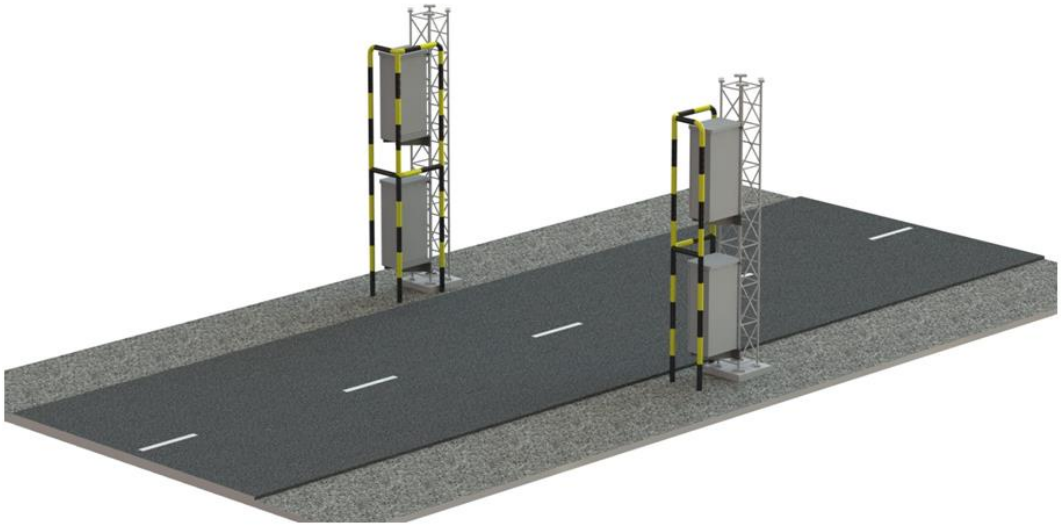

Spartan Gate Radiation Monitoring System

Information in this document is subject to change without notice.

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Table of Contents

Figures

Tables

1 Introduction

There are several devices on the market designed to detect and identify radiation sources. The widely used approach for this is to use sensitive scintillation or semiconductor detectors together with software algorithms to get the alarms on-site in real time.

For radiation portal monitoring applications Environics recommends the system described in detail in this document.

Environics has commercialized the measurement and analysis concept developed by STUK (Radiation and Nuclear Safety Authority in Finland). This concept includes high performance spectrometric analysis, local and remote data analysis, including online connection to expert systems.

Environics has delivered portal RN monitoring systems to a number of customers in the past 10 years.

Similar portal monitoring solutions as presented in this technical description have been recently delivered e.g. Helsinki-Vantaa airport, several seaports and land border crossing stations in Finland. Different types of fixed and mobile measurement solutions have been delivered also in several international customers.

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2 Technical System Description

This document presents technical description and specifications for example to establish Radiation monitoring system solutions based on Spartan Gate spectroscopic portal monitors, including the following items:

- Spartan Gate
- Spartan Gate industrial Vehicle Gamma Spectrometric portal monitor
- Control centre with working station including measurement database server and needed software
- Camera system integrated in the detection point with multiple cameras

The following Fig. 2-1 and Fig. 2-2 show the general structure and principle of two different types of Spartan Gate based monitoring systems.

