

# Rapiscan GaRDS™ Portal Cargo and Vehicle Inspection System



**AMERICAS, CARIBBEAN**

2805 Columbia Street  
Torrance, California 90503  
UNITED STATES of AMERICA  
Tel: +1 310-978-1457  
Fax: +1 310-349-2491

**EUROPE, MIDDLE EAST, AFRICA**

X-Ray House  
Bonehurst Road  
Salfords  
Surrey RH1 5GG  
UNITED KINGDOM  
Tel: +44 (0) 870-7774301  
Fax: +44 (0) 870-7774302

**EMAIL**

[sales@rapiscansystems.com](mailto:sales@rapiscansystems.com)

**ASIA**

240 Macpherson Road  
#07-03 Pines Industrial Building  
Singapore 348574  
SINGAPORE  
Tel: +65-6846 3511  
Fax: +65-6743-9915

**WEB**

[www.rapiscansystems.com](http://www.rapiscansystems.com)

## Copyright Notice

Copyright © 2012 Rapiscan Systems. All rights reserved. No part of this document may be reproduced, transmitted, transferred, stored in a retrieval system, modified or translated, in any form or by any means, electronic, facsimile, photocopying, or otherwise, without the express written permission of Rapiscan Systems.

## Trademark Notice

“Rapiscan” is a registered trademark and “GaRDS” is a trademark of Rapiscan Systems in the United States and other countries.

## Content of this Document

We have made an effort to ensure that the information in this document is accurate as of the date of publication. However, the product you purchase may contain options, upgrades or modifications not described in this document. As a result, there may be differences between the contents of this document and the features of a particular product. Through publication and dissemination of this document, Rapiscan Systems provides no warranties of any kind, whether express or implied, including, without limitation, any implied warranties of merchantability, fitness for a particular purpose, title, non-infringement or accuracy.

If you have questions about the product described in this document, please contact the Rapiscan Systems Sales Department.

## Proprietary and Confidential Materials and Information

These materials and the information contained herein (a) are confidential and proprietary to Rapiscan Systems, (b) constitute valuable trade secrets of Rapiscan Systems, and (c) are protected by all applicable laws throughout the world. You agree that any use, disclosure or duplication of such materials or information is strictly prohibited, except to the extent expressly agreed to in writing in advance by Rapiscan Systems.

## Revisions

With continual development of our products, Rapiscan Systems reserves the right to amend specifications without notice.

## 1 OVERVIEW

The Rapiscan GaRDS™ Portal (“GaRDS Portal”) is a member of Rapiscan’s Gamma Radiographic Detection System (“GaRDS”) family of cargo and vehicle inspection systems, which offer safe and cost-effective non-intrusive inspection capabilities. The GaRDS Portal is a drive-thru portal cargo inspection system for fast, accurate and efficient cargo screening. It is a completely self-contained system which inspects containers, trucks and passenger vehicles to verify the contents and detect contraband, including weapons, explosives and narcotics. Therefore, it is well-suited to cargo screening at entrances to critical facilities, as well as border crossings and seaports.

The GaRDS Portal has a transmission gamma-ray imaging system with an isotopic Cobalt-60 source and L-shaped detector array, which are deployed on a stationary portal structure. Trucks are scanned as they drive through the portal. To protect the occupants, the gamma-ray beam is automatically initiated only after the driver cab passes. The gamma-ray images are sent to a nearby office for examination and evaluation. The images of the scanned vehicle or cargo container and its contents are immediately displayed on a monitor in the Image Analysis Workstation. The inspector then evaluates the image using the comprehensive features of the Rapiscan Cargo Viewer software and decides if the cargo is “clear” or “suspicious.”

The GaRDS Portal facility consists of the portal, which supports the gamma-ray source and detector array, the Traffic Control System and office. The GaRDS Portal facility is designed for easy relocation.

The GaRDS Portal has a unique combination of features:

- **A gamma-ray imaging system.** The GaRDS Portal gamma-ray imaging system provides the imaging performance required to scan vehicles and their cargo. The resulting high-quality images enable the operator to find hidden contraband.
- **Automated high throughput scanning.** The GaRDS Portal automatically scans trucks as they drive through the portal. High scanning throughput is achieved by a continuous flow of trucks through the unit.

The GaRDS Portal offers best-in-class gamma-ray inspection and operational features in a drive-thru portal cargo inspection system.

