

Manage your risk when using
radionuclides and ionizing radiation:

Detect and Identify

with radiation protection instruments
from BERTHOLD TECHNOLOGIES

Instruments for Radiation Protection

- ☐ Contamination Monitors
- ☐ Dose and Dose rate Monitors
- ☐ Measuring Systems for Air and Waste Water
- ☐ Instruments to Search for,
Detect and Measure Radioactivity

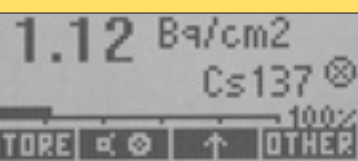


BERTHOLD
TECHNOLOGIES

RADIATION PROTECTION

No Chance for Radioactive Contamination

Radionuclides are needed and useful in many fields of application. However, they may also be dangerous if improperly handled. Therefore working with radioactive materials in Nuclear Medicine, Research or in other fields of radionuclide applications requires continuous monitoring to detect possible contamination of surfaces and objects in working areas, as well as on clothes and on exposed skin.



With **Contamination Monitors** from **BERTHOLD TECHNOLOGIES**, contaminations do not have any chance to remain undetected, regardless which radionuclide or location.



If you need a portable instrument for monitoring surface contamination, we offer three product families: The **handheld monitors LB 122 or LB 124** for single-hand operation with built-in large-area detectors or the **versatile LB 123 UMo system** with externally connected contamination detectors. To detect possible **contamination of personnel**, the **Hand Foot Monitors LB 145 and LB 146** are available. Moreover, for larger laboratories or nuclear facilities, the **Floor Monitors LB 165 and LB 166** are available to reliably assess widespread contaminations.

Measuring safely with one hand:

The beta-gamma Contamination Monitor LB 124

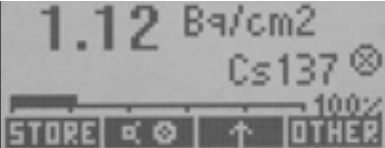
offers superior performance among hand-held instruments.

The advantages:

- The 150 cm² detector measures beta and photon radiation **with highest counting efficiency**, in particular for EC emitters like ¹²⁵I or ^{99m}Tc
- The **large, easy-to read backlit LCD display** shows measured results in cps or Bq/cm² with factory defined, editable **calibration factors for more than 50 radionuclides**
- Powerful software supports **numerous measuring modes** and parameter settings, for example: search, clearance measurement, half-life, background measurement mode
- The monitor is easily configured both for the unskilled user and for the demanding measuring expert
- The memory stores **up to 1000 measurements** with date/time stamp. Data may be downloaded to a PC or printer via the RS232 interface



For Field use or storage:
LB 124 in its transport case



A proven and widespread hand-held instrument:

The alpha-beta Contamination Monitor LB 122

for reliable assessment of alpha and beta emitting radionuclides.

The advantages:

- **Highly efficient** and easily exchangeable 200 cm² detectors to detect either beta / photon radiation, or alpha-beta radiation
- The backlit LCD display shows measured results in cps or Bq/cm² with factory-defined **calibration factors for over 40 different radionuclides**
- The software supports **various measuring modes** and parameter selections, including background measurement and subtraction.
- Many **accessories** such as a docking station for semi-stationary operation to measure alpha-beta radiation with a gas-flow proportional detector



The LB 122 is approved for use at fire brigades

A very efficient and versatile instrument for the Health Physics professional: **The Universal Radiation Protection Survey Meter LB 123 Umo**: The LB 123 A as α - β or the LB 123 B as β - γ contamination monitor

The advantages:

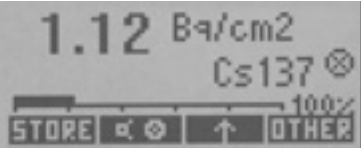
- A series of detectors to connect to the small, portable LB 1230 electronics unit, to measure alpha-beta, beta-gamma, or Tritium contamination or even gamma / Neutron dose rate.
- The electronics unit **identifies automatically the connected probe** and selects the appropriate measuring mode and parameter set.
- **Data storage** and **serial interface** and the features of the LB 122
- A power supply unit to "dock" the LB 123 for **stationary use with mains connection**



For Tritium contamination measurements, the windowless gas flow-through detector LB 1239 is used.



