

# ORTEC<sup>®</sup>

## *Detective-SPM*

High Resolution Spectroscopic Portal Monitor for  
Primary and Secondary Nuclear Screening



**AMETEK<sup>®</sup>**  
ADVANCED MEASUREMENT TECHNOLOGY

# Detective-SPM

The ORTEC Detective-SPM Series of Spectroscopic Portal Monitors offer the best detection capabilities available of any technology for the interdiction of illicit movement and trans-shipment of radioactive materials. The modular and scaleable portal monitor built with ORTEC IDM-200-P HPGe detectors can readily detect and identify so-called “normal” sources of radiation found in cargo every day. These sources cause frequent alarms in other portal monitor technologies, slowing the flow of traffic and creating a nuisance for operators. Detective-SPM test results show a greater than 90% reduction in false alarms with this state-of-the-art technology as opposed to current portal technologies.



## Benefits

- Lowest total cost of ownership over a five year period.
- HPGe detection “drive through” design increases vehicle throughput.
- 90% or greater reduction in False Alarms over other technologies.
- 90% or greater reduction in screening personnel and equipment resources due to lower number of secondary inspections.
- Highest detection and identification of SNM material at the lowest HEU (Highly Enriched Uranium) and WGPu (Weapons Grade Plutonium) quantities.
- True identification analysis, no template matching.
- Lower maintenance cost including service, calibration and repair.
- Minimal operator dependency.
- Alternative non-He<sup>3</sup> neutron detection technology.
- Improved reachback efficiency with HPGe spectra.
- Harsh operating environments.
- Low mean time to repair (MTTR) of 4 hours.

## Features

- Exceeds ANSI N42.38 and IEC 62484.
- High purity modular germanium detectors.
- No liquid nitrogen.
- Lithium-6 neutron detectors.
- Hot swappable detector replacement.
- Advanced nuclear threat algorithms.
- Automatic calibration.
- Automatic alarm notification.
- Automatic isotope identification.
- Automatic traffic control system
- Significant Quantity Alarm (unique to HPGe).
- Largest isotope library for a spectroscopic system (170 IDs).
- Natural background filtering.
- Complete portal health status monitoring and management.
- Global power supply options.
- Automatic shutdown and startup.
- Multiple installation configurations (truck, train, automobile).
- Networked control center.
- Secure data storage.
- Video camera capability.
- Integrated radiation portal and x-ray design.

# Detective-SPM

Detective-SPM portal monitors support a range of radioactive detection and identification applications. With the modular design, low false alarm rate, and high reliability of operation, Detective-SPM portal monitor systems are ideal for monitoring:

- Seaports
- Rail stations
- Customs and border check points
- Airports

Detective-SPM portal monitors can be configured to monitor trains, trucks, automobiles, cargo, or any transit or pedestrian scenario that could potentially be a source for illicit trafficking of nuclear materials.

The Detective-SPM series of HPGe portal monitors offer users significant benefits over other radiation portal technologies, including high performance nuclear threat detection and identification. Higher scanning efficiency with lower risk makes germanium portals the gold standard for identification and detection.

## The Detective-SPM Advantage

At the heart of every ORTEC Detective-SPM portal are high purity germanium (HPGe) gamma ray detectors, sensitive neutron detection, and advanced software that, when combined, provide an unmatched ability to identify and classify nuclear threats

Recent advances have revolutionized the applications in which HPGe technology can be deployed. Advances in solid-state electronics, electro-mechanical cooling and digital signal processing have dramatically reduced the size, complexity, operating power, and cost of the hardware required to support HPGe detectors. These advancements are the result of continued demand for better and more accurate radiation detection and identification systems that can meet the needs of security programs throughout the world.

HPGe combines both sensitivity (the availability of large detector volume) and selectivity (the intrinsically high "energy resolution" of these detectors). No other gamma-ray detection technology compares to the performance of HPGe.

Neutron detection within an ORTEC Detective-SPM is accomplished by using U.S. Department of Energy tested, highly sensitive, Lithium-6 based neutron detector modules. The neutron detector modules provide increased detection performance of Special Nuclear Material (SNM).

Advanced detection and identification software already in use in the successful Detective series hand-held radioisotope identifiers (HHRIDs), and further developed in actual portal monitor field trials, ensures that the ORTEC Detective-SPM portal systems accurately detect, identify, alarm and report in REAL TIME to meet specific operational needs.



