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Mobile Trailer X-Ray Container Truck - Vehicle Inspection Systems

Madoorsscan X-ray Mobile Scanning

Code : *Madoorsscan MX-60 Series*

Data Sheet

MADOORSSCAN MX-60

Adres : Saray Mahallesi / Atom Caddesi / Küme Evleri **No :** 155 Kahramankazan ANKARA / **TÜRKİYE**

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The Madoorsscan MX-60 Trailer model mobile x-ray screening system is designed for ease of operation and can be driven from location to location and be ready for use in less than 30 minutes.

The Madoorsscan MX-60 requires a minimal footprint and external infrastructure while still meeting the most demanding international security-screening requirements.

This system uses a range of accelerators from 4MeV to 6MeV and a variety of scanning modes. The combination of these capabilities with high mobility makes this product ideal for applications that require the quick and easy relocation of the screening checkpoint.

When equipped with the optional Madoors software and sintination dedectors radioactive-material detection system , The Madoorsscan MX-60 can carry out simultaneous X-ray inspections and an analysis to detect radioactive gamma and or neutron materials.

The Madoorsscan MX-60 version is an all-in-one mobile-screening lorry. The Madoorsscan MX-60 version of the range can be towed by a standard truck.

• Throughput of up to 25 trucks an hour in mobile scanning mode and up to 100 trucks an hour in pass-through mode

• Steel penetration up to 320mm (12.6in)

• Madoors software technology for organic/inorganic material discrimination at 6MeV

• Up to six scanning modes

• Adjustable scanning heights and angles

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About Company

The Madoors as the major company providing security systems and solutions in the Middle East was founded in 2005 starting its activity by producing small baggage x-ray inspection systems and body scanner. Soon the company developed its products by incorporating advanced technology and design facilities and high-educated experts in the field of x-ray systems and produced light vehicles scanners and truck scanner systems in two models stationary and mobile.

The company is now a leader in designing, implementation, supplying and execution of security systems and solutions in various fields, including X-Ray inspection systems and has played an important role in meeting the security needs of organizations, institutions, various military and regulatory bodies, customs and airports. It also provide services including installation and commissioning, training and technical support for its customers.

The company is also ready to suggest organizations and companies , packages of x-ray systems together as a total security solution, which provides safety for different parts of organization regarding their specific situations.

The company currently has the following projects on the agenda

1. Design and manufacturing X-Ray systems for inspecting light vehicles without passengers.

2. Design and manufacture of X-Ray stationary inspection system for truck stations.

Our Customers

The company has provided valuable services and systems to the below-mentioned organizations and governmental departments in the field of consulting, supply, design, construction, installation and commissioning and after-sales services for X-Ray systems.

1. General Staff of the Armed Forces
2. Airports
3. Prison Affairs Organization
4. Anti-Narcotics Police
5. Customs
6. Army
7. Ministry of Intelligence
8. Ministry of the Interior affairs

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The use of truck inspection systems as a worldwide inspection aid equipment is expanding. Using images provided by this system, it is possible to have a complete analysis of the truck load under inspection and to discover prohibited substances and objects such as drugs, weapons, etc. that have been embedded in the truck load. The prepared sample of images are illustrated in the following figure.

This system is mobile meaning that all the equipment of this system can be easily transferred to any place by riding the truck tractor. Among the places where this system can be used are the country's entry points such as customs, airports, and so on. In this model , the inspection system is installed on a flatbed trailer and can be towed by a truck tractor. The system can be detached from the truck when it was deployed to a desired place.

The advantage of this model compared with Madoorsscan MX-60 is that its truck can be changed easily and it can be towed by different trucks and trailers. So in case any problem occurs for the truck itself, the whole system should not be transferred to the repair shop.

Madoorsscan MX-60 has also more capability for customization because of its dependence from its trailer. For example this model includes rest room for operators which Madoorsscan MX-60 does not include that feature. It can also be designed to have axils so that the weight of the whole system would be distributed on 2 or 3 wheel axils.

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Specific aspects, advantages and capabilities

Special features of mobile truck inspection system

A. Ability to detect drugs, explosives and smuggled goods and medicines which is hidden among the load.

B. Complete scanning of trucks and trailers and imaging the entire load, vehicle and driver's cabin (if required). The system detect the driver cabin and is able to exclude it from scanning.

C. Inspection of cargo without needing to unload the truck.

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D. Scanning the truck while passing at a maximum speed of 5 km per hour as standard scan and 10 km per hour as fast scan.

