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ISEMIR-IR: A worldwide tool to optimize occupational radiation protection in industrial radiography

ISEMIR-IR: Globalne narzędzie do optymalizacji ochrony przed promieniowaniem na stanowisku pracy w radiografii przemysłowej

ABSTRACT

Industrial Radiography is widely used in non-destructive testing (NDT) in the world. Workers in the sector exposure if incidents happen. The Information System on Occupational Exposure in Medicine, Industry and Research: Industrial Radiography so called ISEMIR-IR was developed by the IAEA as a web-based tool for a regular data collection and analysis of occupational exposure. The system was launched with full function in 2017. It was designed based on the data from an extensive research and results of the worldwide surveys. It assists NDT companies to benchmark their own companies and individual performance against others in the database. NDT companies all around the world are encouraged to participate in the database to enable it to become a worldwide tool for implementing optimization of occupational radiation protection.

Keywords: *ISEMIR; occupational radiation protection; Industrial Radiography, NDT*

STRESZCZENIE

Radiografia przemysłowa jest szeroko stosowana w badaniach nieniszczących (NDT) na świecie. Pracownicy tego sektora w przypadku wystąpienia incydentów mogą być narażeni na niebezpieczeństwo. System Informacji o narażeniu zawodowym w medycynie, przemyśle i badaniach: Radiografia przemysłowa (ang. The Information System on Occupational Exposure in Medicine, Industry and Research: Industrial Radiography) nazwany ISEMIR-IR został opracowany przez IAEA jako internetowe narzędzie do regularnego gromadzenia danych i analizy narażenia zawodowego. System został uruchomiony z pełną funkcjonalnością w 2017 roku. Zaprojektowano go w oparciu o dane pochodzące z obszernych badań i wyników światowych sondaży. Pomaga firmom z branży NDT w porównywaniu własnych i indywidualnych wyników z innymi wynikami w bazie danych. Firmy NDT na całym świecie są zachęcane do uczestnictwa w tworzeniu bazy danych, aby umożliwić jej stanie się światowym narzędziem do wdrażania optymalizacji ochrony przed promieniowaniem zawodowym.

Słowa kluczowe: ISEMIR; ochrona przed promieniowaniem w ramach czynności zawodowych, radiografia przemysłowa, badania nieniszczące

1. Introduction

Industrial radiography is a method of inspecting materials for seeing hidden flaws by using the ability of short X-rays, gamma rays and neutrons to penetrate various materials. It is a major element of non-destructive testing(NDT) and has been widely used all over the world. Industrial radiography work poses a small radiation risk to workers and members of the public if it is performed using appropriate equipment and in accordance with required procedures. However, the practice of industrial radiography continues to result in large numbers of deterministic effects among occupationally exposed individuals and members of the public. Such accidents have resulted in high doses to workers, causing severe health consequences such as radiation burns and, in a few cases, death[1].

The IAEA has developed the safety standards series related to industrial radiography and organized technical meetings to improve the safety level of this field. However, a global perspective is lacking, as is the availability of a systematic means for improving occupational radiation protection in industrial radiography worldwide. Realizing this situation, the IAEA initiated in early 2009 the Information System on Occupational Exposure in Medicine, Industry and Research, referred to as the ISEMIR project, which arose from the Occupational Radiation Protection International Action Plan (approved by the IAEA Board of Governors in September 2003), which identified in Action 7 the need to establish networks for the exchange of information on experience and lessons learned between interested parties[2].

Two specific topic areas are inclued in ISEMIR which are Industrial radiography(IR) and Interventional cardiology(IC). ISEMIR-IR was designed based on the data from an extensive research and results of the worldwide surveys. It assists NDT companies carrying out benchmarking their data against the others in the syetem, and hence in promoting and in implementation of optimization of occupational radiation protection.

2. Development of ISEMIR-IR

2.1 The Working Group on Industrial Radiography

In order to develop the ISEMIR-IR system, a Working Group on Industrial Radiography (WGIR) was formed in 2010. The membership of WGIR is comprised of professionals with experience of working for NDT companies, client companies, NDT societies, technical service organizations, including education, training and inspection, and regulatory bodies.

The objective of WGIR was: to gain a world-wide overview of occupational exposures and radiation protection of individuals in industrial radiography; to identify both good practices and

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shortcomings, and hence define actions to be implemented for assisting each industry, clients and regulatory bodies as well in improving occupational radiation protection; to propose recommendations for harmonizing monitoring procedures; and finally to set up a system for systematically collecting and analyzing occupational doses for individuals in industrial radiography and reporting incidents, and dissemination of this information as well to improve occupational radiation protection[3].

