Rapiscan Eagle® P60 Cargo Inspection System

www.rapiscansystems.com • sales@rapiscansystems.com

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

EUROPE, AFRICA, MID EAST
X-Ray House
Bonehurst Road
Salfords
Surrey RH1 5LG
UNITED KINGDOM
Tel: +44 (0) 870-7774301
Fax: +44 (0) 870-7774302

ASIA
240 Macpherson Road
#08-04 Pines Industrial Building
Singapore 348574
SINGAPORE
Tel: +65-6743-9913
+65-6743-9892
Fax: +65-6743-9915

AUSTRALIA
Rapiscan House
4 Ross Street
South Melbourne Victoria
Australia 3205
AUSTRALIA
Tel: +61 3 9929 4600
Fax: +61 3 9929 4655

INNOVATION TOWER TRADING tel: +964 790 191 8185 / +33 1 83 62 23 64
www.itt-kubba.com

Proprietary and Confidential
Copyright Notice

Copyright © 2010 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” and “Eagle” are registered trademarks 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 Eagle® P60 ("Eagle P60") is a member of Rapiscan’s P-Series of high-energy X-ray, drive-thru portal cargo inspection systems for fast, accurate and efficient cargo screening. Its ability to rapidly scan trucks supports inspection at critical facilities, seaports and border crossings. The Traffic Control and Monitoring System enables automated operation with scan throughput up to 180 vehicles per hour. The X-ray beam is automatically activated after the truck cab passes through the portal, so that the occupants are not exposed to an unsafe dose of radiation. The cab can also be safely inspected with the optional CabScan™ mode. The resulting X-ray images are sent to a nearby office for review and evaluation.

The Eagle P60 has a 6 MV X-ray imaging system that enables inspection of dense cargo, verification of manifests and identification of contraband, such as explosives, weapons and narcotics. Optional capabilities to help find low density contraband and radioactive material in cargo are available with the Eagle P60. The nonintrusive inspection capability using high-quality X-ray images and Rapiscan Cargo Viewer software reduces the need for subsequent manual inspection.

The Eagle P60 facility consists of the portal, which supports the X-ray generator and detector array, the Traffic Control and Monitoring System and the containerized offices. Radiation shielding walls or a weatherproof building can be optionally added. The Eagle P60 facility is designed for easy relocation.

The Eagle P60 has a unique combination of features:

- **A 6 MV X-ray imaging system.** The most powerful X-ray inspection system available in a drive-thru portal scanner. The Eagle P60’s 6 MV X-ray imaging system penetrates and creates an image of dense and densely-packed cargo, which would otherwise have to be manually inspected.

- **Rapiscan’s material separation technology.** The Eagle P60 is the only P-Series product with optional material separation technology, which helps the inspector find low density contraband, such as explosives and narcotics. These low density materials appear differently in the X-ray image than high density materials, such as steel. The material separation capability requires the optional 6 MV dual-energy X-ray generator available with the Eagle P60.

- **Multiple scanning modes.** The Eagle P45 achieves high throughput by automatically scanning trucks as they drive through the portal. The unit can be configured to scan just the cargo or also the driver cab with the optional CabScan™ capability.

Like other Rapiscan Eagle P-Series portal scanners, the Eagle P60 offers best-in-class X-ray inspection and operational features in a drive-thru portal cargo and vehicle inspection system.

- Drive-thru cargo inspection
- Automated scanning operation
- Throughput up to 180 trucks per hour
- 6 MV X-ray imaging system
- Industry leading X-ray imaging quality
- Easy-to-use Rapiscan Cargo Viewer software
- Meets radiation safety standards
- Designed for easy relocation
- Easy to maintain

Options available with the Eagle P60 include

- Drive-thru CabScan™ mode for radiation safe scanning of the occupied driver cab
• Material separation capability with the optional dual-energy X-ray generator
• Gamma or gamma/neutron radiation detection integrated with the X-ray scan
• Automated capture of the license plate and/or container number
• Operator Assist tools to increase inspection efficiency
• Cold and/or hot weather package for expanded operational environment
• Concrete shielding walls
• Diesel electric generator

