Third International Conference on Human Resource Development for Nuclear Power Programmes: Meeting Challenges to Ensure the Future Nuclear Workforce Capability

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Book of Abstracts

Contents

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Technology of self-control development as a tool for prevention personnel mistakes

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INSAG-3 stated that the safety culture is related to personal responsibility and dedication to the work of all persons engaged in any activity that affects the safety of nuclear industry enterprises. As a key element, there is a security-oriented mindset that forms an internal critical position, excludes complacency and involves the pursuit of excellence, the development of a sense of personal responsibility and general self-regulation in matters of security. Nobel laureate Daniel Kahneman in view of recent discoveries in cognitive and social psychology explains why we sometimes commit irrational actions and how we make wrong decisions. He notes that there are two systems of thinking: System 1 and System 2: System 1 is triggered automatically and very quickly without requiring or almost not requiring effort and without giving a sense of intentional control. System 2 highlights the attention needed for conscious mental effort including for complex calculations. System 2 is triggered when an event had been detected that violates the model of the world in the System 1 view. The most important possibility of System 2 is critical thinking, the ability to accept “setting for a task": it can program memory to follow instructions that do not correspond to the usual reaction and as a result the probability of error is at the minimum. Unfortunately according to statistics a person is not more than 25-30% of the time in the System 2 and hence it can be concluded that for the nuclear power plants personnel the development of self-control skills is an important task ensuring the safety of professional activity.

1

Recirculation of manpower for development and utilization program: A case study of Radioisotope Production Facility

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One of the biggest challenges in radio isotope production facility (ERPF) is the a well trained work force and lack of manpower in some technical departments. So our top management forward its concerns to re-circulate the condensed and accumulated employees in some departments to relocate again in some running facilities based on its education and qualifications to guarantee running the nuclear facility without shutdown to satisfy the market demands from medical radioisotopes. To improve and develop the competency of the employees, a training courses should be submitted to them to best fit the necessary tasks and activities that are requested from them in time and a qualified way. Necessary training is fulfilled by available responsible and key persons in facility, so those top management should endeavor to provide basic training and seek local help for specialized training through estimated training period (ETP) to decide that recirculated employee are eligible to do his duty properly.

2

Nuclear Training and Tutoring Activities in Lithuania

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In 1990, after Lithuania declared its independence, the Ignalina NPP came to jurisdiction of the Republic of Lithuania, however, all technical scientific support organizations remained in Russia. With the help of the nuclear safety organisations from most experienced countries and IAEA, during few years the necessary infrastructure for nuclear regulation and technical-scientific support in Lithuania was created. The TSO leader in Lithuania is Lithuanian Energy Institute (LEI), which provide various expertise activities and necessary technical-scientific support in the field of nuclear safety, waste management, radiation protection, as well as drafting of norms, regulations and safety requirements. The specialists from LEI performing R&D activities within the frame of national research programs and European funded projects and very actively participating in the nuclear knowledge sharing. These activities were not stopped after the final shutdown of Ignalina NPP (the operation of Unit 1 was terminated in 2004, Unit 2 - in 2009). As example of such activities are the Regional Basic Professional Training Course, organised by IAEA with LEI in the role of host organisation in 2008 and 2009. LEI has united doctorate together with the Kaunas University of Technology (KTU) in area of technological sciences “Energy and Power Engineering”. LEI specialists developed and providing specific training modules: “Modelling of Processes during the Transients in Nuclear Reactors” and “Safety Analysis at Nuclear Energy” for the MSc degree students and “Simulation of Accidental Thermal-hydraulic Processes” for the PhD students. LEI experts participated in the establishment of European Nuclear Safety Training and Tutoring Institute and from the very beginning is offering short applied training sessions and longer courses based on tutorials for specialists with some professional experience in the nuclear sector. Al these activities allows Lithuanian specialists to strength and systematize the nuclear knowledge, and to preserve competition in nuclear safety.

3

DEVELOPING SITE LICENSING HUMAN RESOURCE; INDONESIA EXPERIENCE

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The ability of a regulatory body to fulfil its responsibilities in controlling Nuclear and Energy Utilization depends largely on the competence of its staff. Building skills and knowledge of its employees is an investment in developing performance of regulatory activities in the future of the organization. Indonesia Nuclear Energy Regulatory Body (BAPETEN) must ensure that the reactors are designed, constructed and operated in a safe manner. A major challenge is now add adequate knowledge and experience of the staff and technical support organization (TSO). TSO external experts chosen based on their expertise required to perform the work and the kind of outcome that is expected.

Based on Government Regulation Number 2 Year 2014 on the License of Nuclear Installation and Utilization of Nuclear Material, several documents required to be submitted to BAPETEN (as a Regulatory Body) in applying license, in example, Site Evaluation Report and Site Evaluation Management System Implementation Report. In order to review and asses those documents, it requires staffs with skill and competence in several aspects: seismic, volcanology, geotechnics and foundation, meteorology, hydrology, human induced events, dispersion of radioactive material, and management system/quality assurance.

BAPETEN had implemented the Education and Training program including degree and non-degree program consist of national and international training as well established on job training (OJT) program since 2010, and providing suitable training/workshop related. OJT program was conducted in collaboration with other experienced countries regulatory body in developing and operating nuclear power plant.

Recently, BAPETEN just issued site license for Indonesia Experimental Power Reactor in Serpong area, submitted by National Nuclear Energy Agency (BATAN). Site documents review and assessment done by BAPETEN staff who had undergo OJT program, workshop/ training related to site application, also involved TSO external experts from university and government institution

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Meeting Challenges to Ensure the Future Nuclear Workforce Capability Pakistan's Perspective

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Pakistan first research reactor (PARR-1) was installed in 1964 under UN program "Atom for Peace" and the first commercial reactor KANNUPP-1 build in 1971 at Karachi. To support these activities PAEC sent about 600 scientists from 1965-70 for training abroad at very renown laboratories in different field of Nuclear Science. At this point Pakistan also felt the need of large quantity of highly qualified work force to run the upcoming nuclear power program. Keeping this in view Pakistan Atomic Energy Commission (PAEC) started capacity building by establishing PIEAS and Karachi Institute of Nuclear Power & Operation Engineering (KINPOE). As planned the program kept on expanding, the second research reactor (PARR-2) installed in 1990, Second Power Reactor C-2 in 2002, third C-3 in 2016, fourth C-4 in 2017 each of 350 MW, beside this three NPPs K-2, K-3, at Karachi & C-5 at Chashma of 1100 MW are under construction. To operate and maintain 5 present and 3 upcoming NPR, experienced, highly qualified and trained technical manpower is required. To meet Nuclear Power development needs, many degree and training program were floated, CNS upgraded into PIAES and another institute CHASNUPP Centre for Nuclear Training was developed in 1997. These institutes are now awarding MS degrees in 7 Nuclear disciplines to about 300 students/year & Postgraduate training in highly specialized fields to about 1200 engineers/year.
To attract best minds of the country PAEC introduced a very strong organization culture to hire large number of quality manpower for the above mention degree programs & to provide them the state of art on job trainings after completion of degree. At the same time job satisfaction was provided by giving them attractive emoluments, with competitive, on time promotion policy and at a given date.

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RECRUITMENT, RETENTION AND ATTRACTION OF A HIGH QUALITY NUCLEAR WORKFORCE FOR NIGERIA'S NUCLEAR POWER INDUSTRY

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ABSTRACT
In its quest to have nuclear power plants to contribute to her energy mix, Nigeria is implementing activities that will lead to the attainment of Milestone 2 of the IAEA's infrastructural approach to NPP programmes with the first of four plants being operational by 2025. Thus, Nigeria has put in place processes of recruiting, retaining and attracting nuclear programme personnel throughout the lifecycle of the plant.
The recruitment criteria vary by job position and activity area but generally are determined by three key requirements, namely educational, psychological/medical and security/background requirements. The recruitment programme is tailored towards recruiting scientists and engineers early enough to enable them to take part in the design and construction of the nuclear power plants. Furthermore, technicians/craftsmen will receive on the job training by working with the construction organization and commissioning personnel in the checking and initial calibration of instruments and controls, and in the initial operation of equipment.
In order to ensure staff retention, adequate remuneration is a necessity and not an option. Remunerations in Nigeria would be as comparable and as attractive as in the nuclear industry all over the world. In addition, personnel would be provided with other incentives (Health and Housing Scheme, schools for family members in the vicinity, etc.).

To attract new workforce, a HR approach with tremendous multiplier effects is in terms of outreach programmes for the secondary school students. The Nigeria Atomic Energy Commission (NAEC), as the promoter of the peaceful uses of nuclear energy in Nigeria, has planned to provide the necessary and needed impetus for the study and understanding of the peaceful uses of nuclear energy through what is referred to as "Catch Them Young" programme.

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NTEC: A Consortium Approach to Develop and Support the Nuclear Workforce

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The successful implementation and continual operation of nuclear power plants and associated facilities is dependent on an educated workforce across many disciplines and many levels. Due to the nature of nuclear energy, subject matter experts for all the nuclear technologies utilised on site are a cornerstone of this workforce. The Nuclear Technology Education Consortium was established in the UK in 2005 to meet the demand for these nuclear specialists with fifteen courses provided by the NTEC members which comprises six universities and the Nuclear Department of the Defence Academy. The content of the courses was decided upon after consultation with industry which also advised the NTEC members to provide the courses in a one-week intensive format, as well as a web-based distance learning format, to provide the flexibility required for the current workforce to benefit from the programme as well as newly graduated undergraduates.
The full-time students can complete the Master's programme in one-year while the part-time students take three years to allow for their full-time job as well. Over 100 students are now accessing the NTEC programme each year whether for individual courses for continual professional development, for a Postgraduate Certificate or Diploma or taking eight courses and completing a dissertation for the full Master's in Nuclear Science and Technology.
The NTEC programme continues to evolve and improve through continual feedback from the students and lecturers, and annual consultations with an External Advisory Board whose members are representatives of the major nuclear companies in the UK. After twelve very successful years the NTEC programme continues to develop and support the nuclear workforce both in the UK and globally.

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Non-Nuclear Countries in HRD Schemes for Nuclear Power Programmes – Interests, Roles, Benefits

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Human resource development (HRD) is fundamental part of nuclear power programmes (NPPs) in both operating and embarking countries. However, it may seem unusual at first glance that non-nuclear countries, i.e. those countries which are neither running, nor planning introduction of nuclear power for electricity generation or whatsoever, may show interest in HRD for NPPs. Broad spectrum of evidence supporting a different perception is discussed in the paper. Mastering nuclear power generation requires extremely complex bodies of knowledge and competence in numerous fields, as well as the ability of their coordinated and focused application/implementation, over long periods of time, spanning the decades – HRD schemes provide for that. While comprehensive HRD for NPPs is indeed not commensurate with non-nuclear countries' needs, some segments/aspects of it are undoubtedly beneficial for every country, non-nuclear ones included. In most cases, non-nuclear countries can considerably benefit if/when they implement some selected/basic elements of HRD for NPPs. This fundamental nuclear knowledge is broadly applicable in various fields of non-power nuclear/radiation applications (e.g. medicine, industry, agriculture, environmental monitoring, science and education, legislation and regulatory issues, integration into international

nuclear security regime, etc.). Non-nuclear countries are often interested in the excesses of electricity their NP neighbors can offer/provide. Cooperation on HRD schemes is normally a way towards putting that in effect. From NP countries' standpoint, involvement of non-nuclear ones in HRD schemes for nuclear power programmes can be seen as an important complementary source of talented nuclear workforce. After all, talent is evenly distributed across the planet. Even the evident brain drain – which can be attributed to such transfer of qualified workforce – should not be considered as an absolutely negative fact, given the reciprocal and multiplicative benefits to non-nuclear countries in various ways.

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Developing an HR Strategic Plan, PNRA experience

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Strategic Planning is irrevocably linked with the human resource planning process in knowledge based organizations. Achievement of future strategic goals depends upon the availability of adequate human resource for which human resource forecasting needs to be conducted.
In order to realize the goals of Pakistan Nuclear Regulatory Authority's (PNRA) Strategic Plan 2015-18, an assessment of required financial and human resources was needed. In view of the expansion of nuclear power in Pakistan, it is imperative that more manpower is inducted at PNRA as the scope of regulatory activities will expand. Such activities will include authorization of new Nuclear Power Plants (which may be of new designs), new nuclear and radiation facilities, increase in inspections of nuclear and radiation facilities, increase in licensing of Nuclear Power Plants operators, increase in review and assessment of technical documents along with establishment of new directorates.
Nuclear regulatory authorities, all over the world, have diverse organizational models and as such have different organizational needs. In 2015-16, PNRA performed the rationalization of manpower with the objective to verify whether the available work force at technical directorates of PNRA was commensurate with the tasks and functions assigned to them. Using the data from the 'rationalization' exercise, PNRA developed an HR Strategic Plan in 2016-17. The HR Strategic Plan had the objective of identifying the future regulatory activities and as a result, the manpower needs of PNRA for fulfilling its strategic goals till 2025. Assessment of future financial needs associated with increased HR till 2025 was also performed.
This paper describes the methodology used for determining the optimal number of manpower needed for PNRA to efficiently conduct its regulatory tasks till 2025. Using this methodology, optimal manpower needs for PNRA were determined for the next ten years considering the forecasted increase in regulatory activities.

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Dummy Abstract

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Dummy

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Outreach to Students and Teachers - Key to Human Resource Development

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With the numerous nuclear power plants being built globally and the prospects for many more, the challenge of the timely availability of a well-prepared, qualified workforce and educated public are a key elements in the "critical path" to commissioning (and decommissioning) these plants. All of these individuals will need a quality education that is rooted in experience and established on safety. In addition, because many of these new plants are typically built in emerging countries, education, training, recruiting, and retaining operations staff can be a significant challenge. Attracting sources of qualified employees for these nuclear power plants in local communities is paramount which implies a strong focus on the science and math education programs and a general understanding of all nuclear applications at every level. This presentation will promote the integration of human resource development strategies, education and training systems, and international cooperation to demonstrate how working in particular with the education sector can not only create interest in future careers in nuclear technology, but can also build community based support for nuclear power programmes.

