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Bruxelles, 3 décembre 2010

et de la réunion conjointe Belgian Nuclear Society (BNS) et BVSABR
Fukushima: report on a field visit
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THE EUROPEAN ALARA NETWORK

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Chairman of the European ALARA Network

Abstract

The optimisation of radiation protection(ALARA) is a key element in practical radiation protection and is already embedded in the radiation protection regulation in Europe and reaffirmed in the ICRP 103 publication. The basic radiation protection principles and regulations state that ALARA principle must be implemented, however no practical guidance is given.Therefore a need for an experience exchange platform was identified in order to gather and disseminate information on the practical implementation of ALARA. The European ALARA Network, created in 1996 with the aid of the European Commission, provides such a platform. It promotes a wider and more uniform implementation of the ALARA principle for the management of worker, public and patient exposures in all types of exposure situations.
In this paper an overview will be given of the networks history and its current activities including workshops, newsletters, guidance and recommendations.

1. Introduction

The three principles justification, optimisation and limitation of exposure to ionising radiation form the bases of the radiation protection in practice. It is clear that the principle of exposure optimisation, keeping the exposure as low as reasonably achievable forms the core of the practical radiation protection. The importance of this principle is underlined in ICRP 103 (2007) by broadening the concept to include stakeholder involvement in the decision process and optimising below appropriate dose constraints and reference levels for all exposure situations planned, emergency and existing.
The practical ALARA procedure can be seen as consisting of five successive steps. The first is the evaluation of the exposure situation to identify the need for action. The second identifies the possible protective options to keep exposures ALARA and evaluate their effectiveness. The third step is the selection of the best option under the prevailing circumstances. This is a complex step where the decision maker needs to

take into account individual equity, stakeholder involvement, technical and economical boundary conditions, safety and safety culture. The selected option needs to be implemented using an effective radiation protection program in the fourth step. The fifth step, a regular review of the exposure situation examines whether there is a need to review the protective options based on the prevailing circumstances. It is a step towards reviewing the protection again and if necessary, starting procedure again at step one. The five steps can be seen as a continuing circle to improve the level of protection.

It is clear that guidance and exchange of experience is needed to implement the different steps in practice for the different exposure situation to which we are confronted. The European ALARA Network provides a platform to achieve this goal.

2. History and development of the European ALARA Network.

The network started in 1996 as one of the European Framework programs for Research and Development. A group of enthusiast experts from different European countries formed the core of the network. The coordination of the network was performed by CEPN (France) and NRPB (today HPA, UK) and a group of experts from several European states.

The commission made it clear from the beginning that the network should look for a mechanism to become self-supporting. The transformation from a European program to a self-supporting organisation was prepared in 2004. The network became a legal entity in 2005 as a non-profit organisation under French law with an administrative board looking at financial matters and a steering group that discusses the activities of the network. The network is financially supported through contributions from different institutions, companies, regulatory authorities, …organised per country.

Currently there are 20 countries that are participating in the steering group with experts from different fields: radiation protection authorities, research institutes, industrial companies, hospitals, services etc.

The focus of the network was first oriented to the ALARA in industry and research, later the scope was broadened to include the medical field and the NORM-industry. A further broadening of the scope is foreseen in the coming years to include all exposure situations.

The aim of the network is to promote a wider and more uniform implementation of the ALARA principle for the management of worker, public and patient exposures in all situations and to provide a focus and a mechanism for the exchange and dissemination of information from practical ALARA experiences. Topical issues of common interest are identified and examined in the network to further improve the practical implementation of ALARA.

3. European ALARA Network Activities and outputs.

The activities of the ALARA network involve the gathering and processing of international and national information from member countries on radiation protection and ALARA. This is done through the organisation of workshops, surveys and of course through networking with other organisation.

Networking

The network exchanges information with different organisations and projects to discuss on subjects of common interest (a list is given below). With some of these organisation collaboration agreements were signed.

Organisations or projects networking with EAN	
EFOMP*	European Federation of Organisations for Medical Physics
EFRS*	European Federation of Radiographer Societies
IRPA	International Radiation protection Association
EURADOS	European Radiation Dosimetry Group
ISEMIR	Information System on Occupational Exposure in Medicine, Industry and Research
EFNDT*	European Federation of Non Destructive Testing
EMAN	European Medical ALARA Network
ESR	European Society of Radiology
EUTERP	European Network on Education and Training in Radiological Protection
RECAN	ALARA Network in the Central and East Europe
ARAN	ALARA network in the ASIA Pacific region
ORAMED	Optimization of RAdiation protection for MEDical staff
ISOE	Information System on Occupational Exposure

*Collaboration agreement signed with the EAN

Besides exchanging information the EAN also provides technical support assistance in the creation of new ALARA networks in central and East Europe (RECAN) and Asia and the Pacific region (ARAN). The network is also involved in the creation of the European Medical ALARA Network (EMAN).

ALARA Workshops

The EAN organises regularly workshops in different subject areas regarding ALARA. The topics are chosen by the EAN steering group based on an evaluation of possible improvements of practical ALARA in these areas. These workshops are attended by 60 to 120 experts from different countries with experience in radiological protection and different professional backgrounds. Papers are presented that set the scene of the subject area followed by papers with practical examples of the implementation of ALARA. The poster sessions allow brief communications on the topic at hand.

For each of the workshops a set of topics and questions in relations to the workshop subject area are prepared in order to be discussed in different working groups during the meeting. The results of the discussions are presented in the plenary session leading to recommendations that are then transmitted to the stakeholders. The recommendations are also published in the ALARA newsletter, on the EAN web site and in different national radiation protection journals.

List of the European ALARA workshops	
ALARA and decommissioning	Saclay, 1997
Good radiation practices in industry and research	Oxford, United Kingdom, 1998
Managing internal exposure	Munich, Germany, 1999
Management of occupational radiological and non-radiological risks: lessons to be learned	Antwerp, Belgium, 2000
Industrial radiography, improvements in radiation protection	Rome, Italy, 2001
Occupational exposure optimisation in the medical and radio-pharmaceutical sectors	Madrid, Spain, 2002
Decommissioning and site remediation	Arnhem, Netherlands, 2003
Occupational radiological protection control through inspection and self-assessment	Uppsala, Sweden, 2004
Occupational exposure to natural radiation	Augsburg, Germany, 2005
Experience and new developments in implementing ALARA in occupational, public and patient exposures	Prague, Czech Republic, 2006
ALARA in radioactive waste management	Athens, Greece, 2008

ALARA issues arising for safety and security of radiation sources and security screening devices	Vienna, Austria, 2009
ALARA and the medical sector	Oscarborg Fortress, Norway, 2011
ALARA in existing exposures situations(*)	Dublin Castle, Ireland, 2012
ALARA Culture(*)	Croatia, 2014

(*) In preparation

Surveys

Since EAN was a well-established network in 2000, it was decided to use the network as a vehicle to support European Surveys on current topics in radiological protection. The surveys are performed through national contacts. The summaries of the surveys can be downloaded from the website. The different topics, which were discussed, are the following:

- The implementation of the European Basic Safety Standards in Directives 96/29 and 97/43 in national regulations (2006),
- The management of radioactively contaminated soils (2006),
- Potential exposures in nuclear installations (2007),
- The Diagnostic Reference Levels (DRLs) in Europe (2007),
- Radon exposure management (2010)
- Aircrew exposures (2011)
- Declaration systems of incidents (2011)

As a follow up after the Fukushima accident a survey will be launched on the dose guidance for emergency workers in the different EAN member countries.