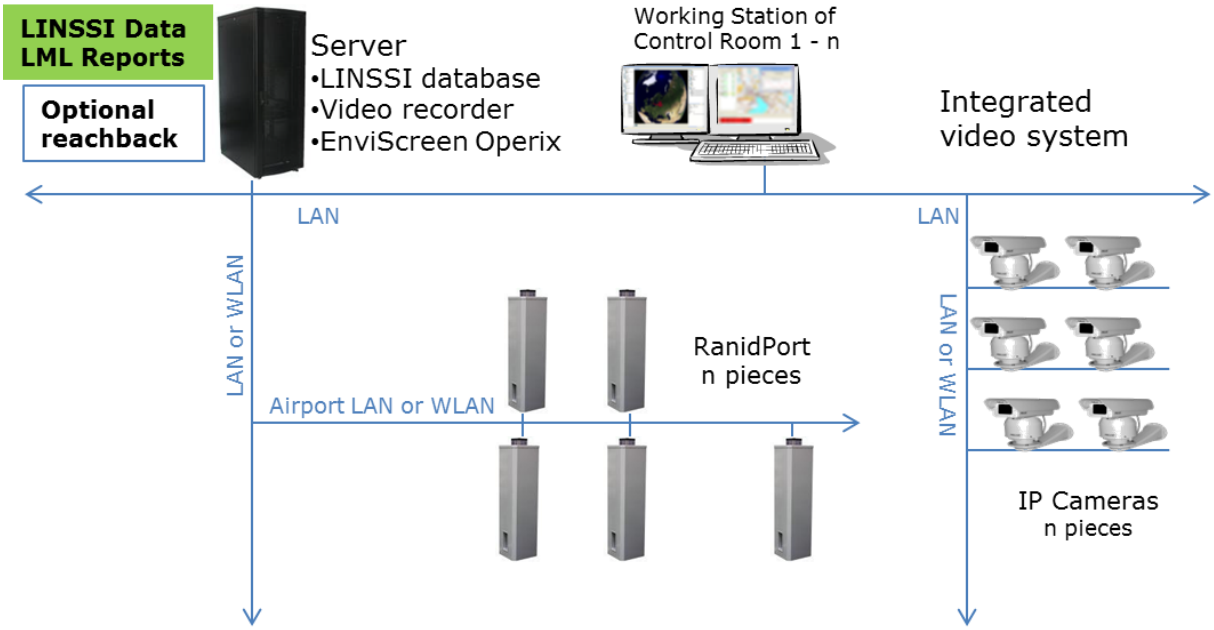

Fig. 2-1 General layout of Spartan Gate based monitoring concept. This type of monitoring network is installed e.g. at Helsinki-Vantaa airport in Finland

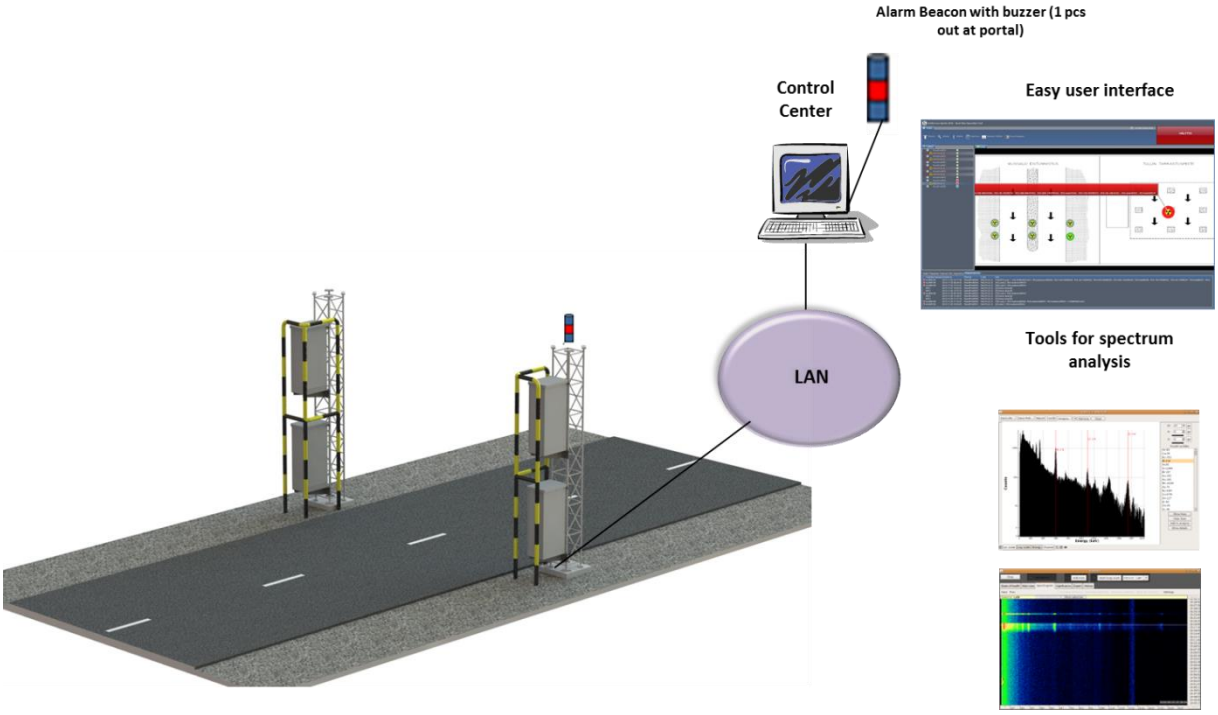

Fig. 2-2 General layout from Spartan Gate Industrial based Truck and Cargo portal monitoring concept. This type of radiation monitoring system is installed e.g. in couple of Finnish seaports

The Radiation monitoring solution is modular and designed to be upgradeable with further detection units or centralised control room equipment and software to be located at another location.

