International Journal of Nuclear Security

Volume 6
Number 2 *INSEN 10th Anniversary Special Issue*

Article 7

7-10-2020

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Recommended Citation

Janssens, Willem; Berthou, Veronique; Kamel, Abbas; Galy, Jean; Luetzenkirchen, Klaus; Mayer, Klaus; and Nonneman, Stefan (2020) "EUSECTRA: European Nuclear Security Training Centre providing hands-on training and education in Nuclear Security and Safeguards," *International Journal of Nuclear Security*: Vol. 6: No. 2, Article 7.
https://doi.org/10.7290/ijns060207
Available at: https://trace.tennessee.edu/ijns/vol6/iss2/7

EUSECTRA: European Nuclear Security Training Centre providing hands-on training and education in Nuclear Security and Safeguards

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International Journal of Nuclear Security, Vol.6, No.2, 2020 – INSEN SPECIAL ISSUE

EUSECTRA: European Nuclear Security Training Centre Providing Hands-On Training and Education in Nuclear Security and Safeguards

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Abstract

The European Nuclear Security Training Centre (EUSECTRA) was inaugurated under this global name about 10 years ago and is operated by the European Commission, Joint Research Centre (JRC), located both on the Karlsruhe (Germany) and Ispra (Italy) sites. It includes a large variety of capacity building and professional development activities, which span from the hands-on training for nuclear security and safeguards actors (e.g. respectively, border guards or customs and nuclear inspectors) to educational efforts in both nuclear security and safeguards. Whereas the first ones, which gave rise to the new name, focus mainly on detection, on-site assistance, crime-scene management, technical reach-back, and nuclear forensics capabilities, the second includes all aspects of nuclear safeguards analytical measurements, containment and surveillance, verification technologies and methodologies, etc. This paper provides an overview of the most salient developments in these areas of both technical and academic teaching engagement in the last decade and includes some hints to the potential for enhanced collaboration with the International Nuclear Security Educational Network (INSEN).

I. Introduction

In the nuclear security sphere, it is well recognized that the widespread use of nuclear and other radioactive materials for medical and industrial applications is associated with the risk of theft or diversion of such materials. Material out of regulatory control (MORC) might be used for malicious purposes in criminal and terrorist acts. The international community, in numerous international commitments and resolutions, has acknowledged these increased threat concerns. In our globalized world faced with steadily expanding trade and growing exchange of goods, directed efforts are required in order to increase nuclear security without hampering international trade. Such efforts include the assistance to countries in developing, enhancing, and upgrading their prevention, detection, and response capabilities.

The success of the fight against illicit trafficking of nuclear and other radioactive materials necessitates the mobilization and interaction of different competent authorities such as police, customs, border guards,

regulators, radiation protection, and expert scientists. Each of these authorities has a specific role and allocated responsibilities during nuclear security incidents. This requires close interagency cooperation, interdisciplinary skills, and an understanding of the technicalities involved with the detection, handling, and analysis of nuclear or other radioactive materials. Thus, non-experts in the radiological field, such as front-line officers, need to be familiarized with radiation detection, radiation hazards, and measuring and relaying technical information obtained from instruments for subsequent analysis by the scientific experts. This complexity and the need for optimized use of radiation measurement equipment obviously call for thorough training of the front-line officers and the other competent authorities relative to their roles in the State's national nuclear security plan.

In the area of nuclear safeguards, the continuous development of new and advanced technologies requires regular training and re-training of nuclear safeguards inspectors of both European and international safeguards inspectorates. In addition, seeing the very special nature of the nuclear safeguards and nuclear non-proliferation work, these disciplines are not typically present in nuclear educational programs. The European Safeguards Research and Development Association (ESARDA), to which the JRC provides a substantial contribution, therefore developed a condensed, academically recognized education program in nuclear safeguards and non-proliferation that is organized yearly by JRC and has been exported multiple times to other areas of the globe.