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Evaluation and implementation of quality control in mammography

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According to the WHO each year there are 1.38 million new cases and 458,000 deaths from breast cancer. Breast cancer is the most frequent in women; the most of deaths (269,000) occur in low and middle income countries, where they are diagnosed in advanced stages due to the lack of early detection and obstacles to access to health services. In Paraguay, cancer is the second cause of death in women. Breast cancer is curable if it's detected early. One of the main success factors of Mammographic studies is to have operational equipment with the highest possible quality, combined with a low dose rate of the patient. To guarantee, it's necessary to establish quality control and operation verification programs for Mammographs To implement these programs, this project will evaluate the operation and quality of mammograms through measurements of physical parameters of radiation generators, imaging devices and irradiation facilities at the time of their commissioning, based on in technical regulations established by the IAEA. The appropriate physical and clinical factors used for the diagnosis of the patients are also checked; using reference hospitals in Paraguay, for studies. With this, it is demonstrated that to evaluate the stability in the operation of the mammograms, with the adequate materials for the control and evaluation, it's possible to obtain the current state of the equipment; in order to know the situation of each equipment and the possible solutions to in order to avoid the over exposure of the patient, the professionals, and get the optimal performance of the equipment.

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The International Nuclear Management Academy

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The successful completion of nuclear projects, whether new build, decommissioning or any other, to the necessary quality, delivered on budget and on time, requires highly competent nuclear technology managers. Many managers given the responsibility for the successful completion of these projects have many years of just technological experience, or are recruited from other industries and therefore do not have the relevant complete set of core competencies

The International Atomic Energy Agency (IAEA) have therefore facilitated the establishment of the International Nuclear Management Academy (INMA) to support the development and sustainability of Master's level Nuclear Technology Management (NTM) educational programmes and the development of nuclear technology management professionals.
A broad range of competencies across four Aspect Groups of External Environment, Technology, Management and Leadership, that have been identified as the basis for the successful management of nuclear projects, have been defined within the INMA framework. The universities can therefore develop programmes that provided the required management and/or nuclear technology competencies.
An endorsement process for NTM Master's programmes has been developed by the IAEA working with worldwide universities with nuclear education programmes. So far, two universities, The University of Manchester and the Moscow Engineering Physics Institute, have so far received INMA endorsement for their NTM Master's programmes. Several other universities - North West University and University of the Witwatersrand (both South Africa), Texas A&M University and the University of Tokyo having been assessed for endorsement, and many others developing nuclear technology management programmes are entering the process.
University education cannot develop the complete range of competencies required by nuclear technology management professionals, so on-the-job training or experiential learning is also an essential component to attain the high level of nuclear technology management capability required. INMA provides the framework to establish and sustain this vital combination.

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Necessities, Difficulties and Potentialities of Nuclear Energy in Nepal

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Nepal is a under developing country. The major energy resources in Nepal are traditional (firewood and others) and imports energy from India, also developing hydro powers for fulfilling energy demand. Nepal is reported to have potential on Nuclear power development. But, lack of access to technology, lack of skilled human resources and investment gap are taken as hurdle for nuclear power development.

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Current State, Gaps, Challenges and Actions Required to Develop Nuclear Workforce in Bangladesh

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In pursuit of a goal to meet the upsurge demand of electricity, Bangladesh considers the introduction of nuclear power in its national energy mix. As a first step towards the development of a sustainable Nuclear Power Program in the country, Bangladesh Atomic Energy Commission (BAEC) has taken initiatives to build two units of VVER reactors (1200 MWe each) under the Rooppur Nuclear Power Plant (RNPP) project, which is being implemented under a turnkey contract with Russian Federation. BAEC is very much concerned to achieve self-reliance for successful implementation of RNPP project through national efforts and international co-operation. Development of human resources is one of the greatest challenges to achieve this goal. We act hand in hand with the IAEA, Vendor, other strategic partners and stake holders to overcome these challenges to achieve initial competence, and then sustainability, of human resources needed to support a nuclear power program. As an embarking country, capacity building initiatives

for trained, educated and competent staff for operation and regulatory oversight of the NPP is an absolute necessity and require long-term planning. Primarily our effort are focused on developing and maintaining of the internal competencies to operate and maintain the plant in a safe and secure manner. The present study assesses the current state of education and training of the country's nuclear workforce, the remaining gaps and challenges. The study also provides recommendations for the actions required to address the corresponding needs to sustain NPP program in Bangladesh.

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Gamma ray spectrum analysis for the activation and fission products

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Electro-nuclear technology consists in creating fission reactions inside a reactor that produce artificial radionuclide that constitute radioactive waste. This waste must be controlled, stored and monitored according to the principles of nuclear safety and security. For this, a reference state of radioactivity must be established for radio-elements of interest before the implantation of a nuclear power device. In this work, we develop a technique for analyzing these radionuclide by the gamma ray spectrometry method. It will discuss the identification and quantification of Cs-134, Cs-137, Co-60 and I-131 in a gamma ray spectrum.

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Ways of Minimizing Negative Impacts of Language Barrier on International Trainings

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Following the signature on Oct.21, 2011 of "Practical Arrangements between CAEA and IAEA on Cooperation in the Field of Safe Nuclear Power Plant Construction", the International Construction Training Center on Nuclear Power Plants (usually referred to as the ICTC) has, under the assistance of the IAEA, organized 9 training programs, benefiting more than 200 participants from 36 countries. The author was once offered an opportunity to take a visitor's seat in the lecture room throughout the whole period of a two-week training program. While enjoying the process of different lecturers sharing their insights and experiences in various areas related to nuclear power plant construction, the author gradually came to realize that the language barrier could sometimes loom so large among participants speaking different native languages, and in certain cases might harm the effectiveness of international trainings to such an extent that a systematic research on the subject of this paper becomes meaningful.

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Manpower Training Plan for Rooppur Nuclear Power Plant in Bangladesh

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Nuclear Power Plant (NPP) is characterized by technical complexities. The development of competent manpower is one of the fundamental requirements for safe and secure operation & maintenance of the NPP. In most cases, the safe and economic operation of NPP depends on knowledge and skills of operational personnel. It is a critical infrastructural issue to the countries embarking on their first NPP. The number and qualifications of manpower required for a successful nuclear power project are sometime underestimated and the resulting shortage of manpower is a restraining factor against development of nuclear technology, in particular, in developing countries. Before embarking on first nuclear power project, it is essential for a newcomer country to determine its real manpower needs in the framework of the envisaged nuclear power program and evaluate the existing organizational, educational and industrial capabilities for meeting these needs. For Bangladesh, a well-planned human resource development plan is in place to run the program in a sustainable manner. Based on the country culture and IAEA guidelines, 2535 personnel have been identified in different categories for Rooppur NPP units (VVER, 1200 MWe each of 2-units). The identified personnel have already been started to recruit and the rest will be recruited sequentially. They will be trained for Rooppur NPP project management, plant commissioning and operation & maintenance. Among them 1424 key personnel will be trained by the Contractor in the frameworks of General Contract wherein required personnel will obtain license in compliance with regulatory requirements. Administrative and common industrial personnel as well as general supporting staffs will be trained locally by the Customer's trained instructor. This paper deals with the availability of human resources for Rooppur NPP and their training plan to make them competent enough to run the NPP independently.

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Radioactive Waste Management Activities in Myanmar

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Although Myanmar has no nuclear facilities such as power reactors, nuclear fuel cycle facilities, research reactors, nuclear research facilities, the utilization of ionizing radiation, radioisotope and radioactive sources to some extent for health, social and economic benefits have been started since late 1950's. The main sources of radioactive wastes are mainly from hospitals that use short-lived radioisotopes for nuclear medicine purposes. Spent seal sources which are generated from the application of radioactive sources in medical diagnosis, treatment and agricultural research were studied. For short –lived radionuclides, waste management may involve collection and storage of the waste for decay until they can be exempted from further regulatory control. For long half –lives radionuclides, waste management may include not only collection and storage, but also more complicated activities such as conditioning and disposal. Main Radioactive Waste Producers in Myanmar are Industries, Medicine and Agricultural Services. The procedures of waste management activities are collection, treatment, conditioning, packaging and storage. The process of Conditioning for Spent Ra226 had been performed in Division of Atomic Energy (DAE) in this work. DAE is responsible for carrying out research and development in radioactive waste management. The purposes of waste management policy are: the waste is returned to the manufacturers, is stored by licensees, and is sent to National Waste Center. All the departments using ionizing radiation sources have followed the IAEA Safety Rules and Standard with care and caution, no radiation hazard or accident or incident has ever occurred at all. Safety and radiation protections are being taken as much as possible to comply with relevant IAEA regulations. Myanmar is also participating in the human resource development programme in connection with IAEA for radioactive waste management of training, workshops, e- learning course and CONNECT Website and platform

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Japan-IAEA Nuclear Energy Management School

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The purpose of the Japan-IAEA Nuclear Energy Management School is to provide a unique international educational experience aimed at building future leadership to manage nuclear energy programmes, to nourish a wide range of knowledge on issues related to the peaceful use of nuclear technology, and to broaden individual networking with people interested in nuclear energy from all over the world. The theme here corresponds to the objectives of the conference " to develop and maintain the human resources needed to support the safe and sustainable operation of nuclear power programmes". The school is organized by member of Japan Nuclear Human Resource Development Network in cooperation with IAEA. The curriculum of the school is designed to cover a range of topics that are relevant to the participating countries, which have been considering introducing or expanding nuclear power programmes. The young professionals of these countries will share the nuclear knowledge with the best experts. It will enable the transfer of wide range of specific knowledge to participating countries towards their capacity building efforts. During the two and a half weeks course, selected participants will be exposed to all modes of instruction and training activities. In the last year (2017), the 6th Japan-IAEA Joint Nuclear Energy Management School was held and has given the young professionals the opportunity to obtain nuclear engineer's responsibility for safety through visiting Fukushima-dai-ichi accident site and also to see the revitalization of Fukushima. The school is the second oldest one after ISTC-IAEA school in Trieste and has already invited about 200 foreign young professionals including Japanese ones. Many of graduates have been working in management field for NPP operation or NPP-intrroduction in own counties as young leaders

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Human Resource Development for Nuclear Technology at nuclear education in Myanmar

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Myanmar, a developing country, has been initiating the human resource development (HRD) for Nuclear Technology (NT) in the university system since 1997. This paper discusses the requirements of HRD programme for NT, its national status and the existing condition of nuclear education in the country. It brings out the linkage of HRD programme in the country. It also describes the initiatives by the university system in the area of nuclear education and support provided by the Division of Atomic Energy (DAE) to the university system by providing access to lab facilities. Needless to say, implementation of any programme requires knowledgeable and skilled manpower. The knowledge and skills are imparted in universities. It would appear that the question of development of manpower for NT would be one of incorporating appropriate curricula at various levels of education. In our country, the curricula for NT were prescribed by local expert academic persons to be able to expect with the International Standards for Bachelor of Engineering (BE), Master of Engineering (ME) and Ph.D degrees in Yangon Technological University (YTU), Mandalay Technological University (MTU) and Technological University (Kyauk Se) [TU (Kyauk Se)]. At present, the two universities such as MTU and TU (Kyauk Se) has been implementing the HRD specified in NT for the preparatory phase if the country aims the Nuclear Power Programmes(NPPs). At Myanmar, universities have been facing to the lack of laboratory facilities in field of radiation. But these are solved by the way of visiting to the DAE and other research centers where the students accessed by the cooperation of teachers and

researchers. At that time, students touch in laboratory equipment facilities and then they submit the reports about the visiting fields to their department in university.

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Identification of Irradiated Foods with Electron Spin Resonance (ESR) Spectroscopy

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Food irradiation uses electromagnetic radiation and is controlled by many identification methods according to the contents in foods. Currently there are ten methods used to identify the irradiated foods and electron spin resonance (ESR) spectroscopy is one of these methods to identify the irradiated food containing bone, cellulose and crystalline sugar. The present work was to detect the un-irradiated and irradiated wheat, rice and chickpea powder, study the ESR intensity with respect to the absorbed dose, and fading of ESR signal with time. As the radiation source, industrial type 5 MeV, 15 kW electron beam accelerator was applied and three grain flour was irradiated with the dose; 1, 1.5, 2.1, 2.6 and 3.2 kGy. The optical absorbance of B3 Windose film dosimeters was measured at 552 nm with GEX (Spectronic Genesys-20) spectrophotometer for absorbed dose measurement. ESR measurements were carried out using an ESR spectrometer (magnettech, MS 400). Free radicals generated by irradiation gave typical signal in the ESR spectrum for irradiation identification. In present study, irradiated samples showed strong ESR signals centered at g = 2.006, where un-irradiated samples had weak signals. And ESR intensity increased linearly with absorbed dose in most of the cases. The fading of ESR intensity of the samples stored at room temperature was studied over storage period of 4 weeks. Following one week after irradiation, ESR intensity decreased significantly with storage time.

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Experience of University of Ibn Tofail in providing Human Resources for different careers in nuclear field through Master's programs.

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The use of nuclear techniques is expanding rapidly in Morocco in various fields such as medical, industrial, agro-food and scientific research. Morocco has a Triga2 research reactor. These techniques require the recruitment of people competent in the use of different nuclear techniques, radiation protection, nuclear safety and security. Several education and training programs have been developed in Morocco in recent decades. The Ibn Tofail University contributed to these courses by developing several Master's programs and thesis defense in the field of nuclear applications. The laureates of these programs currently hold senior positions at various levels in several organizations nationally and in other African countries. In fact, in 2010, the Ibn Tofail University launched a master's program focusing on nuclear techniques and radiation protection around these techniques. In 2015, another master's program in nuclear science and technology has been launched. Both programs are open to Moroccan and african students to help meet the growing demand in the field. In this presentation, I will present the content , the objectives and the expected outcomes of these programs, the interest in these courses by the socio-economic sector and the involvement of some national, regional and international organizations, institutions and associations in these programs. I will also speak about the contribution of these programs to the preparation of executives and skilled people who currently hold key positions in a number of institutions and facilities related to nuclear power. Such programs can help the country prepare for and succeed in any nuclear program that needs qualified human resources in the various disciplines in the nuclear field and related fields.