WB Johnson Instruments will offer comprehensive technical support and maintenance and service support after warranty period.

Example solutions are based on the same system structure and detectors as used in the radiation monitoring systems at the Helsinki-Vantaa Airport and Finnish seaports. System evaluation for the systems has been executed by Finnish Radiation and Nuclear Safety Authority STUK and they are in operational use.

3 Control Center

The Control Centre is connected to all the sensors via communication network (hardwired TCP/IP or wireless). The Control Centre can monitor the online status of all connected units.

The Control Centre usually includes the following components:

- Working stations, 1 piece, consisting of:
  - High resolution widescreen LCD display 24”, 2 pieces
  - Computer with suitable performance and accessories, 1 piece
- Needed software:
  - Web browser based Spartan Gate user interface software
  - WBJ EnviScreen User Interface program
  - Mirasys Video Management Software

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4 Spartan Gate

Spartan Gate solutions are advanced spectrometric portal monitors designed for different types of fixed and mobile applications. Spartan Gate is designed for fixed indoor applications. It has an integrated neutron booster that increases the detection sensitivity of neutrons and it has been designed for operations without the need of external neutron detector.

Neutron booster can be designed in various geometries. Flexible configuration of the neutron booster enables single or double-sided detection direction. It can be used with optional background radiation shield to increase the directional sensitivity and lower the background radiation level.

All of the different versions of the Spartan Gate gamma spectrometric detection units consist of scintillator detector, multichannel analyzer (MCA), data processing unit (Master Module) containing RanidPro200 Radionuclide identification software, audio visual alarm unit and power electronics installed into aluminum casing. Spartan Gate units have web server based Graphical User Interface as a standard and it has internal MySQL based spectrometric database.

Fig. 4-1 Spartan Gate detection unit at an airport

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5 Spartan Gate Industrial

Spartan Gate industrial is designed for rough outdoor applications with extended temperature range. It has possibility to include heating and cooling accessories for extreme temperatures. It has the same integrated neutron detection capabilities as Spartan Gate.

In vehicle and cargo screening applications the sensitivity and the detection area can be increased by using multi detector portals.

Normal vehicle portal designed for the trucks and bigger vehicles contain 4 pieces of 4 liter NaI(Tl) detector units. One detection unit can be seen from the figure below.

Fig. 5-1 Spartan Gate Industrial 4 liter NaI(Tl) detection unit

To enable best possible measurement configuration 2 units will be placed on top of each other on both sides as shown in the Fig. 5-2.

Unit design has been optimized to easy maintenance. Spartan Gate industrial gamma spectrometric detection unit provides monitoring system dose rate measurements with alarms and radionuclide identification.

Fig. 5-2 Spartan Gate Vehicle radiation portal monitor for vehicles consisting of 4 pcs of 4 liter NaI(Tl) detection units

Fig. 5-3 Spartan Gate Vehicle radiation portal monitor installations in seaport

6 Standard System Functionality

Radiation monitoring system is fully scalable from single detector monitoring point to multi detector CBRN network. System uses WBJ EnviScreen Operix monitoring software for continuous real-time situation awareness and guidance.

Fig. 6-1 Example of the User Interface at WBJ EnviScreen system. **Alarm on view:** Live video stream from detector in the alarm on situation

