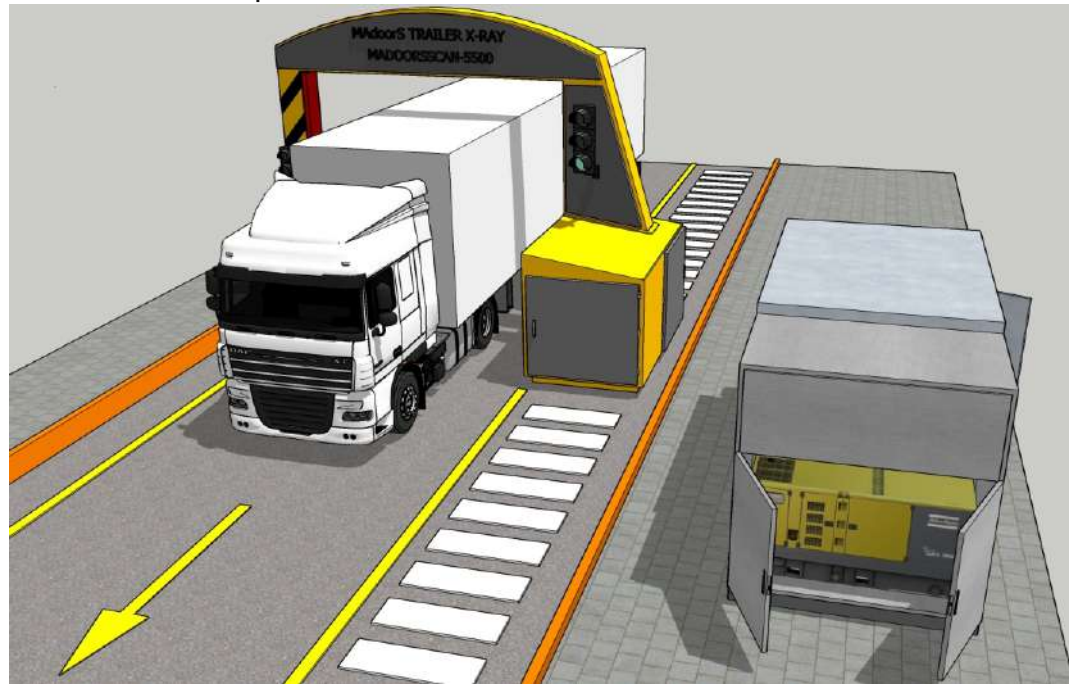


Madoors Truck & Cargo X-Ray Scanning Portal

The MAdoors Truck and Cargo X-Ray Scanning Portal is a relocatable drive through 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 Portal combines two state of the art Dual energy 7.5 MeV and 200 kV X-Ray sources. The 200 kV source is utilised for screening box trucks and larger vans and the cab area only of larger trucks towing sea freight containers. The 7.5 MeV source is utilised for screening sea freight containers. Trucks drive through the scanner under their own power, allowing a high throughput of vehicles. Truck & 40' Sea freight container 30 per hour, Truck & 20' Sea freight container 60 per hour.

