Health Protection Agency

European NDT ALARA Network

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CONTRACT REPORT

EF European Federation for Non-Destructive Testing NDT

European ALARA Network

CONTENTS

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1. INTRODUCTION

1.1 Background

A fundamental principle in radiation protection is that of optimisation, that is, that radiation exposures should be kept as low as reasonably achievable (ALARA). The first summary of the European survey on occupational radiation exposure, ESOREX, specifically identified the non-nuclear industry, in particular industrial radiography, as a work sector that has given rise to some significant occupational exposures. This fact was supported in the second workshop of the European ALARA Network (EAN)[1] which further identified industrial radiography as an area where the ALARA principle could be further developed. Subsequently, industrial radiography was taken as the focus of the 5th EAN Workshop[2] from which, improvements in the following key areas were recommended:

- Analytical techniques to assist in the decision-making process
- Site radiography working procedures, especially the arrangements between the radiography company and the client
- Operational arrangements at management level and in the practical working field
- Training of radiography staff in radiation protection

With reference to this outcome a Joint Working Group on Industrial Radiography was formed in order to review and progress the practical implementation of the workshop recommendations. This working group was a sub-group of the EAN with membership nominated jointly by EAN and by EFNDT (European Federation of Non-Destructive Testing). This joint approach ensured representation from relevant stakeholders.

It was considered at this stage that an established European ALARA Network would facilitate the further progress of the above listed recommendations and, specifically, help to promote the ALARA principle in industrial radiography. When operational, such a network would:

- Provide a mechanism for the direct exchange of experience and information on regulatory requirements, administrative and operational procedures
- Provide a platform for the sharing of knowledge on operational and practical measures between NDT companies, client bodies and radiological protection bodies
- Issue guidance with respect to a structure approach to the ALARA principle in the area of non-destructive testing

It is the intention that, when established, the network will operate under the framework of, and be integrated into the existing European ALARA Network as a sub-network of EAN. The network to extend to all European Member States including Romania, Bulgaria, Croatia and Turkey.

The above is the focus of this project; the specific objectives of the project and a breakdown of the work is given in the following section.

1.2 Specific Objectives: Breakdown of the Work

The overall aim of the project was progressed via a work programme structures around the following key objectives:

a) Review of optimisation and harmonisation of radiological protection in the NDT industry

Previous work has already identified a number of NDT issues where further optimisation or a greater degree of European-wide harmonisation should be pursued. For example, in the areas of regulatory approach, equipment employed, procedures adopted and personnel profile. The first objective of the project, therefore, was to establish more precisely the current status of optimisation and degree of harmonisation. This information was to be obtained from identified contact points, representative of all stakeholders, in each country; use of existing EFNDT and EAN networks to be used to establish to relevant contact points.

It was envisaged that the outcome of this review would result in proposals being made to the EC with respect to harmonisation issues and identified areas for further work.

b) Development of Codes of Practice

The second objective was to produce written guidance, focussing on working arrangements and procedures that, if followed would help to ensure that ALARA is achieved in practice. It was considered essential that guidance address the responsibilities of both contractor and client and the co-operation between these parties although also to have relevance for other stakeholders. Clearly, a first step in this task was to undertake a review of existing guidance documents.

c) Development of initiatives to improve and support training

It is known that national training requirements for radiography personnel vary considerably. As such, a key objective of the project was to develop proposals for a harmonised European policy on training, specifically proposals with respect to:

a. A basic training syllabus for radiographer (up to and including RPOs)
b. The assessment of individual competence
c. The frequency and scope of refresher training
d. Arrangements for recognition of trained personnel between Member States

d) Integration of the NDT Network into EAN

In order to facilitate the operation of a “network” an objective was to make use of the EAN to support the of a specific NDT web-page on the EAN web-page.

The above objectives were obtained via a work programme structured around the following work programme.

WP1: Management of the project and co-ordinations of activities
WP2: Review of optimisation and harmonisation of radiological protection in the NDT industry
WP3: Development of Code of Practice
WP4: Development of initiatives to improve and support training
WP5: Establishment of the NDT-ALARA web-page

2. WP1: MANAGEMENT OF THE PROJECT AND CO-ORDINATION OF ACTIVITIES

2.1 Establishment of the Working Group

A working group was established to take forward the specified tasks. The group consisted of representatives of EAN and EFNDT as well as specific individuals able to contribute an industry perspective. Details of the membership are given in Appendix A.

The Working Group met formally once with ongoing correspondence and communication via email.

2.2 Identification of contact Points

Contact points for all 31 countries, where possible covering all three stakeholder groups ie, Regulators, Radiation Protection community and the NDT industry.

With regard to Regulators and the Radiation Protection Community identification of contact points was straightforward with use being made of existing EAN networks and contacts. However, identification of appropriate contact points within the NDT industry proved more difficult. Although a number of specific individuals were identified by the Working Group as being known to be interested in the issues and likely to be willing to contribute, in the main, these were representatives of the large client organisations rather than NDT providers and not representative of those doing the work (although, clearly, an important stakeholder group). It was considered, therefore that the most appropriate way to elicit views was to establish contact with national NDT societies, these being an apparent route to the industry. Contact details for the relevant societies were obtained via a web-search, EFNDT being unable to provide the requested details.

2.3 Liaison with EFNDT

As will become apparent from the subsequent sections in this report establishing dialogue within the NDT industry itself proved difficult. With one exception (DGZfP, Germany), despite prompting, there were no responses to the project questionnaire from the national NDT societies. The resulting lack of input from the industry was viewed as significant weakness throughout the course of the project.

Prior to, and throughout the project, the view had been held that input from EFNDT would help to secure “buy-in” from the NDT industry but in practice (to date) this appears not have been successful. However, it must be stressed that EFNDT management were supportive of the aims and objectives of the work. Towards the end of the project a meeting was held with representatives from EFNDT in order to discuss the issue at which the exact role and function of EFNDT was clarified.

EFNDT is, in effect, an umbrella organisation for European NDT societies but, in practice it is more of a "concept" rather than an operational body - it cannot compel or instruct member societies in any way or direct on policies etc. The work of the Federation is organised via a number of Working Groups (5 in total). Working Group 2 is concerned specifically with radiation protection. However, these are small groups (typically 3-4 persons) with limited resources and, in effect, can do little more than keep a watching brief on relevant issues and keep other working groups and the Federation as a whole up to date. The groups have little, or no, output in terms of advice, policies etc. and there is no compulsion on members to follow any guidance (for example) that might be produced by the Federation. With regard to the activities of individual societies - some take a keen interest in radiation protection matters, but there is little (if any) interaction between these individual societies.

Clearly, EFNDT is constrained with respect to the practical impact it can have with respect to influencing national NDT societies (and hence the NDT industry itself). However, it does provide a mechanism for promulgating information and guidance (for example) via its website and at meetings and conferences and is keen to do so. This must be viewed as a positive outcome and should help to secure the objective on conclusion of this project of the establishment of Memorandum of Understanding between EAN and EFNDT.

3. WP2: REVIEW OF OPTIMISATION AND HARMONISATION OF RADIATION PROTECTION IN THE NDT INDUSTRY

3.1 Methodology

A questionnaire was prepared structure around the specific objectives outlined in section 1.2 and distributed to identify contacts. A copy of the questionnaire is given in appendix B. For the purposes of the study it was important that there was a common understanding of the key terms used; the following definitions were applied.

"Non-Destructive Testing (NDT)"

A method of testing or inspecting equipment and materials that does not destroy them or affect their performance or properties. There are a number of NDT methods (eg, ultrasonics, dye penetrant) one of which is *industrial radiography.*

"Enclosure Radiography"

Industrial radiography undertaken in a purpose-built, adequately shielded enclosure.

“Mobile Radiography”

Radiography *not* undertaken in a purpose-built enclosure undertaken; the subject under inspection is radiographed in-situ using portable equipment. May also be referred to as “site”, “open-shop” or “portable” radiography.

“Fail-safe”

A term used to describe the operation of safety and/or warning devices eg, door interlocks where, in the event of failure of that device the system will default to a safe condition.

“Search-and-lock-up”

Associated with radiography compounds, such systems require the full area of the enclosure to be properly checked and vacated before the exposure can be initiated. The check is confirmed by the operation of “search” buttons within a pre-determined time before the area is closed and irradiation begins.

“Radiation Protection Expert (RPE)”

The term Radiation Protection Expert (RPE) refers to the specific definition used in a country's law and may be more or less equal to the definition of the "Qualified Expert" in Council Directive 96/29/Euratom, or in the International Basic Safety Standards (Safety Series No. 115, IAEA, Vienna, 1996). That is:

“*An individual who, by virtue of certification by appropriate boards or societies, professional licenses or academic qualifications and experience, is duly recognized as having expertise in a relevant field of specialization, eg, medical physics, radiation protection, occupational health, fire safety, quality assurance or any relevant engineering or safety speciality”.*

“Radiation Protection Officer (RPO)”

An individual appointed by the registrant/licensee/employer to supervise or oversee the execution of practices. Defined in the IAEA international Basic Safety Standards as:

“*An individual technically competent in radiation protection matters relevant for a given type of practice who is designated by the registrant or licensee to oversee the application of the requirements of the standards*”.

“Education”

Within the context of this project, “education” is defined as provision of the initial knowledge base, for example, as might be obtained from a degree or diploma course, post-graduate study etc.

“Training”

Within the context of this project, “training” is considered to be the provision of specific expertise and competencies.

“Training Schemes”

A series of linked training (or education + training) events.

"On-the-Job Training (OJT)"

On-the-Job Training (OJT) is a form of training in which the trainee works at a suitable environment where the facility or the infrastructure needed for the OJT is available, under the supervision of an experienced supervisor/expert (hands-on experience).

"Work Experience"

Experience gained from actively working, gaining in-depth knowledge and understanding of the issues.

"Client"

An employer using the services of another company (or individual) to provide NDT.

"Accident": "Incident"

Within the context of this questionnaire these two words are considered to have the same meaning. An accident/incident is an unplanned

The rate of response to the questionnaire was slow and, in the event, constructive responses were obtained from only 23 of the identified contacts expressing views from 17 countries. The responses broke down into stakeholder groups as follows:

Regulatory Bodies	-	9/23
Radiation Protection Profession	-	7/13
NDT Societies	-	3/23
Industry specific contacts	-	4/23

A detailed breakdown of the final quantitative analysis is given in appendix C. A discussion of this analysis along with broader conclusions is presented in the following sections.

3.2 National Overview

The objective of section A of the questionnaire**,** "National Overview" was to try and make a qualitative assessment of the degree to industrial radiography is undertaken in Member States.

3.2.1 Overview

With respect to numbers of NDT "employers" across European countries, 14/17 countries were able to provide an estimated value. As might be expected, numbers varied considerably from >2000 (Spain) to just 1 (Cyprus) with the higher numbers coming from the larger countries. Of these 14, 9 claimed that the estimate was based, at least in part, on documented evidence generally in the form of licenses or authorisations issued by the Regulatory Bodies. However, for at least I of these countries (UK) licenses are only required by employers wishing to hold and use closed sources (in this case gamma radiography sources) and are not required with respect to the use of x-radiography equipment. Unfortunately, what wasn't made clear in the questioning was whether or not the term "employer" was restricted to those organisations where NDT is the core business or whether it included those organisations where NDT is included my way of support for the core business. It has been assumed that the responses provided reflect the former.

Questions A3-A4 were intended to try and elicit a feel for the degree to which industrial radiography is used as an inspection option (as opposed to other available NDT inspection techniques). Just over 50% of countries responded that not all NDT providers offered industrial radiography as an inspection option. 6/17 countries were unable to provide an indication of what percentage of the NDT undertaken in those countries was industrial radiography but of the remainder more than half responded that this was less than 50%. These figures perhaps suggest that within NDT, industrial radiography is perhaps a lesser favoured – or less applicable - option, than other available NDT techniques.

Looking further into the specific details of the application of industrial radiography, a series of questions were asked with respect to "enclosure" versus "mobile" radiography. With just 2 exceptions all countries responded that, where practicable, radiography is always carried out in enclosures. Of the exceptions, 1 (Lithuania) responded that work was always carried out in-situ with mobile equipment and 1 (Cyprus) responded that work was *rarely* carried out in enclosures. With regard to work in enclosures more than 50% responded that work undertaken was generally a mix of x and gamma radiography with just over 30% commenting that the work was mostly x-radiography; only 1/17 responded that enclosure work was primarily with gamma sources. Where gamma sources are used, the most common isotope is iridium-192 (~ 30 Ci being a typical maximum activity) but selenium-75 (30Ci -100Ci) also appears to be commonly used. Although 6/17 responded that cobalt-60 could be used the majority of these commented that this is, in fact, rare.

With respect to mobile radiography over just over 50% responded that this was mostly undertaken with gamma sources. Comments made in support of this response were typically with respect to a) the "ease" of transport and use of gamma sources with respect to x-ray equipment, b) that client companies specified gamma only and c) the high energy/output of x-ray equipment. Of those that responded that a mix of x and gamma could be used (just less than 50 %) a number commented that the choice depended on the construction of the object under inspection and the desired quality of the final radiograph. Only 1/17 (Latvia) responded that mostly x-ray equipment would be used. Again, the primary choice of isotope is iridium-192 (typically 20Ci-30 Ci) with selenium-75 being used to a lesser extent. Cobalt-60 appears to be retained by companies but most respondents commented that it is rarely used.

With respect to identifying the degree to which different industry sectors make use of industrial radiography there was, as might be expected, a range of answers. This probably reflects national infrastructures. However, the construction industry and the petro-chemical industry were cited by almost all as one of the highest "users" of industrial radiography; those with a strong nuclear industry (eg, France) cited this as the highest user.

16/17 countries were able to provide approximate values for the number of radiographers in the country. Again, there was a wide range here with numbers varying from as low as < 10 (Cyprus, Malta) to > 2000 (Italy, UK). Just over 50% responded that it was felt that the number of radiographers is adequate at the present time; just over 11% responded negatively to this issue with 30% not being able to give an opinion. However, over 50% of countries responded that not all radiographers obtained their primary qualification within that country and that qualifications from elsewhere are accepted. While it is perhaps is difficult to draw any firm conclusions from this (on the basis of the limited response to the study) these figures do perhaps suggest that there is a degree of migration of industrial radiographers between European countries and a preparedness (or need ?) to accept qualifications from elsewhere.

