Final Report Summary - TRASNUSAFE (TRAINING SCHEMES ON NUCLEAR SAFETY CULTURE)

Executive Summary:

The TRASNUSAFE project (Training Schemes on Nuclear Safety Culture, FP7 Euratom – Grant agreement no.: 249674) is part of the response to the needs for a EU industrial nuclear policy. Education and Training is a duty also strongly supported by the European Commission, in its "Basic Safety Standards" (BSS) - COUNCIL DIRECTIVE 2013/59/Euratom laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation. TRASNUSAFE received the support of two groups of European users, consisting of a nuclear regulator, a state owned company in charge of nuclear sites remediation and radioactive waste management, the European Isotopes Transport Association, an engineering company and four other industrial companies active in the nuclear electricity production.

The Consortium in charge of the project included six universities, three national research centres, two European networks – one academic, and one for research -, and two private companies.

TRASNUSAFE designed, developed and validated two training schemes on nuclear safety culture with a common basis, for professionals operating at a high level of managerial responsibilities in nuclear installations. One training scheme is related to the nuclear industry, while the other is related to the installations making use of ionising radiation based technology (mainly in short: the medical sector).

The common basis of the two training schemes consists of a training module entitled: "Managerial Competences and Leadership for Safety Culture". It aims at providing the managers with knowledge and understanding about safety culture in order to avoid incidents occurring as a result of human errors or organisational deficiencies, and to develop adequate concern about the importance of radiological protection issues in the operation of facilities and hospitals or for other users of radiations. For the managers, these topics are closely linked to economical operation and societal responsibility.
Two modules are specifically oriented towards managers in the industry: “Compliance of contractors with safety systems” and “Observation techniques”.

Two others are more oriented towards the training needs of managers of the medical sector, respectively: “Economics of safety culture” and “Setting up a management system”.

All modules, the generic and the four specialised, taught in a highly interactive way, using problem solving session and case studies, involve facilitators and mentors. They were tested in pilot sessions, in the form of five Eurocourses, and optimised thanks to the trainees feedbacks.

The topics of the modules, the training outcomes and the principles of the training methodology were selected at the beginning of the project by means of a survey widely spread over the European Union and a set of local seminars. TRASNUSAFE offered also an opportunity for studying the links between radiation protection, in particular the ALARA principle, and nuclear safety culture, for the benefit of the design of the two training schemes.

The training modules on nuclear safety culture are thus ready for professional use. The ENEN Association will take over their organisation during the five years to come.

Project Context and Objectives:
Nuclear Safety Culture is the result of a continuous effort and commitment to keep high safety standards at all steps of design, construction, operation and dismantling of nuclear installations, including transport of fuel, waste, and other radioactive materials like medical radio-isotopes. It includes radiation safety and the commitment to match the ALARA goals of the radiological protection of the persons.
Nuclear safety culture is based on knowledge and understanding, behaviour, research, experience feedback, training and communication, management commitment, assessments, as well as regulation and regulatory processes.
The Council Directive of the European Union issued on 25th June 2009 about nuclear safety harmonization, stipulates that: “Member States shall ensure that the national framework in place requires arrangements for education and training to be made by all parties for their staff having responsibilities relating to the nuclear safety of nuclear installations in order to maintain and to further develop expertise and skills in nuclear safety.”

In addition, the idea of a “European Passport” acquired through training using the ECVET system (European Credit system for Vocational Education and Training) is gaining interest.
TRASNUSAFE aimed at designing, developing and validating two training schemes on nuclear safety culture with a common basis for professionals operating at a high level of managerial responsibilities in nuclear installations. One training scheme had to be related to the nuclear industry, while the other would be related to the installations making use of ionising radiation based technology (mainly in short: the medical sector).

The two training schemes were developed for professionals at a high level of managerial responsibilities for instance in nuclear installations or in the radiotherapy departments of hospitals. It includes the design of the installations, their construction, operation and dismantling, the transport of fuels, waste and radioisotopes. All types of nuclear installations are concerned: nuclear power plants, research reactors, waste treatment units, etc. The project thus aimed at addressing the needs of managers responsible for nuclear safety in the industrial as well as the medical sectors. The duration of the project was 48 months: from 1st November 2010 to 31st October 2014.

The project was organised in five Work Packages (WP):
WP1 – The analysis of the needs
Through surveys and seminars, WP1 provides qualitative information on the characteristics of the potential trainees, their professional environment, and their expectations. It also enables to evaluate the provisional fluxes of managers that can be expected for the trainings, and in particular the most relevant training modules to be developed.

WP2 – Relations between radiation protection (ALARA principle) and nuclear safety culture
Two reflection groups on this topic were launched: one with the EUTERP Foundation, and the other with the EAN network. They both contributed to the definition of the contents of the training module common to the two schemes.

WP3 – Design and Development of training schemes
Based on the results of WP1 and WP2, WP3 was aimed at designing and developing one common generic training module and two specialised training modules: one for safety managers of the industrial sector, and the other for the medical sector. WP3 was also responsible for training the trainers of the pilot courses. The facilitator guides of the different modules is one of the main outcomes of WP3.

WP4 – Validation of the two training schemes

Five pilot sessions were organised to test and assess the five training modules. First of all, taking into account the conclusions of the first two work packages (WP1 and WP2) and confirming previous work within WP3, the final selection of titles, locations, times, learning outcomes and methodology of the five training modules - called EUROCOURSES was made, leading to the following announcement:

Generic module:

EUROCOURSE 1 - “Managerial Competences and Leadership for Safety Culture”
27th-28th November 2013, Chancellor’s Hotel Fallowfield, Manchester, UK

For the Medical Sector:

EUROCOURSE 2 - Day 1: Mini-generic module; days 2 and 3 : “Setting-up a Management System”
21st-23rd January 2014, SCK.CEN Club House, Mol, Belgium

EUROCOURSE 3 - Day 1: Mini-generic module; days 2 and 3: “Economic Relevance of Safety Culture in Medical Applications”
5th - 7th February 2014, University Politécnica, Madrid, Spain

For the Industrial Sector:

EUROCOURSE 4 - Day 1: Mini-generic module; days 2 and 3 : “Observation Techniques”
14th - 16th May 2014, Hotel International, Bucharest, Romania

EUROCOURSE 5 - Day 1: Mini-generic module; days 2 and 3: “Compliance of Contractors with Safety Systems”
21st - 23rd May 2014, Mohovce NPP, Slovakia.

At the initiative of the University of Manchester, a webpage presenting the five EUROCOURSES was established and continuously updated (www.trasnusafe.eu) and the recruitment campaign of trainees was launched.

A coordination with the NUSHARE project was achieved through an extensive discussion at the invitation of the NUSHARE project management team.

WP5 – Coordination and Quality Assurance of the project.

The coordination of the project was made by the Project Coordination Committee, which met eight times during the project, and reported to the General Assembly three times after the kick-off meeting.

Project Results:

The TRASNUSAFE project (Training Schemes on Nuclear Safety Culture, FP7 Euratom – Grant agreement no.: 249674) is part of the response to the needs for a EU industrial nuclear policy. Education and Training is a duty also strongly supported by the European Commission, in its “Basic Safety Standards” (BSS) - COUNCIL DIRECTIVE 2013/59/Euratom laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation - Act adopted by Council on 05/12/2013 (EN 17.1.2014 Official Journal of the European Union L 13/31).

TRASNUSAFE received the support of two user groups: one under the leadership of TRACTEBEL included the Companies SNN, SEAS, ELECTRABEL, FORSMARK (VATTENFALL) and SOGIN. The other, headed by the Romanian Regulator CNCAN included the EITA Association.

The main results are described in this report.