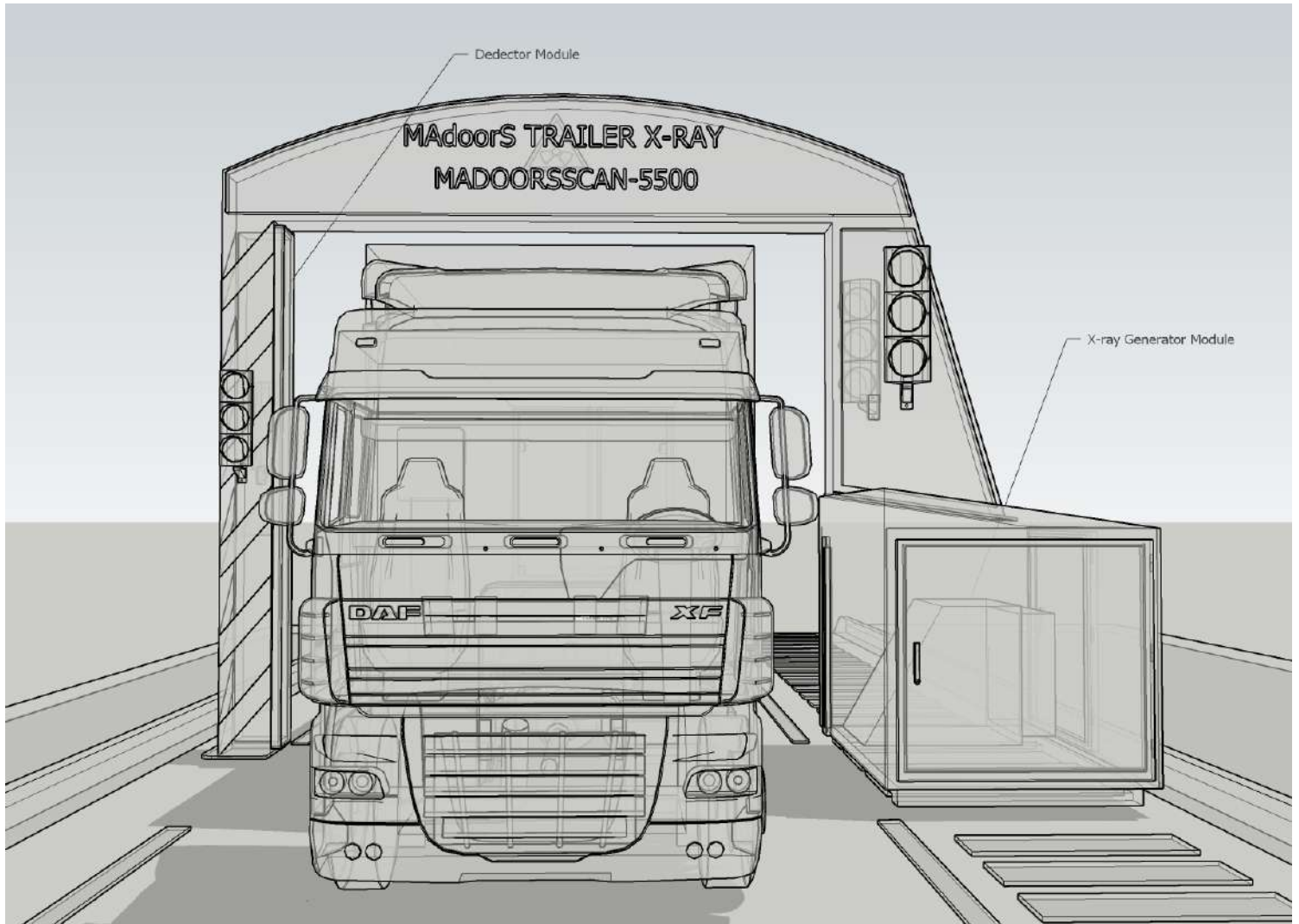
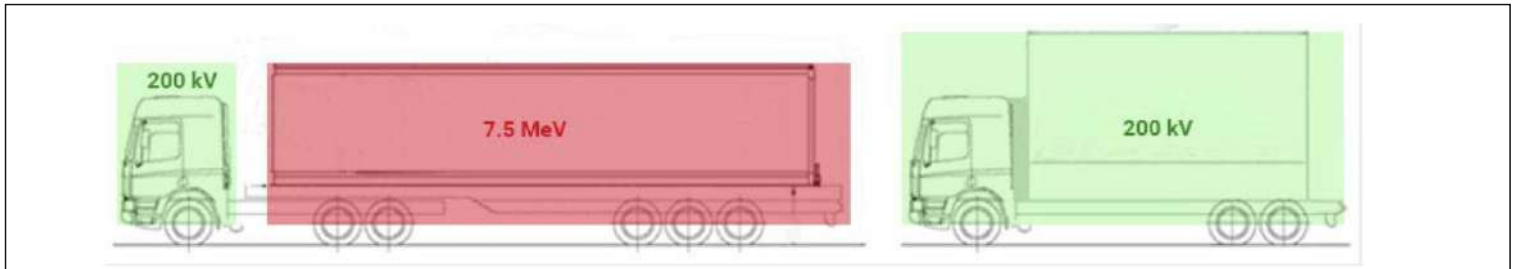
The system has an automatic 3 colour coding for materials separation, providing distinguishing between organic, non-organic and metal materials. This feature assists the operator to detect contraband, explosives, narcotics and weapons.