ALARA newsletter

An ALARA newsletter is published twice a year with contributions on good practices, lessons learned, workshop results and practical implementations of ALARA. Already 28 issues were published, the next one will be fully devoted to ALARA in the medical sector as an outcome of the workshop in Norway on “ALARA and the medical sector”. The Newsletter is distributed through the website, a mailing list and also through the contact persons and national radiation protection societies.

EAN website

The EAN website permits access to different information regarding the networks activities such as the electronic versions of the newsletter, papers of the workshops, summarised conclusions and recommendations. About 1000 individuals per month visit the website and perform downloads.

Incentives to create other networks, subnetworks and working groups

EAN has also stimulated the creation of new networks or subnetworks devoted to a certain subject areas regarding ALARA.

A successful example is the creation of the European Radiation Protection Authorities Network (ERPAN) as a result of the recommendation of the 8th EAN Workshop. This network meets yearly and exchanges information through an email forum. The network aims at a better information exchange between regulatory authorities on issues on the operation level.

The Commission has also supported the European ALARA Network for NORM (Naturally Occurring Radioactive Material) (http://www.ean-norm.net) for 2 years (2007/2008). It is co-ordinated by the IAF - Radioökologie GmbH in Dresden and currently supported by the Federal Office of Radiation Protection (BfS) in Germany. The objective of this network is to exchange information and promote good radiation protection practice for NORM industry managers.

Another proposal of the EAN, following a recommendation of the 6th EAN workshop, is the establishment of the European Medical ALARA Network (EMAN). This project started in November 2009 and is carried out by European radiation protection institutions together with EFOMP, ESR (European Society of Radiology) and EFRS, supported by the European Commission (DGTREN). EMAN aims to create a sustainable EuropeanMedicalALARANetwork (EMAN) where different stakeholders within the medical sector have the opportunity to discuss and to exchange information on various topics relating to the implementation of the ALARA principle in the medical field.

Another way of progressing on ALARA in certain subject areas is through activities in working groups. They are created by requests from external organisations or by initiatives of EAN members. These working groups gather information and prepare deliverables in the form of recommendations, overview or guiding documents on the subject at hand. The working group on radon prepared a statement on radon to be discussed in ICRP. The working group on ALARA culture is preparing a generic paper on the subject to be presented at the IRPA 13 congress in Glasgow in 2012. The same working group is also preparing an update of the book "ALARA from theory to practice" that now has the working title "Optimisation of radiation protection (ALARA): a practical guidebook".

Other working groups that are under consideration are the working group on ALARA tools and the working group on ALARA in research institutes.

4. New challenges for EAN

The range of EAN activities has been gradually extended over the last 14 years from optimisation of occupational radiation protection in industry and research, to occupational radiation protection in medicine and in the NORM area, and further on to the optimisation of radiation protection of patients and the general public.

In the medical sector, even if improvements have been noticed in recent years, there is still a need for the development of ALARA practices, in particular due to the development of new technologies and the constant increase of medical and occupational exposures, and because of a number of serious radiological incidents and accidents. This requires the dissemination of radiation protection and ALARA culture within the medical community. The next workshop in Oscarborg Fortress, Norway, June 2011 will be devoted to ALARA and the medical sector. And will consider on how the ALARA principle can be effectively implemented with regard to both patient and staff exposures in diagnostic and therapeutic uses of ionising radiation.

In 2007, ICRP published its new general recommendations (ICRP 103) in which the optimisation principle is now clearly emphasized for all types of exposure situations, below source-related dose constraints or reference levels. This evolution is very important, especially for emergency and existing exposure situations (e.g. radon and Naturally Occurring Radioactive Materials). Moreover, as the development of national policies for the management of existing exposures situations is increasing in many countries, there is a challenge during the forthcoming years for facilitating the practical implementation of ALARA in such situations. The workshop planned for September 2012 in Dublin Castle Ireland will be devoted to ALARA in existing exposure situations.

Development in the medical sector, as well as the increased interest in the use of non-medical exposures (for example for security reasons) also raise the issue of the justification of exposures, which often cannot be disconnected from the optimisation process. The relation of ALARA and security was discussed in the Vienna workshop in 2009.

In the nuclear sector, the ageing of existing installations and a large-scale retirement of nuclear workers - including radiation protection specialists - requires a new focus on maintaining and expanding skills, through radiation protection and ALARA education and training. In parallel, new nuclear installations (nuclear power plants, nuclear waste disposal, research reactors, etc.) will be built in the near future. The designers then need advices from the radiation protection community on the way to implement the ALARA principle at the design stage. An important contribution in this field has been done through a case study performed for NEA(OECD) on occupational radiological protection principles and criteria for designing new nuclear power plants.

In order to meet these future challenges, EAN has worked out a strategic plan on the objectives of the network including a detailed work programme for the next 5 years (2010-2015) on how to achieve these objectives. The focus of the work of EAN will be on sharing experience and promoting the practical implementation of ALARA in all exposure situations - planned, emergency and existing - with special emphasis on the definition, evolution and dissemination of ALARA culture.

5. Conclusion

The European ALARA Network has proven to be a successful platform to exchange and disseminate practical experience in the field of ALARA. This is emphasised by a presentation by UNSCEAR where EAN is described as being a part of one of the four pillars supporting the global organisation of radiation protection. The four pillars are identified as science, principles, standards and practice. The EAN is mentioned together with ISOE and EURADOS and IRPA as supporting the practical pillar of radiation protection.

The key factors for the success of the European ALARA Network are the informal way of operation and the enthusiasm of all the participants and the support of their respective organizations in willing to share their experience with colleagues from other countries and to promote the ALARA principle from a practical point of view.

