

## Attachment A VOLUME I Technical Proposal Mobile Scanning System with Portal Scanning Capability

№ 3/II	Parameter	Requirements
<b>I. Installation site</b>		
1	International Border Crossing Point Porubne, Chernivtsi Oblast – 1 unit	
2	International Border Crossing Point Uzhhorod, Zakarpattia Oblast - 1 unit	
3	International Border Crossing Point Dyakivtsi, Chernivtsi Oblast - 1 unit	
<b>II. System Parametrs</b>		
1.	Purpose	The scanning system must be capable of inspecting containers as well as vehicles to verify the conformity of cargo with transportation documents and to detect hazardous objects inside containers, semi-trailers, trailers, and within the chassis of vehicles.
2.	Scanning Method	Scanning Modes: <ol style="list-style-type: none"> <li>1. Drive-Through Mode – The scanning system passes alongside the vehicles being scanned. The container and driver's cabin are inspected by a high-energy source of no more than 6 MeV, while the driver or drivers of the vehicles are at a safe distance.</li> <li>2. Portal Mode – During scanning, the driver remains in the cabin of the vehicle, which they operate as it passes through an inspection portal. The container is inspected by a high-energy source of no more than 6 MeV.</li> </ol>
3.	Scanning Direction	The system must have the capability to scan in two directions.
4.	Structural Requirements	The scanning system must be easily and rapidly transportable (mobile). It should be equipped with a foldable, easily movable metal ramp capable of providing 100% scanning coverage of passenger and cargo vehicles. The installation and relocation of the system should not require any additional construction work.
<b>III. Primary technical characteristics</b>		
1.	System Chassis	The chassis must be of European or US manufacture with an engine class no lower than Euro 5.
2.	Tunnel Size	<ul style="list-style-type: none"> <li>– Width: 4000 – 5300 mm</li> <li>– Height: 5000 – 5550 mm</li> </ul>
3.	Maximum Dimensions of the Scanned Vehicle	The scanning system must be able to scan vehicles with the following dimensional limits: Length – Unlimited Width – Up to 3.8 meters Height – Up to 4.9 meters
4.	Minimum Scanning Height	The system must have the capability to scan at a minimum height of $\leq 0.15$ meters.
5.	Throughput Capacity	The scanning system is capable of scanning: <ol style="list-style-type: none"> <li>1. Portal Mode – Not less than 100 vehicles (18-meter container carriers) per hour.</li> <li>2. Drive-Through Mode – Not less than 20 vehicles (18-meter container carriers) per hour.</li> </ol>
6.	Time to Readiness for Operation	Deployment/setup and readiness for operation should not exceed 30 minutes.

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7.	Security System	<p>The status of the security system must be monitored using the following methods:</p> <ul style="list-style-type: none"> <li>- Information on the mode displayed on the operator's (operators') monitor(s).</li> <li>- Additional visual and auditory indicators on the equipment.</li> <li>- A red indicator light indicating the operation of the X-ray source on the X-ray generator control panel.</li> </ul>
8.	Power Supply	<p>The distribution of electrical power must be carried out through a central electrical panel, including circuit breakers, electrical cables, and necessary circuits. The power supply should be 3 phases, 400 V <math>\pm</math>10%, at a frequency of 50 Hz <math>\pm</math>0.5%. The maximum power consumption of the system is 50 kVA.</p> <p>The scanning system must have its own power source, which should ensure operation for at least 15 hours. The system should also be capable of being powered from a ground source. The connection cable should be no less than 50 meters in length.</p>
9.	Operating Conditions	The scanning system should operate outdoors 24 hours a day, 7 days a week, designed for operation in climatic conditions with ambient temperatures ranging from -30°C to +45°C and air humidity up to 99% without condensation.
10.	Degree of Protection of the X-Ray Device Against External Conditions	Not lower than IP65.
11.	Year of Manufacture	Brand new models manufactured not later than 2023
12.	Delivery, installation, connection, and commissioning.	<p>Delivery, installation, connection, and commissioning at the locations indicated in section I. Installation site.</p> <p>Training for a group of personnel (group size not exceeding 20 individuals for each system). The training should include theoretical and practical sessions with knowledge assessment and the issuance of appropriate certificates to system operators.</p>
13.	Warranty period of operation.	A minimum of 60 months. In case the supplier is not the manufacturer, the supplier must provide duly certified documents confirming the warranty commitments from the manufacturer.
14.	Providing information and consulting services on the operation procedure of the "Mobile Type Scanning System with Portal Scanning Function."	Providing training during the warranty period as specified by the Customer
15.	Delivery Schedule	The supplier should provide a schedule of delivery on DDP terms to all three locations. Please provide the fastest realistic delivery term but not later than April 30, 2024.
<b>IV. Technical Specifications</b>		
1.	Type of X-ray Source	X-ray radiation is generated by a linear accelerator based on a solid-state modulator that allows for differentiation between organic and inorganic substances. Systems using radioactive sources are not considered.