# Detective-SPM

## Technology Where It Matters

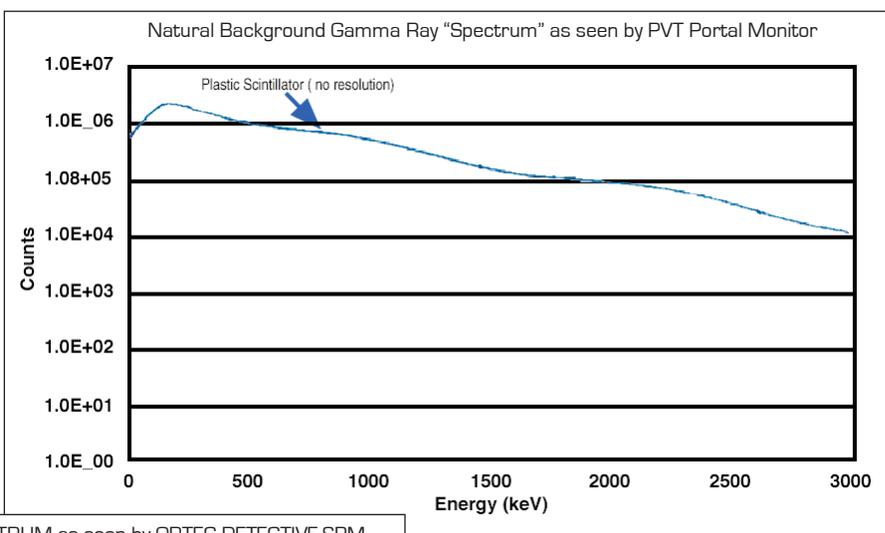
There is no such thing as an innocent alarm. There are false alarms and there are alarms. An “innocent alarm,” is an alarm where the radioactive material is innocent, but it is still an alarm! Therefore to be useful, a portal monitor must IDENTIFY the difference between innocent material and illicit material used by terrorists.

### High Sensitivity for Special Nuclear Materials (SNM) and Innocent Alarm Reduction HOW DO YOU DO BOTH?

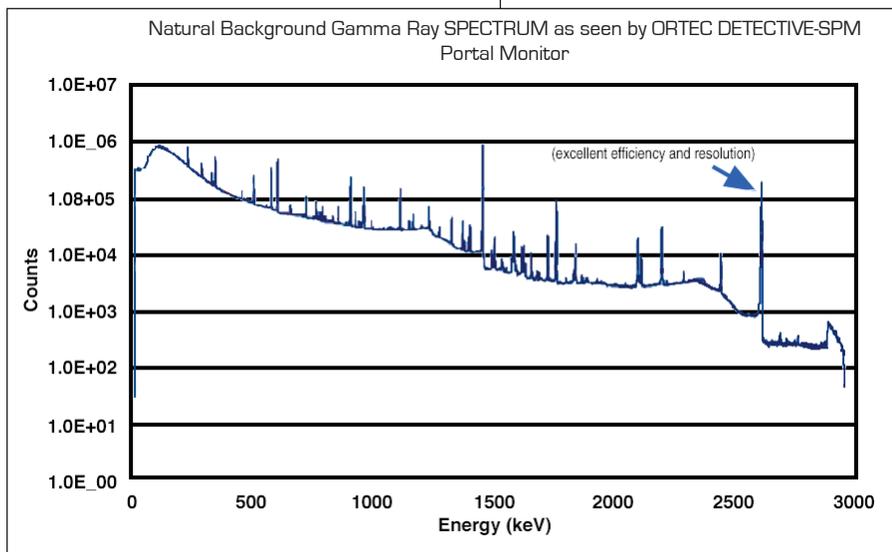
Detection of Uranium or Plutonium with a portal monitor is not difficult, until you get to the REAL world situation:

High background	Mixed sources
Shielded sources	Shipments of NORM

SPECTRAL ANALYSIS: ORTEC HPGe detector technology turns this. . .



Into this.....



Both figures show a natural background spectrum typical of that seen in portal monitors. The first shows the spectrum as seen by a “conventional portal monitor” using PVT (polyvinyltoluene) detectors and the second shows a spectrum from an ORTEC Detective-SPM for the same natural background.

There is no substitute for good data: this figure shows clearly why it is necessary to use spectroscopic portals to avoid so called “innocent alarms.”