3.2.2 Summary Conclusions

i) The evidence suggests that industrial radiography is, on balance, a less favoured inspection technique within NDT. It may that this lower profile within the industry is a contributory factor to the perceived weaknesses in radiation protection standards.

ii) On the basis of the information returned it would appear that the general "spirit" is that radiography should be undertaken in enclosures when practicable. However, in the interests of optimisation and harmonisation the adoption of this approach should continue to be encouraged.

iii) Mobile radiography is primarily undertaken with gamma sources, generally for reasons of logistical convenience. The use of x-radiography on site is rare as is the use of high output sources such as cobalt-60.

iv) It is difficult, on the basis of the information provided to arrive at an overall conclusion regarding the adequacy of numbers of radiographers across Europe. However, it does appear to be the case that there is a degree of migration of workers between countries. This underlines the need for harmonisation in approaches to training and qualification and an expected consistency in working practices.

3.3 Regulatory Requirements

The objective of section B "Regulatory Requirements" was to obtain information on the legislative approach to industrial radiography in EU Member and Candidate States.

3.3.1 Overview

Details of regulation and guidance currently in force along with those of the relevant Regulatory Body(s) were provided by all respondents. These are listed in appendix D.

All countries responded that organisations undertaking industrial radiography are required to licensed or authorised by a Regulatory Authority for both x- and gamma-radiography. However, there are varying approaches with respect to this authorisation/licensing process. At one end of the scale the process is very rigorous with an application being required to address facilities, equipment, source used, workload, intended procedures, worker qualifications etc, etc. At the other, for example in the UK, the system is much less prescriptive. Here, there is a difference in approach depending on whether it is x-radiography or gamma radiography that is being undertaken. Employers are required to have formal, conditional, registration (issued by the regulator) to hold gamma sources and the application process for this involves a two-way dialogue between the Regulator and the employer. For work with x-rays the regulator has developed a generic authorisation; all the employer has to do is satisfy that he is working in accordance with conditions specified in that generic authorisation and there is no requirement for a two-way dialogue.

Again, there is a mixed approach with respect to the requirement for notification to a Regulatory Authority. In 4/17 of the countries notification is required the first time radiography is undertaken, whenever a new enclosure is built/used and each time mobile radiography is undertaken at new premises. Although there were 5 responses to the effect that notification is not required, for each of these countries there does appear to be formal authorisation process so the Regulatory Authority will, at least, be aware of the nature of work undertaken.

In all countries inspections are undertaken at premises where radiography is undertaken in enclosures and it appears to be common place for the retention of licenses to be dependant on the satisfactory outcome of such inspections. Inspections may be pre-arranged or unannounced; only 5/17 reported that inspections are always unannounced. It is a similar situation for mobile radiography.

With regard to the enforcement action available to the Regulatory Authority the general response was that the level of action is dependant on the perceived problem but could range anywhere from verbal/written warnings to fines or imprisonment.

A number of interesting comments were made within this section and these are repeated in appendix C. Perhaps of particular note is the comment that effective inspections require knowledgeable auditors.

3.3.2 Summary Conclusions

i) There are varying approaches to the authorisation and licensing process for organisations undertaking industrial radiography. Some harmonisation in approach with respect to the degree of rigour applied would be prudent.

ii) In general, the retention of licenses or authorisations to operate is dependant on the satisfactory outcome of inspections undertaken on behalf of the Regulatory Authority. This is considered to be a positive situation and an aid to optimisation. There is value in both announced and unannounced inspections.

iii) In general there is a graded approach to the range of penalties meted out by Regulators in the event of infringement of authorisation or license conditions.

iv) It is clear that for inspections to be valid and constructive they must be undertaken by persons who are sufficiently knowledgeable not only about relevant legislative requirements but also regarding the practical radiation protection issues pertinent to industrial radiography.

3.4 Radiography Equipment

Here, the objective was to make an assessment of the standard of equipment likely to be in use with a view to identifying whether not there is scope for optimisation and/or harmonisation of approach.

3.4.1 Overview

Of the 17 countries, 11 responded that there is a specific requirement for gamma containers to comply with the current international standard for gamma source containers (1SO 3999-1(2000)). However for 4 of these 11 this requirement is specified in guidance rather than in regulation/license. Where the requirement is in regulation a high level of compliance was reported (>75%); for the remainder the majority of responders reported the level of compliance with IS0 3999-1(2000) either wasn't known or felt to be rather poor. At least one respondent commented that better harmonisation with respect to compliance with the relevant international standard would be desirable.

With respect to x-ray equipment > 80% of countries responding specify required standards for x-ray equipment and for the majority of these the requirement is specified in regulation or as license condition. In almost all cases reference was made to national (electrical) standards for such equipment. Only 2 countries responded that there is no requirement specified at all.

The requirement for routine maintenance on both gamma and x-ray equipment is clearly viewed as being important with <u>all</u> countries responding such a requirement is specified in either regulation/license or guidance or both. It is perhaps worth noting, however, that no views were expressed as to the perceived level of compliance with this requirement.

3.4.2 Summary Conclusions

i) A greater degree of harmonisation with respect to application of the relevant international standard for gamma source containers (currently ISO 3999-1(2000)) is required. Compliance with this standard should be expected as a matter of course.

ii) Maintenance of equipment, both x and gamma, is an important aid to optimisation and clearly viewed as an important requirement. However, compliance with such a requirement is key. Procedures for maintenance should be specified in working procedures, local rules etc and, ideally, a review of compliance should be an integral part of inspection regimes.

3.5 Radiography Enclosures

The objective was to collate information on the practical approach to radiography within enclosures with the aim of identifying those areas where harmonisation would be beneficial and/or optimisation could be improved.

3.5.1 Overview

In the main there appears be no minimum number of persons specified to be in attendance during radiography in enclosures.

i) Design Considerations

For the majority of countries that provided a response criteria for design and construction of radiography enclosures are specified in regulation/licenses or in supporting guidance and in most cases restrictions are in place with regard to the permissible exposure levels around the exterior of enclosures. While there is some variation in the quantitative value of these levels, for example:

- not to exceed 1 mSv/yr (Belgium)
- not to exceed 2.5 μSv/h (Ireland)
- not to exceed 0.10 mSv/week if outside (Switzerland)

- in all cases the levels are relatively low and generally linked to the dose limits for members of the public (1 mSv/year).

In the same majority of countries there is a requirement for some form of periodic monitoring around the exterior of the enclosure although, again, some variation in the degree of rigour required. In one example, France, monthly dose-rate monitoring is specified; in another, Slovenia, annual inspection and measurement by the Qualified Expert (Radiation Protection Expert) is all that appears to be required.

In almost all cases, storage arrangements for radiography equipment used in enclosures are specified although the responses generally related specifically to the storage of gamma sources.

ii) Effective Devices and Warning Signs

For the majority of countries that provided a response there is a requirement for the installation of effective devices to prevent access to the enclosure during radiography. In most cases this is in respect of both x and gamma radiography; only 2 countries (Austria and Slovenia) responded that this requirement applied in respect of x-radiography only. Just 2 countries (Malta and Switzerland) responded "no" to the question.

A requirement for search-and-lockup facilities appears to be rare. Four respondents reported that that these are only required under certain circumstances. For example, in the UK search-and-lockup is required (in guidance) where there is a risk of receiving an exposure in few minutes that could cause deterministic effects; in Austria it is on "where practicable" basis. However, in two countries (Italy and Germany) search-and-lockup is always required. Interestingly, the same countries that responded "no" to this question reported that the design of enclosures is required to include a contingency in the event of persons becoming trapped inside.

80% of respondents reported that requirements for warning signs and devices are specified in regulation (primarily) or guidance. However, it is interesting to compare the responses for gamma radiography with those for x-radiography.

TABLE 1 Requirements for warning signs and devices

Aspect Considered	Percentage responding "yes" for X-Radiography	Percentage responding "yes" for γ -radiography
Is there is a requirement for a warning for …		
………"Power On "	84%	N/A
…….Pre-exposure	53%	38%
……….…Exposure	92%	77%
Are these required to …..		
…….operate automatically	92%	77%
…….be fail-to-safe	84%	53%
…….be visible inside+ outside enclosure	77%	70%

On the basis of these figures there appears to be a less rigorous approach taken with respect to gamma radiography in enclosures compared to that taken for x-radiography. This is possibly due to the greater ease of integrating warning and safety systems into electrical devices such as x-ray equipment.
For just over half of those responding a requirement for routine maintenance of safety and warning devices is specified in regulations or guidance.

3.5.2 Summary Conclusions

i) Although it is difficult to find any particular fault with the various design criteria applied for the enclosure design there could be a greater degree of harmonisation in approach.

ii) The installation of effective devices for the prevention of access to enclosures during radiography appears to be common place. However, there could be a greater degree of harmonisation with respect to the nature and means of operation of such devices.

iii) There are clear advantages in the adoption of *both* pre-exposure *and* exposure warning devices during both x and gamma radiography, however, the routine adoption of the former appears does not appear to be typical. The requirement for both would be a significant aid to optimisation and should be recommended.

iv) Overall, with regard to the use of warning signs and devices in industrial radiography it appears that a less rigorous approach is taken with gamma radiography compared to x-radiography.

3.6 Mobile Radiography

The objective was to collate information on the practical approach to mobile radiography with the aim of identifying those areas where harmonisation would be beneficial and/or optimisation could be improved.

3.6.1 Overview

This area of questioning covered a number of specific topics.

i) *Staffing*

In 13 out of the 17 countries the number of persons that should be present during mobile radiography is specified, generally in regulation or by way of license conditions (for only 1/13 was the requirement simply reflected in supporting guidance). For the majority, the minimum number in a radiography crew is 2, although 1 country responded that just 1 radiographer is sufficient. Only 2 countries responded that no minimum number is specified.

ii) *Radiography Technique*

Respondents were asked if any restriction is placed on the radiography technique employed. 7/17 responded “no” to this; it is assumed in these cases that the choice of technique is at the discretion of the radiographer(s). It is interesting to note that a similar number responded to the effect that restrictions are placed on radiography companies by the clients. Generally, such restrictions apply in respect of the permitted isotope(s) and maximum levels of activity (20 Ci was quoted as an example).

iii) *Source Storage Arrangements*

For the majority of countries required storage arrangements for gamma sources are specified in either regulation or in license conditions and, typically, these requirements specify the need for lockable, secure storage, for appropriate signage etc. Only 2 countries responded that there are no specified requirements at all but a further 2 responded that while there are no specific requirements good practice tends to be adopted.

iv) *Barriers : Monitoring*

There are a wide range of approaches with respect to the setting up of barriers around areas where mobile radiography is undertaken although the majority of countries (13/17) do have specified criteria.

Criteria appear to be based on dose, dose-rate or a combination of both. Where just dose-rate is applied this ranges typically between 2.5 µSv/h–10 µSv/h. In one case, a time-averaging concept appears to be applied with a maximum dose-rate of 60 µSv/h being tolerated at the barriers provided the cumulative dose in an 8 hour period does not exceed 3 µSv. In another case, (Switzerland) the system appears to be based on the concept of a “weekly” limit which, in practice, has translated into dose-rate limits at the barrier of 0.1 mSv/h if the work is undertaken outside a building and 0.02 mSv/h if the work is undertaken inside a building. In Italy, where a value is not specified in a license then it is expected that appropriate advice would be taken from a Qualified Expert. It is clear that this is an area where there is scope (and need) for a significant degree of harmonisation in approach which, in turn, would aid optimisation of exposure.

For the majority of countries there is no specified maximum for the size of the area demarcated by the barriers. Two countries made reference to the fact that it would be expected that the area demarcated should be easy to manage and supervise. With respect to the nature of the barriers themselves, 50% of the countries responded that there is some specification as to requirements (even if this is just in supporting guidance). However, while typical components were referenced, for example “tape”, warning lights, signs with trefoils etc there is, again, clearly an inconsistency in approach. A similar situation was recorded with respect to warning devices with no consistent pattern with respect to distinguishable warnings, fail-to-safety requirements etc.

Most respondents stated that the position of barriers is verified primarily by means of dose-rate measurement (with visual inspection and supervision being a secondary mechanism). However, while it is encouraging to see that monitoring is a requirement and expected in practice previous evidence[2] suggests that this is often something that is not carried out in practice.

v) *Personal Dosimetry*

15/17 countries responded that wearing dosemeters is a legal requirement (2 countries did not provide a respond to this). Interestingly, in response to this question one respondent (Malta) added a comment to the effect that recorded doses are well below the limit for category A workers.

For 9/17 countries alarming dosemeters are required in addition to the legal dosemeters and for a further 5 such dosemeters are recommended in supporting guidance. For 7/17 electronic cumulative dosemeters are also required.

v) *Emergency Equipment*

Only 50% of respondents reported that emergency equipment is required to be routinely carried by radiographers and for only 5/17 is this a compulsory requirement. Just under 50% responded that while there is no specific requirement, emergency equipment was generally carried in practice. A number of respondents listed equipment likely to be made available, but again, there appears to be little by way of consistency in approach.

Overall, the picture painted here is of a rather weak approach to the use of emergency equipment (and possibly to the wider issue of emergency preparedness?). This is certainly an area where improvements should be sought.

vi) *Liaison with clients : Co-operation*

Respondents were asked if there are requirements for active co-operation between radiography companies and their clients. 15/17 responded positively to this (the remaining 2 did not provide any response) and for 9 /15 such co-operation is a specific requirement in regulation. Obtaining information about client premises prior to work beginning is generally undertaken in practice (in some cases advised in guidance) but this is only a regulatory/license requirement in 2 countries.

It was this aspect of the work that drew most comments from respondents; in summary it is generally that such co-operation is essential not only from a radiation safety point of view but also from the perspective of efficiency.

3.6.2 Summary Conclusions

i) From a practical point of view, the minimum number if personnel required in a team undertaking mobile radiography should be determined by how many it takes – given the specific circumstances – to ensure that a) the work can be carried out the appropriate technical standards, b) can be carried out safely and c) adequate supervision can be maintained. In the main, this minimum number would be expected to be 2, as suggested by the majority of respondents but it should be noted that in some situations more than 2 persons would be required; it would be expected that this would be identified in risk assessments. Some harmonisation of approach would be prudent here.

ii) It appears that it is reasonably common practice for client companies to place restrictions on those providing mobile radiography services. It must be recognised that such restrictions *may* hamper the efficient undertaking of the work and *may* detract from optimisation. Such issues could be resolved with appropriate dialogue and co-operation between parties.

iii) There is a need for greater harmonisation with respect to the criteria applied with respect to the positioning and demarcating of barriers for mobile radiography.

With respect to the former a simple dose-rate criteria, for example 10 μSv/h might represent an optimum approach.

iv) Dose rate monitoring is the optimum method of ensuring the correct positioning of barriers and should be required on all occasions.

v) On the basis of the information provided it must be concluded that a greater degree of both harmonisation and optimisation is required with respect to emergency planning and preparedness.

vi) Effective co-operation between client and provider is an essential component with respect to optimisation in mobile radiography.