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2.	The energy of the X-ray source	The energy of the X-ray source must be up to 6 MeV (inclusive).
3.	Penetrating ability through steel	Not less than 320 mm.
4.	Type of detector	Modular G-shaped linear detector based on cadmium tungstate.
5.	Spatial resolution	Not more than 4 mm x 4 mm in pass-through mode.
6.	Contrast ratio	The expected contrast ratio should be less than or equal to 1% for steel with a thickness of 100 mm.
7.	Detection of a copper wire in space	The scanning system must detect a copper wire with the following specifications: Thickness of 1 mm within cavities. Thickness of 3 mm within steel with a thickness of 100 mm. Thickness of 4 mm within steel with a thickness of 200 mm.
8.	The minimum scanning height	The height from ground level to the lowermost point of the detector (invisible zone) should not exceed 0.15 meters.
9.	The startup time of the X-ray radiation source.	No more than 20 minutes
10.	The size of the area occupied by the system in the folded state	Length - not more than 11 meters; Width - not more than 2.6 meters; Height - not more than 4 meters.
11.	The size of the area occupied by the installation in the unfolded state is in meters.	Length: not more than 11 meters Width: not more than 8 meters Height: not more than 6 meters
12.	Material Segmentation	The scanning system must be capable of differentiating organic materials, low-density inorganic materials, and high-density inorganic materials, displaying them with distinct colors. This differentiation should be achieved through penetration depth and image quality. To better classify various materials, the system should provide a color map based on the continuous assessment of the atomic number (Z).
<b>V. Radiation Safety Requirements</b>		
1.	Notification System	The scanning system must have an audible and visual alarm that activates during the X-ray emission.
2.	Monitoring of dose power.	The scanning system must have three dosimeters: built-in (integrated) and two manual units.
3.	Video Surveillance System	The scanning system must be equipped with a closed-circuit video surveillance system and surveillance cameras that can operate both day and night to allow the operator to view all areas within the security perimeter.  A minimum of 4 (four) video cameras must be positioned on the scanning system (placed at the front, rear of the system, and on both sides of the boom).  They should have an IP66 protection rating and operate at temperatures ranging from -40°C to +55°C.

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4.	Emergency Shutdown Buttons	The scanning system must have at least 5 (five) emergency shutdown buttons (2 on the portal with detector modules, 2 on the X-ray source module, and 1 at the operator's location).
5.	Locking Systems	The scanning system must have protective locking mechanisms.
6.	Warning symbols and signs	The scanning system must have radiation hazard warning symbols, speed limit signs, and vehicle size restriction signs. To designate the hazardous zone of the X-ray equipment, the apparatus is equipped with portable cones (at least 50 cm in height) - 50 pieces.
7.	Audio and visual alarms	The system must be equipped with audio and visual alarms.
8.	Safety sensors for protecting against crane arm collisions and checking object dimensions:	The system must be equipped with sensors to prevent collisions with the crane arm and sensors to check whether the dimensions of the scanned object are exceeded.
9.	Radiation flux detection system:	In the control room, there should be an installed radiation flux detection and measurement system with an automatic scanning halt function when the radiation dose exceeds the permissible limit for the population.
<b>VI. Radiation Doses:</b>		
1.	The maximum dose that operators receive at their workplaces	Should not exceed 0.5 $\mu\text{Sv/h}$ (microsieverts per hour).
2.	The dose at the boundary of the controlled area	Should not exceed 0.5 $\mu\text{Sv/h}$ (microsieverts per hour).
<b>VII. Operator Compartment</b>		
1.	Operator's Station	The scanning system must be equipped with an operator's workspace, which should be an integral part of the system. The operator's workspace should include a minimum of two workstations for monitoring the system, working with documents, analyzing images, printing, and scanning on an A4 format multifunctional device, as well as providing life support for personnel when working with equipment. The hardware part of the system should not have the capability for external connections and unauthorized transmission of information beyond the system. The operator's room can optionally be equipped with an additional workstation.
2.	Life Support System	The operator's workspace should be equipped with a heater, air conditioner, and lighting for the normal operation of personnel.
3.	Communication Facilities	The scanning system must be equipped with radio communication systems for operator communication. The minimum number of terminals is two (2).
<b>VII. Functions of the software</b>		
1.	The functions of the image processing software:	<ul style="list-style-type: none"> <li>– Input and storage of operator work information.</li> <li>– Automatic retrieval of data from the X-ray detector.</li> <li>– Generation of real-time shadow X-ray images.</li> <li>– Adjustment of image brightness and contrast.</li> <li>– Predefined settings for dark and light objects.</li> <li>– Ability to zoom in on the image from 2 to 16 times and enlarge selected areas.</li> </ul>