1. A survey of the needs by means of a questionnaire

A survey of the needs for high managerial level training in nuclear safety culture throughout Europe has been made under coordination of SCK•CEN, with assistance from UCL, TECNATOM, ITN, JSI, UPB, UNIMAN, CEPN, STUBA and UPM, and has delivered some important qualitative and quantitative conclusions, showing among others that the “market” of managers for such training courses in Europe...
The survey shows that organisations where a safety training for managers is available, organise this as an internal training (34%) or work with an external national organisation (20%). For 22% of the responses it is part of a university or a professional training curriculum, generally in the national language, and about 24% take this training at an international level, mostly with IAEA. The durations of the training sessions are very variable, and the registration fees are none or mostly low, showing a not well-developed market for training companies addressing individuals.

For TRASNUSAFE, the participants suggested a wide variety of organisational forms, but a majority of them prefers classroom style multiday sessions combined with homework and/or internet based training. A big consensus was noted on the need for an exam or test, and the need for a diploma or accreditation (over 80%), but many suggestions were expressed on non-traditional exams and on-the-job follow-up. Also a European recognition was demanded (70%).

The proposal of having a generic module was very welcomed without clear preference for the topics, except for those related to the medical use of radiation, which received a lower score than the others. For the specialised modules, the participants were offered a set of 14 topics (management of human performance, feedback practices, knowledge management, safety culture and field management, management of subcontractors, inspection and control, accreditations, societal context – ethics, regulation, communication, radiological safety in medical applications, safety culture in medical applications, safety culture in the transport of radioisotopes, safety culture in the design of new concepts or applications, the relation between safety culture and radiation protection, the relation between safety culture and security culture): all these topics received a high score from the participants. On this basis it was thus not possible to conclude which were the most attractive topics. This is the reason why it was decided to proceed with discussions in workshops.

2. Five regional workshops

The survey was completed by a set of five workshops, held in different parts of the European Union:
- in the region "Rhine": Brussels workshop on September 22nd – 23rd, 2011, coordinated by SCK•CEN;
- in the region "Black Sea": Bucharest workshop on October 19th, 2011, coordinated by UPB;
- in the region "North Sea and Scandinavia": Manchester workshop on January 17th and 18th, 2012, coordinated by UNIMAN;
- in the region "Danube": Ljubljana workshop on February 10th, 2012, coordinated by JSI and STUBA.

Each workshop had a focused attendance from the region, and was built on the results of the questionnaire, and the outcomes of the previous workshop. After each workshop, new questions were put forward for the next workshop to discuss. In total, over 150 persons attended the workshops and contributed to the discussions.

Starting with the Brussels workshop, the need to develop the safety culture training specifically for (high) managerial level was recognised. While the safety training given to the workforce is work related, tuned to concrete working conditions, the safety training for managers approaches safety as a risk management issue, and is largely sector independent. The training of managers should focus on the importance of a safety policy, ways to foster a good safety culture, management systems to manage safety, tools to measure safety culture, and consequences of inappropriate safety culture.

To be successful, the training should use concepts from management sciences and adopt the 'language' of senior managers. Driving forces for safety culture are important factors for managers in both the industrial and the medical sectors; they are for example: the evolving questioning attitude by the general public, triggered by accidents; the follow-up by and the sanctioning role of regulators. Safety management including policy development and return of experience are important to deal with in the training.

More organisational issues were discussed at the Bucharest workshop. Combination of self-study based on readings with class room style sessions was confirmed as the preferred method, while insisting on the stimulating aspect of exchange of experience between the trainees and with the trainers. In this context, the selection of experienced trainers appears as a key success factor. The importance of human errors, the largest causes of accidents, and organisational failures should be illustrated by examples. Focus should be put on the emergency preparedness.

Participants insisted also on the fact that safety culture being an attribute of organisations, it lives together with other cultures, in particular the national culture, full of history. Training not only in English, but also in the local language of the trainees should be envisaged.

At the Madrid workshop, the characteristics of the potential trainees, their professional environment and their expectations were analysed. There was a clear preference to focus on CEO level management and to eventually include targeted sessions for middle level management afterwards, but also to try to invite both the energy and the medical sector CEO's in joint generic module sessions,
preferably called ‘workshops’ than ‘courses’. Case studies were seen as of key importance to simulate CEO’s to take part in the generic module workshops.

Three main learning outcomes were formulated for the generic module:

- Awareness of essential responsibilities, accountability and role of management in building, promoting and encouraging safety culture;
- General knowledge of the context of complex technical and organisational systems with regards to Radiation Protection, Safety and Safety Culture;
- Awareness of commercial and safety benefits of a strong safety culture.

It was also decided to extend the generic module over two full days, and to include a mini-generic module of one day in the three-day specialised modules for the trainees who would not have had the opportunity to follow the generic module as a prerequisite.

It was suggested that exercises would be based on specific problems that some of the participants are meeting in their own organisation and that they would be willing to share during the training, or that alternatively the problems would be suggested by the coach / facilitator. The coach would work with a few specialised lecturers as a course director and as the facilitator during the active work of the participants.

For the sake of conciseness, the generic module would include the minimum of what needs to be known by the “top management”. It was agreed that ideally, a follow-up is needed to make the training efficient. The follow-up would be achieved either by coaching the implementation of the training in the companies (particular arrangements would have to be done for that), and/or through specific modules.

At the Manchester workshop, the general discussion determined that the learning outcomes were largely satisfactory but lacked some specificity and so the following points were considered important:

- Need of an explicit reference to “leadership” and for it to be explained.
- Training on upwards leadership since senior managers will not always have the understanding of the nuclear business.
- Top down leadership / visionary leadership (instigator of change and strategist).
- The phrase “Safety Culture” should be used instead of “RP, Safety and Safety Culture” as the medical sector is unlikely to recognise the meaning of nuclear safety and is more likely to recognise “Radiation Safety”. Safety culture is largely the same for all industries so good practice should be drawn in from across all industry sectors (process safety and chemical industry).
- Training will be sector and country specific so the learning outcomes may need tuning.
- Senior managers need a base level of understanding of their company operation and this needs to be supported by upward leadership. The word “Awareness” should be replaced by “Knowledge and understanding”.

It was considered that early engagement with user groups that could be employers or professional bodies is crucial to ensure the integration of training approaches. Some key pointers to come out of discussion were:

- All managers from the top down to supervisory levels are to be considered as potential trainees.
- Across EU need may vary from country to country.
- Regulatory requirements and approval of qualifications by Professional Bodies would act as a driver for training needs.
- The sector to be covered is not just the nuclear industry and medicine but must go much wider to include defence, research, security, industrial radiography, sources, border control and emergency planning.

The following points were considered crucial to the training of Senior Managers and need to be reflected by balancing the 2 days of training between background information on radiation protection and nuclear safety, theory on leadership and case studies;

- Avoid anything technical or safety related but deal in principles with a focus on justification and optimisation (history of nuclear is unnecessary).
- Distil technical and safety matters down to essential background information that helps provide understanding.
- Focus on leadership and the need to provide a vision for safety culture improvement.
- Provide them with the tools to bring about safety culture improvement and to assess progress.
- Case studies should be used early on and interspersed through the training as a way of illustrating both how to do it and its benefits and detriments. Make sure case studies are meaningful to the points that are being put across.

In addition to the above, a fundamental point to come out that really reflects the UK approach is that whatever approach is taken must be employer led and not delivery body led. The engagement of users and professional bodies that can act as surrogates for employers at an early stage is crucial to success where success is measured both by the uptake of safety culture courses developed by the project
and improvement in nuclear safety that is evidenced in the future across the nuclear sector of the EU.

The work of the UK Human Performance Forum in attempting to codify human performance including safety culture in order to achieve a cross industry code of good practice with possible endorsement by INPO would be an important platform to build training programmes on that were specific to the licensed nuclear industry. The fundamentals of this codification would have applicability across other parts of the sector including nuclear. Once codified the use of both national and international professional bodies in the nuclear and medical sectors would be key in directing the development and implementation of the training and could assist with validation and possible approval or accreditation.