3.7 Accidents/Incidents

Here, the objective was to ascertain the availability of information on incidents and accidents occurring during (or associated with) industrial radiography.

3.7.1 Overview

All 17 respondents reported that accidents/incidents in industrial radiography are notifiable to the Regulatory Authorities with the notification being the responsibility of the employer/license holder. However, the criteria for notification are varied with little consistency between countries; notification may be based on any one or more of –

- worker dose limits exceeded
- public dose limits exceeded
- leakage or loss of material
- damage to, or failure of equipment

More than 50% if those responding reported human error being the main cause of accidents and incidents in industrial radiography with mechanical failure being the next most cited reason. However, in only 6 countries was this based on documented evidence; for others it was either a widely held or personal view that was being expressed. A significant percentage reported that mechanisms are available for the feedback of lessons learned, generally by way of feedback from regulators or via training programmes. Although it is known that at least 2 incident database systems exist (RELIR in France and IRID in the UK) neither of these was quoted as an example of a feedback mechanism.

With respect to whether or not accidents or incidents occurring in the past 5 years had an impact on working practices only 4/17 responded positively. Supporting comments focussed mainly on improvements made to training programmes.

3.7.2 Summary conclusions

i) The fact that human error is so frequently cited as a primary cause of accidents and incidents perhaps points to a lack of sufficient competence amongst radiographers. Lack of competence may be due to lack of understanding, insufficient knowledge, a lack of basic ability or a mixture of all three. Clearly, training is a key issue here and one conclusion that must be drawn is that there may be inherent inadequacies within available training schemes. A further observation is that there may a lack of understanding on behalf of employers as to the personal attributes required of those individuals wishing to become industrial radiographers.

ii) Effective equipment maintenance and adherence to appropriate equipment standards are key factors in the reduction of the potential for accidents and incidents.

iii) Feedback mechanisms for lessons learned are a positive aid to optimisation and the advantages are clearly understood by the respondents. Incident databases, either on a national or international basis, are an invaluable tool in this respect and should be encouraged.

3.8 Personnel Profile and Training Standards

3.8.1 Overview

i) *Radiographer Profile*

In the majority of countries (10/17) the qualification route for NDT personnel is via specific technical training schemes although there may be some choice as to which scheme is followed. In general, such formal technical training is compulsory; only 2 countries (Italy and Slovenia) suggested that evidence of technical experience or demonstration of competence on its own would be sufficient. For the majority of countries there is no pre-requisite level of basic education, although for some education to at least secondary level is expected. (In Slovenia degree level education is required for those wishing to be appointed as RPOs).

There was a mixed response as to whether or not there is a hierarchy of NDT qualification within a country. 5/17 responded “no” but a further 5/17 responded “yes” referring directly to EN473 or a national system based on the requirements of EN473; the latter specifies qualification levels 1 – 3.

Approximately 50% of countries confirmed that the concept of an “assistant radiographer” and in all cases this was supported with information the effect that such assistants typically have a limited range of duties and their work is kept under close supervision. However, there does seem to be considerable variation with respect to the degree of formal training (if any) provided to assistant radiographers.

ii) *Management of Radiation Protection*

For the majority of countries the appointment of an RPO (as defined) is required (2/17 responded “no”). However, >50% reported that an RPO does not have to be present during radiography. In the majority of countries the employer is required to consult with an RPE as defined.

In most cases, with respect to mobile radiography on client premises the responsibility for radiation safety lies with the NDT company, although a number of respondents noted that the principle of co-operation generally applies.

iii) *Radiation Protection Training*

15/17 countries reported that regulation requires that industrial radiographers undertake training specifically in radiation protection, although in most cases this by way of requirement for all radiation workers rather specifically industrial radiographers. In the main, such training is provided by specialist radiation protection training providers. One country (Italy) responded that radiation protection training could be provided via OJT only.

8/17 reported that different levels of training are provided, that is, training for radiographers and then a higher level of radiation protection training for RPOs. One country specifically noted that training is based on IAEA guidance for industrial radiography. In almost countries there is a requirement for refresher training although the required frequency varies between (typically) 2 and 5 years.

3.8.2 Summary Conclusions

i) The concept of “assistant radiographer” appears to be fairly commonplace. However, there could be a greater degree of harmonisation as to the expected role of such assistants (this could be defined in guidance) and the required level of both technical and radiation protection training.

ii) Greater harmonisation could perhaps be achieved with respect to the management of radiation protection in practice, particularly with respect to the role of the RPO. While it could be argued that the RPO does not have to present at all times (for example during periods of radiography in enclosures) there should always be provision for adequate supervision of the work and accessibility to an RPO.

iii) There is an expectation that specialist radiation protection training will be provided. This is considered to be a positive perspective, however, in the interest of promoting optimisation those providing the radiation protection training must have knowledge of the practice of, and issues associated with industrial radiography. This is perhaps not always the case and could well be a contributory factor to the perceived weaknesses in some specialist training.

3.9 General Comments

The majority of the general comments made have been reflected in the preceding text. However, a particular comment of note was that "a link between NDT professional organisations and the radiation protection community could be reinforced". This comment reflects a significant observation of this project in that there appears to be very little interface or engagement between the radiation protection community and the NDT industry; this is considerable weakness.

4. WP3: DEVELOPMENT OF CODE OF PRACTICE

The second objective of this project was to produce written guidance, or "code of practice", focussing on working arrangements and procedures. The guidance should be such that, if followed, it would help to ensure that ALARA is achieved in practice during industrial radiography. Information gained from the project questionnaire largely confirmed existing perceptions that the majority of radiation safety issues (and indeed, the greater potential for radiation accidents) are with respect to mobile radiography and related to either equipment or procedures. This being the case the drafted guidance is focussed on mobile radiography.

The primary target audience for the guidance is the NDT industry, specifically operators and radiography personnel. However, the guidance is also relevant to client organisations and to Regulatory Authorities. The desired outcome is that compliance with this guidance becomes accepted – and expected – practice for the conduct of mobile radiography within Member States. The guidance addresses four main areas: personnel, equipment, procedures and emergency preparedness (as noted in section 3 the latter is possible an area of some considerable weakness). Ideally the guidance should complement any specific requirements of national legislation. It should also complement and/or be included in any training programmes for industrial radiography personnel (although should not be considered as a substitute for training).

It should be noted that within the timeframe of this project the IAEA was drafting a new Safety Guide, "Radiation Safety in Industrial Radiography"[5]. Account has been taken of the contents of this new Agency Guide in the preparation of the European Guidance.

The project guidance is presented as a separate document, "Guidance for Industrial Mobile Radiography".

5. DEVELOPMENT OF INITIATIVES TO IMPROVE AND SUPPORT TRAINING

As noted in section 3:8 there is a wide range of training available to support the qualification of industrial radiographers. With respect to *technical* qualification the majority of countries require (or expect) formal qualification for NDT personnel via specific training programmes. With respect to radiation protection training this appears more often to be provided by specialist providers of radiation protection training and, although it may be inherent to the qualification process, this is perhaps not necessarily the case. It is worth considering the process of technical qualification, in particular the current European Standard EN 473, and existing guidance on radiation protection training for the NDT sector in more detail.

5.1 EN 473: Qualification and Certification of NDT Personnel

Although there may be some choice in the training scheme followed in any particular country a significant number of respondents notes that national schemes followed, or reflected the requirements of, European Standard EN 473:2000[3]. This European Standard establishes a system for the qualification and certification of personnel who perform industrial NDT, including radiographic testing. Within the standard the terms "qualification" and "certification" are defined as follows:

"Qualification" - evidence of training, professional knowledge, skill and experience as well as physical fitness to enable NDT personnel to properly perform NDT tasks.

"Certification" - procedure used to demonstrate the qualification of NDT personnel in a method, level and sector, and leading to the issue of a certificate. Certification does not include operating authorisation.

The standard specifies three levels of qualification (1, 2 and 3) broken down as follows:

<u>Level 1</u> Individual has demonstrated competence to carry out NDT according to written instructions and under the supervision of level 2/3 personnel. Level of competence considered to be sufficient to permit the individual to

- set up NDT equipment
- perform the tests (but not chose the test method)
- record and report (but not assess) results.

<u>Level 2</u> Individual has demonstrated competence to perform non-destructive testing according to established/recognised procedures. Individual may be permitted to:

- select NDT technique
- translate standards and specifications into instructions

- set up, perform and supervise tests
- interpret and evaluate results
- carry out and supervise all level 1 duties
- provide guidance for personnel at, or below, level 2
- organize and report results

<u>Level 3</u> Individual has demonstrated competence to perform and direct NDT operations for which he is certificated. Individuals may:

- assume full responsibility for test facility/centre/staff
- establish and validate instructions and procedures
- interpret standards, codes, specifications' and procedures
- designate test methods to be sued
- carry out and supervise all level 1 and 2 duties

In order to be eligible for certification (at any level) individuals must fulfil the requirements for training and industrial experience and successfully complete the relevant examination. With respect to training the standard minimum training requirements are specified in terms of total duration (to include both practical and theoretical work); a syllabus or guidance on content of training is not specified within the standard but reference is made to recommendations[4] issued by the International Committee on Non-Destructive Testing as an appropriate basis for training and examination syllabuses. Similarly guidance is provided in respect of required minimum duration of experience. These various requirements are summarised in the table below.

Qualification Level	Minimum training[1] duration (hrs)	Minimum experience(Months)
1	40[ii]	3
2	80[iii]	9
3	Not specified[iv]	Not specified[iv]

i) For RT – Radiographic Testing
ii) Or the legal duration of a week of work
iii) Direct access to level 2 examination requires the total hours for level 1 and level 2
iv) There are options for the preparation of individuals for level 3 qualification; this may be by attending training courses, conferences or seminar, by self-study or by a combination of methods.

The syllabus recommended by ICNDT (published 1985) covers 9 topic areas:

1. Physical Principles of radiographic testing
2. Equipment – radiation sources
3. Equipment – detection systems
4. The radiographic process
5. Type of defects
6. Selection of NDT method
7. Selection of testing method
8. Reporting and interpretation
9. Personnel safety and radiation protection

- with some details given as to the subject areas to be covered at each qualification level. However, there is no guidance given with respect to the depth to which each subject should be covered, where it is appropriate to include practical works, what degree of competence is required in that subject area etc. For example, all that is listed in section 9 (Personnel safety and radiation protection) is as follows:

- Hazards of excessive exposures
- Maximum permissible dose levels
- Methods of controlling radiation dose by time/distance/shielding
- Specific equipment requirements (sources, survey, recording, exposure shields/rooms, operation/alarms)

Clearly, how the above is taught and presented is open to interpretation.

ESN 473 specifies the format of the examinations for each level, for example the number of multiple choice questions and the number of technique-specific "short-answer" questions. However, no guidance is given with respect to the content of questions or what the line of questioning should be trying to ascertain by way of "knowledge" or "understanding".

5.2 AEA Initiatives

Radiation safety training for industrial radiographers is an area where the IAEA has been pro-active in recent years. This work has been driven largely as part of the Agency's current strategy for education and training in radiation protection and safety, the ultimate objective of which is to establish self- sustainable training in IAEA Member States. The most relevant initiatives are outlined below.

5.2.1 Specialised Training Packages

In 2000 the Agency commissioned the preparation of a series of "specialised" training packages – aimed at those charged with *providing* training – for a number of sector specific applications, one of which was industrial radiography. The aim of these packages was to provide trainers with sufficient guidance and outline material to run radiation safety courses, at both the basic awareness level and for RPOs. The thinking behind this project was that if prospective trainers followed this guidance then there would be a) consistency in approach b) an appropriate level of training provided and c) a move towards national sustainability (external trainers would not have to be provided). The structure of the package for industrial radiography is summarised below.

Introductory Notes	-	These consist of a brief note outlining how the package is intended to be used, a clear description of the target audiences, aims and objectives of the course(s), the syllabus (broken down into 7 modules) and suggested outline programmes(s).
Module Overviews	-	An overview is provided for each module containing specific guidance for the presenter, the recommended module structure in terms of presentations and exercises (including recommended durations) required resources and associated activities. An example of a module overview is given in appendix E.
Lecture Plans	-	Again, one for each presentation within each module with specific guidance for the presenter as to the preferred structure of the presentation and comment on any specific issues to raise, discuss etc. An example is given in appendix E.
Notes	-	Detailed supporting notes (for students) provided for each presentation.
Powerpoints	-	Outline Powerpoint presentations are provided for each presentation.
Exercises	-	Example practical and desk-top exercises
Exam questions	-	Suggested exam questions for both courses.

This is an extremely useful and well-constructed package a significant feature of which is the guidance provided to presenters. The package is available on request from IAEA (www.iaea.org).

5.2.2 Train-the-Trainer courses

A further initiative form the IAEA in recent years has been the development of the "train-the trainer" approach. The primary objective with this, from the Agency's perspective us to establish a pool of appropriate and competent trainers in member states thus aiding the attainment of sustainability. However, from more general perspective a significant advantage of a train-the trainer's approach is the promulgation of consistent and harmonised training standards. It is considered that such an initiative could be of considerable value with respect to improving, or providing added value, to radiation protection training within NDT with the training of potential trainers being driven by specialist radiation protection trainers with the relevant operational experience of industrial radiography.

5.3 Conclusions

i) One of the key observations from the result of the project questionnaire is that there is a perceived lack of competence (in radiation safety) among those undertaking industrial radiography. It is probably fair to say that there are many qualified and certificated radiographers who lack a sound understanding of radiation issues and to whom the concept of ALARA is not as intuitive as it perhaps should be.

ii) EN473 provide a solid model for qualification and certification and is an appropriate model to follow. However, it could be strengthened with prospect to guidance on required levels of radiation safety training. Specific reference within any future revision to EN473 to an agreed European Training Standard for NDT would be a positive step.

Iiii) IAEA initiatives in the area of radiation safety training for NDT are very positive and a useful model to follow.

Proposals for training standards have been drafted taking into account the specific outcome of the project questionnaire and reflecting the issues raised above. These are presented separately to this report.

6. WP5: ESTABLISHMENT OF WEB PAGE

A web page dedicated to the NDT ALARA network has been developed on the general European ALARA Network (EAN) web site (www.eu-alara.net). The web page includes two sections with different levels of access:

- A public section, where the following information can be found:
  i. Background and objectives of the project,
  ii. Composition of the Working Group.

  In addition, it is intended that the final draft Code of Practice for NDT as discussed above and the agreed Final Report will be made available on that web page.

- A private section, only accessible by the Working Group members, which makes available all documents, which are useful for the work of the Working Group. It includes the original questionnaire and all the responses from the different stakeholders.