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Education – Key Element for the Nuclear Workforce Development

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Human resource development (HRD) is the systematic approach to the development of personal and organizational knowledge and skills throughout a set of organized activities including formal and informal education and training, also increasing collective abilities related to work. Main goal is to develop the most superior workforce so the development should be based on a serious and oriented formal education. Education of nuclear workforce is even more demanding because it should support the safe and sustainable performance of nuclear power programs. Also, education should be coordinated with the requirements according to the national energy strategy and current needs in nuclear-related industry and technology. In Croatia, the Faculty of Electrical Engineering and Computing, University of Zagreb, is a leading institution in nuclear engineering education, assuring almost all the needs for basic nuclear workforce and, in the same time, involving experts with experience in the field of nuclear power in projects and trainings. Institutional specialists are also engaged in operation and expansion of nuclear power program on the national and regional levels. In this work, overview of current and future academic programs and plans for nuclear engineering study will be presented together with problems and difficulties in attracting and recruiting students. Since HRD life cycle demands long-term planning and awareness of sensitivity of nuclear knowledge and skills, academic formal education becomes the key element in nuclear workforce development.

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Human Resource Development: The First Regional School on Nuclear Security held in French

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Nuclear threats are on-going concerns for Member States which are responsible for the security of nuclear material, other radioactive material and associated facilities and activities. All States must therefore also systematically approach their training and educational needs across all levels of relevant organizations for a sustainable nuclear security infrastructure. This can only be achieved with systematic training and educational programmes. In Africa, there are very few educational programmes focusing on nuclear security. The University of Ibn Tofail in Morocco is one of the forerunners in this field, having established its educational programme at an early stage in 2014, while taking into account the need for faculty development courses (FDCs) for national, regional and international participants, as well as student's needs for theoretical and practices oriented programmes. Equipped with experiences of previous courses and capacities within the country, Morocco requested to hold a regional school on nuclear security, based on the joint IAEA-ICTP International School on Nuclear Security. Particularly meaningful was the fact that this would be the first school held in French, to the benefit of French speaking IAEA Member States and Non-Member States. The two-week school was designed for young professionals, with responsibilities covering aspects of nuclear security. Candidates demonstrated a specific career interest in, or knowledge of nuclear security, although their academic and technical background varied. The school programme provided a comprehensive overview of nuclear security related topics for participants coming from various educational and professional backgrounds. This paper aims to share the pilot course experience in organizing such an educational course in French, for 39 participants from 20 countries in Africa.

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The need of staff in NNGC Energoatom and the Company's cooperation with higher education institutions.

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Most of energy companies have already faced a need to make significant changes due to the growth of the quantity of employees in retirement age. The problem of rejuvenation of workers in the coming years will have to be solved in unfavorable demographic conditions. According to demographic forecasts the amount of productive population will decrease resulting, accordingly, in the lack of personnel for electric power industry. Taking into account current situation with personnel in the labor market of energy sector, the Company promotes motivation and personal development of talented young people in the higher education institutions to enable them to train their own specialists and develop them in the areas necessary for the Company. Within the scope of cooperation with higher education institutions, the company carries out the following activities. Energoatom has signed cooperation agreements in the field of personnel training with six higher educational institutions of Ukraine. PRACTICAL TRAINING ON THE SITES OF NUCLEAR POWER PLANTS. The acquisition of practical skills by students is a priority ta sk for the Company. INVIVIDUAL GRANTS OF ENERGOATOM for the best students have been established and paid out since 2008 for popularization of the nuclear scientist profession. Since 2012, an annual award of NNEGC Energoatom "The Best Teacher of the Year" has been established, which is awarded to university teachers of four higher education institutions according to the results of pedagogical activity. SCHEDULE OF COOPERATION WITH HIGHER EDUCATION INSTITUTIONS for the next academic year is developed each year. SUMMER NUCLEAR SCHOOL "Youth and the Future of Nuclear Energy", as one of the tools for training qualified personnel for nuclear energy in Ukraine, was founded in 2011 with the goal of preserving, transferring and improving nuclear knowledge from university scientists and leading specialists of the nuclear industry to students of higher educational institutions.

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MASTER PROGRAMME EDUCATION IN NUCLEAR SECURITY – PROBLEMS AND PERSPECTIVES

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The report will examine the 3-year experience of the International Master Program in "Nuclear Security". The Master's program was developed and implemented under the cooperation agreement between UNWE and the International Atomic Energy Agency (IAEA), signed by the Rector Prof. Dr. Statty Stattev and IAEA Director General Yukiya Amano during his visit to Sofia in June 2014. Currently students form 10 countries are enrolled in the programme as first – group students from six countries - Bulgaria, Burkina Faso, Zambia, Jordan, Nigeria, Lebanon, passed a four-semester English language programme combining theoretical and practical classes according to IAEA requirements, with 22 disciplines, laboratory exercises, technical visits, simulations, etc. The aim of the progrramme is to prepare highly qualified managers at the middle management level for the needs of the nuclear industry. The program is unique in its kind. Since this is interdisciplinary programme, the collaboration between different universities, research institutes, state institutions, industry, different organizations in the field is of critical importance at national as well at international level. Informal character of the consortium led by UNWE has advantages and disadvantages. In this respect the choosing of proper team of lecturers was one of the big challenges to the leadership of the Master programme, provided by the UNWE department 'National and Regional Security'. International students, international staff of teachers from different universities and their different background requires attention to every detail of the life of the programme – from educational background, through accommodation, religious and cultural diversity to interpersonal group dynamic. Unique educational model based on interaction between international organization (IAEA), teaching consortium (almost 10 Universities and institutes), government institutions and business, national governments (for their nominations and career development) was created. Most important factors for success will be presented as well as perspectives for development of the programme.

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Managing knowledge and skills over time for supporting geological disposal project development

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Projects such as those designed to define, build, operate and monitor radioactive waste disposal solutions require the transmission of knowledge over several decades and the preservation of memory over several centuries. This is particularly acute for the Cigeo geological disposal project as far as the requirements in terms of reversibility lead to the choice of an incremental design that allows learning resulting from continuous improvement of knowledge to be integrated. For instance, for robustness purposes, Cigéo is designed on the basis of currently proven technologies, but its step-by-step construction in successive stages must make it possible to integrate improvements derived from the scientific and technical progress as well as from experience feedback from its exploitation. In the field of industrial activity, a significant proportion of the knowledge and skills implemented by employees of a company are not known or even identified by the human resources organization or the mid-management staff. This is mainly due to the fact that (i) the organized knowledge-sharing is often based on documentary tools but little on social modalities and (ii) the organization of knowledge is mostly cross-cutting to the managerial lines. To overcome this bias, the interface between knowledge and human resources management is currently the focus of Andra's specific efforts. The management of jobs and career pathways aims more specifically at developing participative capitalization and transfer of knowledge and skills. Then Andra attempts to deal with such issues not only by ensuring a continuous preservation and sharing through cross-cutting groups of competences positioned throughout the life of the projects but also a transmission through companionship between senior experts and junior staff. This system is part of the global approach to knowledge management that aims at promoting the diffusion and creation of knowledge within Andra

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Experience of Tomsk Polytechnic University in implementing the international nuclear Master's program

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In 2012, within the agreement between TPU and State Corporation "ROSATOM", the international Master's program "Nuclear Power Installations Operation" was opened to develop international cooperation and to export services in the field of nuclear education. Fundamental and applied engineering training of Master's students is being carried out during 2 years, including such basic courses as nuclear reactor physics, operational modes of nuclear steam supply system, nuclear and radiation safety. Students are trained using modern laboratory complex on reactor physics, thermal physics of a nuclear reactor, materials science, and the only Russian operating research nuclear reactor IRT-T. While implementing the program, two groups of international students in the number of 24 people (India, China, Ghana, Nigeria, Egypt, Tanzania) were recruited. The graduates have got a set of the competences in the field of nuclear physics and technology, which allows developing successful career at nuclear fuel cycle enterprises. Also Master's program "Nuclear Medicine" is planned to develop in the field of joint educational activities. The goal of program is training highly qualified medical physicists and scientists in the field of nuclear and beam diagnostics and treatment, radiation therapy. The curriculum provides in-depth specialized training, including research work of students and innovative practice, realized in the laboratories of two universities - Tomsk Polytechnic University and Siberian State Medical University. A considerable amount of studies conducted in specialized teaching laboratories of the two Universities and cancer centers of Tomsk city with modern equipment, including Research nuclear reactor of TPU, different types of tomography systems, Electa Synergy and Theratron Equinox 100. The uniqueness of these programs is that they are implemented fully in English.

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Using E-Learning Platform To Facilitate Institutional Collaboration For Nuclear Security Education in Nigeria

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This paper is focused on the use of institutional collaboration and e-learning tools to foster and facilitate the teaching and learning of nuclear security science in the postgraduate certificate programme of the Centre for Nuclear Energy Studies (CNES), University of Port Harcourt. The programme was designed to expose students to foundation level theoretical and practical knowledge of nuclear security science through modular approach. Its pool of lecturers were drawn from within and outside the University. Four of the courses in the programme were taught by subject matter experts (SMEs) from other institutions during the 2016/2017 academic year. Three courses were taught by SMEs from the Nuclear Security Science and Policy Institute (NSSPI), Texas A&M University, while the other one was taught by one SME from Centre for Energy Research and Training, Ahmadu Bello University (ABU), Zaria. The lectures were delivered remotely by the SMEs using e-learning platforms (Blackboard by NSSPI and Skype by ABU). One SME from the Nuclear Security Institute, University of Tennessee also delivered supplementary lectures using Zoom platform. These platforms provided direct audio-video interaction between the students and the SMEs. NSSPI's portion of the programme was sponsored by the U.S. Department of State's Partnership for Nuclear Security (PNS). PNS also provided CNES with external camera and microphone that enabled it create robust virtual classrooms for the students. The required bandwidth was provided by a local GSM service provider. To facilitate learning, course agenda and pre-recorded video lectures were shared with students before the start of actual lectures. Preliminary analysis of responses from the student's course engagement survey indicated no significant differences between the level of student-lecturer interaction for courses taught via e-learning platforms and those taught in the traditional classroom.

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The CEA scientific and technical offer as a designated ICERR by the IAEA: first feedback with the prime Affiliates

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The IAEA Director General has approved on September 2014 a new initiative, namely the IAEA designated International Centre based on Research Reactors (ICERR), which will help Member States to gain access to international research reactor infrastructures. In fact, for the agency, one of the main goals of this ICERR scheme is to help Member States to carry out nuclear research and development and build capacity among their scientists. CEA has decided to be candidate to its designation as an ICERR and consequently has established a candidacy report. The CEA offer is covering a broad scope of activities on the 3 following topics: - Education & Training - Hands-On Training - R&D Projects. CEA Cadarache and Saclay centers are the first designated ICERR by the agency; this has become official during the last General Conference on the 14th September 2015. The Director General of the agency indicated the agency motivations at a ceremony during which he awarded the designation to CEA: "Such centers will enable researchers from IAEA Member States, especially developing states, to gain access to research reactor capabilities and develop human resources efficiently, effectively, and, probably, at a lower cost". The 3 first Affiliates to CEA signed this agreement in September 2016 (JSI from Slovenia, CNSTN from Tunisia and CNESTEN from Morocco) followed by 3 others Affiliates during the first semester of 2017 (BATAN from Indonesia, COMENA from Algeria and JAEC from Jordan). Some first scientific and technical topics are now going-on giving some concrete examples of collaboration. The paper will present in detail the CEA offer as an ICERR, the template agreement and it will describes, as examples, some first scientific and technical actions recently launched with the Affiliates.

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Instructor : a key role for the development of a competence workforce

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It is obvious that instructors have an essential role in the development of the skills of a nuclear operator, by the explicit knowledge they impart to the students. But their role is also essential by the tacit knowledge they convey, through behaviours and messages that they deliver, which must be consistent with standards and expectations of the company. This is why great attention must be paid to the recruitment and professionalisation of instructors. When EDF began to staff up its nuclear fleet, the choice was made to recruit young graduates engineers (masters level) in various specialties to reinforce its teams of instructors and work alongside experienced staff, experts in their field. This mix of skills and experience was very relevant, not only to carry out the training, but also for the development of expertise among these young instructors. Expertise that they can quickly put to use in their next posts, in operations or engineering in the EDF nuclear fleet. This is an additional feature of the EDF training system in that the instructors do not remain in their initial posts as instructors for long, typically 3 to 5 years. This is a part of their career development, which enables them to deepen their knowledge and develop new skills, before moving on to their next positions. The fact that several senior executives of the company started their careers as instructors, illustrates the success of this model.

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Competences management, a process dedicated to performance improvement

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EDF started the development of its nuclear fleet forty years ago. From the beginning, the question of competences management was central. EDF, alongside the growth of its fleet, has developed its skills management structure from local management to a management controlled nationally, but with close links with each site. This organisation of competences management is now fully part of the Integrated Management System implemented for the management of the nuclear fleet. This closed-loop process, based on the Systematic Approach to Training, involves all the relevant players at the different levels, from the first line managers on the plant, to plant and corporate managers, HR staff and the training organisation. Front-line managers constitute the first link of the process, as their observations of the activities carried out by their staff in the field, feed the skill maps of their team. Then the data is aggregated to ensure their control at the department level, site level, and finally, at the national level. These different levels ensure a coordinated and effective response in matching resources to needs, to career path management and in dealing with any competence deficits. This strong organisation of competences management, applied from the first level of management to the corporate level, contributes to the reinforcement of nuclear safety through a strong commitment of the staff involved.

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E-learning course for the Implementation of Knowledge Management Techniques for Nuclear installations certified by ISO 9001 Standard.

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In 2015 a new version of the ISO 9001 Standard was approved, which for the first time includes a mandatory requirement on Knowledge Management From now on, all organizations in the nuclear sector wishing to certify their QMS under the ISO 9001: 2015 Standard must integrate Knowledge into their key processes. In Argentina, all major nuclear organizations, such the NNP operator "NA-SA", the D2O Production Company "ENSI", the UO2 Conversion Plant "Dioxitek", the manufacturer of fuel elements "CONUAR-FAE" and many laboratories and installations of the R&D institution "CNEA" must re-certify their QMS before September, 2018. In order to face this challenge together with the urgency in handling the risk of loss of knowledge product of the retirement of senior professionals, we are currently working on the design of an E-learning course for the Implementation of Knowledge Management Techniques for certified Nuclear installations. Our new E-learning proposal will focus on IT techniques to preserve knowledge based activities and will include exercises to practice Tacit Knowledge Capture Techniques. After years of experience we have noticed that E- learning techniques are good for attracting the young generations only if the academic proposal is based on more audiovisual content. Our proposal will include tools to make Tutorials, based on the results of the Tacit Knowledge Capture Techniques and the use of free-online apps like "Lucidchart" or "Picktochart" to re-write QMS procedures in a modern visual language. We believe that this approach will encourage senior knowledge based workers in participating without feeling reticent to share their experiences, and will collaborate in knowledge management transfer.

