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European ALARA Network

Newsletter

CONTENTS

Results of the EAN Survey on the Regulatory Approach to Radiological Protection of Aircraft Crew

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Introduction

Earth is continuously exposed to high-energy particles that come from space or the sun. These particles interact with the atomic constituents of the atmosphere and produce a 'cascade' of secondary particles that contributes to cosmic radiation exposure. Thus, cosmic radiation exposure decrease in intensity with depth in the atmosphere: from 7 µSv/h at aircraft altitude (11,000 km) to 0.05 µSv/h at sea level. As certain cosmic radiations are also electrically charged, cosmic radiation exposure depends on latitude (see Figure 1) and solar activity.

The International Commission of Radiological Protection stated in 1990 (ICRP Publication 60) that aircraft crews exposed to cosmic radiation should be recognized as occupationally exposed workers, and, retrospective assessments of dose undertaken since then using computer programs show that aircraft crew have one of the largest collective doses among occupationally exposed workers.

Between December 2010 and January 2011, the European ALARA Network performed a survey on the regulatory requirements for aircraft crew. The survey also aimed to gather numerical data about the exposure of aircraft crew in the individual countries.

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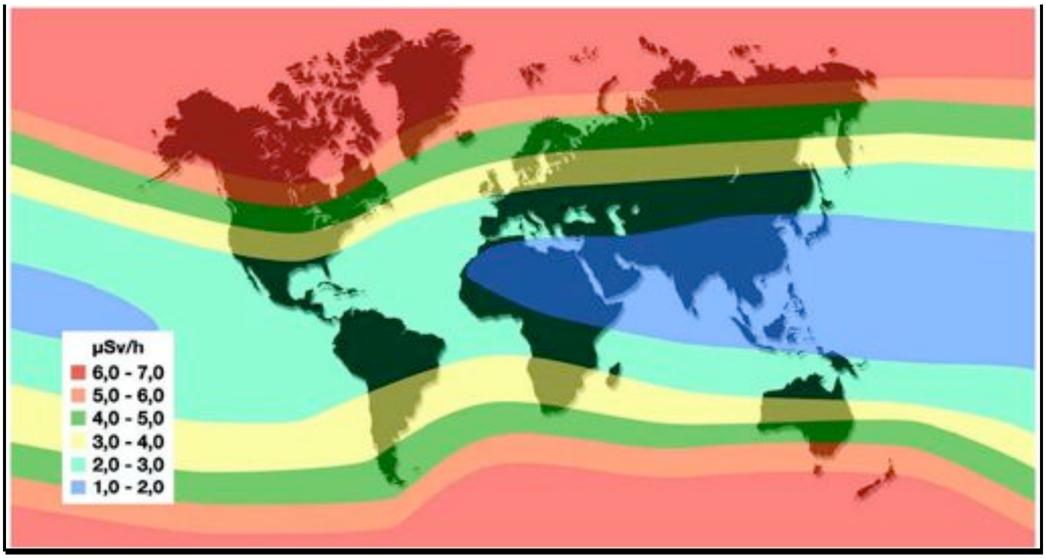

Figure 1. – Geomagnetic shielding of cosmic radiation: ambient dose rate by latitude at 11.000 meters altitude on December 2002.

Questions

The survey was drafted as follows:

1. Is there a regulation concerning radiation protection requirements for aircraft crew in your country?
2. If yes:
    - What are the main requirements?
    - What are the means and tools used to assess aircraft crew exposure?
    - Is there a specific dose criteria defined for aircraft crew?
3. Could you provide data on the number of aircrew personnel exposed, maximum annual level of exposure, average annual level of exposure, etc.?

Results

Requirments

Abbreviations used in Table 1:

- **A**: **A**ssessment of individual dose of aircraft crew using dedicated software.
- **I**: **I**nformation about cosmic radiation are provided by operating management (airlines) to the aircraft crew.
- **Sch**.: **Sch**eduling; taking into account the individual assessment of exposure when the operating management is planning flight schedules. A dose constraint can be implemented.
- **Prg**.: Requirements are in place to limit the exposure of female aircraft crew after declaration of **preg**nancy (embryo/foetus is considered as a member of the public with a dose limit of 1 mSv/year). Generally airline companies have provision in place (ground duties) to ensure the criterion of 1 mSv is not exceeded.