The question: "Employer led or delivery organisation led training?" was the first to be discussed at the Ljubljana workshop. Based on general discussion the outcomes were:

- Level 1 safety culture, the legislative level, consisting in keeping the rules, is well implemented: organisations have to have it, they know what it should be. TRASNUSAFE should concentrate on Level 2 safety culture, employer led, according to which management has to be the driving force for safety culture improvement, while Level 3 deals with the response of individuals, all people having to adopt a questioning attitude, a rigorous and prudent approach, and communicate.

- Modules for nuclear industry: the danger is not so much coming from plant people, but from subcontractors during outages. Therefore compliance of subcontractors with safety systems seems to be an important topic (more related to nuclear power plants, in particular new builds).

- The modules should focus on examples and tools and take into account that new builds take place in a multicultural environment.

- Lessons can be learned from other industries, e.g. oil and gas industry or aeronautics, which developed good approaches to safety culture.

Differences in cultures across the EU is another topic that was discussed during the Ljubljana workshop. The outcomes were:

- Refinement for some specific countries would be needed: basically same learning outcomes and same content everywhere, except for example the selection of case studies.

- Safety culture is related to local culture. One can assume that our historical development is almost the same, and the general culture is about uniform throughout Europe. However some differences are evidenced for instance by the “Eurobarometer”: trust in authorities is not the same everywhere.

- Political situation may affect safety culture.

- Some companies may have more hierarchy than others.

- The companies need to get leaders. Different kinds of leaderships require different approaches to safety culture. TRASNUSAFE should contribute to building the authority and knowledge needed by leaders. The example of the Slovak Republic was mentioned, which started post graduate courses on Safety aspect for the ones with ambition to become manager.

- Managers (leaders) often come from different countries: they are for example lawyers with a good social background, but technical skills are lacking. Therefore case studies can be useful to show the variety of factors that can impact safety.

Regarding possible topics for specialized modules the general discussion outcomes were:

- Occupational safety, including other hazards and problems of other industries to be integrated into the modules, but do not require separate modules;

- The following topics deserve a priority:
  - Compliance of contractors with safety systems,
  - Emergency situations and nuclear safety culture for nuclear industry,
  - Economics of safety culture,
  - Setting up a management system: emphasis should be put to medicine and other institutions, where safety culture is still underdeveloped;
  - Top management, return of investments, how much money to save with safety culture – in principle this should be covered with the generic module.

It was also agreed that the training courses must be short (2 to 3 days) and highly interactive between the trainees and with the facilitators. Awarding a diploma or an accreditation is advisable, especially if many trainees come from the medical sector.

3. Understanding the links between nuclear safety culture and the ALARA principle

The links between nuclear safety culture of the nuclear industry and the ALARA principle currently used in the radiation protection community have been clarified for the benefit of the design of the TRASNUSAFE training courses. For this purpose two reflection groups (RG) were created: one, coordinated by CEPN, aimed at consulting the Members of the ALARA Network (partner EAN), and the
other, coordinated by SCK-CEN, collected advice from Members of the European Training and Education in Radiation Protection Foundation (EUTERP). The first RG focused its work on the optimisation principle, while the other mainly touched on the justification principle. Both RGs worked in parallel in 2011 before the organisation of a “wrap-up workshop” on the 2nd September 2011 in Rome. The EAN RG noted that the application of radiation protection principles is not developed at the same level in the nuclear and the non-nuclear sectors. Most of the time, in non-nuclear industries and in the medical sector, a greater attention is given to the ‘limitation of exposures’ principle, the justification and optimisation (i.e. ALARA) principles being less known and applied. As a result, 'Radiation protection' is improperly perceived and reduced in these sectors to the ‘prevention of radiological accidents’ and the ‘limitation of exposures’. In the nuclear sector, the ALARA principles are often better known thanks to initial and continuous training and dedicated organisation (e.g. ALARA committees). For an organization to function according to the ALARA principle, it is important that everyone in the organization is engaged in the work. The leadership must be clear and focused towards influencing the organization in the right direction. This is closely related to safety culture and the importance of attitudes towards risk and the management of risk. Thus, the RG considered that an in-depth comprehension of the justification and optimisation principles shall improve competences of ‘safety managers’ and be effective in the protection of workers.

In addition to the basic concepts and implementation of safety culture, the EAN RG proposed the minimum content regarding ALARA issues that would be important to add in the generic and specific modules of the TRASNUSAFE training course. The Reflection Group also considered that in addition to the theoretical aspects, practical examples of ALARA implementation as well as lessons learned from past radiological incidents/accidents in different sectors (‘real case studies’), would be essential.

In the generic module, the RG listed the basic elements of the radiological protection system that have to be known by safety managers, and how to knowingly exercise their responsibility for the optimisation of radiation protection in their day-to-day work. The basic elements of the radiological protection system are:

- Short introduction of the historic roles of the international organisations (UNSCEAR, ICRP, IAEA, NEA/OECD, EURATOM, etc.) in the construction of the radiological protection system and the resulting national legal frameworks;
- Potential health effects of ionizing radiations;
- Foundation of the precautionary approach (e.g. linear no-threshold model);
- Definitions of the three radiological protection principles: Justification, Optimisation, Limitation of exposures.

The practical implementation of the optimisation principle at the management level should include the following topics:

- Managers responsibilities (legal requirements, examples of lawsuits);
- ALARA process (dose prediction – follow-up - feedback experience);
- Organisational, technical and managerial conditions for implementing the optimisation principle (ALARA structures, ALARA procedures and tools, importance of the human factors, training needs, etc.);
- The use of dose constraints and reference levels.

The EAN RG proposed also a set of case studies that should be further developed, as training material, within the TRASNUSAFE project. The case studies would be selected for each TRASNUSAFE specific training module according to the domains of activity of the trainees:

- Case studies in the medical sector:
  1. “Interventional radiology event” (Strasbourg, France, March 2009)
  2. “Radiotherapy accident” (Epinal, France, 2000's)
  3. “Radiotherapy incident” (Toulouse, France, 2007)
  4. “Survey of Mammography practice: Equipment performance, image quality and dose” (Croatia)
  5. “Example of good cooperation between stakeholders in an interventional radiology department” (Greece)

- Case studies in the research and industrial sectors:
  6. "Lessons learned from the decommissioning of the Belgian nuclear research reactor no 3 (BR3)” (Mol, 1991-2011, Belgium)
  7. “The ACERINOX accident in a scrap metal reprocessing plant” (Los Barrios, Spain, 1998)
  8. “Radiation accident at a Swedish mining company” (Aitik, Sweden, December 2010)
  10. “ALARA and safety culture in radiography” (Sweden)

The training materials corresponding to incidents/accidents (case studies no 1, 2, 3, 7, 8) should be, as much as possible, analysed through the use of the ‘anatomy of an event’ methodology (i.e. identification of the initiating actions, error precursors, failed defences and latent organisation weaknesses).
The EUTERP RG, coordinated by SCK•CEN, mainly focused its discussions on the justification principle and the needs for a trans-disciplinary knowledge base for nuclear safety and radiological protection. The EUTERP RG agreed that there is a need for safety managers, from both the medical and nuclear energy contexts, to improve their competence base with considerations on the broader societal aspects related to the justification of activities involving exposure to ionising radiation. In particular, there is a need for them to develop insight in:

- the functioning of the concept of risk and the meaning of risk justification in society;
- the interaction between science and policy;
- the meaning of ‘ethics’ in radiological risk governance and the relation of ethics with regulation;
- the meaning of ‘participation’ of civil society and the general public in R&D and decision-making.

The EUTERP RG agreed that E&T programmes for safety managers in the medical and nuclear energy fields should dwell on a common basis dealing with more theoretical reflections and comparative analyses related to the four above presented elements (risk in society, science/policy, ethics/regulation and participation). Consequently, the EUTERP RG recommended that the TRASNUSAFE project should consider the inclusion of specialised course modules on these elements, in the foreseen training schemes.