Numerous accessories for the LB 123 from a wall bracket to a portable printer are available. In addition, also Gamma/Neutron dose rate detectors may be connected.



For easier and quicker **contamination surveys** in major laboratories or nuclear facilities:
Floor Monitors LB 165 and LB 166 with a new generation of extremely large proportional detectors

The advantages:

- **Two versions** for beta-gamma (LB 165) and alpha-beta (LB 166) emitting nuclides
- Detector **entrance window** of 2000 cm²
- Alpha-beta monitor LB 166 with **built-in counting gas supply**
- Measuring and display unit LB 1230 with **data storage and printer interface**
- Dynamic background compensation with additional guard detector available for LB 165 with LB 5330 electronics unit
- **Detector ground clearance adjustable** from 6 to 24 mm



An indispensable monitor for the safety in radionuclide laboratories and nuclear facilities:
Hand-Foot Contamination Monitors LB 145/146 for quick and reliable measurement of **contaminations on hands, feet and clothing**

The advantages:

- **Two versions** for beta-gamma (LB 145) and alpha-beta (LB 146) emitting nuclides
- Large screen with **direct display of contamination values and areas**
- Optional detachable frisker probe allows **measurement of clothes or objects**
- **Stored calibration factors** for numerous radionuclides
- Automatic **compensation for varying background levels**
- Optional **back-of-hands probes**, adapt to different hand sizes for alpha-beta measurements
- Large **data storage**, Serial interface, Optional Ethernet connection
- Ergonomic design, light sensors to ensure correct measurement procedure



Measurement display

The Hand-Foot Contamination Monitors LB 145/146 can also be provided with additional back-of-hands probes which adapt automatically to different hand sizes in the LB 146 alpha-beta version.



*Option:
Separate large TFT screen (standard from 2003 on)*

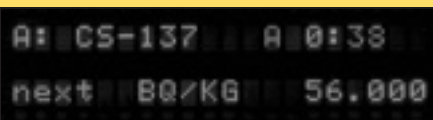
Measuring Radioactivity in Solid and Liquid Samples

In order to meet radiological safety regulations for handling radioactive substances different sampling methods are used in the laboratory to measure activity

such as, smear samples, aerosol filters, evaporation residues. Also environmental or foodstuff samples

may require the measurement of radioactivity.

BERTHOLD TECHNOLOGIES supplies well proven and easy to operate instruments for these tasks.



To measure extremely low alpha and beta activities in solid samples, both the **Low-level Planchet Counter LB 761** for 200 mm planchets and the **10-fold Low-level Planchet Counter LB 770** for simultaneous measurement of 60mm planchets are ideally suited. For **in-situ gamma measurements** of environmental and foodstuff samples up to 1 l volume the **portable Foodstuff Monitor LB 200** is available. For radioactivity measurements in small samples, the **Universal Radiation Protection Monitor LB 123 UMo** is available with several special probes.



The large diam. 200 mm planchets of the **Planchet Counter LB 761** can be used to measure **air filters** or **ash, soil** or **evaporated water samples**.



Typ. Detection Limits within 1 h measuring time: ^{241}Am 60 mBq, ^{90}Sr 50 mBq

Measuring **foodstuff and environmental samples** anytime, anywhere: **The Portable Foodstuff Monitor LB 200** is easy to operate even for an unskilled user and has proven itself more than 1000-fold following Chernobyl.



For ^{137}Cs 10 Bq/l minimum detectable activity. The obtained statistical accuracy of the measured value is indicated during the measurement. Therefore, the user can select the optimum measuring time and accuracy.

For the measurement of **samples up to 25 mm dia:** **The Universal Radiation Protection Monitor LB 123 UMo** with end window counter tube LB 1238 and lead shielding LB 7431

Beta surface contaminations of 1 Bq/cm² are reliably detected using wipe tests.