II. Targeted, Hands-On Training To Combat Illicit Trafficking of Nuclear and Other Radioactive Materials

The original version of the European Nuclear Security Training Centre (EUSECTRA) was specifically established to address the above listed nuclear security concerns. The JRC was tasked by the European Commission (DG HOME) to set up a dedicated training center as recommended by the European Union (EU) CBRN (Chemical, Biological, Radiological and Nuclear) Action Plan adopted by the European Council in December 2009 **[*1*]**. Located at the European Commission, JRC, in Karlsruhe and Ispra, EUSECTRA aims to improve Member States' capabilities to address the threats associated with illicit incidents involving nuclear or other radioactive materials by providing hands-on training using real nuclear materials to front-line officers, their management, trainers, and other experts in the field. Based on the unique combination of scientific expertise, specific technical infrastructure, and the availability of a wide range of nuclear materials, EUSECTRA complements national training efforts by providing realistic scenarios with real, special nuclear material (see Figure 1) **[*2*]**. The training program offers a unique opportunity for trainees to see and experience actual materials and commodities, as EUSECTRA is one of the few places in the world where a wide range of samples of plutonium and uranium of different isotopic compositions can be used for training in detection, categorization, and characterization.

Figure 1: Outdoor facility of EUSECTRA with trucks & vans able to transport (and hide, for training purposes) real fissile materials. This picture was taken during a Radiological Crime Scene Management Training. © European Commission (2020, JRC Karlsruhe)

EUSECTRA represents a substantive, enduring, and sustained new core activity at JRC and positions nuclear security training at the center of its extensive nuclear counterterrorism and nuclear non-proliferation portfolio. This initiative outlines the integration of the different modules into a coherent and comprehensive set of training courses covering both detection and response strands. Training areas for EUSECTRA include border detection, mobile detection, covert search, train-the-trainers, Mobile Experts Support Team (i.e., Mobile Expert Support Team [MEST]), reach-back, creation of national response plans, nuclear forensics, radiological crime scene management, nuclear security awareness, and sustainability of a national nuclear security posture. In the specific area of nuclear forensics, highlight trainings includes, but is not limited to, Awareness Workshop, Applications of Existing Capabilities to a Nuclear Forensics Investigation, advanced gamma spectroscopy, and dedicated technique and instrumentation hand-on trainings (e.g. Inductively Coupled Plasma-Mass Spectrometry, Scanning Electron Microscopy, etc.) **[*3*]**.

EUSECTRA benefits from the experience and the cooperative work of the Border Monitoring Working Group (BMWG) and experts from the Nuclear Forensics International Technical Working Group (ITWG) in elaborating comprehensive training schemes for front-line officers, first responders, measurement expert support teams, and nuclear forensic experts comprising practical and table-top exercises. Such reference and standardized training materials were developed in close collaboration with international experts (e.g., from the International Atomic Energy Agency [IAEA], United States Department of Energy [U.S. DOE], Federal Bureau of Investigation [FBI], Netherlands Forensics Institute [NFI], French Atomic Energy Commission [CEA]) to integrate different available modules into a coherent and comprehensive set of training courses. This concept of EUSECTRA is continuously being optimized with the help of these partners and the States in a complementary and effective combination of national and regional capabilities. Trainers come from the competent Commission services, from EU Member States' authorities, or international organizations, as well as from non-EU countries. EUSECTRA can hence assist States in indigenizing such training activities by integrating these elements into their established law enforcement curricula.

The international community has predominantly focused on efforts related to nuclear detection training for border security and customs officials. Nevertheless, complementary efforts are now ongoing to focus

on assisting law enforcement in thwarting the acquisition of nuclear and radiological materials by terrorists by similarly increasing their capacity and capability to secure all materials and prevent a potentially catastrophic event from happening. EUSECTRA offers the combination of discipline-specific and interdisciplinary trainings for all stakeholders involved in the nuclear security of a State, strengthening their critical role in maintaining effective national-level nuclear detection architecture **[*3*]**.

In the law enforcement context, a most-requested training is on Radiological Crime Scene Management (RCSM). Radiological crime scene management is the process used to ensure safe, secure, effective, and efficient operations at a crime scene where nuclear or other radioactive materials are known or suspected to be present. The training aims at bridging law enforcement procedures, radiation protection needs, and nuclear measurement expertise in processing such a particular crime scene. Self-protection, evidence collection, evidence management, chain of custody, contamination control, initial identification of the radionuclides, and radiological assessment are the primary topics of this one-week course **[*4*]**. These concepts are to be practiced on numerous realistic scenarios in table-top and, most importantly, in hands-on exercises (see Figure 2).

