SECTION 5
RADIOGRAPHY SYSTEM REQUIRMENTS

CONTENTS

A. The Light Vehicle Inspection Radiography System site

1. General

1.1. The purpose of the crossing site is the crossing of people and vehicles between Jorden and Israel. The Radiography system is designated for light vehicle inspections and to creating images to be interpreted by the operators in the site.

1.2. The facility of the Light Vehicle X-Ray system shall be a stationary one, in a designated fixed concrete structure (***screening tunnel***) with radiation shielding walls and doors, operational and managerial rooms.

1.3. Conveyor - The Radiography facility shall be based on a *Conveyor Architecture* based on a vertical radiography layout (*topside* source).

1.4. High Energy X-Ray - The Light Vehicle Radiography system shall generate an images using high energy X-Ray radiation.

1.5. Material Discrimination – The proposed imaging systems shall include material discrimination features enabling differentiation between organic and inorganic materials. And any other type of automatic video analysis programs.

1.6. System's main components:

The system shall include, at least:

1.6.1. A conveyor for embarking, harnessing, moving and disembarking of light vehicles

1.6.2. An X-Ray emission subsystem:

1.6.3. An X-Ray detection subsystem.

1.6.4. Command and control subsystem.

1.6.5. The Light Vehicle Radiography system shall operate in a way of providing automatic co-ordination of these subsystems, independently of any other facility systems, the main generator will be supplied by including the power supply system and backup.

1.7. System's minimal performances are defined in this document.

1.8. System description - A detailed description will be provided in Bidder's proposal, including specific reference to the following issues:

1.8.1. System's architecture.

1.8.2. System's operation

1.8.3. Image Workstation: hardware, software, operation

1.8.4. Data Architecture, linkage to all subsystems

1.8.5. Material Discrimination feature

1.8.6. Image Processing Tools

1.8.7. Systems Performance

2. System's Minimal Requirements

2.1. The Systems Minimum Performance will be expressed in the following parameters (as defined in this document) Ultimate Penetration, Resolution, Contrast, Material Discrimination and Throughput.

2.1.1. Ultimate Penetration

2.1.1.1. The Ultimate Penetration shall be at least 160 [mm] at least at three out of the 9 defined positions at scan velocity of 12 [m/min].

2.1.1.2. The Ultimate Penetration shall be at least 130 [mm] at each of the 9 defined positions at scan velocity of 12 [m/min].

2.1.2. Resolution

2.1.2.1. Wire resolution, when measured at the middle of the vehicle at height corresponding to the center of the beam (or best position) will be, at least:

- 2.5% for 50 [mm] clutter (1.25 [mm] wire behind 50 [mm])
- 2.5% for 100 [mm] clutter (2.5 [mm] wire behind 100 [mm])

2.1.3. Contrast

2.1.3.1. The systems contrast shall be no more than 3% behind 50 [mm] Stainless Steel. The Radiography system manufacturer will declare the contrast quality of the system by using Hole-Type Image Quality Indicators (IQI) indicators in accordance with the guidelines of the ASTM standard E 1025 latest edition: "Standard Practice for Planning, Manufacture, and Material Grouping Classification of Hole-Type Image Quality Indicators (IQI) Used for Radiology.

2.1.4. Throughput

2.1.5. The Light Vehicle Radiography system will be able to inspect at least 24 [vehicles/hour].

2.1.6. Material Discrimination; proven and verified capability of material discrimination, as defined here and after in this document.

2.1.7. Bidder's System Performance - Obligatory

2.1.7.1. The bidder is requested to submit the following tables, referring to system's performance, expressed in the defined parameters according to the test methodology as defined in this document.

Position	a	b	c	d	e	f	g	h	i
Penetration ([mm])									
Value([mm])									
Wire IQI (%)									
Behind 10 [mm]									
Behind 25 [mm]									
Behind 50 [mm]									
Behind 100 [mm]									
Behind 120 [mm]									
Behind 140 [mm]									
Behind 160 [mm]									
Hole IQI (%)									
Behind 10 [mm]									
Behind 25 [mm]									
Behind 50 [mm]									
Behind 100 [mm]									
Behind 120 [mm]									
Behind 140 [mm]									
Behind 160 [mm]									

Bidder declaration, regarding material discrimination capability will be defined at the following:

Position	a	b	c	d	e	f	g	h	i
Basic									
L_{min}									

L_{max}									
Operational									
X									
Y									

3. Operational Requirements

3.1. Inspected Objects types

The radiography systems shall be able to scan and image the following objects:

3.1.1. Light Vehicles

- On each scan cycle, the system must be capable of screening one (1) vehicle of up to maximum size of 2.5 [m] x 3.6 [m] x 6.5 [m] (WxHxL).

3.1.2. Light vehicle Truck / Flatbed.

3.1.3. Cars

- The layout of the radiography systems should be optimized for objects having variable dimensions: heights sizes from ground level up to 3.6 [m] and variable widths sizes up to 2.5 [m].

3.2. Scan dimensions

3.2.1. The layout of the radiography systems should be optimized for the objects having the following dimensions:

3.2.1.1. Min. height - 0.0 [m] above ground level

3.2.1.2. Max. Height - 3.6 [m]

3.2.1.3. Width - 2.5 [m]

3.2.1.4. Length – 6.5 [m] in total length.

3.2.1.5. Weight – 4000 [Kg].

3.2.2. For each of the above mentioned objects, the radiography image shall be displayed in full on the screen without distortion or corner cut-offs.

3.2.3. The bidder shall describe the automatic scan procedures, including particulars of operator's required operations and of the provided means (for example: motorcycle, etc.) to acquire the optimal image of each object.

3.3. Scanning procedure

3.3.1. The scanning process must enable one light vehicle on a conveyor at a time.

3.3.2. One screening cycle, in standard operation, will comprise of screening one (1) object, for example: one 5 [m] long vehicle.

3.3.3. While screening consecutive vehicles on a conveyor, the system will display each vehicle as a separate image (Each vehicle has a specific ID).

3.3.4. While screening a vehicle the system will display the whole vehicle as one image.

3.3.5. In addition to the above configuration, scanning procedure shall be optimized (with reference to scan time, radiation, etc.) for operations when only one object is positioned in the conveyor. Example: while screening one (1) regular vehicle the screening process will end at the end of the vehicle and the scan cycle will proceed when the vehicle has left the conveyor and the next vehicle inline without emitting X-Ray radiation between vehicles.

3.4. The duty cycle of the radiography system should be not less than 100% for 24 [hours/day], 7 [days/week].

3.5. The availability of the system should be not less than 95%.

3.6. The system must meet the following minimum performance criteria under normal working conditions:

3.6.1. Time to turn on the system shall not exceed 30 minutes.

3.6.2. The throughput of the systems shall be not less than 24 [vehicles/hour].

3.7. Environmental Conditions;

3.7.1. The system must operate under climatic conditions suitable for the State of Israel including the Jordan Valley and Eilat.

3.7.2. Operational ambient temperature: minimum temperature of -10°C and maximum temperature of 55°C (-10°C to 55°C). The maximum measured temperature is 49°C. The bidder must take all necessary actions (air flow, A/C, etc.) to maintain optimal operation during harsh environment conditions.

3.7.3. The system must function normally and without impact on its performance at humidity level of 10% to 98% inclusive.

3.8. The contractor is obligated to comply with Israeli law, regulations and requirements and present to the client all the necessary permits.

4. Geometry of the Radiography System

4.1. The Bidder shall design the system's geometry so that all operational requirements shall be achieved. The screening tunnel will not exceed 15 [m] in length (gross). The conveyor can exceed the 15 [m] restriction.

4.2. The layout of the radiography system shall be optimized to image the specified objects, for example: height sizes from 0.1 [m] to 3.6 [m], width sizes up to 2.5 [m] and length of 6.5 [m]. The total length of one object is 5 [m]. The conveyor can exceed the building's length of 15 [m].

4.3. Positioning of the X-Ray Emission unit and the detector arrays will be adapted so that any object positioned in the conveyor will be scanned and imaged in full without corner cut-off.

4.4. The Bidder will optimally design the position of radiation beams centers relative to the center of the object to achieve best performance. As, beam symmetry will be corrected by electronic correction.

4.5. The system include:

4.5.1. X-Ray emission subsystem

4.5.2. Detector Array

4.5.3. Conveyor system

4.5.4. Screening system

4.6. The radiography system will provide automatic coordinated operation of all the subsystem, including the facility subsystems working independently.

5. The X-Ray Emission Subsystems

5.1. The proposal will include a detailed technical description of the radiation emission subsystems, referring to each one of the specified issues:

5.1.1. Control and management (automatic)

The X-Ray emission subsystems will consist of high-stability radiation sources automatically controlled and managed with manual control maintenance and a friendly user interfaces.

5.1.2. Energy Sources - adequate to provide the required radiation dose to achieve the required penetration.

The X-Ray emission subsystems will enable high penetration by using electron linear accelerators (LINAC type) with energy of at least **1 [MeV]**.

5.1.3. Modes of Operation – Material Discrimination

Bidder's proposal will include a detailed description of the proposed X-Ray emission subsystems operational modes, required to enable material discrimination capability, either by operation at dual-energies: generating images at two energies, or any other method.

5.1.4. Collimation subsystems - in order to optimize the coverage of the height of the detector arrays, while minimizing the “cross talk” effect and radiation dose in the inspection screening tunnel, collimation is required.

5.2. The Maximum Absorbed Dose per inspection will be less than **10 [mRad] ([100µGy])** measured at center of testing positions.

5.3. The X-Ray generators will include protection against an uncontrolled rise in temperature above the permitted working temperature to enable continuous use of the systems at a very high capacity, and with minimal wear and tear.

5.4. The lifetime expectation of the X-Ray generators operated in a duty cycle of 100% for 24 [hours/day], 7 [days/week], will be at least 10 years with adequate maintenance and component replacement program.

5.5. The X-Ray emission subsystems shall comply at least with the following:

5.5.1. Manufactured by a worldwide leading producer of linear accelerators with proven experience of more than 10 years.

5.5.2. The proposed model will have a confirmed and reliable history of operational use for at least two (2) years.

6. The Detector Arrays

6.1. The Bidder shall specify detectors' type and provide detectors' parameters affecting their performance, including, among other parameters:

- Number of arrays - required to minimize image distortion in the proposed geometry, based on object dimensions and considerations relating to the "conveyor" system architecture.
- Detector type / array
- Detector size; detector size facing the X-Ray beams shall be not larger than 5 [mm] x 5 [mm].
- Number of detectors / array / module – to form images in the required resolution and without loss of information.
- Array design.
- Spectral response.
- Dynamic range - to ensure reasonable image quality in dense zones where transmitted radiation flux is small.
- Temporal response.
- Detector Collimation.
- Environmental effects (temperature, humidity, electrical interference, etc.).

6.2. The proposal will specify the mounting architecture of the detector modules, manual treatment required and replacement method in the case of service.

6.2.1. The detector arrays will be arranged in a high-resolution linear geometry, to prevent image distortion. The detector arrays will be continuous, with a standard diffusion of the detectors without spaces between the detectors or between the modules, which may cause distortions or deficiencies in the X-Ray image of the screened object.

