BEASTEK S.A.C.

Technical Proposal of RM0610
Backpack radiation monitor

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INDEX

1 Overview

The Nuctech® RM0610 Backpack Radiation Detector is a high-sensitivity, high-performance portable radiation detector designed and manufactured by Nuctech Company Liimited, to quickly detect and search for missing radioactive sources and radioactivity in a concealed manner. Nuclear materials, as well as radioactive contaminants and maliciously introduced radioactive sources. The instrument has the functions of dose alarm, inspection and nuclide identification, and can be applied to customs, port, environmental protection, exploration, mining, nuclear emergency and other fields.

The RM0610 has the function of detecting gamma rays and neutron rays emitted by radioactive materials, enabling rapid searching and localization of radioactive materials in a wide range of areas. The device integrates the functions of radio source alarm, positioning and identification into one.

- The device mainly has the following applications:
- Customs inspection
- Port security
- Military use
- Environmental Assessment
- Nuclear emergency response
- Inspection and quarantine
- Metallurgy industry
- Nuclear power plant

Figure 1 RM0610 backpack radiation monitor (for reference only)

2 Features

- Portable, concealed backpack design;
- It has three working modes: dose alarm, inspection and nuclide identification;
- Highly sensitive NaI(Tl) crystal gamma detector;
- Highly sensitive, high efficiency neutron detector;
- Gain automatic stabilization technology, no need to use a scale source;
- Strong anti-interference ability, able to work in harsh natural environment;
- Handheld PDA terminal display;
- Friendly software interface and easy operation

3 System composition

Nuctech® RM0610 is mainly composed of gamma detection component, GM tube unit, neutron detection component, data acquisition and communication component, embedded data processing component and mobile monitoring terminal (PDA) and software.

- Gamma detection component: consists of a highly sensitive NaI crystal and a low noise photomultiplier tube for detecting gamma rays and transmitting their signals to a data acquisition and processing module;
- GM tube unit: consists of GM counter tube and related circuits, and transmits its signal to the energy spectrum acquisition unit;
- Neutron detection component: consists of a 3He proportional counter tube and a moderator to detect neutrons and transmit their signals to the signal acquisition and communication control components. The neutron detection component can greatly improve the system's ability to detect special nuclear materials;
- Data acquisition and communication components: consists of a signal acquisition and communication control module that acquires signals from the detection device and provides wireless network communication functions to provide an interface for the mobile monitoring terminal. Buzzer alarm device: receives signals from data acquisition and processing components, and sounds an alarm;
- Embedded data processing component: an embedded data acquisition processing CPU component for acquiring, analyzing, and processing signals from the detecting device, and recording the result;
- Mobile Monitoring Terminal (PDA):

  It consists of PDA and mobile monitoring terminal software, and has the following functions:

  Analyze, process, and display the energy spectrum data;

  Sound and light alarm;

Display count rate and dose rate curve;

Provide inspection function;

Nuclide recognition result display

Figure 2 Nuctech® RM0610 Product composition

4 Performance indicators

4.1 Detection sensitivity

The monitoring system shall be able to detect the standard test source in Table 2 with a detection probability of not less than 90% (confidence 95%).

Table 1 Detection sensitivity

Radioactive source	Activity
^{241}Am	370kBq(10μCi)
^{137}Cs	130kBq（3.5μCi)
^{60}Co	63kBq(1.7μCi)
^{252}Cf	8.0×10^{4}n/s

Test Conditions for above results:

- Background: Gamma reference background no more than 20μR/h
- False positive rate: no more than 1 time in 6 hours
- Source distance: 0.5 meters from the detection surface
- Source moving speed: no more than 1.2m/s
- Source activity accuracy: +20%

4.2 Nuclide identification

Built-in predefined nuclide library and can be added or modified：

- Special nuclear material: ^{237}Np，^{239}Pu，^{240}Pu，^{233}U，^{235}U，^{238}U
- Industrial radioactive source: ^{241}Am，^{133}Ba，^{57}Co，^{60}Co，^{137}Cs，^{152}Eu，^{192}Ir，^{75}Se，^{228}Th，^{204}Tl
- Medical radioactive source: ^{51}Cr，^{18}F，^{67}Ga，^{123}I，^{125}I，^{131}I，^{111}In，^{99}Mo，^{103}Pd，^{153}Sm，^{89}Sr，^{99}mTc，^{201}Tl，^{133}Xe
- Natural source: ^{40}K，^{226}Ra，^{232}Th，^{238}U

4.3 Other indicators

Other indicators

Gamma detector index:	
NaI(Tl) Detector crystal size	Φ50mm×100mm
Gamma detection energy range	20 ~ 3000keV
Gamma detector energy resolution	≤8.0%（^{137}Cs@661.62Kev）
GM Counting tube indicator：	
GM Counting tube size	Φ7.5mm×55mm
Neutron detector index：	
Neutron detector	^{3}He Proportional counter
^{3}He Proportional counter tube size (unit:mm)	Φ19mm×125mm 或者 Φ38mm×500mm
^{3}He Proportional counting tube number	1 or 2 optional
Neutron detection energy range	Thermal neutron ～14MeV
Multi-channel indicator：	
Channel number	1024
Integral nonlinearity	＜0.1%，Within 99% of full scale
Differential nonlinearity	＜1%，Within 99% of full scale
Pulse pass rate	＞50kcps
Energy spectrum storage	Can store at least 10,000 for each 1024 energy spectrum
Automatic stabilization	Gain and zero correction automatically
Baseline and stacking	Baseline recovery and rejection
Other indicators:	
Multi-channel spectrum display	Built-in
Nuclide library customization	Built-in

Input power	9VDC/2ADC adapter, adapter input parameters: 100~240VAC，47~63Hz
Operating time	Built-in rechargeable lithium battery for 16 hours at 25°C
Communication Interface	WIFI wireless communication
Alarm sound and light prompt	Built-in
Alarm threshold	Optional
Protection level	IP54
Working temperature	－20℃～+50℃
Working humidity	No more than 93%
Dimensions	L 330mm × W 250mm × H 600mm
Weight	5.6kg

5 Dedicated software

- Handheld mobile monitoring terminal software (for PDA);
- Localized software operation interface and manual;
- The monitoring software has user rights management function, which can customize user rights;
- Wireless connection with backpack equipment;
- The count rate curve can be displayed in real time;
- The dose rate curve can be displayed in real time;
- The alarm information can be displayed in real time;
- The nuclide identification information can be displayed in real time;
- History statistics query function;
- Automatic network interruption function;
- User-definable alarm thresholds;
- User-definable nuclide library;
- Shielding sound and light alarms.