The system can be easily relocated by a standard container truck, and re-commissioned by trained engineers typically within a 72 hour period

The system requires a relatively small ground surface without special requirements for additional infrastructure.

Radiation safety: The system uses low radiation dose technologies together with safety systems to provide a safe scanning system for vehicle drivers, system operators and bystanders

System Components



X-Ray Generator and Detector Modules

- b. X-Ray Generator Module
- a. Detector Module

X-Ray Generator Internal Layout

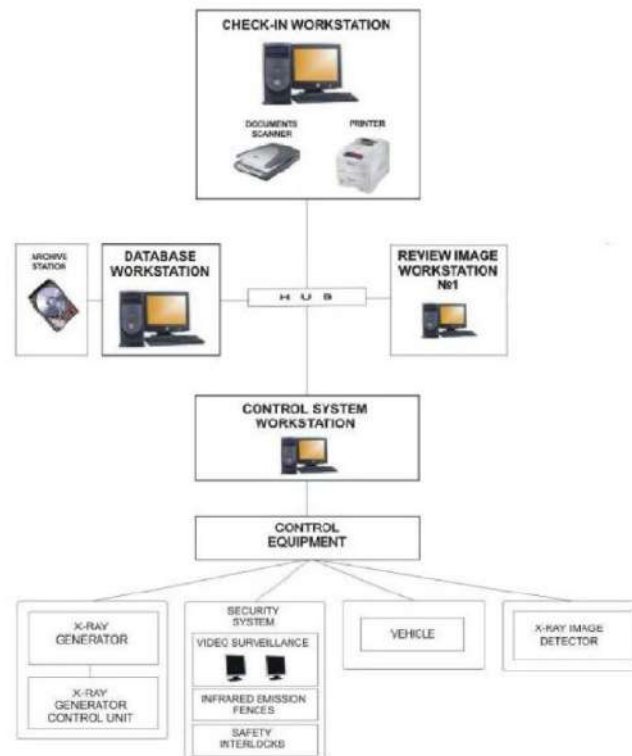
The 7.5 MeV X-ray dual-energy generates short X-ray pulses, with a maximum photon energy of 7.5 MeV. It is enclosed within radiation shielding with a slit-collimator that produces a narrow fan-shaped X-ray beam with the radiation angle of about 50° and the width not less than 2 mm..

The radiation shielding of the accelerator and the collimator ensure a low-level dosage rate of not more than 0.5 µSv/h on average at the edge of the controlled exclusion zone. The beam orientation is adjusted remotely by the operator in the control room, the accelerator and collimator in the shielded case are mounted on the special platform with the electromechanical drives for finite adjustment.

If the system exceeds the pre-set threshold dosage rate an audio-video and light alarms will activate and the system will automatically shut down. The X-ray assembly unit is provided with an air cooling system to sustain a pre-set operating temperature. The 200 kV source is utilised for screening box trucks and larger vans and the cab area only of larger trucks towing sea freight containers

Computer Control System

The schematic diagram below provides an overview of the system layout.



The Computer system is located in the Control cabin and includes the following

- *Control software*
- *Check-in workstation together with a Manifest Scanner*
- *Database workstation server, storing and administering access to images*
- *Review image workstations together with an image printer*

The computer system has been designed encompassing connectivity, security and openness for authorised access. The workstations are connected via a secure local network , there is a connection capability to external networks.

Option - Remote Review Image Workstation and safe remote access to the server data is available.