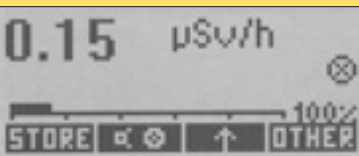
To measure **large quantities of samples with high sensitivity**, the **10-fold Low-level counter LB 770** for 60-mm-planchets is the instrument of choice

MDA's within 1 h measuring time: ^{241}Am 5 mBq, ^{90}Sr 20 mBq simultaneously. Connection of a PC via the LB 530 PC Interface, evaluation and documentation software LB 770 UMS Windows.



Measure the Exposure at the workplace

Whoever works with radiation sources or X-ray machines in laboratories, in radiology, in radiography or at other technical irradiation facilities should be informed about current radiation levels at all times.



With **dose and dose rate monitors from BERTHOLD**

TECHNOLOGIES you will detect reliably and quickly any increase in dose rate at the workplace that could lead to an undesired exposure of personnel.



In Gamma or Neutron radiation field surveys the **LB 123 UMo** does an excellent job as a **dose rate meter**. For measurements of gamma- and X-rays in particular, the **TOL/F** with its **ionization chamber** is ideally suited. For stationary measurement of dose and dose rate with alarm capability the **LB 111 system** is available. Our portable or stationary **neutron probe LB 6411** evaluates with high sensitivity and precision neutron dose rate levels.

A versatile combination system for the expert:

The universal radiation protection survey meter LB 123 UMo as dose and dose rate monitor LB 123 D for **gamma-** and LB 123N for **neutron radiation**

The advantages:

- The small portable electronics unit LB 1230 accepts alternatively the gamma probe LB 1236, the neutron probe LB 6411 or several **contamination probes**
- The basic unit **identifies the connected probe** and selects automatically the required parameter settings
- Optical and acoustical warning via adjustable alarm thresholds
- The basic unit offers **various measuring modes** from counts or cps, dose rate and dose integration as well as a **large data storage and serial interface**
- A (wall mount) power supply unit allows "docking" of the LB 123 for **stationary use with mains connection**

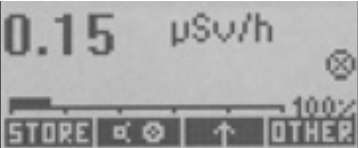


Dose rate measuring range
0.05 µSv/h to 10 mSv/h
Energy dependence
< 30 % from 30 keV to 2 MeV

Neutron probe LB 6411

Dose rate measuring range
30 nSv/h to 100 mSv/h
Energy dependence
< 30 % from 50 keV to 10 MeV
High sensitivity: 3 counts/nSv





The well-proven precision measurement device for gamma- and X-rays:

Dose rate meter TOL/F

with wide energy and measuring ranges

The advantages:

- Measurement of low energy photon radiation **down to 10 keV**
- **Dose rate measurement over 7 decades** in two measuring ranges
- **Automatic gain adjustment** with built-in ^{90}Sr source
- Optical and acoustical **warning** with adjustable alarm thresholds
- Measurement of **pulsed radiation fields**



*Steady state dose rate and dose measuring ranges 0.1 µSv/h to 100 Sv/h, dose from 0.01 µSv
Energy range 10 keV to 7 MeV*

Rugged and versatile:

Dose rate monitor LB 111

for gamma and neutron radiation with data memory and data transfer

The advantages:

- **Two-channel system** for gamma and neutron probes
- **High dose rate range** with optional ion chamber detectors
- Light beacon with horn for **warning** of levels exceeding adjustable alarm thresholds
- Rugged casing with **protection IP 65** for wall assembly
- **Data transfer** in LAN's and WAN's



*Dose rate measuring ranges
0.05 mSv/h to 1 Sv/h in two ranges, with ionization chamber LB 6701N to 1000 Sv/h
Energy ranges
from 20 keV depending on probe type*

Detect and identify Gamma radiation and radioactive sources and measure the dose rate:

Gamma Analyzer LB 125 a hand-held instrument for field and laboratory application

The advantages:

- Easy acquisition of the **gamma spectrum**
- Automatic peak and **nuclide identification**
- Dose rate measurements with **alarm thresholds** and acoustical **warning**
- **Search and identify mode**
- Stores up to **30 spectra**
- **Data transfer** and remote operation



*Dose rate measuring range
0.01 µSv/h to 100 µSv/h
Energy range 25 keV to 2 MeV
Analyzer with 512 channels*

Facing Challenging Tasks with Customized Systems

In large installations and facilities, the regulatory requirements for radiation protection very often

translate into a site-specific approach. Therefore, only systems tailored to the customer's needs will optimally solve

the individual measuring tasks.