In the coming years the focus of the work of EAN will remain on sharing experience on the practical implementation of ALARA. The challenge is to extend the application of ALARA to all sectors and all exposure situations as recommended by ICRP.

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COMBINING SAFETY, DOSE OPTIMISATION AND SECURITY: CHALLENGES AND DIFFICULTIES

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Abstract

In the present mind setting, organisational factors are a vital aspect of nuclear safety, enhancing individual behaviour and guaranteeing an adequate infrastructure. The growing concern for potential terrorist acts has led to a number of new ideas about storing radiological and nuclear materials that are not always compatible with existing practices or infrastructures. This is valid in normal, routine circumstances, but may especially pose problems in case of accidents. As such, the management of nuclear safety, radiological protection and security within an evolving world such as a nuclear research centre sometimes looks like implementing the quadrature of the circle. International guidance is present, but is not always easily converted into an adequate policy comprehensible to all levels in a plant, from management to the work floor.

Just a few examples. First: infrastructure related problems: from a security point of view, fuel storages or radioactive sources are better stored in the heart of a well-protected zone, while in case of criticality, fire… a more peripheral location is more appropriate. Second: safety related problems: access limitations to some areas may be a burden in the management of safety interventions, maintenance… Strong protection infrastructure may lead to difficulties of evacuation in case of emergencies. Third: administrative contradictions: inventories of fuel storages and high active sealed sources are a cornerstone of inspections and verifications; yet, this information is also a treasure for terrorists aiming at actions to obtain special materials. Fourth: dose management: some of the measures taken to secure sources may lead to an increase in dose (e.g. labelling of old sources).

However, the main difficulty is related to the ‘cultural’ aspect. One must recognise that – fortunately - there are synergies between safety culture, “ALARA” culture (doses as low as reasonably achievable) and security culture. An individual aspect of desirable behaviour (e.g. questioning attitude), complemented with an organisational dimension (e.g. training, raising awareness) are obviously common. The objective in each case is also in line: to avoid reduction of well-being of people, to protect the environment, to prevent damage to facilities.

The main difficulties arise however because of the fundamental differences being present as well. There are aspects of trust and distrust, supervision and coaching versus control and

verification; acceptability of measures implemented; having control or being victim of global evolutions.

As a conclusion, it is indispensable that some people, both at the level of regulators and operators dispose of a helicopter view on this subject, in order to achieve optimal solutions understandable to the workforce and taking into account all aspects: safety, security and dose optimisation.

Introduction

In many organisations dealing with nuclear and/or radioactive materials, there have been considerable efforts since a long time to implement an adequate policy for avoiding nuclear accidents (nuclear safety), serious accidents with the workforce (mainly industrial safety) and to reduce doses and to limit contaminations (radiation protection). While nuclear and industrial safety got a lot of attention already in the fifties and sixties of the previous century, also via the regulation put into place, it took longer before institutes started implementing systematic 'ALARA' policies. A real breakthrough here was obtained mainly in the nineties despite earlier guidance of e.g. the ICRP (ICRP 26, 1977; ICRP 37, 1983; ICRP 55, 1989; ICRP 60, 1991). Breakthrough certainly was supported from the publication "Alara, from theory towards practice" (Stokell et al., 1991).

Security issues received a growing attention in the past few years only, to a large part as a consequence of the 9/11 event leading to new concern, later on followed by new legislation on e.g. the management of sealed sources (EC 2003/122/EURATOM); these have led to many organisational measures such as reinforcement of intrusion prevention, surveillance, administrative and technical measures to reinforce access control.

In parallel, the 'safety culture' approach developed, mainly based on IAEA guidance in the aftermath of the Chernobyl disaster and the activities of the so called INSAG, the International Nuclear Safety Advisory Group (a.o. INSAG 4, INSAG 15). This safety culture concern has developed first in nuclear power plants (INPO 2004), while other nuclear facilities followed later. IAEA has developed a methodology to assess safety culture called SCART (IAEA Services Series No. 16).

The management of prevention of accidents in nuclear facilities requires a holistic approach taking into account safety of facilities, workforce safety, environmental impact, security of materials, safeguards issues, and aspects of quality management. All these aspects require the necessary attention; however, in practice there are many difficulties. This paper focuses on the fields of enhancement of this management, but also on contradictory conclusions to be taken, making a coherent policy to be as searching for the quadrature of the circle. Although we are convinced that the difficulties mentioned certainly are also of relevance for industrial or medical applications with radioactivity or ionising radiation, we will focus on nuclear facility related issues. We will also not deal any further with the discussion whether several cultures may exist simultaneously within an organisation, e.g. the culture of the hierarchy, the culture of work floor people, etc. or whether these are just shaping one culture with various expressions; more information on this can be found in (Fucks 2004).

Safety culture, ALARA culture, security culture

Safety culture has been defined in many papers, but the most frequently used definition can be taken from INSAG 4:

> Safety culture is defined as "that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance"

Security culture has also been defined in documents of the IAEA, also making an attempt to be in line as much as possible with the definition above of safety culture (e.g. IAEA STI PUB 1347, IAEA Nuclear Security Series No 7):

For the purposes of this report, **nuclear security culture** is defined as:

> The assembly of characteristics, attitudes and behaviour of individuals, organizations and institutions which serves as a means to support and enhance nuclear security. An appropriate nuclear security culture aims to ensure that the implementation of nuclear security measures receives the attention warranted by their significance.

ALARA management has less well been defined so far, although it has also been discussed in terms of a state of mind, an attitude, a culture. Work on defining ALARA culture better has already been planned via the European ALARA Network, e.g. during the 10th ALARA workshop in Prague (EAN 2006). Radiation protection is now little by little also being linked to nuclear safety (cf. some references in ICRP 103), though further evolution certainly is desirable.

As stated above, we will not tackle the full 'multicultural society' taking into account also the specificities of safeguards culture, quality culture etc.

An evolution that is on-going is the strong link put forward via the IAEA between a management system (organisation of processes) being a necessity to guarantee an adequate safety culture and as such leading to a strong safety (IAEA GS-R-3). This approach is now also seeping through in legislation (EC 2009/71/EURATOM), shortly to be converted into national legislation, though some authors do not agree fully with this way of thinking (Llory 2009).

Synergy between Safety, ALARA and Security culture

A number of characteristics of the 3 cultures show synergy, as is highlighted below.