Moreover the setting-up of the network was announced on the home page of the EAN web site in February 2007. The conclusions of the project will also be published on the web page as well as on the European ALARA Newsletter. Finally, the EAN web site also includes a link towards the EFNDT web page.

7. SUMMARY CONCLUSIONS

The specific detailed observations and conclusions drawn from this project are addressed in the project deliverables. “Code of Practice” and “Training proposals for Industrial Radiography”. A summary of the broader issues is presented below.

1. A key observation from this project is that there could and should be a greater degree of interaction between the various stakeholder groups, in particular between the industry itself – arguably best represented by the NDT societies – and the radiation protection community. Despite the difficulties encountered in engaging with the industry during the course of this project, it became clear that there is a willingness (despite of some constraints) on the part of EFNDT to contribute to future improvements. The establishment of a Memorandum of Understanding between EFNDT and EAN would serve to aid progress.

2. Although the response to the project questionnaire was limited, one evidence provided suggested that industrial radiography is, on balance, a less favoured inspection technique within NDT. It may be that this low profile within the industry is a contributory factor to the perceived weaknesses in radiation protection standards.

3. It appears to be the case that there is a degree of migration of industrial radiographers between countries. This underlines the need for harmonization in approach to training and qualification and an expected consistency in working practices.

4. Inspections of NDT providers, whether by Regulatory Authorities or by client companies are considered to be of valve; they not only serve to help ensure compliance but contribute to a greater awareness of the radiation protection issues. However, it is essential those undertaking inspections fully understand the operational issues, legislative requirements and radiation protection implications.

5. Greater harmonisation with respect to authorisation and licensing processes would be of value.

6. A greater degree of harmonisation with respect to the application of the relevant international standard for gamma sources, currently ISO 3999-1(2000) is required. Compliance with this standard throughout Member States should be expected as a matter of course.

7. With respect to radiography undertaken in enclosures there could be greater harmonization and optimisation with respect to the use of warning signs and effective devices. In particular, it is considered that there should be a greater consistency in approach between x and gamma radiography.

8. Effective co-operation between clients and NDT providers is an essential feature of optimisation in mobile radiography. Such co-operation and dialogue should always be encouraged.

9. Feedback mechanisms for lessons learned as a result of accidents and incidents are a positive aid to optimisation. As such, national and international incident databases are an invaluable tool and should be encouraged.

10. With regard to the provision of specialist radiation protection training for those undertaking or involved in NDT, it is essential that those providing the training have knowledge and understanding of both operational and radiation protection aspects of the practice. This is perhaps not always the case and an area where improvements could be sought by, for example, the promotion of a "train-the-trainers" approach or by the appropriate "approval" of training providers.

8. REFERENCES

1. EAN 2nd Workshop "Good Practices in Industry and Research" – Chilton, UK, November 1998
2. EAN 5th Workshop "Industrial Radiography: Improvements in Radiation Protection" – Rome, October 2001
3. EN 473: 2000 "Non –Destructive Testing – Qualification and Certification of NDT Personnel – General Principles."
4. ICNDT : Recommendation ICNT WH 17-85 Radiographic Testing
5. IAEA: Safety Guide: "Radiation Safety in Industrial Radiography.

APPENDIX A MANAGEMENT and CO-ORDINATION

A1 Establishment of Working Group

The project Working Group was established from representatives from EAN, EFNDT and persons nominated as being able to provide an industry perspective:

Joanne Stewart HPA Radiation Protection Division Occupational Services Department Hospital Lane Cookridge Leeds, UK LS16 6RW Tel : 0044 113 2679041 Mob: 0044 7789922300 Email: joanne.stewart@hpa.org.uk Fax: 0044 113 261 3190	Francois Drouet CEPN 28, rue de la Redoute 92260 Fontenay-aux-Roses France Tel: 0033 1 55 52 19 30 Mob: 0033 6 26 61 52 29 Email: drouet@cepn.asso.fr Fax: 0033 1 55 52 19 21
Hein Hoogstraate Radiologische Advies DienstB.V Ooievaarlaan 22 2566 WV The Hague Tel : 0031 70 362 08 66 Mob: 0031 6 474 605 47 Email: hein@hoogstraate.com Fax:	Gonzague Abela EDF Nuclear Power Plant Operations CAPE-GPR (Risk Prevention Group) 1 Place Pleyel 93282 Saint Denis CEDEX France Tel: 0033 1 43 69 31 13 Mob: Email: gonzague.abela@edf.fr Fax: 0033 1 43 69 45 71
Dolores Aguado Nuclear Safety Council Industrial Radioactive Installations Branch Operational Radiological Protection C/Pedro Justo Dorado Dellmans, 11 28040, Madrid Spain Tel: 0034 91 34 60 180 Mob: 0034 650 217 556 Email: dam@csn.es Fax:	Bernhard Redmer (EFNDT) Federal Inst.for Materials Research and Testing (BAM) Division VIII.3 Unter den Eichen 87 12205 Berlin Germany Tel : 0049 30 81041831 Mob: Email : bernhard.redmer@bam.de Fax : 0049 30 81041837

APPENDIX B: PROJECT QUESTIONNAIRE

European
ALARA
Network

European NDT ALARA Network

Project Questionnaire

Introduction

A fundamental principle in radiation protection is that radiation exposures should be kept as low as reasonably achievable (ALARA). This concept underpins the approach taken to practical radiation protection and has had a positive impact in driving doses down over the years. However, industrial radiography is a work sector that has given rise to some significant occupational exposures and it has been identified as an area where there is scope for further application of the ALARA principle.

In recent years this issue has been taken up by the European ALARA Network (EAN) which took the matter as the focus of its 5th Workshop, “Industrial Radiography: Improvements in Radiation Protection” in Rome in 2001. A direct outcome of this workshop has been the establishment of a Working Group, with representation from both EAN and EFNDT (European Federation of Non-Destructive Testing) to progress, via an EU funded project, the actions identified at the workshop

Aim of the Project

The overall aim of this project is to establish an active European NDT ALARA network that will facilitate the promotion of the ALARA principle in industrial radiography. It is the intention that, when operational, the network will provide a forum for exchange of knowledge and information between all stakeholder groups as well as providing a mechanism for issuing practical guidance with respect to a structured approach to the application of ALARA in NDT. In practice, this network will be a sub-network of the existing EAN.

The overall aim is being attained via the execution of a number of specific tasks over the duration of the project. In summary, these include

- a review of optimisation and harmonisation of radiation protection in the NDT industry
- development of written guidance focussing on working arrangements and procedures, and
- developments of initiatives to improve and support radiation safety training in NDT

Role of this questionnaire

The first stage in the project is to collate information on current practices relevant to radiation protection in the NDT industry in Member States and this is being achieved the attached questionnaire. Data and information obtained from the responses to the questions asked will allow us to progress the tasks detailed above, taking into account national needs and experiences as well as the views of all stakeholder groups.

How you can contribute

You have been identified as representing one of the stakeholder groups and any information that you could provide is extremely valuable to us. We recognise that the questionnaire is very comprehensive, but you will appreciate that the more information that we are able to obtain at this stage the more robust the final outcome will be. For ease of use, the questions have been categorised into sections (detailed below) according to topic - please complete the questionnaire as fully as you can but note *we do not necessarily expect you to complete all sections*. You are, of course, free to pass the questionnaire to colleagues (or obtain data and information from colleagues) but please do not go outside your stakeholder group.
The structure of the document is outlined below:

We recommend that you proceed as follows:

i) Read through the glossary of terms used

i) Provide us with details about yourself in part II; it is important that you identify your stakeholder group

iii) Work through the 8 sections of questions; please note that the questionnaire is designed to be completed electronically. If there are sections on which you do not feel qualified to comment, then please indicate this on the table in part II.

Please send the completed questionnaire back to me by email by the 20 June at the latest. If you need more information about the questions or wish to discuss the issues in more detail please do not hesitate to contact me.

The Working Group thanks you very much for your collaboration in this project.

Yours sincerely

Joanne Stewart
On behalf of EAN NDT Working Group
(etc)

PART I: GLOSSARY OF TERMS

"Non-Destructive Testing (NDT)"

A method of testing or inspecting equipment and materials that does not destroy them or affect their performance or properties. There are a number of NDT methods (eg, ultrasonics, dye penetrant) one of which is *industrial radiography*

"Enclosure Radiography"

Industrial radiography undertaken in a purpose-built, adequately shielded enclosure.

"Mobile Radiography"

Radiography *not* undertaken in a purpose-built enclosure undertaken; the subject under inspection is radiographed in-situ using portable equipment. May also be referred to as "site", "open-shop" or portable" radiography.

"Fail-safe"

A term used to describe the operation of safety and/or warning devices eg, door interlocks where, in the event of failure of that device the system will default to a safe condition.

"Search-and-lock-up"

Associated with radiography compounds, such systems require the full area of the enclosure to be properly checked and vacated before the exposure can be initiated. The check is confirmed by the operation of "search" buttons within a pre-determined time before the area is closed and irradiation begins.

"Radiation Protection Expert (RPE)"
The term Radiation Protection Expert (RPE) refers to the specific definition used in a country's law and may be more or less equal to the definition of the "Qualified Expert" in Council Directive 96/29/Euratom, or in the International Basic Safety Standards (Safety Series No. 115, IAEA, Vienna, 1996). That is:
"*An individual who, by virtue of certification by appropriate boards or societies, professional licenses or academic qualifications and experience, is duly recognized as having expertise in a relevant field of specialization, e.g. medical physics, radiation protection, occupational health, fire safety, quality assurance or any relevant engineering or safety speciality".*

"Radiation Protection Officer (RPO)"
An individual appointed by the registrant/licensee/employer to supervise or oversee the execution of practices. Defined in the IAEA international Basic Safety Standards as:

"*An individual technically competent in radiation protection matters relevant for a given type of practice who is designated by the registrant or licensee to oversee the application of the requirements of the standards*".

"Education"
Within the context of this project, "education" is defined as provision of the initial knowledge base, for example, as might be obtained from a degree or diploma course, post-graduate study etc.

"Training"
Within the context of this project, "training" is considered to be the provision of specific expertise and competencies.

"Training Schemes"
A series of linked training (or education + training) events.

"On-the-Job Training (OJT)"
On-the-Job Training (OJT) is a form of training in which the trainee works at a suitable environment where the facility or the infrastructure needed for the OJT is available, under the supervision of an experienced supervisor/expert (hands-on experience).

"Work Experience"
Experience gained from actively working, gaining in-depth knowledge and understanding of the issues.

"Client"
An employer using the services of another company (or individual) to provide NDT.

"Accident": "Incident"
Within the context of this questionnaire these two words are considered to have the same meaning. An accident/incident is an unplanned event or occurrence with potential or actual consequences with respect to the radiation safety of personnel.

PART II: RESPONDENT DETAILS

Name:

Affiliation:

Address:

Country:

E-mail:

Telephone:

Fax:

Please select which of the following stakeholder groups you represent

☐ Regulators ☐ NDT industry ☐ Clients ☐ Radiation Protection Community

☐ Other (please specify)

We may wish to follow up on specific issues. It would be helpful if you could identify any additional contacts that you feel are relevant.

On completion of the questionnaire, please identify those areas commented on:

A. National Overview	☐ Comments provided	☐ Unable to comment
B. Regulatory Requirements	☐ Comments provided	☐ Unable to comment
C. Radiography Equipment	☐ Comments provided	☐ Unable to comment
D. Radiography in enclosures	☐ Comments provided	☐ Unable to comment
E. Mobile radiography	☐ Comments provided	☐ Unable to comment
F. Accidents/Incidents	☐ Comments provided	☐ Unable to comment
G. Personnel profile/Training standards	☐ Comments provided	☐ Unable to comment
H. General Comments	☐ Comments provided	☐ Unable to comment

PART III: QUESTIONS

A. National Overview

Objective:

To make a quantitative assessment of the degree of application of industrial radiography in each EU Member and Candidate State.

Questions:

A1. Are you able to provide an indication of the number of employers undertaking NDT in your country?

☐ Yes
☐ No

A2. If the answer to A1 is "yes", please provide a value.

This value is (please tick appropriate box)

☐ Based on documented evidence *Please indicate the source:*
☐ Based on an estimated value

A3. Do all of those employers providing NDT services offer industrial radiography as one of the inspection options?

☐ Yes
☐ No
☐ Not known

A4. Please provide an indication of what percentage of the NDT undertaken in your country is industrial radiography.

☐ Not known
☐ < 10%
☐ 10% – 25%
☐ 25% – 50%
☐ 50% – 75 %
☐ >75%

A5. Please indicate which of the following statements best represents the situation in your country.

Industrial radiography is

- ☐ always carried out enclosures
- ☐ where practicable carried out in enclosures
- ☐ rarely carried out in enclosures
- ☐ always undertaken in-situ using mobile equipment

Please comment on your response:

A6. With regard to radiography in *enclosures*, please indicate which of the following best represents the situation in your country.

Radiography is undertaken using

- ☐ mostly x-ray equipment
- ☐ mostly gamma sources
- ☐ a mixture of x-ray equipment and gamma sources

Please comment on your response:

A7. With respect to your answer to A6; if gamma sources are used please complete the following table

Radionuclide	**Usage** ***(Highlight one option)*** **_**	**Typical activity (Bq or Ci)**
Iridium-192	Typically/rarely/not used	
Cobalt-60	Typically/rarely/not used	
Selenium-75	Typically/rarely/not used	
Ytterbium-169	Typically/rarely/not used	
Others (please list)	Typically/rarely/not used	

A8. With respect to *mobile* radiography, please indicate which best represents the situation in your country.

Radiography is undertaken using

☐ mostly x-ray equipment
☐ mostly gamma sources
☐ a mixture of x-ray equipment and gamma sources

Please comment on your response:

A9. With respect to your answer to A8, where gamma sources are used please complete the following table:

Radionuclide	Usage ***(Highlight one option)**_*	**Typical activity (Bq or Ci)**
Iridium-192	Most often/rarely/not used	
Cobalt-60	Most often/rarely/not used	
Selenium-75	Most often/rarely/not used	
Ytterbium-169	Most often/rarely/not used	
Others (please list)	Most often/rarely/not used	

A10. The following is a list of industry sectors. Please rank them 1→6 according to the degree to which each sector makes use of industrial radiography services with “1” being the greatest users and “6” the lowest.

Nuclear sector
Non-nuclear Power
Construction

Petro-chemical
Manufacturing
Other

Please comment on your response:

A11. Are you able to provide an indication of the number of radiographers currently working in your country?

☐ Yes – please provide a value
☐ No

This value is (please tick appropriate box)

☐ Based on documented evidence *Please indicate the source:*

☐ Based on an estimated value

A12. Is the total number of radiographers considered to be adequate at the present time?

