SPECIFICATION

Stationary Monitoring System with Alpha/Beta Survey
for
Contamination and Photon Dose Rate

1. Scope

1.1. This Specification describes the requirements for a Stationary Monitoring System with Alpha and Beta Gamma survey and contamination meter with dose rate indication intended for a rapid detection of surface contamination by Alpha and Beta emitting radionuclides and for provision of the ambient dose equivalent (H*(10)) for Gamma and X-ray radiation (hereinafter referred to as the "System"). The System shall be delivered to the Ministerio de Salud; Centro Nacional de Radioterapia (CNR) (hereinafter referred to as the "End-User").

1.2. The System is used by the radiation protection officers in facilities working with unsealed sources or by radiological assessors in the case of radiological incident or emergency.

2. Applicable Documents

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

2.1. IAEA Safety Guide RS-G-1.3 Assessment of Occupational Exposure due to External Sources of Radiation.

2.2. IAEA Safety Guide RS-G-1.2- Assessment of Occupational Exposure due to intakes of radionuclides.

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. The System shall meet the following functional and performance requirements:

3.1.1. Extremely effective in large area screening and able to detect low level contamination;

3.1.2. Be able to measure simultaneous alpha and beta particle, discriminate the radiation and display the values in particles per time and area;

3.1.3. An X- and Gamma ray sensitive detector shall deliver data for the displayed ambient equivalent dose rate H*(10);

3.1.4. The display shall show simultaneously the results of the dose rate and the particle measurements;

3.1.5. Have two different modes of operation – easy and expert mode. The expert mode shall be password protected and/or reconfigurable via external PC;

3.1.6. Be light-weighted, self-contained and shall have a handhold which keeps the instrument well balanced;

3.1.7. Have a minimum number of buttons to make it easy to get single handed operated, even with gloves;

3.1.8. Have a plate to protect the alpha-beta window if the instrument is not used;

3.1.9. Have a compact and rugged design with digital display to indicate required information in all modes of operation and under all operating conditions; and

3.1.10. Have alarm indicators to inform the user whenever the radiation is exceeding the pre-set alarm levels for particle

3.2. Technical Requirements -

3.3. Essential features

3.3.1. Simultaneous processing and displaying particle and dose rate measurements;

3.3.2. Alpha and Beta particle measurements with particle discrimination capability

3.4. Safety requirements

3.4.1. The System shall meet the following safety requirements given in IEC 61508-1, 61508-2, 61508-3. It is recommended, the System be European “CE” rated (or equivalent), and marked accordingly; i.e., meets all the essential "Health and Safety" requirements of the European Directive(s) 93/68/EEC that provide for the CE marking, or equivalent.

3.5. Minimum buttons to operate

3.5.1. The System shall have a minimum number of buttons for operation. Examples of good practice are 3 – 5 buttons. All buttons shall be clearly marked. The start-up and shutdown buttons shall be protected against unintentional operation.

3.6. Physical dimensions and mass

3.6.1. The outside dimensions shall not exceed a volume of 5,0 dm3 and the mass shall be less than 1,5 kg with built in batteries.

3.7. Data

3.7.1. The Alpha/Beta survey and contamination meter shall provide the possibility to record a minimum of 1000 measured data with date and time stamp, and to read them out on the instrument as well as with specific software installed on a PC. Data transfer shall happen via serial cable or wireless via infrared or blue tooth interface.

3.8. Multilanguage support

3.8.1. The measurement results shall be displayed in SI units. Additional information on the display such as commands or menu points shall be displayed in English language or optional in other IAEA languages if required.

3.9. Detector(s)

3.9.1. In order to detect a low level contamination effectively the System shall have embedded large area scintillator detector with the following properties:

3.9.1.1. Be self-contained, i.e. neither external detector(s);

3.9.1.2. The window for particle measurements shall have a minimum area of 170 cm2;

3.9.1.3. The detection efficiency (relative to activity of a reference source with 100 cm2 area shall not be less than:

3.9.1.3.1. 29% for C-14 at Beta-gamma channel

3.9.1.3.2. 69% for Cl-36 at Beta-gamma channel

3.9.1.3.3. 58% for Co-60 at Beta-gamma channel

3.9.1.3.4. 71% for Cs-137 at Beta-gamma channel

3.9.1.3.5. 36% for Pu-239 for Alpha channel

3.9.1.3.6. 44% for Am-241 for Alpha channel

3.9.1.4. The background rate shall not exceed the following values:

3.9.1.4.1. 0,1 cps for the Alpha channel

3.9.1.4.2. 10 cps for the Beta channel

3.9.1.5. Minimum measurement range of the instruments:

3.9.1.5.1. Alpha channel: 0 to 5000 cps

3.9.1.5.2. Beta channel: 0 to 50000 cps

3.9.1.6. Photons sensitivities if exposed by 1 µSv/h Cs-137:

3.9.1.6.1. Alpha Channel: not detectable

3.9.1.6.2. Beta Channel: less than 100 cps

3.9.1.7. The contamination meter shall provide ambient gamma dose equivalent rate (dose rate) indication. The instruments are not intended to be legal dose measuring devices, with compulsory certification and periodic performance verification by a metrological institution as required by some Member States. The main purpose for this feature is to minimize the risk of accidental exposure. Measured dose rate values are not intended to be used for any legal purpose unless otherwise specified by the instrument Contractor, user, or legislating authority.

3.9.1.8. The detector shall be sensitive to continuous X-ray and gamma radiation

3.9.1.9. The accuracy of the ambient equivalent dose rate in the range of 0.1 µSv/h – 20 mSv/h shall be within ±50% of the conventionally true value in the continuous gamma energy range from 50 keV to 1.33 MeV.

3.9.1.10. The System shall also process and display the accumulated dose

3.10. Display

3.10.1. The System display shall meet the following display requirements:

3.10.1.1. The measurement data shall be presented in digital form on an LCD display or equivalent.

3.10.1.2. The count rate shall be displayed in Bq/cm2, cps/cm2, or cps with conversation table to cps/cm2 or Bq/cm2.

3.10.1.3. The unit for the dose rate shall be µSv/h

3.10.1.4. The minimum dose rate displayed shall be 0.1 µSv/h or less

3.10.1.5. The display shall have an adequate size to guaranty a clear reading of the count rate (digit size 8 mm or more) and the unit of the count rate.

3.10.1.6. The display shall show also a low battery indication

3.10.1.7. A background light activated automatically or manually shall be implemented

3.10.1.8. The display shall also have a freeze indication

3.10.2. Start-up

3.10.2.1. The System shall have buttons to turn the unit on or off

3.10.2.2. The warm up time shall be less than one minutes for initial operations when the instrument is in equilibrium with ambient temperature

3.10.2.3. The System shall run through a self-test procedure and shall display possible errors.

3.10.2.4. During Start-up sequence display shall show firmware version and battery status

3.10.3. Modes of operation: The System shall have two modes of operation, an easy and expert mode.

3.10.3.1. Expert mode shall be password protected

3.10.3.2. Alarm indicators and alarm thresholds. The System shall have audible, visual by light and optional mechanical alarm indication and indications or messages displayed on the screen.

3.10.3.3. Provide alarm if the thresholds for Alpha and/or Beta particles are exceeded.

3.10.3.4. Provide alarm if the threshold for the ambient equivalent dose rate is exceeded

3.10.3.5. Alarm thresholds for Alpha and Beta particle, as well as for the dose rate shall be adjustable through the instrument's menu or via PC.

3.10.4. Communication ports and service software with remote assistance

3.10.4.1. The data transfer of the instrument to a PC shall happen via standard communication interfaces (e.g. infrared or serial cable). Optional specific software shall be available to read out the instrument's history and to create operation orientated detector setups

3.10.5. Power supply

3.10.5.1. Be powered by standard, commercial available batteries.

3.10.5.2. Have a minimum operation time of 50 hours with standard batteries at continuous, non-alarming conditions,

3.10.5.3. Label with the built-in direction of the batteries shall be on the instrument's housing.

3.10.5.4. Wrongly built in batteries shall not damage the instrument.

3.10.6. Vibration

3.10.6.1. Able to tolerate vibration with acceleration of 1 g in the frequency range of 10–500 Hz. When packed for transport, System shall be resistant to harmonic loadings corresponding to conditions of transportation, i.e. to acceleration of 2g in the frequency range of 10–33 Hz.

3.10.7. Microphonics/impacts

3.10.7.1. Since the System may be sensitive to vibrations such as those that may occur from low intensity impacts of sudden contact with hard surfaces, they shall tolerate such impacts according to IEC 60068-2-75, i.e., remain unaffected by the impact of 0.2 J to each side of the housing

3.10.8. Shock

3.10.8.1. The System shall be tolerant to mechanical shocks (half-sine) from all directions at an acceleration of 30g over a time interval of 6 ms, in accordance with IEC 60068-2-27.

3.10.8.2. The System shall be resistant to drop from one meter onto a concrete surface in their transport cases, and from 0.1 m without a transport case

3.10.9. Electromagnetic interferences

3.10.9.1. Electrostatic discharge and radiofrequency

3.10.9.1.1. The System shall be tolerant of exposure to electrostatic discharges at intensities of up to 6 kV for contact and 8 kV for air.