6.2.2. The detectors will not need to be manually treated at all during 24 successive hours of daily operation.

6.3. Systems based on smaller detectors, resulting in a system with improved resolution, may be proposed as an additional option.

6.4. The Electronics of the Detector Arrays

6.4.1. The Bidder proposal will describe the number of bits corresponding to the useful signal (signal/noise ratio or with/without beam signal).

6.4.2. The proposal will specify technique used to send the digitized signals for processing at the processing sub-systems, detailing methods used to reduce the influence of any electromagnetic background and to exclude mutual interferences by radiation leakage and scattered radiation, warning messages, etc.

6.4.3. Real-time diagnostic systems and warning messages, designated to monitor and represent detectors status and performance quality, will be detailed in the proposal.

6.4.4. The Bidder will specify the techniques used to reduce the influence of any electromagnetic background and to exclude mutual interference by radiation leakage and scattered.

6.4.5. Bidder will specify the lifetime expectation of the X-Ray detectors operated in a duty cycle of 100% for 24 [hours/day], 7 [days/week], and with adequate maintenance and component replacement program.

7. The Conveyor Subsystem

7.1. The proposal will include a detailed technical description of the conveyor subsystem, referring to each of the specified issues:

7.1.1. Control and management (automatic)

The conveyor subsystem will be designed by the manufacturer (one or more according to Bidder's specific systems) automatically controlled and managed with manual control maintenance and a friendly user interfaces.

7.1.2. Conveyor Speed - adequate to provide the required speed for each object to achieve the required penetration and image quality.

The conveyor subsystem will consist of a conveyor capable of moving light vehicles weighing up to 4000 [kg] at a rate of at least 24 [vehicles/hour] at sizes of 2.5 [m] x 3.6 [m] x 6.5 [m] (WxHxL).

7.1.3. Modes of Operation – direction of scan

Bidder's proposal will include a detailed description of the proposed X-Ray system. The conveyor subsystem will be durable conveyor with operational modes which

are required to enable forward scan capabilities either by automatic operation or manual.

7.1.4. Conveyor Power Consumption - The conveyor should have low power consumption, be able to be switched on/off whenever it is needed and as compact in size as possible.

7.2. The conveyor subassembly will include protection against an uncontrolled rise in temperature above the permitted working temperature to enable continuous use of the systems at a very high capacity, and with minimal wear and tear.

7.3. The lifetime expectation of the conveyor subassembly operated in a duty cycle of 100% for 24 [hours/day], 7 [days/week], will be at least 10 years with adequate maintenance and component replacement program.

7.4. The conveyor subsystems shall comply at least with the following:

7.4.1. Manufactured by a worldwide leading producer of conveyor subsystems with proven experience of more than 10 years.

7.4.2. The proposed model will have a confirmed and reliable history of operational use for at least two (2) years.

8. Scanning subsystem

8.1. General

Image acquisition of an object is achieved as a result of a relative movement of one system: the vehicle on a moving conveyor set. The entire system is comprised of the X-Ray accelerator and detector array, and an object on the conveyor to be imaged. The final system comprises of conveying the object through the radiation beam along the static X-Ray set.

8.2. Conveyor System

X-Ray system, as specified in this SOW will be a "Conveyor" based system.

8.2.1. The scanning method will be comprised of a moveable conveyor with the X-Ray system fastened to the ground, while moving the imaged objects along the static X-Ray source and detectors.

8.3. As per Bidder design, the scanning system may include rails (fixed on the concrete surface) with the scanning units mounted on it, if so required for smoother and faster inspection.

8.4. Scan routine procedure

8.4.1. Standard scan routine shall be based on one scan, of one (1) vehicle positioned in line on a conveyor in the radiation screening tunnel.

8.4.2. All images required for images analysis, including images which are part of material discrimination process, will be created in one scan.

8.5. Scan velocity

In order to achieve high throughput a variable constant velocity is required:

8.5.1. Nominal velocity (standard): 12 [m/min] (0.2 [m/sec]).

8.5.2. High velocity: 24 [m/min] (0.4 [m/sec]), (Bidder's specification), to be used for low density object.

8.6. The Bidder will provide detailed description of the offered scan system, including specifications referring to its parameters, including among others, the following:

- System’s Architecture (concept, reasons, advantages and disadvantages)
- Dimensions: Vertical and horizontal distances
- System’s movement command and control system
- Scanning velocities

- Scanning stability
- Characteristic times (while changing scanning mode)
- Operational Options
- Power requirements
- Maximum and minimum environmental working conditions

9. Command and Control

9.1. The major function of the command and control subsystem is to control each of the subsystems and the system as a whole by taking responsibility for the communication and coordination within all parts of the systems and between the components of the systems and the host systems.

9.2. The control and command sequence starts with the completion of scanning of a vehicle in the radiography system. It will build up a corresponding processing queue and files of the transmitted information. The sequence control indicates that an IAW is ready to receive the images and data of a vehicle for evaluation.

9.3. When several IAWs are in use, a pipeline operation is a necessity.

9.4. The Image Command and Control subsystem will make it possible to examine the image and data of a vehicle while the next one is being inspected, and the Radiography images of a previously inspected unit is at the same time awaiting examination. At the same time there may also be one or more units being rechecked because suspicious items have been detected on the Radiography images.

9.5. The data processing system must support the pipeline operation.

9.6. Any image stored in the system shall be designated to any IAW in order to increase the system's flexibility of use. Without any intervention, the next image to be examined is transmitted to the first free IAW.

9.7. Vehicle’s data will be linked to all Radiography images. Depending on the decision being "suspicious" or "non-suspicious", the Image Command and Control subsystem directs the data either to the workstation at the Pit search facility, where the marked images can appear on the screen and/or on video printouts, or immediately to the archive system.

9.8. Each operation (storage, visualization) shall be stored in the Image processing system’s logbook to enable tagging of the processing done by a given operator on a given image.

9.9. One of the standard features of the system will be the possibility of image and data transfer from the IAW for archiving purposes and for future reference.

9.10. The Image Processing command and control subsystem will provide the all IAW with free and immediate access of the following information:

9.10.1. Real-time Radiography images and data;

9.10.2. Radiography images and data from Archive

10.Material Discrimination

10.1. General

10.1.1. Visual analysis of X-Ray images acquired in X-Ray inspection technology based on transmitted radiation only has a limited capability for identifying materials within the vehicle. Specifically, detecting contraband covered or shadowed by shielding materials.

Today, one of the means deployed in order to enhance operator's capability, in addition to the traditional radiography, is based on material discrimination.

10.1.2. Material discrimination feature, including the basic and operational tests as defined in this document, is a mandatory requirement and shall be deployed as part of the proposed system.

10.1.3. Generally, the term of "material discrimination" corresponds to the ability, either to enhance organic materials, and/or to identify, in areas of the inspected vehicle, the effective atomic number (Z) of the content and to correlate it to groups of materials: organic, metallic, heavy metals, etc.

10.1.4. Evaluation of the effective atomic number results from the fact that the X-Ray attenuation factor - μ (E, Z) (as result of absorption and/or scatter processes), depend on the X-Ray energy (E) and on the material's atomic number (Z). Therefore, using adequate, sophisticated image fusion algorithm the effective atomic number can be estimated from comparisons of pairs of images: X-Ray transmittance images acquired at various, at least two, predefined energies or from comparisons of transmittance images and scattered radiation images.

10.2. Bidder's proposal shall include detailed description of the proposed material discrimination feature that shall be implemented as part of the inspection system, with specific reference to the following topics.

10.2.1. Method

10.2.1.1. Basic technological and theoretical approach, including Bidder's approach detailing the advantages / disadvantages of the preferred method that will be implemented in the system:

- Transmittance images vs. scattered (Back / Forward)
- Chosen X-Ray Energies

10.2.2. Application Method

10.2.2.1. Description of the proposed solution, including technical details of the system, referring to the following topics:

- Method of implementation
- Considerations (pros / cons)

10.2.2.2. System Hardware – implemented in the system:

- Accelerator / accelerators type
- Alternating energies (if available)
- Detectors technical specifications (type, number of arrays, detector/array, etc.)
- Image workstation (IAW) additional hardware, ex: displayed Image/images (type, number, etc.)

10.2.2.3. Operational issues (scan routine, number of required scans, scanning options)

10.2.2.4. Algorithm and processing features (groups coloring, etc.)

11.System Workstations

11.1. General

11.1.1. Each work station will include all the necessary hardware and software needed for the proper operation of the system according to the operational flow process and requirements as described in Section 3.

11.1.2. The following sections describe system's various work stations and their minimal required content.

11.1.3. The bidder is obligated to describe each work stations and detail its content in his proposal.

11.2. Radiography System Operators' Workstations

11.2.1. General

11.2.1.1. Operators' main room (in Radiography Building), as defined in section 4 (Ch 4.4), will comprise of, at least, the following workstations:

System Operator – two (2) stations, one (1) regular station at the IAW room and one (1) of standing station (outdoors ,before the entrance to the tunnel)

- Image Analysts – three (3) stations, two (2) regular stations at the IAW room and one (1) of standing user type at the manual inspection site [Pit side])
- Training station – one (1) station at the IAW room as stand alone
- Technical Diagnostics – one (1) station at the technician room

11.3. The workspace will be designed considering human engineering principles.

11.4. System Operator (SO)

11.4.1. The system will include a control and monitoring workstation that will enable operation and monitoring of the radiography system status.

11.4.2. The workstation will operate in real-time mode.

11.4.3. The provided information will be comprehensive and include:

11.4.3.1. Scanning speed

11.4.3.2. X-Ray emission status.

11.4.3.3. Scanning Mode (Single / Dual Energy / other)

11.4.3.4. Subsystem Status

11.4.3.5. Radiation Safety Status, including all Interlocks and doors status

11.4.3.6. CCTV display of screening tunnel volume and conveyor

11.4.3.7. Error or warning indicators

11.4.3.8. Errors messages will be clearly presented.

11.4.3.9. The system operator workstation will enable full diagnosis of system malfunctions and display the location of the malfunction on the system diagram for fast technical response.

11.4.4. Radiography System Controls

11.4.4.1. The operator's workstation should provide to the greatest possible extent, automatic operations, minimizing manual intervention

11.4.4.2. The system operator workstation will enable parameters to be set based on the technician access authorization.

11.4.4.3. The system must be user-friendly.

11.4.4.4. All controls and screens will be in English. Contractors will indicate if the system can support Hebrew.

11.4.4.5. All physical labeling on the work station will be in English and Hebrew with heavy duty labels.

11.4.4.6. Operational procedures and controls must be clear, without any ambiguity.

11.4.4.7. Operational activities will be displayed and monitored on the operator's workstation.

11.4.4.8. The system will be self-protective, so that operator errors will not damage the system or scanning procedures.

It enables performance of the following:

11.4.4.9. Opening / closing the doors of the radiography screening tunnel (if needed and/or exists

11.4.4.10. Supervising the drivers, using the CCTV display, out of the screening tunnel and confirming no one is in the screening tunnel.

11.4.4.11. Automatic camera detection system of people in the radiography tunnel (see Appendix B).

11.4.4.12. Verification of car details

11.4.4.13. Authorize start of the screening process

11.4.4.14. At the end of screening procedure, supervise the driver return to the vehicle, while directing the next vehicle in queue to the correct positions.