☐ Yes
☐ No

Please comment on your response:

A13. Have all radiographers currently working within your country obtained their NDT qualification within your country?

☐ Yes
☐ No
☐ Don't know

If "no", is a qualification gained elsewhere acceptable for employment?

☐ Yes
☐ No

Please comment on your response:

B. Regulatory Requirements

Objective:

To obtain information on the legislative approach to industrial radiography in EU member and candidate states.

Questions:

B1. Please list any national regulations relevant to industrial radiography. Please provide the title of the regulations and (for each) indicate whether they are general regulations, specific to industrial radiography or specific to certain aspects of radiography.

If would be helpful of you could provide web-links to regulations (in English) where available.

B2. Please list, and provide details of, any guidance documents, codes of practice etc relevant to industrial radiography in the table below. Again, it would be helpful if you could include web-links where relevant.

Document	Issued by	Target Audience

Additional comments on the above:

B3. Please list the name (and contact address) of the relevant Regulatory Authority (s). If more than one please indicate the aspect of work that each Authority is responsible for.

B4. Are organisations undertaking industrial radiography required to be authorised/licensed by a Regulatory Authority?

- ☐ Yes – for both radiography in enclosures and mobile radiography
- ☐ Yes – for radiography in enclosures only
- ☐ Yes – for mobile radiography only
- ☐ No

B5. If the answer to B4 was a "yes" please provide a brief description of the process. In particular, include details of any pre-requisites to be satisfied by the applicant, how long it might take before an authorisation/license might be granted and an indication of any fees payable.

B6. Aside from any requirements for authorisation/licensing are there requirements to <u>notify</u> a Regulatory Authority in respect of work undertaken? Please tick any of those that apply.

- ☐ Yes – Employer/licensee undertaking industrial radiography for the first time
- ☐ Yes – In the event of additional enclosures being used/built
- ☐ Yes – Each time mobile radiography is undertaken at a new site
- ☐ No – Notifications are not required

If you answered "yes" above please provide the following details (in respect of each).

- Where the responsibility for notification lies (the radiography company or the client)
- To whom the notification is made
- How far in advance of the work of the work the notification has to be made (days)
- With respect to mobile radiography, any special arrangements for urgent/emergency radiography

B7. Does the Regulatory Authority undertake inspections at premises where compound radiography is undertaken?

- ☐ Yes
- ☐ No

If you answered "yes" above:

- Is the retention of any authorisation/license issued conditional on satisfactory outcome of the inspection? ☐ Yes ☐ No
- Are the inspections pre-arranged ☐, or are they unannounced ☐ ?
- Is there a specified frequency for inspections? ☐ Yes (please state)

☐ No

B8. Does the Regulatory Authority carry out inspections when mobile radiography is in progress?

☐ Yes
☐ No

If you answered “yes” above:

- Is the retention of any authorisation/license issued conditional on satisfactory outcome of the inspection? ☐ Yes ☐ No
- Are the inspections pre-arranged ☐ or are they unannounced ☐ ?
- Is there a specified frequency for inspections ☐ Yes (please state)

B9. What enforcement action eg, prosecution, cancellation of license etc is available to Regulatory Authority(s) in the event of an employer’s arrangements for radiation safety being deemed to be unsatisfactory or a cause for concern? Please provide as much detail as possible.

Are details of any enforcement action taken by the Regulatory Authority(s) made available to employers, workers etc? (eg, published on a web-site).

☐ Yes
☐ No

If “yes” please provide details

B10. *Additional comments:* Please let us have any views you may have on the benefits/disadvantages of the approach to authorisation, notification and inspection in your country.

C. Radiography Equipment

Objective:

To make an assessment of the standard of equipment likely to be in use with a view to identifying whether or not there is scope for optimisation and/or harmonisation of approach.

Questions:

C1. The current international standard for gamma source containers is ISO 3999-1 (2000). Is there a specific requirement in your country for containers in use to comply with this standard?

- ☐ Yes – required by regulations or authorisation/license conditions
- ☐ Yes – recommended in guidance/codes of practice
- ☐ No

Additional comments on the above

C2. Please indicate the percentage of gamma source containers that comply with ISO 3999-1 (2000).

- ☐ Not known
- ☐ < 10%
- ☐ 10% – 25%
- ☐ 25% – 50%
- ☐ 50% – 75 %
- ☐ >75%

C3. Are any specific equipment standards applied with respect to x-ray equipment?

- ☐ Yes – required by regulations or authorisation/license conditions
- ☐ Yes – recommended in guidance/codes of practice

Please provide details

- ☐ No

Please comment on usual practice

C4. Are there are any requirements' for routine maintenance of gamma source containers (+ ancillary equipment) or x-ray equipment?

- ☐ Yes – required by regulations or authorisation/license conditions
- ☐ Yes – recommended in guidance/codes of practice

Please provide details

- ☐ No

C5. *Additional comments:* Please let us have any further views you may have on equipment standards

D. Radiography in enclosures

Objective:

To collate information on the practical approach to radiography with the aim of identifying those areas where harmonisation would be beneficial and/or optimisation could be improved.

Questions:

D1. In your country is the type and number of personnel that should be present during radiography in enclosures specified?

☐ Yes – in regulations or conditions of authorisation/license
☐ Yes – recommended in guidance/codes of practice

Please provide details

☐ No

If not, what are the usual arrangements?

D2. In your country, are requirements specified (in regulation, guidance, codes of practice or as conditions of authorisations/licenses) with respect to the design and construction of enclosures?

☐ No
☐ Yes – please provide reference

D3. Is there a restriction on the maximum dose-rate around the exterior of the compound?

☐ No
☐ Yes – please specify

D4. Is there a requirement to monitor dose-rates around the exterior of the compound periodically?

☐ No
☐ Yes – please specify

D5. Please summarise the normal storage arrangements for x-ray equipment and gamma sources used for radiography in enclosures.

Please indicate whether the above are:

☐ Regulatory requirements/license conditions
☐ Just representative of good practice

D6. Are there requirements for the installation of effective devices (eg, electrical or mechanical interlocks) to prevent access?

☐ No
☐ Yes – for x radiography only
☐ Yes – for both x and gamma radiography

If you answered "yes", please provide details

D7. Is there a requirement for search-and-lock-up *(see glossary)* facilities?

☐ No
☐ Yes – always
☐ Yes – under certain circumstances. Please specify

D8. Is the design/construction of a radiography enclosure required to includes a contingency in the event of a person becoming trapped inside during an exposure (eg, emergency cut-off buttons, shielded areas)?

☐ No
☐ Yes – please specify

D9. Are requirements for warning devices/signs prescribed?

☐ No
☐ Yes – please provide an answer to each of the following

X-Radiography: select which of the following are required

☐ indication that the tube is in a state of readiness (power on)

☐ a pre-exposure warning

☐ an exposure warning (*distinguishable* from pre-exposure warning)

Where required, are the above expected to operate automatically? ☐No ☐ Yes

" " " " " be "fail-safe"? ☐ No ☐ Yes

Are the warnings visible/audible outside and inside the compound? ☐ No ☐ Yes

Please comment on any supplementary warnings or sign/notices required (eg, explanatory notices, emergency stop signs etc)

Gamma radiography: select which of the following are required

☐ a pre-exposure warning

☐ an exposure warning (*distinguishable* for the pre-exposure warning)

Where required, are the above expected to operate automatically? ☐No ☐ Yes

" " " " " be "fail-safe" ? ☐ No ☐ Yes

Are the warnings visible/audible outside and inside the compound? ☐ No ☐ Yes

Please comment on any supplementary warnings or sign/notices required (eg, explanatory notices, emergency stop signs etc)

D10. In your country is there any requirement for routine maintenance of safety and warning devices in radiography compounds?

☐ Yes – required in regulations or conditions of authorisations/licence
☐ Yes – recommended in guidance/codes of practice

Please provide details

☐ No

D11. *Additional comment:* Please let us have any further views that you may have on practical issues associated with compound radiography.

E. Mobile Radiography

Objective:

To collate information on the practical approach to mobile radiography with the aim of identifying those areas where harmonisation would be beneficial and/or optimisation could be improved.

Questions E12- E15 relate specifically to the relationship between the client and the radiography company.

Questions:

E1. Is the type, and number of, persons that should be present during mobile radiography specified?

☐ Yes – in regulations or authorisation/license conditions
☐ Yes – in guidance/codes of practice

If “yes” please provide details

☐ No

If “no” what are the usual arrangements?

E2. Are any restrictions placed on the radiography technique employed during mobile radiography (eg, use of x-ray prohibited, certain isotopes prohibited, restriction on source activities etc).

☐ Yes – specified in regulations or authorisation/license conditions
☐ Yes – specified in guidance/codes of practice
☐ Yes – sometimes by the client

If “yes” please provide details

☐ No

E3. Please summarise the normal storage arrangements for x-ray equipment and gamma sources used during mobile radiography.

Please indicate whether the above are:

☐ Regulatory requirements/license conditions
☐ Just representative of good practice

E4. In your country is there a dose or dose-rate criteria for determining the position of the barriers during mobile radiography?

☐ Yes – specified in regulations or authorisation/license conditions
☐ Yes – specified in guidance/codes of practice

If “yes” please provide details

☐ No

If “no” what is usual practice?

E5. Is there any restriction on the maximum size of the area demarcated by the barriers?

☐ Yes Please specify

☐ No

E6. Is there any specification with respect to the nature of the barriers? (eg, minimum number of warning signs, lights required, degree of supervision etc ..)

☐ Yes – specified in regulations or authorisation/license conditions
☐ Yes – specified in guidance/codes of practice

If "yes" please provide details

☐ No

If "no" what is usual practice?

E7. In practice, how is the correct positioning of the barriers checked?

E8. Are there specifications for required warning devices, signs etc?

☐ No

If "no" what is usual practice?

☐ Yes – specified in regulations or authorisation/license conditions
☐ Yes – specified in guidance/codes of practice

If "yes" please provide an answer to each of the following:

X-Radiography: select those required

☐ indication that the tube is in a state of readiness (power on)

☐ a pre-exposure warning

☐ an exposure warning (*distinguishable* from pre-exposure warning)

Where required, are the above expected to operate automatically? ☐No ☐ Yes

" " " " " be "fail-safe" ? ☐ No ☐ Yes

Gamma Radiography: select those required

☐ a pre-exposure warning

☐ an exposure warning (*distinguishable* from the pre-exposure warning)

Where required, are the above expected to operate automatically? ☐No ☐ Yes
" " " " " be "fail-safe" ? ☐ No ☐ Yes

Please comment on any supplementary warnings or sign/notices required (eg, explanatory notices) required during mobile radiography.

E9. With respect to personal dosimetry, which of the following are expected to be worn by radiographers undertaking mobile radiography? Please indicate whether this is a legal requirement or just recommended in guidance/codes of practice.

- A "legal" dosemeter (film badge or TLD) used to formally assess and record individual dose. ☐ Required ☐ Recommended
- An electronic alarm dosemeter, ie one that emits an audible alarm depending on the dose-rate. ☐ Required ☐ Recommended
- An electronic alarm as above that also measures and displays accumulated dose. ☐ Required ☐ Recommended

Additional comments on personal dosimetry

E10. Is the use of survey meters to measure dose-rates during mobile radiography required?

☐ Yes – required by regulations or authorisation/license conditions
☐ Yes – recommended in guidance/codes of practice
☐ Not required but generally used in practice
☐ No

Additional comments on dose-rate monitoring

E11. When undertaking mobile radiography are radiographers required to carry emergency equipment (ie, sufficient equipment to allow the recovery of any reasonably foreseen incident) in addition to the equipment required for routine work?

☐ Yes – required by regulations or authorisation/license conditions
☐ Yes – recommended in guidance/codes of practice
☐ Not required but generally done in practice
☐ No

If "yes" please specify what is required

E12. Are there any requirements in place for active cooperation between client and radiography company in advance/during the course of the work?

☐ No
☐ Yes – required by regulations or authorisations/license conditions
☐ Yes – specified in guidance/codes of practice

If "yes" please provide details

E13. Is information about clients' premises (eg, site plans, other work undertaken, safety personnel) required by the radiography company prior to the work being undertaken?

- ☐ Yes – required by regulations or authorisation /license conditions
- ☐ Yes – recommended in guidance/codes of practice
- ☐ No – but generally provided
- ☐ No

E14. Is a visit to the site (by the contracted radiography company) required prior to the work being undertaken?

- ☐ Yes
- ☐ No

E15. *General comments*: Please let us have any additional comments or observations that you would like to make regarding the practical aspects of mobile radiography.

F. Accidents/Incidents

Objective:

To ascertain the availability of information on incidents and accidents occurring during (or associated with) industrial radiography.

Questions:

F1. Are incidents/accidents in industrial radiography notifiable?

- ☐ Yes – required by regulations/conditions of license or authorisation
- ☐ Yes – recommended in guidance/codes of practice
- ☐ No

If "yes":

To whom is the notification made?

Who is responsible for making the notification?

What are the criteria for notification (please describe as fully as possible)?

F2. If possible, please identify the main causes of accidents/incidents in industrial radiography in your country.

Please indicate (select as many as appropriate) if your response is:

- ☐ based on documented evidence [Please reference the source]
- ☐ a generally accepted view in your country
- ☐ your own personal view

F3. Is there any mechanism for feedback of "lessons learned" as a result of radiation accidents/incidents?

- ☐ No
- ☐ Yes. Please describe

F4. Have any incidents/accidents that gave occurred in the past 5 years had an impact on working practices in industrial radiography?

- ☐ No
- ☐ Yes. Please provide details

F5. *Additional comments*: Please let us have any additional comments or observations that you would like to make regarding accidents and incidents.

G. Personnel profile/Training standards

Objective:

To build up a picture of the requirements for the training and qualification of personnel undertaking industrial radiography, with specific respect to training in radiation protection.

Questions G9 – G12 relate to NDT qualifications in general (ie, technique/skill), questions G10-G13 are concerned specifically with training in radiation protection.

Questions:

G1. What is the training/qualification route for NDT personnel in your country?

☐ Specified training scheme(s) that must be followed in order to become fully qualified.

Please provide details*

☐ Formal qualification required but a number of formal training schemes are available. Potential radiographers (or their employers) have a choice as to which route is taken.

Please provide details*

☐ Formal qualification not necessarily required, evidence of competence/work experience can be sufficient

Please provide details

* *Please include web-links to training schemes, national/international standards, training syllabus if possible.*

G2. Is there pre-requisite level of basic education (eg, secondary, graduate etc) for any of the qualification routes identified in G1?