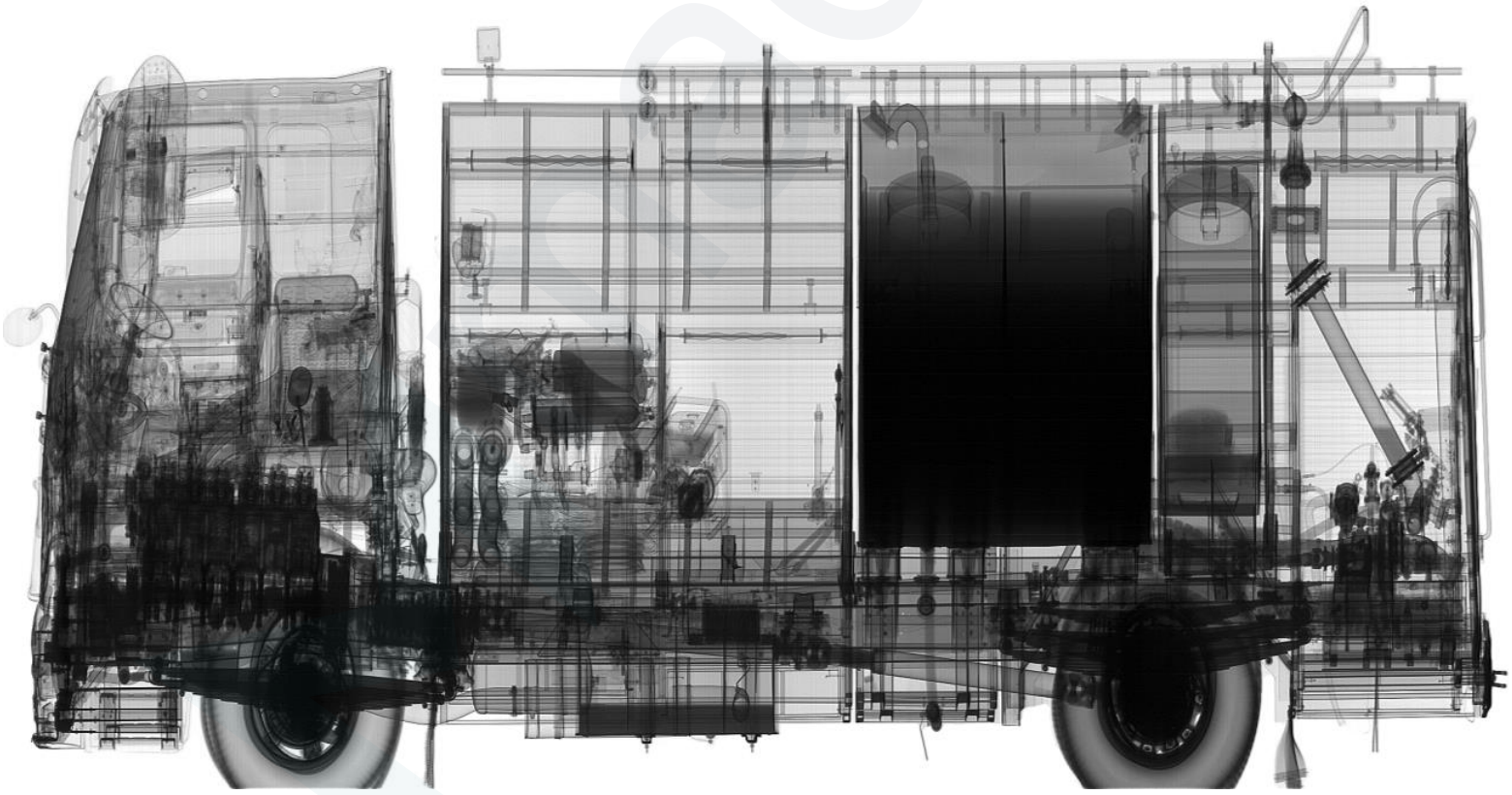
E. Very low error rate in truckload inspection compared to conventional inspection methods.

F. Scanning vehicles with maximum dimension of 2.8 m width, 4.8 m height and 20 m in length.

G. High penetration depth of produced beams, 280 to 320 mm in steel.

H. The system is capable of working with three-phase power generator.

I. The operator's room has suitable amenities including refrigerator, tea maker, air conditioning and operator's desk and chair.



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Environmental conditions

Environmental conditions			
Row	**Environmental factors**	**Explanation**	**Amount °c**
1	Maximum ambient temperature	Operational mode	45
		OFF mode	60
2	Minimum ambient temperature	operational mode	-10
		OFF mode	-20
3	Environmental humidity	operational mode	0 to 90 percent

Technical and operational specifications

Technical And Operational Specifications		
Row	**Specification**	**Explanation**
1	X-ray source type	Dual energy linear electron accelerator
2	Normal energy	3/6 Mev (low energy 3 Mev, high energy 6 Mev)
3	Penetration depth	280 to 300 mm in steel
4	Operating capability	Detection and discrimination of drugs, explosives, smuggled goods and medicines
5	Type of detectors	High resolution Photodiode detectors (Scintillator + Photodiode)
6	Accelerator Warm-up Time	10 min at 25 °C
7	Arms opening time	5-10 min
8	Scan Rate	Up to 80 (40-foot) containers per hour
9	Scanned vehicle speed	Up to 5 km per hour for standard scan Up to 10 km per hour for fast scan
10	Scan Area	38 × 40 meters
11	Safety zone	50 × 50 meters
12	Maximum dimensions of the scanned vehicle	Width: 2.8 meters, Height: 4.8 meters
13	Number of standard operators	2 persons
14	Control System	PLC controller
15	Scanning Method	The object passes through the scan gate (Drive-through mode)
16	Vehicle type of system	SCANIA, VOLVO or the like

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17	Air conditioning system	heating and cooling system inside the operators room
18	Mobility	Mobile
19	Maximum transportation speed	60 kilometers per hour
20	Power consumption	40 kVA
21	Stabilizer (for Linac only)	9 kVA
22	Power Generator	380 (v), 50-60 (Hz), 3 phase, 40 kVA
23	UPS for PCs	3 kVA
24	Maximum doze rate on the borders of beam safe area	Less than 2.5 µSv per hour (IEC62523 2010-06)
25	Radiation doze to staff in control room	Less than 1 µSv per hour (IEC62523 2010-06)
26	Ambient dose equivalent to the object being inspected	less than 1 mSv per scan (IEC62523 2010-06)
27	Average doze rate of the system boundary	Less than 2.5 µSv per hour (IEC62523 2010-06)
28	Radiation dose level	In accordance with standard IEC62523 2010-06
29	Basics of system	Accelerator, detectors, power generator, electrical and mechanical equipment, chassis, image inspection system, driver cabin detection system, detector temperature control system, beam collimator, radiation protection system, x-ray imaging subsystem, image processing software, safety equipment, surveillance cameras, Audio and visible alarm, emergency shutdown keys, Hydraulic system, Document scanner and printer
30	Beam shape	Horizontal FAN perpendicular to the motion direction
31	Pixel depth	16 bits
32	Image discovery mode	Real Time Scan
33	Magnification	8x-4x-2x-1 / 2x-1 / 4x
34	Image analysis	Image processing technics stated in the next sections
35	Dosimetry system	Environmental Dosimetry system with audio alarm Portable dosimetry system (optional)
36	Deliverable documents	User's operation, installation and commissioning manual System maintenance manual Technical manual including electrical diagrams
37	Checklists	daily and periodic inspection checklists of the device

