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1ST SITUATION REPORT ON EDUCATION AND TRAINING IN THE NUCLEAR ENERGY FIELD IN THE EUROPEAN UNION

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1. INTRODUCTION

Education and Training (E&T) is a centrepiece in ensuring welfare in the EU. Consequently, "An Agenda for New Skills and Jobs" is one of the seven Flagship Initiatives put forward by the European Commission in its Europe 2020 strategy. It aims at better matching labour supply and demand, including through labour mobility. This issue is of particular importance in the field of nuclear energy in the EU.

The role of nuclear energy is currently undergoing an intense debate at national and international level and it is finally up to the Member States to make their decision, be it "as planned" or long-term operation, power upgrade, new build or phase out. The recent Fukushima events (Japan, earthquake and tsunami, 11 March 2011) suggest continuing to improve the various information and training policies on nuclear matters and to coordinate them on a global scale.

Whatever the chosen option would be, the availability of a sufficient number of well trained and experienced staff is key for the responsible use of nuclear energy. This is true in all areas: design, construction, operation, decommissioning, fuel cycle and waste management as well as radiation protection.

Chapter 1 of the Euratom Treaty refers explicitly to the obligation for the Commission to carry out training actions[1]. Article 33 of the Euratom Treaty requests also that each Member State "shall take the necessary measures with regard to teaching, education and vocational training".

Actually, the demand of hiring skilled employees is rising, given the high average age of existing experts leading to a significant retirement rate in the coming years.

The Council of the European Union, in its conclusions on the need for skills in the nuclear field 15406/08 of 13 November 2008, points out that there is a real risk of the loss of nuclear competencies for the European Union if no measures are taken and emphasises strongly that the preservation of skills in the nuclear field requires a general effort involving public and private players and in particular the nuclear industry.

Therefore the Council encourages the Member States and the Commission to establish a "review of professional qualifications and skills" in the nuclear field for the European Union and invites the European Commission and the Member States to provide regular information about existing programmes awarding degrees in Europe.

It also invites the Commission to report to the Council on a regular basis regarding the follow-up to these Council Conclusions.

The challenge of ensuring a sufficient number of qualified staff in the nuclear sector has been acknowledged widely among the different stakeholders, in particular the nuclear industry, national regulatory authorities and Technical Support Organisations (TSOs). The issue is increasingly addressed in several national and international forums. In 2007, the OECD/NEA Steering Committee for Nuclear Energy issued a statement on the government role in ensuring qualified human resources in the nuclear field[2] and requested that governments should take

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1 Consolidated Version, 2010/C 84/01, OJ 30.3.2010

2 http://www.oecd-nea.org/press/2007/2007-05.html

action to monitor the situation and to ensure national and international cooperation to enhance nuclear education and research and to attract students and young professionals to become the nuclear experts required for the future.

Also the IAEA regards the establishment of sustainable E&T programmes as fundamental to safety. This view is supported by several General Conference Resolutions, dating back to 1992, by which the Agency was requested, inter alia to intensify postgraduate educational and specialized training courses in appropriate official languages of the Agency, and to develop syllabuses and training material for specific target groups.

The objective of this 1st situation report is to provide – to the extent possible – a comprehensive picture of the situation, to identify the current challenges, and to present the spectrum of both current or planned EU, national or international initiatives which could address the identified challenges in the most efficient and systematic manner possible. The report thus responds to the Europe 2020 strategy as well as the Council Conclusions 15406/08.

2. PRESENT SITUATION IN THE EU AS TO HUMAN RESOURCES

Nuclear safety is a paramount condition for the responsible use of nuclear energy. That is why in 2008 the Commission launched a study titled "Nuclear Safety in a Situation of Fading Nuclear Experience" published in 2008. It did not cover the overall situation of the nuclear sector, but analysed the EU situation for a critical group, namely the availability of **nuclear safety relevant personnel** with **Nuclear Power Plant operators and regulatory bodies**. While the study did not identify an acute threat of a shortage in any of the Member States, some concern was raised for the years up to 2020. It was noted that, as a consequence, Member States, organisations and the EU started initiatives to improve the situation.