- Drive-thru cargo inspection
- Automated scanning operation
- Rapid scanning supports high throughput
- Gamma-ray imaging system
- Industry leading gamma-ray imaging quality
- Easy-to-use Rapiscan Cargo Viewer software
- Easy to operate with small crew
- Meets radiation safety standards
- Designed for ease of operations, training and maintenance.
- Easily relocated

Options available with the GaRDS Portal include

- Cs-137 source

- Automated capture of the license plate and/or container number
- Gamma or gamma/neutron radiation detection
- Cold and/or hot weather package for expanded operational environment

### 1.1 Rapiscan GaRDS Products

Rapiscan GaRDS gamma-ray cargo and vehicle inspection systems include:

- GaRDS Mobile – A gamma-ray imaging system incorporated on commercial truck chassis capable of driving on public roads.
- GaRDS Gantry – A gamma-ray imaging system configured as a rail-mounted gantry that scans unoccupied vehicles parked between the rails.
- GaRDS Portal – A gamma-ray imaging system configured as a portal that achieves high-throughput scanning of trucks as they drive through the portal.

Rapiscan GaRDS gamma-ray products are easy-to-use and efficient scanners for inspecting cargo containers and vehicles transporting light to moderate cargo. The highly reliable isotopic source is safely housed and deployed during the scanning process. These compact and lightweight scanners offer low cost of acquisition and operation, including ease of training and maintenance.

### 1.2 Application Scenarios for Rapiscan GaRDS Products

**Inspection at Border Crossings.** A GaRDS Mobile scanner is randomly deployed at different border crossings with no advance warning. This approach multiplies the effectiveness of a single scanner to counter smuggling because the unit can be located at any of the border crossings.

**Inspection at a Facility Entrance.** A GaRDS Gantry unit scans vehicles at the entrance to a critical facility, such as a government facility. Higher throughput is achievable by using the optional drive-thru mode.

**Inspection of Containers at a Seaport** – A GaRDS Portal unit is used to scan outbound empty or moderately loaded containers at a seaport. The containers are scanned as the truck drives through the portal, which supports high scanning throughput.

### 1.3 Rapiscan Approach to Cargo and Vehicle Inspection Products

All Rapiscan cargo and vehicle inspection products reflect our corporate commitment to excellence in imaging performance, design, ease-of-use and quality. This commitment results in products that have best-in-class imaging, low cost of ownership, high reliability and high operator satisfaction. Rapiscan offers its customers the largest selection of cargo and vehicle inspection products that share a common design philosophy.

- Modular design elements that are common across multiple products – Common design elements, such as the operating software, enable operating and maintenance staff trained on one product to quickly move to a different product. It also simplifies operation, training, service and spares.
- Multiple operation modes for one product – One product is able to inspect in different ways to respond to changing operational requirements. For example, a GaRDS Mobile scanner can also be used as a drive-thru portal scanner when high throughput is required. This capability provides operational flexibility and maximizes the effectiveness of each scanner.
- Products available to meet the full range of inspection requirements – Rapiscan's unmatched range of cargo and vehicle inspection products enables us to work with customers to define a solution that

meets their inspection requirements. We can choose from products capable of scanning occupied vehicles to dense cargo in mobile, gantry, portal and fixed deployment configurations, which can be used alone or in optimal combinations.

- Minimize cost of ownership – Rapiscan recognizes that a customer's price for a scanner must include the cost of ownership over the unit's lifetime as well as the cost of acquisition. Therefore, we are constantly working to reduce cost of ownership, such as by improving fuel efficiency and offering shore power operation for our Eagle M-Series mobile products

## 2 FEATURES

The GaRDS Portal shown in Figures 1-3 is a gamma-ray imaging system configured as a drive-thru portal with the following principal elements:

- A transmission gamma-ray imaging system, including the isotopic gamma-ray source, gamma-ray detector array and computer hardware and software.
- The portal structure that supports the gamma-ray source and detector array.
- Traffic Control and Monitoring System to ensure safe flow of trucks through the cargo inspection facility.
- A containerized office that houses the inspector(s) and operator and associated computer systems and other equipment.