1.1 Rapiscan Eagle P-Series Products

Rapiscan Eagle P-Series portal cargo and vehicle inspection systems include:
• Eagle P45 – Drive-thru portal scanner with a 4.5 MV X-ray imaging system
• Eagle P60 – Drive-thru portal scanner with a 6 MV X-ray imaging system

Rapiscan Eagle P-Series portal cargo and vehicle scanners deliver high quality X-ray imaging in a high-throughput scanning operation. Trucks are scanned as they drive through the portal formed by the X-ray generator and the X-ray detector array. In the drive-thru portal scan mode, the X-ray beam automatically turns on after the driver cab passes, so that only the cargo is scanned. In the optional drive-thru CabScan™ mode, the driver cab is also safely scanned with a low energy X-ray beam. The Traffic Control and Monitoring System enables safe automated scanning, so that the crew can focus on evaluating the X-ray image. Crew members are housed in comfortable containerized offices.

1.2 Application Scenarios for Rapiscan Eagle P-Series Products

**Inspection at a Seaport.** At a busy seaport, an Eagle P-Series unit can meet the throughput requirements for inspecting inbound and outbound cargo containers. The drive-thru portal scan mode quickly and efficiently scans just the cargo container, which is the focus of the inspection. Shielding walls can be used to minimize the size of the scanning site and save space at a crowded seaport.

**Inspection at a Facility Entrance.** An Eagle P-Series unit provides the throughput required to keep up with busy traffic at the entrance to a critical facility, such as a government facility or military base. The optional drive-thru CabScan™ mode enables inspection of the entire truck – the driver cab and the cargo – where threats may be hidden. If necessary, the inspectors can be located a safe distance away from the portal to protect the crew.

**Inspection at a Remote Site** – The Eagle P-Series requires a small operating crew. At remote sites, it is conceivable that the unit can be operated by one person, who serves as operator and inspector. Images can also be transmitted to a remote office for evaluation, further reducing the work of the on-site operator.

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, an Eagle P-Series scanner can be used to scan an entire truck, including the driver cab, or just the cargo. 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 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. For example, the Eagle P-Series products require a small crew, which reduces labor costs associated with the cargo inspection operation.

2 FEATURES

The Eagle P60, shown in Figure 1, is a high-energy X-ray imaging system configured as a drive-thru portal with the following principal elements:

- A transmission X-ray imaging system, including the linear accelerator X-ray generator, X-ray detector array and computer hardware and software.
- The portal structure that supports the X-ray generator and detector array.
- Containerized offices that house the inspector(s), operator and check-in officer and associated computer systems and other equipment.
- A Traffic Control and Monitoring System (TCMS) that ensures a safe continuous flow of vehicles through the portal.
- Optional concrete walls surrounding the portal, which provide radiation shielding if sufficient space is not available to accommodate the required radiation exclusion zone.

Figure 1. The Eagle P60
Figure 2 illustrates the location of the X-ray generator and detector array within the portal structure and the X-ray fan beam that the truck moves through during a scan. The X-ray imaging system is designed to scan an object up to 2.8 m wide from 0.4 m to 4.6 m above the ground.

Trucks are inspected as they drive through the portal between the X-ray generator and detector array, as shown in Figure 3. To avoid exposing the occupants to harmful radiation, the X-ray beam is automatically activated after the driver cab passes. The resulting X-ray image of the cargo is sent for evaluation to an inspector in a nearby office. System throughput can be increased by employing multiple inspectors to keep up with the flow of trucks through the system.

2.1 Imaging System

X-ray Generator. The Eagle P60 uses a linear accelerator (LINAC) to generate a 6 MV X-ray beam. The X-ray generator is heavily shielded and the beam tightly collimated into a fan shape, which minimizes
radiation dose while maximizing beam intensity at the center of the object being scanned. The fan beam is oriented to cover an area from the axle to the top of a truck or container on a truck without corner cutoff. A dual-energy linear accelerator is used with the optional material separation capability and a low energy X-ray generator with the drive-thru CabScan™ option.

**Detector System.** The Eagle P60’s detector system uses scintillating cadmium tungstate crystals mounted to a silicon photodiode to detect transmitted X-rays. The detectors and their electronics are organized in modules arranged in an L-shaped array. This design minimizes the source-to-detector distance while still enabling 100% inspection of a truck or cargo container on a truck. The detector housing protects the detectors from environmental degradation. Doors provide easy access for servicing individual modules. The output from the detectors is sent to Rapiscan proprietary imaging electronics and then to a computer for display.