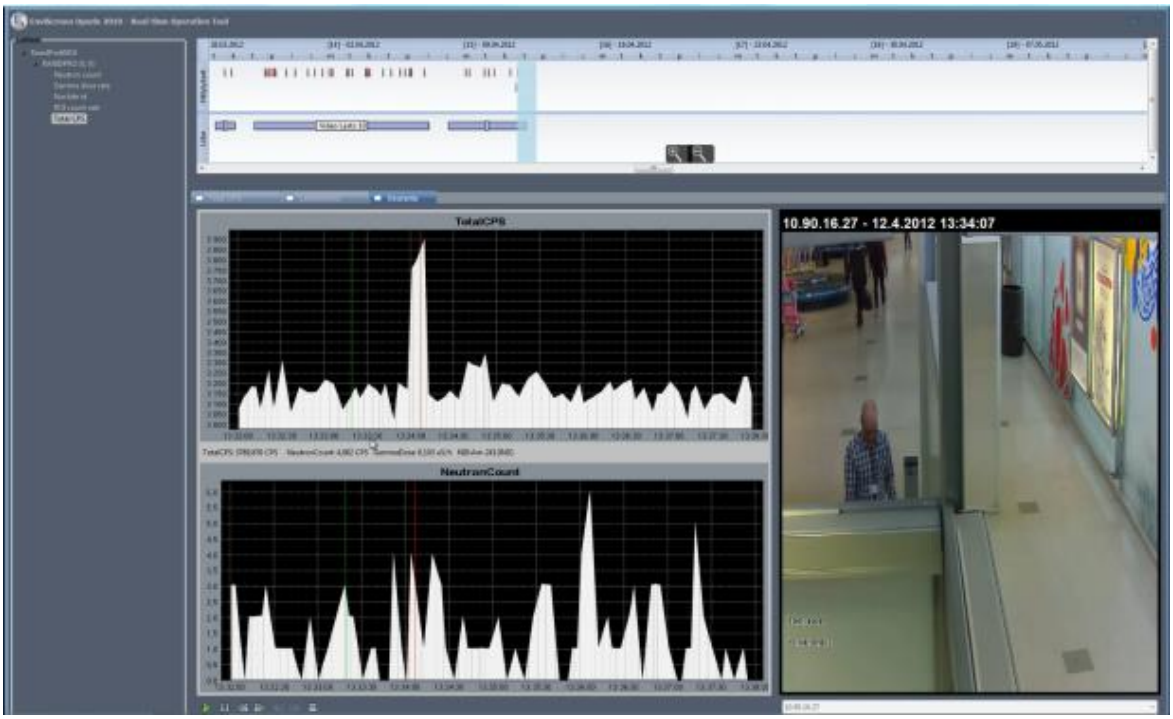

Fig. 6-2 Example of the User Interface at WBJ EnviScreen system. History viewPlayback: Video record synchronized with the gammaand neutron count data