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		<ul style="list-style-type: none"> <li>– Pseudocolor representation based on optical density with a choice of color palette.</li> <li>– Dual-energy imaging with automatic color coding of materials using a continuous color map (unlimited colors) to distinguish organic, inorganic, and metallic materials.</li> <li>– Enhancement of image contrast.</li> <li>– Gradual edge enhancement and sharpness adjustment.</li> <li>– Pseudo-relief effect.</li> <li>– Ability to mark suspicious objects with comments.</li> <li>– Ability to adjust markings on suspicious areas individually.</li> <li>– Selection and framing of suspicious areas on the X-ray image using the mouse.</li> <li>– Independent image processing for each scanned area, separate from other areas and the main image.</li> <li>– Image inversion.</li> <li>– Measurement of linear dimensions.</li> <li>– Display of scanning date and time.</li> <li>– Generation of reports with image analysis results, saved alongside snapshots.</li> <li>– Export of images in PNG, JPEG, and TIFF formats.</li> <li>– A scan counter.</li> <li>– Printing of the shadow X-ray image or selected parts.</li> <li>– Comparison mode, allowing the retrieval of saved images to be displayed simultaneously with the active image.</li> <li>– Pause and stop modes for image reception on image analysis workstations.</li> </ul>
2.	Integration	The system should have an interface (API) for interaction with the customs clearance information system using the SOAP protocol.
3.	License Plate Recognition	The system should feature automatic license plate recognition for vehicles, and it should work in both unidirectional and bidirectional scanning modes.
4.	Container Number Recognition	The system should have a function for automatic recognition of container numbers, and this function should also work in both unidirectional and bidirectional scanning modes.
5.	Software Requirements	It is prohibited to use software and active elements produced by the Russian Federation or any other countries (manufacturers) subject to personal special economic and other restrictive measures (sanctions).
6.	Additional Software License	Seven (7) additional licenses for image processing software are required for connecting remote operators outside the scanning system installation location.
7.	Interface Localization	All interfaces and documentation must be provided in the Ukrainian language.
<b>IX. Computer System Requirements</b>		
1.	Operating System	Pre-installed by the manufacturer OS Microsoft Windows 10 or 11 Pro (64Bit). The software version installed should be suitable for use in Ukraine, including Microsoft Office 2021.
2.	Technical Specifications:	Form Factor: All-in-one, Desktop, or Laptop.

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	<p><i>For at least two Automated Workstations (AW) for image analysis and AW for document registration:</i></p>	<p>Processor:</p> <p>At least 8 physical computing cores.  Number of threads: at least 16.  Support for Turbo Boost Technology with a minimum clock speed of 4.9 GHz.  Support for HyperThreading or equivalent technology.</p> <p>RAM (Random Access Memory):</p> <p>At least 32 GB.  Type: DDR4 or SO-DIMM DDR4.  Support for installing at least 64 GB of RAM.  Frequency: not less than 3200 MHz.</p> <p>Storage:</p> <p>SSD M.2 NVMe PCIe.  At least 2 TB.  Support for installing an additional SATA 2.5" drive.</p> <p>Graphics Card:</p> <p>Discrete graphics card.  Hardware support for DirectX not lower than version 12.X (where X is a digit from 0 to 9).  Hardware support for OpenGL not lower than version 4.X (where X is a digit from 0 to 9).  Video memory: at least 6 GB.</p> <p>Interfaces:</p> <p>At least 5 USB ports, including at least 2 USB Type-A ports with a version not lower than USB 3.0.  Universal audio jack for a 3.5 mm TRS plug.  At least 1 HDMI port.  1 x LAN (RJ-45).</p> <p>Network Interface:</p> <p>RJ-45 with a speed of 10/100/1000 Mbps.</p> <p>Monitor:</p> <p>At least 27 inches.  Display type: IPS or equivalent with an anti-glare coating.  Brightness: at least 250 cd/m<sup>2</sup>.  Aspect ratio: 16:9.  Resolution: not lower than Full HD 1920x1080.  Color gamut: not worse than NTSC 70%.</p> <p>Additional Accessories:</p> <p>Standard (full-size) Latin-Cyrillic keyboard with manufacturer-labeled letters in Latin (US International) and Ukrainian alphabets with a USB interface.  Black optical mouse with scrolling and a USB interface.</p> <p>Security:</p>

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		Mandatory presence of a Trusted Platform Module (TPM) module, not lower than version 2.0.
3.	Data Storage System:	<p>The data storage system (on hard drives) must ensure the preservation of scanned images of objects and documents and provide quick access to them for the image analysis workstations (AW). The storage capacity of the data storage system should be capable of storing no less than 100,000 images of inspected objects and associated documents for a period of at least 1 year.</p> <p>The data archiving system must support long-term storage of archives and allow searching based on various criteria of scanned objects. Data archiving and restoration should occur independently of the data collection process. Images of scanned objects and their associated documents should be archived on hard drives. Additionally, the system should allow for external archiving to network storage (e.g., NAS, etc.).</p> <p>The equipment for data archiving and restoration should include an external archiving device to ensure the storage of no fewer than 100,000 images.</p>
4.	Local Computing Network	<p>The local computing network should consist of the following components:</p> <p>Managed switch with a number of ports equal to or greater than the total number of ports of the X-ray inspection systems (XIS) with a 40% reserve.</p> <p>Horizontal structured cabling system (UTP Category 5e cable) for connecting workstations (AW) and the video surveillance system.</p> <p>Copper patch panel with Category 5e cabling and an organizer in the network cabinet.</p> <p>A sufficient number of sockets with 2 network ports at the installation locations of AW and BFIs (Border Force Image) workstations.</p> <p>Network cabinet for housing server components of the data storage and archiving systems, active network equipment, and an uninterruptible power supply (UPS).</p>
5.	Autonomous Operation:	The computer system must be powered by an uninterruptible power supply (UPS) to ensure that devices and software can continue to operate when needed. The UPS must have sufficient capacity to prevent any data loss in case of a power failure for at least 30 minutes after power loss. The computer system should have an automatic shutdown procedure to ensure a proper shutdown of computers in case the power outage lasts longer than the UPS's autonomy.