As stated in the BSS, the requirements apply if the annual dose is above 1 mSv.

Table 1. – Synthesis of the regulatory requirements for aircraft crew.

Country	Regulation and requirements	Assessment of exposure (software)	Dose criteria
Belgium	Royal Decree of July 20, 2001, § 4 and 9. ***Requirements***: **A, I, Sch., Prg**.	Graphics to assess whether aircrews are likely to receive more than 1 mSv/y If > 1 mSv/year use IASON-FREE, PCAIRE, CARI or GLOBALOG	If > 6 mSv/year: medical surveillance, reporting of monthly dose and adjustment of flight time or route dose.
Czech Republic	Regulation No. 307/2002 ***Requirements***: **A, I, Sch., Prg**.	CARI-6	If > 6 mSv/year, all the requirements for cat. A worker shall apply.
Denmark	*Guidelines on the Control of Exposure to Cosmic Radiation of Aircrew in the Nordic Countries* ***Requirements*: A, I, Sch., Prg**.	EPCARD, CARI-6, FREE	Objective is to limit the number of people > 6 mSv/year.
Finland	Radiation Act 1991/592 - Chapter 12, Radiation Decree 1991/1512 - Chapter 7, Guide ST 12.4 - Radiation safety in aviation ***Requirements*: A, I, Sch., Prg**.	CARI-6	Aircraft crew annual dose should not exceed 6 mSv.
France	Labour Code (article R.4451-140 to R.4451-144), Order of 8 December 2003 ***Requirements*: A, I, Sch., Prg**.	SIEVERT (www.sievert-system.org)	-
Germany	Radiation Protection Ordinance, § 103 ***Requirements*: A, I, Sch., Prg**	Graphics, then if > 1 mSv/year, assessment using an approved code: EPCARD, PCAIRE or FREE	If > 6 mSv/year: medical check-up.
Greece	Radiation Protection Regulation, § 1.2.5 ***Requirements*: A, I, Sch., Prg**	Assessment with computer code	Aircraft crew annual dose should not exceed 6 mSv.
Ireland	Ionising Radiation Order, SI No. 125 of 2000, Guidance note for air operators – 2008 ***Requirements*: A, I, Sch., Prg.**	CARI-6 or EPCARD	If > 6 mSv/year: additional protective measure.
Italy	Legislative Decree No. 230 Chapter III - Article 10 ***Requirements*: A, I, Sch., Prg.**	CARI-6	One company has an internal action level at 3 mSv/year.
Lithuania	Law on Radiation Protection, Hygiene Standard HN 73:2001, Hygiene Standard HN 85:2003 ***Requirements*: A, I, Sch., Prg.**	CARI-6	Aircraft crew annual dose should not exceed 6 mSv. If > 6 mSv/year, all the requirements for cat. A worker shall apply.

Country	Regulation and requirements	Assessment of exposure (software)	Dose criteria
Slovenia	RP and Nuclear Safety Act § 45 and 46 ***Requirements*: A, I, Sch. (dose limit at 6 mSv), Prg.**	CARI-6	Dose constraint is 2 mSv/year (3 mSv/year in 2009). Dose limit: 6 mSv/year (cat. B workers).
Sweden	Directive EEC 3922/91 and subpart D, OPS 1.390 ***Requirements***: still those from JAR-OPS1: **A** if > 6 mSv/year.	CARI-6	-
The Netherlands	Radiation Protection Decree of 16 July 2011 - Chapter VIII - Article 111 ***Requirements*: A, I, Sch., Prg.**	CARI-6	If > 6 mSv/year: limiting flight time/route dose.
United Kingdom	Air Navigation (Cosmic Radiation) Order 2000 ***Requirements*: A, I, Sch., Prg.**	Not specified. CAA guidance allows any validated software, including CARI, EPCARD, SIEVERT and PCAIRE	-

For every country that responded, the regulations on radiation protection of aircraft crew are national regulations, except for Sweden, which has implemented the international recommendations JAR-OPS 1. For most regulations, the main requirements for aircraft crew above 1 mSv/year are assessing of dose (A), information (I), taking into account individual exposure when planning flight schedule (Sch.) and limiting the exposure of pregnant aircraft crew (Prg.).