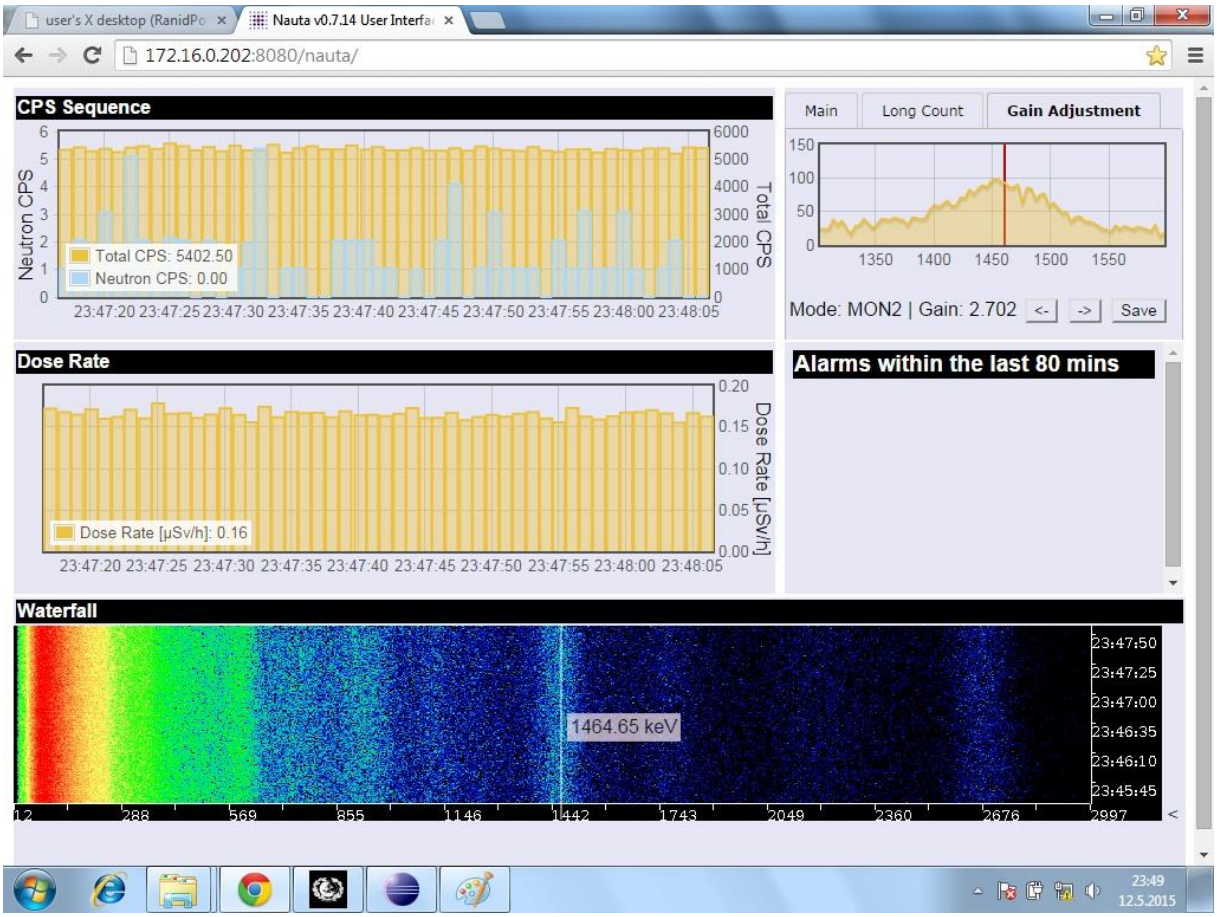

Fig. 6-3 Example of the Spartan Gate Web User Interface

6.1 Automatic Energy Stabilization

The Spartan Gate N is easy to use (switch-on principle) and it has high quality internal stabilization based on the natural gamma radiation of ^{40}K nuclide.

The spectrum of a NaI(Tl) detector has a tendency to drift depending of the ambient temperature. This feature of scintillator detectors are compensated and it gives advantages like increased peak stability and lower false alarm rate.

Fig. 6-4 Automatic energy stabilization window

6.2 Software Operation

Spartan Gate system is designed to operate automatically. Once switched on and after the initialization it will begin measurements and the measurement data will be stored into its database. The data acquisition is done in three different modes (search, monitoring 1 and monitoring 2) simultaneously creating maximum sensitivity from longer monitoring measurements and short response time from search mode measurements. Basic measurement signals are shown in the figure below.

Fig. 6-5 Measurement signals of the Spartan Gate. From the main window it is easy to monitor Neutron and Gamma CPS signals and Gamma dose rate

6.3 Detector Unit Database

Spartan Gate/(vehicle) unit has its own onboard LINSSI database. The LINSSI database is a MySQL based database designed for storing spectral data. The database can be used for storing background, monitoring and control measurements. The only limitation for the size of the database is the size of the computer hard drive.

The measured spectral data can be uploaded to the central server. The standard format of the measurements are lml-files (linssi markup language) which is xml based data format that contains all spectroscopic data.

6.4 Radio Nuclide Identification

Radio nuclide identification software performs a peak detection algorithm on the incoming spectra. The peak detection data is then used to confirm or deny the hypothesis that a given nuclide is present based on an identification rule for the nuclide.

An identification rule for a nuclide defines the key lines that must be present as peaks in the spectrum for the nuclide to be considered present. Secondary lines can also be specified, these are not required to be present, but may bolster the confidence of the identification. Identification rules for nuclides that may cause interference in the identification may be specified for a given rule. These exclusion rules are then evaluated together with the rule under consideration to mitigate the effects of interference.

Also, neutron detection capability is a basic feature of Spartan Gate. The neutron moderator improves neutron detection capability with more than factor of two.

6.5 Radionuclide Library

In built radionuclide identification library is designed to fulfill and exceed standard N42.34 ANSI Isotope list. It categorizes Medical and Industrial Special Nuclear Material and Normal types of radio nuclides.

Customizable user defined radio nuclides and ROIs can be added to the nuclide identification list also.