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		The UPS should have a form factor suitable for installation in a standard 19" network cabinet.
6.	Multifunctional Printing Device:	<p>Print Type: Laser or LED.  Paper Format: A4.  Printing: Color.  Scanning: Color.  Color Printing Resolution: Not less than 600x600 dpi.  Scanning Resolution: Not less than 1200x1200 dpi.  Black and White Printing Speed: Not less than 27 pages per minute.  Color Printing Speed: Not less than 27 pages per minute.  Features: Duplex printing (double-sided printing).  Interfaces:  Network Interface: Ethernet 10/100/1000 Mbps.  At least 1x USB 2.0.  Paper Density: 60-120 g/sqm.  Display: Touchscreen.  Paper Capacity: Not less than 250 sheets.  Consumables: Toner cartridge set with a yield of not less than 2100 pages (at 5% coverage of A4 sheets).</p>
7.	Power On and Off	The entire computer system can be powered on and off by pressing the power button or using the icon in the main interface.
8.	Connection	Secure electronic communication means should implement the connection of the information and communication system to the Global Internet using WiFi and LTE technologies and establish a secure connection between the information and communication system and remote users, as well as between the information and communication system and the automated customs clearance system, using cryptographic information protection means for which the State Special Communications Administration has issued a positive expert opinion as a result of expert research.
<b>X. Compliance with Standards and Certificates</b>		
1.	Standards and Certificates	The scanning system must have a CE certificate.
2.	Production Certificate	The manufacturer must have an ISO 9001 quality management certificate.
3.	Supporting and Operational Documentation	<p>The system's supply package includes:</p> <ul style="list-style-type: none"> <li>– Detailed user manual.</li> <li>– Specification (passport).</li> <li>– Specification (passport) of the X-ray radiation source.</li> <li>– Set of operational documents for components.</li> <li>– Other documentation as specified by the manufacturer.</li> </ul> <p>All documentation must have a translation into the Ukrainian language.</p>



## 1. General Provisions and Conditions

1.1 Scanning systems of mobile type (hereinafter referred to as MSS) shall be delivered, installed, tested, and commissioned at the following locations:

International Border Crossing Point Porubne, Chernivtsi Oblast – 1 unit

International Border Crossing Point Uzhhorod, Zakarpattia Oblast - 1 unit

International Border Crossing Point Dyakivtsi, Chernivtsi Oblast - 1 unit

1.2 The Supplier must have a dedicated project manager who is proficient in English (Ukrainian) to ensure coordination with the Customer. The Supplier must have at least two similar project experiences in European Union member countries.

1.3 Within 30 calendar days from the date of contract signing, the Supplier must provide:

1.3.1. An indicative schedule of planned works, deliveries, and tests.

1.3.2. Final design documentation for the mobile scanning system (MSS).

1.3.3. A list of licensed manufacturers of scanning systems that provide warranty, after-sales, and technical support.

1.4 Once a month, no later than the 7th day of the following month, the Supplier must provide a monthly progress report on the work related to this Agreement.

1.5 The Supplier must provide all documents required to apply for (or amend) a license to perform activities involving the use of ionizing radiation sources or provide an existing contract with an authorized representative of the MSS manufacturer holding a valid license for activities involving the use of ionizing radiation sources.

1.6 The documents required for obtaining a license for the operation of mobile scanning systems of this type must be prepared within two calendar months from the date of contract signing.

1.7 The Supplier must provide a declaration (certificate) of compliance with technical regulations.

1.8 The Supplier must provide the conclusion of the state sanitary and epidemiological examination for the equipment.

1.9 The Supplier must complete all formalities related to equipment importation and cover all expenses incurred during the project's implementation.

1.10 The Supplier must sign a declaration stating that the Supplier and subcontractors comply with the requirements of legislation regarding information protection with restricted access in information, electronic communication, and information and communication systems.

1.11 The Supplier must have an ISO 27001 certificate.

1.12 As a project estimation, equipment delivery must be completed by June 30, 2024

1.13 After conducting factory acceptance tests of the equipment (Factory Acceptance Test), information about the individuals who performed the equipment-related work must be provided to the Supplier for approval in advance.