☐ Yes – please provide details

☐ No

G3. In your country is there a hierarchy, or grading, for qualifications in NDT/radiography? Please provide details.

G4. Is the concept of "assistant radiographer" generally applied? If so, please provide a brief description eg, training requirements (if any), restrictions on duties etc

☐ Yes

Details

☐ No

G5. Is the employer of industrial radiographers required to appoint an RPO (see glossary) or equivalent (please provide title)? If so, please provide a brief description of the role and expected duties.

☐ Yes

☐ No

G6. Is an RPO (or equivalent) required to be present during radiography work? If not, what level of supervision is required? Please make clear any distinctions between compound and mobile radiography.

☐ Yes

☐ No

G7. Is the employer required to consult a Radiation Protection Expert (see glossary)? If so, please provide details as the nature of consultation required.

☐ Yes

☐ No

G8. With respect to mobile radiography on clients' premises, where does the responsibility for radiation safety lie? Please select the description that best fits the situation in your country.

☐ The client has overall responsibility for radiation safety; it is up to the client to make sure that all appropriate radiation safety arrangements are in place

☐ The NDT Company has overall responsibility for radiation safety

☐ Legislation requires that there is sufficient degree of co-operation between both parties to ensure an optimum level of radiation safety.

If none of the above, what is usual practice?

G9. Within your country is there legislation in place that requires industrial radiographers to undertake training specifically in radiation protection?

☐ Yes – legislation requires that all radiation workers undertake radiation protection training
☐ Yes – legislation specifies radiation protection training for industrial radiographers
☐ No

Please comment/provide details

G10. What is the usual route for obtaining radiation protection training?

☐ Generally incorporated as a component of the technical qualification schemes identified in question F1.
☐ Radiation safety training is generally obtained separately to the technical qualification from specialist training providers.
☐ No formal route, radiation protection training obtained on-the-job.

☐ A combination of the above.

Please provide details

G11. Are levels of radiation protection training specified?

☐ Yes – in regulations or conditions of license/authorisation
☐ Yes – in guidance/codes of practice

Please provide details *

**Please include web-links to training schemes, national/international standards, training syllabus, examinations etc, if possible.*

☐ No

G12. Is there a requirement for refresher training in radiation protection?

☐ Yes – specifically required by regulation/conditions of license or authorisation
☐ Yes – recommended in guidance/codes of practice

Please provide details

☐ No

G13. *Additional comments* : Please let us have any additional comments or observations that you would like to make regarding training, qualifications, requirements for supervision, expert advice etc.

General Comments

Please use this space to provide us with any further comment, additional information, suggestions etc that you feel might be useful to us in this project. Thank–you.

APPENDIX C: RESPONSES to QUESTIONNAIRE

Responses were obtained from a total of 17 countries, with the majority of respondents representing the either the regulatory or radiation protection stakeholder groups.

An overview of the responses to the individual sections of the questionnaire is given below. (In some cases the response provided from within a country was ambiguous; where this was the case this has been reported.)

Section A. **“National Overview”**

Objective: *To make a qualitative assessment if the degree of application of industrial radiography in each EU Member and Candidate State*

A1/A2 Are you able to provide an indication of the number of employers undertaking NDT in your country? If so please provide a value

Responses: 15/17 provided an estimate. Of these, 9 claimed that the number was based on documented evidence.

Numbers ranged from > 2000 (Spain) to 1 (Cyprus)

A3: Do all employers providing NDT services offer industrial radiography as one of the inspection options?

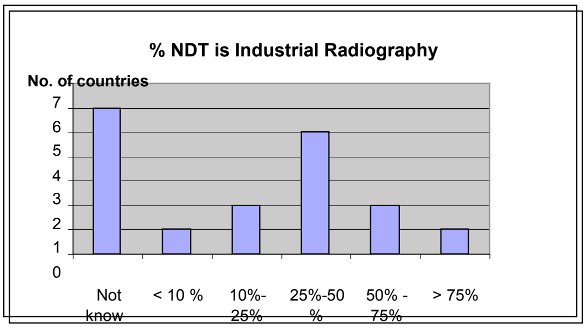
Responses:

“NO”	-	8/17
“Yes”	-	5/17
“Don’t know”	-	3/17
Ambiguous	-	1/17

A4. Please provide an indication of what percentage of the NDT undertaken in your country is industrial radiography.

Responses:

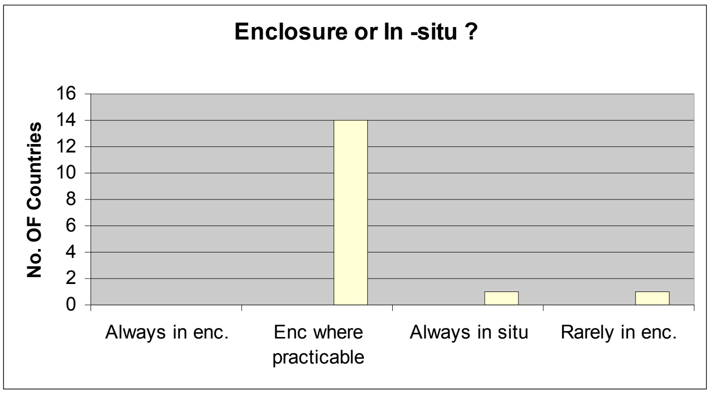
Not known	-	6/17
< 10 %	-	1/17 (Ireland)
10%-25%	-	2/17
25%-50 %	-	5/17
50% - 75%	-	2/17
> 75%		1/17 (Italy)



A5: Please indicate which of the following best represents the situation in your country.

Responses:

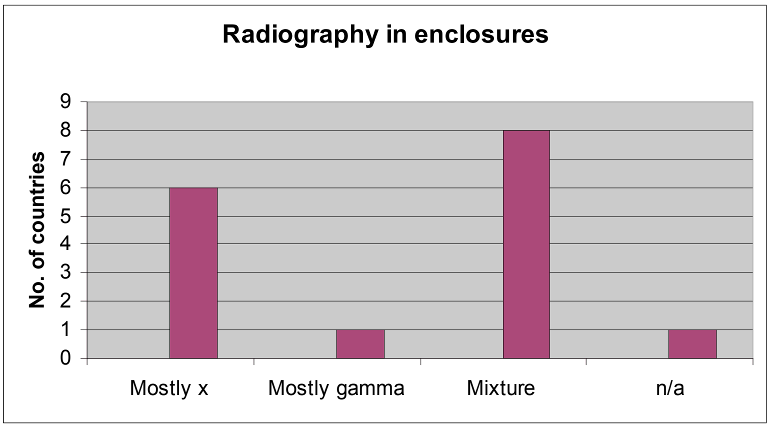
"Always carried out in enclosures"	-	0/17
"Where practicable carried out in enclosures"	-	14/17
"Always in situ with mobile equipment "	-	1/17 (Lithuania)
"Rarely carried out in enclosures"	-	1/17 (Cyprus)
Ambiguous	-	1/1



A6: With regard to radiography in enclosures please indicate which of the following best represents the situation in your country

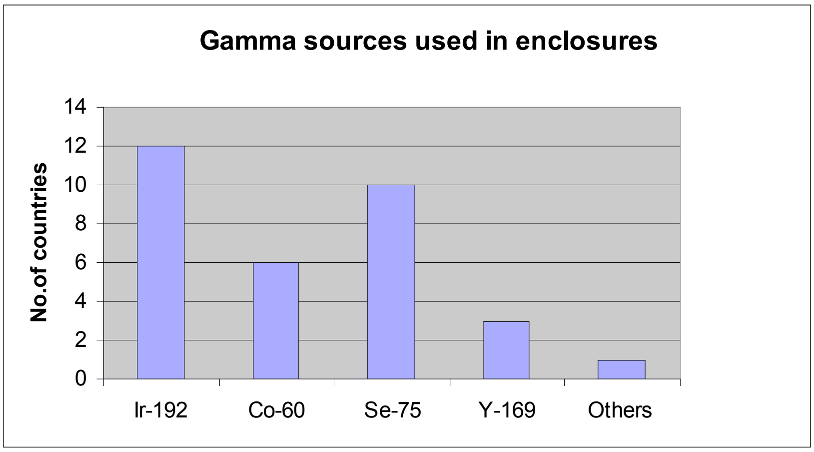
Responses:

"Mostly x-ray equipment"	-	6/17
"Mostly gamma sources"	-	1/17
"A mixture of x and gamma"	-	8/17
"N/A"	-	1/17
Ambiguous	-	1/17



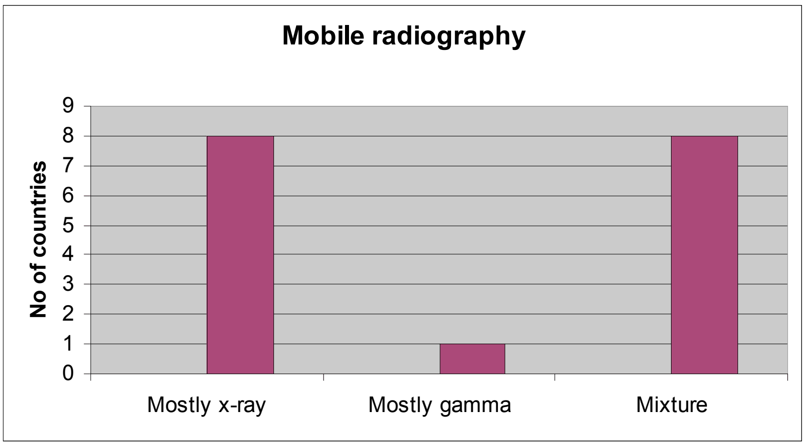
A.7 Please provide detail of gamma sources used in enclosures

Responses:	Ir-192 -	12/17	(30 Ci-1.2 TBq)
	Co-60 -	6/17	(30Ci – 620 Ci) (but rarely used)
	Se-75 -	10/17	(30 Ci – 100 Ci)
	Y-169 -	3/17	(10Ci -27 Ci)
	Others -	1/17	(Cs-137)



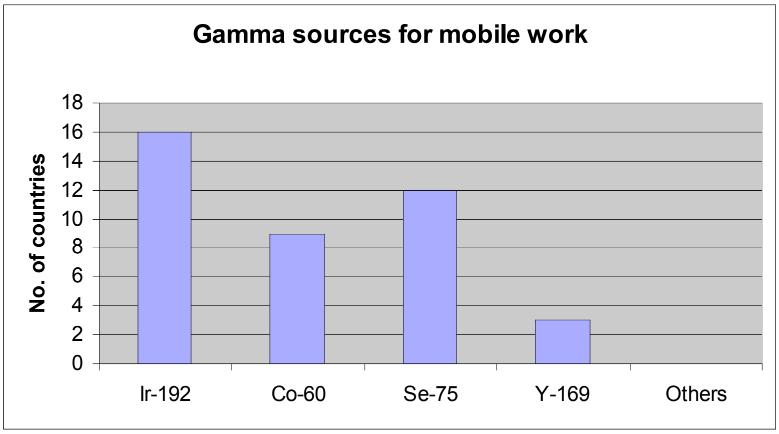
A8: With respect to mobile radiography. Please indicate which best represents the situation in you country.

Responses:	"Mostly x-ray equipment"	-	1/17 (Latvia)
	"Mostly gamma sources"	-	8/17
	"Mixture of x and gamma"	-	8/17



A9: Please provide details of the gamma sources used for mobile work

Responses:	Ir-192 -	16/17	(20 Ci-30 Ci)
	Co-60 -	9/17	(27Ci-100 Ci) (but rarely used)
	Se-75 -	12/17	(3 Ci - 120 Ci) (3 commented rarely used)
	Y-169 -	3/17	(10Ci -50Ci) (1 commented rarley used)
	Others -	0/17	(Cs-137)



A.10 Please rank industry sectors according to the degree to which each sector makes use of industrial radiography. ("1" greatest, "6" lowest")

Country	Nuclear	Non-Nuclear	Construction	P-chem	Manufacturing	Other
Austria	6	4	3	2	1	5
Belgium	5	4	2	1	3	0
Cyprus	-	1	2	-	3	-
France	1	3	5	2	4	-
Germany	1	2	5	3	4	6
Ireland	-	3	1	2	4	5
Italy	4	1	3	-	2	-
Latvia	-	3	2	1	4	5
Lithuania	1	2	4	3	-	-
Malta	-	2	-	3	-	1
Netherlands 1	4	3	5	2	1	6
Netherlands 2	5	4	1	3	2	6
Norway	5	4	1	2	3	6
Slovenia	4	3	1	6	2	5
Spain	5	1	2	3	4	-
Sweden*	N/R	N/R	N/R	N/R	N/R	N/R
Switzerland	3	2	4	6	1	5
UK†	NK	NK	NK	NK	NK	NK

* Responded as "not relevant"
† Not known

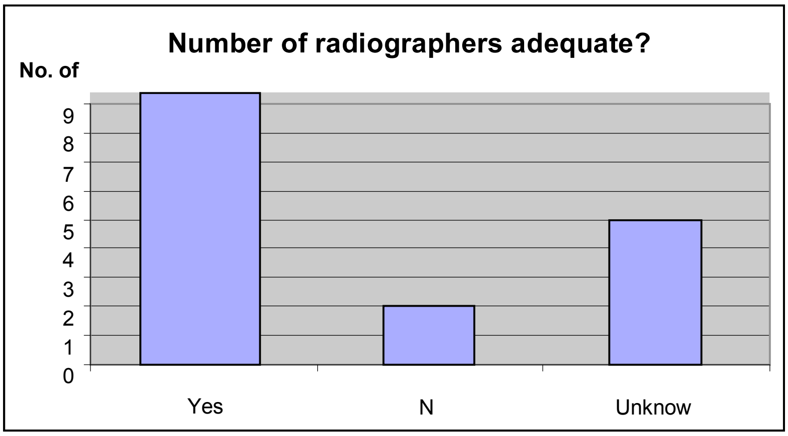
A.11 Are you able to provide an indication of the number of radiographers currently working in your country? If "yes" please provide a value and comment on whether or not this an estimated value or based on documented evidence.

Country	Number of radiographers*
Austria	150
Belgium	600
Cyprus	4
France	1560
Germany	Unknown
Ireland	148
Italy	2000
Latvia	25
Lithuania	99
Malta	8
Netherlands 1	700
Netherlands 2	300
Norway	600
Slovenia	140
Spain	1550
Sweden	120
Switzerland	400
UK	2,500

* Red – estimated   Green – based on documented evidence

A12 Is the total number of radiographers adequate at the present time?

Responses: "Yes" - 9/17
"No" - 2/17
"Unknown" - 5/17
Ambiguous - 1/17



A.13: Have all radiographers currently working in your country obtained their NDT qualification within your country?