Software

Software functions for X-ray image obtaining, storage and processing

- Adjusting the intensity scale over the whole image or in the window
- Automatic acquisition of data from the X-ray detector
- Brightness and contrast adjustment
- Vehicle Counter
- Dual-energy imaging - an automatic 3 colour coding for materials separation, distinguishing between organic, non-organic and metal materials
- Enhancing edges and pre-setting the edge sharpness
- Enhancing the contrast
- Login user information
- Image inversion
- Image scrolling
- Linear distance measurement
- Annotation, marking suspicious objects with comments
- Pre-setting brightness and contrast for heavy and weak absorbing objects
- Printing images or a selected portion (pictures, comments and accompanying documents on separate pages)
- Pseudo colouring according to the density with, selection of colour palettes
- Pseudo relief
- Scanning manifest with scanned image
- Step-by-step: Smooth Zoom from 2 up to 32
- Supporting different image formats, original format BMP, JPEG
- Visualisation date and time
- Visualisation of the image in real time

Traffic Control System

The Traffic control system manages from the control room vehicles entering, passing through and leaving the scanning system.

The system operators in the control room are provided with CCTV oversight surveillance to assist them with managing the traffic flow and the co-ordination of the operation of the scanning system together with the safety systems.

Other Elements

- Intercom system
- Mobile radios
- Modem
- Telephone communication
- Traffic lights
- Wireless internet connection on request
- Optional: Raising Arm barrier

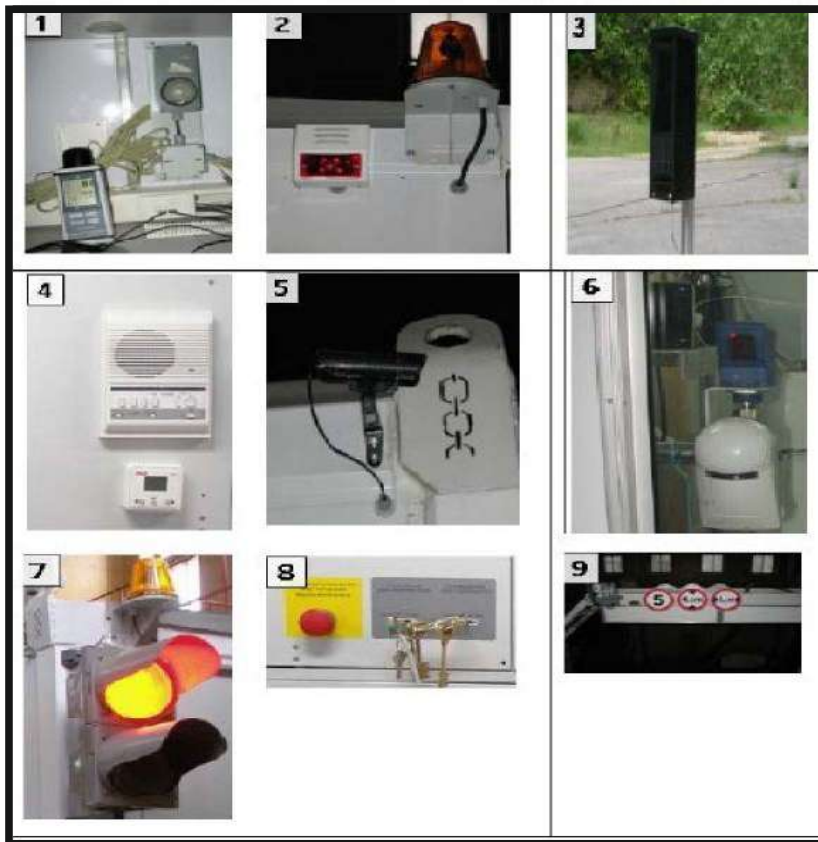
Radiation Safety System

The Radiation Safety System provides protection from x-ray radiation to drivers within the exclusion area and system operators and the general public outside of the exclusion area.

The exclusion area is defined by the following safety requirement

The ionising radiation dose outside the exclusion area shall not exceed 0.5 μ Sv on average in any one hour of system operation.