38	Certificates	QC certifications CE certificates
39	Operation capability	Day /Night operation and using generator and the mains

Accessories and Special Items of the System

No.	Item	Description
1	CCTV Security System for operators room and surrounding	Camera
2		NVR
3		Storage Memory
4		Monitor
5	Audio system	Sound Amplifier
6		Desktop Microphone
7		Loud Speaker
8		Camera Stand
9	Dosimetry System for the Environment	Dosimetry Probe
10		Data logger
11	Tester (optional)	Standard 62523 Test Equipment
12	Illumination System	Gate Surrounding Illumination
13	Cable	30m , For connection to the mains
14	Operator's Room Installations	Fire Alarming System
15		Fire Extinguishing Capsules
16		Illumination System
17		Air Conditioning System of Operator's Room
18	Operator's rest room	Including bed, oven and hand wash basin
19	Scanner	-
20	Printer	-
21	Power Generator Room Installations	Fire Alarming System
22	Power Generator	40 kVA
23	Enter/Stop Indicators	-
24	Warning Plates	-
25	UPS	3 kVA
26	Internet Network Capacity	For Remote Connection and Services
27	Operators Table	-
28	Chair	-
29	HMI	-
30	Computer	-

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31	Monitor	3 for x-ray images + 1 for surveillance cameras
32	Mouse and Keyboard	-
33	Emergency Stop Button	Manual Push Button with lock
34	Computer Rack	-
35	Network Switch	-
36	IR Sensor	Fixed on the gate for driver cabin detection
37		Portable for entrance detection
38	Detectors	XCU
39		XCARD
40		Power Source
41	Temperature Control System	For detector's only
42	Micro switches and Interlocks	Doors
43		Arm mechanism
44		Accelerator
45		X-ON for operator
46	Buzzer	Gate opening and closing
47		Pre-X-ON (buzzer + light)
48		X-ON (buzzer + light)
49	Air Conditioning of the System	Accelerator Room
50	Accelerator	Head
51		Modulator
52		Chiller
53	Stabilizer	9 kVA
54	Isolator Transformer	Only for PC systems
55	Control Panel	Inside Operator's Room
56		System outer body
		Remote (for opening and closing the gate only)

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Design and Architecture

The X-Ray Truck Inspection System includes a set of electron linear accelerator and an array of photodiode detectors that are arranged perpendicular to the line of beams in a single direction on the crane arm (gate) which is installed on the scanner vehicle. All subsystems including the control room are also mounted on the vehicle.

Components and Configuration

- Electron linear accelerator
- Array of photodiode detectors
- Keyboard, monitor and processor
- System image processing software
- System collimator
- Truck - System control center
- Three-phase power generator
- CCTV Camera
- Environmental Radiation monitoring equipment

Electronic Linear Accelator

Electronic linear accelerator is the source of X-rays in the system. For mobile truck inspection systems , small accelerators can be used with easy transport capability. This accelerator energy are 3/6 Mev or 4/6 Mev dual energy.

Figure 4 – Dual energy 3/6 Mev Electronic Linear Accelerator

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Array of Photodiode Dedectors

X-rays collide with the truck's load, pass through the load and hitting detectors. From collision of the X rays to the detectors, signals are generated and entered into the system's central processor. From the accumulation of all signals and using image processing software, a clear image of the load is formed on the system display. The technical specifications of photodiode detectors are as followıng. Specification Amount

Technical specifications of photodiode detectors	
Specification	**Amount**
Detection energy range	450 kev to 9 Mev
Pixel pitch	Maximum 4.6 mm
Type of detector	Scintillator + Photodiode detector
Number of detectors	48
Number of pixels	32 × 48

System Image Processing Software

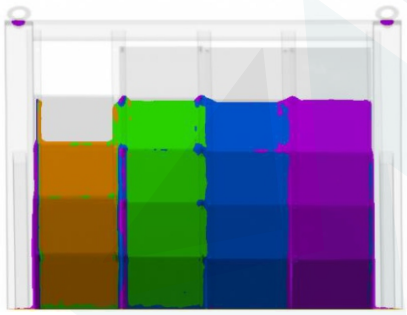
All processing on ımages prepared from the collision of X rays with objects, are performed by existing image processing software. The image processing software includes the following functions

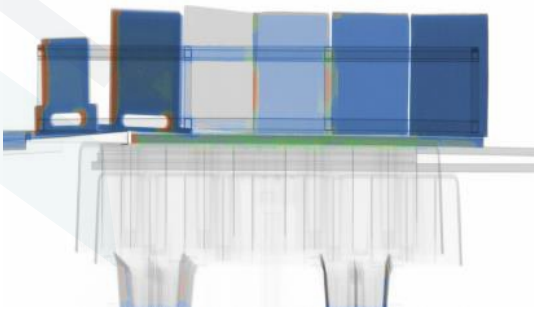
1. Zoom functions: These functions make it possible to display the image from 8x-4x-2x-1/2x-1/4x.
2. Negative functions
3. Contrast enhancement
4. Supper enhancement
5. Histogram equalization function: By performing uniform histogram on gray areas of the image, its high frequency details are better displayed.
6. High and Low Penetration functions: The High Penetration function shows the image with more and the Low Penetration function shows image with less penetration.
7. High Spot function: Automatically brightens dark areas of the image with the help of High Penetration function.
8. Material discrimination and image colorizing based on material types
9. Pseudo coloring
10. Gama correction
11. Flip X, Flip Y

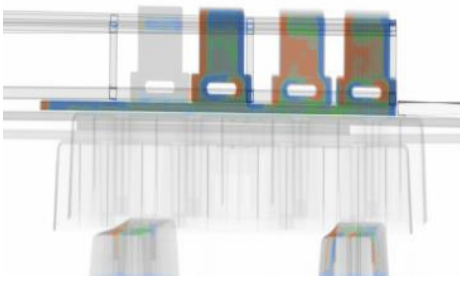
Array of Photodiode Dedectors

12. Marking
13. Color or Black/White image
14. Image sharpening
15. High and Low

In x-ray images a combination of the above functions is also applicable for producing images with higher quality. In X-Ray images of this system, the material discrimination function is based on X-Ray images obtained with two energy level of 3 Mev and 6 Mev. As shown in the figure below, X-ray images are provided from four unknown materials. Based on the material discrimination algorithms, polymers are shown in orange, aluminum in green, iron in blue and lead is shown in black.