# Detective-SPM

## The ORTEC Detective-SPM Portal Monitor Concept, Modular from the Foundations

1. HPGe Gamma Detectors
2. Neutron Detectors
3. Computers and Power Supply
4. Industrial Heating and Cooling Unit
5. Tower Brace (Option)
6. Mounting Base Plate
7. Road Loop Sensors



## HPGe Gamma Detector Module (IDM-200-P)

The IDM-200-P is a completely self-contained subsystem comprising a single, mechanically cooled high-purity germanium (HPGe) detector of standardized crystal dimensions and all necessary electronics in a RUGGED package.

- “Hot-Swappable” assembly.
- Scalable. Typically, 16 modules used for a primary radiation portal.
- Ease-of-service design.
- Hardened packaged design for harsh environment conditions.
- Integrated HPGe detector with a long life cryostat.
- 85 mm dia. x 30 mm HPGe detector optimized for large surface area and high efficiency detection of SNM.
- Integrated collimator for controlled detection zone.
- No periodic calibration required.
- Integrated back-up battery for 4 hours cooling.
- Constant state-of-health diagnostics.



# Detective-SPM

## Neutron Detector Module (NDM)

The Detective-SPM NDM is a completely self-contained subsystem, consisting of two Lithium-6 neutron detectors, cabling, and moderated sealed housing.

The Detective-SPM Lithium-6 based neutron detector coupled with ORTEC gamma hardware and software platforms provide performance comparable to  $^3\text{He}$  in neutron detection and in gamma rejection. Detective-SPM neutron detectors have earned the SAFETY Act designation as Qualified Anti-Terrorism Technology (QATT).

- Hot-Swappable assembly.
- Scalable. Typically, 4 modules used for a primary radiation portal.
- Ease-of-service design.
- Designed for harsh environment conditions.
- Integrated Lithium-6 detectors with sensor electronics.
- 102 cm L x 27.9 cm W x 12.7 cm H moderator, optimized for increased sensitivity on the front surface.
- No periodic calibration is required.
- Constant state-of-health diagnostics.

## Computer Systems and Power Supplies

The Detective-SPM is installed with an industrial network and control system to provide monitoring and software analysis support for the portal monitor. The portal monitor is outfitted with industrial communications, rugged data acquisition computers, environmental monitoring system, power distribution, battery backup system, and an analysis computer.

The industrial network communications system is designed to provide communications between all the components within the portal monitoring system. The industrial network switch is a rugged multi-media device that provides network access through copper and fiber optic network nodes. The system also supplies Power-over-Ethernet capability to the CCTV camera systems.

Each Detective-SPM portal tower is equipped with redundant data acquisition computers that control the IDM-200-P modules installed in the tower. The DAQs acquire spectral data from the IDM-200-P modules, perform some initial processing of the spectra/event data, and then send the data to the analysis computer inside the portal monitor over the internal network.

A status and control system is integrated into the portal system to monitor secondary environmental conditions. System parameters such as air flow, temperature, power, and detector status are monitored continuously in real-time and reported to the system operators.

The Detective-SPM contains a power distribution and control system for managing the power delivery to all equipment and components inside and outside the portal. Computers, detectors, traffic lights, and CCTV equipment are powered from the distribution system.

A military grade Smart UPS system is provided for the orderly shutdown of the computers in the event of a power outage and will provide for the automatic start-up once power is restored. Additionally the internal IDM-200-P batteries will maintain the crystal at the operational temperature for up to 4 hours to allow the Detective-SPM to immediately resume full operation once power is restored.



# Detective-SPM

## Analysis and Event Generator Program

The Detective-SPM utilizes proprietary acquisition and analysis software developed specifically for the identification of illicit nuclear materials. The software has been deployed successfully and used over the past decade by government agencies responsible for homeland security and portal applications and improved upon based on the input of these agencies.

The Analysis and Event Generator Program receives data from each Data Acquisition Program managing a separate tower panel. The Analysis and Event Generator Program has several duties:

- Combine the data from tower panels, and maintain running integrations of that data.
- Analyze the data, and identify the nuclides involved.
- Determine when occupancies begin and end.
- Generate alarms for various conditions. (For example, count rate thresholds exceeded, identification of nuclear threats, vehicle acceleration through the portal, or bad state-of-health of the portal.)
- Write the events, alarms, analysis results, and supporting data to a log file.
- Send the identification list to any third party application.

## Supervisor Client Software

The Supervisor Client software provides audible and visual alarms for different types of threats, alerts, and status indicators of the portal operation. Gamma, neutron, and speed alarms are presented to the user. Each event is color-coded based on the severity of the threat and listed chronologically for viewing should multiple events occur over a period of time.