Figure 1. GaRDS Portal



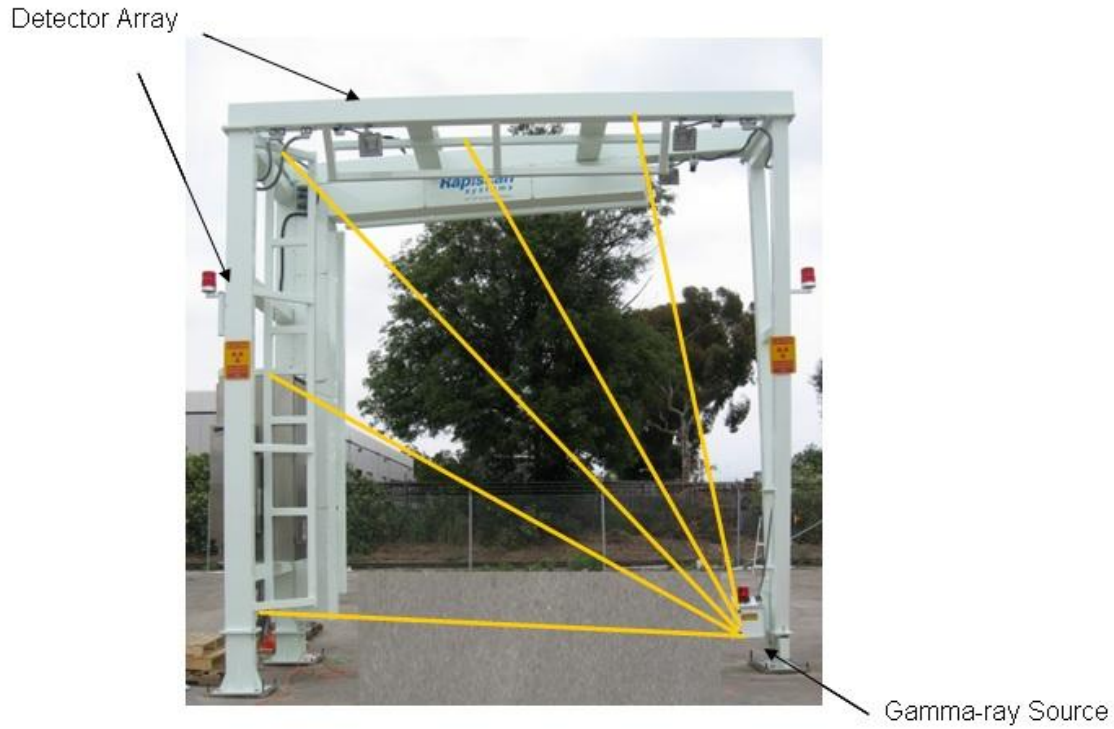


Figure 2. GaRDS Portal Imaging System



Figure 3. GaRDS Portal Performing a Scan

Figure 2 illustrates the location of the gamma-ray source and detector array within the portal and the gamma-ray fan beam that sweeps past the inspected object during a scan. The gamma-ray imaging system is designed to scan an object up to 3.1 m wide from 0.4 m to 4.6 m above the ground. To protect the occupants, the beam is automatically initiated only after the driver cab passes through the portal

## 2.1 Imaging System

**Radiation Source.** The GaRDS Portal uses a Co-60 gamma radioisotope source to generate the radiation beam. The standard 1 Curie Co-60 source produces approximately a 1.25 MV beam. An optional Cesium 137 (Cs-137) isotopic source produces approximately a 0.6 MV beam. Because the intensity of the source decreases over time, the source needs to be replaced periodically. For example, the Co-60 source is typically replaced every 5 to 7 years.

The isotopic source is housed in a shielded source enclosure. During a scan, the source is moved to the open position, which enables the radiation to be emitted from the shutter. The gamma ray source is shielded and tightly collimated into a fan-shaped beam to minimize radiation dose while maximizing beam intensity at the center of the object being scanned. The fan beam, illustrated in Figure 2, is oriented to achieve a scan field of view from mid-axle to the top of a truck or container on a truck without corner cutoff. The low position of the source enables the bottom of a truck or container to be thoroughly inspected. The beam is oriented at a 10° offset angle (80° to the inspected object), which improves detection of false walls and inspection of the ends of a container or truck. The GaRDS Portal is also available with the beam oriented perpendicular to the inspected object.

**Detector System.** The GaRDS Portal uses sodium-iodide scintillators with photomultiplier tubes to measure the energy signal of the gamma rays transmitted through the inspected object. The detectors and associated electronics are arranged in an L-shaped array, which minimizes the source-to-detector distance, while still enabling 100% inspection of a truck or cargo container. The detector housing protects the detectors from environmental degradation. Doors provide easy access for servicing individual modules. The output from the detectors is processed in real time by Rapiscan Systems proprietary imaging electronics and simultaneously sent to the Image Analysis Workstation for display.