A close cooperation between manufacturer and customer early in the planning phase is a key for an



BERTHOLD TECHNOLOGIES has acquired in recent years a considerable know-how in handling customer-specific projects, and has excellent national and international references. You will find some examples below.

effective implementation. There are more and more requirements for turnkey solutions. Widespread use of Quality Systems imposes ever-higher demands on documentation and project management.



A highly modern facility for nuclear waste disposal: **ZWILAG** Intermediate Radioactive Waste Storage Wuerenlingen AG, Switzerland



Centralised for Switzerland, radioactive waste from medicine, industry, research and nuclear power plants is conditioned for permanent disposal, and stored intermediately in the ZWILAG facility. **BERTHOLD TECHNOLOGIES** has installed the following instrumentation:

- Dose rate measurement for both gammas and neutrons
- Room air monitoring
- Exhaust air monitoring
- Isokinetic sample extraction from stacks and ventilation ducts
- Stack monitoring at the plasma incineration facility

The National Institute for Public Health and Environment of the Netherlands **RIVM** monitors with 14 measuring stations the airborne alpha and beta activity in the Netherlands

These measuring stations are equipped with particulate moving filter tape monitors BAI 9128 from **BERTHOLD TECHNOLOGIES**.

The National Agency for Environmental protection **ANPA** operates in Italy a measuring network to monitor the airborne radioactivity

Data acquisition takes place with nuclide specific filter tape instruments BAI 9100DG from **BERTHOLD TECHNOLOGIES** from Piedmont in the North down to Sicily. The data are transferred to central stations in Rome and Milan. The high-resolution gamma spectroscopy with Germanium detectors ensures extremely low detection limits and identification of the measured radionuclides.



In numerous **PET Centres** like e.g. Bonn, Berlin, Juelich, Munich, Geneva or Vienna, the exhaust air is monitored with monitors from **BERTHOLD TECHNOLOGIES**

Our concept for measuring PET nuclides such as ^{11}C , ^{15}O or ^{18}F is based on the detection of positrons, which is superior to the detection of annihilation radiation. **BERTHOLD TECHNOLOGIES** is capable of planning and installing these systems meeting all requirements of regulations, standards, EU laws, and licences of the authorities.

Monitoring Airborne Radioactivity

The permanent supervision of radioactivity in room and exhaust air of larger laboratories or nuclear facilities and the environmental monitoring of nuclear

power plants is an important radiation protection task. In recent years, the number of applications in

nuclear decommissioning, processing and storing radioactive waste is increasing.

BERTHOLD TECHNOLOGIES offers for this purpose a complete range of mobile instruments to customized, complete measuring installations for particulates, gas, Iodine and Tritium monitoring. The data from different measuring instruments including dose rate meters, e.g. for PET centres or in environmental networks, can be visualized and archived, by the **MEVIS Central Station**. Get in touch with our product specialists if air monitoring is your problem.



Below is a summary of our airborne activity sampling and measuring systems:

Particulates: Fixed filter instruments for diam. 47, 50, 60 and 200 mm filters; filter tape systems with scintillation and solid state detectors.

Iodine: Monitors for gaseous and organic ^{125}I , ^{131}I or ^{129}I with collection on industrial standard cartridges, refillable Marinelli beakers or active charcoal filters.

Noble gases and PET nuclides: Monitors for noble gases like ^{85}Kr , ^{133}Xe , ^{41}Ar and PET nuclides like ^{11}C , ^{15}O or ^{18}F . Monitors with fixed geometry in by-pass or detectors for installation directly in the stack.

Combined measurements: PIN monitors for particulates (P), Iodine (I) and noble gases (N).

Tritium: As vapour or gas ^3H -monitoring systems with compensation of the influence of ^{14}C , noble gases and background.