The study came up with a number of recommendations, incl. a better cooperation between key players and universities as well as operators and regulatory bodies in order to mutually optimise their training programmes, a better reporting on the staff situation under the Convention on Nuclear Safety, an increased international and bilateral information exchange on operating experience, the establishment of a post graduate nuclear academy capable to educate graduated engineers in Europe-wide valid principles of nuclear safety, and finally a regular screening of the staff situation in the EU.

While this study was performed with a view on nuclear safety, the recommendations and subsequent discussions identified two essential needs:

- A regular and comprehensive supply and demand analysis at EU level. On the demand side it should identify the qualitative and quantitative needs for new staff as well as the experienced or expected shortages at the various stakeholder groups concerned. On the supply side, it should analyse the capacities to educate new professionals, as well as the type of qualification required.

- A continuous monitoring of the challenges identified and how well they are addressed by already existing or planned initiatives in order to achieve early action to cover gaps and to ensure a better coordination of initiatives to maximise their effectiveness.

Although several actions have been already taken as described in chapter 3, it appears that a number of challenges should still be tackled at EU and international level.

- In many Member States the **number of university students** and graduates with a strong background **in nuclear sciences** is insufficient, possibly caused by the perceived lack of professional career perspectives at national level.

- There is an increasing difficulty to **interest graduates from technical and other studies to take up a job in the nuclear sector**.

- There are increasing needs to ensure **mobility and multicultural skills** as response to the globalisation of the nuclear industry.

- **Maintaining and continuously improving the expertise** of those professionals already working in the nuclear sector is a constant challenge.

While it is mainly the task of Member States and their industry and research organisations to address these challenges, international cooperation and initiatives at EU level can continue to improve the situation. The EU provides an ideal platform to create synergies, to collect and disseminate knowledge and expertise, to assist in post-graduate and professional training and to promote and support mobility. Initiatives at EU level are recommended in particular when providing an added value to the actions at national level.

There are already quite a number of initiatives at EU level, an outline of which is provided in the following chapters with particular emphasis on the challenges they address. More details are provided in a Staff Working Paper.

3. INITIATIVES AT EU AND INTERNATIONAL LEVEL

3.1. Enhancement of university studies in nuclear sciences

When choosing a curriculum, students are interested mainly in promising career possibilities. Thus, this issue needs to be addressed, although mainly at national level. However, initiatives at EU level have been identified to facilitate and strengthen the efforts of national stakeholders. It is worth stressing here the new governance in knowledge and education & training in the EU policy with emphasis on the free movement of knowledge.

Today, it is mainly the **European Nuclear Education Network (ENEN**) Association, created in 2003 as a non-profit international organization and composed today of 60 universities, study centres and industries from 17 EU Member States, which endeavours to ensure the free movement of nuclear knowledge, in particular, through higher education and training at the EU level. It is co-financed by the registration fees of their members and by their participation in the Community Framework Programmes.

ENEN endeavours to achieve a harmonisation of European Master of Science curricula in nuclear disciplines, to promote PhD studies as well as the exchange of students and teachers in the frame of this network. It also seeks to increase the number of students by providing incentives, to establish a framework for mutual recognition, and to foster and strengthen the relationship between universities, research organisations, regulatory bodies, the industry and any other organisations involved in the application of nuclear science and ionising radiation.

ENEN has also recognised the need for post-graduate and continuous professional training (lifelong learning) and has widened its field of activities accordingly as provided for in chapter 3.4 below.

3.2. Incentives for university graduates and graduates working in other sectors to take up jobs in the nuclear sector

Creating incentives for university graduates and graduates already working in other sectors to chose a career in the nuclear sector is mainly a task for private organisations and companies. Nevertheless, cooperation at EU level can strengthen the efforts in this regard.

That is why six of Europe's leading nuclear companies (AREVA, Axpo, EnBW, E.ON Kernkraft, URENCO and Vattenfall) established in January 2010 the **European Nuclear Energy Leadership Academy (ENELA)** to train future leaders in the nuclear industry. The European Commission supported launching the Munich-based academy whose idea was created in European Nuclear Energy Forum (ENEF)[3]. ENELA offers to young graduates, but also managers with already some years of experience and a potential for top-level functions, to provide them with the skills and expertise they will need to become future leaders and to ensure the further development of sustainable European nuclear energy solutions. It thus offers highly attractive perspectives for young people leaving university or working already in other sectors. The European Commission provides in-kind assistance in form of e.g. speakers and advice but not financial support.