Finally, both RG Members concluded that the organisation of training courses on nuclear safety, that would include radiation protection considerations - especially with regards to justification and optimisation principles - is obviously necessary. In order to favour the discussion between the trainees, the RGs pointed that it would be useful to have break-out sessions leaded by (a) facilitator(s). The basic elements of the radiological protection system and the practical elements for implementing the optimisation principle at the management level should be included in a one-day generic TRASNUSAFE training module. For each training session and according to the audience (from the industry or the medical sector), one or two case studies - selected in the list proposed by the EAN RG group (see above) should be presented in the specific TRASNUSAFE training modules.

The RG Members also point out that it would be probably difficult to mobilise safety managers for more than two consecutive days. As a consequence, in-depth discussions and debates on the justification principle and the elements for developing a trans-disciplinary knowledge base for nuclear safety and radiological protection (i.e. dealing with the following issues: societal risk acceptability, science vs. policy, ethics vs. regulation and public participation in decision making processes) – which are also considered as of great interest for improving safety managers competences – should be also addressed, but preferably in dedicated training modules according to the sector.

4. The design of two training schemes

Based on the conclusions of the needs and on the recommendations made by the two reflection groups, two training schemes have been designed under the leadership of TECNATOM, with participation of UNIMAN, CEPN, SCK•CEN and EAN: one for the nuclear industry and one for the radiological sector, with a common generic module. In addition to this common generic module, two specialised modules were designed for each training scheme. The design of each of these five training modules has included:

- the definition of the learning outcomes
- the training methodology
- the definition of the contents

The common generic module, designed and developed by TECNATOM with participation of UCL, SCK•CEN and EAN has been entitled: 4.1 “Managerial competences and leadership for safety culture (nuclear and radiation)”

Even more than the others, this module has been basically designed for senior managers. Its purpose was to raise the knowledge and understanding about safety culture in order to avoid incidents occurring as a result of human errors or organisational deficiencies and to develop adequate concern about the importance of radiological protection issues in the operation of facilities (nuclear plants, research reactors), and hospitals or for other users of radiations. For the managers, these topics are closely linked to economical operation and societal responsibility.

This purpose is carried out by helping the participants to better understand the behaviour of employees and of leaders and by exploring the processes and values of the organisation that cause or prevent the errors. A practical way of thinking consists in helping participants imagine actual or potential risks associated with human performance in a most creative way. In addition to the effectiveness of the functions of plant equipment, in addition to the good level of training, oversight and procedures, and in addition to the good way in which workers, engineers and managers carry out their tasks, people have to be supported by a good safety culture in their organisation.

Human error is the result of a set of conditions related not only to an individual performance but also to inappropriate management practices, inadequate leadership and organisational weaknesses or a leak of ethical responsibilities.
In this generic module it was decided to review the fundamental knowledge of human behaviour and the organisation so that the employee in the plant/installation/lab can manage the keys to minimizing human errors and avoid incidents or operational events. Not only the workers but also managers and supervisors must manage the keys that exist before the error happens. It is hard to anticipate how a problem that seems trivial can influence individual performance at work. Issues that cause errors in the operation or decrease human performance are everywhere and must be eliminated systematically and at every opportunity. Therefore, monitoring should be a characteristic of the attitude and behaviour of everyone in every moment of the day.

o The definition of the learning outcomes

Through active participation to the training module, including pre-study of learning tools, the senior managers will gain:
- Knowledge and understanding of essential responsibilities, accountability and role of management in building, promoting and encouraging safety culture; importance of leadership;
- General knowledge of the context of complex technical and organisational systems with regard to Radiation Protection, Safety and Safety Culture;
- Knowledge and understanding of commercial and safety benefits of a strong safety culture;
- Knowledge or deepening of social and ethical behaviour.

o The training methodology

Before entering the generic module, the senior managers are encouraged to prepare the description of one specific case concerning safety and focusing on organisational aspects they are facing in their own organisations. The Coaches for problem solving sessions will select those cases fitting better the aims of the seminar.

After registration, the trainees would receive some relevant documents that they are invited to read before the training session.

This common generic module would then extend over two days.

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During the training session, the team of trainers would involve:
- Expert lecturers whose responsibility is directly related to teaching a single topic:
- Facilitator(s) who is (are) the key person(s) to stimulate interactivity with and between the trainees, run-problem solving sessions, etc.;
- an External Coach / Mentor who should be a senior person of recognised authority standing and solvency in the field of Safety culture or Radiological Protection and is a role model. His/her function is to coach and act as a mentor during the entire seminar providing practical points of view and a positive way of change in the appropriate direction. The figure of the External Coach / Mentor provides first-hand experience to the participants. Its main function is to strengthen the role of participants as part of the management team as well as share experiences and encourage participants to apply standards of excellence. The role of the External Coach / Mentor is to provide guide, support and experience instilling an optimistic approach and telling the participants positive stories about organisations in which a good actuation in terms of safety culture has produced good economic results and better work environment.

o The definition of the main contents

1. Introduction: Why is Safety so important; Hazards; Examples of accidents in nuclear industrial and medical sectors.
2. The need for Radiological Protection
- Introduction of the historic roles of the international organisations in the construction of the national legal frameworks;
- Radioactivity and the effects of ionizing radiation on health (basic concepts: internal and external exposures); Dose vs. health risks, precautionary approach and linear no-threshold model;
- The definition of the 3 principles of Radiation Protection with emphasis on the optimization principle; the use of dose constraints and reference levels.


4. The need for Nuclear Safety; Defence in depth.

5. Safety Culture definition; IAEA: INSAG 4; SF-1; GS-R3; GS-G-3.1; How to measure Safety Culture; How to manage Safety Culture; Safety culture principles and attributes (ref. INPO / WANO documents “Principles for a Strong Nuclear Safety Culture”)

6. Excellence In Human Performance (Human Performance Fundamentals): Human Performance; Origins of Events; Principles of Human Performance; Human Fallibility and Vulnerability; Error-Likely Situation; Performance Modes; Error Prevention; Team Errors; Learning by errors; Role of Organization in Human Performance; Defences, Leader Defined, Key Leadership Practices; Positive doing or acting and as an outcome, positive solutions.

7. Case studies.

8. Final reflection exercise and course feedback.

4.2 Specific modules

The specific modules, two for the industrial, and two for the medical sector were selected:

- Industry
  - Compliance of contractors with safety systems (STUBA)
  - Observation techniques (UPB)
- Medical
  - Economics of safety culture (UPM + CIRTEN)
  - Setting up a management system (SCK-CEN + JSI)

A module on Emergency Situation and Safety Culture for Nuclear Industry has been withdrawn because there is a risk of duplication with the future FP7 project NUSHARE.

It was also decided that for each specific module would extend on three days, the first day being devoted to a short version of the common generic module for the trainees who would not have the opportunity to follow the full generic module. The short version of the generic module would not involve chapter 3, and large part of chapters 5 and 6 of the content of the normal version. By condensation of some topics, one should target 5 to 6 hours for interactive lectures, and 2 to 1 hour of teamwork exercise.

Training methods similar to those selected for the generic module would apply. The learning outcomes and the content will be defined in the next section, reporting on the development of the training schemes, since they were progressively built in the development phase.

5. The development of the two training schemes: the facilitator's guides

The preparation of the facilitator’s guides was made during the next step, as well as the course material, the videos to be presented for the case studies and the tools for the practical exercises. Other support tools were also selected like the Jenga Tower game.

In this section, we report more explicitly on the specific modules extending on three days, that were developed in coherence with the common generic module. The project included a short version of this generic module to be taught on the first of the three days. Its content is reported above. Hereafter, we report only on the proposals for the last two days.