The accumulated annual dose will not exceed the permissible limit of 1 mSv (ICRP 2007), provided that no person is exposed to radiation more than 2,000 hours during a year (standard duty schedule)



Components of Radiation Safety System

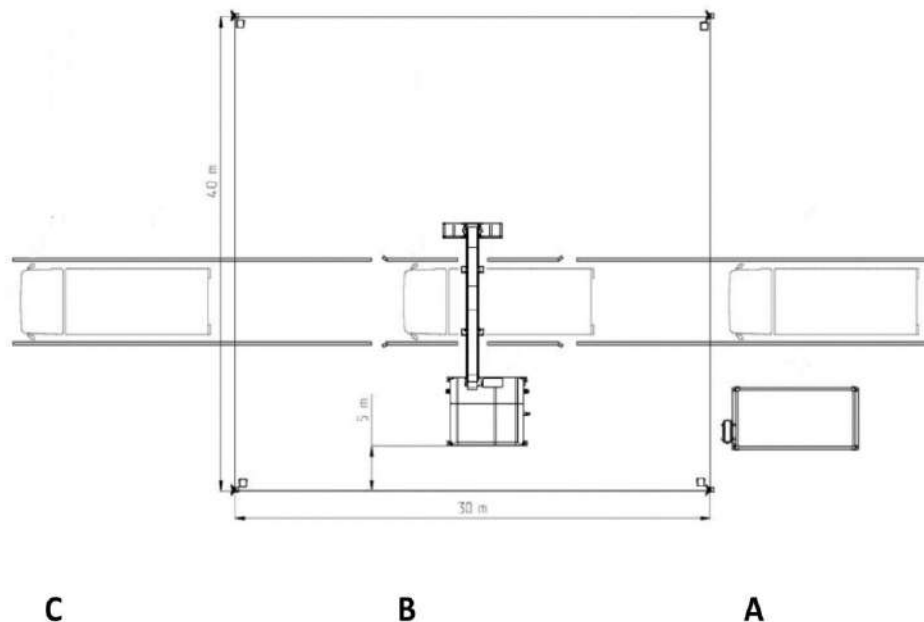
1. Radiation dosimeter
2. Audio and visual alarms
3. Optional Infrared exclusion perimeter control system
4. Intercom system
5. CCTV system
6. Sensors to locate the position of the inspected vehicle
7. Traffic lights
8. Emergency stop buttons
9. Warning signs

Size of Controlled Area (in compliance with ICRP 60) ≤ 30 (W) m x ≤ 40 (L) m for 0.5 μ Sv/h

Radiation Safety Systems

- One (1) AT1123 Radiation monitor with the sound and light alarm unit located in Control room
- One (1) Built-in dose rate monitor in the accelerator beam
- CCTV video surveillance, four (4) video cameras and one (1) monitor 19"
- Infrared perimeter control system monitoring exclusion area
- Emergency shut down buttons located in control room, X-Ray source module & X-Ray detector module
- Four (4) Red flashing lights and acoustic siren
- Vehicle presence optical sensors
- Warning signs located on the equipment, at the edge of the exclusion zone area

Typical Operating Area Requirements



- A - Entrance, Waiting & Registration area
- B - Inspection & Exclusion Area
- C - Exiting Area

Depending on the local radiation regulations, dimensions of the inspection area can vary, with no additional protection the dimensions of the Inspection & exclusion area is shown above. By applying the additional radiation protection measures, such as concrete walls the dimensions of the inspection & exclusion area can be significantly reduced.

Equipment Configuration

X-Ray Sources

- 1 x 7.5 MeV Dual energy radiation source
- 1 x 200 kV Dual energy radiation source
- 2 x Radiation protection shields
- 2 x Collimation systems

X-Ray Detector Modules

- Framework
- 2 x Detector modules

Control Module

- 1 x Control cabin based on 20' container
- 4 x PC Workstations
- 3 x Tables
- 3 x Chairs
- 1 x Local network
- 1 x Air conditioning

Radiation Safety

- Interlock system
- Sound and light alarm system
- 1 x Dosimeter
- Optional - Infrared exclusion zone system

