation from one of the listed isotopes and desirably shall be indicated as "Bremsstrahlung" differentiating its spectrum from that of a shielded gamma source.



The RID shall display the presence of 2.23 MeV (n,γ) neutron capture gamma line from hydrogen as “neutron capture gamma rays”

7.2. Indication of isotope identification results

The RID shall be capable of displaying the results of the measurement in terms of the isotope and category, or shall display a message such as “weak signal”, “not identified” or “not in the library”. In any case it shall be possible to continue, also in the easy mode, the measurement without restarting RID.

7.2.1. Operation of the RID in easy mode

The following indications are required for the RID in easy mode:

- If any uranium isotope is detected, the RID shall display: “Uranium – Nuclear”;
- If any plutonium isotope is detected, the RID shall display: “Plutonium – Nuclear ”;
- If Th-232 + daughters are detected, the RID shall display: “Th – NORM”;
- If Ra-226 + daughters are detected, the RID shall display: “NORM” or ”Industrial”; and
- If the 2.2Mev neutron capture gamma line from hydrogen is present, the RID shall display “neutron capture gamma rays”.

The confidence level of the isotope identified shall also be clearly indicated by displaying the certainty of identification results.

7.2.2. Operation of the RID in manual (expert) mode

The following indications are required for the RID in manual (expert) mode:

- (a) If any uranium isotope is detected, the RID shall display “DU, NU, LEU, HEU”, depending of the grade of the material;
- (b) If any plutonium isotope is detected, the RID shall display “Low burn-up” or “High burn-up” Pu, depending on the grade of the material; and
- (c) If the 2.2 Mev neutron capture gamma line from hydrogen is present, the RID shall display “neutron capture gamma rays”.

7.3. False Indications

The RID shall have the following performance characteristics for the indications:

(a) False negatives

For a single nuclear or industrial isotope the probability to misinterpret the isotope as medical or NORM isotope shall be less than 10^{-2} with confidence level of 0.95.

(b) False positives:

None of the single industrial (e.g. Ho-166), medical (e.g. Ga-67) or NORM isotopes (Tl-208) from the library, as well as those which are not present in the RID’s library (and therefore can not be identified correctly) shall be misinterpreted as nuclear material with a probability of less then 2×10^{-2} at a confidence level of 0.95.

7.4 Identification of radioactive materials typically causing “innocent” alarms due to NORM

The following materials containing NORM are often encountered:

- Colored glass containing Uranium;
- Optical lenses with Thorium;
- Video screen with Thorium;
- Gas lantern mantles;
- Wrist watches containing Ra-226;



- Fertilizer containing K-40;
- Ceramics and tiles containing Thorium, Uranium, Ra-226; and
- Thorium in welding rods.

The RID shall be capable of identifying all items listed above, without shielding present. Due to the low dose rates of these materials at the detector the measurement time for the RID shall be extendable up to 10 minutes at a dose rate level three times above background.

7.5. Repeatability of the verification

At a confidence level of 0.95 the RID shall have a repeatable accuracy of measurement (probability of the correct identification) of:

- 90% for mixtures of isotopes (i.e. 96 identifications in 100 measurements for a mixture of isotopes, each with a dose rate of about 0.5 $\mu\text{Sv/h}$); and
- 95% for all other isotopes (i.e. 99 identifications in 100 measurements for sources with a dose rate of about 0.5 $\mu\text{Sv/h}$).

7.6. Display indications during measurements

The RID shall be capable of displaying the following during measurement:

- Dead time or upper count rate limit indication;
- Gamma dose rate (in easy mode);
- Time left until processing of spectra (count down);
- Neutron alarms (if any);
- Indication that device is busy with processing of the spectrum; and
- If interrupted by user - identification results if available.

8. Option of external detector, sensitive to alpha and beta radiation

The external detector shall be able to distinguish between alpha and beta radiation and indicate both particle fluxes separately. The detector window shall have a minimum size of 120 cm^2 .

9. Physical Dimensions, Weight

The RID *shall* meet the following dimension and weight requirements:

- The RID shall measure no larger than 300mm length, 150 mm width, and 120 mm depth;
- The RID shall weigh less than 3 kg; however in the case of a detector supplied with the option of high neutron sensitivity, the weight will be less than 4 kg;
- The RID shall be self-contained, i.e. the RID shall have no external detectors or cabling with the exception of an optional attachable surface contamination probe; and
- The RID shall be comfortable, ergonomically designed and with a carrying handle that allows for extended, single-handed operation for long periods, even when protective gloves are being worn by the user of the RID.

For certain applications, a smaller and lighter RID than meeting the specifications of 9(a)-(d) may be desired. Additional consideration will be given to a RID that meets the following dimension and weight specifications:

- The RID measures no larger 2,000 cm^3 .
- The RID weighs less than 2 kg.

10. Graphical User Interface (GUI)

Graphical User Interface of the RID shall contain the following features in easy and expert modes of operation.