**Computer Hardware.** The GaRDS Portal computer system is used for data acquisition, image display, image analysis, image archiving and image retrieval. The Operator Station is housed in a nearby office, which serves as the control room. The GaRDS Portal computer hardware consists of a Windows XP workstation, which runs Rapiscan Systems proprietary Cargo Viewer software. The user interacts with the computer via a keyboard and mouse. The Operator Station has two monitors, one that displays the radiographic images and one that displays the CCTV camera images. Figure 4 shows an exemplar GaRDS Portal Operator Station.



Figure 4. GaRDS Portal Operator Station

**Computer Software.** The GaRDS Portal software is used for: 1) acquiring data, 2) creating the scanned radiographic image, 3) displaying and processing the scanned image, and 4) monitoring and controlling systems, including the safety system. The Rapiscan Cargo Viewer software provides an easy to use interface for the operator to analyze and evaluate the image. It includes a comprehensive suite of image processing functions including contrast and brightness adjustment, zoom, edge enhancement, logarithmic filters, histogram functions and pseudo-colors. This software is common to all Rapiscan Systems cargo and vehicle inspection products, which enables them to be operated and maintained by the same personnel.

## 2.2 Facility

A typical layout of a GaRDS Portal facility is shown in the schematic drawing presented in Figure 5. The portal is typically positioned in the middle of the facility. The facility layout is optimized for the specific site and inspection requirements. For example, the length of the operational area will increase if longer trucks are to be inspected. The compact portal and radiation exclusion zone minimize the required operating area. Figure 5 illustrates the 10° offset angle of the detector array and gamma-ray beam.

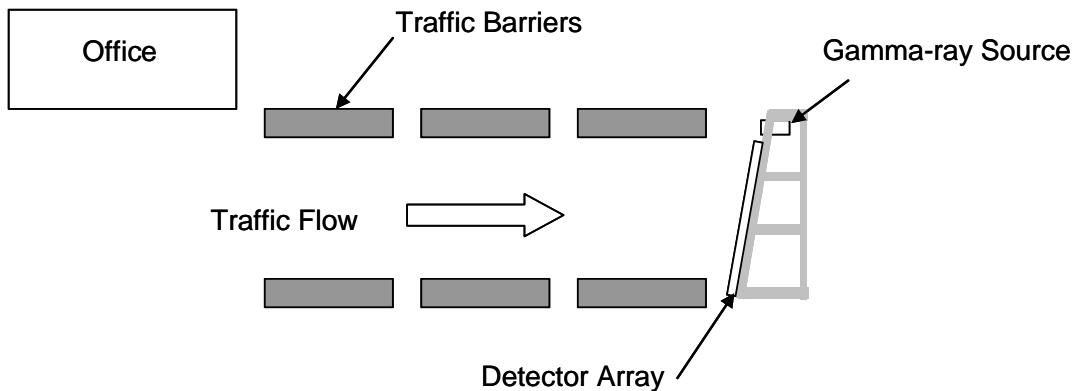


Figure 5. GaRDS Portal Schematic Layout

The GaRDS Portal cargo inspection facility shown in Figure 6 includes the portal on the right and control room office on the left. The site needs to be relatively flat, not subject to flooding and capable of supporting the weight of the portal structure, control room and inspected vehicles. In Figure 6, notice that there are no civil works, such as a canopy, building or radiation shielding walls, which are not needed for a GaRDS Portal. The GaRDS Portal is fully self-contained and requires only minimal infrastructure at the site, including local power.





Figure 6. GaRDS Portal Facility

**Offices.** The GaRDS Portal site typically includes the control room office for the cargo inspection facility. The gamma-ray images are sent to the office for review by the inspector using the GaRDS Portal's Imaging Analysis Workstation and Cargo Viewer software. From there, images can be transmitted via a network to a more remote facility for further evaluation by other inspectors or supervisors.

The control room is a prefabricated, containerized office. It accommodates the crew, including the operator, inspector(s) and their computer equipment in a comfortable working environment. The portal and control room are connected by cables for power, control, LAN and equipment, such as the CCTV cameras and safety system. Alternatively the operator/inspector can be located in an existing facility assuming that there is sufficient room for at least the computer system and a work space.