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A Framework for a Robust, Coordinated & Sustainable Human Resource Development Strategy to Support Responsible Nuclear Energy Programs

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The success of global nuclear energy expansion requires interested states to staff related programs with highly capable, deeply knowledgeable and qualified professionals. In addition, this success also requires an understanding of both the individual needs of responsible operation of nuclear energy programs (e.g., human health safety obligations and regulatory security requirements) and how their interactions can impact overall nuclear energy program performance. As a result, there is a need to help states create robust, coordinated and sustainable human resource development (HRD) strategies to support responsible nuclear energy operations.

In response, invoking key tenets of systems theory and organization science provides the basis of framework to help guide national-level responsible nuclear energy program HRD strategies: interdependence, emergence and hierarchy. Together, these three tenets provide a lens through which to organize interactions between opportunities to meet responsible nuclear energy program operational needs into a robust, coordinated and sustainable national-level HRD strategy to support responsible nuclear energy operations.

An associated framework is based on five key attributes: (1) requirements-centered (based operational needs); (2) dynamic (evolving to address changing needs); (3) flexible (matching scope to needs); (4) scalable (matching size to needs); and, (5) balanced (leveraging the full suite of opportunities). This framework also helps organize the various International Atomic Energy Agency (IAEA) opportunities and explain their ability to support responsible nuclear energy operations. Additionally, this framework could help guide the evolution of national-level HRD strategies through different maturity milestones (e.g., basic awareness raising to collaborative R&D) as exemplified by the legacy of projects supported by the Center for Global Security and Cooperation at Sandia National Laboratories. Ultimately, this framework could help translate lessons learned into best practices to create robust, coordinated and sustainable national-level HRD strategies in support of responsible nuclear energy operations. (SAND2017-12882A)

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New Qualification and Training system for Inspectors in Japan

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The Nuclear Regulation Authority (NRA) established Human Resources Development Center (HRDC) in 2014 and the HRDC has been tackling with the human resource development for NRA staff as its important mission.
In 2016, NRA received the Integrated Regulatory Review Service (IRRS) mission conducted by IAEA to review the Japan's regulatory framework for nuclear and radiation safety. In the IRRS mission Report, necessity of improving a training system for inspectors was identified as one of suggestions. As a response to this suggestion, NRA first established a new qualification system in 2017. Now a new training system combined with the qualification system is under development for its starting in 2018.
HRDC's activities focusing on the new training system are described in the paper.

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Using STPA, Systems Theoretic Process Analysis, as a learning tool

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We live in a time where people are constantly connected to the world. Being connected seems so natural. Yet, most people do not realize their jobs are part of a system with national and global connections, and their decisions affect, and are affected by, other components of this system.
The understanding of how these connections work is essential for strong security and safety cultures. For example, one of the security culture indicators for personal behavior is vigilance. But, knowing that we should be vigilant is not enough unless we know what we should look for. In this work we discuss the use of STPA – Systems Theoretic Process Analysis, as a tool for training and continuous learning. STPA is based on systems theory and STAMP – Systems Theoretic Accident modeling and Processes. In STAMP safety and security are emergent properties that arise as a result of the interactions between the components of the system.
STPA can be a powerful tool to help the personnel make sense of the connections between their jobs and their organization and beyond. The system is modeled as a hierarchical control structure, where the higher levels control the lower levels behavior.
The process of building the control structure is dynamic. It is necessary the collaboration between members from different departments, and even different organizations. The hierarchical structure shows the roles, or functions, of the components, including features such as responsibilities, process model (or mental model), types of control actions (or decisions), feedbacks, and other flow of information that could impact decisions.
One interesting contribution of the STPA study is the identification of the common features between security and safety cultures as part of the organizational culture, and the role of leadership in the process. Some examples are provided to illustrate the benefits of STPA as a learning tool.

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EDUCATIONAL COURSES TO DEVELOP AND SUPPORT THE NUCLEAR WORKFORCE IN NIGERIA

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Nigeria has developed a mechanism to educate and train the workforce needed for the National Nuclear Power Programme (NNPP) which is implemented through national institutions and bilateral/multilateral co-operations. Nine universities and two polytechnics are designated to support the NNPP. With Nigeria Atomic Energy Commission (NAEC) as facilitator, curriculum for Nuclear Science and Nuclear Engineering at the Bachelors /Masters levels;and for the National Diploma/Higher National Diploma (ND/HND) levels has been developed and being implemented. The implementation is tripartite: 3-month bridging programmes in nuclear science and engineering to train and convert physical scientist and engineers to start careers in Nuclear Industry, ND/HND programmes to train technicians and technologists and Degree programmes for engineers and scientists. ND is 2 years for engineering and physical sciences while HND is 2 years after at least one year post ND industrial attachment; Bachelors is 5 years for engineering and 4 years for science while Masters is 1 year for Nuclear Engineering and Nuclear Science. Diploma courses are mainly practical and are skill based while degree courses are theoretical and are knowledge based. The education programmes through the national institutions has generated 33 graduates with Masters in Nuclear Science and Nuclear Engineering while 20 graduated in both courses through bilateral co-operations. 14 graduates from the national institutions and 6 graduates from the bilateral co-operations are currently undergoing PhD programmes outside the country. In addition, over 20 staff are currently undergoing Masters in universities within and outside the country. These staff will form the faculty staff in the universities and trained for specialised skills for the NNPP. The educational courses are gradually bridging the current manpower limitations across the institutions, enhance critical educational infrastructure development and positioning NAEC to build the needed capacity to meet its manpower training obligations.

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A Case Study: Applying Expert Solutions to Today´s Knowledge Challenges using Nuclear Technical Cooperation Data in Brazil.

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The nuclear industry has been knowledge-based since its inception. The present generation is the owner and custodian of this body of nuclear knowledge. Several education and training programmes have been set up to maintain the nuclear knowledge bank. These programmes were intended to ensure that there are suficient numbers of suitably qualified employees, at all levels, to sustain decades of research and development of nuclear technologies, for both power and non-power applications. In Brazil, many multidisciplinary nuclear professionals from the National Nuclear Energy Commission (CNEN) have been encouraged to go abroad to gain further knowledge and experience, thus building capacity relating to the use of nuclear science and technology for sustainable socioeconomic development. The national development of knowledge in the field has been monitored within the standing policy of the nuclear sector. This is done under the government umbrela which is in charge of approving professionals who wish to go abroad for training. The implementation of the program and all the staff documents are processed in the International Relations Office (CGAI) at CNEN´s Headquarters and are forwarded on to the central government in Brasília. With this process, CGAI has built a data base where intellectual capital is preserved. This data base facilitates the immediate access to the talent bank in the institution. This paper maps the profiles of all of the professionals from the National Nuclear Energy Commission and its Institutes who have had nuclear assignments abroad since the year 2010.

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MAINTAINING THE NUCLEAR HUMAN RESOURCE AT VINATOM: CURRENT STATUS AND RELATED ACTIVITIES

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Viet Nam has decided to cancel its nuclear power plant projects. However, the national nuclear energy program for the application in various areas including industries, agriculture, healthcare, education and research has been continued. Recognizing the importance of the HRD, Vietnam Atomic Energy Institute (VINATOM) is considering how to address this issue in an attempt to maintain nuclear human resource. This paper describes the current status and activities related to human resource development in nuclear energy in general and in VINATOM in particular.

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Organizational Change Development and Employee Engagement

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Ignalina Nuclear Power Plant has, for a number of years, been in a transition from operation to decommissioning. This strategic transformation is being approached not so much as a "period" but as a "process" leading to substantial organizational changes and significant challenges in change management, and employee engagement. Once the decision to decommission a nuclear power plant is taken, a determined, result driven senior management team should be established and this team should give their full commitment to ensuring the success of the transition from operation to decommissioning. The integrated structural transformation strategy should be prepared well in advance. An early thorough analysis and top management commitment to long-term personnel planning for the whole decommissioning period is of paramount importance. Equally important is the identification of suitable personnel for key positions and developing them within the new organizational structure. Setting challenging, incentivized, project delivery targets within a framework of high standards and good governance fully supported by senior management should form the basis for achieving good performance and creditable results. Development of an employee recruitment and retention strategy, and the required training and retraining for new decommissioning activities, should be ensured. An employee engagement survey serves measuring staff satisfaction, motivation and engagement for further decommissioning. Finally, proper internal communication ensures staff support for constant changes and high employee engagement. It may be concluded that the transitional challenges on change management and employee engagement are more complex to solve than the technical issues.

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Progress of Teaching and Learning in the Undergraduate Program of Nuclear Engineering at Polytechnic School, Federal University of Rio de Janeiro (UFRJ)

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Now in the 21st century, the nuclear sector is in dire need of more qualified personnel. Numerous engineers who have been playing vital roles in researching and developing nuclear technology in the international community are reaching retirement age. Developing a continuous human capital in nuclear with required ethical behavior, nuclear background and professional qualifications is necessary to support the implementation of nuclear power projects. Sufficient educational and

training skills are required to ensure that the human resources needed by the nuclear power industry meets a high standard. The Government of Brazil has made the decision to increase its nuclear education and training program with the creation of the first bachelor degree in nuclear engineering as another educational option for the nuclear activities in the country. The Federal University of Rio de Janeiro (UFRJ), in tandem with the government initiative to promote nuclear knowledge, is taking the responsibility in developing human capital in the area of nuclear power and technology for supporting the national nuclear safety and security frameworks. This paper describes the progress of teaching and learning in the newest nuclear engineering undergraduate program and the teaching staff at UFRJ.

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New ways of learning at NPP – Value drivers and lessons learned from VR simulators, interactive 360 video and other new ways of competence building

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This Fortum presentation will describe how newest digital technologies (VR, AR and interactive 360 video) are used to improve the efficiency of training at Nuclear Power Plants. It will present practical, easy to implement examples, that can be applied into practice by different Nuclear stakeholders: NPP owner & operators, new build projects & engineering , plant & equipment vendors, training & simulator service providers. The systematic development initiated at Loviisa NPP 2015 has resulted in a rapidly increasing number of different use cases for these new ways of learning. They range from simple contractor training before maintenance into systematic, well in advance planned, virtual reality control room simulator training. As the technologies mature and we get more and more experience on applying them, we learn what works and what not. We learn where are the low hanging fruit where organisations should start and what is required to build more extensive training programs.

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GHANA'S NUCLEAR POWER PROGRAM: STAFFING THE NUCLEAR REGULATORY AUTHORITY PROGRESS AND CHALLENGES

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Ghana's quest to deploy nuclear energy as part of the energy mix, demands for a tailor-made approach to education and training of personnel to effectively provide regulatory oversight of the entire phases of a nuclear power programme. Ghana has since the promulgation of the Nuclear Regulatory Authority Act, 2015 (Act 895), established an independent Nuclear Regulatory Authority (NRA) with its functions and responsibilities defined. The law provides for the regulation and management of activities and practices for the peaceful uses of nuclear material or energy, radioactive material or radiation; the protection of persons and the environment against the harmful effects of radiation hazards and to ensure the implementation of the country's international obligations and for related matters. To ensure the functionality of the regulatory authority, an action plan has been drawn covering human resource development. This paper seeks to highlight the approach adopted by the NRA to capacity building of staff for Ghana's planned nuclear power programme.

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From Education to Employment- Attracting,Recruiting and Retaining a high quality nuclear workforce

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The UK is experiencing a nuclear renaissance. Constructing and operating new stations and decommission the existing fleet will require a sizable skilled workforce therefore Inspiring and recruiting the next generation and retain a sustainable workforce is critical to success and core to the UKs future strategy. The need to create a sustainable workforce is no easy task. The widening skills gap caused by low numbers of young people following careers in STEM industries (Science Technology engineering and Maths) coupled with the imminent retirement of an ageing workforce in the nuclear industry provides and interesting national and global challenge. To support the nuclear programme the UK is devising strategies with its supply chain to address this. And in particular EDF Energy is leading the way in the development of a unique progressive pathway from education through to employment that we are confident will not only deliver the diverse workforce needed but create a sustainable legacy once the station is complete. Hinkley Point C, the first of the potential new fleet of nuclear power stations planned for the UK, requires a workforce with skills that either do not currently exist or exist but not in the quantities required. Reaching over 5,000 at peak and more than 25,000 opportunities over the period of construction alone, inspiring and developing the next generation is critical. The increasing demand for these skills sets coupled with a lower take-up of STEM (Science Technology Engineering Maths) subjects, is contributing to a critical future skills gap. To meet this need EDF Energy have developed a unique progressive pathway from education through to employment that we are confident will not only deliver the diverse workforce needed but create a sustainable legacy once the station is complete.

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Leading Innovative teams; a virtual reality case study.

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The topic of innovation has often been labelled a “buzzword”. Something that attempts to offer businesses a competitive advantage but in reality, fails to deliver tangible outcomes Conversations around innovation have historically focused on the importance and need of innovation. It’s a word that brings a lot of expectation to leaders and their employees but what is lacking from most books, blog articles and videos is a focus on how to innovate. Without focus it can become arbitrary and in some cases confusing. Organisations not only need to create a culture of innovation, where usual ways of working are challenged, and new ideas are generated but they need to address the skills and competencies associated with innovation; thus creating a roadmap for employees to develop. The people plan for innovation needs to aligned with the wider company strategy – only then are teams able to allow innovation to thrive. This presentation shall address the following: • How to innovate: using examples from within EDF Energy • Setting up a strategic approach to innovation: by using a virtual reality (VR) case study that was used within EDF Energy’s nuclear fleet we will discuss a methodology for teams to innovate in alignment with company strategy • Enabling teams to innovate: How you can set up your team and enable innovation

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Readiness and perception of Sri Lanka for using nuclear energy as a cleaner energy to meet the power crisis in Sri Lanka.