Responses: "Yes" - 5/17
"No" - 9/17 (all 9 accept a qualification from elsewhere)
"Unknown"- 3/17

Section B: Regulatory Requirements

Objective: To obtain information on the legislative approach to industrial radiography in EU member states.

B1/B2/B3 Details of national regulations, guidance. Regulatory Bodies provided by 17 countries. See appendix D.

B.4 Are organisations undertaking Industrial Radiography required to be licensed/authorised by a Regulatory Authority?

Responses: "Yes – for both enclosure and mobile radiography" - 17/17

Note: Varying rigor with respect to the authorisation process.

B.5 Please provide description of the authorisation/licensing process

Responses: Varying approaches: Not repeated here; see main text.

B.6 Are there any requirements to notify a Regulatory Authority in respect of work undertaken?

Responses:

"Yes – at the first time radiography is undertaken"	-	8/17
"Yes – in the event of additional enclosures used/built	-	9/17
"Yes – each mobile radiography undertaken at a new site"		8/17
"No – no required"	-	5/17

Note: 4/17 require notification with respect to all 3 options
2/17 for the 1st and 2nd options

B.7 Does the Regulatory Authority undertake inspections at premises where compound radiography is undertaken?

Responses: "Yes" - 17/17
"No" - 0/17

With regard to the supplementary questions:

Is retention of license conditional on satisfactory inspection? - 14/17

Are Inspections Pre-arranged ? - 8/17 or unannounced ? - 5/17 or both ? 4/17

Is there specific frequency for inspections? - generally “no”, (some annually)

B.8 Does the Regulatory Authority carry out inspections when mobile radiography is in progress?

Responses:	“Yes”	-	15/17
	“No”	-	1/17
	No response	-	1/17

B.9 What enforcement action is available to Regulatory Authorities in the event of the outcome an Inspection being unsatisfactory?

Responses: In general responses were to the effect that any “penalty” was dependant on the perceived problem. Action ranges from verbal/written warnings to prosecution, fines, jail etc

B.10 Additional comments

Responses:

- Notification is not really accepted by the NDT companies; the inspector should call the NDT company in order to have an idea of the location of the radiographer for the next few days (since the time schedule can change rather quickly). Therefore it is sometimes difficult to organise a real unannounced inspection. *(Belgium)*
- The RPII is currently exploring this sector in more detail and has a peer review planned for mid 2007. the results of this review and of the EU ALARA Network questionnaire will be studied and implemented as required to ensure continued best practice (*Ireland)*
- Offices issuing licenses in Italy are not at the same level all over the country; therefore licenses are issued with rather different levels of awareness that the NDT field is one of the most dangerous fields were ionising radiation sources are used. (*Italy)*
- Notification can slow down the flexibility of performing NDT inspections in a client oriented environment. In particular in the petrochemical industry and repairs on pipelines in the infrastructure.
- Inspection is a good thing but most auditors have little knowledge about the way industrial radiography is carried out. In the Netherlands the approach by in

particular the Ministry of VROM is not in line with the requirements by other EU state members. (*Netherlands)*

- Fairly strict system concerning authorisations but limited resources for inspections (*Norway)*
- The qualification re: the NDT could be a pre-requirement of the authorisation procedures. Also, new companies which are going to start a practice of NDT without an enclosure could report to the SNSA in the 1st few months when and where they are going to perform a practice (*Slovenia)*

Section C: Radiography Equipment

Objective: To make an assessment of the standard of equipment likely to be in use with a view to identifying whether or not there is scope for optimisation and/or harmonisation of approach.

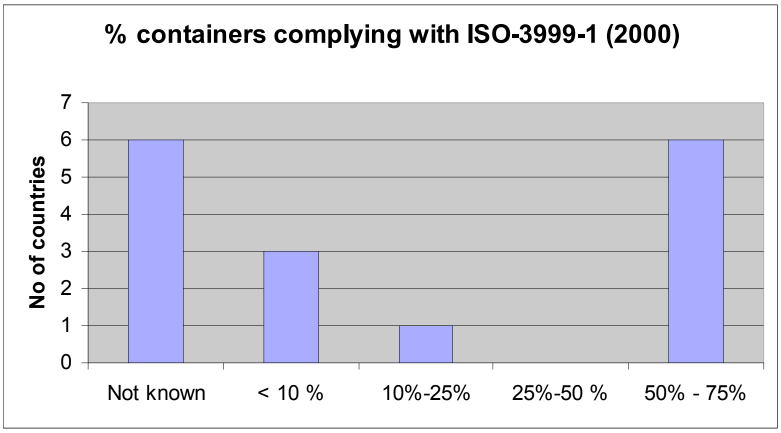
C1: The current international standard for gamma source containers is ISO 3999-1(2000). Is there a specific requirement in your country for containers in use to comply with this standard?

Responses:			
	"Yes" (R)	-	7/17
	"Yes" (G)	-	4/17
	"NO"	-	5/17
	Ambiguous	-	1/17

(R – in regulation, G- in guidance)

C2: Please indicate the percentage of gamma source containers that comply with ISO 3999(2000)

Responses:			
	"Not known"	-	6/17
	<10%	-	3/17
	10% - 25%	-	1/17
	50%-75%	-	0/17
	> 75%	-	6/17
	Ambiguous	-	1/17



C.3 Are any specific equipment standards applied with respect to x-ray equipment?

Responses:

"Yes" (R)	-	6/17
"Yes" (G)	-	3/17
"Yes" (R+G)	-	6/17
"No"	-	2/17

(R – in regulation, G- in guidance)

C.4 Are there any requirements for routine maintenance of gamma source containers (+ancillary equipment) or x-ray equipment?

Responses:

"Yes" (R)	-	6/17
"Yes" (G)	-	15/17
"Yes" (R+G)	-	1/17
"No"	-	0/17

(R – in regulation, G- in guidance)

C.5 Please let us have any further views you may have on equipment standards.

Responses: See section H.

D. Radiography Enclosures

Objective: *To collate information on the practical approach to radiography with the aim of identifying those areas where harmonisation would be beneficial and/or optimisation could be improved.*

D.1 Is the number of personnel that should be present during radiography specified?

Responses:

"Yes" (R)	-	4/17
"Yes" (G)	-	0/17
"Yes" (R+G)	-	1/17
"No"	-	10/17
No response	-	1/17

For those that responded "yes" the minimum ranged from 1 to 2

(R – in regulation, G- in guidance)

D.2 Are requirements specified with respect to the design and construction of enclosures?

Responses:

"Yes"	-	13/17 (some references were provide for regs/guidance)
"No"	-	3/17
No response	-	2/17

D.3 Is there a restriction on the maximum dose-rate around the exterior of the compound?

Responses:

"Yes"	-	13/17 (7.5 μSv/h was typically quoted)
"No"	-	2/17
No response	-	2/17

D.4 is there a requirement to monitor dose-rates around the exterior of eh compound periodically?

Responses:

"Yes"	-	9/17
"No"	-	5/17
No response	-	2/17
Ambiguous	-	1/17

D.5 Are storage arrangements for equipment used in enclosures specified?

Responses:

"Required by regulation/license"	-	13/17
"No –good practice only "	-	0/17
"Both"	-	2/17
No response	-	2/17

Responses generally related to the storage of gamma sources

D.6 Are there requirements for the installation of effective devices to prevent access?

Responses:

"Yes" for both x and gamma	-	10/17
"Yes" for x only	-	2/17
"No"	-	2/17
No response	-	2/17
Ambiguous	-	1/17

D.7 Is there a requirement for search-and-lock-up facilities?

Responses:	"No"	-	9/17
	"Yes –always"	-	2/17
	"Yes – under certain circumstances"	-	4/17
	No response	-	2/17

D.8 is the design if enclosures required to include a contingency in the event of persons becoming trapped inside?

Responses:	"Yes"	-	9/17
	"No"	-	4/17
	No response	-	3/17
	Ambiguous	-	1/17

D.9 Are requirements for warning signs/devices specified?

Responses:	"Yes"	-	13/17
	"No"	-	1/17
	No response	-	2/17
	Ambiguous	-	1/17

With respect to the 13 (including NL) that responded "yes", with to x-ray

Are warnings required for			
	-	power on?	11/13
	-	pre-expsoure?	7/13
	-	exposure?	12/13
And are these required to			
	-	operate automatically?	12/13
	-	be fail-to safe?	11/13
	-	visible inside + outside?	10/13

and with respect to gamma radiography:

Are warnings required for			
	-	pre-exposure?	5/13
	-	exposure?	10/13
And are these required to			
	-	operate automatically?	10/13
	-	be fail-to safe?	7/13
	-	visible inside + outside?	9/13

D.10	Are there any requirements for routine maintenance of safety and warning devices in radiography compounds?

Responses:	"Yes" (R)	-	8/17
	"Yes" (G)	-	1/17
	"Yes" (R+G)	-	2/17
	"No"	-	3/17
	No response	-	3/17

(R – in regulation, G- in guidance)

D.11 Additional comments

Responses: See section H

Section E: Mobile Radiography

Objective: To collate information on the practical approach to mobile radiography with the aim of identifying those areas where harmonisation would be beneficial and/or optimisation could be improved.

E.1 Is the type/number of persons that should be present specified?

Responses:	"Yes" (R)	-	11/17
	"Yes" (G)	-	1/17
	"Yes" (R+G)	-	1/17
	"No"	-	2/17
	No response	-	2/17

(R – in regulation, G- in guidance)

Where there was a "yes" answer:

Minimum number of people 2	-	10/13
" " " 1	-	1/13
No response	-	2/13

E.2 Are there any restrictions placed on radiography technique?

Responses:	"Yes" (R)	-	2/17
	"Yes" (G)	-	2/17
	"Yes" (by Client)	-	6/17
	"No"	-	7/17
	No response	-	1/17

(R – in regulation, G- in guidance)

A number of those who responded to "yes" responded to more than one option. Restrictions were on activity (<20 Ci) and specified isotope.

E.3 Where are storage arrangements for gamma sources specified?

Responses:	"Regulation/License Conditions"	-	13/17
	"Not specified, but good practice applies"	-	2/17
	"No requirements"	-	2/17

Note: standard requirements of lockable containers, secure storage etc were quoted.

E.4 Is there a dose or dose-rate criteria for determining the position of the barriers?

Responses:	"Yes" (R)	-	9/17
	"Yes" (G)	-	3/17
	"Yes" (R+G)	-	1/17
	"No"	-	2/17
	No response	-	2/17

(R – in regulation, G- in guidance)

Note: Dose-rate values varied from 2.5 μSv/h - 20 μSv/h.

E.5 Is there a restriction on the maximum size demarcated by the barriers?

Responses:	Yes	-	1/17
	No	-	13/17
	No response	-	3/17

E.6 Is there any specification with respect to the nature of the barriers?

Responses:	"Yes" (R)	-	3/17
	"Yes" (G)	-	5/17
	"Yes" (R+G)	-	1/17
	"No"	-	6/17
	No response	-	3/17

(R – in regulation, G- in guidance)

E.7 In practice how is the correct positioning the barriers checked?

Responses:	Dose-rate measurement	-	11/17
	Via documentation	-	1/17
	Supervision	-	1/17
	Radiographer knowledge	-	0/17
	Visual checks	-	0/17

Note: Those who quoted does-rate measurement also cited supervision, visual checks and radiographer knowledge.

E.8	Are there specifications for required warning devices?		
Responses:	"Yes" (R)	-	6/17
	"Yes" (G)	-	3/17
	"Yes" (R+G)	-	3/17
	"No"	-	3/17
	No response	-	2/17

(R – in regulation, G- in guidance)

E.9 What are the arrangements for personal dosimetry?

Responses: Legal dosemeters required? 15/17

Electronic alarm dosemeter required? 9/17 recommended? 5/17

Alarm dosemeter + cumulative dose required? 4/17 recommended 7/17

E.10	Is the use of survey meter required?		
Responses:	"Yes" (R)	-	13/17
	"Yes" (G)	-	0/17
	"Yes" (R+G)	-	2/17
	"No"	-	1/17
	No response	-	2/17

(R – in regulation, G- in guidance)

E.11	Are radiographers required to carry emergency equipment?		
Responses:	"Yes" (R)	-	4/17
	"Yes" (G)	-	4/17
	"Yes" (R+G)	-	1/17
	"Not required but generally done"	-	6/17
	"No"	-	0/17
	No response	-	2/17

(R – in regulation, G- in guidance)

E.12 Are there requirements for active co-operation?

Responses:			
Responses:	“Yes” (R)	-	9/17
	“Yes” (G)	-	5/17
	“Yes” (R+G)	-	1/17
	“No”	-	2/17

E.13 Is information about client’s premises required prior to the work being undertaken

Responses:	“Yes” (R)	-	2/17
	“Yes” (G)	-	4/17
	“No, but generally provided”	-	5/17
	“No”	-	2/17
	No response	-	4/17

(R – in regulation, G- in guidance)

E.14 Is a visit to the site prior to the work being undertaken required?

Responses:	“Yes”	-	7/17
	“No”	-	7/17
	No response	-	4/17

E.15 Comments

Responses:

- Informative cooperation with the clients is standard *(Germany)*
- Current best practice is that NDT companies are required by clients to submit risk assessments for each job rather than generic RA's (*Ireland)*
- This is a topic between the company and the client, not part of the regulatory process (*Norway)*
- rules very strict (*Slovenia)*
- Think that contact between the radiographer and the client is important as it can help reduce time consuming and worthless work (*Switzerland)*
-

Section F: Accidents/Incidents

Objective: To ascertain the availability of information in incidents and accidents occurring during (or associated with) industrial radiography.

F.1 Are accidents/incidents in industrial radiography notifiable?

Responses:	"Yes" (R)	-	17/17
	"Yes" (G)	-	0/17
	"No"	-	0/17

In almost cases notification is made to the Regulatory Authority and is made by the licensee/employer. Criteria for notification were varied (with little consistency between countries) but restricted to:

- worker dose limits exceeds
- public dose limits exceeded
- leakage/loss of material
- damage/failure of equipment

F2: Please identify the main causes of accidents/incidents in industrial radiography.

Responses:	"Human Error"	-	9/17
	"Mechanical failure"	-	6/17
	"Not registered"	-	1/17
	"Poor set up"	-	1/17
	"Not known"	-	1/17
	No response	-	1/17

Only 6 countries responded to the effect that they had documented evidence of the cause of reported incidents. The remainder were expressing either a widely held or a personal view.

F.3 Is there any mechanism for feedback of "lessons learned" as a result of radiation accidents/incidents?

Responses:	"yes"	-	10/17
	"No"	-	6/17
	Not known	-	1/17

F.4 Have any incidents/accidents that have occurred in the past 5 years had n impact on working practices?