10.1 Easy mode GUI

The easy mode of the RID shall include the following features in the Graphical User Interface (GUI):

- (a) Search, dose rate, isotope identification;
- (b) Battery status indication;
- (c) Gamma and neutron alarm indication with visual and audio alarms - vibration alarm desirable;
- (d) An always active gamma and neutron safety alarm indication with visual and audio alarms;
- (e) Limited setup functions;
- (f) If recalibration not automatically done, manual re-calibration of the energy scale using K-40 or Th-232 shall be possible without password protection;
- (g) Battery charging indication;
- (h) Extend the measurement of gamma ray spectra even the results is being indicated
- (i) Save the spectrum in the device memory; and
- (j) Retain saved spectra even if the main battery is depleted.

10.2. Expert mode GUI

The expert mode of the RID shall include the following features in the Graphical User Interface (GUI):

- (a) The GUI of the expert mode shall be protected by password or equivalent;
- (b) Gamma spectrometer functions, including visualization of the spectrum, analysis of its structure by pointing to peak positions with the cursors;
- (c) Gamma and neutron timer counter mode indication;
- (d) Manual re-calibration of the energy scale using C-137;
- (e) A neutron dose indication that is user configurable, will be desirable;
- (f) Full RID setup menu; and
- (g) Diagnostic functions.

11. Signals and Alarms

The signals and alarms of the RID shall meet the requirements specified below.

11.1. General Requirements

The signals and alarms of the RID shall have the following alarms:

- (a) Different audio and visual alarms for gamma and neutrons in search mode;
- (b) Acoustic dose rate safety alarms if a specified level is exceeded; and
- (c) Visual and acoustic low battery alarm at least 5 min before device stops working.

11.2. Search Mode Requirements

The signals and alarms of the RID shall meet the following search mode requirements:

- (a) No signals shall be indicated unless gamma or neutron alarm conditions are met;
- (b) If gamma radiation is present and the alarm condition is exceeded, the audible alarm shall be proportional to the gamma count rate. If neutron counts are also present, then single “beeps” of neutron audible signal shall overlay the gamma audible signal and the gamma and neutron audio signals shall be clearly different;
- (c) Gamma background shall be determined upon startup of search mode and if initiated by the user of the RID;
- (d) A gamma alarm signal shall be triggered off if counts exceed background. The algorithm of determining a gamma alarm shall be documented and supplied with the RID. The alarm threshold shall be user settable to meet the gamma FAR requirement of less than one per min;



- (e) Neutron search alarm signal shall be triggered off if neutron count rate exceeds alarm threshold, which shall be set to meet FAR requirement of no more than one per hour. The algorithm of determining a neutron alarm shall be documented and supplied with the RID;
- (f) User of the RID shall be able to manually silence an audio radiation alarm;
- (g) The dose rates corresponding to the gamma safety threshold shall be indicated on the dose rate display; and
- (h) The prevailing gamma dose rate shall be indicated.

12. Setup Parameters Requirements

The RID shall meet the requirements specified below with regard to the parameters of operation, which shall be adjustable in “expert” mode only or through a PC connection.

12.1. Search Mode

The RID shall display the following parameters in gamma search mode:

- (a) Background averaging time as a fixed value;
- (b) Regulating FAR and search sensitivity as a sigma multiplier or equivalent,; and
- (c) Dwell time.

The RID shall display the following parameters in neutron search mode:

- (a) Neutron count rate threshold; and
- (b) A settable (between 1 and 60 sec) dwell or averaging time, which is the period over which the neutron counts are averaged before a comparison with the constant threshold is made, will be desirable.

12.2. Isotope Identification Mode

The RID shall display the following parameters in isotope identification mode:

- (a) Use of a standard library or selection of task oriented libraries;
- (b) Creation of user customized libraries; and
- (c) Measurement period.

13. Spectrometers Requirements

The RID shall meet the requirements specified below for the spectrometers.

13.1. Expert mode

In “expert” mode, it shall be possible for the user of the RID to:

- (a) Graphically display the gamma spectrum;
- (b) Measure in the energy range 0.03- 3 MeV;
- (c) Store at least 100 spectra of 1024 channels each, in the internal memory;
- (d) Set Log and lin Auto Y scaling;
- (e) Set X-axis to 1 k channels or full memory range and allow spectra expansion around the cursor;
- (f) Vary the cursor function to energy/channel/content or desirable peak area; and

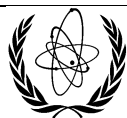
13.2. Peak Stabilization Requirements

- (a) To maintain the RID’s energy scale the RID’s stabilization shall be fully automated.
- (b) The RID’s stabilization shall be based on an LED, temperature sensor, or equivalent, reading.
- (c) An external naturally occurring re-calibration source shall be delivered with the RID.