11.4.5. Operator's workstation shall have all devices and subsystems defined for operations of these functions.

11.4.6. The workstation includes, at least:

11.4.6.1. Radiography System controls

11.4.6.2. CCTV

11.4.6.3. SDMS WS

11.4.6.4. Customs computer

11.4.6.5. PA

11.4.6.6. Automatic Camera detection system of people.

11.5. Image Analyst Workstation (IAW)

11.5.1. General scope

11.5.1.1. The Radiography inspection system includes the supply of 5 IAWs: three (3) routine Image Workstations, of which one (1) of a standing user type at the manual inspection side, one (1) training WS (as defined in section 4 (Ch. 4.6)). This configuration will assure inspection throughput rates, even during high traffic hours, while enabling a thorough examination of each image.

11.5.1.2. The digitized signals from the data acquisition electronics of the Detector Array/arrays will processed in real time to produce one or more images of the scanned object (as per Bidder specific system).

11.5.1.3. The images (at least at 16 bit) shall be available less than 3 seconds after the end of the image acquisition process

11.5.1.4. The radiography (transmission and/or scatter) images, linked to the computerized data file of the vehicle, will be routed to one of the 3 Image Analyst Workstations (IAW).

11.5.1.5. At the IAW, the Image Operator's task is to examine the acquired radiographic images of the vehicle, each one on a screen, using Bidder's image processing tools.

11.5.1.6. The information in the data file linked to the specific vehicle, containing the vehicle data, manifest, packing bill or any other type of data associated with the

vehicle, assists the Image Analyst to verify this information and to spot irregularities and anomalies while evaluating the actual radiography image.

11.5.1.7. At the end of this process the image analyzer enters the results of his evaluation into the examination data file. In case of suspicion, he marks the suspicious area of the image and enters a verbal description (input in Hebrew) of the reason and nature of the suspected area into the computerized data file of the scanned object. This accumulated data will be available for supervision and for further inspection at the Recheck Workstations located at the Pit search installation.

11.5.2. Each IAW will be composed of these major components:

11.5.2.1. Images Display (dedicated screen with a keyboard and mouse) – quantity tailored to Bidder's specific system

11.5.2.2. Data Display (system's and Customs) and Processing

11.5.2.3. Storage of Images and Data

11.5.3. Image Display

The Image Display module shall be presented in the proposal with specific reference to the following issues:

11.5.3.1. The Image Display system of each IAW will be composed of dedicated monitors (consistent with number of the acquired images), a keyboard and a mouse.

11.5.3.2. Display monitor

The following parameters will be specified in Bidder's proposal:

- Screen type, size, resolution
- Display frequency and colors.
- Additional features: flicker-free, anti-reflective, “human touch”, scratch protected.
- Compliance with regulations TCO99 / MTR.

11.5.3.3. Each image of the screened object will be displayed on a high resolution monitor, as will be customary at the time of deployment, at least: 24’’ for a LED type (or equivalent). If feasible, the screens will be flicker-free and anti-reflective

11.5.3.4. Bidder's proposal shall include detailed description of proposed image displays and provided image manipulations.

11.5.4. Generally the screen comprises of the following main parts:

- Data & Menu bar
- Main image part
- Coordination / Overview window (Bottom / Top)

11.5.4.1. The control bar comprises of groups of functions offering information data, image processing, image manipulations and visualization tools.

11.5.4.2. The Data part of the Menu Bar contains information on the currently displayed image. It will display data needed for identification of the inspected object, including, at least: date, time of X-Ray, image number, inspection number, etc.

11.5.4.3. The Menu Bar will contain a graphic interface (as Icons), containing all the necessary commands for the activation of all available image manipulation modes,

11.5.5. Main window

11.5.5.1. The Main window of the screen displays, by default, the Overall (Global) Image of the scanned object.

11.5.5.2. The Image Analyst will be able to select a particular zone or portion of the whole Image (Local Image) and utilize all the various basic or advanced image manipulation modes. In that case, the Local Image will be displayed on the Main window in full resolution.

11.5.6. Coordination (orientation) window

11.5.6.1. The Bottom/Top window of the screen will display the Overview Image, while the Local Image is being displayed in the Main field. The Local Image outline will be marked for orientation on the Coordination Image by a highlighted frame.

11.5.6.2. Time for obtaining a local image after selection of a zone on the global image shall be immediately.

11.5.6.3. The graphic interfaces will be activated by a mouse on the Icons.

11.5.7. Image Manipulation Features

11.5.7.1. General

11.5.7.1.1. Image processing features available for the Image Analyst at the IAW shall be designed to meet two basic requirements:

- Support the Image Operator in detecting a large variety of contraband concealed in different types of goods;

- Enable the Image Operator to conduct an efficient image examination and interpretation and to reach a reliable decision as fast as possible;

11.5.7.1.2. The Bidder will submit a full technical and functional description of the processing image features, addressing each of the following desired image manipulation features in a detailed method.

11.5.7.1.3. Image processing features will be presented at the Design reviews meetings, subject for approval by the Customer.

11.5.7.2. Feature Activation: graphic interfaces - by a pointing device *i.e.* mouse or trackball on the Icons.

11.5.7.3. Independent application: if so desired, any image processing function can be applied independently, without pre-conditioning. (For example: gray scale modification / zoom etc.

11.5.7.4. Moveable Window

Image modification function will be applied in two modes:

11.5.7.4.1. On the whole image

11.5.7.4.2. On operator's pre-selected local zone

In this mode, if applicable, the dynamic modifications will be performed continually sliding or resizing the selected “window” along the image.

11.5.7.5. ZOOM - local (in arbitrarily selected and varied in size window) image enlargements (zoom), on at least 3 levels: x2; x4; x8.

11.5.7.6. Pan and scroll - provide easy movement of the selected window within the displayed image.

11.5.7.7. Negative and mirror - reverse monochrome/mirror Radiography image.

11.5.7.8. Edge Enhancement - may provide an improved image definition and better identification of individual objects and items. For efficient work the function will be activated inside a screen window of variable area as selected by the Image Analyst.

11.5.7.9. Contrast - to optimize the whole image as well as an operator pre-selected area:

11.5.7.9.1. Contrast modification of the whole image according to pre-selected zone as a calculation reference

11.5.7.9.2. Dynamic Gray-scale modification of a selected zone with the middle of the window as a calculation reference, window size will be variable in size. For this, the image operator will adjust the contrast sensitivity by continually sliding a “window” along the image gray-scale.

11.5.7.9.3. The activation of different contrast modes (adapted to low / high / very high radiation absorption) will be achieved by pointing the Contrast Icon in a down drop manner.

11.5.7.9.4. Image modification based on Histogram equalization function on operator-selected area will be provided.

11.5.7.10. High Density Alarm

11.5.7.11. Marking the Suspicious Area

11.5.7.11.1. The feature is used to mark objects in the image, especially those that could not be identified or were found to be suspicious.

11.5.7.11.2. Marking method: position and size of the Suspect Designation Marking Window, pointing device *i.e.* mouse, trackball, colored frame

11.5.7.11.3. Adding Hebrew annotation, X and Y coordinates will be indicated on the image.

11.5.7.11.4. The marking will appear as a colored frame on the screen and on the hard copy printed by the video printer. The frame color will contrast with the image background.

11.5.7.11.5. After an area of the image has been marked, the Image Analyst will be able to switch off the mark that has appeared on the screen, to avoid interference with the examination of the rest of the image. The marked area coordinates will be stored with the image so it will be possible to show all the marked areas by a single command.

11.5.7.11.6. It will be possible for the Image Analyst to delete or add a marked area.

11.5.7.12. Measuring Displayed Objects - to measure the real size of an object displayed on the screen.

11.5.7.13. Split Screen

11.5.7.13.1. In case of re-examination, the function will enable simultaneously comparison of the current image with previous one (loaded from the archive automatically) ,if the vehicle has been inspected before and compare the images.

11.5.7.14. Pseudo-Colors

11.5.7.14.1. The representation of the image by a wide range of the available combinations of colors and shades, in addition to the limited visible gray levels, may improve the visual contrast sensitivity.

11.5.7.14.2. Several preset color charts, each consisting of 256 different colors for the full gray scale, will be available to be selected by the Image Analyst.

11.5.7.14.3. Dynamic Gray-Scale Manipulation will be available for the Pseudo-color feature as described above.

11.5.7.15. Special Features

The bidder will implement further image processing features to support the Image Analyst in detecting a large variety of contraband, *i.e.* weapons, explosives, drugs concealed in different types of goods.

11.5.7.16. Material discrimination – while scanning in material discrimination mode the system will have the ability to display, at least:

11.5.7.16.1. Density image (gray levels).

11.5.7.16.2. Image of both Organic and Inorganic materials in different colors

11.5.7.16.3. Image of only Organic materials Highlighted in Orange color

11.5.7.16.4. Image of Inorganic materials Highlighted in Blue color

11.5.7.16.5. High Energy Image (image created at high energy)

11.5.7.16.6. Low Energy Image (density image created at low energy)

11.5.7.16.7. All image processing functions (as defined above)) should work on the material discrimination image.

11.5.7.16.8. The proposal shall include description of:

- Material discrimination Software
- Reference image database
- Discrimination features of the proposed system:
  - Groups of materials discriminated (number and type: Organic, inorganic, light / heavy metals, unknown)

- Display features, color coding

11.5.7.17. Pre-set Image Processing - Bidder's set of preset image processing adapted for best visualization of the operator;

11.5.7.18. Image Comparison - loading a previously archived radiography images and data from Archive for comparison with currently analyzed image

11.5.7.19. Undo

11.5.7.19.1. Ability to return "one step" back of the image manipulation

11.5.7.19.2. Ability to the original scanned image by "one click"

11.5.7.20. Special Features- The bidder will implement further image processing features to support the Image Analyst as far as possible in detecting a large variety of contraband, *i.e.* weapons, explosives, drugs concealed in different types of goods

11.5.7.21. Print - ability to print the following:

11.5.7.21.1. Original scanned image

11.5.7.21.2. Processed image

11.5.7.21.3. Image displayed

11.5.7.21.4. All printing will include relevant details (date, time, analyzer's decision, etc.) and suspicious markings.

11.5.7.21.5. The proposal will include the possibility to view the images via portable tablets (tablets must be supplied by the bidder) and possibility for Laser color printer to print the images which are needed for manual inspection (will be supplied by the bidder).

11.5.7.22. Save

11.5.7.22.1. The System will have the capability to save scanned images to a specific folder, defined by user, or to an external media (flash drive etc.)

11.5.7.22.2. Images will be saved in a known file format without loss of information and will be able to be exported to known file format (JPG, BMP, etc.)

11.5.8. A detailed technical and functional description of the image processing features at the IAW, including the operating GUI, shall be submitted in the proposal.

11.5.9. The final design of the system, including the MMI will be subject to Client's approval at the Design Review meetings.