5.1 “Setting-up a management system”

For this first specific module of the training scheme devoted to the medical sector, developed by SCK•CEN and JSI, the learning outcomes were defined as follows:

- The definition of the learning outcomes

Upon successful completion of this training course, the participants will be able to:

In terms of Knowledge:
- Understand the concept of management systems;
- Define the role, importance and essential responsibilities of management in setting up a management system;
- State the context of integrated management systems;
- Introduce structure in the management system documentation;
- Explain requirements regarding human resources and working environment;
- Demonstrate a basic understanding of performing self-assessment and independent assessment of a management system;
- Explain how to control non-conformance by identification, reporting and initial actions and attribute the corrective and preventive actions;
- Explain how to make continuous improvement of a management system;

In terms of Skills:
- Develop a questioning attitude towards safety in a management structure;
- Apply a graded approach in the requirements of a management system, in terms of documentation and resources;
- Evaluate resource management, including provision of resources, human resources, infrastructure and working environment resources;
- Identify, analyse and develop organisational policies;
- Develop and implement an incident notification system within the management structure;
- Develop and manage processes, including the review of generic management system processes;
- Carry out the measurement, assessment & improvement of a management system;

In terms of Competences:
- Support a strong safety culture embedded in an integrated management system.

The following references were suggested as pre-course readings:

The participants would be invited to bring one example of a policy and a process map (or at least one process flow) of their own organisation.

Different learning approaches would be used in this training course, consisting of interactive lectures, case studies and problem solving sessions. The content is based on international reference documents (such as from IAEA, ISO, ...), appended by relevant examples from the nuclear and radiological sector.

A specific case study was selected within the TRASNUSAFE project for this specialised training course on management systems: the Strasbourg radiology accident, which occurred in March 2009 in France. This would be discussed in terms of error precursors, failed defences, organisational weaknesses, and follow-up actions from a management point of view.

The module would mix participants from different companies/organisations to have the maximum benefit from interchanging experiences during the problem solving sessions. Therefore the number of participants has to be limited.

The role of the learning facilitator / mentor was to provide guidance, support and experience, instilling an optimistic approach and telling the participants positive stories about organizations in which a good actuation in terms of management structure and safety culture has produced good economic results and a better work environment. He/she will provide first-hand experience to the participants, with the aim to strengthen the role of the participants as member of the management team as well as to encourage participants to apply standards of excellence.

The definition of the main content
The definition of the main content for the two last days is given below:

Day 2:

I. Integrated management system (IMS)
IMS in general; Documentation of the management system; Grading the application of IMS requirements; Interface arrangements;
Safety culture in the IMS; Incident notification system; Case study (Strasbourg radiology incident) and exercise on incident notification.

II. Management responsibility
Management commitment; Organizational policies; Satisfaction of interested parties; Exercise on organizational policies.

Day 3

III. Resource management
Provision of resources; Human resources; Infrastructure and the working environment.

IV. Process implementation
Developing processes; Process management; Exercise on process development and management; Generic management system processes.

V. Measurement, assessment & improvement
Monitoring and measurement; Self-assessment; Independent assessment; Management system review; Non-conformances and corrective and preventive actions; Improvement.

5.2 “Economic relevance of safety culture in medical applications of radiation sources”
This second specific module of the medical training scheme was developed by UPM and CIRTEN. The learning outcomes were defined as follows:
- Knowledge and understanding of essential responsibilities, accountability and the role of management in building, promoting and encouraging safety culture;
- General knowledge of the context of organisational systems for Radiation Protection, Safety and Safety Culture;
- Understanding the economic impact of accidents and unplanned losses; developing or enhancing the current safety culture as a necessary task if an organisation wants to stay in business;
- Understanding the importance of management’s attitude toward workers for safety.

The training methodology
Before the training session, all participants would receive some suggested pre-course reading (IAEA documents, reference documents). The training session would be facilitated in a highly interactive manner.

The definition of the main content

Day 2
Introduction to specific module; the ICRP recommendations for radiological protection in medicine; case studies (including interaction):
General overview of some major accidental medical exposures in radiotherapy. Problems identified. Patterns in the lessons learned;
Presentation of a full case study: Accident occurred in the linear electron accelerator at the University Hospital in Zaragoza, Spain, December, 7th – 9th, 1990;
Presentation of a full case study: Radiotherapy accident at the Hospital Jean Monnet in Épinal, France (2004-2005).
Economic impacts of lack of safety culture: Relationship between safety and production; the cost of accidents and the effect of unplanned losses on the company; the development of safety culture as a way to accident prevention; benefits of developing a strong safety culture; logical prioritization of safety needs; compliance with legal responsibilities for safety; more efficient maintenance scheduling and resource utilization; continuous improvement of operational processes; improved employee morale and productivity; establishing a marketable safety record; reduction of the direct and indirect costs of accidents; avoiding incident investigation costs and operational disruptions.
Economic benefits of good organization in medical radiology and radiotherapy services, including examples.

Day 3
Safety culture needs with regard to the use of new advanced technologies in radio-diagnosis, radiotherapy and nuclear medicine;
The industry perspective and experience with regard to safety improvement: design and maintenance of equipment used in radio-diagnosis, radiotherapy and nuclear medicine;
Final reflection exercises: the trainees would be invited to present some improvement opportunities related to their own expertise; Feedback and exam.

5.3 “Observation techniques”
Human Performance Observation Tool is one of the “management tools” designed to be used by managers (and supervisors) to help identify latent weaknesses in the organisation. These are mainly undetected deficiencies in organisational processes or values that create workplace conditions that provoke errors (error precursors) or degrade the integrity of defence (flawed defence).
The main objective of the observation is to identify opportunities to improve the organisation of work (work environment, tools, etc.), while monitoring individuals doing work. In addition to paying attention to performer practices and attention, observer monitors the job-site context, potential hazards, and the controls relevant to the work activity. The results of observation are recorded for trending purposes to help identify strengths and weaknesses over time. Behaviour observation can flush out organizational weaknesses that may not be obvious by any other means. When managers and supervisors spend time in the field with individuals doing work, performance improves and error rate tends to decrease.

Senior managers should not only know and understand but also use the basic human performance tools, for example three way communication, pre-job briefing, self-checking etc. because although they are not touching physically a plant component or equipment, their managerial work is also subject to errors that can lead to latent errors that will produce eventually an active error. Another reason is that senior managers should be a "role model" for their people and for this reason they should use and demonstrate that they are aligned with a culture that gives a paramount importance to minimize human errors. This justifies the selection of "observations techniques" as a topic for the first specific training course of the industrial scheme, developed by UPB. The learning outcomes were defined as follows:

- Knowledge and understanding of essential responsibilities, accountability and the role of management in building, promoting and encouraging safety culture;
- General knowledge of the context of organisational systems for Radiation Protection, Safety and Safety Culture;
- Knowledge and understanding of the barriers and defences, as ways and measures to prevent undesired events and their precursors;
- Ability to identify effective questioning techniques to use when conducting observations;
- Ability to recognise good practices and areas for improvement;
- Ability to explain reasons for performance gaps and possible countermeasures;
- Knowledge and understanding of techniques providing feedbacks and coaching, as well as reporting requirements.

The training methodology

Before entering the Observation Techniques Modules, the senior managers would be encouraged to prepare the description of one specific case concerning safety and focusing on organizational aspects they are facing in their own organizations. Those cases fitting better the aims of the seminar would be selected by the Facilitators for problem solving sessions. Trainees should also read in advance the preselected readings (IAEA documents, reference documents) that would be provided at the registration of the course.

The module would mix participants from different companies/organizations to have the maximum benefit from interchanging experiences during the problem solving sessions. Therefore the number of participants has to be limited at 12.

In the seminar there would be an External Facilitator / Mentor who should be a senior person of recognized authority standing and solvency in the field of Safety Culture or Radiological Protection and would be a role model. His/her function would be to coach and act as a mentor during the entire seminar providing practical points of view and a positive way of change in the appropriate direction. The figure of the External Facilitator / Mentor would provide first-hand experience to the participants. His/her main function would be to strengthen the role of participants as part of the management team as well as share experiences and encourage participants to apply standards of excellence.

The role of the External Facilitator / Mentor would be to provide guide, support and experience instilling an optimistic approach and telling the participants positive stories about organizations in which a good actuation in terms of safety culture has produced good economic results and better work environment. The facilitator would lead the team of lecturers (usually 2 persons) and would interact with them during lectures and case study approach.