Figure 2: tabletop and in-field exercises to both find nuclear materials and implement a proper radiological crime scene management. © European Commission (2016, JRC Karlsruhe)

In border security trainings, focus is put on the use of radiation portal monitors and the importance of secondary inspection in the process of combatting illicit trafficking of nuclear or other radioactive material. This course explores radiation basics, familiarization of participants with radiation detection equipment for nuclear security applications, when and how to use them, and how to verify and respond to an equipment alarm. This specific one-week course addresses front-line officers, border guards, customs

officials, and law enforcement officers around the world using handheld radiation detection instruments by providing hands-on training using real nuclear materials.

III. Capacity Building on Innovative Tools and Approaches For Implementing Nuclear Safeguards

In addition to its long-standing expertise in nuclear security, JRC has several decades of experience in measuring nuclear materials (bulk, small sample, particles, etc.) for nuclear safeguards and non-proliferation purposes, as well as provides a variety of tools, equipment, and approaches for nuclear safeguards containment and surveillance, sealing technologies, verification methodologies, and support to safeguards analysis work in the frame of the state evaluation and the formulation of safeguards conclusions **[*5*]**.

Development of analytical methods and applying them for verification measurements under the EURATOM Safeguards (in Support of Directorate General Energy [DG ENER]) and under the Non-Proliferation Treaty and Comprehensive Safeguards Agreement (in support of IAEA) is a key activity for JRC **[*6*]**. In safeguards, the emphasis is on quantitative measurements of amounts of nuclear materials. In contrast to measurements for nuclear security applications where the focus is on detection and identification of nuclear and radiological material, for Safeguards Non-Destructive Analysis (NDA) measurements, the demands on precision and accuracy are much higher: the fissile material needs to be determined and quantified within tight limits (so called international target values). This constitutes a key challenge of NDA-safeguards measurements. Over the past decades, many training courses on safeguards measurement techniques have been delivered by the JRC to both IAEA and EURATOM inspectors. The long-established JRC expertise on safeguards measurements has been combined with new, dedicated measurement laboratories (offering typical safeguards NDA equipment, such as active and passive neutron measurements as well as techniques based on gamma measurements, dedicated samples, and mock-up fuel elements) at the EUSECTRA facilities to better support hands-on training of IAEA and EURATOM safeguards inspectors.

To complement nuclear materials measurements in the area of nuclear safeguards, JRC develops a large variety of tools and approaches for process monitoring, containment and surveillance, sealing technologies, verification tools and methodologies, strategic trade control, use of open source and geospatial information, and supports the nuclear inspectorates also in analysis tasks by contributing to the analysis methods and tools used to draw the legally required safeguards conclusions (both by DG ENER in EURATOM and by IAEA under the Non-proliferation Treaty [NPT] and Comprehensive Safeguards Agreement, with or without additional protocol, depending upon the country). The Research & Development (R&D) contributions are typically combined with training courses for the nuclear safeguards inspectors which have to use these products in the field. Occasionally for very specific applications, as it is the case for certain IAEA verification activities in Iran, dedicated approaches and capacity building initiatives have been undertaken.

Since October 2012, a very special training course takes place at EUSECTRA, taking advantage of the large number of unique and specialized facilities available at JRC: within the framework of the European Commission (EC) support program to the IAEA, a practical exercise on Complementary Access (CA) was provided to IAEA Safeguard Inspectors. CA is recognized as one of the most powerful safeguards measures to verify completeness and correctness of a State’s declaration (to the IAEA) and hence helps to assure the absence of undeclared nuclear material and activities in the territory of a State. Preparing and conducting CA inspections in a complex R&D environment remains one of the key challenges for IAEA safeguards. This includes evaluating a State's nuclear capabilities, the scale and dimensions of its nuclear fuel cycle, and relations to plausible acquisition or diversion pathways for undeclared activities as key steps in designing State-level approaches. Along these lines, JRC designed a dedicated training course in

EUSECTRA, and IAEA trainees had the unique opportunity to be "exposed" to a complex and advanced nuclear R&D environment. The IAEA has repeatedly acknowledged the value of this exercise leading to an annual recurrence of the exercise.

IV. Continuous Development of Training and Educational Capabilities

Since its official launch, EUSECTRA has hosted trainees from over 80 different countries. During the year 2019, more than 250 participants were trained in various areas related to nuclear security and safeguards. EUSECTRA trainings effectively contribute to improving confidence in international nuclear safeguards measures and to enhancing preparedness, detection of, and response to nuclear security events. EUSECTRA's unparalleled training opportunities lead to a steadily increasing demand for training sessions. Within only a few years of operation, EUSECTRA has developed into a cornerstone of an EU and international training network aiming to ensure, in the most appropriate way, the transfer and the dissemination of knowledge necessary to spread worldwide rigorous nuclear security and safeguards culture.