According to the answers, the annual dose of 6 mSv is viewed differently depending the countries:

- Some countries consider it as a "dose constraint", or a dose reference level, that should not be exceeded. This is implemented in Denmark, Finland, Greece, Italy and Lithuania and ensure by limiting flight time and route exposure.

- Other countries add specific requirements for individuals above 6 mSv/y, for example monthly reporting, or requirements for cat. A workers. In Belgium, Czech Republic, Germany, Ireland and the Netherlands, 6 mSv/year is regarded as an "action level".

- It should be noted that Slovenia have implemented a dose constraint of 2 mSv/year and an Italian company (Italfly) have an internal dose constraint at 3 mSv/year.

Exposure data

The data received are generally an annual dose distribution for the aircraft crew of the country. Extracted from these data, Table 2 and Figure 1 below present the mean and maximum annual effective dose. The complete data can be found in the results of the survey available on the EAN website[1].

[1] http://www.eu-alara.net/index.php/surveys-mainmenu-53/36-ean-surveys/275-aircraft-crew.html

Table 2. – Some numerical data regarding the exposure of aircraft crew.

Country	Number of exposed individuals	Mean annual effective dose (mSv)	Maximum annual effective dose (mSv)
Belgium	2,912	1.27	4.77
Czech Republic	2,158	1.09	3.85
Denmark	3,824	1.8	6.0
France	19,830	2.2	5.5
Germany	36,596	2.3	7.0
Ireland	9,726	N/A	N/A
Lithuania	213	N/A	N/A
Slovenia	322	1.16	1.74
Sweden	1,431	2.55	5.43
The Netherland	11,100	1.73	4.55
United Kingdom	about 40,000	about 2	N/A

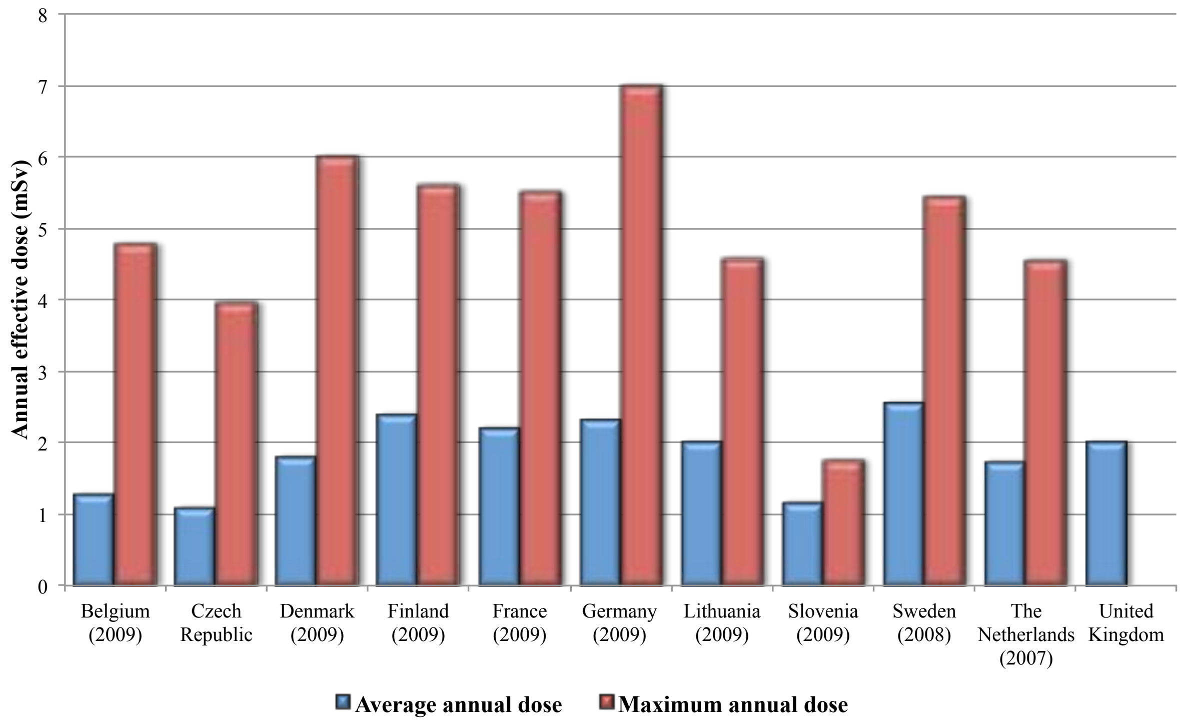

Figure 2. – Average and maximum annual effective dose due to cosmic radiation for aircraft crew.