2.2 Worldwide survey of industrial radiography

The main activity of WGIR is to gain insight into occupational radiation protection in industrial radiography worldwide using questionnaires. Three different types of questionnaires were designed and distributed to the national or state regulatory bodies responsible for radiation protection, NDT companies, and individual industrial radiographers of IAEA Member States. The survey was distributed for a period of one year, from 2010 until 2011. The Topics addressed by each questionnaire included training in radiation protection; incidents; safety of the radiographer, the public and sources; inspections; emergency plans and individual monitoring.

Responses were received from 432 industrial radiographers, 95 NDT companies, and 59 regulatory bodies. Analysis of the survey results indicated that there is a need for improved implementation of the radiation protection principle of protection optimization and safety in industrial radiography world-wide[4].

2.3 ISEMIR-IR system

It is clear from the world-wide survey that there is a need to explore an international database for the systematic collection and analysis of occupational doses for individuals in industrial radiography, and then for the use of this information to improve occupational radiation protection. In the design phase, the IAEA was assisted by an Advisory Group with representatives of international organizations from five main world regions. In June 2017, ISEMIR-IR was launched and it assists NDT companies in implementation of the optimization principle in occupational radiation protection.

ISEMIR-IR can provide three broad types of analyses which are: occupational doses per radiographic exposure for a given industrial radiographer as a function of personnel and facility attributes, benchmarking and trends with time. With the help of ISEMIR-IR, the NDT facilities are able to benchmark their own companies and individual personnel performance against global, regional or even country data. They can also identify areas for improvment and corrective actions that should lead to an improvement in radiation protection.

The participation is free of charge and many parts of the data entry are voluntary in order to make it accessible to all interested parties[5]. Each participating NDT company is able to provide annual information about company, inculding the sources used, company procedures, training related to radiation protection, and individual industrial radiographers in the company. As an outcome of the data entry, a NDT company is able to assess the effectiveness of the optimization of radiation protection. The metric is determined by occupational dose per radiographic exposure for a given industrial radiographer.

The IAEA is currently on the process of disseminating ISEMIR-IR to the Member States and collecting the anonymous data from all world. After more than one year since the official launch, 34 companies regularly participate in the data collection and others have expressed their interest. Once the data reaches a significant level, the IAEA plans to publish a report, which will identify areas for improvement and corrective actions that should lead to enhancements in radiation protection worldwide.

3. Functions of ISEMIR-IR

ISEMIR-IR can provide 2 types of analysis and benchmarking, one is company-based while the other one is individual-based.

3.1 Company-based analysis and benchmarking

The company-based analysis and benchmarking is defined by the main metric – mean occupational effective dose per exposure. The user can conduct analysis of it's own company's mean dose per exposure, as well as average effective dose base on the collecting data. Figure 1 and 2 displayed an example of the company-based report[6].

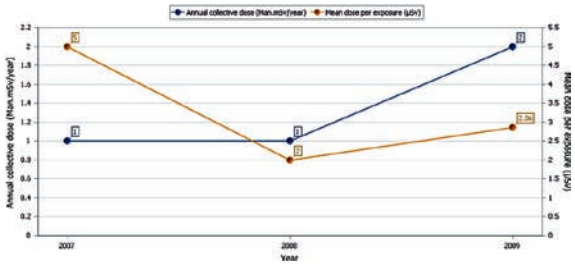

Fig. 1. Company-based annual collective dose and mean dose per exposure report.
Rys. 1. Roczna dawka zbiorcza i średnia dawka dla firmy przypadająca na raport dotyczący narażenia.

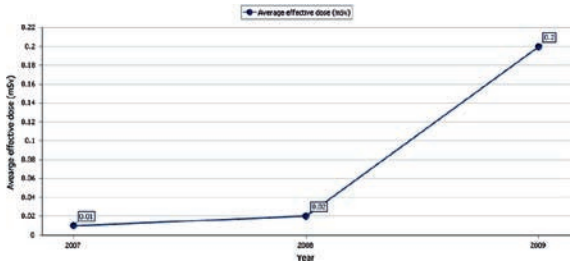

Fig. 2. Company-based average effective dose report.
Rys. 2. Raport ze średniej skutecznej dawki (dane firmowe).

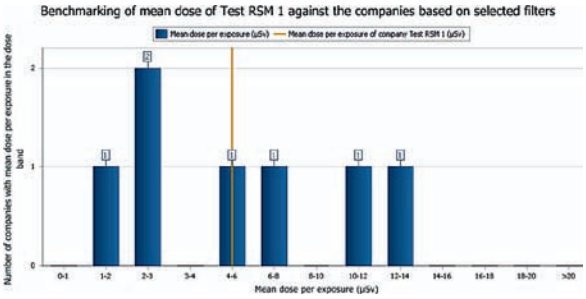

Fig. 3. Company-based benchmarking of mean dose per exposure.
Rys. 3. Analiza porównawcza średniej dawki na ekspozycję w oparciu o dane firmowe.

