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# WG Entire Truck & Cargo X-Ray Scanning Gantry

The WG Entire Truck and Cargo X-Ray Scanning Gantry is a state-of-the-art dual-energy x-ray scanner for checking cargo compliance to manifest documentation and the detection of contraband, explosives, narcotics and weapons.

## Applications

- Airports
- Border check points
- Customs
- Government facilities
- Hotels
- Military bases
- Seaports
- Sporting facilities
- VIP facilities

## Key Features

The Gantry x-ray system is mounted on rails which enables the screening of the entire vehicle to take without the driver in the cabin. The vehicle is parked the driver leaves the vehicle then the entire X-Ray Screening system moves on rails passing by and over the target vehicle.

The scanning takes place by the synchronous movement of ionising radiation source and radiation detector units mounted on either side of the gantry as it traverses over the entire length of the vehicle.

The system has an additional screening mode – the gantry remains stationary, whilst the vehicle drives through the gantry without the cab being screened this facilitates a high throughput of vehicles.

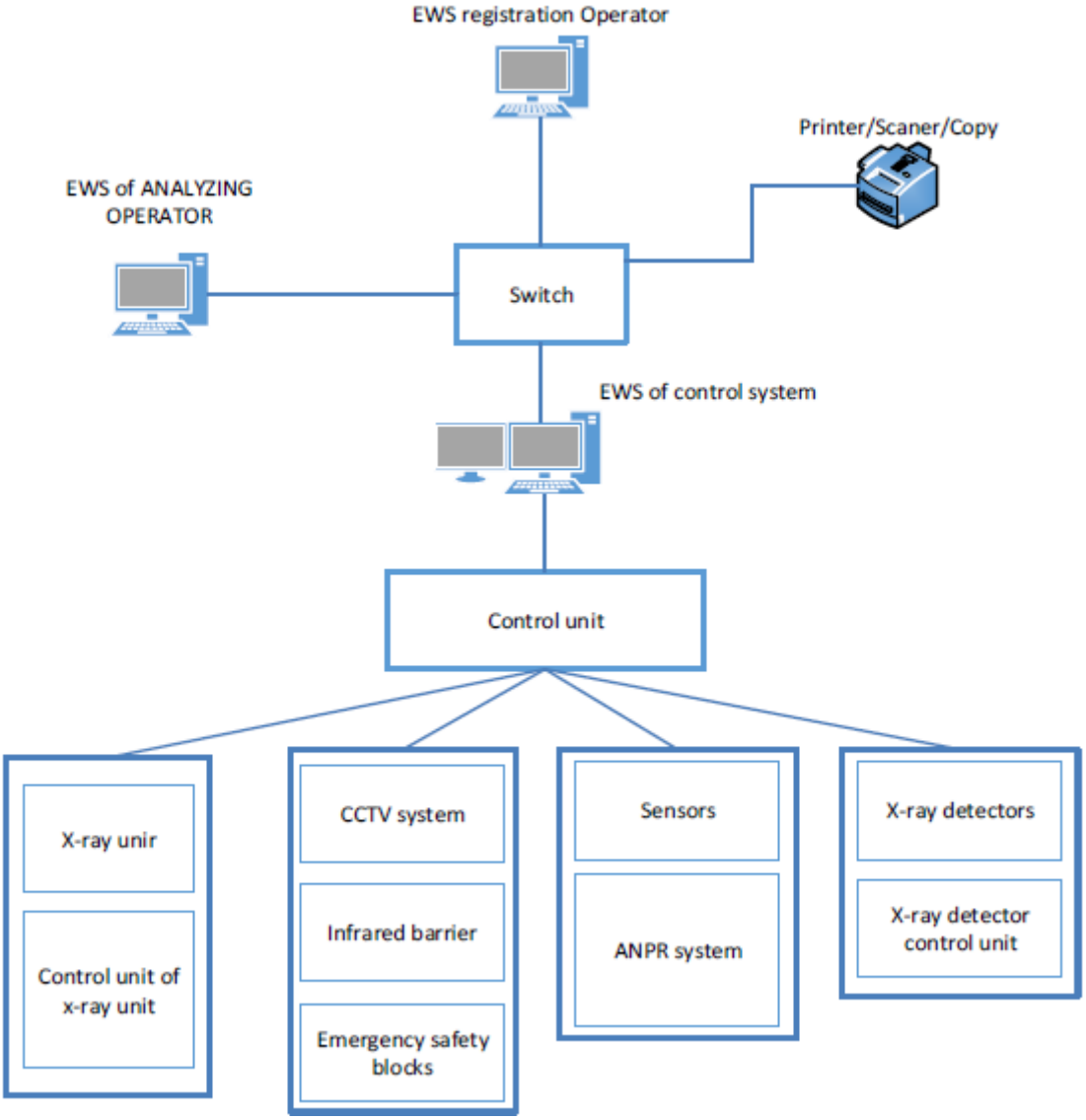
The high-energy 6 Mev Betatron x-ray linear electron accelerator will penetrate steel up to 340 mm.