1. An individual dimension: each individual working with radioactive or nuclear materials should show skills and attitudes contributing to the limitation of risks. As an example: a questioning attitude; adequate planning; think before you act. Risk conscious co-workers not only performing a task, but being critical towards what they are told to do and having adequate social relations with their colleagues to observe non-acceptable behaviour are supporting all three cultures.
2. An organizational dimension: the entire picture should fit: management should be supportive of all aspects, be aware of risks, be setting the right policy priorities. A right balance between risk averted and effort made is important for all three issues. Adequate processes ensuring sufficient attention and means to continuously enhance and improve the culture(s).
3. A common objective: avoid harm in a broader sense (health, environment, facilities,…), a.o. by putting organisational measures into practice to avoid or to limit the consequences of technical failures and human error.
4. A technical component that needs specialised knowledge, investments, adequate maintenance.

Fundamental differences between Safety, ALARA and Security culture

Nature of the risk

The main difference between Safety and ALARA culture on the one hand, and Security culture on the other hand is the nature of risk. While one can assume that normal people strive to avoid accidents and do their best to mitigate them, security related issues clearly have a dimension of malicious intent. This has important consequences for the policy to be implemented.

Security issues furthermore have an external dimension, i.e. an event starting outside the fence of the facility: a threat of theft, sabotage, intrusion… originating from the outside. This is less the case for safety issues (although external events also may lead to difficult circumstances), and much less for ALARA culture. However, security may also have an in-house dimension: malevolent intentions of members of the workforce, contractors, apprentices, students, visitors. In this respect, safety culture and ALARA culture can be considered to be based on trust, coaching, respect and reinforcement of ideas between staff, hierarchy and operators, prevention advisors and managers. Security may lead to distrust, control instead of supervision, and suspicion instead of support.

Probabilistic aspects

Probabilistic arguments are important for assessing the risk of an activity and its acceptability e.g. in terms of design of facilities or judgements in a context of approval processes.

In this respect, safety culture and ALARA culture are not really in line. Nuclear safety often deals with very improbable events, why ALARA often concerns daily tasks and assessments. Nuclear safety rather deals with low probability – high consequence events, while ALARA is mainly regarding high probability – low consequence actions. This has practical implications for e.g. the validity or non-validity of statistical follow-up and other quality assurance related techniques (Llory, 2009) and in the mind set of people. Dealing with very low probability events may lead to lack of awareness or over-confidence (it never went wrong). In case of ALARA, it may rather be negligence (in day-to-day work doses in nuclear facilities usually are very small).

In case of security - in a context of intentional harm - probability is a doubtful concept, and the impact assessment of an event is also very hard to predict as it is not clear at all how many barriers could be damaged simultaneously.

Acceptability

The acceptability issue is apparent in many cases. A first example is related to the acceptability of consequences in emergency conditions. While it is appropriate to apply stringent intervention levels for the application of countermeasures related to a radiological release (e.g. in Belgium 5-15 mSv effective dose is the intervention level for sheltering – Royal Decree 2003), it is much less evident to use these values in case of terrorism. It is obvious that the nuclear industry wants to be top in all safety related issues, but application of these very low values as the upper bound for the maximum acceptable doses in case of e.g. theft of a source appears to be excessively stringent, and imposes protective measures beyond the reasonable, certainly if one compares to the ease by which other means can be used to cause dead to victims (explosives, toxics, weapons of all nature).

In terms of behaviour, it is very uncomfortable if not unacceptable to people to feel being systematically controlled and supervised by colleagues, chefs, guarding personnel. Social control and adequate supervision by hierarchy are well accepted and part of an adequate safety culture, but suspicious control to identify malevolent actions leads to social tensions. The systematic use of personal data, cameras, all types of sensors, checks by intelligence services etc. is also a negative side effect of the security policy that is imposed.

Safety, radiation protection and security require important investments in means, staff, maintenance, administrative support. For many people, it appears much more acceptable and ethically more justifiable to spend this money in safety enhancing measures as compared to measures to counteract malevolent use of radioactivity or nuclear material.

Time dependence

The risk of nuclear, radiological or industrial safety depends on the inherent aspects of the products dealt with; there may be fluctuations over time due to variability in operations (e.g. routine operation or maintenance), variability in potential impact (quantities of products, nature of experiments). This time dependence however depends on in house planning and processes, and if some change in policy is desired to adapt to particular circumstances, this can be anticipated in house.

The security issue is different. The threat of an intrusion or sabotage depends on external situations, and as such is beyond control of the operator. The protective measures required depend not only on the radioactive inventory, but also on the external circumstances (such as presence of terrorists on the territory, events in conflict areas), even at a global level. This dependence on external, hard to predict events makes policy making very difficult.

Reason

The aspect of reason is very obviously part of ALARA-culture. But both the safety and security culture definitions by the IAEA refer to 'reason' as well, albeit formulated a little differently ("warranted by their significance", cf. supra). As stated above, the "significance" of security is very hard to assess, which is a fundamental difficulty in the definition of STI/PUB/1347. As the external risk can hardly be assessed, this situation leads very often to over dimensioning of the security protection put in place. It is very difficult to obtain an adequate balance between the risk of terrorism (radiological consequences) and the efforts put into place for protection, the target often being "zero risk". There is maybe need for an 'ASARA' approach: as secure as reasonably achievable.

Practical difficulties in stimulating the synergy between safety, security and ALARA culture

Practicalities

In many organisations nuclear safety and security are managed by different services or sections, and often radiation protection and/or industrial safety may belong to still different ones. This of course hinders a joint policy, though striving for an integrated approach seems highly recommendable.

Technical competence is also an issue: the knowledge needed to avoid reactor excursions or criticality incidents (nuclear safety) is much different from the knowledge needed for an adequate radiation protection policy (justification and optimisation of exposures), for preventing an industrial safety related event, and has nothing to see at all with knowledge of security related technical measures such as identification of persons, strengths of fences,…

Legislation – relation to regulator and authorities

Much legislation is applicable to working in nuclear facilities. Often this legislation originates from different regulators. As an example, even at the European level, Radiation protection and nuclear safety are not well linked to general safety on the workplace and to environmental impact neither. Nuclear security issues mainly originate from IAEA guidance (INFCIRC 225 Rev 4C), with less implication of the European regulator.

In many countries, regulations including licensing and inspections have been attributed to different authorities. This may lead to different visions, and different expectations being imposed on the plant. As a consequence, implementation of an integrated approach is often made difficult.

Some practical cases inspired by daily practice in a nuclear research centre

The examples below do not intend to be exhaustive; they are just examples showing that integration of safety, radiation protection and security policies is often difficult, and that the requirements imposed on people may be contradictory.

Communication and information

Openness is a key feature of an adequate safety culture, and access to information is a cornerstone of modern management, supporting adequate safety and ALARA policies. As an example, it is good safety practice to clearly label radioactive products, to make inventories, to indicate where radioactive products are found. However, from the viewpoint of security, this helps potential terrorists in identifying the areas of interest to them.