Depending on the size of the national airline industry, the number of exposed aircraft crew varies from 213 in Lithuania to about 40,000 in Germany and United Kingdom.
The mean annual effective dose varies from 1 mSv (Czech Republic) to 2.5 mSv (Finland and Sweden). The highest effective dose is 7 mSv/year for a German aircraft crew but is generally less than 6 mSv/year. Apart from exceptional circumstances, such as fierce solar eruptions, it is almost impossible for aircraft crew to receive doses higher than 10 mSv/year.

Conclusion

The regulations regarding the radiological protection of aircraft crew are broadly similar in the responding countries, and are in line with current international recommendation (ICRP, Euratom). It can be noted that there are different interpretations of the significance of 6 mSv/year, ie in terms of whether it is viewed as a constraint or as a practical limit.

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Industrial Radiography: Hand Injury from Exposure to X-Ray Beam

An OTHEA Report

Readers are reminded of the OTHEA website (www.othea.net), which contains descriptions of radiation accidents in different sectors, and considers the lessons that can be learned. It is in English and French, and is intended to be used as a radiation protection training resource. It is also free to access and use.

OTHEA relies on being supplied with reports of accidents from which lessons can be learned. Readers are encouraged to contribute to this process. All reports are carefully checked to ensure that individual and other identifying information is removed prior to posting. An example of a recent OTHEA report on an industrial X-ray radiography accident is given below.

Introduction

A Company carried out industrial radiography (X-ray and gamma) in its own radiography enclosures, and also at other locations using mobile equipment (site radiography).

Prior to this incident, there was a fault with the portable X-ray warning signals, which prevented site radiography work being carried out as planned. Consequently, managers instructed that this equipment should be pre-tested in the radiography enclosure. A method for this was devised, which involved connecting the mobile warning systems into one of the radiography enclosure systems. Using this method, the enclosure safety and warning systems (door interlock, audible pre-warning and exposure warning lights) were disabled, but the X-ray set could still be operated.

On the day of the incident, two radiographers were carrying out X-ray radiography in an enclosure. They went for a break, but left the operating key in the X-ray control panel. A different employee noticed the enclosure was empty, and decided to test the mobile safety systems using the above method for the first time.

The radiographers returned to set up the next exposure in the enclosure, unaware that the safety systems had been disconnected. They did not see their colleague testing the mobile systems and he did not see them enter the enclosure. While one of the radiographers was moving the X-ray tube, the employee testing the mobile systems started an exposure. The radiographer's fingers on his right hand were directly over the beam port of the X-ray set: fortunately, the beam was not directed at his body. The radiographers noticed a "radiation" warning light (from a separate detection system installed for gamma radiography) and left the enclosure immediately

No immediate investigation was carried out: the incident was reported 3 weeks later when the radiographer informed the Company of radiation burns on the ends of his fingers (see Figure 1 below).

Radiological Consequences

It was estimated that the exposure to the radiographer's fingers was approximately 23 Sv (based on a 2 second exposure to the beam).

The radiographer suffered severe tissue damage to fingers on his right hand (see Figure 1). He did have surgery, but his fingers remain numb, with occasional tingling, although he has now been able to return to work.

The Company was prosecuted by the national regulatory authority, and received a fine equivalent to approximately €40,000.

Lessons to be Learned

This incident could easily have been prevented and radiation exposures could have been much higher. Specific lessons learned from this incident include:

- Industrial radiography uses high output sources. Even very short exposures to the main X-ray beam can produce radiation injuries. Safety and warning systems should never be disconnected or overridden unless other precautions can be put in place to maintain the same overall level of radiation safety.

- Industrial radiography safety systems should be regularly tested; however the testing methods should be subject to a proper risk assessment process, in consultation with a Radiation Protection Expert (RPE). Such an assessment would have highlighted the potential dangers of disconnecting the installed safety systems. In this case, it would have been relatively simple to arrange for alternative safety systems to prevent access to the enclosure during testing.
- Key-controlled X-ray control panels are an important safety feature. In this case, the key was left unattended in the control panel, even though the working instructions required it to be removed. In the subsequent investigation this was found to be a common practice.
- A separate independent safety system (in this case, an installed "gamma alarm" radiation detector) prevented the dose from being much higher. Personal electronic alarms/dosemeters provide a similar function, and should be considered for all industrial radiographers.
- There were no specific safe working procedures for testing the mobile safety systems, and there were no provisions for ensuring that this task was properly supervised ❑.