**Computer Hardware.** The Eagle P60’s computer system is used to operate the facility, acquire the X-ray image, display and process the image and store and retrieve images from the database. It utilizes commercially available Windows PC workstations, which run the Rapiscan Cargo Viewer software. High-resolution, color flat-panel monitors display the X-ray image, the user interface controls and the cargo manifest. There is a high capacity server for data storage and a CD/DVD drive for data archiving. Images are displayed on the flat panel color monitor and printed on a color printer. The images can also be sent from the inspection office to other locations within the Eagle P60 facility or to remote locations.

**Computer Software.** Rapiscan's Cargo Viewer software used in the Eagle P60 supports the entire cargo inspection process, including check-in, scanning and image evaluation. The inspector uses Cargo Viewer to view, process, evaluate and store the X-ray images. Cargo Viewer includes a comprehensive suite of image processing tools, including contrast and brightness adjustment, magnify/demagnify, edge enhancement, filters and histogram functions. Features of interest in the image can be highlighted and annotated for future reference. Each of Rapiscan’s cargo and vehicle inspection products uses this same Cargo Viewer software, so that trained inspectors can operate different Rapiscan scanners.

**Operator Assist Tools.** The Eagle P60 is available with optional tools to help the inspector more effectively and efficiently evaluate X-ray images. For example, an operator assist tool is available for automatically analyzing an image of a cargo container to determine if it is empty. This tool is particularly helpful at ports where there are many outbound empty containers that need to be screened. Other operator assist tools address finding anomalies in otherwise uniform cargo and finding high atomic number materials, which may be associated with fissile materials used in weapons of mass destruction.

### 2.2 Facility

A typical layout of an Eagle P60 facility, which includes the portal, offices and optional shielding walls, is shown in the schematic drawing presented in Figure 4. The facility layout is optimized for the specific site and inspection requirements. The X-ray images are sent to the inspection office for review by an inspector. From there, images can be transmitted via a network to a more remote facility for further evaluation by other inspectors.

The required radiation exclusion zone, which surrounds the portal, can be reduced by using optional concrete shielding walls on either side of the rails, as shown in the figure. The walls can be cast in place or constructed of concrete panels to enable them to be disassembled and moved to a different site. The unit can be installed within a building, which is designed to provide protection from the environment and radiation shielding. Shielding walls and a building are not part of the standard Eagle P60 configuration.

**Offices.** The Eagle P60 facility includes two offices, a check-in office and an inspection office, which house the cargo inspection facility crew and their equipment. At the check-in office, information about the truck and/or container, the cargo and the inspection is entered into the database. Shipping documents...
are also scanned into the database. The X-ray images are sent to the inspection office for review by the inspectors using the Eagle P60’s Imaging Analysis Workstation and Cargo Viewer software. The operator, who monitors the facility operation, is also located in the inspection office. A third office may be dedicated to supporting service activities, including preventive and corrective maintenance and spare parts storage. Offices can optionally be configured to meet specific customer requirements.

![Figure 4. Eagle P60 Facility with Optional Radiation Shielding Walls](image)

The offices are prefabricated from a 20-foot cargo container, which makes them easy to ship, transport, install and relocate, as shown in Figure 5. They are designed to provide a comfortable and safe work environment for their occupants. They are built in a factory and outfitted with all required utilities, including electrical wiring, lighting, HVAC (heating, ventilation and air conditioning), and work spaces prior to shipment. Therefore, installation is limited primarily to attaching the office to the local power source and installing furnishings and equipment. The offices are rugged and designed to work in the wide variety of environments experienced at seaports and border crossings worldwide.

Figure 6 presents an exemplar interior of an Inspection Office with one inspector. It shows the computer monitors for operation, including CCTV images, image evaluation and monitoring and control. The E-stop and loudspeaker microphone are also seen in the photograph. The Image Analysis Workstation and monitors shown in Figure 6 are replicated for each additional inspector.