By implementing the material discrimination algorithms in the system software, in accordance with the above classification, the X-Ray image obtained from the load is displayed as the following image:

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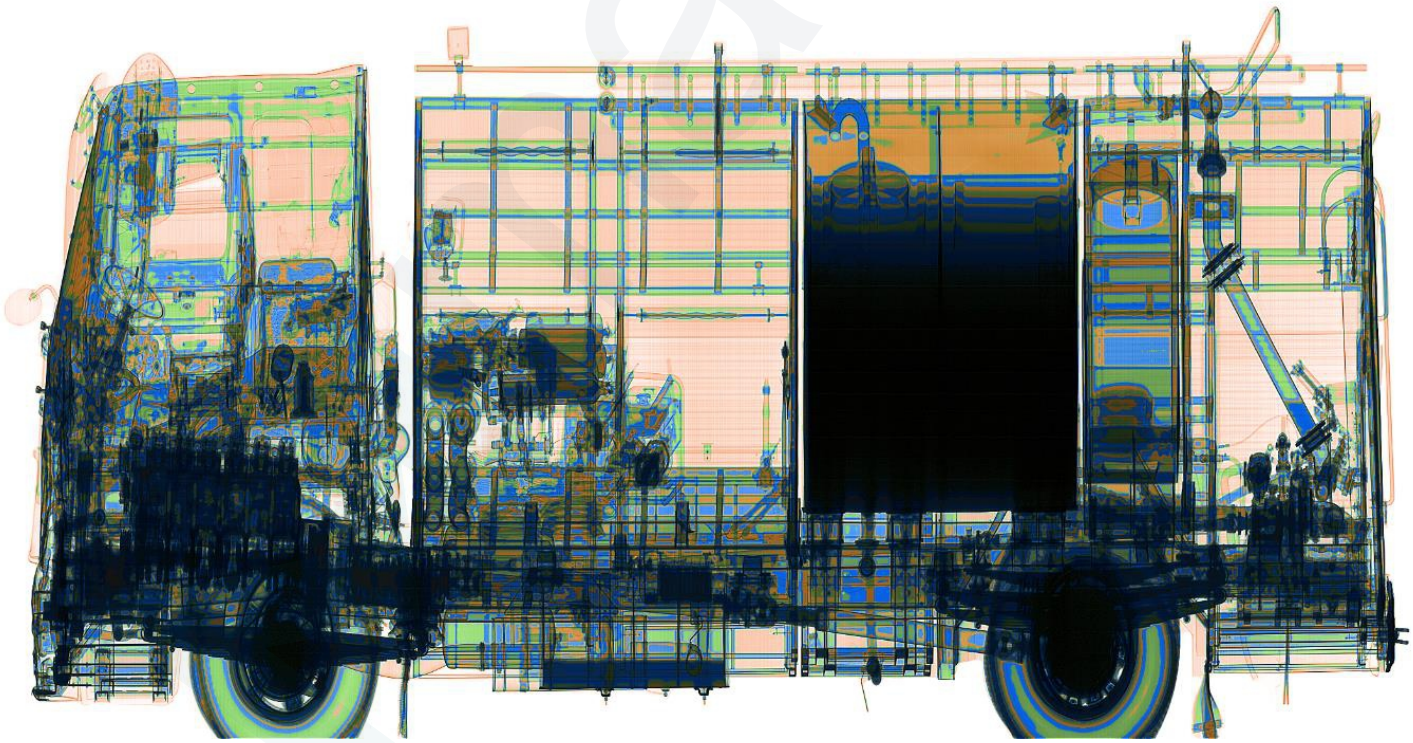
Colorful scanned image of fire fighter vehicle distinguishing between



Colorful scanned image with another image processing algorithm

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System hardware

The technical specifications of the hardware of the computers used in the system are as follows:

System hardware	
Part	**Feature**
CPU	Core i7
RAM	8GB extendable up to 16 GB
HDD	Min. 1 TB
Monitor	4 sets; each 20 inch Full HD 3 for x-ray images + 1 for surveillance cameras images
Mouse/Keyboard	USB
VGA	1GB
DVD-RW	General
Operating System	Win 7 / win 10

System software

The software of the system has the following capabilities:

- User friendly for operators
- Control connections of hardware sections at startup time
- Record, process and save scanned images
- Improving the contrast and resolution of scanned images by software
- Separation of groups of organic, non-organic materials and metals (**Figure 7**) based on color separation and classification according to the following table:

Material Classification			
Organic	**Non-Organic (Mineral)**		
Plastic/TNT/RDX/C4	Light metal	Heavy metal	Others

- Saving images based on recording date, scanning system and operator ID
- Saving at least 5,000 high resolution scanned images and related information.
- Automatic information storage.
- Image Re-Read
- Capturing image of scanned vehicle and attach it to the x-ray scanned image and additional information.
- Separating and saving images of suspicious scanned vehicles in a different place.
- Managing images stored in the system software, which includes the following:
  - Displaying a list of all scanned images
  - Image sorting based on scanning date
  - Ability to define unlimited number of users with access limitations.