**Traffic Control and Monitoring System.** The GaRDS Portal facility includes a fully automated Traffic Control and Monitoring System (TCMS), which controls and monitors the flow of vehicles through the portal to ensure safe operation. The TCMS typically includes the following elements:

- Traffic control light at the entrance to signal when it is safe to enter the facility
- Vehicle speed measurement device.
- A "beam on" sensor that detects when the driver cab has passed through the portal and enables the gamma-ray beam to turn on.
- CCTV cameras to enable the operator to monitor the flow of traffic at the site

**Relocation.** The GaRDS Portal is easily relocated to a new inspection site. The portal structure and office are loaded on to trucks or rail cars for shipment to a new site. If necessary, power can be provided by a generator that is also easily moved with the system. The easily relocated unit provides the flexibility required to respond to changing operational requirements.

### 3 Operation

The GaRDS Portal scans an object, such as a truck or a container on a truck, in a single pass from approximately the axle to the top of the object. The resulting transmission X-ray image shows the entire object and its contents. The X-ray beam is oriented at 80° or optionally perpendicular to the inspected object. During a scan, CCTV cameras are used to monitor the inspection tunnel and the area around the unit. The optional Automated Number Plate Reader and Automated Container Number Reader capture

the license plate and/or cargo container number. The image is immediately available to the inspector in the nearby control room office. Images can also be transmitted to additional inspectors at a nearby office. The image is used to determine if a vehicle is “clear” or “suspicious” and requires further inspection, such as devanning and manual inspection of its cargo.

### 3.1 Scan Mode

Trucks are inspected as they drive through the portal between the source and detector array, as shown in Figure 3. The speed of the vehicle is measured by a speed sensor, so the driver does not need to maintain a precise, constant speed.

The TCMS for the GaRDS Portal supports a safe, continuous flow of vehicles through the facility, which increases the scanning throughput. Inspection of a truck in drive-thru portal mode typically consists of the following sequence of events:

1. If there is no truck in the facility, the traffic control light at the entrance is green signifying that it is safe for the truck to proceed.
2. The truck proceeds into the facility at a target speed of 1 m/s (2.2 mph). When the truck enters, the traffic control light turns red to prevent another truck from entering.
3. The truck drives through the portal.
4. The beam control sensor detects the back of the driver cab. The gamma-ray beam subsequently turns on and remains on until the back of the truck is detected. The resulting gamma-ray image is sent to the control room for review by the inspector.
5. The truck drives out of the facility to a parking area and waits for the results of the gamma-ray image evaluation.

### 3.2 Throughput

At a speed of 1 m/s (2.2 mph), a 20 m long truck is scanned in 20 seconds for a scanning throughput of 180 trucks per hour. Inspection throughput of 30-45 trucks per hour is achievable with a steady flow of trucks and 1-2 minutes for image evaluation and data entry, assuming that there are enough inspectors to keep up with the scanning rate.

### 3.3 Crew

The GaRDS Portal is designed for highly automated operation, which reduces the size of the crew required to operate the system. The typical crew includes an operator and inspector. However, the size of the crew can be reduced by fewer personnel sharing these duties, particularly at locations where traffic is light. Additional inspectors will increase overall inspection throughput.

### 3.4 Operating Environment

The GaRDS Portal is designed to operate in a wide-range of weather conditions.

- Operating Temperature range: 0°C to 50°C
- Optional Cold Weather Kit extends the low temperature range to -20°C when cold weather operating requirements are followed (see below). Custom designs are available for colder temperatures.
- Optional Hot Weather Kit extends the high temperature range to 55°C.
- Humidity 5% to 95% non-condensing

- Wind gusts up to 20 m/s
- Altitude up to 2000 m.

The design draws on Rapiscan Systems' experience deploying cargo inspection systems at a wide variety of locations. The GaRDS Portal units are designed to perform in all deployment environments, including seaside, dusty and sandy sites and tropical conditions and various weather conditions, including rain and snow. The unit must be operated in accordance with the Operator Manual and maintained in accordance with the Maintenance Manual. Design features, including paint and finishes, are intended to prevent corrosion in a marine environment. Floodlights are located on the unit to support scanning operations after dark or in poor visibility conditions.