The system has an automatic 3 colour coding for materials separation, providing distinguishing between organic, non-organic and metal materials. This feature assists the operator to detect contraband, explosives, narcotics and weapons.

The system's gantry will screen vehicles of up to 4.5 metres height and 3.5 metres wide, with a maximum length of up to 25 metres length.

Typical throughput of 20 trucks with containers per hour in stationary vehicle with the gantry passing over vehicle mode, in vehicle driving through stationary gantry mode typical vehicle throughput is 100+ per hour.

The systems software supports the entire screening process starting from vehicle registration to image analysis, backup and database search.




**Schematic Diagram of the Control System**

**The Control System main functions are:** -

- Control entry traffic lights.
- Registration of the vehicle and container.
- Sense vehicle is correctly located in scanning area.
- Monitor safety exclusion zone by infra-red beams & CCTV.
- If persons detected in exclusion zone shut system down.
- Operator – operate the microphone & loudspeaker system.
- Operate the traversing of the gantry.
- Operator - monitor the quality of the scanned image produced.
- Operator - check image for contraband.
- Operator - compare the image to delivery documentation / bills of laden.
- Operator – direct track carrying suspicious contents for further manual inspection.
- Operator – Images can be printed, allowing manual inspection pinpointing.
- Record all vehicle & container numbers and images in database.
- Database can be interrogated.
- Control exit traffic lights.

## Image Manipulation

The system is provided with: -

- Ability to choose between a black and white, or a pseudo-colour image, with a palette of at least ten combinations.
- Adjustment of the contrast and brightness.
- Digital filters for the improvement of the quality of the image.
- Improvement of the image at the edges and at selected sections.
- Automatic scrolling of the entire image.
- Marking and making text notes in order to highlight suspicious areas, these arks and notes are stored together with the scan image and are printable.
- Alternate viewing of original and processed image in the same window in order to compare them.
- Showing colours according to the intensity of their shade in digital expression.
- The image conversion tool provides exporting the image in the JPEG format and can convert the image format to the TIFF or the BMP.
- Digital zoom in/out 1/4×, 1/2×, 1×, 2×; 4×; 8x of a selected place.

**Communication system** – That ensures transmission of audio signals to the driver using a loudspeaker and includes an intercom system between the operator's room and the security gateway.

**Traffic control system –** That includes traffic lights, road signs, barriers.

**Power supply system** - That allows connection to a 400 V AC power network that has voltage surge and spike protection from voltage surges and drops. The system can be powered from an autonomous diesel generator.

**Video monitoring system** includes monitoring cameras located in the inspection gateway, a video recorder and a CCTV system monitor located at the operator's AWS for the control of system operation.

## System Software

The automated workstation's image analysis suite allows for an external network data storage device, as well as a data backup and recovery device.

The data storage device is accessible via LAN by the image analysis operators and system administrators.

The Software provides search and recovery of images based on identifying characteristics.
The data backup and recovery process does not affect the image data collection process.

## Technical Specifications

| Operating Transporting & Storage – Environmental Conditions | |
|---|---|
| Ambient temperature range | From -30°C to +55°C |
| Air humidity | From 0 to 99% |
| Transportation and storage temperature | From -30°C to +55°C |
| Air humidity during transportation and storage | 0-99% without condensation |

| Power Supply Requirements | |
|---|---|
| Power supply from the external AC network | Emission module 380 V +10/-15%,3 phases, 50 Hz +/-1%,<br><br>Peripheral components and computer equipment 230 V +10/-15%, 50 Hz +/-1% |
| Power consumption | Up to 55 kW |

| Operating Dimensions & Mode | |
|---|---|
| Maximum vehicle dimensions, metres | 25m Length x 3.5m Width x 4.7m Height |
| Dimensions of scanning tunnel, metres | 3.8m Width x 4.8m Height |
| Scanning speed, metres per second | 0.13 m/s, 0.2 m/s, 0.4 m/s |
| Minimum screening height | 0 cm from the ground level |
| Number and type of projections | One, side view |
| Operation mode | 24/7with the option of temporarily stopping system operation |