Final examination is a test based on multiple choice answers and some logical actions to be done/explained by the trainee. The structure of the activities and their duration is as follows:

<table>
<thead>
<tr>
<th>METHODOLOGY</th>
<th>DURATION</th>
<th>EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interactive lectures</td>
<td>9.5 hours</td>
<td>optional</td>
</tr>
<tr>
<td>On the job training</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Laboratory</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Problem solving sessions</td>
<td>1.5 hours</td>
<td>optional</td>
</tr>
<tr>
<td>Case study approach</td>
<td>3.0 hours</td>
<td></td>
</tr>
<tr>
<td>Feed-back and Examination</td>
<td>2.0 hours</td>
<td>final</td>
</tr>
</tbody>
</table>
The definition of the main content

Day 2
1. Human performance observation tools: Enabling statements; definitions and duties; barrier to prevent events as "protection in depth"; observation and coaching objectives; the four steps in observation-coaching process.
2. Step 1: preparation and planning: Observation tasks assignation (examples of activities that generally provide a good indication of overall performance; selecting an observation subject); predefined the four "W"; human performance and behaviour; observer fundamentals.
3. Step 2: observation (properly): initial actions and strategies, paired observation; define the three "P"s; worker performance assessment; observer attributes and duties, observation techniques; correct understanding of observed process; record and discuss the findings; human performance tools.

Day 3
4. Step 3: feedback and coaching: evaluation feedback; the observer role; causes of gaps in human performance; coaching and discussing solutions; avoid at-risk practices.
5. Step 4: follow-up: finding solutions; the report and database; correcting actions and measures.
6. Conclusions: the use of "observation-coaching tools"; recommended practices when using this tool.

5.4 "Compliance of contractors with safety system"
The primary intent of this second module of the industrial scheme, developed by STUBA with input from CIRTEM was to make managers of both contracting companies and contractors aware of impacts of their activities on nuclear safety of facilities in building, operation or decommissioning. The learning outcomes were defined as follows:

- Knowledge and understanding of essential responsibilities, accountability and the role of management in building, promoting and encouraging safety culture;
- General knowledge of the context of organisational systems for Radiation Protection, Nuclear Safety and Safety Culture;
- Knowledge about management systems and understanding of possible impact of decisions on nuclear safety.

The training methodology
The course would be facilitated in a highly interactive manner.

Pre-course: Before the training session, all participants would receive some suggested pre-course reading (IAEA documents, reference documents).
Solving problem session: the participants would be requested to propose case studies including policy documents, process flow description and an incident report mentioning corrective actions. This information should be given at the beginning of the training to the mentor for possible selection.

6. The validation of the two training schemes
In order to check the design of the training courses, five prototypic courses were organised in the form of five Eurocourses. They are listed below as well as the places and dates, and the numbers of respective trainees.

<table>
<thead>
<tr>
<th>Eurocourse #</th>
<th>Title</th>
<th>Place</th>
<th>Date</th>
<th>Number of Trainees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(Generic Module) Managerial Competences and Leadership for Safety Culture</td>
<td>Manchester (UK)</td>
<td>November 27th and 28th, 2013</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>(Medical Sector) Setting up a Management System</td>
<td>Mol (BE)</td>
<td>March 31st to April 2nd, 2014</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>(Medical Sector) Economic relevance of Safety Culture in medical applications</td>
<td>Madrid (ES)</td>
<td>April 28th to 30th, 2014</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
We refer to deliverables D4.12 to D4.16 for the detailed reporting of these five pilot sessions prepared by UNIMAN in cooperation respectively of TECNATOM, SCK•CEN and JSI, UPB and STUBA. Hereunder we list a set of transverse considerations.

6.1 Launching five Eurocourses
After the determination of the programme and the selection of mentors, facilitators and lecturers, the preparation of the pilot sessions by each organising institution included the selection and booking of the facilities (hotel, auditorium) where the course would take place, the determination of the budget of the course, and hence the fixation of the registration fees, the preparation and submission of the announcement to UNIMAN for uploading it in its special web site: www.trasnusafe.eu and of course, the use of as many databases (a.o. the database used for the initial questionnaire on the needs) and many contacts as possible to recruit attendees. In particular, the Members of the User Groups under the leaderships of TRACTEBEL and CNCAN brought their full support.
Due to the pilot character of the courses, the recruitment of attendees required a huge effort from the organisers. This was by far the most difficult problem: most courses ran at a loss.

6.2 The training of the trainers
A set of preparatory meetings were held under responsibility of TECNATOM in order to transmit requests and recommendations to the potential facilitators/mentors:
1. July 11th 2012 at TECNATOM premises with UPM specialists to prepare Eurocourse #3 Economical Relevance of Safety Culture in Medical Applications.
2. November 5th 2013 in Manchester University to prepare the Generic Module (Eurocourse #1)
3. February 27th 2014 in UPM in a video conference with different specialists in Radioprotection from France, and Cataluña to prepare and refine Eurocourse #3.
4. May 12th and 13th 2014 in Bucharest to prepare Eurocourse #4 together with specialists from Cernavoda NPP to detail the recommendations and eliminate certain risks of duplications between the Mini generic module and the Observation Techniques specific module.
5. 20th May 2014 in Mochovce to prepare Eurocourse #5.

6.3 Running the five Eurocourses
A delegate from the Coordinator of the project (UCL) was present at least part time at 4 out of the 5 pilot courses to get an overall view on these activities.
A certificate of attendance has been delivered to the trainees by the course organiser at the end of each course, and, for the small number of attendees who requested it, an exam was organised and enabled them to receive a certificate of successful completion of the training.
At the end of each course, feedback forms were collected with questions on different aspects of the course, allowing the trainees to score the items (excellent – good – sufficient – poor) and add comments on general aspects of the course organisation. The mentor and some lecturers provided their conclusions in writing. For two of the courses, also an oral feedback session was organised.
Since the feedbacks of Eurocourse 1 was not entirely positive, it was decided to take benefit from this first experience to improve the next Eurocourses. This was achieved with a real success attested by the overwhelming positive feedback from Eurocourses 2 to 5.

6.4 Lessons learned from Eurocourse 1 and recommendations for the next courses and for the future use of the training schemes
First of all, it must be recognised that due to lack of interest from the real target public, the trainees were people (not all managers!) already familiar with the subject. However, from their relevant remarks, UNIMAN deduced a set a recommendations valid for the next editions of this course, in particular, and some recommendations that were further applied to the condensed version of Eurocourse 1 to be used as a generic part of the four remaining Eurocourses.
- Many of the trainees felt that the delivery of Eurocourse 1 suffered from poor time management due to the amount of material that was originally intended to be included. Some of the topics where therefore only discussed superficially.

Recommendation 1: Include a facilitator that does not have lecturing responsibilities to ensure timekeeping and smooth running of the programme. This could be included in the roles of the Mentor.

Recommendation 2. Include fewer topics and discuss them in greater depth.
The delivery technique of the material was said to lack variety with too many PowerPoint presentations and too little hands-on learning.

Recommendation 3: Increase the amount of pre-course reading. This would then enable a reduction in number of PowerPoint slides and increase the time available for alternative learning techniques such as interactive, case studies, film clips and group exercises.

- The trainees were from various aspects of the nuclear industry but only examples for NPPs were included. This could be due to the course being based on INPO material. For Eurocourses 4 & 5, material used throughout all the course elements, including the generic mini-course, should be from the relevant nuclear sectors represented by the delegates.

Recommendation 4: Include case studies from different parts of the nuclear industry. This will support the importance of safety culture beyond just the NPP.

- Some diagrams and models were used that did not seem to be linked.

Recommendation 5: The course content should be rationalised with fewer models used and their relationships explained.

- Some material was not consistent with the Glossary of Terms.

Recommendation 6: Check all slides and material used are consistent with the Glossary of Terms.

- Some of the slides used have old dates, which may or may not be the latest version.