While training and professional advancement play an important role in familiarizing various nuclear security stakeholders with best practices and interdisciplinary challenges related to the detection of and response to nuclear security events, we have to consider also the need for introducing young people into this area. The area of nuclear security in general and of nuclear forensics in particular draws heavily upon the knowledge and expertise available in the broader nuclear field and, in particular, from radiochemistry and nuclear physics. An aging "nuclear workforce," however, has not been balanced equally by the emergence of young researchers, resulting in a scarcity of young scientists entering the discipline of nuclear forensics **[*7*]**. This discontinuity will limit the transfer of highly specialized experience from seasoned nuclear forensics experts to the next generation. By extension, it will deteriorate capacity in an area pivotal to nuclear security and inhibit response to a nuclear security event. Therefore, educational activities are required to highlight the specific applications and the scientific basis for them. The JRC is involved in such activities at different levels.

At the university level, JRC experts provide lectures on nuclear forensics. In the curriculum of the University of Heidelberg in Germany, for instance, the lecture cycle on radiochemistry includes a class of 2 hours per week, which addresses nuclear detection and nuclear forensics **[*8*]**. The scientific basis for radiation detection, gamma spectrometry, signatures related to the geological origin of uranium, process related signatures, and age dating of radioactive material are explained. This allows students to basically walk through the nuclear fuel cycle and look at it from a different perspective, entering the processes applied in some detail. Real-life examples illustrate the application of these scientific principles for investigating the origin of nuclear material found out of regulatory control. Moreover, the specific analytical techniques applied for the identification of the signatures are presented and discussed.

In an international cooperation, EC-JRC and the U.S. DOE’s Office of Nuclear Smuggling Detection and Deterrence (U.S. DOE NSDD) took the initiative and generated a “Next Generation of Nuclear Forensic Scientists” Project, which is intended to address precisely the deficit in young researchers in the area of nuclear security **[*9*]**. The project is implemented in the GUAM Countries (Georgia, Ukraine, Azerbaijan, Moldova) and is part of a larger set of initiatives that address sustainable nuclear forensics expertise development in the GUAM countries. They are co-funded by the United States of America and the European Union and implemented by the Science and Technology Center in Ukraine (STCU). The project on “Next Generation of Nuclear Forensic Scientists” includes three components: opportunities for internships (several months) hosted by the Kiev Institute for Nuclear Research (KINR), post-doctoral positions at KINR and at Kharkov Institute of Physics and Technology (KIPT), and a nuclear forensics summer school. This Summer School on Nuclear Forensics for GUAM Countries (Georgia, Ukraine,

Azerbaijan, Moldova), was held in September 2019 at KINR and is quite unique amongst training and educational initiatives in nuclear forensics. The objectives of the summer school included:

- Raising awareness of the field of nuclear forensics among students of physics, chemistry, and other scientific disciplines
- Communicating the principles of conducting a nuclear forensic investigation
- Teaching the scientific fundamentals relevant to nuclear forensics (including elements of radiochemistry, nuclear physics, and instrumental analysis)
- Providing examples of real seizures of material out of regulatory control and its examination

The Summer School agenda and the training materials were developed by Kyiv Institute for Nuclear Research (KINR) with support by experts from Moldova, Georgia, and Azerbaijan, as well as experts from EC-JRC and the U.S. DOE NSDD. The one-week course benefitted from the training infrastructure available at KINR and offered a mixture of instructional types, including theoretical course elements (lectures), demonstrations, hands-on exercises, and interactive classroom exercises. Students had to apply to participate in the program, and 5 to 6 students were selected from each country; qualified applicants typically studied at the masters (MS) level in a variety of scientific disciplines.

The course also demonstrated the viability of regional approaches to building nuclear forensics capacity. Students made substantive contacts with nuclear forensics subject matter experts from their own country, as well as other countries – said another way, they were exposed to expert members of a community of practice of international nuclear forensics. In addition, they used the opportunity to form a regional network of young researchers with an awakening interest in nuclear forensics. These contacts can serve as invaluable support in establishing pathways for the next generation of nuclear forensics in the GUAM region. Student feedback indicated that the course generated significant interest in, and knowledge of, a variety of aspects of nuclear forensics. All of the participants shared the fascination of this scientific area and appreciated the opportunity to gain insights in the many avenues of professional and scientific endeavors this discipline covers. In summary, students and participating experts agree that the Nuclear Forensic Summer School for GUAM Countries was a valuable undertaking with a lasting impact on all participants. It will certainly serve as a model to the transferred to other regions.