3.3. Post-graduate and professional training, improving of expertise, mobility

The EU institutions are since long very active to collect and disseminate knowledge and expertise, to assist in post-graduate and professional training and to promote and support mobility. But also the industry, TSOs and international organisations are recognising increasingly the need and advantages of cooperation at EU level.

3.3.1. EU Initiatives

One of the new challenges for knowledge creation and competence building in the EU is to integrate the requirements of borderless mobility and lifelong learning, with the aim to produce, for example, **"European Skill Passports**", wherever appropriate.

To this end, and like in other industrial sectors in the EU such as aeronautics and automobile, it is appropriate to use the "**European Credit system for Vocational Education and Training (ECVET)**" (see Recommendation of the European Parliament and of the Council of 18 June 2009[4]), the objective of which is promoting mutual trust, transparency as well as recognition of competencies and qualifications in VET across the 27 EU Member States.

Euratom training programs are usually addressed to research and industry workers with higher education and are being adapted to the recent developments in the nuclear industry and regulation, i.e. internationalisation, deregulation and privatisation, a trend towards outsourcing of activities, and new approaches for the management of advanced technologies and human resources.

Financially supported by the current 7th Euratom Research and Training Framework Programme (2007 – 2013) the **European Nuclear Education Network (ENEN)** Association is organising a number of "European Fission Training Schemes" (EFTS) addressing the need of specific competencies in some selected domains, using the tools provided by ECVET. The projects and training programmes are providing, for example, basic nuclear knowledge as

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3 http://ec.europa.eu/energy/nuclear/forum/forum_en.htm

4 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2009:155:0011:0018:EN:PDF

well as specialised training schemes on nuclear design and construction challenges of present and future nuclear power plants. They also cover Nuclear Safety Culture as a key issue for the responsible use of nuclear energy.

A further objective is developing European standards in radiological protection in synergy with the competent authorities and setting up an EU-wide recognised "European radiation protection training scheme" (ERPTS).

The responsible use of nuclear energy does not only entail the operation of nuclear power plants but also the management of the resulting radioactive waste including its disposal in geological repositories. To this end, a dedicated EFTS aims at building competencies required by radioactive waste management organisations.

The Commission Joint Research Centre (JRC) has a number of nuclear facilities for research and E&T purposes. Over the years E&T has been an integral part of the JRC work in form of trainee programmes and grant holders schemes at PhD and post-graduate levels. In addition, training of students and professionals has been realised through periodic training courses, dedicated schools and workshops in nuclear safety and security. Within the European Safeguards Research and Development Association (ESARDA), academically recognised nuclear safeguards and non-proliferation courses are organised by the JRC. A training centre for safeguards and nuclear security has been ongoing since 2009 in synergy with other Commission's global security initiatives. In the context of a "European school for Nuclear Safety and Security", the JRC is developing an integrated concept to offer specialisation in fields of nuclear technology related to safeguards and nuclear security, nuclear materials, nuclear data, and actinide science in support to European graduate programmes. It has a unique opportunity to enable the students to get hands-on experience in JRC's specialised nuclear laboratories and participating to cutting-edge research.

Under the Euratom JRC programme on nuclear safety and security, implemented at the Institute of Energy in Petten, a special project CAPTURE is dedicated to nuclear knowledge management in nuclear reactor safety. The project is based on three pillars: Evaluation of Human Resources Trends in the Nuclear Energy Sector (EHRO-N, see chapter 3.4.), Contribution to Nuclear E&T (through ENEN, see chapter 3.1.) and Knowledge Preservation, which contributes to maintaining, consolidating and transferring EU knowledge in nuclear technology in support to DG RTD Euratom FP7 relevant projects and the IAEA core activities on knowledge management.

Moreover, cooperation with third countries under the EU's **Instrument for Nuclear Safety Cooperation[5] (INSC)** also covers activities to increase the technical knowledge and capabilities of the nuclear safety authorities in third countries. This is addressed under INSC both in the bilateral cooperation tracks as well as through specific projects with a global scope, e.g. on *Training and Tutoring for experts of the nuclear regulatory authorities and their technical support organisations for developing or strengthening their regulatory and technical capabilities* (Project MC.03/10).