| Throughput Direction & Warm Up | |
|---|---|
| Throughput capacity, Vehicle Stationary Gantry passing over | 20 vehicles per hour |
| Throughput capacity, Vehicle driving though Stationary Gantry (Cab not scanned) | 100+ vehicles per hour |
| Scanning direction | Forward & reverse |
| Warm up time | 30 minutes |

| X-Ray Source | |
|---|---|
| Source | Linear accelerator |
| Radiation source energy | 6 Mev |
| Impulse resolution modes | Minimum 4.0 Mev<br>Maximum 6.0 Mev |

| X-Ray Image Detector | |
|---|---|
| Source | Linear accelerator |
| Radiation source energy | 6 Mev |
| Impulse resolution modes | Minimum 4.0 Mev<br>Maximum 6.0 Mev |

| X-Ray Image Quality | |
|---|---|
| Penetration - Steel | 340mm |
| Wire resolution – Copper wire | 1.5mm |
| Spatial resolution – vertical & horizontal | 4mm |
| Contrast sensitivity | 1% |

| Database | |
|---|---|
| Server | HP ProLiantML30 |
| Storage capacity | 16 TB |
| Image storage capacity | 100,000 |
| Backup capacity | 8 TB |
| Back up Image storage capacity | 200,000 |
| Images can be exported on | DVD / CD |

**System Operation Software**

The Cargo- Manager software provides interaction of individual components of the Cargo-Vision software suite and consists of Cargo-Reg for vehicle and cargo registration, Cargo- Scan for the scanning process and X-ray module control, and Cargo- View for the processing and analysis of the x-ray image.

In the regular operational mode, the software modules switch automatically according to the developed algorithm for operators' work. It is also possible to change from one module to another from the software suite in any sequence. The Cargo Manager allows dividing operators by their functions and setting up accounts.

There are four access groups of operators within the system:

1. **Administrators** - This group of operators has all the system control right, they can run any software and functions of the system, as well as perform software updates and system recovery.

2. **Registration operators** - Operators in this group have the right to register vehicles and cargoes, check accompanying documents, and use the Cargo-Reg software module.

3. **System operators** - Operators in this group have the right to view and change vehicle registration data, perform the scanning procedure, control video monitoring cameras, view image archives, and use the Cargo-Scan software module.

4. **Image analysis operators** - These operators use the Cargo-View software module and analyse the received x-ray images with the help of software tools, prepare a report on the findings of analysis.

## UPS

All operator workstations are connected to uninterrupted power sources with an autonomous operation time of 10 minutes. Power supply switching is automatic in case of failure of the main power supply or in emergency situations. The control system automatically monitors the shutdown or restart of the entire system to rule out operator errors.

## Backup

The following measures ensure uninterrupted software operation: -

- Regular data backup from operator workstations hard disk for fast data recovery.
- All operator workstations are equipped with the data recovery function.

## Radiation Safety

The radiation safety system is designed to ensure the safety of people inside and outside the controlled area, it ensures radiation protection of people, operators, drivers and passengers and the environment within and around the system.

The system includes an x-ray controller that collects information from all safety units, analyses it, and either allows or disallows x-ray system, the following are components of the controller:

- Radiation source on/off unit
- Scanning area perimeter control with optional IR barriers
- X-ray radiation indicator

The boundaries of the radiation exclusion area are selected for the deployment and operation of the system based on the following radiation safety requirements: -

- The ionizing radiation dose beyond the controlled area may not exceed 0.5 μSv on average during one hour of system operation.
- The combined annual dose may not exceed the allowable limit of 1 mSv (ICRP 103), provided that no person is exposed to radiation for more than 2,000 hours per year.

Radiation safety system components:

- Blocking system
- Dose meter
- Emergency stop buttons
- Intercom communication
- Internal communication system
- Sound and light alarms
- Vehicle presence detector
- Video monitoring system
- X-ray protection

| Radiation Safety | |
|---|---|
| Dose rate inside operators' room | Not more than 0.5 µSv/h<br>Not more than 1 mSv/year |
| Dose per scanning per entity | Not more than 20 µSv |
| Exposure dose of ionizing radiation at the boundary of the zone, not more than | 0.5 µSv in average during 1 hour of system work |

A lead shield is installed around the high-energy X-ray source to reduce scattered radiation. On the vertical part of the arm behind the detectors a lead plate is located to ensure protection against ionizing radiation and reduce the scattered radiation area. If the system is deployed inside a building, this will providing additional protection against ionizing radiation.

### System Safety

**Emergency Stop buttons -** The Emergency Stop buttons immediately stop the x-ray system when pressed, pressed, information about the button will appear on the operator's display.

**Sound & Light Alarm -** An Audio (siren) and Light signal located on the system's body will activate when the scanning process starts and throughout the scanning procedure.