11.5.10. Data Display

11.5.10.1. General

11.5.10.1.1. Each IAW includes Data and Image displays and processing. The workstation will be connected to the SDMS.

11.5.10.1.2. Data Display comprises of two separate parts, each displayed separately:

- Radiography Computerized Data File (connected to Radiography site's systems)
- Customs Computerized Data (part of Customs main Database) – displayed on Customs computer (supplied by the Customer -not part of this tender)

11.5.10.1.3. The Radiography Computerized Data File of the object will be automatically transmitted to the Data Display Apparatus simultaneously with the transmission of the Radiography images to the Image Displays.

11.5.10.1.4. The radiography data file will be displayed on a 24" LCD/LED color monitor.

11.5.10.1.5. A user-friendly graphic Man Machine Interface will operate the Data Display and Processing equipment.

11.5.10.1.6. The Image Analyst operator will receive on the Data Displays a full and clear data containing all the relevant information on the scanned object and its contents. This information will include:

- Data scanned and keyed-in during the check-in process
- Additional data displayed in Customs Computer

The data will enable the operator to verify this information by comparing it with the real contents of the shipment/ object description, shown in the Radiographic image.

11.5.10.2. Validation area

11.5.10.2.1. The proposal will present detailed description for the application of the validation method consistent with the operational process and following the principles outlined hereafter.

11.5.10.2.2. At the end of the analysis process the Image operator will enter the result of his evaluation using a dialog box interface approach. When a graphic "Decision" button on the screen is clicked, a dialog box will show-up containing two graphic buttons:

- "Suspicious" (a symbol (X) in red)

- "Non-Suspicious" (symbol (√) in green)

11.5.10.2.3. "Non-Suspicious"

Clicking the Non-Suspicious button will activate a secondary dialog box containing the phrase:

- "Are you sure?" and two graphic buttons:
  - "Confirm".
  - "Cancel".

11.5.10.2.4. Confirming the non-suspicious decision will terminate the analysis process of that object and automatically initiate the following:

11.5.10.2.4.1. Reception of the next images and data pending in the queue on the IAW;

11.5.10.2.4.2. Traffic Control system (SDMS) will be automatically updated and notified that the vehicle is cleared and allowed to exit the site

11.5.10.2.5. In addition, the operator will update the Customs Computer regarding the results.

11.5.10.2.6. "Suspicious"

11.5.10.2.6.1. Clicking the "Suspicious" will open a dialog box that will enforce the image analyst to indicate the reason for suspicion. An active file will be displayed and the Image Analyst is required to select from a list of categories one representing the type or reason for suspicion, key-in a verbal description and/or comments, and reference to a specific marked area (free form).

11.5.10.2.6.2. After completing entry of the data necessary for further handling of the suspicious object, the Image Analyst will be able to terminate the process and to automatically initiate the reception of the next pending image for analysis.

11.5.10.2.6.3. Traffic control system (SDMS) will be updated and notified that the vehicle is suspicious and is not allowed to exit the site

11.5.10.2.6.4. In this case ("Suspicious"="Send to Manual"), the accumulated data of the suspicious vehicles will be transferred to the Image Analysis Workstation in the Pit area. The data, including a color hard copy printing of the image with the markings of the suspicious areas, will serve the inspectors at the manual inspection area to pursue the inspection and effectively allocate the suspicious items.

11.6. Standing type Manual Site Workstation (MSW)

11.6.1. The MS workstations: one (1) located at the manual inspection site; display all radiographic images that were defined as suspicious by the Image Analyzer. Based on these remarks the manual inspector / mechanics checks the object

11.6.2. Each workstation will include:

11.6.2.1. Image analyst workstation (IAW) as defined in this clause with adapted dialog box.

11.6.2.2. Driver's tag reader, SDMS workstation, PA system

11.6.3. At the end of the examination the Pit Inspector/mechanics, using the PSW, will enter inspection results using a dialog box interface approach.

11.6.4. The dialog box will show-up containing two graphic buttons (in Hebrew), for example:

- “Irregular" (a symbol (X) in red)
- “Clear” (symbol (√) in green)

11.6.4.1. "Clear"

11.6.4.1.1. Clicking the "Clear" button will activate a secondary confirmation dialog box containing the phrase:

- “Are you sure?” and two graphic buttons:
  - "Confirm".
  - "Cancel".

11.6.4.1.2. Confirming the "clear" decision will terminate the inspection process of that object and automatically initiate the following:

- Traffic control system (SDMS) will be updated and notified that the vehicle/car's status is "cleared" and it is allowed to exit the site.

11.6.4.1.3. The operator will update the Customs computer regarding the results.

11.6.4.1.4. Pit check results submitted will be recorded in addition to the Image Analyst decision and will not replace it.

11.6.4.2. “Irregular"

11.6.4.2.1. Clicking the “Irregular" will open an active file in which the Inspector is required to type for the findings, key-in in freeform a verbal description and/or comments.

11.6.4.2.2. After completing entry of the data necessary for further handling of the object, the Inspector will be able to terminate the process.

11.6.4.2.3. Traffic control system (SDMS) will be updated and notified that the vehicle is not allowed to exit the site (the bidder must make sure that the software he provides has complete capability to interconnect to the SDMS system).

11.6.4.2.4. The operator will update the Customs computer regarding the results.

11.6.5. The data workstation will also serve as an interface for the Image Processing command and control subsystem, which will be managed by the Image Analyst during his assignment to the IAW (password, authorization, start, brake, etc.).

11.6.6. The final configuration of the dialog boxes will be defined by the customer at System Design Review.

11.7. Archive

11.7.1. The Archive module designated for storing all images, and its linked data, which were produced as result of site's inspections, will be detailed in Bidder's proposal.

The Archive database is required to afford:

- Future analysis and / or for future investigation purposes
- Comparison of real-time images and vehicles data to previously inspected similar vehicles;
- Statistics of system and operators performance

11.7.2. The proposal will include a detailed functional and technical description of the archive module hardware and software, with reference to the following issues.

11.7.3. The data base of the stored files for each inspected vehicles shall include, at least, the following:

- The raw (pre-processed) radiography image;
- The data file of the vehicle
- Inspection data: Analyzer's name
- Final Processed Image – the result of operator’s processing, initiated by the operator;
- Log file of Image Analyzer’s operations;

11.7.4. The archive subsystem will provide capabilities for storage, search, load, organization, export and retrieving data with extensive data capacities, taking into

consideration the actual system throughput, the requested duty cycle, and the expected volumes.

11.7.5. Search, export and report capabilities

11.7.5.1. The proposal will present system search capabilities and a detailed description of reports formation (defining report format, keywords, parameters, etc.)

11.7.5.2. This shall include search according to a large variety of keywords and parameters, for example at least the following:

- Inspection date, period
- Analyst name,
- Vehicle ID,
- Vehicle type,
- Customs ID,
- Driver name
- Owner of car name

The final parameters will be defined by the customer at System Design Review.

11.7.5.3. Data exporting: methods for extracting and publishing stored images/data using standard image formats (jpg, bmp, etc.) and methods for evacuating storage space will be detailed (in accordance with the IT specification of the ITA).

11.7.6. The archive system will include an option for an analyst-training tool, adaptable by the user on request.

11.7.7. The archive system will include an option to send vehicle's file (data and images) to a customer through the internet network; the specifications depend on the field of application and will have to be adjusted accordingly.

11.7.8. The bidder will submit a full and detailed functional and technical description of the proposed archive system including hardware, software, administration, performance and all other items.

11.7.9. The archive volume must support at least one (1) year of operations.

11.7.10. The archive system will include:

11.7.10.1. Storage unavailability warning

11.7.10.2. Routine for transferring the data to a removable storage device and freeing up active storage space

11.7.10.3. Internal HD with one (1) year storage capability

11.7.10.4. External HD with one (1) year storage capability

11.7.11. The system must include data backup function, including periodic back-up reminders.

11.8. Automatic Threat Image Projection – Option -the system will automatically alert to suspicious objects

12.Computerized Training System for Image Analysts

12.1. Training of Image Analysts is crucial since the Radiography scanning system can only be as effective as the level and skill of its Image Analysts.

12.2. The computerized training System, installed as a standalone WS, should expose the trainee to a large variety of vehicle images with and without a threat objects.

12.3. The system shall include a large variety of interactive lessons and tests designed to gradually upgrade the Image Analyst's skill. It will also enable an instructor to test and monitor the analyst's progress.

12.4. The system will be designed as an "open system" capable of adapting to any specific application. For that purpose it will be possible to input new images, update the image database, and prepare new lessons and tests.

12.5. The system will have the capability to load raw images from an external media (USB, Ext. HD)

12.6. The bidder will submit a full and detailed functional and technical description of the Training system, including hardware, software, administration, performance etc.

13.System Access authorization

13.1. The system will have protection against viruses, spywares and malwares.

13.2. The system computers will not have remote access capability (see Annex A.).

13.3. The system shall include three defined access authorization levels - user, administrator and technician.

13.4. User Level

13.4.1. The system shall allow users to run only applications required for system operations, including archive system applications.

13.4.2. The system files and operating system shall be protected against alternations and deletions.

13.4.3. The user will not be authorized to copy or install any other software on the system.

13.4.4. Log-in shall be associated with user's name or ID number. The system shall allow multiple log-ins, with each user assigned a separate personal log-in and password.

13.4.5. The Image Analyst's decision and Pit Inspector's findings will be documented with their names/id which will be saved with the vehicle record, available for retrieval, if and when necessary.

13.5. Administrator Level

13.5.1. The Administrator level shall include all user level access authorizations.

13.5.2. Additionally, the administrator shall have access to:

- CD/DVD Burner
- Screening logs
- Managing user data base/authorizations
- Viewing system parameters
- Other authorizations, as decided by ITA/Customs.

13.5.3. The administrator will NOT be authorized to:

- Alter system parameters
- Alter/delete system files
- Copy or install any other software

13.6. Technician Level will have all levels of access.

13.7. In case the operating system software (such as Windows, UNIX etc.) version is not supported anymore, the vendor is obliged to upgrade the operating system to a newer version and accordingly the scanner software without cost.

14.Stand-alone software

14.1. The vendor will supply 2 sets of stand-alone image analyzer work station software for the purpose of self-training or for instructor demonstration.

14.2. The stand-alone software will be completely identical to the system software.

14.3. In case of system software upgrading, the vendor will supply identical updated stand-alone software and hardware upgrades without any added cost.

14.4. The software will have the capability to load raw images from an external media (USB, External HD).

15.Reliability and availability

15.1. Radiographic System availability will be 95%.

15.2. The duty cycle of the facility will be as follows: 24 [hours/day], 7 days a week.

15.3. System Mean Time between Failures should be minimal in order to provide high reliability. The Contractor must include in the proposal statistical data of the proposed radiography system MTBF.

B. Radiographic Imaging Performance Tests

1. General

1.1. Radiographic System Performance is defined as the quality of the Radiographic imaging displayed on the IAW image screens. These results from the individual performance qualities of the various subsystems: the X-Ray radiation subsystem, the X-Ray detectors, scan stability, data acquisition and processing electronics, computing and the images processing systems.

1.2. This section defines both the imaging performance of the system and the methods used to measure them.

1.3. The performance, the tools and test methodology described here are the only one effective for this project. All evaluation tests; the Verification tests, the Factory Acceptance Tests (FAT), the Preliminary Acceptance Test (prior to Training session) and the Final Acceptance Test, will be performed according to the Test Tools and Test Methodology detailed hereby.