Monitors from **BERTHOLD TECHNOLOGIES** guarantee safe and reliable measurements. But there is even more: make use of our know-how and our expertise for:

- Concept, design and layout
- Customized engineering and manufacturing
- Installation and Commissioning
- Calibration
- Documentation
- Service



Particulate Monitors

Applicable in all locations:

Filter tape particulate monitor BAI 9128

with silicon solid state detector for continuous measurement of **alpha and beta particulate activity**



Air throughput 3.3 m³/h; Instrument Detection limit at 1 h measuring time
6 mBq/m³ for alpha and 40 mBq/m³ for beta emitting radionuclides

The advantages:

- Transportable compact unit
- Advance speed of filter tape selectable
- Compensation of influence from Radon decay products
- Dose rate probe optional

For simultaneous evaluation of artificial **alpha and beta particulates** with highest sensitivity:

The **fixed filter monitor LB 150 D-R** with measurement and compensation of natural radioactivity

The LB 150 D-R fixed filter air monitor with integrated electronics Gracon LB 3404-S samples particulates on filters with diam. 200 mm. For natural background compensation a combination of ABPD and alpha range discrimination is used.

The advantages:

- Isokinetic airflow with correction for retention of particulates
- Energy independent compensation method
- Nearly independent of Radon/Thoron ratio
- Continuous measurement and alarm checking during air sampling

Typical detection limits for 1 h measuring time:

Instrumental Det.Lim. to DIN 25482-1 with

$$k_{1-\alpha} = k_{1-\beta} = 1.645$$

alpha 2×10^{-3} Bq/m³, beta 1×10^{-2} Bq/m³

At 10 Bq/m³ natural activity

alpha 1.7×10^{-1} Bq/m³, beta 3.5×10^{-1} Bq/m³



The flagship of the air monitors from

BERTHOLD TECHNOLOGIES:

The filter tape monitor BAI 9100DG

measures continuously the **alpha and beta particulate activity** in exhaust or environmental air and analyses the **nuclide composition** of the gamma component.

Measuring ranges and detection limits for

1 h measuring time in Bq/m³:

alpha 1×10^{-3} to 5×10^4

beta 1×10^{-2} to 5×10^4

¹³⁷I 2×10^{-2} to 1×10^5



This filter tape monitor finds special application in measuring the activity release from nuclear facilities. It provides fast and reliable automatic detection of airborne activity in environmental measuring networks with data storage and data transfer.

The advantages:

- For the measurement of artificial activity concentrations the influence of natural radioactivity is compensated by using the alpha/beta ratio or the alpha-beta pseudo-coincidence (ABPD) method.
- Air flows of up to 25 m³/m are measured and these values are used to calculate the volumetric activity concentration in Bq/m³
- The PC-based spectroscopy system offers, together with the proven GammaVision software, the user an easy to operate instrument for more sophisticated measurements.

Iodine, noble gas and combined monitors

Ideally suited to survey laboratory air in nuclear medicine facilities are the **the mobile Iodine monitors BAI 9122 and BAI 9123** in various versions

Measuring ranges and detection limits for 10 min measuring time, in Bq/m³:

¹²⁵I 2.5 x 10⁰ to 5 x 10⁶

¹³¹I 1 x 10¹ to 1 x 10⁷



The monitor BAI 9122 is designed to measure ¹³¹I, the BAI 9123 for ¹²⁵I. Lead shields with different thicknesses are available to optimise the performance for the laboratory conditions.

The advantages:

- Self-contained mobile system for application at various locations
- Compact design
- Networkable
- Easy accessible components
- Optimised for low noise

If **radioactive noble gases** such as ⁸⁵Kr or ¹³³Xe are to be assessed, then the **noble gas monitors LB 101 or BAI 9109** are the most suitable instruments. Detection limits down to 1 kBq/m³ can be achieved

However, most frequently noble gas measurements are required in combination with Iodine and/or particulate measurements. In this case, PIN monitors as described below are required.

A monitor for all applications: The **mobile air monitor BAI 9850-19/PINN** measures simultaneously beta particulates (P), ¹³¹I (I) and noble gases (N) in low and high volumetric activity concentrations

The compact and environmentally – resistant design makes the monitor BAI 9850-19/PINN an ideal instrument for routine and intervention measurements in the operation or decommissioning of nuclear installations. This monitor is also available as P, PI or PIN monitor.