Traffic Control System

- Traffic lights
- Video surveillance system

Power Supply System

- Primary power distribution
- Emergency stop system
- Optional - Autonomous diesel generator with diesel oil reserve for 24 hours continuous operation

Climate Control

- Heating system
- Air conditioning system

Other

- Spare Parts Kit
- Operation documentation set

Operating, Transportation & Storage Environmental Conditions

Ambient temperature range Operating	- 20 °C to +40 °C (option -20°C to +50 °C)
Relative air humidity range Operating	45% up to 90 % at t = +25 °C
Ambient temperature range Transportation	-20 °C to +40 °C (option -20°C to +50 °C)
Relative air humidity range: Transportation Storage	Max 90 % at temperature + 25 °C. Max 90 % at temperature + 25°C.

Power Supply Requirement

Supply voltage	380V, 3 Phase, 50/60 Hz,
Maximum power consumption	23.0 kVA

General

Cargo inspection technology	Drive-Thru Portal Vehicle is moving through the stationary portal. Drivers stay with their vehicles during scanning operations driving them under their own power through X-ray portal. Cargo area is scanned at 7.5 MeV, the driver's cabin is only scanned at 200 keV
Truck Cab, Box Vans and Cars	Drivers & passengers stay in vehicle, it only scanned at 200 keV.
Maximum size of the scanned vehicle	Width 3 metres Height 4.6 metres
Ground level to lowest point of detector	0.145 metres
X-Ray Beam shape	Vertical fan-shaped beam
Vehicle scanning speed	5-10 km/h
Vehicle throughput	Up to 60 per hour
Relocation set up time	72 hours typical

High Energy X-Ray Source

Source	Betatron MIB-7.5
Nominal energy, (MeV)	7.5 / 500
Focal spot, mm	0.3x3

High Energy X-Ray Image Detector

Detector type	Monoenergetic LED scintillator
Detector X-ray sensitive element pixel size, mm	4.6

Low Energy X-Ray Source

Source	X-ray tube
Nominal energy, (keV)	200

Radiation Safety Low Energy X-Ray Source

Maximum dose to driver and passengers	<0.15 $\mu\text{Sv}/\text{scan}$
Regulatory	ANSI 43.17-2009 compliant

Radiation Safety Systems

Radiation status monitor in operators room with the sound and light alarm.	1 x Radiation monitor AT1123 with the sound and light alarm unit
Built-in dose rate monitor in the accelerator	1 x Dose rate monitor included in the complete set of the accelerator
CCTV video surveillance cameras	4 x Video cameras and LCD 19" monitor
Exclusion zone monitoring	Infrared perimeter control system
Emergency shutdown buttons	Operators' room, X-Ray source module X-ray detector module.
Safety interlocks	everywhere as necessary
Light and acoustic signals	4 x Red flashing lights and an acoustic siren
Vehicle presence sensors	Optical sensors
Warning signs & symbols	Perimeter of exclusion area on the compartment of the X-ray generator

Low Energy X-Ray Detector

Detector type	Dual energy linear detector
Detector X-ray sensitive element pixel size, mm	2.5

Image Quality

Image quality depends on the scanning speed and detector settings; typical and guaranteed characteristics are shown below:-

Nominal energy	7.5 / 5.0 MeV	200 keV
Penetration (steel), mm	350	30
Wire resolution (copper wire), mm	1.5	1.0
Spatial resolution, mm	2	2

Radiation Safety High Energy X-Ray Source

Dose for scanning object	<1.0 $\mu\text{Sv}/\text{scan}$ (typically 0.2-0.6 μSv)
Maximum dose to driver, cabin not scanned	<0.05 $\mu\text{Sv}/\text{scan}$ (typically 0.012-0.015 μSv)
Dose rate outside exclusion zone of 28m x 40m	<0.5 μSv on average 1 hour of operation
Exclusion area size in compliance ICRP60	$\leq 28\text{m (W)} \times \leq 40\text{m (L)}$ for 0.5 $\mu\text{Sv/h}$ on average hour of operation