1.4. The test results will be determined according to the common human observation capability of the screened test tools on the displayed image.

1.5. All image processing features available for real-time processing and manipulation of the image at the IAW may be used in determining the test results.

1.6. Scan Velocity

1.6.1. Test measurements will be performed at system's nominal scan velocity: 12 [m/min] (0.2 [m/sec])

2. Ultimate Penetration

2.1. The definition of Ultimate Penetration for this tender will be: The maximum stainless steel (Type 300 series) clutter thickness through which a totally absorbing object can still be visible.

2.2. The Ultimate Penetration performance parameter represents the feasibility limit of the radiographic imaging of the system.

2.3. Test Tools for measuring the Ultimate Penetration

The Test Tool for measuring the Ultimate Penetration will consist of two parts:

2.3.1. Clutter

The clutter substance will comprise a series of stainless steel plates (Type 300 series) 600x600 [mm^2] and 20; 10; 5 [mm] thick. The required specific clutter thickness will be achieved by combining steel plates with the cumulative thickness required for the measurement.

2.3.2. Target

2.3.3. The target object for this measurement will be a lead brick 50x100x200 [mm^3].

2.4. Measurement Protocol for Ultimate Penetration

2.4.1. The Penetration will be measured by scanning the target against clutter thicknesses as written in the table of performance.

2.4.2. The target will be considered visible if 30% of it or more is observed when the displayed image is examined on screen utilizing the various image processing features.

2.4.3. Positioning the Test Tool

2.4.4. The Target lead brick will be affixed lengthwise and diagonally to the clutter steel plates.

2.4.5. The Target will be placed on the source side of the clutter steel plates.

2.4.6. In each of the measuring spots described below, the Test Tool will be positioned so that the plane of the Test Tool will be perpendicular to the radiation beam.

2.4.7. The ultimate penetration will be measured in the following nine (9) positions (see Fig. 1):

a. At the point at which the top (roof) at the side wall of the vehicle is located during normal inspection of the vehicle.
b. At the point at which the top (roof) of the height at the center top wall of the vehicle is located during normal inspection of the vehicle.
c. At the point at which the top (roof) at the side of the vehicle is located during normal inspection of the vehicle.
d. At the point at which the middle of the height of the side of the vehicle is located during normal inspection of the vehicle.
e. At the point at which the middle of the height at the center of the vehicle is located during normal inspection of the vehicle.

f. At the point at which the middle of the height of the side of the vehicle is located during normal inspection of the vehicle.
g. At the point at which the bottom at the detector side wall of the vehicle is located during normal inspection of the vehicle.
h. At the point at which the middle of the bottom at the detector side wall of the vehicle is located during normal inspection of the vehicle.
i. At the point at which the middle of the bottom at the detector side wall of the vehicle is located during normal inspection of the vehicle.

2.5. The minimum required performances for this project are defined in the following paragraph.

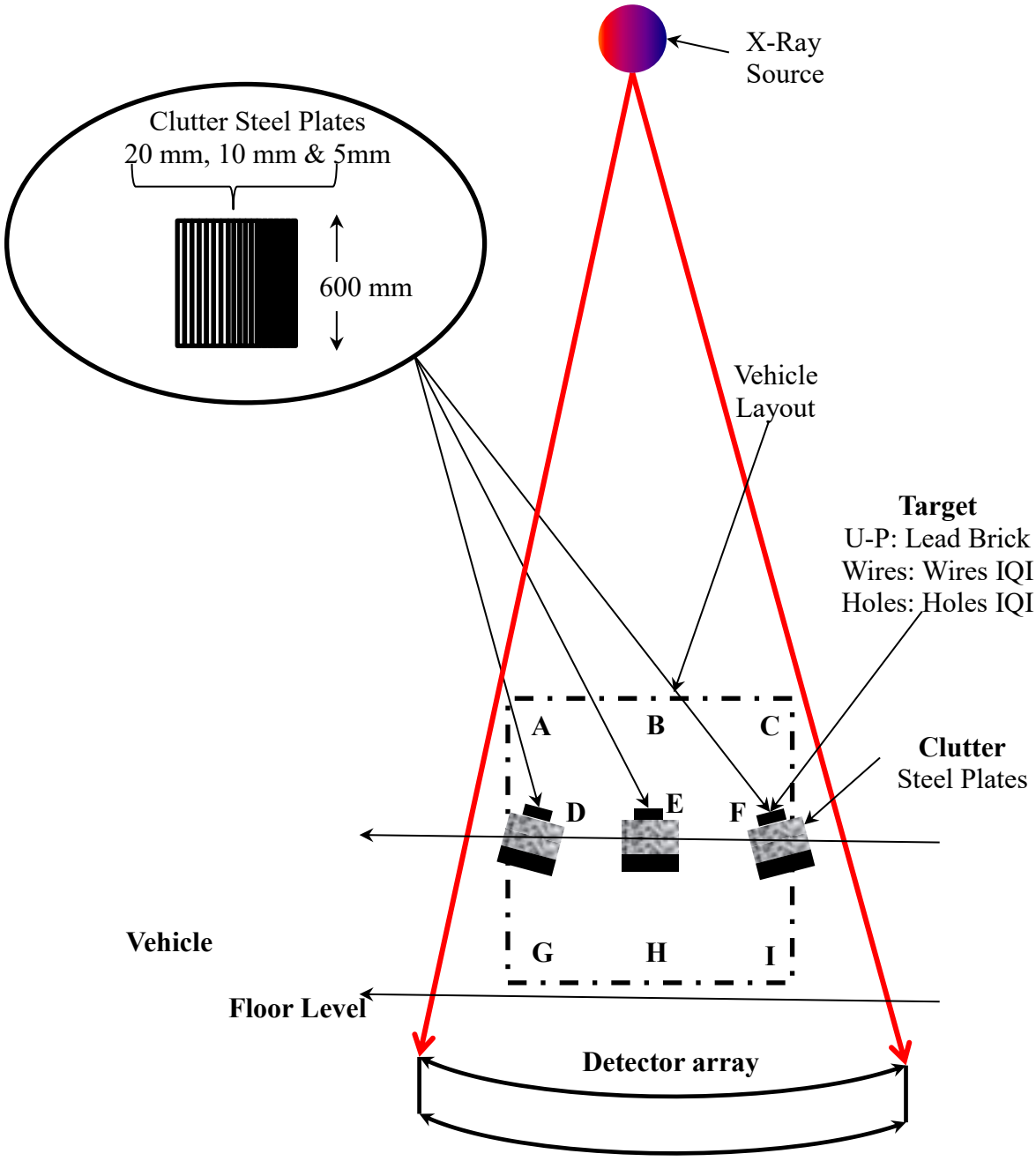


Fig. 1: Schema for the nine (9) (A-I) ultimate penetration positions. D, E and F show an example of where the Clutter steel plates and lead brick are positioned.

3. Wire Image Quality Indicator

3.1. The Wire Image Quality Indicators will be used for evaluation of the contrast sensitivity and spatial resolution of the radiographic imaging of the system.

3.2. The Wire Image Quality Indicator will be defined for this SOW as the ratio between the diameter of the thinnest stainless steel wire (Type 300 series) visible and the thickness of a cluttering stainless steel substance (Type 300 series). The Wire Image Quality Indicator will be expressed in percentage values.

3.3. The Image Quality Indicator values (in %) will be measured for the following stainless steel (Type 300 series) cluttering thickness: 50 [mm]; 100 [mm]; 150 [mm]; 200 [mm]; 250 [mm].

3.4. The Image Quality Indicator values will be measured at locations a-i as described above. The Image Quality Indicator values will be measured for a matrix of operating modes available for the operator.

3.5. Description of the Wire Image Quality Indicators

3.5.1. The Wire Image Quality Indicators will comprise a series of cylindrical steel wires (Type 300 series stainless steel) affixed to a steel plate (Type 300 series stainless steel) 600 by 600 [mm] in size and 10 [mm] thick.

3.5.2. The wires shall be arranged along the width of the steel plate (width-wise), in an order of increasing diameter, 30 [mm] apart from each the other, forming three sinusoidal curves. The wire diameters will be an expanding series; the specific values for the wire diameters will be in accordance with the expected performance of the system.

3.5.3. The clutter substance used for measuring the Wire Image Quality will comprise a series of stainless steel plates (Type 300 series) 600x600 [mm^2] 20; 10; 5 [mm] thick. The specific clutter thickness required would be achieved by combining steel plates with the cumulative thickness required for the measurement.

3.6. Positioning of the Wire Image Quality Indicators

3.6.1. The Wire Image Quality Indicators will be attached in the plane of the Clutter steel plates.

3.6.2. The Wire Image Quality Indicators will be placed on the source side of the Clutter steel plates.

3.6.3. In each of the measuring spots which are described below, the Wire Image Quality Indicators will positioned so that the plane of the Indicators will be perpendicular to the radiation beam.

3.6.4. Positioning of the Wire Image Quality Indicators on a supporting block is acceptable, provided shims are placed under the Indicators. The shims shall exceed the Indicator's dimensions so that the outline of at least three sides of the Indicators image shall be visible on the Radiography image. The supporting block and shims shall be positioned so as not to overlap the Indicators on the Radiography image.

3.6.5. The Image Quality Indicator values will be measured in nine (9) spots as described above.

4. Hole-Type Image Quality Indicators

4.1. The Hole-Type Image Quality Indicators will be used to evaluate the Radiographic Imaging System quality.

4.2. The image quality levels will be designated by a two-part expression X-YT. The first part of the expression X refers to the IQI thickness expressed as the percentage of the clutter specimen thickness. The second part of the expression YT refers to the diameter of the hole and is expressed as a multiple of the IQI thickness, T.

4.3. The Hole-Type Image Quality Indicator values (in X-YT) will be measured for the following stainless steel (Type 300 series) cluttering thickness: 50 [mm]; 100 [mm]; 150 [mm]; 200 [mm]; 250 [mm].

4.4. The Hole-Type Image Quality Indicator values will be measured at locations a-i as described above. The Image Quality Indicator values will be measured for a matrix of operating modes available for the operator.

4.5. Hole-Type Image Quality Indicators description

4.5.1. Hole-Type Image Quality Indicator will be designed and manufactured in accordance with the guidelines of the ASTM standard E 1025 latest edition: "Standard Practice for Planning, Manufacture, and Material Grouping Classification of Hole-Type Image Quality Indicators (IQI) Used for Radiology.

4.5.2. The Hole-Type Image Quality Indicator will be fabricated of stainless steel (Type 300 series).

4.6. Positioning of the Hole-Type Image Quality Indicators

4.6.1. The Hole-Type Quality Indicators will be attached parallel to the plane of the Clutter steel plate.

4.6.2. The Hole-Type Image Quality Indicators will be placed on the source side of the Clutter steel plates.

4.6.3. In each of the measuring spots which will be described here, the Hole-Type Image Quality Indicators will be positioned so that the plane of the Indicators will be perpendicular to the radiation beam.

4.6.4. Positioning of the Hole-Type Image Quality Indicators on a supporting block is acceptable, provided shims are placed under the Indicators. The shims shall exceed the Indicator's dimensions so that the outline of at least three sides of the Indicator's image shall be visible on the Radiography image. The supporting block and shims shall be positioned so as not to overlap the Indicators on the Radiography image.