Responses:	"Yes"	-	4/17
	"No"	-	13/17

Comments provided in support of "yes" answers mainly focussed on improvements made to training programmes.

F5 Additional comments

Responses : see section H

Section G: Personnel Profile/Training Standards

Objective: To build up a picture of the requirements for the training and qualification of personnel undertaking industrial radiography.

G.1 What is the training/qualification route for NDT personnel in your country?

Responses:	Compulsory specified training schemes	-	10/17
	Compulsory training but choice of schemes	-	3/17
	Evidence experience/competence sufficient	-	3/17
	No response	-	3/17

NB 1 country responded positively to all 3 options

G.2 Is there a pre-requisite level of basic education?

Responses:	"Yes"	-	5/17*
	"No"	-	9/17
	No responses	-	3/17

*In general this was education to at least secondary level. For one country education to degree level for RPOs is required.

G.3 Is there a hierarchy for qualifications in NDT/Radiography?

Responses:	"Yes"	-	5/17
	"No"	-	5/17
	No response	-	4/17

NB 3 countries responded to the effect that requirements of EN473 were followed or that a period of general work experience was required before an individual could be considered for radiography training.

G.4 Is the concept of "assistant radiographer" applied?

Responses:

"Yes"	-	8/17
"No"	-	6/17
No response	-	3/17

For those that responded yes this was supported with information to the effect that an assistant radiographer would have restricted duties and be under supervision. There appears to be some variation as to specified (if any) training requirements for assistant radiographers.

G.5 Is the appointment of an RPO required?

Responses:

"Yes"	-	12/17
"No"	-	2/17
No response	-	2/17
Ambiguous	-	1/17

G.6 Is an RPO required to be present during radiography?

Responses:

"Yes"	-	4/17
"No"	-	10/17
No response	-	2/17
Ambiguous	-	1/17

G.7 is the employer required to consult an RPE?

Responses:

"Yes"	-	12/17
"No"	-	3/17
No response	-	2/17

G.8 With respect to mobile radiography on client premises, where does the responsibility for radiation safety lie?

Responses:

"The client"	-	0/17
"NDT company"	-	10/17
"Co-operation applies"	-	5/17
No response	-	2/17

G.9	Is there legislation in place that requires industrial radiographers to undertake training specifically in radiation protection?		
Responses:	"Yes- a requirement on all radiation workers"	-	14/17
	"Yes- specific requirement for radiographers"	-	1/17
	No response	-	2/17

G.10	What is the usual route fro obtaining radiation protection training?		
Responses:	Incorporated into basic training schemes	-	1/17
	From specialist training providers	-	9/17
	On the job training only	-	1/17
	Combination of the above	-	4/17
	No response	-	2/17

G.11 Are levels of radiation protection training specified?

Responses:	"Yes" (R)	-	6/17
	"Yes" (G)	-	2/17
	"No"	-	6/17
	No response	-	3/17

(R – in regulation, G- in guidance)

G.12 Is there a requirement for refresher training in radiation protection?

Responses:	"Yes" (R)	-	10/17
	"Yes" (G)	-	3/17
	"No"	-	1/17
	No response	-	2/17

(R – in regulation, G- in guidance)

G.13 Additional comments

Responses: There were a number detailed comments on this.

- NDT, integrated in the technical NDT courses should be 'nice to have' or at least a European Standard scope of content for such courses. These requirements should be implemented in the nation's regulations (via European Directives?). It should be worthwhile to have a more uniform European technical and radiation protection training and qualification standard in these matters (so as to facilitate the NDT companies to go abroad - the case of France will be difficult!)

- In our country the way of education and training in the field of radiation protection by DGZfP is optimal established. The first courses and training including practical exercises were carried out in an excellent and effective way more than 25 years ago.
- For both G11 and G12, these are normally carried out since the qualification schemes used by the employer requires this.
- the current training for radiation safety in the Netherlands are not adequate. Mostly oriented on hospitals. It would be a good idea to have a special training for industrial radiographers.
- Training also required for persons indirectly involved in industrial radiography. Such employers should have an RPO. Training for this type of employer = 12 hours.

Section H: General comments

As detailed below:

- To put the used terms correct: An accident cannot be equated with an incident. In the field of radiation protection: an accident claims corrective actions and an incident claims preventative actions. *(Germany)*
- The RPII has contracted the HPA (Scotland) to undertake a peer review of all aspects of industrial radiography work in Ireland. A preliminary meeting has taken place and the peer review mission is due to take place in the week of the 18th June. This questionnaire has also been provided to the reviewer to assist in the deliberations. The assistance of the NDT companies is acknowledged in the completion of this questionnaire. (*Ireland)*
- All answers are based on a series of inspections performed in past years in this field. The main results are reported in my paper presented at EON Workshop held in Chilton (UK) 1998. Since that time the Italian situation has not changed. We have had some important accidents reported in the referred paper. The main problems are connected to the fact that Italian legislation is simply based on the activity of the source, no matter how dangerous the way the source is being used is. Sealed sources for therapy and sealed sources for NDT are simply considered on the basis of their activity, not on the fact that a NDT source for mobile equipment is much more dangerous. NDT employers must be licensed by a Prefect, but not all provinces have the same level of awareness. Survey tasks are attributed to many survey bodies, not all of them at the same level. (*Italy)*
- Our problems with NDT are related with a small number of users in this field. Because there is not a complete system of training and certification of our NDT specialists in Latvia. Our specialists are trained in other countries. (*Latvia)*
- It would be appreciated if a basic template guidance could result from this project. Malta's position is that there is a very limited number of NDT companies that carry out radiography and so it is very difficult and time consuming to produce guidance. Big reference is made to the English guidance for IRR99. (*Malta)*
- A link between NDT professional organisations and RP community could be reinforced (*Slovenia)*

- The hyperlinks in the next columns display 2 posters presented at the EAN ALARA Workshops in Rome and Uppsala which may illustrate the "RP situation" of industrial radiographers in Switzerland. NB The number of companies executing mobile radiography is very manageable and therefore not typical of the situation in larger countries. I personally know most of the radiographers as I'm the course instructor for all the German speaking radiographers in Switzerland.// Furthermore, we think that the collaboration with the National society for NDT (SSNT) is very rewarding. Some members of the RP Expert Commission of the SSNT are working in the NDT industry. This fact is very helpful by working out guidance and practicable codes of practice.// I personally would prefer to answer the questions face to face. Under these circumstances unclarities can be avoided and the statements would become more significant. *(Switzerland)*
- Re-write and Re-issue the 1997 Safety Manual - Radiation safety for site radiography 1st published by Engineering Construction Industry association formally the "Code of Practice for Site Radiography". The guidance is seen as extremely useful by our NDT team and there have been a number of key regulation changes since its last update. *(UK – BNFL Sellafield)*

APPENDIX D: NATIONAL LEGISLATION

Country	Regulation(s)
Austria	STG + STVO www.ris.bka.gv.at
Belgium	Employment and Labour: Codex on the labour welfare Radiation Protection: General regulations for the protection of the population, the workers and the environment against danger of ionising radiation http://www.fanc;fgov.be/en/regulation.htm
Cyprus	No Response
France	http://nuclear-safety.asn.fr/ **(General) - Code de la santé publique:** articles L.1333-1 et suivants (ordonnance n°2001-270 du 28 mars 2001) articles R.1333-26 à R.1333-54 (décret n°2003-462 du 21 mai 2003) (texte renumérotant les articles du décret n°2002-460 du 4 avril 2002 pour les insérer dans le code de la santé publique) **(General) - Code du travail:** articles R.231-73 à R231-113 (décret n°2003-296 du 31 mars 2003) articles R.237-1 à R.237-28 (décret n°92-158 du 20 février 1992) Arrêté du 30 décembre 2004 relatif à la carte individuelle de suivi médical et aux informations individuelles de dosimétrie des travailleurs exposés aux rayonnements ionisants Arrêté du 26 octobre 2005 relatif aux modalités de formation de la personne compétente en radioprotection et de certification du formateur Arrêté du 26 octobre 2005 définissant les modalités de contrôle de radioprotection en application des articles R.231-84 du code du travail et R.1333-44 du code de la santé publique **Specific:** Décret n°85-968 modifiant l'article R.233-83 du code du travail et définissant les conditions d'hygiène et de sécurité auxquelles doivent satisfaire les appareils de radiographie industrielle utilisant le rayonnement gamma et arrêté d'application du 11 octobre 1985 fixant le contenu et les règles d'utilisation des documents de suivi nécessaires à l'application des dispositions de l'article 22 du décret n°85-968 relatifaux appareils de radiographie gamma industielle Arrêté du 25 juin 1987 modifié par l'arrêté du 16 décembre 1988 (CAMARI) **Normes:** NF M 60-551; NF M 61-002; ISO 1677; ISO 2919; ISO 9978 Arrêté du 2 mars 2004 fixant les conditions particulières d'empoli applicables aux dispositifs destinés à la radiographie industrielle utilisant le rayonnement gamma

Germany	German Ordinance of Radiation Protection (Instruction for the protection against damage caused by ionising rays) Strahlenschutzverordnnung - StrlSchV vom 20. Juli 2001 X-ray Ordinance (Rontgenverordnung - RoV vom 30. April 2003) Novelle der Strahlenschutzverordnnung - Erlauterungen fur die Praxis August 2001 ISSN 1013-4506 TUV - Verlag GmbH, Koln 2001 http://www.fs-ev.de/fs-ev/deutsch/index.html Gesetz uber hochradioaktive Strahlenquellen (HRQ-Gesetz)-Ordinance of high radioactive sources-August 2005 www.bmu.de www.bfs.de http://www.bmu.de/en/1024/js/anglish/alldownloads/
Ireland	http://www.irishstatutebook.ie Radiological Protection Act, 1991 (IR) Order, 2000 (S.I. No. 125 of 2000) Radiological Protection (Amendment) Act, 2002 (No. 3 of 2002) Carriage of dangerous goods by road regs 2006 (S.I. No 405 of 2006) European Communities (Carriage of dangerous goods by road) etc. (S.I. No. 406 of 2006) Radiological Protection Act, 1991 (control of HASS) Order 2005 (S.I. No. 875 of 2005)
Italy	Decreto Legislativo March 17, 1995 n. 230 and Encl. IX Decreto Legislativo May 26 n. 241, fully implementing EC directives 90/641, 92/3 and 96/29
Latvia	http://www.vidm.gov.lv/eng/likumdosana/?doc=3305
Lithuania	Government Resolution No. 205 On Republic of the Lithuania Government Resolution No. 653 "On Regulations of Licensing the Practices Involving sources of Ionising radiation" modification (adopted on 23 February 2004) Hygiene Regulations HN 73:2001 "Basic Standards of radiation Protection" Hygiene Regulations HN 52:2005 "Radiation protection and Safety in Industrial Radiography" Hygiene Regulations HN 83:2004 "Radiation Protection of the Outside Workers" "Monitoring order of exposure of workers and workplaces" Order Nr.V-1020 (2005) Regulations on the "control of High Activity Sealed Ionising Radiation Sources and Orphan Ionising Radiation Sources" Order Nr.V-687 (2005) Regulations on the "Physical Security of Ionising radiation Sources"
Malta	LN 44 of 2003 Nuclear Safety and Radiation Protection Regulations (http://www.ohsa.org.mt/docs/laws/ohs_cap_365_03.pdf) LN 13 of 2006 Control and Security of High activity Sealed sources Regulations (http://www.ohsa.org.mt/docs/laws/ohs_ln_13_06.pdf)
Netherlands	'Kernenergiewet" and "Het Besluit stralingsbescherming" http://www.senternovem.nl/stralingsbescherming/ http://www.vrom.nl/ http://arbeidsinspectie.szw.nl/index.cfm?fuseaction=dsp_rubriek&rubriek_id=390409
Norway	http://www.nrpa.no/archive/Internett/Publikasjoner/Annet/act_eng.pdf

Slovenia	http://www.ujv.gov.si/fileadmin/ujv.gov.si/pageuploads/si/Zakonodaja/SlovenskiPredpisi/zvisjv-ang.pdf
Spain	Regulation governing nuclear and radioactive installations (Royal decree 1836/1999) Regulation of Health Protection against ionising radiation (Royal Decree 783/2001) Royal Decree 229/2006 about control of high activity radioactive sealed sources and orphan sources European agreement concerning the international carriage of dangerous goods by road (ADR) Regulations concerning the international carriage of dangerous goods by rail (RID) International Instructions for the safe transport of dangerous goods by air – International Civil Aviation Organisation (ICAO) International Maritime Code on the transport of dangerous goods by sea – International Maritime Organisation (IMO)
Sweden	SSI FS 2000:8 (attached to questionnaire) http://www.ssi.se/forfattning/Eng_ForfattLista.html#_2000_11
Switzerland	http://www.admin.ch/ch/d/sr/index.html
UK	Ionising Radiations Regulations 1999 Radioactive Substances Act 1993 Radiation Safety for Site Radiography (*currently out of print)* Transport Legislation

APPENDIX E: MODULEOVERVIEW

RADIATION PROTECTION AND SAFETY IN IDUSTRIAL RADIOGRAPHY

MODULE 4 REQUIREMENTS FOR OCCUPATIONAL EXPOSURE

Guidance for presenter

This module consists of four presentations which together address the responsibilities of the operating organisation in terms of required procedures in industrial radiography ie the control and supervision of work and the need for individual and area monitoring. Throughout the module the emphasis should be on the practical requirements in the workplace and on how adherence to established safety procedures is essential in order to ensure that exposures are kept to a minimum and the potential for accidents minimized. The importance of dose-rate monitoring should be stressed; this is consolidated via the inclusion of a practical exercise on monitoring.

Recommended module structure and times

Lecture 7	*Classification of Areas, Local Rules And Supervision*	*1.0 hour*
Lecture 8	*Individual Monitoring*	*0.5 – 1.0 hour*
Lecture 9	*Workplace Monitoring*	*1.0 hour*
Practical 1	*Use of radiation monitors*	*1.0 hour*

Resources

Lecture 7: Classification of Areas, Local Rules & Supervision

Lecture notes: Classification of areas, local rules & supervision
PowerPoint presentation [IR/CLRS]

Lecture 8: Individual Monitoring

Lecture notes: Individual monitoring
PowerPoint presentation [IR/IM]
Example dosemeters eg i) film badge
ii) thermoluminescent dosemeter
iii) personal alarm monitor
iv) QFE

Associated Activities

Practical: Use of radiation monitors

Practical demonstration on the correct use of doserate monitors and interpretation of results.
Presenter's guide: PRACTIR1
Simulated radiation monitors, eg RADSIM or equivalent