Figure 1. – Hand injury from overexposure to X-ray beam.

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Radium Action Plan in Switzerland

Nicolas STRITT

Federal Office of Public Health, Bern, Switzerland

Radium (^{226}Ra) luminescent painting was used in Switzerland between 1920 and 1960 in the watch industry for clock hands and dials. This work was done before the radiation protection ordinance entered into force in 1963. After the 70s the use of radium was abandoned in the watch industry and replaced by tritium or by other non-radioactive agents.

From 1963, the watch industry was controlled and the regulatory body issued licenses for the use of radioactive substances. Remediation of polluted sites was performed in large workplaces and in workshops. However, before the 60s some work with radium was also performed in private homes. At that time radium was not considered an issue and there was no need to search and remediate systematically these homes.

In the beginning of 2014, the discovery of radioactive contaminated soil on a construction site of a new road changed the perception of the population and the media about its risk. The media dug into federal archives in order to determine the origin of the discovered radium. They found addresses of private homes, listing the locations where radium luminescent painting was used.

The media published the addresses online and in newspapers, after which the population asked a lot of questions. The federal authorities were obliged to perform measurements on site to reassure the population. Some traces of contamination were found in several houses. However, until now, no immediate remediation was undertaken. However, some remediation is now considered necessary in order to comply with the dose limit of 1 mSv per year if a person is assumed to live in the contaminated rooms. As a result of a concerned population, the government asked the regulatory body (Swiss federal office of public health) to react and solve this problem.

Hence, a radium action plan was launched by the SFOPH in order to systematically search, find, measure and remediate sites where contamination is still present. This action plan is supposed to last from 2015 to 2020 until all potentially contaminated locations are found and remediated if necessary. The financing of this action plan is under discussion. ❑

Figure 1. – Example of clock with luminescent radium painting.

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EAN 16th WORKSHOP

More than 10 years after the EAN Workshop in Roma, the next European ALARA Network Workshop will also be focused on Industrial Radiography and Non-Destructive Testing. One of the objectives of the Workshop is to evaluate the evolution of radiation protection in these fields since Roma.

The targeted audience is member of the national authorities and regulators, users, equipement suppliers and manufacturers as weel as training providers.

The Programm Committee first gathered in June 2014 and decided that the workshop will take place at *Kursaal Bern*, Bern, Switzerland, from 14 to 16 March 2016.
The 1st official announcement will be published in March 2015 and the 2nd announcement in December 2015.
The EAN ALARA Newsletter will keep its readers posted about the program. ☐

THIS ARTICLE COULD BE YOURS!

EAN Newsletter Editorial Board

The European ALARA Network produces the ALARA Newsletter, which is widely distributed throughout Europe and other countries, to provide a link between all those concerned with ALARA, including health physicists, but also managers, radiation protection organisations, research bodies, regulatory bodies, trade union representatives and the medical sector.

This Newsletter intends to reflect some major aspects of the 'ALARA life': the evolution of regulations, results of research, description of existing databases, ALARA programmes, available ALARA tools, the need for ALARA improvements, lessons learnt from incidents, and recommendations.

The contenant of the ALARA Newsletter has mainly been provided by EAN representatives. However, the EAN Newsletter editoral board has decided to also encourage the recipients of the EAN Newsletter to submit articles for inclusion in future issues.

Submission

Submitted articles should aim to fit with the current editorial line of the Newsletter and will be selected on that basis; former Newsletters are available at:
http://www.eu-alara.net/index.php/newsletters-mainmenu-37.html

Submitted articles should be written in English language and send electronically in doc format to sylvain.andresz@cepn.asso.fr. ☐

ALARA NEWS

EAN Strategic Agenda for the 2015 – 2020 Period

In 2014, the EAN Steering Group decided to extend the duration of the EAN association for another period of 5 years. A Strategic Agenda for the 2015 – 2020 was drafted at the occasion of a brainstorming seminar that took place in June 2014.
The Strategic Agenda aims to replace the former EAN Strategic Plan 2010 – 2015 and described the expected work of EAN during the period with regard to the challenges at stake, namely radon and NORMs, industrial radiography and emergency and post-accident situations.