4.6.5. The Image Quality Indicator values will be measured in 9 spots as described above.

5. Test Device

5.1. As specified, the following tools are required in order to perform each one of the defined tests:

5.1.1. Stainless Steel Plates – to serve as clutter - provided by the bidder

5.1.2. Test tools: lead brick (provided by the bidder), wires and holes (provided by the bidder)

5.1.3. Test Device – a support, designed for positioning the defined test tools in the required 9 locations (a-i) at the desired angle (provided by the bidder)

5.2. Supply of one Test Device, the Clutter Plates, and the lead brick is part of this project.

5.3. Test Device Description.

5.3.1. The Test Device will be used to hold the clutter and test-tools in the correct angle so the clutter plates are perpendicular to the radiation. The angle will be varied according to the positioning of the device in each of the required 9 locations (a-i).

5.3.2. It should be possible to position the clutter and test-tools at heights corresponding to the required 9 locations (a-i).

To achieve the desired height, either

a. The device should have its own ability to reach the desired heights, or
b. The device will be designed to be lifted by a standard forklift (or any other standard leverage tool) to the desired height.

5.3.3. The Test Device will enable an easy removal and insertion of clutter plates between scans.

5.3.4. The Test Device will enable viewing the whole surface with no scattering.

5.3.5. In order to optimize testing time, it should be possible to position two (2) sets of clutter + test-tools, side-by-side (each one of at least 300x400 [mm]). In that way clutter will be removed from one pile and added to the other pile, thus performing two tests in each scan.

5.3.6. Supply of Stainless Steel clutter plates (Type 300 series) in the above dimensions, 20 [mm] and 10 [mm] thick and (at least) two (2) 5 [mm] thick, (total 170 [mm]) designed to be used in the Test Device, is part of this project.

5.3.7. Supply of the lead brick, 50x100x200 [mm^3] is part of this project.

5.4. The Supplier will submit the Test Device design drawings and operating method as an integral part of its proposal.

5.5. Test Device Description.

6. Material Discrimination

6.1. General

The purpose of these tests is to present the system capability of material discrimination *i.e.* to display organic materials and inorganic materials in different colors.

6.1.1. The Bidder's proposal shall include detailed description of material discrimination feature, including the proposed test methodology, test device and the expected results.

6.2. Material discrimination tests comprise of two parts:

- Basic tests
- Operational tests

6.3. Basic Test device - Material Discrimination tests

6.3.1.1. The Bidder's proposal shall include detailed description of

- Material discrimination tests methodology.
- Tests Device (dimensions, materials).
- Test protocol proposed by the bidder.
- Expected results

6.3.1.2. The basic test device may be based on 2 sets of "steps" only.

6.3.1.3. Testing of a system that is capable to present three or more classes of materials a 3rd and 4th set of steps is required.

6.3.1.4. Each set should have 4 steps.

6.3.1.5. Each step should have Surface area of 12.5 [cm] x 12.5 [cm], which will be positioned perpendicular to the X-Ray beam.

6.3.1.6. The Thickness of each step is the distance that the X-Ray beam needs to pass through the material.

6.3.1.7. The cumulative density of all 4 steps in each one of the sets will be the same and will equal to: material density ([g/cm^3]) x thickness ([cm]).

6.3.1.8. Example of dimension and materials of the required sets:

Set	Material	Density [g/cm3]	Thickness of steps ([cm])			
			Step 1	Step 2	Step 3	Step 4
1	Graphite (Organic)	1.87	10.7	21.4	32.1	42.8

2	Aluminum (Intermediate)	2.70	7.4	14.8	22.2	29.6
3	Iron (Inorganic)	7.80	2.6	5.2	7.7	10.3
	Cumulative Density		20	40	60	80

6.3.1.9. In case that the supplier is using different materials with different densities the proposal will include the appropriate calculations.

6.3.1.10. The proposal should include the test device design and dimensions.

6.3.2. Tests methodology

6.3.2.1. The test will be done in all of the previously defined 9 test points (a-i)

6.3.2.2. In each test point the device should be positioned in an angle that will make it perpendicular to the X-Ray beam.

6.3.2.3. The steps should be designed and positioned in the device in a way that will prevent shading of one part on another in all the test points.

6.3.3. Required results

6.3.3.1. The organic materials steps should be colored in shades of orange/brown

6.3.3.2. The inorganic material steps should be colored in shades of blue.

6.3.3.3. While looking on the same scanned image without material discrimination manipulation, all sets of steps will look at the same shades of gray

6.3.4. The test device including the sets of steps is part of the scope of supply for this project.

6.3.5. Testing the performance of system's basic material discrimination features will be detailed in Bidder's proposal.

The description will refer to the following subjects:

6.3.5.1. Test tools

- Definition of standards
- Definition of test samples: type, number of samples, each sample's material and size (width, length, thickness)
- Device for positioning the test samples

6.3.5.2. Results evaluation

Results evaluation method will be described, including:

- Characterization of the clutter (type, size, location and parameters) that will be used to test material discrimination
- Accuracy of testing

6.3.5.3. Test Protocol

6.3.5.4. Detailed test protocol will be submitted for approval, including statistical evaluation of system's performance.

6.4. Operational Material Discrimination Tests

6.4.1. System material discrimination performance shall be also defined according to system capability in detecting and discriminating simulated organic bricks, of predefined size, positioned in the vehicle volume and in front / behind a steel/ organic clutter as defined in this document.

6.4.1.1. The following objects shall be required to present the discrimination capabilities:

a. Target - bricks simulating organic material
b. Clutter - Steel plates
c. Organic Clutter (Delrin/Water tank)

6.4.1.2. Test Target

6.4.1.2.1. Material– As a simulant of Explosive/Drug (organic) Delrin plastic can be used.

6.4.1.2.2. Brick Size

a. Standard: 10x10x10 [cm]
b. Special: 10x10x L [cm], L- defined by the Bidder

6.4.1.3. Test methodology

The test comprises of three parts:

6.4.1.3.1. Part 1: Free brick - Screening the target bricks (no clutter) in the vehicle's volume.

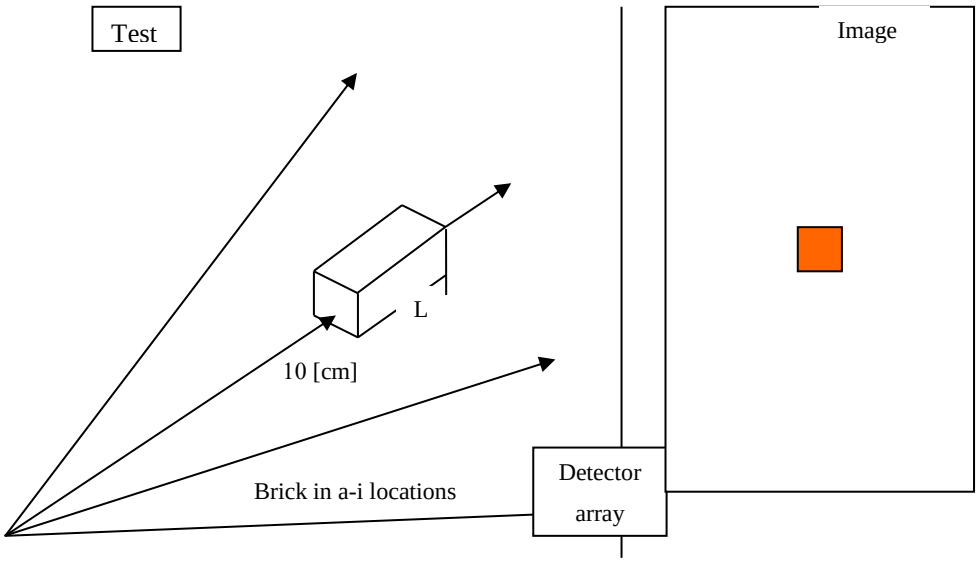
6.4.1.3.2. Part 2: Organic brick behind steel Clutter - Screening the target brick positioned behind a clutter of X [cm] of steel plates.

6.4.1.3.3. Part 3: Steel behind organic Clutter - Imaging steel plates, width Y ([cm]) positioned behind large organic clutter.

6.4.1.4. Operational Test - Part 1

6.4.1.4.1. In that part the target bricks will be positioned, with no clutter, at locations a-i. (See drawing MD1)

6.4.1.4.2. The Contractor shall specify the minimal and maximal L value that results in declaring the brick as "organic".



Drawing MD 1: Schematic presentation of tests to define the minimal/maximal size (L) of organic brick

6.4.1.5.Operational Tests - Part 2

6.4.1.5.1. That part is designated to define the maximal (X [cm]) steel clutter behind which the organic brick can still be discriminated as "organic".

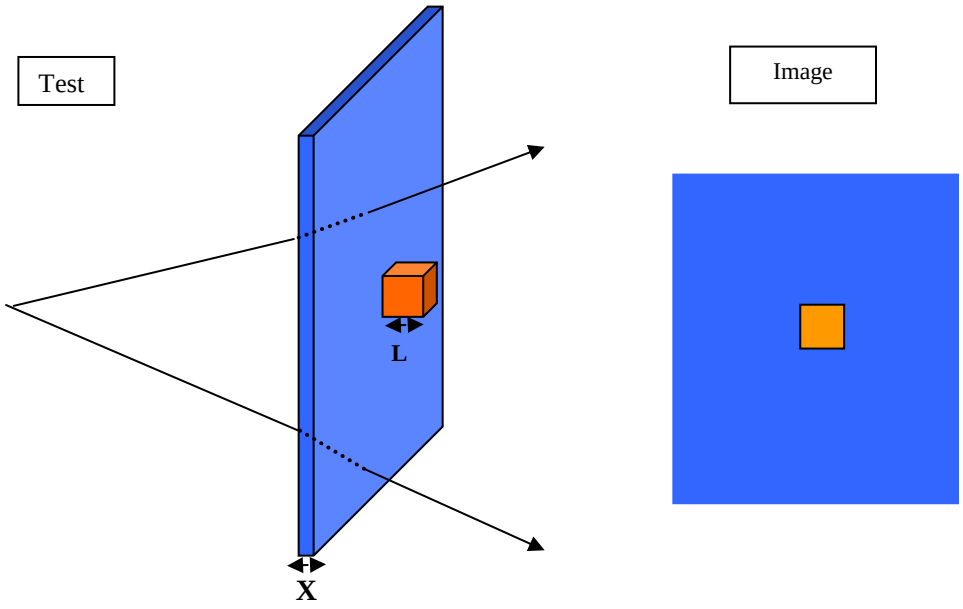
6.4.1.5.2. The test comprises of imaging one organic brick (brick's size: 10x10x10 [cm^3] or 10x10xL [cm^3], if Bidder's minimal L is greater than 10 [cm]) behind X [cm] of steel plates (as in penetration tests).

6.4.1.5.3. The test will be performed in the following three locations: a, b, c

6.4.1.5.4. The screened Image should display both "organic" part and "metal" part.

6.4.1.5.5. By adding steel plates until the brick area cannot be defined as "organic" the maximal value of X is defined.

6.4.1.5.6. The Contractor shall specify the maximal X value of stainless steel that results in declaring the plates' area as "metal" and brick area as "organic".