1.14 The MSS, including the software used, must allow connection to the Customer's systems without additional costs.

1.15 The Supplier must ensure that RAW data (folder created after scanning an object, including all X-ray image files) and other service files (registration information of the scan, images from the automatic license plate recognition system, scanned documents, etc.) can be automatically exported to external systems for further processing upon request.

1.16 If any important requirement has not been included in this technical specification, the Supplier must take it into account to ensure that the MSS can be used without any additional expenses.

## 2. General Technical Conditions

- 2.1 The proposed X-ray technology's technical life cycle should be at least 10 years, during which the availability of spare parts must be guaranteed.
- 2.2 The equipment must be new (manufactured in 2023 or 2024) and cannot be a prototype.
- 2.3 The equipment's design should include all necessary details (including safety features) and be highly resistant to wear and vandalism.
- 2.4 Scanning Modes:
  - 2.4.1 Portal Mode: During scanning, the driver remains inside the vehicle cabin, which passes through the inspection portal. The container is inspected using a high-energy source of no more than 6 MeV.
  - 2.4.2 Drive-Through Mode: The scanning system travels alongside the vehicles being scanned. The container and the driver's cabin are inspected using a high-energy source of no more than 6 MeV, and the driver(s) of the vehicles are at a safe distance.
- 2.5 Scanning Direction: The X-ray scanning system must be capable of scanning in two directions.
- 2.6 The equipment must be operated by a minimum of two individuals regardless of weather conditions.
- 2.7 Continuous operation of the mobile X-ray scanning systems should be 24 hours a day.
- 2.8 The dimensions of the object being inspected should be minimum (L x W x H) - 20m x 3.8m x 5.2m.
- 2.9 The throughput capacity of the mobile X-ray scanning systems per hour should be no less than 20 vehicles.
- 2.10 The equipment should be ready for operation in no more than 20 minutes (calculated from the moment of arrival until the start of the first scanning).
- 2.11 The radiation safety system of the mobile X-ray scanning system must ensure the protection of personnel and the public from ionizing radiation used in the complex and comply with the norms of radiation safety according to the [NRBU-97, Basic Sanitary Rules for Ensuring Radiation Safety in Ukraine](#) (Order of the Ministry of Health of Ukraine dated February 2, 2005, No. 54, registered with the Ministry of Justice of Ukraine on May 20, 2005, No. 552/10832).
- 2.12 The equipment must be able to operate on slopes of up to 4%.
- 2.13 The X-ray device of the mobile X-ray scanning system must be at least IP65 waterproof and moisture-resistant.
- 2.14 All equipment components located in the open air must be protected against corrosion according to marine standards. The equipment should undergo additional anti-corrosion treatment, which needs to be renewed every two years during the warranty period.
- 2.15 All sound sources, including sirens and other devices, should have a maximum sound level of 70 dB, following acceptable noise levels. The volume of the siren of the device should be adjustable from the operator's control.
- 2.16 The equipment, including its core software and mechanical components, must be protected against unauthorized access.
- 2.17 Equipment data systems must require entry with a personal identifier. Authorization can be based on a username and password.
- 2.18 The equipment must be equipped with diagnostic software that operates in real-time mode to detect and analyze technical errors.
- 2.19 All supplied systems must have the capability to connect to an external server through a secure channel and allow image analysis outside of the equipment.

- 2.20 The supplier must provide a minimum of 2 (two) workstations with installed software for real-time image analysis.
- 2.21 The supplier must provide image analysis software with 7 licenses and installation instructions. The licenses must be multi-use and valid until the end of the X-ray device's service life. The image analysis software should be openable, in UFF file format, and allow for basic image processing functions such as histogram, edge enhancement, organic material differentiation, black and white image, negative image, color image adjustment, and the ability to work without a network or server connection. The software should be capable of synchronous processing of up to four images simultaneously.
- 2.22 The format of the images generated by the mobile X-ray scanning system must be in UFF format. The operator should also have the option to save images in the manufacturer's original file format. The use of the UFF format must be tested by the customer, and the supplier should provide the necessary information for testing.
- 2.23 Separate files must be created for each object being scanned. Each file must have a unique identifier composed of a system identification number, date, and time. The file should include color photos of the inspected object from the front and back, RAW X-ray images, scanned documents, and additional information (location and time of inspection, vehicle type, make, license plate number, and analysis results).
- 2.24 The equipment's software should be configured so that X-ray inspection can only be performed with limited input data if necessary (e.g., only the vehicle or container number).
- 2.25 The supplier should provide detailed technical requirements (including possible architecture solutions, including mandatory hardware and software) for an external database that the customer can use for centralized data collection of mobile X-ray scanning system results.
- 2.26 Updates that ensure compatibility and data transfer with different external databases and software solutions must be allowed for the mobile X-ray scanning systems.
- 2.27 The workstations controlling the equipment must be located in the departmental telecommunications network.
- 2.28 Data systems must be equipped with a data backup solution that provides automatic backup of X-ray images (including input data) and its own software. Instructions and technical documentation for the backup solution should be provided for data verification and recovery.
- 2.29 Outside the radiation protection zone of the X-ray device, the effective dose should not exceed 200  $\mu\text{Sv}/\text{year}$ . Once a year, inspections of the equipment are carried out with the customer's representative, and a corresponding report is prepared.
- 2.30 Radiation safety requirements are derived from the Norms of Radiation Safety in Ukraine (NRBU-97). The time-averaged radiation level at the edge of the radiation protection zone should not exceed 0.5  $\mu\text{Sv}$  during scanning.
- 2.31 The radiation dose to the object being inspected should not exceed 20  $\mu\text{Sv}/\text{hour}$  for a single scanning.
- 2.32 Image quality of the equipment should be checked in accordance with ANSI N42.46-2008: penetration, spatial resolution, contrast, and wire detection, and material discrimination based on IEC 62523:2010 methodologies.
- 2.33 All quality parameters of the mobile X-ray scanning system included in the tender must be provided and maintained during the warranty period.
- 2.34 The tender participant should supply two sets of tools necessary for equipment servicing, diagnostics, and repair. A single set of test objects in accordance with image quality and material discrimination standards for the mobile X-ray scanning system should be provided.