E&T is also part of the **Sustainable Nuclear Energy Technology Platform (SNE-TP)**, composed of all stakeholders of nuclear fission and radiation protection (over 75 organizations). It aims at being a driving force, amongst others, in programmes for education

[5] Established by the Council Regulation (Euratom) No. 300/2007 of 19 February 2007 establishing an Instrument for Nuclear Safety Cooperation

and training as well as knowledge management (ETKM group). In December 2010, they produced together with FORATOM a report entitled: "Nuclear Education and Training: Key Elements of a Sustainable European strategy".

3.3.2. Other Initiatives at EU level

Four European TSOs, located in France, Germany, Czech Republic and Lithuania, created in 2010 the **European Nuclear Safety Training and Tutoring Institute (ENSTTI)**.

It is open to TSOs and nuclear safety authorities that wish to offer their experience and competence, and covers the whole spectrum of competences in nuclear safety. ENSTTI offers short applied training sessions and tutoring periods for university graduates and for those with some professional experience in the nuclear sector, adapted to the profile of each individual.

On the industry side, the European Atomic Forum – FORATOM – has set up in November 2010 an Education, Training and Knowledge Management Task Force (ETKM TF) to provide a gateway for the nuclear industry to exchange ideas and information with the EU institutions and various initiatives in the ETKM across the EU.

It will promote actions undertaken by nuclear industry and will be a reference point for questions directed to the industry on ETKM issues.

3.3.3. International initiatives

The European Nuclear Education Network (ENEN) is a partner of the **World Nuclear University (WNU)**, a global public-private partnership committed to enhancing international education and leadership in the peaceful applications of nuclear science and technology. Central elements of the WNU partnership are global organizations of the nuclear industry, inter-governmental nuclear agencies and leading institutions of nuclear learning in some third countries.

The **IAEA** has many projects concerning knowledge management on nuclear energy. It offers a selection of information in nuclear energy publications, manages over 20 databases on different nuclear issues as well as an Internet Directory of Nuclear Resources. It is also active in organising frequent meetings, conferences and workshops in the area of nuclear education and knowledge management. One significant activity of the IAEA is the International Nuclear Information System – INIS.

The **OECD/NEA** established at the end of 2009 an Ad-hoc expert group on Education and Knowledge Management, involving 23 experts representing 15 countries, EC and IAEA. Its main task is to produce a snapshot of the current situation in nuclear education, facilities and training and provide a "blueprint" for assuring nuclear competence. The publication of the results is foreseen at the end of 2011 in a report entitled "Nuclear Education and Training: Assuring a Competent Workforce".

The **International School of Nuclear Law (ISNL),** established in 2001 by the OECD/NEA and the University of Montpellier, benefits from the support of the IAEA. Its objective is to provide a high quality, intensive course in international nuclear law, addressing, in particular, nuclear law students at doctoral or masters level and young professionals in the nuclear sector. Participants enrolled in the ISNL programme have the possibility of applying for a University Diploma (Diplôme d'université - D.U.) in International Nuclear Law. This Diploma is recognised within the ECTS (European Credit Transfer & Accumulation System).

3.3.4. National initiatives

A number of National Education Networks have been established in several EU Member States and are collaborating under ENEN. Quite a number of big national initiatives increase the number of students and enhance qualifications.

Several EU Member States have ongoing or commencing programmes on the area of national nuclear education networks, including the following ones:

BELGIUM	BNEN	http://www.sckcen.be/BNEN/
CZECH REP.	CNEN	http://www.cenen.cz/kontakt.html
DENMARK	NKS	http://www.nks.org/en/welcome.htm
FINLAND	FINNEN	http://www.tkk.fi/en/
FRANCE	INSTN	http://www-instn.cea.fr/Page-Home.html
GERMANY	Kompetenzverbund Kerntechnik	http://nuklear-server.ka.fzk.de/Kompetenzverbund/start.htm
ITALY	CIRTEN	http://www.cirten.it/
NETHERLAND	KINT	http://www.kint.nl/
ROMANIA	RONEN	http://www.ronen.ro/
SWEDEN	NKS	http://www.nks.org/en/welcome.htm
U.K.	NTEC	http://www.ntec.ac.uk/

While in the past the initiatives often focused mainly on the university level, the new developments lead to a widening or re-orientation of existing approaches and also to new initiatives covering post-graduate programmes as well.