Drawing MD 2: Schematic presentation of tests to define the maximal size (X) of Inorganic Clutter

6.4.1.6. Operational Tests - Part 3

6.4.1.6.1. That part is designated to define the maximal (Y [cm]) organic clutter that still can discriminate one steel plate positioned behind it.

6.4.1.6.2. The test comprises of imaging one steel plate behind organic Clutter (water/Delrin).

- Clutter dimensions: 60x60xY [cm^3]
- Steel plate dimensions: 25x25x2 [cm^3]

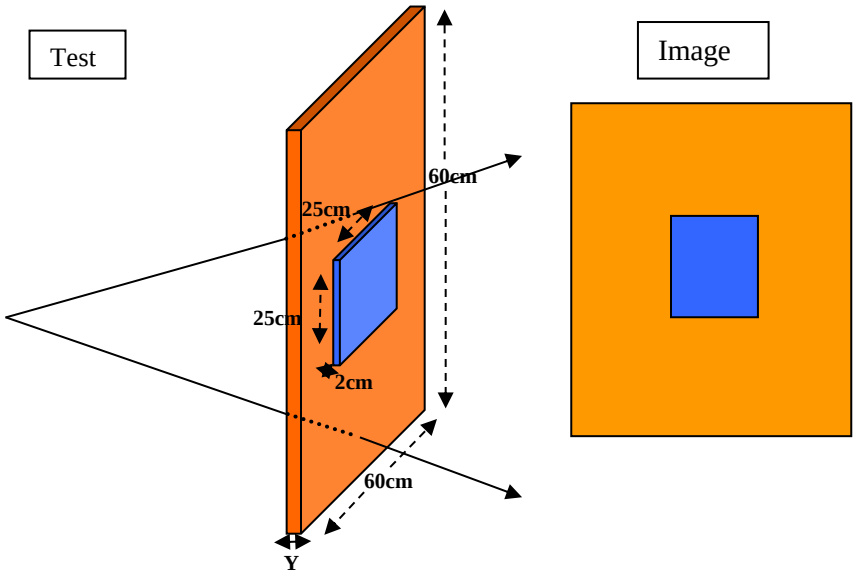
6.4.1.6.3. The tests will be performed in the following three locations

- a, b, c

6.4.1.6.4. The screened Image should display both "organic" part and "metal" part.

6.4.1.6.5. By adding organic clutter until the steel plate area cannot be defined as "metal" surrounded by "organic" - the maximal value of Y is defined.

6.4.1.6.6. The Contractor shall specify the maximal Y value of organic clutter that results in declaring the plates' area as "metal" and clutter as "organic".



Drawing MD 3: Schematic presentation of tests to define the maximal size (Y) of Organic Clutter

6.4.1.7.Test results

The Bidder shall submit the following tests results regarding material discrimination capabilities for each of the systems:

6.4.1.7.1. Minimal and Maximal dimensions of brick's length (L) to be displayed as of organic material in the free brick test;

Position	a	b	c	d	e	f	g	h	i
L_{min}									
L_{max}									

6.4.1.7.2. X maximal dimension of steel plates still displaying the organic brick as "organic"

6.4.1.7.3. Y maximal dimension of organic clutter still displaying the metal plate as "metal";

Position	a	b	c
X ([cm])			
Y ([cm])			

C. Radiographic System Performance

1. Minimal requirements

The System Minimum Performance will be expressed in the previously defined parameters: Ultimate Penetration, Resolution, Contrast and Throughput, Material Discrimination.

1.1. Ultimate Penetration

1.1.1. The Ultimate Penetration will be at least 160 [mm] at least, at three positions out of the defined 9 positions, measured at scan velocity of 12 [m/min].

1.1.2. The Ultimate Penetration will be at least 130 [mm] at each of the defined 9 positions, measured at scan velocity of 12 [m/min].

1.2. Resolution

1.2.1. Wire resolution, when measured at the middle of the vehicle at height corresponding to the center of the beam (best position) will be at least:

- 2.5% for 50 [mm] clutter (1.25 [mm] wire behind 50 [mm])
- 2.5% for 100 [mm] clutter (2.5 [mm] wire behind 100 [mm])

1.3. Throughput

1.3.1. The systems contrast shall be no more than 3% behind 50 [mm] Stainless Steel. The Radiography system manufacturer will declare the contrast quality of the system by using Hole-Type Image Quality Indicators (IQI) indicators in accordance with the guidelines of the ASTM standard E 1025 latest edition: “Standard Practice for Planning, Manufacture, and Material Grouping Classification of Hole-Type Image Quality Indicators (IQI) Used for Radiology.

1.4. Throughput

The Radiography system will be able to inspect, at least, 20 [vehicles/hour].

2. System Performance – Periodical tests

2.1. In order to maintain system performance during operational period the contractor shall test the radiographic performance each year, as part of the service and maintenance routine. Upon tests results the contractor shall modify/fine-tune the system to achieve the required performance and all tests results shall be archived.

2.2. These tests, performed according to the procedures described in this document and using the approved test means and test device, shall also be performed following any major change/repair/adjustment of the system.

2.3. A client's representative can accompany the aforementioned procedures at any time.

2.4. The tests results will be submitted to the client when needed.

3. Bidder's Declaration - System Performance - Obligatory

3.1. The bidder is requested to submit the following table, referring to system performance, expressed in the previously defined parameters, for each of the systems.

Measure \ Location	a	b	c	d	e	f	g	h	i
1. Ultimate Penetration (in [mm])									
2. Wire Image Quality Indicator (%):									
a. Behind 10 [mm] of steel									
b. Behind 25 [mm] of steel									
c. Behind 50 [mm] of steel									
d. Behind 100 [mm] of steel									
e. Behind 120 [mm] of steel									
f. Behind 140 [mm] of steel									
g. Behind 160 [mm] of steel									
3. Hole-type Image Quality Indicator (%):									
a. Behind 10 [mm] of steel									
b. Behind 25 [mm] of steel									
c. Behind 50 [mm] of steel									
d. Behind 100 [mm] of steel									
e. Behind 120 [mm] of steel									
f. Behind 140 [mm] of steel									
g. Behind 160 [mm] of steel									

3.2. Material Discrimination Performance

Bidder declaration, regarding material discrimination capability will be defined for each of the systems at the following:

Position	a	b	c	d	e	f	g	h	i
Basic									
L_{min}									

L_{max}									
Operational									
X									
Y									

D. The Radiation Safety System

1. The Radiography installation shall include an autonomous and exclusive system designated to ensure the safety in and around the X-Ray facility in the site. The radiation safety system will ensure prevention of any danger or injury to the health of personnel working at the site, to drivers, visitors or to the surroundings as a result of the radiation used at the installation.
2. The installations shall meet all the requirements concerning radiation safety which are in force in Israel under any law, regulations, orders or procedures relating to setting up radiation installations, handling Radiation Devices, preventing environmental damage, environmental monitoring of personnel working with ionized radiation and the safety and health regulations for personnel working with ionized radiation.
3. The installation shall meet all the requirements concerning Noise regulation, EM as well as RF radiation, which are in force in Israel under any law, regulations, orders or procedures relating to setting up installations, handling radiation devices, preventing environmental damage, environmental monitoring of personnel working with ionized radiation and the safety and health regulations for site personnel
4. The Bidder will submit an overall safety plan, which shall include a survey of risks and a plan of the means and procedures designed to ensure the required level of safety.
5. After its approval by all authorized bodies in Israel the safety plan will become the certified obligatory safety plan.
6. The Client shall be entitled to demand any change or addition to the safety plan or the safety means if it should seem to him important and necessary for ensuring the prevention of health risks to personnel working at the installations, to visitors or to the environment.
7. The Supplier shall be responsible for arranging all inspections required in Israel under the law in order to obtain all necessary approvals and permits required according to any law for setting up radiation installations, dealing with Radiation

Devices, for operation and installation of radiation devices to ensure the prevention of damage to the environment and to ensure the safety of personnel.

8. The complete implementation of all parts of the radiation safety plan is a critical, mandatory condition for operating the Radiography Installation for the purpose of performing the Acceptance Test.

9. Without prejudice to the general statement aforesaid and in addition to it, the safety measures will ensure the following:

9.1 The system will provide permanent radiation protection for everyone at all times.

9.2 Two types of zones shall be defined in the installation and in its surroundings:

9.2.1 Restricted area: zone exposed to radiation.

9.2.2 A zone protected from radiation.

9.3 The restricted area

9.3.1 The restricted area: a zone exposed to radiation, shall be limited to the Radiography screening tunnel (including rooms with the X-Ray emission subsystems accelerators and collimators and electronics rooms: X-Ray Detection). The Bidder shall clearly describe the dimensions of this restricted area.

9.3.2 The radiation - exposed zone will be shielded by permanent means (reinforced concrete walls, lead, steel or other for the shielding doors), that will ensure the shielding of the exterior of the restricted area.

9.4 The radiation protected area

9.4.1 Any part of radiation protected area cannot be a restricted area.

9.4.2 Areas adjacent to radiation shielding means (external to walls/doors) will be part of radiation protected area and not a part of the restricted area.

9.4.3 All areas, rooms, systems and installations required for the operation of the Radiography Installation, including Operators' and Image analysis room and /or stations will be in the radiation protected zone: fully protected where no additional precautions are necessary.

9.4.4 All openings and approaches to the zone exposed to radiation will be permanently closed and locked (also the doors of the Radiography screening tunnel which will open and close automatically during the inspection cycle).

9.5 All openings and approaches to the radiation zones will be safe-guarded by an Interlock System. The Interlock System will operate at all times even when the Radiography installations are not operating. Opening an aperture whatsoever at any time, shall result in indications displayed on System Operator's workstation. Radiography system activation will be enabled only after safety confirmation of the operator of the radiography installations.

9.6 CCTV-R (CCTV in the radiography screening tunnel)

The screening tunnel and connecting adjacent areas will be surveyed at all times by a CCTV system. The CCTV-R system shall be designed and deployed as part of the radiography system safety devices (and not as part of site's CCTV subsystem), completely separated from the site CCTV, implying its intact operation is a compulsory required precondition for any authorization of operation of the radiography system. Also, the specifications for the Automatic Camera detection system of people is described in Annex B.

9.7 Using hardware only, the Interlock System will prevent the operation of the Radiography System when any opening leading to the radiation - exposed zone is open. The system will immediately stop the operation of the radiation source when the said opening is opened during radiation source operation.

9.8 The X-Ray safety system will insure safe access to and in the restricted area using, in addition to the CCTV system, the following elements:

- Emergency stops
- Emergency stop pull-cords
- Sensors (for external doors)
- Warning lights
- Sirens
- Door interlock (switch)
- Beacons for X-Ray measure, with automatic siren;
- Service switch.
- Automatic Camera detection system for people as described in Annex B.