For similar reasons as those evoked above in the nuclear security area and motivated in addition by the fact that the discipline of nuclear safeguards and non-proliferation is typically not covered in existing university programs (with only few exceptions across the globe) **[*10–12*]**, about 15 years ago, the European Safeguards Research and Development Association (ESARDA), in close collaboration with JRC, designed a one-week academically recognized course module in this field, which is held annually at JRC-Ispra and has been "exported" several times to other regions on the globe **[*13, 14*]**. The course is open to an average of 50 master's degree students, in particular nuclear engineering students, but also to young professionals in nuclear regulations or operations and international relations. This course is organized in collaboration with the Training and Knowledge Management Working Group of ESARDA. Figure 3 shows the schedule of the 2019 ESARDA Course session (April 1st-5th), which gives of an overview of the content of the course and also on various international organizations that took part in lecturing.

	Mon., Apr. 1st		Tue., Apr. 2nd		Wed., Apr. 3rd		Thu., Apr. 4th		Fri., Apr. 5th
	Opening Addresses *W. Janssens & K.Abbas, EC JRC Ispra*	08:45-09:30	Nuclear Material Accounting and Control *L. Roussel, ORANO, France*	08:45-09:30	NDA II: gamma-ray spectrometry *K. Abbas, EC JRC Ispra*	08:45-09:30	Nuclear Trade Regulation *Q. Michel, Liege University, Belgium*	09:00-09:45	Security & Safeguards: French SSAC *P. Funk, IRSN, France*
	History of Non-Proliferation *T. Jonter, Stockholm University, Sweden*	09:30-10:30	Group Exercise 1, *LV*	09:30-10:15	Destructive Assay *Y. Aregbe, EC JRC Geel, Belgium*	09:30-10:15	Safeguards State level Concept *S. Hambaryan, IAEA Austria*	09:45-10:30	Japan's SSAC *O. Aruga, JSGO NRA, Japan*
	Break/Group Picture	10:30-10:50	Break	10:15-10:35	Break	10:15-10:35	Break	10:30-10:50	Break
	EURATOM, historical facts *M. Gerlini, Firenze University, Italy*	10:50-11:30	NDA I: neutron counting *H. Tagziria, EC JRC Ispra*	10:35-11:15	Safety and Security of Radioactive Sources *F. Raiola, EC JRC Ispra*	10:35-11:30	Group Exercise 3, *QM*	10:35-11:20	Information Collection and Analysis *J. Baute, IAEA, Austria*
	Material & Facilities Subject to Safeguards *G. Maenhout, EC JRC Ispra*	11:30-12:15	Legal Instruments Implementing NPT *L. Rockwood, VCDNP, Austria*	11:15-12:00	Safeguards and Security, JAEA Experience *M. Sekine, JAEA ISCN, Japan*	11:30-12:15	Physical Model *S. Hambaryan, IAEA Austria*	11:20-12:05	Nuclear Forensic *M. Wallenius, EC JRC Karlsruhe, Germany*
	Lunch	12:15-13:30	Lunch	12:00-13:30	Lunch	12:15-13:30	Lunch	12:00-13:30	Lunch
	Lab Visits	13:30-15:00	Lab Visits	13:30-15:00	Lab Visits	13:30-14:15	Statistical Accounting *R. Bencardino, EC ENER, Luxembourg*	13:30-15:00	Lab Visits
						14:15-15:00	Monitoring Containment/Surveillance *P. Funk, IRSN, France*		
	Break	15:00-15:15	Break	15:00-15:15	Break	15:00-15:15	Break	15:00-15:15	Break
	Nuclear Fuel Cycle *L.Van den Durpel, Nuclear-21.Net, Belgium*	15:15-17:30	Group Exercise 2, *LR*	15:15-16:30	Safeguards and Nuclear Export Control Arrangements *M. Tarvainen, MJT Consulting* Inspection on-site *C. Kröger-Negoiță , EC ENER, Luxembourg*	15:15-16:00	Satellite Imagery *E. Montero, EU SATCEN, Spain*	15:00-16:15	Course Closure: Quiz, Course Evaluation, Distribution of Attendance Certificates & Closure addresses
	Physical Protection *L. Satkowiak, ORNL, US*	16:30-17:15							
	Welcome Cocktail & Evening Lecture (R&D and E&T in EC-JRC) *S. Nonneman, EC JRC Ispra (Hotel Europa)*					19:00-21:30	Social Dinner & Iraq Case Study *J. Baute, IAEA, Austria (Hotel Europa)*		

Figure 3: Typical ESARDA Course Schedule when implementing the course in Ispra.