### **3. Technical Specifications for the Mobile X-ray Unit**

- 3.1. The X-ray radiation should be provided by a linear accelerator based on a solid-state modulator that allows distinguishing organic and inorganic substances. Systems using radioactive sources are not considered.
- 3.2. The X-ray unit must be capable of material discrimination.

- 3.3. X-ray source energy should be up to 6 MeV (inclusive).
- 3.4. Penetration capability should be no less than 320 mm of steel.
- 3.5. Spatial resolution: no more than 4 mm x 4 mm in the drive-through mode.
- 3.6. Contrast ratio: the expected contrast ratio should be less than or equal to 1% for 100 mm thick steel.
- 3.7. Detection of a copper wire in space:
  - 3.7.1. - thickness of 1 mm in voids;
  - 3.7.2. - thickness of 3 mm for 100 mm thick steel;
  - 3.7.3. - thickness of 4 mm for 200 mm thick steel.
- 3.8. Emergency shutdown buttons: the scanning system must have at least 5 (five) emergency shutdown buttons (2 on the portal with detector modules, 2 on the X-ray source module, 1 at the operator's location).
- 3.9. The mobile X-ray system must be installed on a standard vehicle with a minimum of three axles (rear axles must be non-steerable) and powered by a diesel engine with a capacity of at least 350 kW.
- 3.10. Minimum emissions class EURO 5.
- 3.11. The vehicle must comply with:

The Law of Ukraine on Road Transport;  
The Resolution of the Cabinet of Ministers of Ukraine dated December 22, 2010, No. 1166 "On the Unified Requirements for the Design and Technical Condition of Wheeled Vehicles in Operation."
- 3.12. The truck must have left-hand drive.
- 3.13. The truck must have a leather steering wheel.
- 3.14. The driver's cabin of the truck must be equipped with an air conditioning system.
- 3.15. The driver's cabin of the truck must have three seats.
- 3.16. The mobile X-ray system must be equipped with a diesel generator for mobile operation and should be capable of connecting the equipment to the electrical network with a three-phase power supply of 400V/63A.
- 3.17. The deployment and folding of the mobile X-ray system must be carried out using a remote control.
- 3.18. The driver's cabin must be equipped with a safety system that prevents the movement of the vehicle when the system is not fully ready for road use.
- 3.19. All dimensions and measurements must be in the metric range.
- 3.20. The equipment must be suitable for use at temperatures from -30°C to +45°C, and the X-ray system's boom must have heating to prevent ice formation on the boom.
- 3.21. The lower scanning limit should not be higher than 15 cm above the road surface level.
- 3.22. The mobile X-ray system must be equipped with a foldable, easily movable metal ramp capable of providing 100% scanning of passenger vehicles with a minimum weight limit of 3.5 tons.
- 3.23. The maximum size of the safety zone should be 30 x 50 meters.
- 3.24. The operator's room must comply with current hygiene standards and have proper heating and cooling equipment with temperature control.
- 3.25. The operator's room floor should have adjustable underfloor heating.
- 3.26. If there are windows in the operator's room, they should be tinted and equipped with blackout curtains.
- 3.27. There must be a locking cabinet for metal keys in the operator's room, with dimensions not less than 150x150x80 mm (H/W/D).
- 3.28. Additional 230V sockets should be installed in the operator's room near each workstation, not less than 4 outlets.
- 3.29. Work computers must be equipped with uninterruptible power sources (UPS) to ensure the operation of systems for at least 30 minutes in case of a power outage, allowing computers to be safely shut down.