The EAN Strategic Agenda 2015 – 2020 is available online on the EAN website:
http://www.eu-alara.net/index.php/presentation-of-the-ean-mainmenu-39/ean-strategic-plan-mainmenu-81.html

The Areas of Focus for Follow-up of the AIEA International Conference on Occupational Radiation Protection

The AIEA International Conference took place on Vienna from 1st to 5th December 2014.

According to Mr. Sasha Enriques from IAEA Office of Public Information and Communication, the 460 attendees identified 9 keys areas of focus that require global attention going forward:

- Implementing the existing international safety standards to enhance occupational protection of workers, including assisting Member States in facilitating implementation and encouraging a holistic approach for worker protection.
- Developing and implementing new international safety guidelines for occupational radiation protection in different exposure situations, including advanced accelerator facilities and interventional radiology.
- Enhancing assistance to Member States with less developed programmes for occupational radiation protection to support practical implementation of international safety standards.
- Promoting exchange of operating experience, particularly for industrial radiography and medical radiology, and including appropriate consideration for human factors, not just among Member States and regulatory authorities, but also among operators, radiation protection officers and vendors.
- Enhancing training and education in occupational radiation protection to equip workers with the necessary knowledge, skills and competencies to implement protection measures for workers, including periodic refresher training in radiation protection and practical measures to reduce exposures.
- Improving safety culture among workers who are exposed to ionizing radiation, including promotion of safety culture by regulatory authorities through outreach and education.
- Developing young professionals in the area of radiation protection, particularly for developing nations, through communication, networking, training, research, hands-on experience and participation in technical meetings and conferences.
- Applying the graded approach of the IAEA Radiation Protection and the Safety of Radiation Sources: International Basic Safety Standards (BSS) in protecting workers against exposures to elevated levels of naturally occurring radiation or radioactive materials, including flight crews, miners and other workers.
- Convening an appropriate international forum to exchange additional information and analysis of worker protection in different exposure situations, including during nuclear emergencies, to identify lessons learned, implement plans for the protection of

workers and helpers, enhance worker preparedness, guide the development of measures for the rapid transition from planned exposure to emergency response, and improve radiation protection in emergencies.

Publication of the ISOE working group report on Severe Accident Management

Following the Fukushima-Daiichi nuclear accident, the Information System on Occupational Exposure (ISOE, www.isoe-network.net) established an Expert Group on Occupational Radiation Protection in Severe Accident Management (EG-SAM).

The objectives of the expert group were to contribute to occupational exposure management within Fukushima-Daiichi plant and develop a state-of-the-art report on radiation protection management in emergency and post-accident situation.

The report is now published and is available on the isoe website:

http://www.isoe-network.net/index.php/publications-mainmenu-88/others.html

6th EUTERP Workshop on Legislative change in Europe

EUTERP will organize its 6th workshop on "Legislative change in Europe: the implications for training in radiation protection – Rising to the challenge".

This workshop will be organized at Athens from September 30 till October 2 2015. Short summary of the objectives of the Workshop, programme and miscellaneous information can be found on the workshop website:

http://academy.sckcen.be/en/Events/6th-EUTERP-workshop-20150930-20151002-ff76bbf7c85de411b6ac00155d010700

EAN Life

Mrs. Camilla Larsson, from SSM, replaces Mrs. Birgitta Ekström as EAN contact member for Sweden.

The French CEA/INSTN has joined EAN and will be represented by Mr. Paul Livolsi as EAN contact member for France.

All the Members welcome them warmly! ❑

FAQ ALARA

The IAEA proposed a list of frequently asked questions (FAQ) which intends to provide information to radiation protection specialists sot hey can answer quickly and correclty the most frequently asked questions. The EAN Newsletter proposes a selection of this FAQ in each issue.

Is it worthwile to implement ALARA for the workers exposed to radon and for those working in NORM industry?

Yes, according to ICRP Publication 103 and the last Basic Safety Standards it is clear that ALARA should be applied to these workers in the same manner as for the orher workers from the nuclear, industrial medical and research areas ❑.

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