In addition, JRC benefits from its large network with international organizations, such as with the EU Member States, IAEA, the Japanese Atomic Energy Agency (JAEA), U.S. DOE, and the European Nuclear Educational Network (ENEN), and thus is often invited to lecture in Education & Training events organized by its partners. An example is the lecturing in the two-week international State Systems for Accounting and Control (SSAC) training course, which is organized in a collaboration between JAEA and IAEA in Tokai. Selected candidates from this SSAC are then invited to JRC to attend a hands-on NDA follow-up course.

The experience of the ESARDA courses is also recognized internationally, and quite a few outreach courses in these fields were organized in several regions by JRC with Directorate General Development Cooperation funding **[*15*]**. For these regional trainings, countries are invited aiming at building an effective educational and training network in the area on nuclear safeguards and non-proliferation. Some of those outreach regional trainings in safeguards are listed below:

- Two regional trainings were organized in South East Asia in Bangkok (Thailand) and Kuala Lumpur (Malaysia) in 2013 and 2015 respectively with the participation of ASEAN countries.
- One regional training was organized in collaboration with the University of the Witwatersrand, Johannesburg and took place in Centurion (Pretoria). Figure 4 shows the country participation in the event. The follow-up session, in collaboration with the African Commission for Nuclear Energy (AFCONE), was scheduled for March 2020 in Cape Town, where the original participants were asked to substantially contribute to the course implementation by running the relevant exercises, discussing the feedback, and thus developing their lessons and exercise plans for an eventual third session in the foreseeable future. Due to the recent pandemic however, the March 2020 session could not take place.
- Another regional training for nine North African and Sahel regions was successfully organized in Algiers (Algeria) in October 2018 (see Figure 5). The event was hosted by the Algerian Atomic Energy Commission (COMENA), and a follow-up might take place under the ENEN umbrella in the course of 2021.

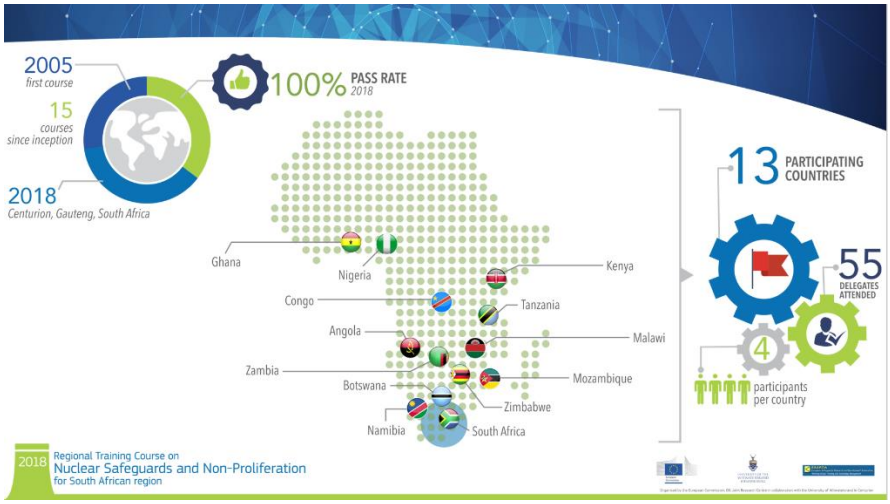

Figure 4: Participation to the ESARDA course in Centurion, South Africa, February 2018.

Figure 5: A lecture session of the ESARDA Course in Algiers, October 2018.

V. EUSECTRA Partnership with INSEN and Other International Training And Education Bodies

As shown all through the previous sections of the paper, EUSECTRA has successfully built a robust international partnership (IAEA, U.S. DOE, FBI, JAEA, NFI, CEA) to support sustainable, global capacity building either in nuclear security or in safeguards and non-proliferation. EUSECTRA is continuously evolving training concepts to ensure optimized knowledge transfer methodologies thanks to

the support of these partners and States in a complementary and effective combination of national and regional capabilities.