- 3.30. The mobile X-ray system must be equipped with an integrated system and two calibrated portable devices that allow the operator to monitor radiation levels in close proximity to the X-ray system.
- 3.31. Yellow flashing lights should be installed at the front and rear of the vehicle. The vehicle should be equipped with 10 yellow battery-powered magnetic flashlights.
- 3.32. The sides of the transport vehicle must be equipped with white continuous contour reflective tape and a red continuous reflective contour on the rear part of the vehicle.
- 3.33. To mark the hazardous zone of the X-ray equipment, the device should be equipped with portable cones (with a height of not less than 50 cm) numbering 50 units.
- 3.34. The color scheme of the X-ray device should be confirmed by the Customer to the Supplier. The Supplier must provide support in creating the appropriate color design.
- 3.35. The direction of movement during scanning should not be determined by a physical device attached to the steering wheel.
- 3.36. A rear-view camera with a color flat screen should be installed in the driver's cabin of the truck. The camera should have a lens heater, a protective cover, and should be installed in the center of the rear part of the vehicle.
- 3.37. It should be possible for both the operator and the driver to monitor the entire area of the hazardous zone surrounding the X-ray device and the scanned object from the operator's room and the driver's cabin.
- 3.38. Surveillance cameras must cover the perimeter of the X-ray equipment at 360 degrees, including the visible area between the scanning device and the scanned object (the sizes of the scanned object and the X-ray device must be different). Video surveillance cameras must transmit color images to screens in the operator's room and the driver's cabin with a minimum size of 23.8 inches.
- 3.39. The fuel tank capacity of the transport vehicle must be at least five hundred liters. In the case of multiple tanks, they must be permanently connected to each other. The operation of the diesel generator is ensured up to the specified reserve fuel level (one hundred liters with adjustable regulation).
- 3.40. The operator's compartment must be equipped with a multifunctional printer and connected to all computers in the operator's room.
- 3.41. There should be two workstations for image processing in the operator's room.
- 3.42. The operator's cabin of the mobile X-ray system must be equipped with an additional space for an auxiliary portable computer (including a power supply and network socket).
- 3.43. Monitors for workstations should have curved displays with no less than 27-inch IPS panels.
- 3.44. Scanning software should automatically check the history of whether the vehicle or container being scanned has been scanned before, and if the information is available, display it on the operator's workstation screen.
- 3.45. Image analysis software should provide synchronized analysis of multiple X-ray images, i.e., perform the same functions on different images simultaneously.
- 3.46. Computer systems must have the MS Windows operating system, not lower than version 10. They should be assembled in such a way as to exclude common security vulnerabilities registered in the OWASP network, and comply with the security requirements of the latest ISO 15408-2 standard. Systems should be equipped with software that allows different levels of user privileges.
- 3.47. The computer configuration should ensure uninterrupted operation of the systems without interruptions, with the following minimum parameters:  
Form factor: all-in-one, desktop, or laptop;  
Processor: at least 8 physical computing cores, at least 16 threads, support for Turbo Boost Technology with a minimum frequency of 4.9 GHz, support for HyperThreading or equivalent;  
RAM: at least 32GB, DDR4 or SO-DIMM DDR4 type, with the possibility of installing at least 64GB of RAM, with a frequency of at least 3200 MHz;  
Storage: SSD M.2 NVMe PCIe, at least 2TB, with the possibility of installing an additional SATA 2.5" drive;



Graphics Card: discrete, hardware support for DirectX not lower than version 12.X and OpenGL not lower than version 4.X, with at least 6GB of video memory;

Interfaces: at least 5 USB ports, including at least 2 USB Type-A ports not lower than USB 3.0, a universal 3.5mm TRS audio jack, at least 1 HDMI, and 1 x LAN (RJ-45);

Network Interface: RJ-45 with a speed of 10/100/1000 Mbps;

Monitor: not less than 27 inches, IPS or equivalent type, with anti-glare coating, brightness not less than 250 cd/m<sup>2</sup>, 16:9 aspect ratio, resolution not less than FullHD 1920x1080, color gamut not worse than NTSC 70%.

3.48. Archiving of saved image files in UFF, original, jpeg, and png file formats on external digital storage should be possible.

3.49. LED external lighting (IP67) should be installed to illuminate the working area within a radius of four meters. The light intensity at the edges of the working area should be not less than 30 lux. The area between the X-ray device and the object being scanned should be illuminated.

3.50. The X-ray device should be equipped with sensors for mechanical impact. The sensor rods should be illuminated.

3.51. The official service center for the technical maintenance of the transport vehicle should have a representation in Ukraine.

3.52. Technical documentation (detailed user manual, passport, passport of the X-ray source, a set of operational documents for components, and other documentation provided by the manufacturer) for the mobile X-ray system should be provided in Ukrainian and English in both printed and electronic formats (on a USB drive).

#### **4. Built-in Automatic License Plate Recognition System for Mobile X-ray System**

4.1 The system should be able to identify both the front and rear license plates of the scanned vehicle as well as the container number.

4.2 The identified numbers should be automatically added to the vehicle and/or container registration fields.

4.3 There should be an option to manually adjust the automatically entered digits. Manual changes to the license plate should be recorded in the system log, including information about the operator who made the correction.