13.3. Spectrometer Amplifier and MCA Requirements

The spectrometer amplifier and MCA of the RID shall meet the following requirements:

- (a) The MCA shall have at least 1024 ADC channels;



- (b) Maximum non-linearity of energy scale, after linearization, shall be less than $\pm 1\%$ up to 1 MeV and less than $\pm 2\%$ for the energy range above 1 MeV,
- (c) The operation shall be stable without manual re-stabilization at least for 24 hours within the required temperature range;
- (d) Dead time for 40 kcps input rate shall be less than 50% (Cs-137);
- (e) Peak shift due to a high dose rate shall be less than 1 % for dose rate up to 100 $\mu\text{Sv/h}$ for Cs-137;
- (f) Pile-up rejecter or equivalent shall have a clean spectrum without piled pulses, i.e. 50 $\mu\text{Sv/h}$ for Am-241 on detector shall not lead to indication of Co-57;
- (g) ADC and amplifier shall have dead time correction;
- (h) Standard industrial link to a computer by USB or wireless to transfer spectra and change instrument setup using IAEA ASCII string spectrum format or translation software;
- (i) User friendly computer support software for use by experts, including transfer, spectrum viewer, setup, and editing of isotope libraries; and
- (j) Isotope ID, in response to sudden temperature gradients, shall within 10 min operate as specified after the temperature changes from room temperature to a temperature in the range from -20 up to +50 degrees C with one re-stabilization allowed after 1 hour.

14. Data Transfer and Software Requirements

The RID shall be supplied with the following software products:

- (a) A computer based, easy to use Windows software to transfer and view spectra;
- (b) Expert software for post-processing of the spectra data if input of spectra into commercially available programs is not possible;
- (c) Translation software to IAEA standard ASCII format and ANSI 42.42 format to get downloaded, or translated, by provided software; and
- (d) File conversion utility to IAEA ASCII (*.spe) format with detector specific setup and calibration parameters if the RID software includes a proprietary file format.

15. Gamma Imagery

The RID shall meet the following gamma imagery requirements:

- (a) 162° horizontal, >122° vertical; full color
- (b) Option for 100° horizontal, 85° vertical with better optical res. $\pm 2^\circ$ to radiation image in front $90^\circ \times 90^\circ$
- (c) 4π (360°) omnidirectional (Compton imaging)
- (d) $86^\circ \times 86^\circ$ (coded-aperture imaging)
- (e) $\pm 1^\circ$ source localization for all 4π (real time)
- (f) $\sim 30^\circ$ FWHM for all 4π (real time; >250 keV)
- (g) $\sim 20^\circ$ FWHM for all 4π (post processing; >250 keV) External battery charger shall function from 100 to 230 V, and from 50 up to 60 Hz with auto voltage sensing
- (h) $\sim 5^\circ$ FWHM in coded-aperture field of view (<450 keV)

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16. Power Supply Requirements

The RID shall meet the following power supply requirements:

- (a) External battery charger shall function from 100 to 230 V, and from 50 up to 60 Hz with auto voltage sensing;
- (b) Trickle charging mode, if connected to mains power, shall allow continuous device operation without overheating the batteries;
- (c) Battery life time, if used with re-chargeable batteries, shall be at least 8 hours;
- (d) Charging time, if the RID is turned off, shall be less than 8 hours to reach 90% of full battery charge;
- (e) Battery replacement shall be possible without special tools;
- (f) Incorrectly installed batteries, or use of non-rechargeable batteries installed, will not damage the instrument when operated or connected to the charging station;
- (g) If operated using consumable batteries, the batteries shall be widely available;
- (h) The RID shall have an internal back up battery for real time clock, data and parameter storage;
- (i) The RID shall indicate charging of the battery and shall indicate the fully charged state of the battery;
- (j) Loss of power supply shall not affect memory of the unit and set-up parameters.
- (k) It is desirable for the RID to have the following:
 - (i) The optional use of standard rechargeable and non-rechargeable C, D or AA type batteries; and
 - (ii) For this desirable option a warning label shall warn users that non-rechargeable batteries shall not be recharged.

17. Documentation

All documentation shall be provided with the RID in English language of the GUI of the RID:

18. Maintenance and support scheme (Optional)

- a) Training of a local technical support group shall be quoted separately (i.e. trouble shooting and diagnostic, firmware upgrades, performance monitoring).
- b) Instrument training for local end users (e.g. front line officers) shall be quoted separately.

19. Packing

The RID, for the shipment to the End-User, shall be packed in accordance with international standards that are applicable for the shipment of this kind of equipment.

Each individual unit shall have its own packaging and include all necessary manuals, chargers, and other equipment.

20. Quality Requirements

19.1 The RID shall be manufactured, tested, and shipped in accordance with the Contractor's ISO quality assurance system or an equivalent quality assurance system.

19.2 The Contractor shall document the compliance with this quality assurance system.

21. Testing and Acceptance

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

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22. Other conditions

- a) Warranty on the RID shall be for a minimum of 2 years on labour and parts
- b) The Contractor shall entirely be responsible for providing all documentation/certification necessary to allow legal export and use of the RID in the country of use. This may include, for example, export licenses, type test certification with subsequent entry into a State's register of measuring instruments and initial metrological (secondary standard laboratory) verification of the instrument's characteristics.
- c) In the event of firmware changes for the RID, software shall be provided free of charge to the Agency, for use by the Agency and any Member State, to enable field changes to the RIDs.