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In early 1990's hydro-power contributed to 90% of electricity requirement in Sri Lanka. However, due to increase in demand, the situation has changed drastically. currently 90% of power in Sri Lanka is generated from thermal power and 10% from hydro-power. To evaluate the possibility of replacing thermal power usage in Sri Lanka with nuclear power as cleaner energy , structured questionnaire interviews and direct discussions with stakeholders were conducted to understand the perception of peoples towards the use of nuclear energy and readiness of Sri Lanka for using nuclear energy. Stratified random samples from Government and private sector officials, communities in urban and rural sector and women groups were selected for the study. Total of 400 individuals were interviewed for the study from 3 provinces in Sri Lanka and data was analyzed using SPSS package. Result reveled that the awareness of existing of nuclear energy as power source in the world is 19% and 64% in rural and urban sector respectively. Acceptance of use of nuclear energy as power source is only 16% in urban sector and 9% in rural sector. Being an island unavailability of escaping route if the nuclear disaster happened was the main reason for rejecting the use of nuclear energy in both urban and rural communities. Among the officials in government and private sector, 74% of graduates in science stream was positive about the use of nuclear energy as power source as a solution for the present power crisis. among the positive respondents 83% preferred small scale power reactors. 3% of respondents expressed to seek the possibility of using nuclear fusion type reactors if available. Based on the results it was concluded awareness creation is very essential among all the officials and communities for future use of nuclear energy in Sri Lanka.

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Recent challenges in Mongolian nuclear workforce

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In Mongolia, specialists in nuclear field have been prepared at National University of Mongolia since 1967. Up to now over 200 graduates were graduated by majoring in nuclear physics and technology and they work for radiation regulatory body, hospitals, mining companies, universities, research institutes and high schools. In order to implement the state policy on radioactive minerals and nuclear energy in Mongolia which was adopted by the Government of Mongolia and Mongolian Parliament in 2009, educational program on nuclear energy for preparation of human resources in domestically was started at National University of Mongolia since 2012. However after two years, it was needed to change the index for educational program as "Nuclear engineering" which have to be coordinate with UNESCO index due to request of Ministry of Education, Culture, Science and Sport of Government of Mongolia. It can say that the current Nuclear Engineering program is a kind of mixed program of nuclear power and nuclear technology. In 2016 Mongolian Parliament was adopted "Sustainable Development Concepts-2030", which stated that the nuclear energy will be utilized in Mongolia from 2030. In addition, the human resources on nuclear technology would be needed in near-future labor market due to growth in mining company and establishment of new hospital with particle accelerator in Mongolia. We estimated the number of required nuclear workforce who work for 600 MW NPP in Mongolia from 2025 in our previous study. Based on this estimation and to prepare nuclear workforce in nuclear application sectors and nuclear energy field which are needed in near-future and far-future, we proposed two separate educational program "nuclear engineering" and "applied nuclear physics" at bachelor level which are compared to those of other countries.

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BUSINESS ACUMEN SIMULATIONS FOR TRAINING OF NUCLEAR LEADERS

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INBEx (Institute for Nuclear Business Excellence) has developed nuclear business simulations to train decision-making and to improve communication across disciplines decision-makers in the nuclear industry. Two versions are offered, for new-built plant and for aging plant. A similar simulation for planning of nuclear decommissioning is underway, as well as for Nuclear new-build roject management.
Instead of traditional presentation-based training, these simulations are centered around simulation of real-life challenges. The participants work in teams of 4-6 and try out what it is like to be the CEO of a nuclear power plant. The team defines a business strategy, takes strategic decisions (upgrade or keep in present condition?), plan regular work like outages, perform improvement projects, and last, but not least, handle a variety of unexpected events.
This simulation was originally developed as part of the leadership program of a utility. Today, it is used all over the industry, including supply chain companies and regulators. It has been used with excellent client satisfaction for executives as well as younger potentials.
Participants from nuclear power plants testify that their understanding of the complex reality has improved significantly. They take better decisions afterwards and communicate better across organization. Participants from companies in the supply chain commonly express that their communication with their client has been taken to a higher level. Participants from regulatory authorities claim they have got a deeper understanding of the challenges in industry, and how this affects the relation to the regulator.

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PLAYING GAMES FOR TRAINING OF NUCLEAR SAFETY EXPERTS

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Participant-active training of handling transients, ranging from minor perturbations to severe accidents, in nuclear power plants has been developed based on games, simulations, scenarios and role-play. Initially intended for staff at nuclear power plants and the regulator, the concept has been extended to competence development of academic teachers.
Typically, each session of a course begins with a brief introduction to a challenge, i.e., a game, a role-play, a scenario, a case, or some other exercise, after which the trainees work with the challenge anywhere from ten minutes to an hour depending on the challenge. When completed, there is a de-briefing session that can last from a few minutes up to an hour, in which the participants present their result and the course leaders provides feedback. It is not uncommon that these feedback sessions contain “spontaneous lectures”, motivated by questions from the participants.
Our experience is that this participant-active methodology results in significantly deeper Learning than traditional lecture-based training. This conjecture is corroborated by testimonies from participants.

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Self –Rostering: A Tool for Effective Service Delivery among Working Women in the Federal Polytechnic, Bida, Nigeria.

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Abstract Quite a handful of empirical works exist on work and family relationship, much of which centred on how to establish a work-family balance. Contrarily, a self-rostering approach

for attaining work-family balance particularly as it affect the Nigerian work situation has been under-reported. This study aimed at highlighting this concept in the light of managerial decision making as regards flexibility in job environment and the attendant enhanced service delivery among working women in the Federal Polytechnic, Bida. The study identified three (3) major factors as responsible for adopting such approach these includes; family factors, organizational factors and management desire for high commitment. Data was collected from 151female staff of the Federal Polytechnic, Bida Nigerian. Convenience sampling method was employed, while Krejcie and Morgan (1970) table was used to determine the sample size. The respondents are required to rate the levels of self-rostering influence based on the 5-point likert scale. Data collected was analyzed using computer software; SPSS and results reported in frequencies, means, correlation analysis and multiple linear regressions. The correlation coefficient analysis showed that self-rostering constructs are statistically significant at .01 level of significance, while the multiple linear regression analysis showed that family factors and management desire for high commitment with a.262 standardized beta coefficient are the most important factors influencing self-rostering adoption in the Federal Polytechnic, Bida Nigeria. Keywords: Conflict, Family, Flexible working hours, Bida, Nigeria

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Nuclear Education & Training for Stakeholders following the Milestone Approach and Nuclear New Build Supply Chain Perspective

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Skilled and competent workforce is a necessary pre-requisite for the safe and efficient introduction , implementation and expansion of a nuclear power programme (NPP)
This paper will highlight that the task of educating and training students, professionals and leaders is not solely to prepare them to work in a nuclear power plant, but importantly also to train human resources to support other organizations that require skilled and competent personnel in nuclear and other related fields, including Government agencies and Ministries, Business and Industry, Academia, Research Organizations, Financial sector, International agencies and media agencies, amongst others. As nuclear education and training (E&T) stakeholders deliberate and discuss to identify suitable syllabus and courses to offer for education and training to support NPP, it is critical that the milestone approach as well as the nuclear new build supply chain is taken into consideration in the identification and introduction of relevant courses by Universities and Institutions to nurture and educate skilled manpower in the planning, construction, manufacturing , commissioning, operation and maintenance and decommissioning for the nuclear power industry. Thus, it is within this context , that this paper will outline best practices in nuclear education and training offered by the United Kingdom the trailblazer of nuclear power in the 1950s and now restarting its nuclear new build which covers training students, professionals, leaders , technicians as well as craftsmen not only for employment in a nuclear power plant but also for supporting the nuclear policy formulation in Government Agencies and for supporting nuclear power industry sectors including engineering , construction , manufacturing and services. Malaysia's experience in identifying and introducing training courses for working professionals will also be outlined.
This paper will offer recommendations for enhancing cooperation in nuclear education and training aimed at building synergy amongst the international member countries

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Ghana's Nuclear Power Agenda: The Impact of IAEA Support and Need for Further Strengthened Collaboration

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Dr. Hans Blix on March 8, 1995 during the inauguration of the Ghana Research Reactor 1 (GHARR-1) stated the IAEA's resolve to make every efforts to consolidate and strengthen collaboration with Ghana with the focus on promoting the peaceful use of atomic energy to contribute to the health and prosperity of the people of Ghana.
Since Ghana became a Member State of the IAEA on September 28, 1960, Ghana's nuclear programme has spanned a wide spectrum of activities, the result of which has lifted the country to the forefront in many areas of applications of nuclear techniques. Much of the IAEA's collaboration with Ghana has typically included capacity building, expert assistance, and equipment procurement. IAEA assistance to Ghana has been widespread and far-reaching, spanning areas such as agriculture, health, water resources, reactor technology, radiation protection, and nuclear power infrastructure development.
In regards to nuclear power infrastructure development, the IAEA through its various projects, in particular the National Technical Cooperation (TC) (GHA2001 – 2003) projects, and regional and interregional nuclear power projects, such as RAF2010 and INT/2018 have strongly supported Ghana in its nuclear power infrastructure human resource development, and in particular, the nuclearization of various personnel from stakeholder institutions of the Ghana Nuclear Power Programme Organization (GNPPO).
This paper presents a general snapshot of the effect these IAEA projects have had on Ghana's nuclear power programme, and provide an opinion on how these different projects could be strengthened to make them even provide better impact for the country, and possibly other newcomer member states.

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The Role of the Organizational Culture in the knowledge Management for the Human Resource Development

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Global competition and rapid changes in technology demand more innovation in organizations. Such an increase in innovation depends on developing the capabilities of employees and providing them with knowledge management support that accelerates learning and discovery. Knowledge Management is the way to improve the conditions of stability of organization and it is considered one of essential developer Human resources to increase the human being ability of fulfill their responsibilities by growing their competence. Building employees' skills and knowledge is an investment in each employee and in the future of the its organization. This building must be the competence of its staff integration, its safety culture, the essential to ensure competent human resources as required in the IAEA safety standards and other documents, in which the need and importance of ensuring human competence is emphasized. Organizational culture was one of the interesting and important issues of organizational behavior. The organization's culture is play an extremely important role for increasing the knowledge management in nuclear industry. A 'knowledge-sharing culture' is believed to be inherently good because of the growing importance of intellectual capital to organizations and the need for effective knowledge management practices. Therefore, cultures which inhibit knowledge-sharing are widely considered to be significant barriers to creating and leveraging knowledge assets. Installing a knowledge-sharing culture is thus a necessary prerequisite for organizations that believe that it is a significant way to differentiate themselves. Type of organizational culture can be a guide to encourage the knowledge management implementation strategy and programs. This paper investigates the relationships among organizational culture (OC) and Knowledge Management (KM) and describes the process to determine the organizational culture and suggestion future culture for implement knowledge management in nuclear industry.

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Nuclear Energy Challenges in this Century

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The past fifty years have witnessed the advent of a new energy source and the beginning of yet another in the series of energy-use transitions that have marked our history since the start of our technological development. Each of these transitions has been accompanied by adaptive challenges. Each unique set of challenges has been met. Today the world faces the need for another transition. This paper outlines some of the associated challenges that lie ahead of us all, as we adapt to this new and exciting environment. The first step in defining the challenges ahead is to make some form of prediction of the future energy supply and demand during the period. Herein, the future up to 2010 is presumed to include two major events – first, a decline in the availability and a rise in price of petroleum, and second a need to reduce greenhouse gases in our atmosphere. Both of these events are taken to be imminent. Added to these expected events is the assumption that the total of wind, solar, and other such energy sources will be able to contribute, but only in a relatively small way, to the provision of needed energy to our ever-expanding human population.

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Qualification of Non-Destructive Testing personnel for the inspection of nuclear plants

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Non-Destructive Testing (NDT) of components, assemblies, and structures is required by the design codes of nuclear plants. It ensures the safety and reliability of the plant by detecting, characterizing, and evaluating the defects that can cause catastrophic failures, moreover; NDT is essential for the plant's life assessment programs. IAEA has been promoting NDT technology in the Member States through national and regional Technical Cooperation projects. The efforts of the IAEA have considerably contributed to the harmonization of training and certification of NDT personnel to standardize the human factor. However, the standardization has not specifically addressed the training of personnel who perform NDT in the nuclear sector constructions, nor those who perform, administrate or analyze in-service NDT for plant's maintenance and life management. This paper reviews the current strategies of the NDT personnel qualification for the inspection of nuclear-grade constructions and discusses the importance of collaboration among them. Moreover, the paper discusses the need for dedicated and systematic schemes to qualify personnel for the NDT applications to the in-service inspection and Plant's Life Management.

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Leading the Workforce by Fostering a Safety Culture

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Nuclear organizations are generally at the frontier of knowledge in terms of technology, but when it comes to risk perception they tend to underestimate all those factors not directly related to ionizing radiation. To shift that tendency, is imperative to promote the participation of the entire staff in the safety activities.

Frequent concerns about the fringe benefits of an employment are often 'how much is the salary?', 'how much vacation is offered?', 'may I work from home?', but it is rarely asked in a job interview, 'what is the safety policy?' The dearth of understanding about how valuable a safe work environment is, can easily show us how distant is our behavior from an appropriate safety culture.
It is common to hear in trainings and meetings that safety depends on all the staff. Nonetheless, some safety activities are often seen by the management as only a series of indicators that we expect to decrease year by year; and on the part of workforce, are considerate as a series of procedures, or solely as the lack of accidents. On the other hand, it is an undeniable fact that regulatory agencies do their work efficiently most of the time, but frequent checks are not neither enough.
Addressing some of these biased and rooted prejudices in the workplace about risk perception is a tough task that will take time and will imply also a big commitment from the whole organization. To make it, the key is leading by promoting the involvement of the workforce. How do we do it? We must make the safety culture part of each element of human resources management, by involving it in each activity of the institution or organization. Achieving good safety standards will only become a reality if we make safety a clear benefit for all workers.

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Building the Sudan Nuclear regulatory body competency

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This presentation gives information about the current status of Sudan nuclear power program in relation to the HRD planning, with emphasis on the nuclear regulatory body. It presents the efforts done by Sudan NEPIO to plan for the workforce needed by the main organizations and stakeholders in Sudan, which are the owner/operator, and the regulatory body. Moreover, the presentation talks about the main features of the draft HRD plan prepared by a consultant and the role of the national team to improve and implement this plan. It provides the vision on how Sudan nuclear regulatory body working to achieve a mature HRD plan according to the IAEA standards and presents gaps to be filled, types of assistance may be needed from the international atomic energy agency(IAEA), and needs; included the need for using a state-of-the-art modeling technique for planning and implementation.