9.9 The above elements will be connected to Radiation Safety System Controller. The controller will gather all safety information and accordingly authorizes or not the

functioning of the X-Ray. Controller output will be graphically displayed at the following positions;

- Radiography Operator consoles
- Shift supervisor (at the Radiography building)
- Building external

9.10 The permitted dose of radiation (following the known updated) in the protected zone will not exceed (half) **0.5 [µSv/h] (0.05 [mR/h])** at any point, at a distance of 10 [cm] from the installation (wall/door). Maximum Dose Rate in Operators working area or in the environment will not exceed **0.5 [µSv/h]**. The measurement shall be taken during normal operation of the installation during X-Ray irradiation of a full vehicle by source operating at maximum capacity. It is emphasized that these values are the known values at the time this document is prepared and that it's the Bidder responsibility to clarify and validate the method of measuring as well as the permitted values with the Israeli authorities.

9.11 The Maximum Absorbed Dose per inspection will be less than **10 [mRad] ([100 µGy])** measured at center of the testing position.

9.12 In all parts of the zone exposed to radiation, audio and visual warnings will be installed which will give warning of a radiation system on Stand-by mode and/or of emission of radiation. The coverage level of these warnings will be 100%.

9.13 In all areas exposed to radiation, emergency cutouts will be installed. These cutouts, operated by hardware alone, will immediately stop the emission of the radiation source.

9.14 In all areas exposed to radiation, an intercom system will be installed to enable contact with the system operator of the Radiography installations.

9.15 Doors (apart from the external door to the Radiography screening tunnel used by vehicles) shall be equipped with special locks, each with only one key to open it. No “master” keys for these doors will be allowed on the installation. The doors shall be opened from the outside only by this key. The doors may be opened from the inside by means of an emergency (panic) lock. It will not be possible to slam the door shut without the key.

10. Bidder's proposal shall include a detailed description of all safety measures taken in order to ensure the safety of everyone in the site.

List of Drawings:

143-07-01-01

Appendix B.

Technical specification for the person detection system in the radiography tunnel

Following several incidents of scanning a person who remained in the radiation zone in the various radiography complexes in Israel, a directive was received from the Ministry of Environmental Quality in Israel, according to which the systems must include a component of locating people in the radiography tunnel.

These specifications come to clarify the technical specifications of the system for identifying a person in the radiography tunnel, for the benefit of prevention operating the system on a person and for the benefit of compliance with radiation safety requirements.

The purpose of the appendix is to present the specifications of the system and how it is integrated into the set of radiation safety measures which are activated in the radiography system.

1.1 The purpose of the Video Analytics (VA) system - locating a person in the radiography complex based on Optical analytical identification, receiving an indication (audio and visual alert) of detection in accordance with and subject to the settings as detailed in the future and preventing a person from being mirrored.

1.1.1 The VA system will analyze the image coming from the cameras as part of the dedicated TMS system to be fixed.

1.1.2 The control and programming of the system will be fully possible from the position of the operator of the radiography system. Any change in the predetermined and

defined parameters will be carried out by a technician or a person who has access privileges and approval for that.

1.1.3 The system will work all the time, continuously, and without breaks if the radiography system is on. Breaks of field learning will not exceed more than one second. The system will mark the study time on the screen as well as in the log of the system.

1.1.4 The system will maintain all its features, including detection percentages, for its entire lifetime (at least 10 years), and without any decrease in performance.

1.1.5 The system is required to be modular so that cameras can be added.

1.1.6 The system is a VA system for outdoor and indoor conditions which allows detection and tracking of at least 5 targets, on each camera/channel at the same time.

1.1.7 The image of the camera in whose coverage area an event has occurred, the alert will immediately appear on the screen in the system computer and the control screens respectively and at the same time you will hear an audible alarm (which will be activated only when the doors are closed, and the system is ready to be activated/is running) indicating an alarm. The entire system will be connected to the reflector's interlock system which will not allow the activation of the radiation/will immediately stop the radiation if necessary.

1.1.8 In the event of an alert, the recording system will immediately record the alerting area, the recording time is the duration of the alert which includes at least the 30 seconds preceding the alert in a format of 24 images per second or up to resetting the system, all in a full interface to the control and recording systems for the existing TMS systems on the site.

1.1.9 The system will be able to mark and display more than one alert at the same time.

1.1.10 The system will be connected to the C&C system which will be located at the operator's/marshal's position, so that an alert received from the VA system will also be indicated on the graphic display in the C&C system as well as a marking of the alerting area on a dedicated monitor (at least a 21" screen and on top of the operating station monitor).

1.1.11 The system will include, among other things, a 21" size screen at the operator's position, which all cameras will appear on this screen, and a computer screen with the computer including all the hardware required at the technician's position. In total, there will be 2 viewing positions.

1.1.12 The system will operate using fixed cameras with a minimum resolution of 2 MP.

1.1.13 System configurations - systems can be offered when the data processor is in different locations including that the deployment of the systems will meet the customer's information security requirements, and in particular the systems must meet the techno-operational requirements:

- Data processing is performed at the end site by the hardware and software installed in the camera.
- in designated cards of the system.
- Data processing is done on the server at the control position (operator/marshal).

1.1.14 For further clarity, it is clarified that the contractor's responsibility for the VA system includes the transmission of video signals "from end to end" starting from the camera installed in the field to the system at the control position (operator/marshal). For any length, the contractor will take all necessary measures to ensure compliance and proper operation of the system without interference in the

field and the conditions existing in the facility including possible electromagnetic interference.

1.1.15 The system will maintain all its features including detection percentages for the entire duration of its defined life and without any decrease in performance, as well as once every five years or as needed (whichever comes first) the supplier undertakes to upgrade the software and the hardware, including all the installed cameras, computers and accompanying subsystems, screens, etc... without extra charge.

1.2 General functional requirements:

1.2.1 The system will allow the detection to be displayed in accordance with the settings in the C&C system.

1.2.2 The system will enable traffic detection and management of entrances/intrusions to pre-defined areas through marking and mapping of a virtual line, which will define the radiography complex. Also, the system will allow management of notifications of predefined modes.

1.2.3 The system will work for as long as the radiography system is on.

1.2.4 The system will allow definition of many "alert zones" at the same time.

1.2.5 The alert zones will be programmable according to the daily routine in the field (at the access authorization level of Director).

1.2.6 The system will trigger an indication/alert in any case of attempted tampering, treatment, or interference (blocking) in the operation of a camera such as blocking the field of view. The system will run an automatic self-test and alert you of the faults.

1.2.7 The system is required to detect the following types of traffic in all areas (including vehicles) in the field as defined bellow:

- Walking at a normal pace.
- Fast running at a speed of about 6 meters per second.
- Walking slowly (heel to toe) until standing/sitting (static position of a person).
- Crawling on all fours.
- Partial body movements.
- Camera dazzle.

1.2.8 The system will operate in real time. It will be possible to freeze an image in alert mode and/or restore and display photos of the area before the start of the event that caused the alert.

1.2.9 As soon as a situation that has been defined in the software as a cause for alarm is detected, an audible and visual indication will be given, and a recording will be made on the warning image in the system's recording system.

1.2.10 The VA system will be connected to the digital recording system with a communication protocol and in full synchronization and without losing images (frame dropout).

1.2.11 The system will support "smart backup" (Redundant topology).

1.2.12 The system software will contain an event log (Event log) in which every alert received will be recorded in the system, including Pre & Post alarm video recovery.

1.2.13 After removing the object that caused the warning, it will be possible to activate the radiography system without delay and without needing to reboot. Also, the technician will be given the option, and only with his permission, to operate the

system even though a warning exists and if there is no danger of a person being in the radiography tunnel.

1.3 Criteria and rules for detecting a person in the radiography area and in the driver's cabin:

1.3.1 The system will know how to divide the image into sub-areas that can be defined for detection/identification.

1.3.2 The system will know how to accept masking areas for places where it is not required to alert.

1.3.3 For each area defined for discovery, it will be possible to activate all the required discovery capabilities and rules of the system, as defined in this document and/or defined by the customer in addition to this document.

1.3.4 The system will warn of any movement of people in the defined areas while marking the discovery. Additionally, the system will alert a person who does not move in the mirroring area.

1.3.5 Detecting an object with minimal displacement.

1.3.6 The system will enable tracking of people or vehicles that will generate an alert in the defined areas.

1.3.7 The system will allow the definition of a minimum object size for generating an alert, by selecting the number of pixels in the picture, and considering the different distances in the imaging range.

1.3.8 The system will know how to identify and warn of many discoveries in one scene.

1.4 Technical requirements:

1.4.1 The level of detection percentages and false alarms:

- The disclosure percentages required to detect a person 95% disclosure.

- Monthly system availability 95%.
- The level of false alerts required by the system is - 0.6% of alerts in a period of one working week (five days).

1.4.2 Marking detections:

- The system will mark the source of the alert with a red circle/square.
- Each object will be marked separately, the system will not be limited in the number of marked objects.
- All the information about the discoveries will be transferred to the operating system at the control station that will be located at the marshal's station/ the operator station will also be kept in the VA system for 90 days.

1.4.3 Defining the prohibited area:

- The Video Analytics system screen will allow marking of the prohibited area/desired disclosure area, to reduce the number of false alarms, areas of the image where detection is not required will be closed.
- The marking of the areas by the contractor will take into account that the camera is watching from the side and in two dimensions so that a person figure can be seen in several sizes.

1.4.4 Object size settings:

- The location of the camera will sometimes be far from the detection area. Also, in large areas there is a difference between the size of the objects at the beginning of the detection area and the size of the objects at the end of the detection area. Therefore, there should be a clear definition for the object’s size for each point in the detection area.

- Pedestrian size must be defined as a reasonable human size in standing, walking, lying and static position. Required to emphasize the difference in the width of the object between people in the different situations.
- It is also necessary to define situations in which the system will only partially recognize human body parts (only head, only hands, only feet), and know how to mark and warn about it.

1.4.5 Ignoring interruptions:

- The detection system must include sophisticated algorithms for ignoring interference. Below is a list Some of the symptoms to be ignored:

1. Climate effects such as rain, wind, cloud movement.
2. Puddles from rainwater infiltration.
3. direct sun.
4. electrical disturbances.
5. electromagnetic interference.
6. Birds passing through the detection area.
7. Small animals passing through the detection area.
8. Insects near the camera.
9. Objects that move in the wind and are not the size of the detection profile.
10. Fog.
11. Flashes of light from trucks entering the compound.
12. Shadow of fixed objects such as light poles, barrier arms, rolling gates, etc.
13. Shadow of passing objects: clouds, birds, airplanes (open radiography sites).
14. Objects moving at high speed.
15. A decrease in the quality of the video image due to lighting or other conditions.

1.4.6 Documentation of the disclosures:

- System log entry of event details (time of receipt of the indication/warning, camera, etc.).
- Marking in the recording system the time of the event.

1.5 Integration:

1.5.1 The VA system will operate in full integration with the following systems:

- The radiography system - the VA system will know how to connect to any type of radiography system that exists at the ordering party, as an interlock mechanism which upon receiving an indication will immediately stop/not allow the radiography process, all of that along with a visual and audio indication in the system.
- TMS system - to make use of television cameras.
- The digital recording system - so that at the time of the warning/alarm, a continuous recording of the images and the detection marks will take place, and the event will be marked in the recording system.
- The C&C system (command and control system) which will be located at the operator's/marshal's position - receiving a warning from the VA system, it will be specified on the graphic display on the computer and on the video screens at the operator's position as well as transfer the information about the disclosure to an electronic event log.