- Ability to search among images based on scan date, license plate, operator name, presence of suspicious items, incorrect or distorted license plate reading cases, inspection system (in network mode for multiple systems).
- Ability to save images in TIFF, BMP and JPG formats
- Ability to define the operator and limit his access to deleting and editing data and images.
- Ability to change and recover user passwords
- The software has a control menu for setting the system control section.

System collimator

The collimator is made of lead and is used to limit the radiation of the beam and direct it towards the detectors.

Truck Tractor

In MX-60 All the equipment and subsystems of X-Ray system is installed on a 2 or 3 axil flatbed trailer which is completely isolated from its truck tractor. The truck can tow the system and leave it at any desired place. It is also possible to tow the system by different trucks each time.

System Control Center

Main control panel of the system is located inside the control center cabin which is completely safe in terms of radiation.

The system is equipped with a remote control panel by which the gate mechanism can be opened or closed.

The system is also equipped with a control panel installed on the outer body to open/close the gate mechanism etc.

Three-phase power generator

To generate the required electricity for the system, a three-phase power generator is used. In case the city electricity (the mains) is available, the generator can be taken out of the circuit.

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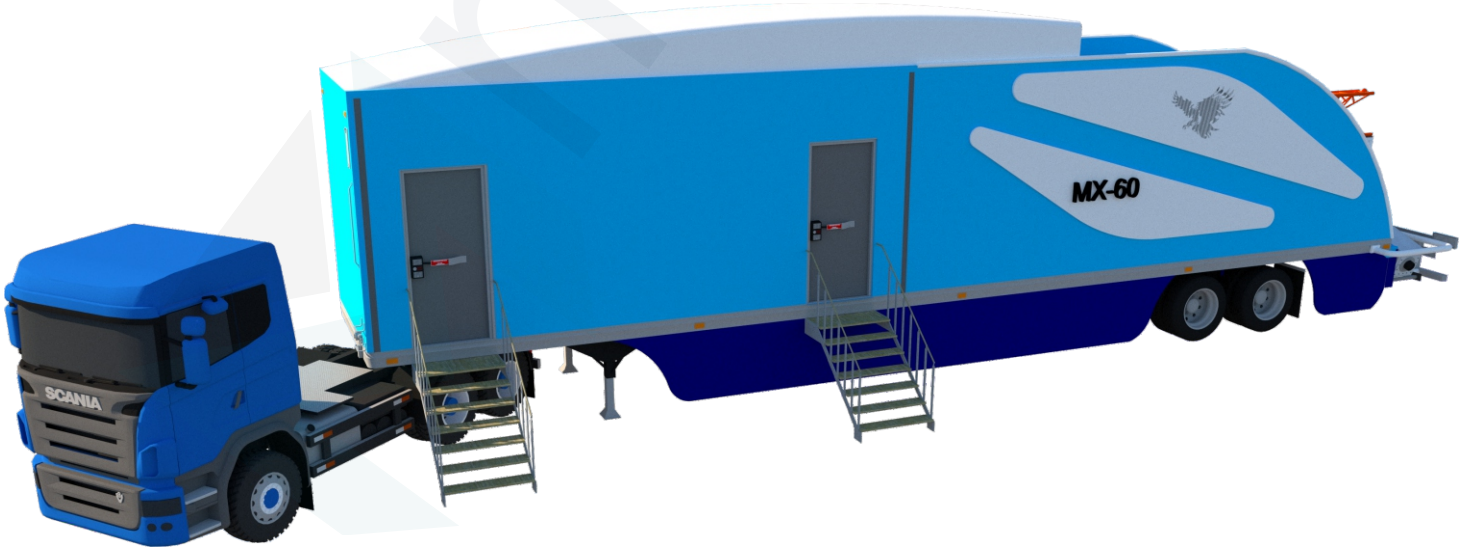
Information and Explanation of Operation Performing Scanning Operation

In order to scan a cargo, first close the area around the scanner truck for about 50 meters in length and 50 meters in width with danger signs (red bar) and leave a way for vehicles to enter the scan area.

The operators located in the control center at the same time can open the crane arm (gate) and switch on the accelerator from control center. The accelerator will start the warm-up process and takes 10 minutes to get ready for scan operation. Meanwhile the crane arm (gate) has been opened and now is ready for operation. This process is performed only once at the beginning of operation and there is not needed to be repeated for each scan.

As the cargo vehicle passes through the gate, the sensors detect the cargo and driver's cabin. The operators can decide whether to scan the driver's cabin or not. By entering the cargo truck into scan area, the accelerator starts to generate X beams and begins to scan the vehicle (the entire truck or only the cargo). Accelerator stops generating beams after the cargo has passed the gate. During the scan, the image of cargo and driver's cabin (if it's chosen to be scanned) will be displayed on the system screen as real time.

When scanning the load, the environment around the truck is controlled by using CCTV cameras installed on the scanner truck. In addition, with the environmental dosimetry system, the amount of dose received at the operator's location and the vehicle is monitored. It should be noted that the system is equipped with emergency keys that can be used to stop scanning operations in the event of an accident.



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Services

Delivery method

The mobile truck inspection system is delivered to the customer after preparation and implementing all factory tests along with related certificates, technical documents, user and maintenance manuals etc.