3.4. Continuous monitoring of the situation

While the general concerns as to the timely availability of sufficiently qualified and experienced staff are obvious in many Member States, and while numerous activities have been launched already or are planned for the near future, it is not possible at present to get a comprehensive view of the situation in the EU in order to arrive at a proper decision making on the coverage of E&T needs.

ENEF recognised this challenge and recommended an initiative at EU level.

Therefore in 2009, a **European Human Resource Observatory in the Nuclear Energy Sector (EHRO-N)** was established to regularly provide qualified data and analyse the short-, medium- and long-term needs and trends in supply and demands of human resources for the different stakeholders in nuclear energy sector. Thorough analysis of strengths, gaps and deficiencies in the European nuclear E&T infrastructure allows elaborating recommendations for remedial actions and optimisations in support to the development of a European scheme of nuclear qualifications and mutual recognitions and to policy decisions to ensure adequate EU capacities. Relevant outcomes and data will be regularly communicated to the Member States governmental, academic and private organisations involved in nuclear education and training and be reviewed by a Senior Advisory Group with members from the EU major nuclear stakeholders.

4. CONCLUSIONS AND RECOMMENDATIONS

In summary, it can be noted that the challenge of ensuring the availability of sufficiently qualified and experienced staff for the further responsible use of nuclear energy has in the meantime been well recognised at national, EU and international level. The initiatives taken already appear to be promising and are highly appreciated. While it is obvious that challenges at university and post-graduate level have to be addressed mainly at national level, the added value of EU initiatives is increasingly acknowledged at governmental, regulatory and industrial level. All opportunities and options available to increase effectiveness through the use of synergies and cooperation should be used to further improve the situation. In this context, the "European School for Nuclear Safety and Security" initiative of JRC should be complementary, stimulating new synergies and enhancing existing graduate programmes in collaboration with leading academic universities in Europe.

EU institutions are providing a wide range of offers, ensuring continuity of knowledge creation and competence building at EU level. The European Nuclear Education Network (ENEN) and other EU initiatives contribute to render university studies more attractive, to harmonise European Master of Science curricula in nuclear disciplines and to establish a framework for mutual recognition. They also aim at fostering and strengthening the relationship between universities, research organisations, regulatory bodies, the industry and any other organisations complementing national activities. They also stimulate lifelong learning actions, taking advantage of operational feedback from industry and exploring new scientific disciplines such as nuclear risk and safety governance.

In this context and as a consequence of the Fukushima events, further training initiatives will be brought forward under the Euratom Framework Programme in the near future to further strengthen the nuclear safety culture throughout Europe, with particular emphasis on the human element in crisis situations, and to aid public understanding of nuclear fission technologies and radiation protection issues in general.

The initiatives ongoing on different levels well respond and even exceed the 2008 Council Conclusions and are fully compatible with the Flagship Initiative "An Agenda for New Skills and Jobs" of the EC. It is therefore recommended to continue on this promising route in a spirit of close cooperation between all stakeholders involved.

However, despite all this welcomed initiatives there is still no comprehensive assessment available whether the initiatives undertaken either on national or international level match fully the needs either in quantity or quality. Furthermore, the impact of the Fukushima event on supply and demand trends of human resources in the nuclear energy sector is yet not assessed. EHRO-N is therefore the initiative to fill this gap, especially as it can provide a continuous monitoring and scanning of future challenges. EHRO-N will be the central information source for all stakeholders in the EU interested in the optimisation and rounding up of the initiatives taken. Member States are therefore invited to fully support the Commission in developing this promising tool.

The Commission intends to provide a follow-up report and further recommendations once EHRO-N has fully taken up its work - by the end of 2011 - and has arrived at a more comprehensive picture on the needs and their coverage at EU level. A report from EHRO-N to the Commission is foreseen to take place at the end of 2012. Based on this report, the Commission will issue its 2nd situation report to the Council and to the Parliament.