Concrete examples are the requirements in the context of sealed sources: it is clearly an advantage in the management of sources to have adequate descriptions and to have a policy of evacuation of sources that are no longer used. On the other hand, the inventories of these sources may be a point of orientation to potential terrorists. Therefore, restrictions on information such as inventories are to be imposed. For a broader discussion, we refer to IAEA STI/PUB/1437. Excessive regulation to enhance the security of e.g. sealed sources may also be against the ALARA principle. High active sealed sources must be checked somehow, but imposing to possess pictures, to check labels on the source itself etc. may require important interventions having only a marginal impact on enhanced security.

Design of facilities

In terms of limiting the impact of criticality incidents, fires,… in places where nuclear and radioactive materials are stored or used, it is optimal to have some isolated or peripheral rooms. On the other hand, such places are much harder to protect against intrusion, and a central position in the building is often preferred.

Emergency circumstances

In case of technical difficulties in a controlled area, fast access can be important. This can be hindered by authorisation checks or procedures. This is true for normal interventions after technical failures and in real emergency conditions where external emergency workers are called in. A compromise must be sought between hermetic isolation of some rooms, and adequate measures to have people evacuated in emergency situations, knowing that each system to bypass the protection system is an extra opportunity for abuse by terrorists.

Conclusion

The integration of adequate policies to simultaneously enhance safety culture, ALARA or radiation protection culture and security culture is a complex task, which may lead to situations in which one has to invent the quadrature of the circle. Besides some technical arguments, there is a big mental impact on the people, both in the decision making and in the daily application. The contradictory nature of some of the rules that need to be imposed may lead to discomfort and cognitive dissonances (Festinger, 1957).

In order to facilitate this process of enhancing all components of safety, radiation protection and security, there definitely is a need of a helicopter view by international advisory bodies and regulators. It is the merged policy that needs optimisation, and not various pillars safety, security and ALARA culture separately. An ASSARA-approach (As Safe and Secure As Reasonably Achievable) is what we all should be aiming for.

Epilogue

This text is a written version of a presentation given at the occasion of the scientific meeting of the BVS-ABR in December 2010. In the period between that presentation and this publication, we have lived the Fukushima accident. First of all, we wish to express our deep regrets for the disasters that happened in Japan, and express our deepest feelings of empathy with all victims.

In the context of safety and security, it is obvious that the Fukushima event will have an important impact on design and site selection for new facilities, and on the reassessment of existing facilities. The cultural aspect of guaranteeing safety and security in design certainly will be further developed in the forthcoming years as well.

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SUBJECT: VISION ON POSSIBLE HELP FROM THE EU TO THE RECOVERY OF THE NUCLEAR SITUATION IN JAPAN

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Abstract

In the weeks after the nuclear accident in Japan, Mr Bharat Patel and later Mr. Pierre Kockerols have been assisting the European Union Delegation in Tokyo, in order to advice the Delegation staff and other Embassies representatives about the information provided by the Japanese Authorities and the concerns raised by radiological consequences of the accident.

In conclusion of their mission, they have written a document for the European Delegation and for the Commission services, giving their personal vision on possible European help to recover the situation in Japan.

The current text gives an extract of this document.

1 Introduction

The on-going nuclear accident at Fukushima Daiichi represents the most significant nuclear accident in the last 25 years. In view of the importance of the accident, this document gives a vision and makes concrete proposals on how the European Union and the European Commission could further support Japan in the recovery from the consequences of the nuclear accident.

These proposals are based on the experience acquired by the authors over six weeks, working locally as nuclear experts from March till May 2011, supporting the EU Delegation in Tokyo. Through multiple exchanges with the Japanese Ministries (mainly the Ministry of Foreign Affairs (MoFA), the Ministry of Education/Science/Technology (MEXT), the Ministry of Health (MHLW) and the Ministry of Agriculture and Fishery (MAFF), the Nuclear Safety Authorities (NISA), and the operator TEPCO, it has been possible to observe and evaluate the developing situation and gain a unique perspective on the impact of the accident.

There is much interest in understanding the broader *consequences* of the accident in terms of the radiation spread into the environment, the effectiveness of countermeasures to protect the population, and the activities of the Japanese Authorities to recover from the situation.

This document identifies four key areas where nuclear assistance and support would be mutually beneficial.

This document intentionally does *not* address immediate concerns such as identifying the cause of the accident, improvements on nuclear safety, risk assessments of nuclear facilities, nuclear energy policy etc., as these are already the subject of extensive actions within the European Union, in combination with international partners like the IAEA and with the Japanese Authorities.

2 Current recovery work of the Fukushima Daiichi nuclear power plant

A significant recovery effort is on-going, the priority of which is the improvement of the safety of the affected Daiichi nuclear power plants, which is still far from what could be considered as acceptable according to international nuclear safety standards. TEPCO announced its "roadmap" on 17.4.2011, focussed on the improvements of the cooling, mitigation of the risk for releases, improved monitoring, reducing radioactivity discharges into the environment, and processing the collected radioactive water. The purpose is to bring the plants back to an acceptable safety situation within 9 months.

The timescale of the work appears relatively ambitious as there are many factors not known, and the working conditions make it difficult to conduct detailed surveys to assess the corrective actions needed to achieve stability. It is clear that there is a need for international support here, but the support needs to be very reactive; further it appears that TEPCO and the Japanese authorities are already working with chosen companies (e.g. US and French) with experience in these particular areas. For the moment, there is no real advantage for coordination at EU level here; the actions should preferably be handled on a Member State to Japanese Government level or directly at company to company level.

However, the EU should stay alert to the progress of the recovery work at the site by keeping contacts with TEPCO and other partners, and be ready to respond to bids for work, if European organisations and companies with *relevant specialist experience can both contribute and benefit from such work.*

3 Monitoring and recovery of the affected region

Key Area 1 : Support on the monitoring of the affected region

The dispersal of radioactivity into the environment necessitates a number of control measures at distances of several tens of km away from the Daiichi plant. The different Japanese Ministries and the local Prefectures are coordinating many monitoring programmes in order to assess the evolution of the situation in the (0-30km) evacuation zones surrounding the plants but even more focussed on the whole area (> 30km) covering the Fukushima prefecture and the neighbouring prefectures. It mainly consists of:

- the monitoring of the *environmental radiation* (radiation dose, air sampling, soil sampling, sea water sampling,…)
- the monitoring of the *food chain* (milk, vegetables, meat and eggs, feed, fishery products, …).