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Challenges and Options for Delivering the Right Skills for Kenya Nuclear Industry

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With its NPP, Kenya must focus its attention on the human resources question – How to build and sustain a competent nuclear workforce. The challenges of building Kenya nuclear skills base are very significant. Kenya's existing expertise lies primarily in the other uses of nuclear technology (general engineering, nuclear sciences, physics, chemistry etc.), rather than NPP Technology. Kenya will need to re-skill workers or attract new skills to meet the changing workforce needs. Many of the Kenya best potential nuclear students/experts proceed for higher education in developed countries higher institutions of learning. They acquire specialized advanced skills, but their return to work in Kenya sector is not guaranteed, leading to high brain drain. These highly trained and skilled expert opt working abroad where they consider more rewarding. Statistics from Government shows that between 500,000 and 1.8 million Kenyans work overseas, although their skills are much needed locally. Although more than 30,000 Kenyans leave for higher studies overseas, less than 9,000 of them return home on completing their learning. Nuclear sector must attract its fair share of the potential nuclear experts. Nuclear sector will likely also need to

source talent from overseas to meet the demand. Fewer skilled specialists will be needed. Yet as these workers take between five and twenty years to develop their skills, they may prove more difficult to source. Creating a pipeline to foster these skills, coupled with processes to accurately predict potential skills shortfalls will be vital. The Government must set ambitions, including clear goals, for delivering a sufficient, high-quality and diverse nuclear workforce in the sector that is renowned globally for its professionalism, experience and excellence.

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Organizational Cultutre for Safety as a Regulator of the Performance

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The main function of an organizational (and not only organizational)culture is to regulate behavior of the organization members. The cuylture implements it through regulators. Safety Culture as an a part of the organizational one develops work competences for safe and qualitative performance. Each organizational culture regulates human performance.. We could enumerate a set of those organizational regulators, for example, requirements, procedures, manager's expectations and so on. Each regulator influences on the personnel reliability and finally on the work performance. So, effectiveness of a regulator contributes into minimization of inappropriate work performance risk. There are four main levels those organizational regulators are contributed: society\government, organization, team, individual. Each area consist of following typical regulators. 1.Society\Government level:moral,duty,behavior stereotypes,traditions,visions,legislation, requirements of regulatory body,contract requiremens. 2. Organization level: values,moral norms,policy,goals and strategies, activity motives, leadership,senior manager expectations, traditions, instructions, procedures, man-machine interface standards, training, other organizational factors, like organizational knowledge, communication ways, decision making, resource allocation and so on. 3. Team level: values, moral norms,traditions,supervisors and line managers expectations, team work, group pressure. 4. Individual level: knowledge, skills, attitude (KSA), fitness for duty, behavior patterns, cognitive style, way to resolve conflicts and so on.
Safety Culture enhancement process should be realized in the organization to manage all regulators which contribute in the organization adheres business goals safely. Main goal of the process to form and ensure commitment to satety both on individual and organizational levels.

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Safety Culture Enhancement Integration into TVEL Fuel Company Management System

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In accordance with IAEA standards Safety Culture enhancement activity should be integrated into the nuclear organization management system.

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MANAGEMENT OF HUMAN RESOURCES IN THE DATA-BANK.

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ABSTRACT. The Databank is an iterative network management system created for the development of nuclear/radiological regulatory authority (NRA) and its technical support organization (TSO). It consists of four separate and inter-dependent management systems; information systems, management of human resources, management of evaluation processes, and management of improvement processes. Management of human resources is the second important component in the DataBank after the management of information systems. The present work discusses the methodology of human resources management adopted and its principles. This methodology selected is considering, partially, some various international management techniques. However, mainly, it based on ranking the employees in different groups; scientific, regulatory, technical, interface network, chief-leader, consultant, and advisory groups. This first classification is done according to their scientific educations and desire. According to performance recorded and analyzed by the reports of DataBank cycles, the employees in the groups are rearranged. The rearrangement process shall locate the appropriate worker in the right place to gain its highest performance efficiency. Additionally, this methodology helps to overcomes problems of overstaffing, and lack of employees in scientific/work fields.

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'Embedding Knowledge Retention & Transfer processes within a nuclear new build organisation

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The identification, capture and transfer of knowledge are common objectives found in formal Knowledge Management (KM) programmes. Nuclear new build projects present a number of distinct challenges and opportunities with respect to knowledge retention and transfer (KRT), challenges associated with very long project life-cycles spanning development, construction, operation and decommissioning and with those timescales inevitable workforce churn; and potential opportunities afforded by the implementation of dedicated, targeted KRT processes from the outset of the new build project and the new project organisation. Taking the UK based new build organisation NuGeneration (NuGen) and its Moorside Project as a case study, this paper outlines an approach to embedding KRT processes within the organisation. In particular, the paper outlines the scope and drivers for a proactive, continuous, approach aimed at embedding appropriate actions throughout an employee's tenure within the organisation. Such an approach seeks to avoid the pitfalls and limitations associated with more common, reactive, KRT that is triggered by the pending departure of an employee, or employees, from the organisation. The KRT approach and supporting processes that are set out within the paper are first described within the broader context of the Moorside project, UK regulatory expectations with respect to KM, and NuGen's overall KM Strategy. That strategy provides a framework for supporting other key functions, processes and behaviours within the business such as those associated with on-boarding, competency management, career development and succession planning; as well as providing a basis for supporting a knowledge sharing culture. In keeping with the Moorside project overall, the implementation of the NuGen KM strategy and the KRT processes are still in their early stages. Reflecting this maturity level, the paper concludes with a summary of lessons learned to date and the next steps in embedding, effectively, rigorous and sustainable KRT.

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Visualization in nuclear training

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Large numbers of terms, formulas, graphs, schemes etc. characterize scientific disciplines related to the nuclear industry. This fact especially important to be taken into account in high-school children and young students training. Young people prefer simple visual data like movies, cartoons, electronic presentations etc. However, the count of this type of data in the world is increasing rapidly together with decreasing interest to it. Fortunately, some information could be presented in hard-copy training materials and will not be missed in electronic content. The usage of modern technologies allows to increase effectiveness of nuclear training. It is proposed to use 3D-printing to visualize objects, which are used in nuclear industry (see Fig.1), for supporting of the better understanding of their function. Another approach is to use visual games (puzzles, table quests etc.) for involvement of young students to the learning process. Both described methods is focused on the explicit knowledge obtaining. These teaching techniques together with standard lecturing, case studies and students' research projects are used in Physical-Energy Faculty of V.N.Karazin Kharkiv National University for the first-year students. As a result, the interest to the nuclear energy is higher than to the other energy disciplines.

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Establishment of the Center of Excellence for Nuclear Reactor Technology in Ethiopia

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Ethiopian is implementing multi layered activities that would enhance the capacity of the nation in Science, Technology and Innovation and its effective application to economic transformation. Surely, the role of the peaceful applications of Nuclear Science and Technology and its associated tools over the years has proved to be determinant in addressing developmental problems in key socio- economic sectors; such as agriculture and food security, human health, water resource management, environment, radiation protection and industry. Because of many important and practical applications of the use of radiation being inevitable in human society, it is an urgent task to establish the education and research center relevant to Nuclear Technology and Engineering in this country. For the realization of this purpose, the first and most important is to establish a new department of Nuclear Engineering in Addis Ababa Science and Technology University (AASTU) and to start human resource fostering in terms of the systematically well-organized education program of both undergraduate and graduate courses. Simultaneously, a radiation research laboratory under the name of 'AASTU nuclear reactor technology center' equipped with stateof-the art experimental facilities, including a research nuclear reactor, is to be established according to the annual schedule of construction.

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THE IMPACTS OF "EDUCATION AND TRAINING" IN THE DEVELOPMENT OF NUCLEAR WORKFORCE FOR NIGERIA NUCLEAR POWER PROGRAMMES: CHALLENGES AND PROSPECTS FROM THE PERSPECTIVE OF A REGULATORY BODY

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Nuclear power is a source of great industrial potential in world developing economies; it helps to ease over dependent on fossil fuels and for energy mix, Nigeria has a good nuclear power program which has been going on for quite a while, the country hopes to have its first nuclear power plant in operation by 2030, and efforts to build a new multipurpose reactor of 10MW capacity are underway. To achieve these there would be great need for training of personnel and developing human capacity. Education and training nuclear power staffs and regulatory body

Inspectors are usually long and rigorous due to complexity, technical capability availability of experienced Inspectors to license Nuclear Power Plant (NPP) and safety aspects of nuclear power. It is therefore essential that the Nigerian Authorities prepares early in developing its nuclear regulatory expertise. There are several approaches to training and assessing the impacts of how well the training and education can achieve the objectives of developing critical workforce for countries with no experience in nuclear power, these are conducting feasibility studies, bench marking exercise, preparing long term human resources development, increasing exposure on nuclear power technology to management staff and other staffs who would have critical roles to play in regulating NPP in Nigeria, employing the assistance of relevant agencies and International partner for exchange programs, fellowships,scientific visits,and on the job training. This paper examines the activities, efforts and the impacts of education and training with emphases on how far the Nigerian Nuclear Regulatory Authority has trained its personnel and what is needed to be done based on the IAEA milestone approach and International best practices in the development of workforce for Nigeria's NPP. The various issues and challenges faced by the Regulatory Body and the Country in human resource development are discussed.

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How schoolbooks contents influence the understanding of radiation and nuclear concepts of pupils from EU countries

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Education on basic knowledge concerning ionizing radiation, nuclear energy and nuclear applications in high school is the first step to capture the interest of the young generation for the nuclear industry and the associated jobs. In addition, a well-developed education program for especially the young generation with a talent for science may trigger their interest in nuclear technologies to avoid a shortage of expertise and skilled manpower for future needs in regard with the NPPs to be built, the existing NPPs, their maintenance and their dismantling. A well-developed nuclear education program for highschool students could also be considered as one of the key factors in the governance of ionizing radiation risks. To understand how well high school students (aged 17-18) were educated on these topics, the European Commission within its Research Framework Program 7, launched the EAGLE project. The project intended to compare the content of education books, mainly Physics books, from the different EU countries (Belgium, Poland, Romania, Slovenia, France, Spain and the UK). To conduct a relevant comparison, the content of each book was screened first through its table of contents and the number of pages used for the development of each topic. This approach makes it possible to show the differences in teaching methods and how the nuclear concept is approached by high school teachers in the different EU countries. Although limited, the comparison of schoolbooks is definitely an indicator of the way the nuclear concept is viewed and explained in a specific country depending of the existence or the planning of nuclear programme and of its public acceptance. The presentation will explain the outcome of the comparison between the different EU countries and present the Eagle project recommendations on nuclear education.

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Educational potential and benefit of practical involvement of high school pupils in environmental radioactivity evaluation

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Since the nuclear accident of Fukushima Daichi NPP, the public worldwide has used IT tools and internet to understand the magnitude of nuclear risks in their environment. In particular, people

started to try to evaluate environmental radioactivity using all types of existing counters and to map their results. IRSN experts, who gave already, as part of the public education program, interactive lectures for high schools about radiation and nuclear risks, suggested that students could learn to use a variety of tools for environmental measurements. It was within this objective that IRSN proposed the RADON PROJECT including environmental radiation measurements with an interdisciplinary approach for high school students. During the project, high school pupils became aware about what radioactivity is and its associated risks. They developed their abilities to measure radioactivity levels in different environments, to understand the physics of radiation probes and their responses depending on the nature and level on ionizing radiation. They also interpreted the results in mapping them and used it to compare results to the regulatory limits or reference levels. Their results were thus disseminated to the public. This Educational Experiment with active participation of Teachers and Students and in partnership with SAFECAST or Openradiation proved to be successful and was further developed. In addition this project with high schools is at the same time a first step to trigger the interest of the young generation for nuclear physics and pursue a career in the nuclear field. This experience showed that appropriate technical support within an educational context helps fostering interest in citizen-based radiation measurements. At the same time it allows young people to develop a more accurate view of ionizing radiation. The basic knowledge acquired enables the pupils to discus and exchange with friends and family on radiation risks and emergency preparedness and response.

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Education Across Nuclear Silos

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Existing education tends to silo nuclear expertise, where science and engineering are taught separately from policy. Each of those siloes contains its own divisions among the 3S—safety, security and safeguards—as well as among energy and other applications. The separation of spheres of knowledge is a problem because the field would benefit from deeper knowledge about how nuclear science and engineering, safety, safeguards, security, and health applications reinforce one another. Major accidents have shown that risks can be compounded. Efficiencies and improvements can also be compounded through targeted interventions to improve power generation and the 3S. Individual career paths would be richer with possibilities spanning silos. As nuclear power production expands into new kinds of facilities and new applications, expert regulators in government and NGOs will need a view of the nuclear enterprise as a whole. This approach is not entirely novel. Nuclear newcomer states all have 3S regulators. The boundary-spanning high level education that can support these regulators is an advance if it identifies how the 3S plus power and other applications can be mutually reinforcing. Nuclear newcomers sometimes receive education packages alongside technology, and these education packages could be improved by a more holistic approach. We identify specific instances of mutually reinforcing initiatives across silos, and we offer a specific example of a graduate certificate that supplements nuclear science, engineering, policy, and international relations education with the knowledge and skills to transcend disciplinary boundaries, professional practices, and organizational cultures. The certificate uses project-based learning to allow students with different disciplinary backgrounds to collaborate on problems involving complex technical, diplomatic, legal, and policy challenges.

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Nuclear security start-ups activities in sub-Saharan Africa – a needs analysis

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Nuclear development activities in Africa has been from the well known natural radioactivity discovered in Gabon, west Africa. Furthermore, mining activities have continued to increase with china being a major player in the industry. This study uses a collection of specialist information

from World Institute of Nuclear Security and a classification of companies involved in nuclear security activities to give a basic assessment of the available resources and the needs. Some countries like Nigeria with regulatory body, at the time of this study, do not have any independent national or private company that provides consulting or technical services for nuclear security. This study also assesses the needs for start-up company, the market potential and the scalability of their activities. Histories of nuclear security threats coupled with data from GTD in some African countries will be assessed and used to benchmark threat levels. The higher the threat level, the higher the need for local and regional companies to provide these services. Some challenges like awareness and technology option is also addressed. The prospects of the nuclear security business provide a platform for promotion of manpower skills development. This will also increase the awareness about nuclear technology and its spin-offs. Government involvement as to the ease of doing business in these countries is also assessed in terms of the time and requirements to setup a company. The study presents a developmental needs analysis and could serve as a resource for integrated regional partnership platform for information sharing on nuclear security technology needs. The metrics can be used for technology companies to target their market appropriately. thus leading to increased local manpower development and enhanced cooperation.