In addition to EUSECTRA activities mentioned above, a new relevant initiative, for which EUSECTRA looks forward to liaise strongly along with the International Nuclear Security Educational Network (INSEN), is the recently started collaboration between ESARDA and ENEN in collaboration with several European universities and research centers and based on funding made available by DG DEVCO, aims to develop a specific Master (after master, i.e. for students already having a master degree) Degree in Nuclear Safeguards and Non-Proliferation. Whereas the development work will be done by key European partners, the attendees this outreach program aims to reach are students from outside the EU. Thus, ENEN looks forward to receiving soon expressions of interest from multiple universities across the globe to identify students to enroll for this future program, and the INSEN network could be very instrumental for this purpose. To our knowledge, this is a first-of-its-kind initiative, aiming to provide students from multiple disciplines (technical, legal, historical, political, etc.), after having gone through the mandatory "qualifying" introductory modules and based on their background, to then follow a comprehensive program to educate them on the multidisciplinary aspects of nuclear safeguards and non-proliferation. Multiple European laboratories are foreseen to make their facilities and infrastructure available for the exercise/workshop parts of this master education and also offer opportunities to the participants to execute their master thesis work in a relevant R&D environment. As already discussed with key people responsible in INSEN, there are quite some parallels with the original efforts undertaken by INSEN, of which the lessons learned can be taken on board in this development, starting from the discussion on the content of the master program, the definition of the relative weight of different modules (and disciplines), the development of the curriculum and teaching materials, the identification of partner universities, the mutual recognition of academic programs across different countries, and last but not least, the strong efforts to make the initiative sustainable. EUSECTRA thus looks forward to liaising strongly with INSEN and aiming possibly at a similar medium-term goal where multiple universities, after a first implementation of a full-fledged pilot, do not necessarily repeat the full program, but instead use parts of the developed curriculum (lecturing materials, exercises, etc.) to integrate into their existing course programs (which can be nuclear engineering, physics, chemistry, law, history, political sciences, etc.). In this way, EUSECTRA aims to achieve the goal of raising substantially the academic awareness of nuclear safeguards and non-proliferation issues and also looks forward to the expression of interest by the INSEN members to integrate such teaching materials into their programs once available.

In addition to the above, EUSECTRA also aims to see the utilization assessment of the emerging innovative visualization technologies in the perspective of remote training implementation. Any training course usually includes several sessions, such as plenary lectures, tutorials, practical exercises, and, most importantly, lab sessions with hands-on practice with real instrumentation and material. In case of a necessity for a remote training, all training sessions (other than lab sessions) can be successfully organized remotely, as with e-leaning concepts, and with thanks to numerous available (typically videoconferencing) platforms. Physical (real) lab sessions could be complemented by the utilization of virtual and augmented reality tools that have made drastic developments in the last decades. The implementation of these innovative technologies in the training and education field would be very beneficial for the organization of smart and remote trainings. A task force could be set up between people responsible for training and education to discuss the added value of these approaches. Last but not least, the imposed confinement due to the recent pandemic led to the cancellation of almost all hands-on training activities as of March 2020. The availability of innovative training technologies, however, would allow the implementation of large parts of the training under such conditions, except for the hands-on parts involving real nuclear or other radioactive material.

VI. Outlook

The areas of nuclear security and nuclear safeguards continue to evolve, showing new challenges and new technologies and approaches to address these. In consequence, efforts for appropriate and modern training and capacity building are a continuous undertaking. Additionally, the rotation and career progression of trained staff call for a lasting and sustained vocational training program and opportunities for professional development. All of these elements result in a steadily increasing demand for qualified training initiatives.

For the same reasons and, most importantly, due to the age distribution of the professionals working in the nuclear area, measures have to be taken for bringing a new generation of experts to the field. To this end, EUSECTRA continues to invest in nuclear security, nuclear safeguards, and non-proliferation education, to raise awareness with the young generation on these topics (alongside nuclear safety, radiation protection, and other nuclear topics typically already quite well covered in university programs), as well as to build up their academic insights in these multidisciplinary fields. We believe there are many opportunities for a strong collaboration between the community of nuclear security and the one of nuclear safeguards in these endeavors. Knowledge transfer and recruitment of the next generation of nuclear experts should profit to a maximum extent from the experience in the nuclear security and in the nuclear safeguards/non-proliferation fields and thus may generate synergies between these disciplines, properly reflected in coherent educational programs.

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