Based on the results, restrictions are imposed on the accessibility of some areas and on the consumption and distribution of food products.

These monitoring programmes have been set in place in the days and weeks after the accident and have been gradually enhanced. It is clear that the system will further progress in the coming months and will require a continuous attention during coming years, g*iven the long radiological half-life of particular radionuclides (e.g. caesium 137 – 30 years)*.

Although the prompt evacuation of people within 20km (and later 30km) radius of the plant mitigated the severest effects of radiation discharges, the variable radioactive fallout in areas as far as 60km or so has caused some elevated radiation dose-rates in populated towns and villages to the north and west of Fukushima Daiichi plant. The monitoring of the health of people living in the affected region will also require coordination during years.

For the further deployment of these extensive monitoring programmes by the Japanese Authorities, international support could be requested for the procurement of suitable radiation measurement/protection equipment. The EU has a very diverse market for this type of equipment (including also manufacturers from Eastern European countries). The European *technologies in this field are also quite advanced). As the monitoring programmes will have to be implemented for years, this type of support can be managed in a more scheduled way. Coordination at EU level could be helpful, e.g. exploring the EU market when a specific request is made.*

Besides the procurement of equipment, EU scientific expertise could also be provided in support of the monitoring programme. The European Commission Joint Research Centre has some unique expertise in the management of monitoring networks, the realisation of overall assessments (e.g. cartography of the depositions), inter-laboratory comparisons and specific measurement techniques (e.g. detection or interpretation of traces of radioactivity).In addition to the specific radiation issues, one could also mention that the European Commission has developed an overall know-how in the coordination of the control of the food chain (sampling, assessment, recording, reporting).

Key Area 2: Support on the recovery and rehabilitation of the affected areas

Affected areas where there has been a significant dispersal of radioactive dust will sooner or later need to be "rehabilitated", to allow the evacuated inhabitants to come back to there community or to lower the exposure of the inhabitants of communities which were not evacuated. This issue is only marginally addressed for the moment but will require increased attention in coming weeks.

The recovery of urban areas, parks, houses, gardens, etc. can be done by cleaning (decontamination) or removal of the contaminated material (e.g. removal of the upper ground layer). Other techniques may also be applied. Expertise in this field has been acquired in Europe with the recovery actions taken in the last 25 years after the Chernobyl accident.

As the recovery of the affected region will also necessitate relatively long term planning, support coordinated at EU level could also be helpful, in providing the suitable expertise and technology for specific requests.

4 Lessons and experience feedback from the accident response

Key Area 3: Support in evaluating experience of civil protection countermeasures

In the early days of the accident after 11th March, the Japanese authorities systematically applied the evacuation and sheltering orders issued by the central government. The means by which these were carried out, the overall effectiveness, the screening programmes for personnel who had been evacuated and arrangements for the subsequent welfare and support of evacuees is of interest from a civil protection as well as radiological protection point of view.

The EU should aim to engage in discussion and follow-up with the central and local Governments and Japanese civil defence authorities about possible lessons that could be learnt for the future. The subject is of particular importance given the location of some nuclear facilities in Europe. This activity could be in the form of meetings and visits for exchange of information. Given the sensitivity of this issue, it is suggested to make direct contact with government officials with whom contacts have been made by the EU delegation or by the authors in the course of their missions.

Key area 4: Support in evaluation of current regulations, guidance and practices on radiological protection in emergency situations

The operational follow up of the Fukushima accident highlights a number of areas where the application of international standards, national regulations, and current accepted practices may be improved or clarified. For example, the control levels for radioactivity in foods following a nuclear emergency, the action levels for re-establishment of access to contaminated areas, and the criteria for occupancy of radiation affected public areas for long-duration incidents should be studied for the purpose of learning lessons and international harmonisation.

The experience of the Japanese Authorities should be followed through direct meetings with the relevant government agencies. This could also be followed through other international partners.

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VIEWS ON THE FOLLOW-UP OF THE NUCLEAR SITUATION IN JAPAN

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Abstract

This document has been written in May 2011 for the EU Delegation in Tokyo and gives some personal views on the future follow-up of the information flow about the nuclear situation in Japan.

Over the last weeks, the EU Delegation in Tokyo has made impressive efforts to better understand the crisis situation and to disseminate the information, in support of the EU. Considering that the information flow will still continue for some time, that the number of measurements, calculations, assessments etc... can even increase, it looks important that a kind of *"filtering"* is done between *what is relevant for the EU* and what is perhaps important for Japan but less for the EU.

In my opinion, following information should require priority in continuous attention:

1. the risk for new significant releases from the Dai-ichi units 1 to 4;
2. the situation in Tokyo and the situation and accessibility of the Fukushima and surrounding prefectures;
3. the control of the food chain and the control of the borders;
4. the lessons taken from the accident, the future of nuclear energy in Japan, and in a more short term the restart of stopped nuclear power plants.

For the first three items, I made in the next pages a summary of the situation, on the basis of the information that we gathered *and I give my personal view (in italics) on how I expect that the evolution could be in the coming months.* I have not included in this assessment item 4, as I could not really focus on the topic over the last weeks.

Besides, it looks important to me that "alarming" information which could pop up in the future is always *put in its right perspective*. If news arrives on "high radioactivity" or "high doses", one should ask about the *quantification* (Bq or mSv) and further *compare* it with the respective reference

levels or limits, or with other (e.g. natural) exposures. By doing so, the *relevance* of the information can be concretely assessed.
Also for news which could appear on health consequences from the accident, one should be very careful. *Short term effects* (like e.g. radiation burns) should in principle *not* appear, even for the intervention workers who were exposed to doses close to 250 mSv (assuming that the dose monitoring has been correctly done). On the other hand, cancer is a *long term effect*, and could only appear after a latency period of several years. Considering the current announced doses to the workers and to the surrounding population, it will be difficult and it can only take a very long time (up to 10 years and more) to determine possible increases which are statistically significant.

Summary of the situation in relation to the Daiichi nuclear accident and view on the evolution in the coming months

1. Risk for new significant releases from the Daiichi units 1 to 4

Situation of the Daiichi nuclear power plants:

The control on the situation of the Daiichi units 1 to 4 has been improved since the first weeks after the accident, but remains far from what is acceptable according to usual safety standards. Cooling of the reactors and the spent fuel pools are still done with quite “artisanal“ means. There are still on-going releases to the atmosphere and to the sea, but (according to the information from MEXT on 27.4.2011) at a much lower level than it had been in March and early April.