## Industrial Environmental HVAC System

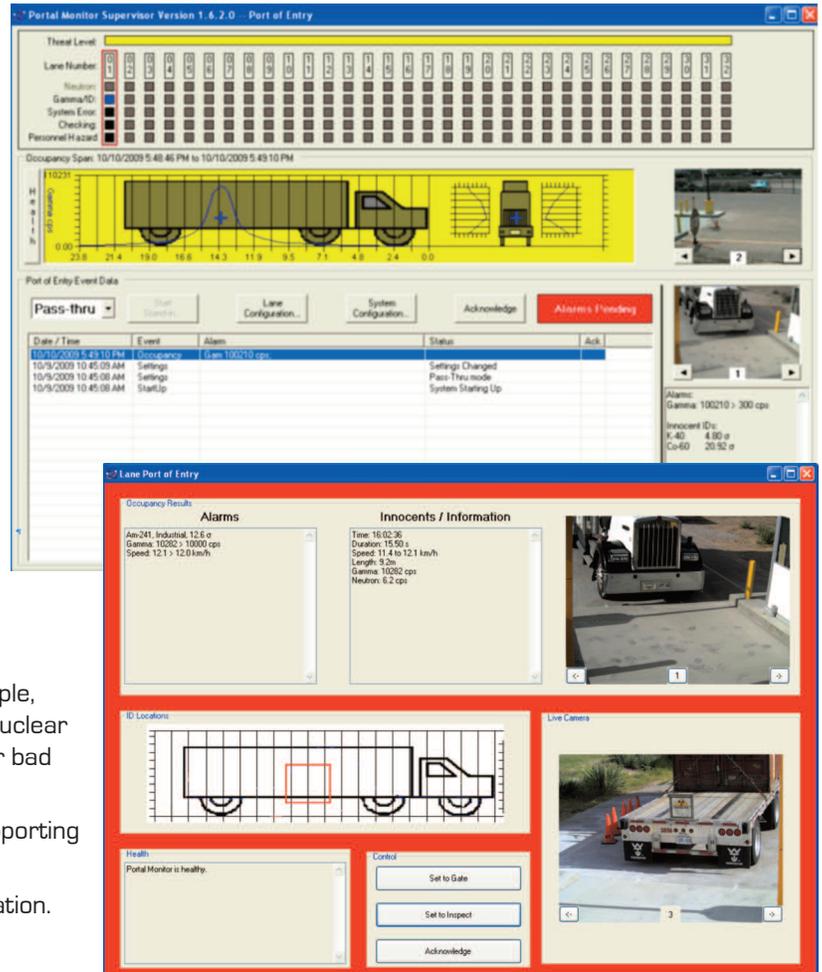
The Detective-SPM includes a single HVAC heating and cooling system on each tower. The system provides climate control of the internal components of the portal monitoring system, and maintains an internal operating temperature environment of 0°C to 40°C, while the outside temperature is -30°C to 55°C.

The HVAC system designed into the portal cabinet provides continuous-duty fans that supply evenly distributed airflow over all of the internal equipment through a unique ducting system. The HVAC system is also installed with airflow and temperature sensors that constantly monitor the intake and exhaust airflow to ensure the system is operating efficiently and effectively. If airflow or temperature parameters are exceeded, the user or system operators are notified that maintenance is required.

## Tower Support Brace

The Detective-SPM is designed to be installed in any location. The portal systems do not require additional shielding for operation which makes the towers lighter and easy to setup. The Detective-SPM can be mounted in multiple ways and can be delivered with bracing for free standing or wall mounted applications.

To support installations at existing locations, the Detective-SPM can be supplied with adaptable base plates that will provide the necessary loading and mounting infrastructure to secure the portal in many configurations.



# Detective-SPM

## Ground Loop or Infrared Beams for Occupancy Notification

The Detective-SPM detects the occupancy and conveyance speed with one or more sensor technologies such as ground loop or infrared. The ORTEC Detective-SPM can be delivered to operate with either technology to accommodate new or replacement locations.

The occupancy sensor system has a fail-safe mode such that, when one or all sensors fail, the system triggers an alarm and will shut down the lane if traffic signals are installed.

For vehicle and cargo applications, the Detective-SPM is capable of measuring the average speed over the duration of the conveyance scan in the range of 1 to 4.4 m/s with an accuracy of  $\pm 10\%$ .

The occupancy sensors can detect the presence of all vehicles including motorcycles, passenger cars, commercial vehicles towing trailers, recreational vehicles, large trucks, and cargo conveyances.