The advantages:

- All relevant components of airborne radioactivity will be measured simultaneously and separately in whatever combinations
- Measurement is effected with highest sensitivity and over wide range
- Built-in optical and acoustical alarm signalisation

Instrumental measuring ranges and detection limits for 10 min measuring time in Bq/m³:

Particulate beta activity 3 x 10⁰ to 8 x 10⁶

¹³¹I activity 7.2 x 10⁰ to 1 x 10⁷

⁸⁵Kr activity 2 x 10⁴ to 8 x 10¹⁰ and 5 x 10⁴ to 2 x 10¹¹



Tritium monitors

If the requirements are for mobile application or a high measuring range in surveying Tritium-in-air at nuclear installations, the **flow-through ionisation chamber monitor LB 671** is the instrument of choice

The advantages:

- Wide measuring range
- Compensation natural alpha emitters (Radon gas)

Measuring range 300 kBq/m³ to 300 GBq/m³



With its detection limit of 0.5 kBq/m³, the LB 110 is about a 100 times more sensitive than conventional ionisation chamber devices. The measuring range reaches up to 20 MBq/m³.



³H-in-air specific and high sensitivity the **Tritium monitor LB 110**

with flow-through proportional counter and pulse rise-time discrimination

The advantages:

- Compensation of ¹⁴C or noble gas radionuclides
- Compensation of external gamma radiation
- Separate registration of the above mentioned radionuclides in a second measuring channel

Detect Radioactivity in Waste Water

Waste water from radionuclide laboratories and nuclear facilities may contain radioactive substances. It therefore must be controlled by measurements when release limits of

radioactivity concentrations are observed. To that purpose, **BERTHOLD TECHNOLOGIES** offers various **on-line measuring systems for beta and gamma emitting radionuclides**.



For laboratories in nuclear medicine in particular, the **Waste Water Monitor LB 127** has been designed. The **BAI 9125** instrument, on the other hand, is primarily meant for application in **nuclear facilities**.

When monitoring of gamma emitting radionuclides with highest sensitivity is required, then the **waste water monitor BAI 9125** is the instrument of choice.

The advantages:

- Low detection limit and wide measuring range
- Polished stainless steel vessel ensures high contamination resistance
- Alarm indication and electronic signals for automatic control of waste water processing



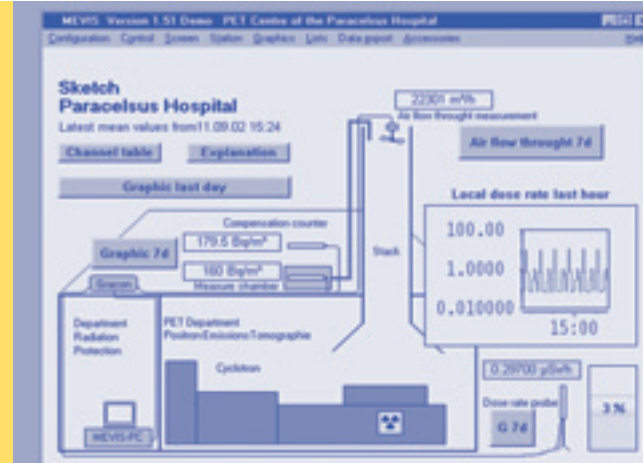
Measuring ranges in kBq/m³ for 1 h measuring time:
⁶⁰Co 1 x 10⁰ to 1 x 10⁷
¹³¹I 5 x 10⁻¹ to 3 x 10⁶
¹³⁷Cs 6 x 10⁻¹ to 6 x 10⁶

Radiological Measurement Data Visualizing and Evaluating

In major radionuclide laboratories or nuclear medical facilities like e.g. PET centres, radiation protection requires a continuous monitoring of the momentary radiological situation and immediate action if limits are exceeded. This task is performed by the PC-based **Central Data Unit MEVIS**, adapted specially to the needs and requirements of the measuring systems and instruments from **BERTHOLD TECHNOLOGIES**.