Training system documentation

The people introduced by customer will pass operation and first level maintenance training courses as operators and technicians. Documentation submitted to customers after system installation and commissioning:

- Operation and maintenance manuals
- Technical information of the device (introduction of the system and its various parts)
- First level repairing instructions including introduction to types of failures, diagnosis methods and solutions for repairing and fixing
- Safety instructions for working with the device (for operators and technicians of the system)
- software
- List of consumable and spare parts of the device

Warranty and support

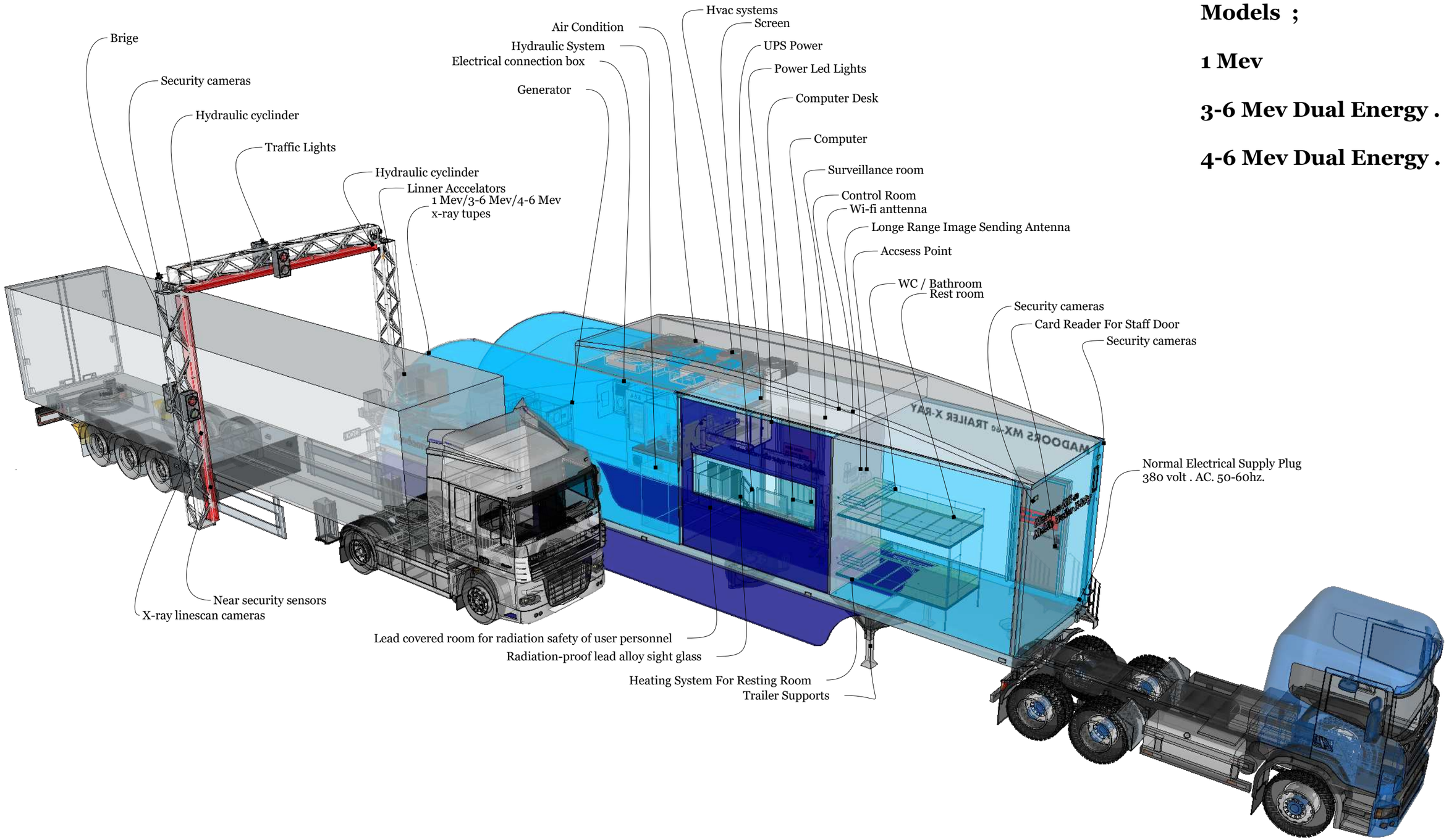
The system hardware and software is under warranty from the date of installation and delivery for 12 months. From the end of warranty period, it includes 120 months technical and engineering services and full technical support of hardware and software. Warranty includes the followings:

- All parts and different hardware sections, system components, connections and communications of the system (in case of proper use).
- System software including control, processing and display units
- Sensors and cameras
- Electronic linear accelerator
- Operator cabin and control equipment

The warranty does not include failures caused by improper use of the system.

The following services are provided within the period of warranty, technical support and after-sales services:

- Technical support from the date of installation and delivery
- Providing parts and components for the system if needed
- Technical inspections, quality control
- Diagnosis and repair of failures in case of occurrence



Models ;

1 Mev

3-6 Mev Dual Energy .