![Figure 5. Representative Eagle P60 Offices](image)
**Traffic Control and Monitoring System.** The Eagle P60 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, illustrated in Figure 7, typically includes the following elements, which may differ in type, quantity or location depending upon the specific application requirements:

- Traffic control light at the entrance to signal when it is safe to enter the facility
- Sensors that detect the position of the truck in the facility.
- A speed sensor to measure the vehicle speed, which is used to adjust the linear accelerator operation and minimize image distortion due to speed variations.
- Signs can be used to instruct the driver to maintain the target speed.
- A “beam control” sensor that detects the front and back of the truck and the end of the driver cab. It also is used to turn the X-ray generator(s) on and off at the appropriate time.
- CCTV cameras for monitoring the facility and its vicinity.

![Traffic Control and Monitoring System (TCMS)](image-url)
Relocation. The Eagle P60 cargo inspection facility can be designed for easy relocation to a new inspection site. The portal and offices are easily and quickly disassembled, transported to a different location and reassembled at the new site. The optional concrete walls are constructed from panels that are disassembled and moved. If necessary, power can be provided by an optional 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 Eagle P60 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 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 Identification Number Capture capability captures a license plate and/or cargo container number. The image is immediately available to the inspectors in the nearby office. Images can also be wirelessly transmitted to additional inspectors at a nearby office.

3.1 Scan Modes

The Eagle P60 has two scan modes:

1. Drive-thru Portal Mode - Trucks are scanned as they drive through the portal at speeds up to 8 km/h. The X-ray beam automatically turns on after the driver cab passes, so that only the cargo is scanned.

2. Optional Drive-thru CabScan™ Mode – Trucks, including the driver cab, are scanned as they drive through the portal at speeds up to 8 km/h. The driver cab is scanned with a low-energy X-ray beam and the cargo is scanned with the 6 MV X-ray beam. The CabScan™ mode enables the entire truck to be safely scanned using two different imaging systems designed to separately scan the cab and the cargo.

The TCMS for the Eagle P60 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 8 km/hr. 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 X-ray beam subsequently turns on and remains on until the back of the truck is detected. The resulting X-ray image is sent to the inspection office for review by the inspector.

5. The truck drives out of the facility to a parking area and waits for the results of the X-ray image evaluation.

The same operational sequence applies to the drive-thru CabScan™ mode. However, the low-energy X-ray beam first scans the driver cab and then turns off when the beam control sensor detects the back of the driver cab. The high-energy X-ray beam is then used to scan the cargo area of the truck.

3.2 Throughput

The truck drives through the portal at a nominal speed of 8 km/hr, which enables a truck carrying a 40-foot container to be scanned in less than 20 seconds. A scan throughput of up to 180 trucks per hour can be achieved with a continuous flow of trucks.
3.3 Crew

The Eagle P60 is designed for highly automated operation, which reduces the size of the crew required to operate the system. The standard offices are designed to house a check-in officer, operator and two inspectors. However, the size of the crew can be reduced by fewer personnel sharing these duties, particularly at locations where traffic is light. Where high throughput is required, additional inspectors are needed to keep up with the traffic flow.

3.4 Operating Environment

The Eagle P60 is designed to operate in a wide-range of weather conditions.

- Operating Temperature range: -10°C to 40°C
- Optional Cold Weather Kit extends the low temperature range to -40°C when cold weather operating requirements are followed (see below)
- 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 mobile cargo inspection systems at a wide variety of locations. The Eagle P60 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 each side of the unit and on the horizontal boom 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 -10°C to -40°C. At these temperatures, the following Eagle P60 cold weather operating requirements must be followed:

- Use specified low temperature fluids
- Allow for an extended equipment warm up time prior to operation
- Maintain electric supply to warm key components when the unit is not operating

4 SAFETY

The Eagle P60 is designed and manufactured to applicable international safety standards and regulations. The TCMS incorporates safeguards that enable trucks to safely drive one after the other through the facility. The traffic control light at the entrance controls access to the facility. The CCTV cameras enable the operator to monitor the area. Warning lights and alarms indicate when the X-ray generator is enabled and operating and emergency stops immediately disable the generator. The status of the safety system is displayed on the Eagle P60 monitoring and control system.