MEVIS offers:

- A propriety, tamper-proof database
- Drivers to collect data from the monitors in a background process
- Components and channels to assign the connected monitors
- Alarming functions
- Mimic panel overview screen, embedded measurement data and status fields
- Graphical and tabular presentation of measurement data
- Report generator



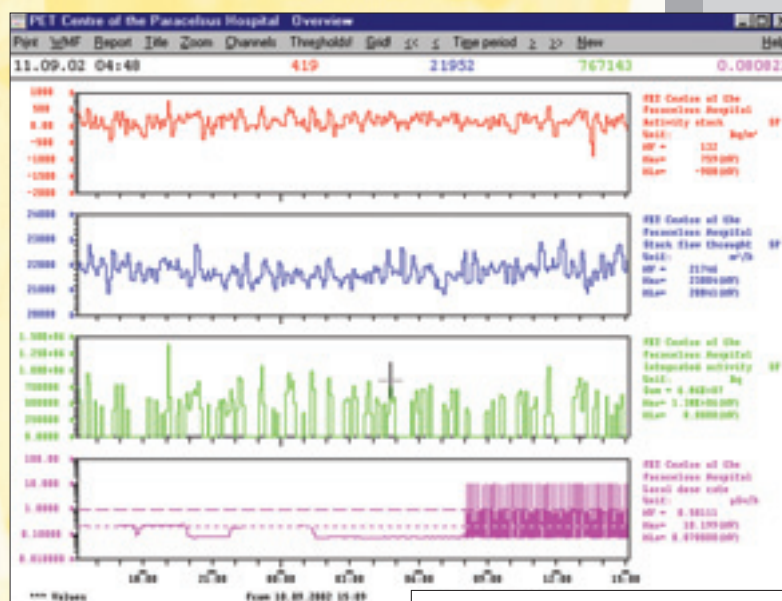
MEVIS collects the measured data from the connected monitors, displays the data graphically in relation to place and time, creates tables, checks and reports alarms. For documentation, the data may be presented in various file formats. Via pull-down menus or F-keys, from the overview screen all submenu functions and screens may be reached to control the communication with the measuring systems, to display data in tabular, listing or graphic format. Extensive possibilities for configuration and customizing.

An example MEVIS application:

The Synchrotron Light Source (SLS) at the Paul Scherrer Institute (PSI) in Switzerland is a modern accelerator facility, where numerous international research groups are doing experiments.

BERTHOLD TECHNOLOGIES has installed a

number of mobile dose rate systems at this installation, which are connected, to a MEVIS Central Data Unit to display and archive the results.



Example of graphical data visualization over 24 hours:
Shown on the curves are activity concentrations in the exhaust air,
the stack airflow, the total release and the local dose rate values.

Search and Analyse Radioactive Materials and Sources

To find radioactive scrap, lost sources or hidden nuclear fuel material, - with **measuring** and

analysing instruments from BERTHOLD TECHNOLOGIES you are well equipped for the job.



An easy-to-handle **gamma tracing instrument** that finds sources in obscure locations is the **universal monitor LB 123 UMo with NaI-probe**. The **portable Gamma Analyzer LB 125** detects even weak radiation fields, displays the energy spectrum and allows the identification of peaks and radionuclides. The **highly sensitive Pu monitor LB 6414** discovers even the smallest amounts of plutonium.

Search and Identify gamma emitters: Gamma Analyzer LB 125

as hand-held monitor for field and laboratory application



The advantages:

- Easy acquisition of the **gamma spectrum**
- Rapid and reliable **nuclide identification**
- Intelligent software for displaying and **analysing measured data**
- **Search mode** facilitates source finding
- Stores up to **30 spectra, 512 channels**, max 20 μ s dead time
- **Data transfer** and remote operation possible

About 10 g reactor Pu will be detected at 1 m distance within a few seconds. Therefore optimally suited to search for illegal Pu or to check nuclear waste.



The advantages:

- Highest possible **sensitivity** in a hand-held equipment
- **Certified** by Research Centre Seibersdorf/IAEA VIENNA



Another version of the versatile combination system for the measurement expert:
the universal radiation protection survey meter LB 123 UMo
with NaI probe to track radiation sources

With the separate high-sensitive gamma probe even hidden sources, e.g. in scrap or wastes will be detected reliably.

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