**Dose Meter -** A portable Dose Meter is located in the operator's room that monitors the dose rate within the room.
If the maximum allowable x-ray dose rate is exceeded, the device triggers a visual and sound alarm, it will automatically disable the x-ray source. When the dosimeter alarm is triggered, a corresponding message is displayed on the operator's display.

**Door locks -** The front door of the X-ray source module is equipped with a magnetic-type safety lock and triggers when the door is opened. Radiation can only be activated when the doors are closed, and the locks are in place. The x-ray source can only be activated when the doors to the entrance / exit area are closed in the inspection room

### Vehicle Presence Sensor

When the gantry remains in stationary mode, whilst the vehicle drives through the gantry without the cab being screened, the vehicles are fitted with reflective type sensors, the system uses these sensors to monitor the position of the vehicle and container relative to the scanner to ensure the x-ray radiation is only activated when the driver's cabin has left the scanning beam area. The sensors also assist in traffic monitoring, giving the position of individual vehicles to prevent collisions occurring.

### Safety Radiation Exclusion Area

To protect third party persons during scanning operation, a safety radiation exclusion area must be formed around the system. The radiation dose at the edge of the safety zone must not exceed the maximum permissible level. The dimensions of the safety radiation exclusion area do not exceed the size of the scanning room.

Warning signs that are visible from a distance of at least 3 metres must be placed at the perimeter safety radiation exclusion area

The CCTV monitoring system enables the system operator to monitor the preparation for and progress of the scanning process. The system consists of colour cameras and video displays and ensures control of the entry, exit to and from the inspection tunnel and scanning room during the inspection and includes six cameras and video displays and a recorder.

### Optional OCR Container Number Recognition

An optional 3 cameras for container code recognition can be included, they will provide automatic container code recognition (ACCR) to ISO 6346. Reading of shipping containers numbers makes logistic environments more intelligent by building comprehensive databases of traffic movement, automating and simplifying airport, railways or harbours, managing border control inventory and container surveillance systems. ACCR reads

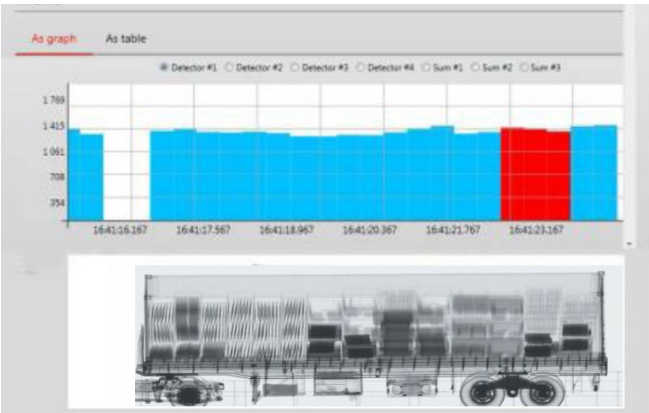
The ACCR reads the container codes from digital still images, digital image flow or live video signal. The unique serial number with check digit, owner, country code, size, type and equipment category as well as operational marks (if any) of every cargo container with the highest accuracy. The number detail is saved in the data base with the scanned x-ray image.

## Optional ANPR Licence Plate Number

An optional ANPR can be included that automatically reads the vehicle license plate from many camera images with very high recognition accuracy. The system can read Arabic, Cyrillic, Chinese, English, Latin, Korean, Thai and many other character sets. The number plate detail is saved in the data base with the scanned x-ray image.

## Optional Integrated Radiation Detector

An optional Integrated Radiation Detector can be included that will detect radioactive and nuclear materials being transported through the x-ray area of the system. The radiation detection system overlays the x-ray scan with the profile of the gamma and neutron.