## Optional Lane Control and Alarm System

The Detective-SPM can be delivered with an enterprise lane control system (LCS) to support real-time situational awareness of containers, vehicles, conveyances and alarms. The integrated software system presents a single monitoring display that combines video sequence data with container and license plate numbers with portal monitor scan results.

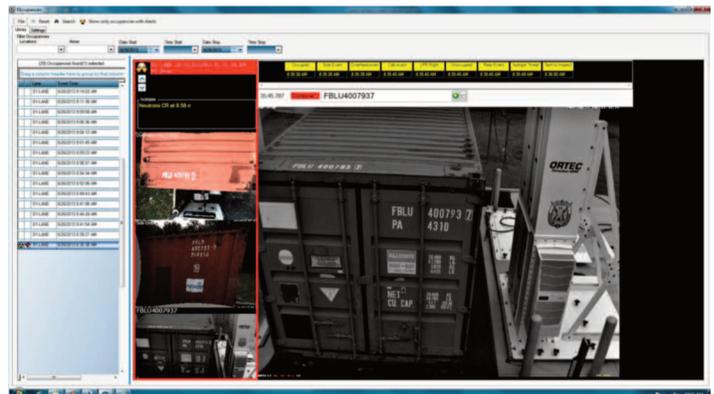
The integrated container number recognition and manifest tracking systems provide security personnel an increased level of adjudication by cross verifying each conveyance that processes through the portal monitor.

The system is delivered with five high resolution video cameras that provide multiple camera views to provide the systems optical character reader (OCR) reliability.

Advanced storage management allows for the collection, archival and cleanup of millions of vehicle occupancies and alarms.

Other Features include:

- Character recognition
- Manifest reconciliation
- Optimized for touch screens
- Graphical user interface
- Synch across all monitoring stations
- Real-time display and tracking
- Advanced storage management
- Supports multiple lanes
- Supports multiple sites



Truck  
Cleared  
Screen



Truck  
Alarm  
Screen



# *Detective-SPM*

## **Technical Data: Major Hardware**

### **General Hardware Specifications**

- One or more HPGe IDM modules with standardized HPGe crystals.
- One or more moderated  $^3\text{He}$  tubes (optional when neutron detection is not required).
- A data acquisition and control computer (one or more), with optional uninterruptible power supply.
- Occupancy and speed sensors (as required by the application).
- NEMA-4X enclosure if required.
- Internal heating and air conditioning for external temperatures  $-30$  to  $55^\circ\text{C}$ , up to 100% relative humidity.
- Thermally insulated.
- Configurable for vehicles and rail cars.

### **Interchangeable HPGe Detector Module (IDM)**

- Self-contained integrated “hot-swappable” assembly.
- Integrated high purity germanium detector in long life cryostat.
- 85 mm dia. x 30 mm deep active volume.
- 16k channel, high-performance MCA with digital stabilization.
- Detector bias supply.
- State-of-Health diagnostics.
- USB 2.0 communications.

### **Portal Control System (PCS)**

- Central processing unit for data, alarms, and systems related to a single complete portal monitor system.
- Controls all gamma and neutron alarm settings, generates alarms against those settings from incoming data streams.
- Processes incoming data: spectral data, occupancy sensors, cameras (if present) and generates alarms.
- >3 hour data buffer in event of lost communication.
- Reports events, alarms and operational information to supervisory computer.
- Controls and activates annunciator panels.

### **Supervisory Computer**

- Controls one or more Portal Control Systems.
- Sets/changes settings for PCS.
- Archives processed and raw data.

### **Vehicle Identification System (VIS)**

- Image data of each portal occupancy stored in an industry standard JPG file.
- Up to four high resolution, low-light camera may be employed.

### **Uninterruptible Power Supply (UPS)**

- UPS systems are available to meet the needs of the installation where local power supplies may be unreliable or suffer from “brown-outs.”

# Detective-SPM

## Technical Data: Analysis Software

- Derived from the highly successful Detective hand-held identifiers.
- “One gamma ray at a time” data analyzed in real time using “list mode” acquisition technique:

“Searches” in energy, time, and position for the highest possibility of detection of point source, and distributed sources; uses the optimum combination of data to get the most sensitive results. . . IN REAL TIME.

Analyzes:

- All events in all detectors in a given time slice.
- All events in a single detector in a single time slice.
- All events in a group of detectors in a time slice.
- Rolling averages of successive time slices for the same combinations.