Radiation Safety. The Eagle P60 is designed to be radiation safe for the vehicle occupants, crew and bystanders, in accordance with international and local standards. As with all Rapiscan products, the principle of ALARA (As Low As Reasonably Achievable) is fundamental to the design.
• Vehicle Occupants – The Eagle P60 is designed to be radiation safe for occupants of the truck driver cab. The radiation dose to occupants from scattered radiation in the drive-thru portal mode and from the low-energy X-ray beam in the optional drive-thru CabScan™ mode does not exceed the maximum dose allowable.

• Crew - During an inspection, the crew members are housed inside the offices that are located outside the exclusion zone. Therefore, the crew is not exposed to a radiation dose above the maximum allowable.

• Bystanders - To protect nearby personnel and prevent unauthorized access, the Eagle P60 facility includes a radiation exclusion zone, warning signs, lights and alarms and barriers and fences, as appropriate. Optional external concrete shielding walls may be used to reduce the size of the exclusion zone and the unit’s overall footprint. The controlled area boundary is designed so that the radiation dose at the boundary does not exceed the maximum allowable.

5 IMAGES

A representative Eagle P60 image is presented in Figure 8.

![Figure 8. Representative Eagle P60 Image of Cars in a Truck](image-url)
# EAGLE P60 OPTIONS

Options available with an Eagle P60 unit are listed in Table 1. Unless specifically noted in the table, each option can be ordered separately with any other option.

## Table 1. Eagle P60 Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inspection</strong></td>
<td></td>
</tr>
<tr>
<td>6 MV dual-energy linear accelerator – required for material separation capability</td>
<td>6 MV linear accelerator X-ray generator</td>
</tr>
<tr>
<td>Low-energy X-ray generator – required for drive-thru CabScan™ mode</td>
<td>6 MV linear accelerator X-ray generator</td>
</tr>
<tr>
<td>Drive-thru CabScan™ Mode – low energy driver cab scan and high energy cargo scan ; requires low-energy X-ray generator</td>
<td>Drive-thru Portal Mode – scan only cargo not driver cab</td>
</tr>
<tr>
<td><strong>Operator Assist Tools</strong></td>
<td></td>
</tr>
<tr>
<td>License Plate Reader</td>
<td>Photo of inspected object</td>
</tr>
<tr>
<td>Container Number Reader</td>
<td>Photo of inspected object</td>
</tr>
<tr>
<td>Gamma Radiation Detection</td>
<td>X-ray imaging system</td>
</tr>
<tr>
<td>Gamma and Neutron Radiation Detection</td>
<td>X-ray imaging system</td>
</tr>
<tr>
<td>Material Separation, including Dual Energy 6 MV Linear Accelerator X-ray Generator</td>
<td>High quality greyscale and pseudocolour image</td>
</tr>
<tr>
<td><strong>Operating Environment</strong></td>
<td></td>
</tr>
<tr>
<td>Cold Weather Package – extends operating temperature to -40°C to 40°C</td>
<td>Operating Temperature Range: -10°C to 40°C</td>
</tr>
<tr>
<td>Hot Weather Package – extends operating temperature to -10°C to 55°C</td>
<td>Operating Temperature Range: -10°C to 45°C</td>
</tr>
<tr>
<td><strong>Facility</strong></td>
<td></td>
</tr>
<tr>
<td>Concrete shielding walls</td>
<td>No external shielding walls</td>
</tr>
<tr>
<td>Diesel electric generator</td>
<td>Shore power operation</td>
</tr>
</tbody>
</table>
6.1 Material Separation

With the optional Rapiscan material separation technology, low atomic number and high atomic number materials appear differently in the X-ray image. This capability enables low atomic number (low density) contraband, such as explosives, to be distinguished from high atomic number (high density) materials, such as steel. The example material separation X-ray image presented in Figure 9 displays on the left a steel test fixture and on the right different thickness plastic test samples, which serve as explosive simulants. Notice that the test fixture appears in blue and the plastic test samples are green. The optional material separation capability requires a dual-energy LINAC X-ray generator.

![Material Separation Image](image)

**Figure 9. Material Separation Image**

6.2 Radiation Detection

The Eagle P60 is available with an optional radiation detection capability, so that radioactive materials in the cargo are detected during a scan. The system is available with gamma radiation detection or gamma and neutron radiation detection. The longitudinal location of the alarm is shown on the X-ray image. The radiation detection system is integrated with the X-ray imaging system, so that they do not interfere with each other.