3.10.9.1.2. The System meter's response shall not be affected by radio-frequency (RF) fields over a range of 80 MHz–2500 MHz at the intensity of 10 volts per meter (V/m). Due to possible interference with mobile or satellite phones, the intensity of 50 V/m shall not affect normal operation.

3.10.9.2. Magnetic field

3.10.9.2.1. The System shall tolerate exposure to constant magnetic field intensity of 10 Gauss (800 A/m) in three orthogonal directions to the main axis of the instrument.

3.10.9.3. Environment, Temperature, and Humidity

3.10.9.3.1. The System shall be able to be switched on and be tolerant to ambient temperature from –20 to +40°C.

3.10.9.3.2. The System shall be resistant and tolerant to rapid temperature changes within the temperature range from –20 to +40 °C.

3.10.9.3.3. The System shall withstand condensing moisture. It shall remain fully functional and tolerant to relative humidity of up to 80% at non condensing conditions.

3.10.9.4. Degree of protection – ingress rating

3.10.9.4.1. The housing of the System shall meet ingress protection rating IP53 according to IEC 60529 requirements, i.e., it shall be dust protected and protected against spraying water.

3.10.9.5. Reliability and Lifetime

3.10.9.5.1. The normal operating period or lifetime of the System is the period of time after an ample initial trial use or burn-in, where the effects of wear are negligibly small and quality has levelled off to a constant failure rate with regard to time.

3.10.9.5.2. The lifetime of the survey meters shall be at least 10 years.

3.10.9.6. Mean time between failures

3.10.9.6.1. Mean time between failures MTBF shall be at least four years

3.10.9.6.2. The Contractor shall be committed assuring that the mean time to repair (MTTR) be a maximum of four weeks.

4. Spare parts and maintenance services

4.1. The Contractor shall ensure the availability of spare parts and maintenance services for the entire lifetime of the survey meter.

5. Documentation

The Contractor shall provide the documentation specified below, in English language, and if available and requested in other IAEA languages.

5.1. Technical specification

5.1.1. Type of instrument, purpose, types of radiation to be measured;

5.1.2. Complete description of the instrument with general technical data, including optimum configuration, type of radiation detector and its size, range of ambient equivalent dose rates, reference point(s), modes of operation, alarm initiation algorithms, kinds of alarm, markings, power supply, mechanical, environmental and electrical characteristics, electromagnetic compatibility, reliability and any other relevant information.

5.1.3. Complete description of test methods used, or references to international standards used

5.2. Manuals and Checklists

5.2.1. User manuals, software manuals, maintenance manuals, as well as system configuration(s).

5.2.2. A quick start manual, a list of recommended spare parts, and a trouble-shooting guide.

5.2.3. Periodic test procedures; a test procedure for the verification of all relevant parameters. The manufacture shall provide an initial calibration service with certificates for each instrument.

5.2.4. Factory test report

5.2.4.1. The Contractor shall provide a test report for all factory tests conducted on each individual instrument.

5.3. Certificates and legalization.

5.3.1. In order to ensure reliable and safe operation, the Contractor shall provide a valid safety certificate and, preferably, a type test certificate of compliance with the relevant national/international standards. Additional test protocols from a recognized institution may be required.

5.3.2. The Contractor is entirely responsible for providing all documentation/certification necessary to allow legal export and use of an instrument 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.

6. Marking

6.1. The System shall have all safety markings in English language. The System shall be clearly marked with designation of the type, model, Contractor and serial number. The reference point(s) of the instrument's detector (each one for every embedded detector) shall also be indicated.

7. Packing

7.1. 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 air of this kind of equipment.

8. Quality Requirements

8.1. The System shall be manufactured, shipped and installed in accordance with the Contractor's ISO quality assurance system or an equivalent quality assurance system. This

quality control system must ensure testing of instruments occurs at least to the standards comparable to the IAEA's Nuclear Security Team (NST) 'Acceptance Test Protocol'. Detailed information about the IAEA's acceptance test will be provided upon request.

8.2. The Contractor shall document the compliance with this quality assurance system. Results obtained by the Contractor shall be attached to each batch of instruments delivered to IAEA.

9. Warranty

9.1. Warranty shall be provided for a minimum of 2 years on labour and parts

10. Testing and Acceptance

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

11. Installation and Training

11.1. The Contractor shall provide installation and training to the End-User

12. Deliverable Data Items

12.1. The Contractor shall provide two complete sets of operation and servicing manuals and technical drawings in the English language, and if available and requested in other IAEA languages.