Recommendation 7: Check all material and references are from up-to-date documents.

Recommended course checklist for future Eurocourses:
- Pre-course reading can be more extensive and used to reduce the amount of new material during the course, giving more time for discussion and case studies.
- Programme: do not overload the programme with early starts and late finishes. Allow time for delegates to relax and network.
- Safety information should be given at beginning of course (this should be the norm at any meeting).
- Facilitators: a second facilitator would have been unnecessary on the generic course. The mentor can act as both.
- Have a detailed programme (what case studies/exercises are going to be done in which session) planned at the outset.
- Learning Outcomes: check these are accurate and specific. The published aims of the course must match the Learning Outcomes.
- USB sticks: containing course notes were appreciated, particularly from those who are flying back.

Actions Taken by the TRASNUSAFE Team:
Meetings held on January 15th 2014 reviewed the material to be used on the one day generic course and the specific material for Day 2 and 3 for Eurocourses 2 to 5. The material was reviewed against the above recommendations (length, alignment to learning outcomes, what can be delivered as pre-course material, balance of lectures with exercises, group discussions, case studies, other group activities, English grammar and spelling).

6.5 Impact on the other Eurocourses; coherence and resumption
Although the feedback of Eurocourse 1 was good generally speaking, the trainees being satisfied with the facilitation techniques used during the seminar, some of them expressed their concerns about the training content. They said the content was too much devoted to Human Performance and not enough to Safety Culture. The TECNATOM facilitator expressed the opinion that both aspects are intimately related to each other, and thus that it is always difficult to separate these two issues.

Anyway the content was modified based in those comments and the Safety Culture part was increased including state of the art concepts from INPO and recognized speakers and consultants in this area. The training content delivered during the Day 1 of the following Eurocourses (Mini Generic module) included these modifications.

The following recommendations should be applied also in the future:
- Try to make a good dissemination plan in order to assure enough trainees for the future seminars.
- It is very important to select appropriate speakers and facilitators that not only have a sound technical knowledge about the subject but also have good facilitation skills.
- It is necessary to reinforce the figure of the mentor and have more clear expectations regarding the mentor election for each specific seminar and also to give him/her clear expectations about his/her contribution and participation in the seminar.
- The solving problem sessions have to be improved. It implies that trainees bring a particular specific technical-organisational issue in their organisations to be shared among all the participants so that they can learn from each other and establish a good “helping relationship” for their future work and establish a good networking.
- It is necessary to establish more clearly the economical issues regarding the fees and minimum number of trainees to make the Eurocourses feasible and economically viable.
- Instead of establishing a final test it looks better to give trainees an end of course assignment so that they prepare a final work about some issue related to the subjects explained and they send within one month to the coordinator to grade their course progress.
- The format of the feedback form should be the same for all seminars in order to assure the comparison of results.
- The trainees should be encouraged to read and study in advance the selected previous readings in order to better use the time in the seminar. This was requested from them, but not always put into practice.
- Some part of e-learning could be introduced so that finally the seminars are not only face to face but also virtual; in this way the trainees could better arrange their physical presence and make it compatible with their actual work in their companies (blended-learning).

It could be interesting to establish some kind of “follow up” activity in order to see how trainees apply the concepts analysed in the different seminars to their actual work: It is very important to assure the “transfer” from training to actual work.

7. Dissemination plan
According to the agreements reached within the TRASNUSAFe Consortium, in the PCC meeting and General Assembly held in Brussels, at SCK•CEN headquarters on 14-01-2014, the further use and valorisation of the TRASNUSAFe Courses will take place under the ENEN Association after the conclusion of the TRASNUSAFe project under the following conditions:

- Taking into account the agreements set in its Consortium Agreement, the TRASNUSAFe Consortium will transfer the exclusive right to use the products to the ENEN Association for 1 € + the moral obligation to valorise and maintain the products during 5 years (called below: “valorisation and updating period”);
- The ENEN Association accepts the obligation to give the intellectual property of the products due consideration: the products cannot be altered without the explicit permission of its authors (owners);
- To facilitate the valorisation of the products and their updating, most Members of the TRASNUSAFe Consortium will become an “ad-hoc TRASNUSAFe Committee” of the ENEN Association for 5 years;
- Each year, the products will be valorised thanks to some training sessions organised by the ENEN Association with the assistance of the TRASNUSAFe Committee. The ENEN Board will take all logistics and financial decisions. Course content and training methodology are the exclusive concern of the TRASNUSAFe Committee.
- During the valorisation and updating period, the Members of the “ad-hoc TRASNUSAFe Committee” will pursue their operation as if the TRASNUSAFe project was extended for 5 years. This means that the Members will provide the individually required / agreed services (preparation of the sessions, production of updated materials, coordination meetings, etc.) under financial and organisational conditions similar to those prevailing during the project development. Real costs will be included in the budget of each valorisation action.
- The ENEN Association will take care of the marketing and practical aspects of the sessions.
- In order to increase the audience, the sessions’ language should not be restricted to the English.

This agreement will be expressed in a Memorandum of Understanding to be signed by the participating Members of the TRASNUSAFe Consortium on the one side, and the ENEN Association on the other side.

8. Quality assessment
ENEN, which has been in charge of the quality assessment of the project, has proposed the following SWOT analysis for the project, that we reproduce here as originally presented:

- Strengths:
  o The material and content of the courses is highly regarded by the students and the facilitators.
  o The project has proper brand recognition between the participants and stakeholders in the project.
  o The facilitators/trainers in the pilot sessions which will remain available for future implementations have an outstanding and prestigious profile for the training.
  o Synergies with other actions inside the ENEN Association.
  o There is an enriching network of professors from academia and managers from industry which provides a broad vision for future implementations.

- Weaknesses:
  o There has been a lack of clear identification of beneficiary participants for the training sessions. More market research is advisable
to really address the public effectively.

- The performances of the pilot sessions have not been equal and the lessons must apply differently to each particular condition.
- The finance of courses are to be decided for the actions to be taken in the next years.
- There is a demographic dispersion of the target groups which may need to localise the next implementations by country, language, region, etc.

**Opportunities:**
- There is a beneficial identified interaction with the NUSHARE project.
- In the case that the proposal ANNETTE submitted by ENEN to the NRFP 10 was successful the interaction would benefit both initiatives.
- There have been a real success with some implemented pilot sessions like the module which took place in Romania.
- It could be created based on the work of the TRASNUSAFE project a NSC academy.
- The industry has shown interest in the NSC training.

**Threats:**
- There are other existing courses on Nuclear Safety Culture being offered.
- It must be mentioned the perceived financial weakness of several actual and potential participants.
- There may be an overlap with other summer schools limiting the seasoning of the future offer.
- The perceived engagement in the Nuclear Safety Culture topic has been perceived as slow in terms of spreading interest to other co-workers.

9. Publications
The following publications were made during the project:
CLARIJS, T., COECK, M., PROŠEK, A.: Setting up a management system with focus on safety culture: a specialised training course from TRASNUSAFE, NESTet 2013, Nuclear education and training, 17th – 21st November 2013, poster presentation.

10. Conclusions
In TRASNUSAFE, two training schemes on nuclear safety culture have been designed, developed and validated for managers for both the “nuclear industry” and the “radiological sector” (including medical). Based on the experience of this project, the Coordinator suggests the following non-exhaustive conclusions:
- The five topics are well chosen because of their practical importance to enhance the Nuclear safety Culture among the managers of both the industrial and the medical sectors.
- However, it appears that recruiting trainees from the medical sector is an unresolved issue; maybe to attract them, courses should be organised in their familiar environment, for example hospitals having a well-developed radiotherapy department, or schools of medicine.
- Diversifying the languages and organising courses in the language used at the place where they are taught would be a factor of success: this has to do with the cultural aspect of the safety culture.
- The duration of the courses has to remain short: 2 to 3 days looks an optimum.
- The number of participants should range around 10, and not exceed 20.
- Increasing the links with the Safety Authorities, and in particular obtaining their recognition for these course would be a major factor of attractiveness.
- The residential style seminar suits best with the objectives of interactivity between managers.
- A clear definition of learning outcomes is of upmost importance to attract trainees.
- There was a natural trend in the pilot sessions to add too much material: the largest part of the time should be allowed for interactive activities and problem solving.
- The importance of facilitators and mentors to offer an appropriate learning environment to the managers is outstanding.
- Lecturers should have strong communication and didactic skills in addition to their relevant expertise on their subjects.
With short courses for managers extending over two or three days, an exam can best take place as a follow-up of the courses.

