JUSTIFICATION AND OPTIMIZATION OF X-RAY IMAGING FOR THE CARGO AND INDIVIDUALS

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ABSTRACT:

Increasing the rate of use of security examination techniques for individuals and cargo quickly in line with the growing increase in security concerns at the level of the world and is among the techniques used in those disguise that depends on the use of the ionizing radiation. Therefore human activity causes an individual to be exposed to ionizing radiation, the activity needs to be justified and optimized. Radiation protection in Iraq follows the principles of justification, optimization and limitation, as recommended by the International Organizations. When it is planned in advance to introduce a new activity requiring radiation protection and where actions can be taken on the source of the radiation to control exposure then the principle of justification applies. The justification principle requires that no situation involving planned exposure should be introduced unless it can be demonstrated that sufficient net benefit is produced to the exposed individuals or to society to offset the radiation detriment it causes so that in Iraq the terrorist threat and unstable secure situation that justify the use of imaging screening. Security screening using ionizing radiation, if determined to be justified, is a planned exposure situation, and should be subject to the appropriate regulatory framework for optimization of protection, authorization, and inspection to ensure radiation safety in operation. Dose constraints should be established for each identifiable category of exposure (individuals to be screened, members of the public who are not being screened but may be in the vicinity of the screening, occupational exposure), and used in the optimization of protection. Screening of cargo and materials may pose circumstances of exposure, particularly for drivers of conveyances being screened, that should be avoided. Exposure of such individuals should not be a matter of operational convenience. Drivers should not be allowed to occupy conveyances during screening, except for very unusual circumstances.

Because Iraq is unstable country, so that the non-medical imaging technique is used for the purpose of examination large wheels primary detection system was implemented in the port and detecting system and imaging screening (rapscan) for detecting in the survey mode and the explanation of optimization for operational and drivers and public for the using imaging screening in borders and airport also to maintain the radiation protection for the workers.IRSRA check all procedure of justification and optimization of companies that work with the rap scan, in order to authorized these companies that deals with this technique

Key words: Security Screening, Justification , Optimization.

I. INTRODUCTION

The phrase “human imaging for purposes other than medical diagnosis or treatment” is the terminology that is being used in the revision of the BSS to refer to these imaging procedures, but in recognition of its wordiness, the shorter phrases “non-medical human imaging” and “human imaging for non-medical purposes”[1] Whenever a human activity causes an individual to be exposed to ionizing radiation, the activity needs to be justified and optimized[2]. On-site inspection by the regulatory body is often the principal means for face-to-face contact with personnel in the non-medical human imaging facility. The regulatory body should have established a system for prioritization and frequency of inspections, based on the risk and complexity associated with the particular uses of ionizing radiation. The inspection of non-medical human imaging facilities by the regulatory body should be performed by staff with the specialist expertise to be able to competently assess the compliance of the non-medical human imaging practice with the radiation protection regulations and authorization conditions[3] The three general
principles of radiation protection, justification, optimization of protection and safety and the application of dose limits, are expressed in safety principles 4,5 and 6 of the Fundamental Safety Principles[4]. Justification is one of the fundamental principles in the international radiation protection framework established by the International Commission on Radiological Protection[5]. The intention behind the act of justification is to ensure that the benefit of the exposure outweighs the associated potential radiation detriment. The necessity for individual justification is reinforced in the new European Basic Safety Standards Directive and the International Basic Safety Standards[6,7]. The Safety Requirements publication on Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards (GSR Part 3) [8], in elaborating requirements for planned exposure situations in order to apply this principle, states that “The government or the regulatory body, as appropriate, shall ensure that provision is made for the justification of any type of practice and for review of the justification, as necessary, and shall ensure that only justified practices are authorized. “We as a society are now accustomed to seeing security screening systems in use at airports, Even with all of the screening, radiation exposure—both to the person being screened and the system’s operator—is minimal and far below any level that would be of concern. This document will introduce and explain security screening equipment and its potential for exposing people to radiation. As with any use of radiation, the overarching concept is one of risk versus benefit. As we will see, the tiny incremental amount of risk, if any at all, posed by this radiation exposure is far outweighed by society’s need for safe air travel, safe ports of entry etc.[9]

JUSTIFICATION

The biggest challenge regarding the use of non-medical human imaging is justification.

According to the IRAQI RADIOACTIVE REGULARORY AOUTHTRITY SOURCE(IRSRA)

The challenge is because Iraq is not secure country and the malicious threats, that leads to make Practice of Cargo inspection system, for the Purpose of screening passenger cars and cargo using x-rays for the detection of concealed objects, to reduce drug and weapons smuggling entering to Iraq.