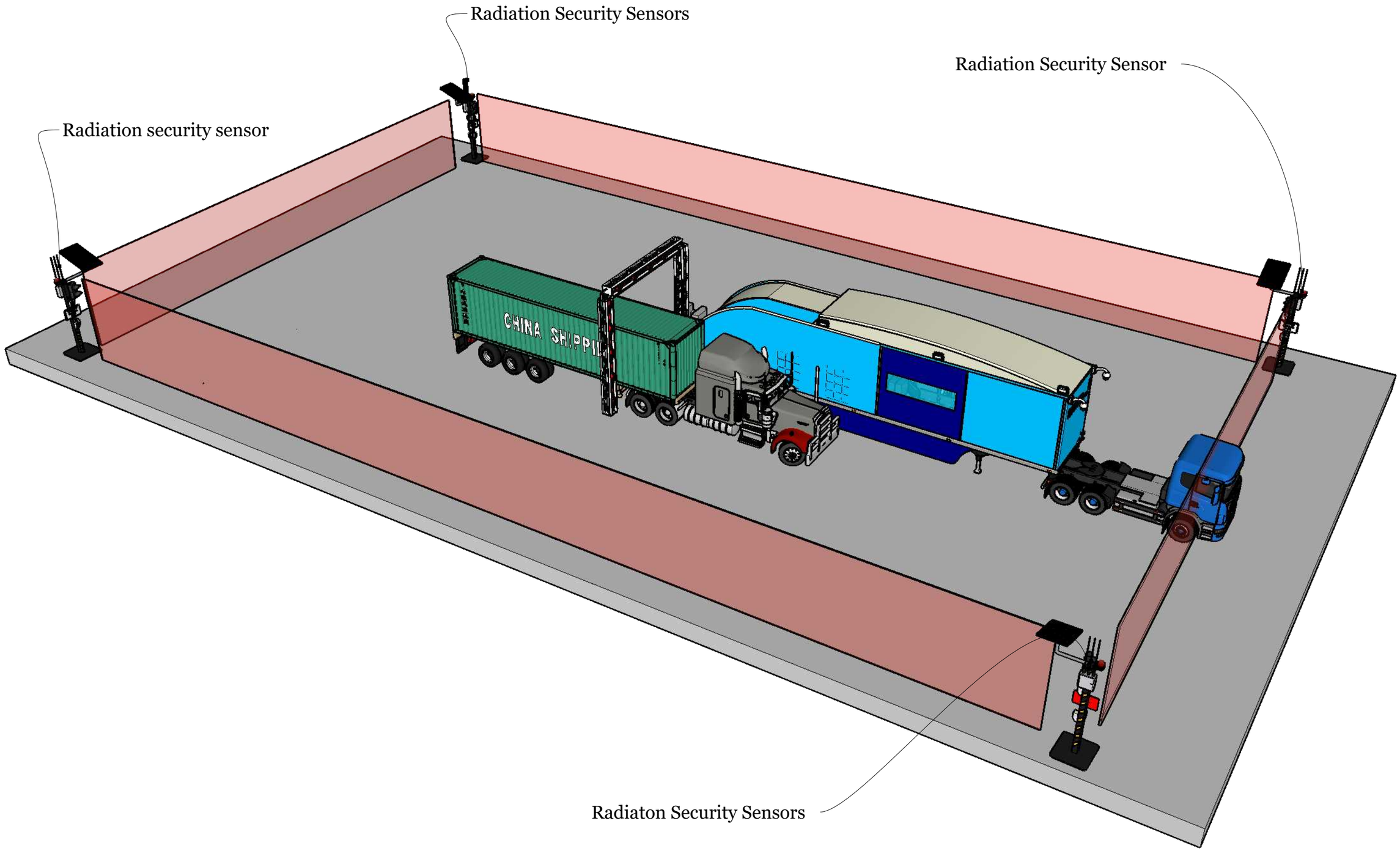
4-6 Mev Dual Energy .

Madoors System ; Mobile Trailer Model X-ray Truck , Container , Cargo Scanning Systems	madoors	REVISIONS
	Model ; 1 Mev/3-6 Mev / 4-6 Mev Dual Energy .	

	MM/DD/YY	REMARKS
1	__/__/__	...
2	__/__/__	...
3	__/__/__	...
4	__/__/__	...
5	__/__/__	...

01

A



Madoors System ; Mobile Trailer Model X-ray Truck , Container , Cargo Scanning Systems	madoors	REVISIONS
	Model ; 1 Mev/3-6 Mev / 4-6 Mev Dual Energy .	1 _ _/_ _/_ _ ...
		2 _ _/_ _/_ _ ...
		3 _ _/_ _/_ _ ...
		4 _ _/_ _/_ _ ...
		5 _ _/_ _/_ _ ...