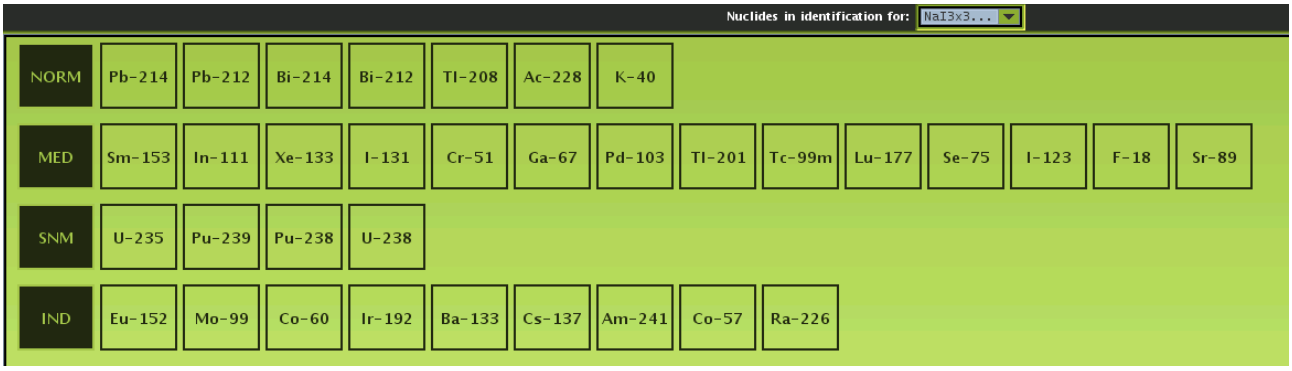

Fig. 6-6 Standard nuclides in radionuclide identification library

6.6 Communication

The monitoring station has two communication possibilities as standard:

- Wired through LAN / WAN as primary communication
- Wireless via WLAN as backup communication
- 3G/4G communication can be offered as an option

Station includes data processing unit (Master Module) that controls the communication as well as monitors the operation of each sensor. Configuration and other design and installation work of any communication network is out of the scope of this technical description.

7 Cabling Specifications and Site Prerequisites

7.1 Hardwired Data Communication Network

This system is based on the fact that there is an existing (or customer will provide) TCP/IP network between Radiation portal monitors and the Control center. The TCP/IP network connection shall be no further than in 30-meter distance from each monitoring point and control center (or closer).

7.2 Cabling Specification

The following cabling specification shall be used in the system:

Tab. 7-1 Cabling speficications

Connection type	Cable type/specification	Max. distance from the connection to the detection location
Ethernet	Cat 5e	Network connection shall be in 30-meter distance (or closer) from each monitoring point and control center
Power supply cables	3 x 1.5mm^2	Power connection shall be in 30-meter distance (or closer) from each monitoring point and control center

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8 Site Prerequisites for Fixed Monitoring Points and Control Center

8.1 Power

The fixed detection station, as well as the fixed control centre with its computer devices, require 230VAC (50Hz) power. This mains power must be available in every detection point and for all the computers including related accessories. The mains power connection shall be no further than in 30m distance from each monitoring point and command centre. A UPS backup system is recommended in places where the electrical network is unstable or there is possibility of electrical blackouts.¨

8.2 Electrical Grounding

All the fixed detection stations and detectors/sensors (if any in the system) must be provided with effective groundings. One part of the environmental protection system is based on grounding. Environics consults on grounding system installation.

8.3 Other Prerequisites

In order to deliver the system, the following information is needed from the customer

1. Detailed technical specification of the used communication system and network, including wireless and hard-wired systems
2. Detailed information on Ethernet and mains power network locations
3. Detailed information on preferred detector locations
4. Customer is also expected to be responsible and organize the following:
    a. Facilities for possible local training courses
    b. Facilities for the fixed control centre
    c. Facilitate the fixed control centre with necessary tables, chairs, communication network with related devices and power supply according to Environics' specification

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9 Appendixes

A. Spartan Gate Technical Specifications

In the following tables contain the technical information about the Spartan Gate Industrial gamma spectrometric detection unit.

Tab. 9-1 Spartan Gate Industrial dimensions and electrical specifications

Attribute	Value or description
Size (H x W x D)	4000 x 1000 x 500mm
Power supply	100.. 250VAC 50… 60Hz
Communication	12V, 30Ah; 3 hours independent operation
Alarm Unit	Status lights: Green (normal), red (gamma radiation alarm), blue (neutron radiation alarm, optional) Audible alarm device
Operational temperature range	-30… +50°C
Storage temperature range	-20… +50°C

Tab. 9-2 Spartan Gate Industrial performance specifications

Attribute	Value or description
Gamma	Four 4 x 4 x 16” Nal(Tl) detectors
Resolution	<8.5% at 662keV
Energy range	30keV… 8MeV
MCA	Configurable as 2048, 1024, 512 or 256 channels Maximum count rate > 250k cps
Nuclide identification and categorization	Designed to fulfill and exceed standard N42.34 ANSI Isotope list Medical, Industrial, SNM and NORM nuclide categorization Customizable user defined nuclides and ROIs
Functions	Dose rate calculation Nuclide identification Spectrum analysis

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