4.4 The license plate recognition system should be able to recognize no less than 98% of vehicle and container license plates.

#### **5. Training**

5.1 Training on the use of the X-ray system.

5.1.1 Ensuring the training of 20 employees per unit, a total of 60 in the use of the X-ray machine, with training conducted in Ukrainian or English with the use of an interpreter.

5.1.2 Training is conducted at the planned location of the mobile X-ray system.

In addition, training should be provided for four employees as internal trainers, with the issuance of a certificate from the equipment manufacturer with additional training rights.

5.2 Image analysis training.

5.2.1 Image analysis training is conducted for 5 per unit, 15 employees total (included in an overall 60 trained employees), and training should be conducted in Ukrainian or English with the use of an interpreter.

5.2.2 Training is conducted at the planned location of the mobile X-ray system.

5.2.3 Image analysis training should be conducted using software provided by the supplier. The visualization software used for training should be compatible with the X-ray image processing software provided.

5.2.4 In addition, the supplier should provide training for 4 employees as internal instructors for image analysis, with the issuance of a trainer certificate.

5.2.5 Training materials should be provided to each participant in printed form and additionally in electronic form.

## **6. Testing and Equipment Handover**

6.1 Equipment compliance verification must be carried out in accordance with the technical specifications.

6.2 The supplier provides all necessary resources for conducting equipment testing and test objects.

6.3 The equipment must pass all tests without altering system settings during the process.

6.4 The supplier must provide quality image testing reports for the mobile X-ray equipment as part of the initial tender submission. The final testing report should be common for all tender participants.

6.5 The supplier is responsible for arranging factory acceptance testing (FAT) of the equipment (or its parts) by three representatives of the contracting authority at the manufacturer's facility. The contracting authority should record the test results in written form and provide them to the supplier within two weeks. The expenses for factory acceptance testing should be covered by the supplier.

6.6 After the equipment is delivered to the location specified by the contracting authority, an on-site acceptance test should be conducted. After passing the test, the test results should be documented in written form and provided to the supplier within two weeks.

6.7 As part of the on-site acceptance test, the X-ray equipment should undergo an IT audit.

6.8 After successful on-site acceptance testing, the trial period in operational mode will begin. The trial period is considered complete when the equipment has operated without malfunctions for 15 consecutive days. In case of malfunctions, the countdown of trial period days restarts.

6.9 Equipment acceptance-receipt acts may be signed when the following operations are completed without critical issues:

Factory acceptance tests of the device (factory acceptance testing).

On-site acceptance tests.

User training (see Section 5).

Trial period in operational mode (see Section 6.8).

6.10 The calculation of the warranty period begins after the signing of the final equipment acceptance-receipt act and the provision of the following documents:

6.10.1 A document confirming the year of manufacture of the device.

6.10.2 Warranty certificate for the mobile X-ray system.

6.10.3 Technical documentation for the mobile X-ray system, including the CE (Conformité Européenne) compliance certificate along with a list of relevant standards.

6.10.4 User manuals for the use, maintenance, and restoration of the mobile X-ray system, including software licenses and software.

6.10.5 Administrator's instructions for the mobile X-ray system, including access codes and passwords, system configuration description, minimum requirements, and system architecture, including database versions.

6.10.6 Equipment maintenance plan.

6.10.7 Technical specifications for the mobile X-ray system must be provided in both Ukrainian and English in printed and electronic formats.

## **7. Warranty and Service Maintenance**



- 7.1 The minimum warranty period for the equipment is 60 (sixty) months. The warranty includes full servicing of the equipment and the vehicle chassis, including all spare parts.
- 7.2 The response time during the warranty period and during the contract period for equipment failure should not exceed 24 hours.
- 7.3 If the same part fails for the third time, it must be replaced with a new one without fail. The warranty for the replaced part starts from the moment of installation, and a separate written report is prepared for it.
- 7.4 If the SSM is not operational for two or more weeks during the warranty period, the warranty is extended for the downtime period.
- 7.5 Software updates for the SSM and image processing must be provided free of charge during the warranty period, including security error corrections. Updates should be installed within one month of becoming available.
- 7.6 Spare parts for the equipment must be available for a period of at least 10 years after the equipment is received.
- 7.7 Planned maintenance should not result in equipment downtime exceeding 18 hours.
- 7.8 The response time during the warranty period and during the contract period for technical maintenance should not exceed 72 hours.
- 7.9 During the service life of the mobile scanner, web-based software for managing services/failures with all necessary equipment and network connections must be provided.
- 7.10 This software should allow operators or other employees to collect, store, and exchange information about faults, repairs, and technical maintenance of the equipment. It should also include the ability to compile statistics (including records of condition, maintenance, usage, repair time, and percentage of operation for different time periods). The solution provided should have a firewall and a crypto tunnel.
- 7.11 If the equipment is damaged by a technician/operator who has undergone training or is authorized by the supplier and has followed technical and operational instructions, the warranty remains valid.