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Needs Analysis of Nuclear power in Nigeria

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The large energy deficit in Africa is enormous, a recent data show Nigeria has one of the worse electricity supply it is more evident whereby more than 50% of the African population is still without adequate supply of electricity. The abundance of uranium resources in certain regions of Africa like Namibia and other select locations are enough to fuel the whole sub-region effectively although other countries with similar amount of resources are not utilizing it but are energy sufficient. As countries in Africa leap-frog into new low carbon development strategies, there is need to consider the nuclear option for a balance mix of technology, baseload and ramp load. This study will assess the economic, infrastructural and manpower resource in comparison with developed countries and new builds. The study looks at activities in some countries in Africa. It can serve as a reference for nuclear power risk analysis and investment channeling. It will also discuss successes in other energy infrastructure investments. The needs analysis metrics is derived from levels of progress in university programs in nuclear engineering, nuclear related activities, nuclear power road map or master plan, existence of a functional regulatory body. The need is also assessed with regards to performance in energy related investment programmes.

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COURSE DEVELOPMENT GRANT : AN APPROACH FOR ENCOURAGING FACULTY MEMBER INNOVATIONS IN NUCLEAR SECURITY DEVELOPMENT PROGRAM IN UNIVERSITAS GADJAH MADA

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In 2011, nuclear security had been introduced to Department of Nuclear Engineering and Engineering Physics of Universitas Gadjah Mada (UGM) which is the only university in Indonesia offering a nuclear-engineering curriculum. Since that year, the department committed to play the important role in the development of nuclear security culture in Indonesia, especially in human resources development. As consequently, the knowledge and participation of faculty member in developing nuclear security within the department is essential. In this regard, the department

offer a grant named "Course Development Grant for Enhancing Present Nuclear Engineering Courses with Nuclear Security Subjects" in 2015 and 2016 to encourage 4 faculty members per year to innovatively develop their present courses with nuclear security development subjects. This program was supported by Partnership for Nuclear Security (PNS)-USA, CRDF-Global, Texas A&M University (TAMU) and University of Tennesse-Knoxville (UTK). The grantees had to present their work in the department and also in an international nuclear security education forums, such as INMM annual meeting and International Conference on Nuclear Security of IAEA in order to improve participation of UGM in developing peace utilization of nuclear technology. Although there were only eight courses during 2 years, but this program had succesfully attracted the faculty members to enhance all possible present courses with nuclear security topics. This program also could escalate the participation of department to the world in order to promote nuclear for peace. The finding is that nuclear security topics is prefered to be embeded in present course instead of to be lectured as a single course in UGM. As consequently, faculty member should choose the relevant topics for their courses from several information, such as INSEN modules, IAEA security series, etc.

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Role of low power research reactors in developing human resources for national nuclear power programmes

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Nowadays 258 research reactors in 52 countries are in operation. Research reactors can be used in a wide range of nuclear activities, from supporting nuclear technology through nuclear science, neutron activation analysis, radioisotope production, to education and training.
Low power research reactors are suitable for education of students at all academic levels not only in nuclear engineering, but also in various non-nuclear engineering studies, such as power engineering, electrical engineering, natural sciences, medical sciences, physical sciences, etc. Education at a research reactor is a specific discipline, which is very different from R&D. Education at a research reactor is very expensive compared with other laboratories at a university. It means effective education at research reactor is needed, otherwise high and needless reactor running costs are incurred. State-of-the-art experimental equipment at universities and research reactors and methodologies specifically developed for education and training are trends that can be noticed today all over the world. Providing an effective education at a research reactor involves adapting the educational methodology to the initial students' background level and using adequate experimental educational instrumentation.
The most common professional nuclear training at low power research reactors covers a wide range of employees such as reactor operators, reactor physicists working at nuclear power plants, staff and researchers from research reactors, including subcontractors, nuclear applications experts, regulatory body inspectors, nuclear safety experts, health physicists and radiation protection workers from hospitals and environmental companies, etc. Various types of training such as face-to face training, simulators and hands-on training including training at research reactors are complementary types of training – all are necessary for effective training. The role of research reactors in training, as an excellent tool for hands-on training, cannot be replicated by other types of training.

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Human Resource Development in Tajikistan

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The availability of nuclear knowledge is the result of the past and present conditions of organizations of knowledge in the field of atomic and nuclear physics in Tajikistan. It is shown, that despite today's weak material resources, with the support of IAEA and other intergovernmental contracts and the international funds, and also presence of rich intellectual fund of the republic, it is possible to reserve Nuclear Knowledge in Tajikistan. The Republic of Tajikistan is not a nuclear country, but it uses achievements of nuclear science and technology in a number of manufacturing branches. That is why the important problems for us are training of staff and preservation of nuclear knowledge. During the Soviet period we did not have such problems, as during that time well-educated specialists, both in central institutes of higher education and particularly in the Chair of Nuclear Physics of the Tajik State National University (TSNU) were trained regularly and according to plan. Chair of Nuclear Physics of TSNU was established in 1961. Well known physicists from Moscow worked in the field of cosmic rays in the Chair of Nuclear Physics. They simultaneously worked in Pamir expeditions of the Physical Institute of the Academy of Sciences of USSR (PIAS). The research theme of the Chair of Nuclear Physics until 1975 has been devoted to research in the field of physics of space beams. In 1970 and the beginning of the 1980, employees of the Chair were also engaged in physics activation analysis and radiation physics. Sometimes scientific themes and training directions were changed.

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Develop the human resources needed to support safe and sustainable nuclear power

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The need for human resources development programs in the areas of security and nuclear power has become understood. These programs received particular attention at various meetings, conferences, and workshop of the International Atomic Energy Agency (IAEA). The agency offers a training program in the field of nuclear security of different countries on a regular basis. More than 50 associated IAEA members have expressed their willingness to embark on a nuclear power program. Also, many states already have nuclear power programs. The human resources development capable of supporting the implementation of programs is a significant challenge.. IAEA emphasized the need for human resources development programs in nuclear security at some IAEA conferences. The IAEA also emphasized the importance of developing nuclear security support centers (NSSC) that would facilitate and improve human resources. NSSC aims to support and facilitate the systematic development of sustainable human resources through the implementation and elaboration of a nuclear security training program based on needs assessment. The IAEA has developed a strategy for various types of short training, such as specialized training courses, to programs leading to a master's degree in nuclear security to sustain and enhance nuclear security. The program consists of two main areas: training and education. It is useful to see this process in a broader context, such as choosing a concept for implementing nuclear security in universities, developing qualifying colleges, developing textbooks and teaching materials, and creating appropriate laboratories. Nuclear power is an essential location in the future of energy, as it will safely provide electricity and transportation fuel products that will be economical, clean and sustainable. The revival of nuclear power promises to be successful in reactivating electricity generation around the world and in helping address concerns about greenhouse gas emissions.

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TOWARDS THE FIRST NUCLEAR RESEARCH REACTOR IN CAMEROON

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Since approximately ten years there is a need to put in place the first nuclear research reactor in Cameroon. Activities using ionizing radiation in medical and industrial sectors are growing in Cameroon. Producing locally radio-isotopes for these sectors becomes a prerequisite for the country. Several actions are made in line with the setup of the nuclear research reactor. The universities, the regulatory body and the national institute in charge of nuclear research are prepared to play their respective role during the implementation of the project. At the university, teaching of nuclear reactor physics is introduced in the academic curriculum at postgraduate level to contribute to human resources development. Prefaisability study to indroduce nuclear research reactor is considered since 2017 in the strategic development planning of the research institute in charge of nuclear research. A new national institute of nuclear sciences and technology will be shortly created to better coordinate this project on nuclear research reactor. The present work will summarize all activities undertaken towards the implementation of the above project.

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Education and Training in Nuclear Human Resource Development at Kindai University

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The Atomic Energy Research Institute (AERI) at Kindai University operates an Argonaut type research reactor, UTR-KINKI, with rated thermal power of 1 Wt, which is now one of three university owned research reactors in operation in Japan. Since the first criticality in 1961, AERI has utilized this reactor for education and training for preparing human resource for the Japanese nuclear industry. The extremely small thermal power of UTR-KINKI allows the institute to provide educational and training programs to students and trainees at various levels. In order to encourage young people to interest in the careers in nuclear industry, AERI's programs begin with outreach to secondary education. The programs for secondary education include workshops for science teachers and high school students, in which trainees experience reactor operation and radiation measurement as well as lectures on the topics of basic nuclear and radiation science. The workshop for science teachers has been held since 1987 and financially supported by nuclear industry. The main activities of the institute are of course in programs for higher education. AERI provides various laboratory programs at graduate and undergraduate levels, which includes experiments on reactor physics, neutron detection and applications, and radiation protection. Because the number of nuclear facilities as educational resources is very limited, AERI provides the opportunities to learn in these programs not only to Kindai University's students but also to students from all over Japan. In 2017, twelve universities including Kindai University utilized UTR-KINKI in their nuclear programs, and some of the programs were financially supported by the Japanese government. Many of the students who studied in AERI's laboratory programs start their carriers in nuclear industry after graduation. AERI also provides the employees of nuclear companies with training workshops from basic to working levels.

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'Developing and implementing a Competence Framework within a nuclear new build organisation to support a learning culture'

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It has been well documented by the IAEA that the development of an Organisational Competence Framework has numerous benefits. One key benefit is that it can be used to develop overall

organisational capability, to ensure the right people are in the right place at the right time to carry out required activities.
A Competence Framework will help establish a benchmark against which to evaluate performance, set criteria for recruitment, support succession planning and can also be used by individual employees to evaluate themselves against a defined set of requirements; this helps them understand what they need to do to improve their performance and work more effectively, as well as how to create their own career development plans. Taking the UK based new build organisation NuGeneration (NuGen) and its Moorside Project as a case study, this paper outlines an approach to the development and implementation of an organisational Competence Framework which defines the competencies required by the business during the different phases of the Moorside project. The NuGen Values and Leadership competencies are embedded in the Competence Framework, defining the behaviours needed in establishing a learning culture. The paper will show that by using a systematic approach to specifying, recording, and reporting the competence of employees against required activities, the resulting output can be used to plan for future business capability requirements. This, together with the establishment of required qualifications and training for each post, allows for a gap analysis to be used to develop appropriate interventions to meet business needs and support NuGen in establishing adequate arrangements. The paper concludes with a summary of lessons learned to date and the next steps in embedding this process to ensure a capable organisation is established to ensure the right skills are developed at the right time at each phase of the project.

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Role of Professional Trainings in Enhancing Regulatory Effectiveness - PNRA Case

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Pakistan Nuclear Regulatory Authority - PNRA was established in 2001 as national nuclear regulatory body responsible to regulate all nuclear installations, radiation facilities and associated activities in the country. The regulatory ambit of PNRA is quite diverse which includes nuclear power plants, nuclear research reactors, molybdenum production facility, nuclear medical centers, radiotherapy centers, irradiators, industrial and agricultural radiography units, diagnostic radiology centers, etc. The regulatory domain of PNRA encompasses areas like Nuclear Safety, Radiation Protection, Civil Liability, Physical Protection, Transport Safety, Waste Safety, Emergency Preparedness etc.
Well qualified, highly skilled and experienced regulatory professionals are needed to effectively perform the technical and challenging regulatory functions which include licensing and authorization; review and assessment; and inspection and enforcement; etc. At the time of its inception, PNRA had to augment its workforce by outsourcing some of the major review, assessment and inspection activities to foreign regulatory body. However, PNRA took several initiatives for competence development of its regulatory staff. These initiatives included in-house professional trainings; competence and skill development through national institutions; and capacity building with the support of international organizations and regulatory bodies of other countries. These indigenous initiatives and efforts of PNRA remained fruitful and productive and today PNRA's professionals are recognized for sharing their regulatory expertise with other countries especially those embarking on nuclear power in the areas of regulatory framework, competence development and core regulatory functions like licensing, review and assessment and inspection and enforcement.
This paper is intended to describe the endeavors and initiatives of PNRA for professional training and grooming of its officials by highlighting various initiatives of PNRA's competence development matrix.

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The Nuclear Power Human Resources Model

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Nuclear Power Human Resources (NPHR) is a systems dynamics model of a nuclear power programme. The model projects human resource requirements of a nuclear power programme and the national human resources that can be used to satisfy those requirements. NPHR can be used to examine national and organizational strategies for developing human resources through educational programmes, outsourcing, training programmes, and more. The model and data may be modified by the user to reflect specific details of their programme. This talk will give an overview and demonstration of the model and discuss key challenges encountered in developing the model. IAEA provides to member states the NPHR model and data at no cost, along with training in use and modification of the model.

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Digital transformation to support the development of nuclear skills

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As the French Applied School for Nuclear Energy, and an IAEA Collaborating Center, INSTN has been supporting the development of talent and skills, in order to serve the programmes of both France and its partner countries, for over 60 years. The current situation is challenging due to an ageing nuclear workforce, combined with a lack of young candidates choosing to study STEM subjects and move into the energy sector, and in particular nuclear. The digital transformation represents a real opportunity for improving knowledge transfer, life-long development of skills for the workforce, and nuclear knowledge management. It can also serve to "refresh" the image of the nuclear sector, which can be seen as "old fashioned" in some countries. The digital solutions employed must be considered together with other learning tools and methods, a mix of complementary approaches being key for acquiring and further developing essential knowledge, know-how and behavior. A series of interesting examples shows clearly how digital transformation can support activities used to develop nuclear skills. INSTN's experience covers both education of students and training of professionals. The digital solutions implemented by INSTN support large-scale transfer of knowledge (MOOCs) as well as more focused specialized training (SPOCs), serious games, simulators, 3D augmented reality... New learning platforms providing an enhanced training experience, and adapted to new learners' expectations, are also currently under construction. Alongside on-demand access to resources, the platforms support skills assessment and tracking over time. Creating digital resources is also an excellent means of recording experts' experience and knowledge for subsequent sharing, notably in the event of retirement. Strong partnerships are essential for the effective implementation of solutions which are adapted to operational needs. They ensure project affordability and access to a wider audience, as well as bringing together the best talents and capabilities.