Example – **Red** Section of Graph Showing Radioactive Material Present

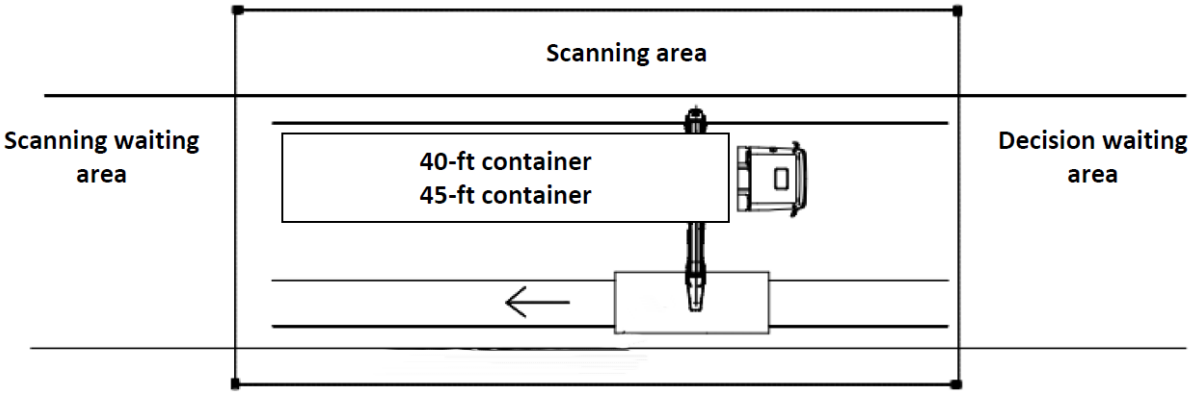
## System Layout

There are three working areas shown in the diagram below: -

**Scanning waiting area**–Where vehicles wait for traffic signal permission to enter the scanning area.

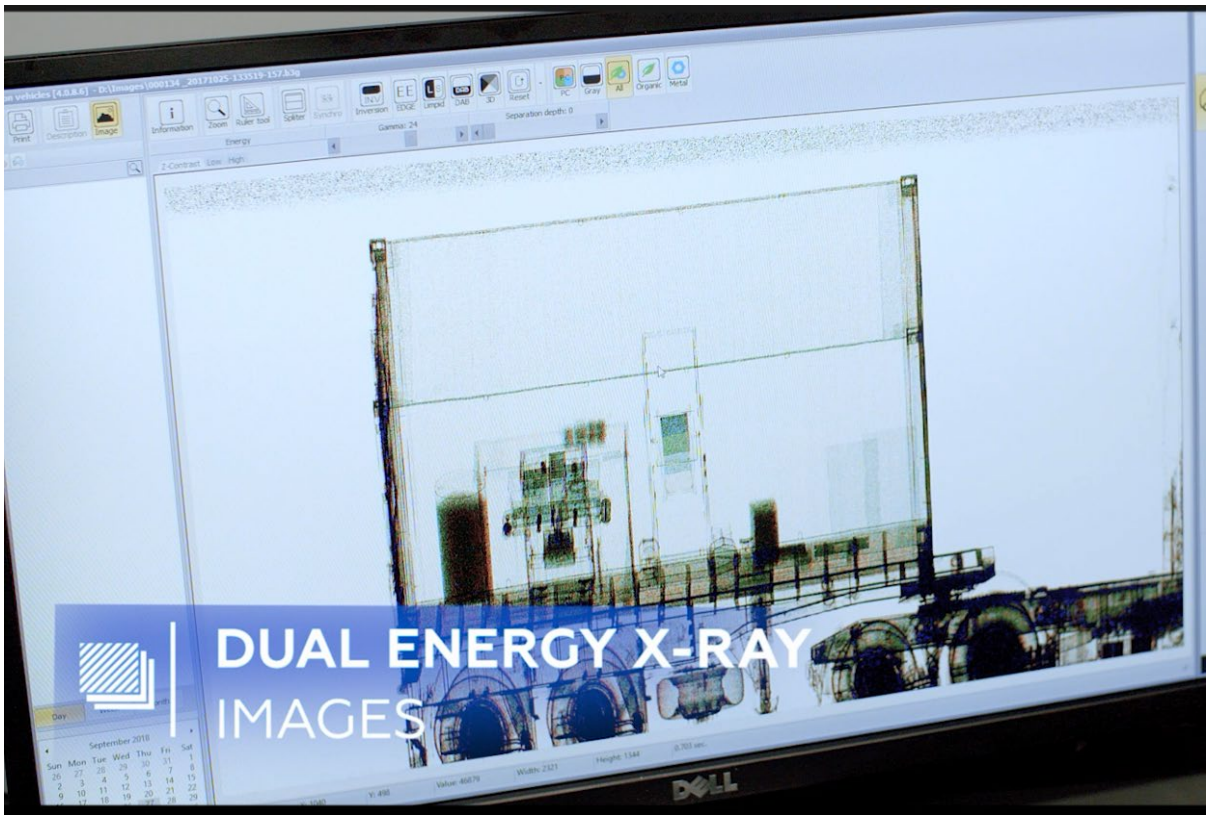
**Scanning area** – Where the vehicle is scanned.

**Decision waiting area**–Parking space whilst inspection results are determined.




If the system is to be installed in a custom building the overall dimensions must not be less than 30 metres Length x 12 metres Wide x 6 metres Height.

Typical Images


EXCLUDING A DRIVER
CABIN FROM SCANNING