Most concerning is for the moment:

– the status of unit 2 where a leakage caused an accumulation of high level contaminated water in the basement; the resulting discharge to the sea could be stopped but the reliability of the stops is not really guaranteed; pumping operations to a tank outside the units has been started two weeks ago but the whole operation at the current flow rate and with interruptions will take several months;
– the status of the spent fuel pool of unit 4 where a temperature increase to more than 80° C had been observed end of April; the pool had to be flooded in order to control the temperature; there is also a suspicion of leakages due to structural damages; the support of the pool has to be reinforced.

For the future one should consider:

– *the risk of further damages, especially the pool of unit 4 and the stops on unit 2, in case of after-chocks;*
– *the risk of interruptions in cooling or pumping operations due to the lack of reliability of the systems in place or due to after-chocks.*

Independently of the actions undertaken, a positive trend will come from:

– *the fact that the overall inventory of radioactive products will gradually decrease as some short-living nuclides will disappear, like the I-131 (half life of 8 days);*

– *the fact that the residual heat from the fuel will gradually decrease, although this process is rather slow at this stage; the heat should be now roughly at a level of 0.1 % of the nominal power and will reach about 0.03-0.02 % after one year.*

Actions undertaken by TEPCO:

TEPCO has announced on 17.4.2011 its roadmap with 63 actions for improving the cooling, the mitigating of the risks and monitoring and clean-up operations at the site. The implementation of the plan over 6 to 9 months would lead to a more sustainable safe situation *and the risk for significant releases should be then under control.*

It was announced that NISA would monitor the follow-up of the actions.

It is clear that the plan is very ambitious, taking into consideration the fact that not only a single but four units are affected, that there are many damages and high radiation levels. But there is anyway no alternative.

It has also been reported that for the moment about 220 workers are involved in the recovery works (by way of comparison, for a normal revision of a single nuclear power plant, 500 to 1000 workers are involved). The low number is probably related to the high radiation levels. This necessitates much more planning.

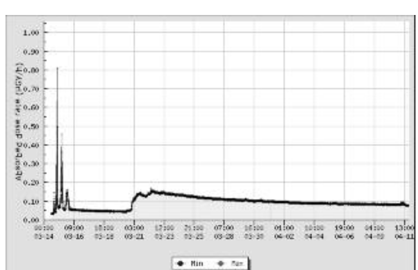
For the future, the monitoring of the progress of the roadmap is essential. In the last MoFA briefing, NISA promised a report. The NSC has also pushed NISA to report to them on the follow-up.

In future briefings with TEPCO, I would advice to primarily focus on the progress on the roadmap.

2. Situation in Tokyo; situation and accessibility of Fukushima and surrounding prefectures

Situation in Tokyo:

At two times Tokyo has been influenced by the atmospheric discharges from the plant.



On 15.3.2011, contaminated clouds passing over the city gave peaks with a maximum dose rate level of 0.8 microSv/h (p.m., the dose rate from cosmic radiation in an airplane at high altitude is 5 microSv/h). There was that day nearly no deposition and the dose rate level dropped again to the background level.

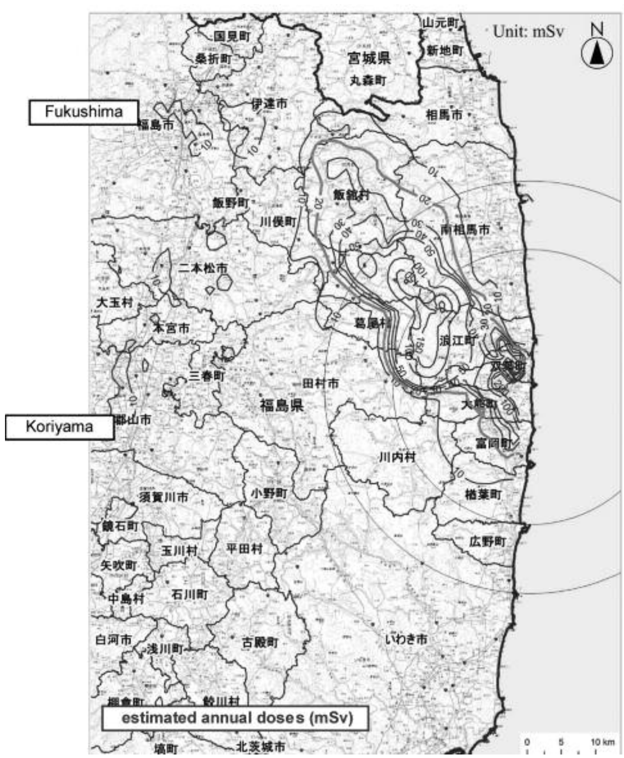
On 21-23.3.2011, there were again peaks, which were lower (< 0.2 microSv/h), but due to the atmospheric conditions there was a deposition, which led and still leads to a remaining measurable dose rate. The estimated deposit in Tokyo was about 70,000 Bq/m^2 of I-131 and 6,000 Bq/m^2 of Cs-137 (for Cs-137, this is e.g. comparable with the deposits in Eastern France after the Chernobyl accident).

The dose rate from these deposits has gradually decreased, due to the decay of I-131. Early May, the dose rate level is about 0.06-0.07 microSv/h outdoors. Within the buildings the level is lower, close to the background.

In the future weeks, as the iodine 131 disappears, the dose rate level will further decrease to about 0.05 microSv/h outdoors, which is about half more than the natural background.

Situation and accessibility of Fukushima and surrounding prefectures:

In the region around Daiichi there have been of course much more deposits than in Tokyo, particularly North West of the Daiichi plant. On 21.4.2011, the Authorities have issued a map with the estimated annual dose, based on the current environmental monitoring.



In the immediate vicinity of Daiichi, the evacuation zone of 20 km has been extended by the "Planned evacuation zone", where the inhabitants have to evacuate within one month (roughly corresponding with the area where a yearly dose > 20mSv can be expected), and the "Evacuation prepared zone", where specific constraints apply (roughly the rest of the surrounding districts in the area between 20 and 30 km).

But one can observe that outside these areas, there are several locations, in particular some areas of the cities of Fukushima and Koriyama, where the expected dose on an annual basis is about 10 mSv (which is 10 times the dose limit for "the public", i.e. the non radiological workers). In these areas the dose *rates* are currently around 1 to 2 microSv/h.

It has been observed (see related mission report dd. 24.4.2011) that, when coming from Tokyo, the dose rates start to increase in a radius of about 100 km from Daiichi.

In the coming weeks, the dose rates of the large area around Daiichi will further decrease, but not more than with 50 %. So for the whole area precautions should apply.

The conclusions of our mission to the North on 24.4.2011 have been written in this sense. For transits through the area or short stops, there is no problem as dose rate levels are low enough. But staying in the region should be avoided, unless there is a clear benefit from it.