02

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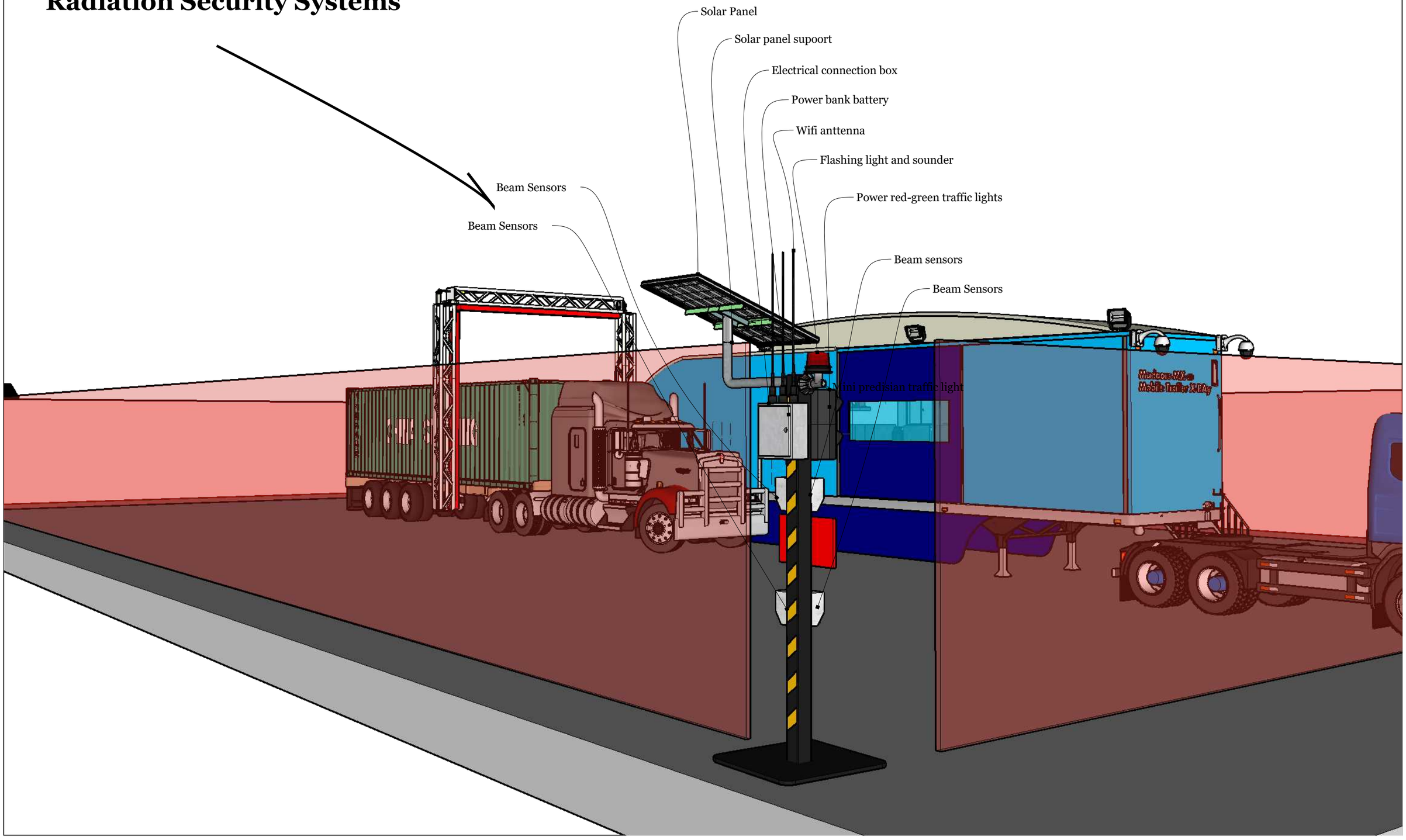
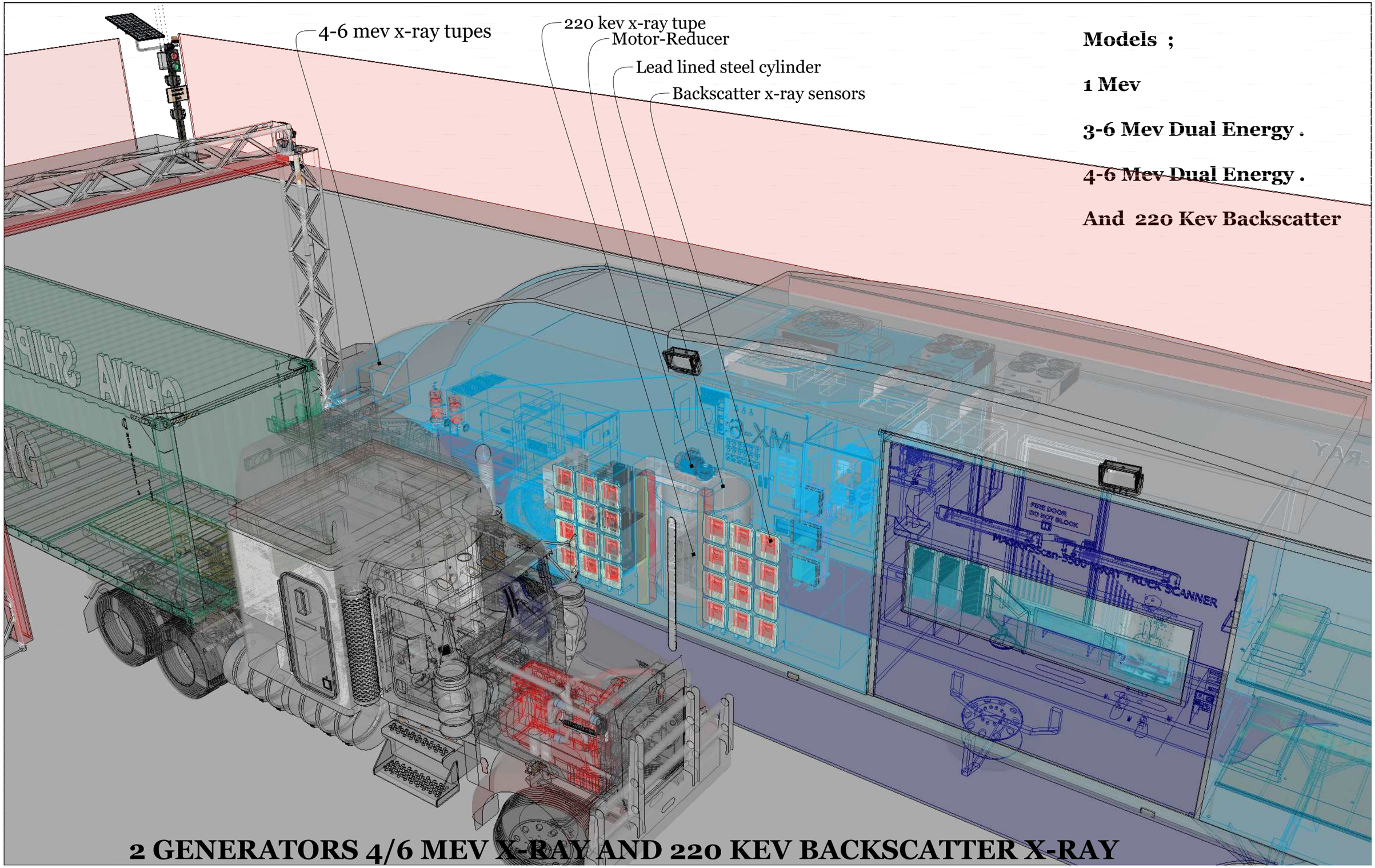
Radiation Security Systems



Madoors System ; Mobile Trailer Model X-ray Truck , Container , Cargo Scanning Systems	madoors	REVISIONS	03
	Model ; 1 Mev/3-6 Mev / 4-6 Mev Dual Energy .	MM/DD/YY / REMARKS	A
		1 __/__/__ ...	
		2 __/__/__ ...	
		3 __/__/__ ...	
		4 __/__/__ ...	
		5 __/__/__ ...	



2 GENERATORS 4/6 MEV X-RAY AND 220 KEV BACKSCATTER X-RAY

Madoors System ; Mobile Trailer Model X-ray Truck , Container , Cargo Scanning Systems	madoors	REVISIONS: 1 MM/DD/YY __/__/__ ... ; 2 __/__/__ ... ; 3 __/__/__ ... ; 4 __/__/__ ... ; 5 __/__/__ ... (REMARKS)
	Model ; 1 Mev/3-6 Mev / 4-6 Mev Dual Energy .	A 04