The user could also benchmark its company against others relating the radiation protection level such as mean dose per exposure. Figure 3 shows an example of the benchmarking

analysis of a company named "Test RSM 1". As shown in the figure, there are 7 companies apart of company "Test RSM 1". The mean dose of Test RSM 1 is 5 μSv, which is lower than the mean dose per exposure of the 7 other companies.

In addition, the ISEMIR also offers the graph showing annual collective dose of all companies based on the selected filters. If the user would be interested in taking into consideration the number of employees or size of the company, he/she can also proceed with this option.

3.2 Individual-based analysis and benchmarking

The individual-based analysis and benchmarking is defined by the main metric – mean occupational effective dose per exposure. Figure 4 shows an example of a worker's individual-based dose report. It can be seen that the worker's annual effective dose as well as the mean dose per exposure has been higher in the years 2007-2009, and the annual effective dose dropped to 3 mSv in 2010 and remained at that level through 2012.

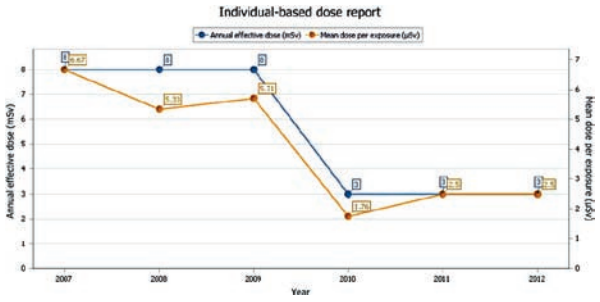

Fig. 4. Individual-based dose report.
Rys. 4. Raport dotyczący dawki dla osób indywidualnych.

The ISEMIR-IR can offer two kinds of benchmarking for the employees in the user's company against others in the database. Fig. 5. is the example of company Test RSM 1 benchmarking the mean dose per exposure of individuals against the others in the database. We can see that there are 20 full time industrial radiographers in the database who have all radiation protection training as filtered in advance. Their mean dose per exposure is 7.22 μSv while the ones in company Test RSM 1 is 2.81μSv. This means that the individual radiographers working in the company Test RSM 1 have a lower occupational exposure on average than the others having the same radiation protection training[7].

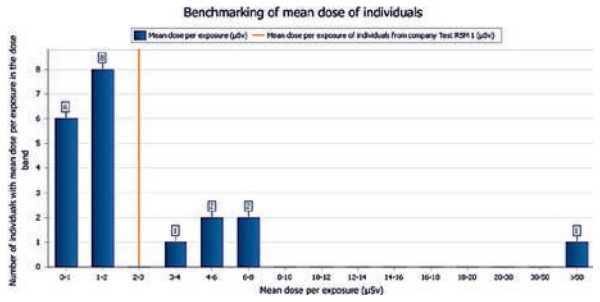

Fig. 5. Benchmarking of mean dose of individuals.
Rys. 5. Raport dotyczący dawki dla osób indywidualnych.

In addition, if the user prefers to compare the annual effective dose instead of the mean dose per exposure, he/she can see the following graph fig. 6 which is automatically displayed in the screen.

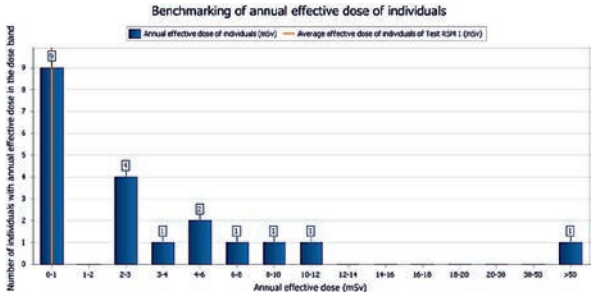

Fig. 6. Benchmarking of annual effective dose of individuals
Rys. 6. Porównanie rocznej skutecznej indywidualnej dawki.

4. Conclusions

Optimization of protection is one of the three fundamental principles in radiological protection system. The ISEMIR-IR database is being developed to provide a tool that can be used by NDT companies to improve their implementation of optimization of occupational radiation protection in industrial radiography.

The 60th and 61st IAEA General Conference Resolutions addressed that the Secretariat to promote ISEMIR to facilitate the implementation of as low as reasonably achievable (ALARA) practices and effective exposure control, and recommends that Member States provide data on occupational exposure to the ISEMIR programme.

NDT companies all around the world are encouraged to actively participate in the database to enable it to become a worldwide tool for implementing optimization of occupational radiation protection. It is necessary for the IAEA to introduce ISEMIR-IR system to the Member States especially to the industrial radiography companies and employees. The individuals and companies are anonymized in the database. IAEA can't reveal the identity of company, all submitted data are considered to be confidential and will not be shared.

5. References/Literatura

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