The main reason for justification is for the national security threat

Benefits

Considering the fact that many times the vehicles were used to transport explosive materials, weapons and ammunition in the areas of the planned attacks, it is clear that the use of the vehicle Cargo scanning would increase the effectiveness of security measures. There are obvious benefits of the practice of X-ray inspection system used for scanning the occupied cars and vans, for both society and individuals, which include the following:

(a) Social benefit: security checks using modern technologies increase the safety of citizens and contribute to ensuring a high level of security for society as a whole. Depending on the objective pursued, a failure to use X-ray scanners for vehicles can cost much more than the loss of human lives and the damage (direct) and indirect losses to society (decreased confidence in the authorities, induction of panic and terror). In addition, the presence of such inspection points is a serious preventive for criminals and has significant benefits for our society.

(b) Individual benefits: Increased individual confidence. People are clearly influenced by security, as it was seen in relation to a significant increase in the number of terrorist attacks in past such as isis threat.

“There is always a need to balance individual risks against societal benefits for the many potential uses of x-ray screening related to, national security”.

(c) National and international economic benefits: attacks have led to significant financial and economic losses.

II. OPTIMIZATION

Optimization of occupational exposures

Occupational exposure may be received by operators, technicians doing the installation, service and maintenance, surveys and calibration, and other appropriate activities. The optimization of protection and safety is a process for ensuring that the magnitude and likelihood of exposures and the number of individuals exposed are as low as reasonably achievable, with economic, societal and environmental factors taken into account. This means that the
level of protection would be the best possible under the prevailing circumstances. In addition, for practices that are justified and subsequently authorized, optimization measures must be taken so that all exposures are as low as reasonably achievable (the ALARA principle) for workers, the general public, and the population as a whole.

The WG X-Ray Vehicle Scanning system provides an adequate shielding and distance from the source. Safety and radiation protection instructions for the workers are issued in the Installation and User’s Manual.

III. OPTIMIZATION OF SCREENED INDIVIDUALS AND PUBLIC EXPOSURES

Considering the specific scan vehicles occupied by the driver and possibly by other passengers, WG X-Ray scanner manufacturer primary aim is to minimize the radiation dose delivered to the occupants during the equipment lifecycle-design, engineering, production, use and service.

The portal is designed tube radiation safe for the driver, crew and bystanders, in accordance with international and local standards. The principle of ALARA (as low as reasonably achievable) is fundamental to the design.

WG X-Ray scanner manufacturer has taken the concrete steps to optimize radiation protection:

- The X-ray generator is heavily shielded and the beam tightly collimated into a fan shape, which minimize radiation dose while maximizing beam intensity at the center of the object being scanned.
- The fan beam is oriented to cover an area from the axle to the top of a truck or container on a truck without corner cut off.
- The Portal's detector system uses a scintillating cadmium tungstate crystal mounted to a silicon photodiode to detect transmitted X-rays.
- Trucks are inspected as they drive through the portal between the X-ray generator and detector array, to avoid exposing the occupants to harmful radiation, the X-ray beam is automatically activated after the driver cab passes.
- The facility layout is optimized for the specific site and inspection requirements. The required radiation exclusion zone, which surrounds the portal, can be reduced by using concrete shielding walls on either side of the rails, fig1 a&b explaining the Generator shielding and Detector shielding as shown in the figure.

Fig1 a (Generator shielding) Fig1 b (Detector shielding)

- Notice that the walls are typically thicker behind the X-ray detector than behind the X-ray generator. The walls can be cast in place or constructed of concrete panels to enable them to be disassembled and moved to a different site.

The unit can be installed within a building, which is designed to provide protection from the environment and radiation shielding

- public exposures - to protect nearby personnel and prevent unauthorized access the portal facility includes a radiation exclusion zone, warning signs, lights and alarms and barriers and fences as appropriate. External concrete shielding walls may be used to reduce the size of the exclusion zone and the unit's overall footprint.
The controlled area boundary is designed so that the cumulative dose rate at the boundary dose not exceed the maximum allowable, as shown in figure 2.

Fig 2 explaining the BRC fence to prevent the individuals from access the portal facility.

- Automatic validation of the vehicle speed when the driver of the vehicle passing through the portal scan reduces the speed below the minimum acceptable value of 8 km/h, the system automatically stops the beam of radiation, protecting the driver and the occupants from receiving a higher dose generated by slowdown or stop for various reasons during the scanning.

- Commissioning and periodic maintenance The Portal is designed and manufactured to applicable international safety standards and regulations.