Each occupancy record contains:

- Gamma and neutron gross count rate data.
- Identified source(s) list.
- Vehicle speed and position data.
- Spectroscopic data.
- Neutron count data.
- Occupancy sensor data and all VIS data.

## Service and Training Options

We realize how critically important the availability is of a portal monitor. Reliability has been designed in. Should a subsystem fail, the system is designed to continue operation at reduced sensitivity. The supervisory computer is notified of the failure.

All major subsystems, including the gamma-ray and neutron detector systems, are easily exchanged in the field. If a spare IDM-200-P is kept in operational condition (powered up and cold), it can be swapped out should an installed unit fail and the system be returned to 100% performance in a few minutes.

The Detective-SPM may be serviced by ORTEC personnel, trained subcontractors local to the installation, or customer employees who can be trained by the ORTEC Service Team in front line subsystem trouble shooting and service exchange. Spare modules may be kept on customer site for immediate availability and removed modules replaced by service exchange from the ORTEC Service Department. These options are flexible and derive from the modular nature of the design.

Detective-SPM training for supervisors, operators and service personnel is available at the ORTEC facility in Oak Ridge or in conjunction with system installation.

# Detective-SPM

## Ordering Information

Model	Description
<b>Detective-SPM-16</b>	Primary Screening Spectroscopic Radiation Portal Monitor for trucks, cars, and container applications.
<b>Detective-SPM-8</b>	Secondary Screening Spectroscopic Radiation Portal Monitor for trucks, cars, and container applications.

### Nuclides Identifiable by the Detective-SPM

All ORTEC Detective-SPM systems provide the following identifications:

Ac-228	Po-210
Am-241	Possible Cd-109
Am-241 (shielded) +Cs-137	Possible nuclear material
Am-241 (unshielded)	Possible weapon
Am-241 (unshielded) + Cs-137	Pu
Am241 + Cs-137	Pu, can't determine type
Ba-133	Pu, including Am-241
Bi-207	Pu, shielded
Cf-252/Cf-249	Pu-238
Co-56	Pu-240
Co-57	RGPu
Co-60	Ra-226
Cr-51	Sb-125
Cs-131	Se-75
Cs-134	Sm-153
Cs-137	Sn-113
DU	Sr-82/Rb-82
Elevated Uranium	Sr-89
Enriched Uranium	Sr-90/Y-90
Eu-152	Strong peaks consistent w/bgd
Eu-154	Ta-182
Eu-156	Tc-99m
Ga-67	Th K x-rays
HEU	Th-232
Ho-166	Ti-200
Ho-166m	Ti-201
I-123	Ti-202
I-125	Ti-204
I-131	U-232/Th-228
In-111	U-233
Ir-192	U-235
Ir-192, shielded	U-238
Ir-194	U-natural
K-40	U/Th consistent with background
La-138	Uranium K x-rays
La-140 (FP)	Uranium ore likely
Medical - positron emitter	WGpu
Mn-54	Xe-131m
Mo-99	Xe-133
Mo-99 + Tc-99m	Xe-135
NORM background	Y-88
Na-22	n-g H
Np-237	
Pd-103	

# Detective-SPM

## ORTEC Products Group

ORTEC has more than 50 years of experience in the design and manufacture of highly sensitive radiation detectors used by government and industrial laboratories, nuclear facilities and in medical research and nuclear safeguards. ORTEC manufactures over 1600 products used for nuclear power plant and government nuclear facility operations, special nuclear materials safeguards, search and identification of radioactive materials, and chemical weapons detection.

Founded in 1960 by scientists from Oak Ridge National Laboratory, ORTEC first developed the technology for silicon-based radiation detectors. Today, it is a leading manufacturer of high-purity germanium, high-resolution radiation detectors and instruments and systems which exploit this technology. We have been growing our own HPGe crystals since the 1970's.

ORTEC is a business unit of AMETEK Advanced Measurement Technology (AMT), a division of AMETEK, Inc. (NYSE-listed, ticker symbol: AME) a leading global manufacturer of electronic instruments and electric motors. Headquartered in suburban Philadelphia, AMETEK is a leading global manufacturer of electronic instruments and electromechanical devices with nearly 14,000 colleagues worldwide. It operates 120 manufacturing facilities and a dozen direct sales and service centers in the United States and has more than 80 direct sales and service operations in over 30 other countries around the world. Annualized sales for AMETEK are over \$3.3 billion.

Specifications subject to change  
072313

**ORTEC**<sup>®</sup>

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