**Cold Weather Operation.** The optional Cold Weather Kit is required for operation at sites where the minimum temperature is less than 0°C. At these temperatures, the following GaRDS Portal cold weather operating requirements must be followed:

- Use specified low temperature fluids, including hydraulic oil and grease
- Store the unit in a garage out of the weather on shore power when not in use
- Allow longer time for start-up

## 4 Safety

The GaRDS Portal is designed and manufactured to applicable international and US safety standards and regulations. The safety system includes warning lights, alarms and signs; emergency stops and safety interlocks; CCTV cameras and fire extinguisher. The emergency stops and interlocks immediately stop scanning and gamma-ray transmission and must be in the required configuration for the unit to operate. The status of the safety system is displayed on the unit's monitoring and control system.

**Radiation Safety.** The GaRDS Portal is designed to be radiation safe for the crew, truck drivers and bystanders, in accordance with international, US and local standards. As with all Rapiscan products, the principle of ALARA (As Low As Reasonably Achievable) is fundamental to the design.

- Crew – Crew members in the control room office are outside the radiation exclusion zone, so are not exposed to radiation above the maximum allowable.
- Drivers –The beam is emitted only after the driver cab passes through the portal. Therefore, drivers are only exposed to scattered radiation. The dose to the driver does not exceed the maximum allowable.
- Bystanders - To protect nearby personnel and prevent unauthorized access, the GaRDS Portal includes warning lights and alarms and radiation exclusion zone warning signs. The radiation exclusion zone is a small area around the portal structure. The cumulative radiation dose rate at the radiation exclusion zone boundary does not exceed the maximum allowable.

## 5 IMAGES

The representative GaRDS Portal cargo images presented in Figures 7-9 illustrate the system's capability to create high-quality images of hard to inspect cargo. In addition, the Cargo Viewer imaging software enables the inspector to adjust the image in many ways to support the evaluation of the cargo. Please note that the appearance and resolution of images displayed on the system's operator image workstation is better than the highly reduced images reproduced here.



Figure 7. Image of an Empty Truck

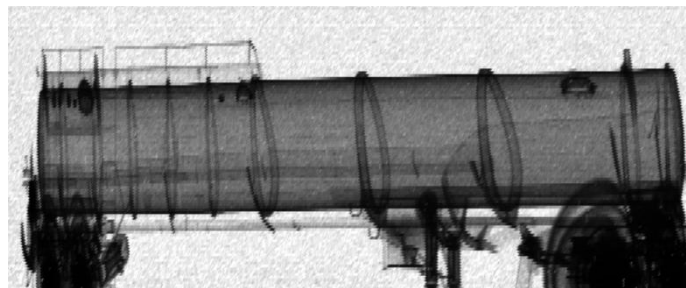


Figure 8. Image of an Empty Tanker Truck

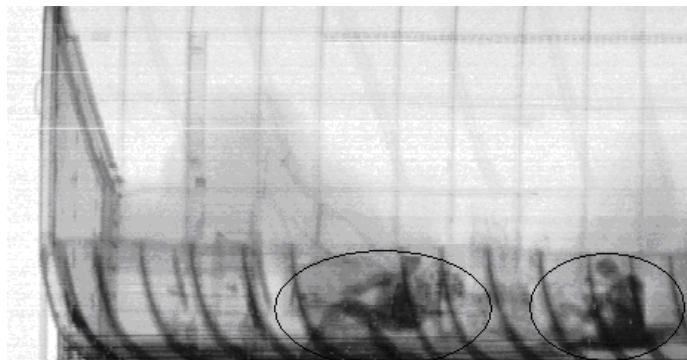


Figure 9. Image of Stowaways in a Container

## 6 GaRDS PORTAL OPTIONS

Options available with a GaRDS Portal unit are listed in Table 1. Unless specifically noted in the table, each option can be ordered separately with any other option.

Table 1. GaRDS Portal Options

Option	Standard
<b>Inspection</b>	
Cs-137 source	1 Curie Co-60 source
Automated number plate reader	Photo of inspected object
Automated container number reader	Photo of inspected object
Gamma radiation detection	Gamma-ray imaging system
Gamma and neutron radiation detection	Gamma-ray imaging system
<b>Operating Environment</b>	
Cold Weather Package – extends operating temperature to -20°C	Operating Temperature Range: 0°C to 50°C
Hot Weather Package – extends operating temperature to 55°C	Operating Temperature Range: 0°C to 50°C

### 6.1 Radiation Detection

The GaRDS Portal is available with an optional radiation detection capability, so that radioactive materials in the cargo are detected during a scan. Trucks drive through a Radiation Portal Monitor, which is positioned in line with the portal. The system is available with gamma radiation detection or gamma and neutron radiation detection.