In radiation protection, even when exposures are below the limit, a balance is always made between benefit and possible health detriment (i.e. the "ALARA" principle: keeping the exposures "as low as reasonably achievable"). For this reason, it should be noted that for people living in the area, the conclusion can be very different than for people going there.

3. Control of the food chain and control of the borders

Control of the food chain

The results of the monitoring of the food chain are reported by the Ministries (MHLW, MAFF and FA) in the MoFA briefings. The implementation of the monitoring programme and control measures is however for a big part delegated to the prefectures.

A methodology document of 8 pages ("inspection planning" and requirements regarding the restrictions) has been presented mid April at the MoFA briefing.

For the assessment of the contamination levels in food, the Japanese Authorities apply following provisional regulation values:

Bq/kg	Milk for infant food	Milk products	Other foodstuffs	Drinking Water
I-131	100	300	2000	300
Cs-134/137	200	200	500	200

These values are integrated in the recent specific European Regulation 351/2011 dd. 11.4.2011 (and former Regulation 297/2011 dd. 25.3.2011) which had been issued to deal with the import of food from Japan and for which more strict levels had been introduced than the former European levels.

By way of comparison, herewith the levels of the initial regulation 3954/87 issued after the Chernobyl accident and the FAO/WHO levels.

European Regulation 3954/87 dd. 1987

Bq/kg	Infant food	Milk products	Other foodstuffs	Liquids
Sr-90	75	125	750	125
I-131	150	500	2000	500
Cs-134/137	400	1000	1250	1000

FAO/ WHO «Codex Alimentarius» for contaminants in food dd.2006

Bq/kg	Infant food	Milk products	Other foodstuffs	Liquids
Sr-90	100		100	
I-131	100		100	
Cs-134/137	1000		1000	

Looking to the way the control of the food chain is currently managed, it is clear that the Authorities want to have a coherent system in place but avoid “overacting“ (avoid to be “more catholic than the pope“). This pragmatic approach enhances of course the risk that some food products escape the controlled circuit.

Besides this, it should be noted that the Sr-90 is still not measured. It has been assumed by the Japanese Authorities that the Sr-90 activity from the releases would be much lower than the Cs-137 (based on few measurements).

One should argue that the consumption of food products with contamination levels above the reference levels doesn`t necessarily lead to a significant dose (e.g. the “annual limit of intake“ of Cs-137 for an adult is 77.000 Bq, meaning that the consumption of 77.000 Bq in total would lead to a dose of 1 mSv). But here also the ALARA principle applies: what can be reasonably avoided, even below the limits, should be avoided.

However, it is clear that the main problem relates to the lost of trust by the population, would it appear that contaminated food products are escaping the controlled circuit.

The follow-up of the food chain will require continuous attention for years. The methodology will have to be further strengthened by the Authorities and more systematised in the coming months, in order to build or restore trust (perhaps in analogy with what happened with the BSE crisis or other food crises in Europe).

One can expect that from time to time some “released” food will be found which has escaped the control and with activity levels above the reference levels. The probability for this can increase, as one can expect that more checks by independent bodies will be done (e.g. Greenpeace, checks at the borders). But the probability will also decrease as the control system of the Authorities becomes more efficient.

Related to the above-mentioned concern on the Sr-90, it would be worthwhile to question again the Authorities on this issue in the coming weeks.

Control of the borders

As said above, the control of the food imported in Europe has been subject of a specific European legislation, requesting a systematic sampling and measurement of the Japanese exported products. A contact with DG SANCO Mid-April learned us that, for the measurements till 19.4.2011, no significant contamination in food had been found at the EU borders (p.m., the number of food products imported from Japan is however limited to few products like tea, bamboo germs, algae, …).

The control of other products at the borders of Japan is managed by MLIT. It looks like that the monitoring system which is currently used is mainly based on the equipment which was installed in the past years for the security checks the containers and trucks (action taken as result of the security concerns after S-11).

It looks rather unlikely that significant contaminations will be found in Japanese non-food products.
Should some contaminated food be detected at the EU border, one should of course be careful on how the information is disseminated.

Acronyms used

MoFA: Japanese Ministry of Foreign Affairs
NSC: Japanese Nuclear Safety Commission
NISA: Japanese Nuclear and Industrial Safety Agency
TEPCO: Electricity utility (operating the Daiichi NPP)
MHLW: Japanese Ministry of Health, Labour and Welfare
MAFF: Japanese Ministry of Agriculture, Food and Fishery products
FA: Japanese Fishery Agency
MEXT: Japanese Ministry of Education, Science and Technology, Sports and Culture
MLIT: Japanese Ministry of Land, Infrastructure, Transport and Tourism

Annex

Official websites
for the follow-up of the situation in relation to the nuclear accident

1) Situation at the Daiichi nuclear power plant

Information from the operator **TEPCO** (inclusive press releases)
http://www.tepco.co.jp/en/nu/fukushima-np/index-e.html
Roadmap towards restoration
http://www.meti.go.jp/english/speeches/20110417.html
Information from the Japanese **Nuclear and Industrial Safety Agency**
(inclusive press releases)
http://www.nisa.meti.go.jp/english/

2) Radiological situation outside the nuclear power plant (inclusive sea)

Environmental Monitoring Plan outside the Daiichi nuclear power plant
http://www.mext.go.jp/english/incident/1304079.htm
Results of the **Environmental Monitoring**
(Fukushima Prefecture, other Prefectures)
http://www.mext.go.jp/english/incident/1303962.htm
Evaluation of the **Environmental Monitoring** results by the Japanese **Nuclear Safety Commission**
http://www.nsc.go.jp/NSCenglish/mnt/index.htm

3) Control of the food chain

Results of the inspection of **Drinking Water and Food Products** on land
(Press releases and Reports, incl. applicable restrictions)
http://www.mhlw.go.jp/english/topics/2011eq/index.html
http://www.mext.go.jp/english/incident/1304083.htm
Results of the inspection of **Fishery Products**
http://www.jfa.maff.go.jp/e/inspection/index.html

4) Travel and transport

Information on radiation levels in **Airports** and **Ports**
http://www.mlit.go.jp/page/kanbo01_hy_001428.html

5) Other follow-up sites

Fukushima Prefecture
http://www.worldvillage.org/fia/kinkyu_english.php

Japanese **Ministry of Economy, Trade and Industry (METI)**
http://www.meti.go.jp/english/speeches/20110417.html

International Atomic Energy Agency (IAEA)
http://www.iaea.org/newscenter/news/tsunamiupdate01.html