DOSE LIMITS
The third principle of the ICRP’s system of protection is that of dose limitation. This principle requires that the dose to individuals from planned exposure situations, other than medical exposure of patients, should not exceed the appropriate limits recommended by the Commission.

The reference effective dose shall not exceed 0.25 μsv per scanning.

The reference effective dose received by individuals from one facility shall not exceed 250 μSv over a 12-month period.

The ambient dose equivalent, H*(10), outside of the inspection zone shall not exceed 20 μSv in any 1 hour.

The system should be positioned and operated such that the ambient dose equivalent at any work station does not exceed 1 mSv per year.

Under maximum operating parameters, the leakage ambient dose equivalent at any point 30 cm from any external surface of the system, outside of the primary beam, shall not exceed 2.5 μSv in any 1 hour.

REGULATORY AUTHORITY PROCESS
The Iraqi Radioactive Sources Regulatory Authority(IRSRA) According to the national legislation and the letter of Prime Minister to the authorization system in Iraq, in 2014, Customs department notify the Iraqi Radioactive Sources of their needs to import and use the "WG X-ray Vehicle Inspection System" at some critical border to reduce drug and weapons smuggling depending on threat assessment study. The Authority the task of supervisory supervision of radiological practices for security purposes. The initial inspection of the Rap scan -P60 type radiation detection system that was installed in the port in order to obtain the approval of the Iraqi Authority of Radioactive Sources. Necessary to design the site and the procedures prepared for handing it over to the site administration that will take over the operation process, provided that the result of this disclosure is necessary and essential to grant operating authorization to management later.

The party that will undertake the task of operating the security systems must submit an application for a license from the regulatory authority to operate the system and each site in a separate manner. The regulatory Authority
undertakes the practice of supervisory oversight that covers all supervisory requirements related to security and safety. It has worked with the requirements of the International Atomic Energy Agency (IAEA) and the International Committee for Radiation Protection (ICRP) in this context, which includes licensing, periodic, sudden, and obligatory inspection. The license includes approval for the design of the infrastructure and concrete shields for the inspection sites. It also includes approval for the design of the required procedures during the examination, such as drawing paths, the use of signs and warning signs, cameras, and amplifiers.

IV. RESULTS

Table 1 of dose limits for occupationally exposed workers and for the vehicle Driver per hour working

<table>
<thead>
<tr>
<th>Type of limits</th>
<th>occupational</th>
<th>vehicle Driver</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hp (0.07) μSv/h</td>
<td>0.31</td>
<td>0.19</td>
</tr>
<tr>
<td>Hp (10) μSv/h</td>
<td>0.33</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Table 2 of dose limits for occupationally exposed workers and for the vehicle Driver per year working

<table>
<thead>
<tr>
<th>Type of limits</th>
<th>occupational</th>
<th>vehicle Driver</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hp (10) μSv/h</td>
<td>600</td>
<td>309</td>
</tr>
<tr>
<td>μSv/year</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The detection included the site design aspects such as achieving the required dimensions that were (40 * 50), energy radiation ray shield (6Mv), isolating the site from the neighborhood, the location of the control room, the way of the trucks are organized, the direction of the steering mechanism, and the alarm means, and the personal exposures of the operators and the Hp (10) μSv/h μSv/h driver were also measured, Hp (0.07) μSv/h and that the operators of the Rap scan wheel have their working hours limited during one week (35 hours) 7J per day for each operator on the wheel, and the spatial exposures of different regions at the site H*(10) were measured according to the recommendations of the International Committee for Radiological Protection in this regard and for this The practice has adopted IAEA standards for the purpose of comparison.

In the Table 1&2 shows the limits on effective dose for the occupational and vehicle Driver for each scan it observe that these values are considered for the radiation safety of the operators and individuals. for a throughput of 180 vehicles/h, the dose for the operator is less than 0.33 μSv in one hour, 11 μSv/weak, 600μSv/year. For the evaluation of the dose/scan for the vehicle Driver, the dosimeter was placed within a typical car. The average value was about 0.17 μSv.

After inspecting the site In Basra, the design was good according to the international requirements, the concrete shielding was made in proper way as well as the generator armor. Workers’ exposures were measured and were within acceptable limits.

V. CONCLUSIONS

Dose levels are below the limits recommended by the International Commission on Radiological Protection (ICRP). The regulatory recommends that personnel dosimetry service in Iraq should start operating so that occupationally exposed workers in the scanning screening can be consistently monitored

REFERENCE

2. HUMAN IMAGING FOR SECURITY SCREENING PURPOSES USING IONISING RADIATION Australian radiation protection and nuclear safety agency.