The links with a club of users are a mean to stimulate progress.

Potential Impact:

1.- Potential impact of TRASNUSAFE: importance of the training of managers on nuclear safety culture

The TRASNUSAFE project (Training Schemes on Nuclear Safety Culture, FP7 Euratom – Grant agreement no.: 249674) is part of the response to the needs for a EU industrial nuclear policy. Education and Training is a duty also strongly supported by the European Commission, in its “Basic Safety Standards” (BSS) - COUNCIL DIRECTIVE 2013/59/Euratom laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation - Act adopted by Council on 05/12/2013 (EN 17.1.2014 Official Journal of the European Union L 13/31).

Indeed, to maintain high safety standards, specific training opportunities of high quality need to be offered to managers of both industrial and radiological installations, like nuclear power plants, radioactive waste repositories, radiotherapy department of hospitals, or components of the medical radioisotopes supply chain. It is the purpose of the TRASNUSAFE training modules to raise the knowledge and understanding of managers about safety culture in order to avoid incidents occurring as a result of human errors or organizational deficiencies and to develop adequate concern about the importance of radiological protection issues in the operation of facilities. Nuclear safety culture is based on knowledge and understanding, behaviour, research, experience feedback, training and communication, management commitment, assessments, as well as regulation and regulatory processes. Through this highly interactive training, the managers will better understand that their leadership is key in building, promoting and encouraging safety culture in the context of complex technical and organisational systems. They will also understand that nuclear safety culture is closely linked to economical operation and societal responsibility.

2.- Assessment of the needs

A survey of the needs for high managerial level training in nuclear safety culture throughout Europe has been made in the framework of the TRASNUSAFE project by means of a questionnaire. It has delivered some important qualitative and quantitative conclusions, showing among others that the “market” of managers for such training courses in Europe involves over 100 persons per year. The respondents set was well balanced:

- geographically, with 120 answers from 25 countries (450 persons invited by e-mail to fill in the on-line questionnaire),
- and evenly distributed between nuclear industry and other users of radioactive materials.

The survey shows that organisations where a safety training for managers is available, organise this as an internal training (34%) or work with an external national organisation (20%). For 22% of the responses it is part of a university or a professional training curriculum, generally in the national language, and about 24% take this training at an international level, mostly with IAEA. The durations of the training sessions are very variable, and the registration fees are none or mostly low, showing a not well-developed market for training companies addressing individuals.

For TRASNUSAFE, the participants suggested a wide variety of organisational forms, but a majority of them prefers classroom style multiday sessions combined with homework and/or internet based training. A big consensus was noted on the need for an exam or test, and the need for a diploma or accreditation (over 80%), but many suggestions were expressed on non-traditional exams and on-the-job follow-up. Also a European recognition was demanded (70%).

The proposal of having a generic module common to the “industrial” and the “radiological” schemes was very welcomed without clear preference for the topics, except for those related to the medical use of radiation, which received a lower score than the others. For the specialised modules, the participants were offered a set of 14 topics. All these topics received a high score from the participants. On this basis it was thus not possible to conclude which were the most attractive topics. This is the reason why it was decided to proceed with discussions in workshops.

The survey was completed by a set of five workshops, held in different parts of the European Union:

in the region “Rhine”: Brussels workshop on September 22nd – 23rd, 2011;
in the region “Black Sea”: Bucharest workshop on October 19th, 2011;
in the region "North Sea and Scandinavia": Manchester workshop on January 17th and 18th, 2012;
in the region "Danube": Ljubljana workshop on February 10th, 2012.
Each workshop had a focused attendance from the region, and was built on the results of the questionnaire, and the outcomes of the previous workshop. After each workshop, new questions were put forward for the next workshop to discuss. In total, over 150 persons attended the workshops and contributed to the discussions.

The workshops enabled to discuss the training methodology in details, to define the learning outcomes of the common generic module, and to select the four most promising topics for the specialised modules as follows: “Setting up a Management System”, “Economic relevance of Safety Culture in medical applications”, “Observation techniques”, and “Compliance of Contractors with Safety Systems”.

3. A validated product
After the design of the five training courses in terms of learning outcomes, pre-course readings, course contents, problem solving sessions, and case studies, five prototypic courses were organised in the form of five Eurocourses and the selection of the facilitators and mentors was made to ensure a highly interactive pedagogy. The titles and places and dates of these pilot sessions are listed below:
Eurocourse 1:  (Generic Module) “Managerial Competences and Leadership for Safety Culture” Manchester (UK), November 27th and 28th, 2013;
Eurocourse 2: (Radiological Sector) “Setting up a Management System” Mol (BE) March 31st to April 2nd, 2014;
Eurocourse 3: (Radiological Sector) “Economic relevance of Safety Culture in medical applications” Madrid (ES) April 28th to 30th, 2014 ;
Eurocourse 4: (Industrial Sector) “Observation techniques” Bucharest (RO) May 14th to 16th, 2014;

After the pilot sessions, the design and methods have been revised with the help of the feedbacks. This closes the validation loop of the five training modules, which can be considered as ready for professional operation at the end of the project.

4. Stakeholders support
The TRASNUSAFE project received the support of two user groups: one under the leadership of TRACTEBEL included the Companies SNN, SEAS, ELECTRABEL, FORSMARK (VATTENFALL) and SOGIN. The other, headed by the Romanian Regulator CNCAN included the EITA Association.

In addition, one should note the important involvement of TECNATOM in the project itself.

5. Dissemination
The TRASNUSAFE project was presented by means of posters at three scientific conferences: TOPSAFE 2012, IRPA 13, and NESTet 2013. It was also invited for an oral presentation at the large PATRAM 2013 (Symposium on packaging and transportation of radioactive materials).

It was also presented and discussed with the NUSHARE partners in 2013 at their invitation.

6. Valorisation plan
For the five years to come, the operation and valorisation of the TRASNUSAFE training courses will take place under the umbrella of the ENEN Association under the following conditions:
• Taking into account the agreements set in its Consortium Agreement, the TRASNUSAFE Consortium will transfer the exclusive right to use the products to the ENEN Association for 1 € + the moral obligation to valorise and maintain the products during 5 years (called below: "valorisation and updating period");
• The ENEN Association accepts the obligation to give the intellectual property of the products due consideration: the products cannot be altered without the explicit permission of its authors (owners);
• To facilitate the valorisation of the products and their updating, most Members of the TRASNUSAFE Consortium will become an “ad-hoc TRASNUSAFE Committee” of the ENEN Association for 5 years;
• Each year, the products will be valorised thanks to some training sessions organised by the ENEN Association with the assistance of the TRASNUSAFE Committee. The ENEN Board will take all logistics and financial decisions. Course content and training methodology are the exclusive concern of the TRASNUSAFE Committee.
• During the valorisation and updating period, the Members of the “ad-hoc TRASNUSAFE Committee” will pursue their operation as if the TRASNUSAFE project was extended for 5 years.
This means that the Members will provide the individually required / agreed services (preparation of the sessions, production of
updated materials, coordination meetings, etc.) under financial and organisational conditions similar to those prevailing during the project development. Real costs will be included in the budget of each valorisation action.

• The ENEN Association will take care of the marketing and practical aspects of the sessions.
• In order to increase the audience, the sessions’ language should not be restricted to the English.

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Related documents
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Last update: 21 May 2015
Record number: 164237