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Lessons Learned during Optimization of On-site Training Program of PAEC through Job Rotation Policy

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Pakistan Atomic Energy Commission (PAEC) has implemented a policy of job rotation for engineers and scientists of design offices through their placement at NPP site during construction and commissioning for a certain period. Generally, the deputation at site varies from 3 to 12 months. The aim is (i) to gain knowledge regarding site issues during construction and execution of various activities (ii) indigenization of NPPs (iii) Design verification (iv) Quality Control. Resultantly, there is a marked improvement in the capabilities and expertise of the manpower of

the design offices. However, it has been observed that the required duration for optimum human resource development in nuclear industry depends on various factors, e.g. experience, age and already available expertise of the individual etc. The senior officials need less time for capacity building at management level, while the juniors require more time to grasp the logical sequence of various activities. It is concluded that placement for a duration of six months produce better results for building competence in design, construction and safety of NPPs.

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The Strategic Approach to Promote Communication between KAERI Staff

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Recently, Korean nuclear energy polices have rapidly changed. According to such an environment, nuclear institutes are required to actively communicate with public against anti-nuclear. As KAERI(Korea Atomic Energy Research Institute) is a national nuclear R&D institute, it needs to respond these changes. Meanwhile, for effective communication with public, we have to share right information and build communication culture between internal staff members. This is because nuclear institute staff will be a channel to communicate with public. For this reason, KAERI is trying to build the communication-oriented organizational culture as organizational performance objective. From the human resource development perspective, we strategically developed education programs to promote communication between KAERI staff. Our strategies consist of three different approaches; 1) direct communication and information sharing training program on nuclear major issues, 2) staff's communication competency improvement training program, and 3) organizational activation program to provide communication opportunity. First of all, nuclear energy empathy course is designed to promote understanding and consensus among the KAERI staff on latest nuclear issues and our action plan. It is being promoted as compulsory training program for all staff. Second, we implement the training programs such as communication and discussion competency course, and leadership coaching program for senior managers. In this approach, we are trying to improve the effectiveness by combing formal and informal learning. Last one is organizational activation course for each department. Through this program, the department has an opportunity to understand each other's minds, share experiences, and discuss future plan of department improvement. From these approaches, we can support the achievement of organizational performance objectives that emphasize the communication and trust. In addition, it is expected that it will be possible to establish a foundation to act as a channel for external communication.

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Challenging the preparation of human resources for nuclear power programme in Madagascar

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Building human resources for a first nuclear power programme for a country like Madagascar is not an easy task within its economic context. Many constraints need to be addressed with holistic approach and concrete commitment. Ambitious long term programmes are considered to be implemented in the country before embarking to and during the nuclear power plant programme running. For the case of Madagascar, two strategic approaches are retained to implement the human resources building programme. First, the country started to operate an academic programme in nuclear safety and security domains. A master degree curricula has been opened and operated at the "Institut National des Sciences et Techniques Nucléaires de Madagascar" since two years. The programme has received the agreement of the Ministry of Higher Education and Scientific Research. It focuses on the production of a core skilled human

resources in nuclear safety and security. Further, their competence in nuclear safety and security will be extended to the higher level in order to create a pool of trainers. These later will increase the dimension of the available pool of capabilities in these fields. Second, a master degree academic programme in nuclear energy and nuclear reactor physics is under establishment and will be submitted soon to the higher education authority for accreditation. The aim of the programme is to produce young human resources having needed level that enable them to follow specific training programmes oriented to nuclear power plant specialities. The country must seek partnerships with developing and or developed countries experienced in nuclear power plant operation. The undertaking is challenging in terms of capacity building investments, however better choice on relevant dynamic modalities to be adopted is very important in order to ensure the attainment of the country objectives for the future nuclear power programme.

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KOICA-IAEA-KAERI Nuclear Cooperation Program

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Nuclear Training & Education Centre (NTC) in Korea has operated a variety of nuclear training programs for IAEA Member States since 1988 in mutual cooperation with Korea International Cooperation Agency (KOICA). The cooperation was based on the high demand of many developing countries to learn Korean nuclear technologies and experience. Consequently, It allowed the NTC to have operated joint training program in the field of "nuclear power planning and implementation". The main purpose of this program is to consolidate foundations in the nuclear industry area as well as to transfer learners a variety of nuclear technologies and know-hows. The NTC also operated many nuclear-related training programs on the bilateral cooperation between Korea and the Southeast Asian, Middle eastern and African countries in 1990s. Recently, Asia-Pacific countries showed the high demand in the field of radiation technologies. This demand makes the NTC with the IAEA develop training programs in the field of radioisotopes and radiation technologies. Furthermore, the development of these programs is associated with group assignments and country report presentation to enhance the learning effect. Finally, we should consider to create additional but separately training programs under the circumstance of nuclear phase-out.

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Donation for education on radiation

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The Korea Radioactive Waste Agency(KORAD) continues to provide the future generation(adolescent) with donation for education th cultivate good relations with them sinc 2014. The useful information on radiation was giver at the student's level is contibuting to change their attitudes regarding radiation.

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Human resource development for nuclear generation – from the perspective of a new comer country.

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Kenya is currently in the planning phase of its nuclear power program, with the first unit targeted to be operational by 2027. The training period of nuclear power plant (NPP) staff is usually long and rigorous due to the complexity and safety aspects of nuclear power. Kenya Nuclear Electricity Board (KNEB) has identified the most relevant areas in HRD to be; workforce planning, training and education, recruitment and stakeholder's engagement. As the NEPIO in the country, it is therefore essential that KNEB prepares early in developing its human resource and nuclear expertise as a potential NPP owner-operator. KNEB also has to be well advised in managing its workforce efficiently and effectively, to ensure that adequate preparations are made to acquire the necessary nuclear knowledge with sufficient training lead time, conducting feasibility studies and benchmarking exercises, preparing long term human resource development, increasing the exposure on nuclear power technology to both the top management and general staff, and employing the assistance of relevant agencies locally and abroad. This paper discusses the activities and steps taken by KNEB in its human resource development for Kenya's nuclear power program.

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BUILDING SKILLED HUMAN RESOURCE FOR REGULATION OF NUCLEAR POWER ACTIVITIES IN UGANDA

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BUILDING SKILLED HUMAN RESOURCE FOR REGULATION OF NUCLEAR POWER ACTIVITIES IN UGANDA. MR. OBOO MOSES Radiation Protection Officer, Atomic Energy Council P.O.BOX 7044, Kampala, Uganda

Building and maintaining human resource is one of the core challenges most organizations face while executing their duties. A regulatory body with competent human resource aids in public acceptance by politicians and elites in any given country for the establishment of any nuclear installation.

However, having a competent regulatory on nuclear power regulations remains wanting for Uganda although the country is preparing for the establishment of the first nuclear power plant by the year 2031. The Nuclear Energy Unit, the entity responsible for the promotion of nuclear energy in the country is currently carrying out feasibility studies on siting among others. However, currently Atomic Energy Council has only five staff with expertise in nuclear engineering and have inadequate knowledge and practical skills to execute its regulatory role of managing nuclear power activities.

This paper will discuss broadly the five major areas which need urgent attention to improve and strengthen the regulatory body on regulation of nuclear power activities in Uganda. They include; Establishment of University diploma and degree programs that have course units on nuclear science. This will enable the regulatory to recruit persons who have basic knowledge on nuclear science and technology, building a research reactor in the country to aid practical teaching, establishment of a coherent and comprehensive human resource development policy frame work in line with the national planning policies of the country, Investing and encouraging individuals to attain higher qualifications in areas of nuclear science and technology and provision of adequate funding to the regulatory body.

Through the implementation of the above ideas the regulatory body will develop adequate, qualified and competent staff to effectively regulate nuclear power activities.

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CONSIDERATIONS FOR HUMAN AND ORGANISATION FACTORS IN THE ESTABLISHMENT OF A NUCLEAR SAFETY INFRASTRUCTURE.

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The nuclear power technology has become indispensable in the general energy mix for countries across the globe. This is particularly to ensure a secure, reliable and stable energy supply for industrial, social and economic well-being with an aim of mitigating the global climate change consequences. The nuclear industry being technology intensive with a lot of human-machine interface, it is likely that human errors could be committed which might compromise the overall safety of the nuclear power plant. It is imperative that countries consider the lessons learned from the past nuclear accidents in the establishment or strengthening of their nuclear safety infrastructure taking into consideration the influence of organisational factors to human performance. In order to ensure that an effective nuclear safety regulatory regime, the regulatory body is required to establish sound and clear nuclear safety requirements, policies, procedures and guidelines for safe operation. Whereas these descriptive documents are paramount to guide human behaviour in achieving safety, it should be noted that humans are unreliable sources of reliability. Consequently, the management system to be established should ensure that human factors such as social and psychological behaviour, physical abilities, etc. of concern in the nuclear safety perspective are provided for. These paper therefore, seeks to explore further the human and organizational factors that should be considered during the establishment of an effective and reliable nuclear safety regulatory infrastructure. This is to ensure that appropriate framework and guidance for safety are provided for in advance for the protection of the environment and society from undue risks associated with the use of nuclear power technology.

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Case Study on The Role of Knowledge Management in Human Resource Development of Nuclear Manpower

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Knowledge management is the concept that turns the information and data into concrete results, and makes them workable and usable in the applications. This paper attempts to understand the knowledge transfer and management practices and experiences of the non-destructive testing (NDT) at Sudan atomic energy commission (SAEC) from HRD perspective. The study addressed relevant issues that examine knowledge management and transfer across the human resource development lifecycle and understanding the challenges. Case study methodologies were used and data have been collected depending on primary sources, namely personal interviews and secondary sources such as technical reports and references. The collected data revealed existence of problem related to NDT practice as a consequence of lack of qualified and certified personnel. The data has been analyzed and the major findings showed that the commission has used the opportunities from the external environment such as the technical cooperation (TC) projects funded by the international atomic energy agency (IAEA) to qualify adequate number of core human resource. Knowledge transfer and good management has been implemented to solve challenges related to human resource and business development, such as establishment of national NDT training center and the sustainability of the NDT service. Conclusion was made that SAEC has good knowledge transfer and management mechanisms. Hence development of the nuclear manpower for nuclear power programs could be achieved via the knowledge transfer and good knowledge management.

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The role of human resources development in the sustainability of the nuclear energy sector in Sudan

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Abstract: - The main objective of this study is to reflect the effectiveness role of human resources development in the sustainability of the nuclear energy sectors in Sudan, also reflect the status of the human resources development in these sectors; and to what extend the HR policies and programs are appropriate for sustainability of nuclear energy sectors. The study covers all Sudanese institutions applying nuclear techniques either Sudan planning to establish first nuclear power plant. This study is analytical study used secondary sources namely reports. The study also used primary data which was collected by interviews with stakeholders. The study has come out with the findings that the human resources development played a major role in sustainability of nuclear energy sectors and management of different fields related to application of nuclear technology. Also the study find that HRD planned for the NPP has been approved. IAEA through TC projects, Sudanese universities and vocational school contribute effectively in providing qualified training and post graduate studies to meet the high need in nuclear energy sectors.

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Integrating new sociological trends and expectations into human capital management at Andra

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Andra faces a systemic paradox that challenges human resources management (HRM), by combining 2 major sociological trends (i) promoting an individualistic approach to career paths and (ii) calling for and then enhancing collective work and co-construction. The adequate understanding of these trends and their projection into our organization however preempts our ability to develop, support and then recognize the individual and collective commitment of employees, also contributing to strengthen capacity. Shifting from collective to individual HRM now leads to implement new tools through the identification of both key knowledge/skills and key individuals (holding expertise, interfacing or coping abilities) in order to develop job and career pathways. In parallel, the Andra's workforce perspective shows retirement departures bound to increase in coming years (70 people to leave by 2021, 80% concerning executive employees) that might induce a significant risk of knowledge loss. In this context Andra is turning to: - Leading competences with more focus on individual career, training and pathways management and reinforcing the capacity of managers to taking on additional delegations - Focusing on people through individual interviews and agency-wide screening in order to identify the "managers of tomorrow" (50 persons) The logic of co-construction developed through a three-party agreement between the employee, her/his hierarchy and HRM is now a way to improve a performance, that is more respectful of employees. Quite an extensive people review is then dedicated to develop job and career pathways and to manage human capital. In a French context of decreasing interest for nuclear professions, our stake today is to give employees who join us the meaning to work, the pride and satisfaction of having participated by their individual actions in a recognized collective work, but also to accompany them for the time they decide to stay in our organization.

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The practical activities to improve transfer of learning in the nuclear-related continuing professional educations for developing countries in Korea: focusing on in-class training held by the Korea Atomic Energy Research Institute (KAERI)

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Much in-class education and training for developing countries have focused on how a learner absorbs knowledge and skills efficiently or effectively in the class, whereas less interested in how

the learner should transfer the knowledge and skills into his/her jobs in their workplace. In principle, in-class education and training have a difficulty with applying the learned knowledge and skills to learners' jobs in the workplace in comparison with any other practical-basis training. To overcome this difficulty, many educational stakeholders in the nuclear field have concentrated on how a learner can transfer the knowledge and skills absorbed in the class into his/her jobs in their workplace. The action plan activity for learners can be one of the solutions to apply the knowledge and skills to their job in the workplace. The purpose of this study is to clarify how the transfer of learning has been implemented in the nuclear-related continuing professional educations and training for developing countries in Korea. To accomplish this purpose, this study implements as follows. First is to define the concept of the "transfer of learning" clearly. Second is to clarify core elements of the transfer of learning. Along with the clarification, third is to show how the transfer of learning has been implemented in the nuclear-related continuing professional educations and training for developing countries in Korea. Forth is to present core problems in the nuclear-related continuing professional educations and training. Fifth, this study suggests alternatives to overcome the core problems in the nuclear-related continuing professional educations and training.

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Enhancement of Self-sustainability of Nuclear Engineering Education Programs at Universities in New Comer Countries through International Cooperation Activities

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Human resources in nuclear engineering are a key for the introduction of the first nuclear power plant for newcomer countries. To meet the manpower requirements in the nuclear industry, it is important to provide nuclear major students with a basic nuclear engineering knowledge so as to play key roles in the nuclear industry. It is necessary to upgrade nuclear education programs of the developing countries to support them establish their own nuclear manpower and infrastructures. This paper describes cooperative experiences in the enhancement of nuclear education programs of universities in Newcomer Countries. Hanyang University, together with Korea Nuclear Association for International Cooperation has established a systematic cooperation scheme and supported upgrading nuclear education programs of new comer countries for past five years. Progress in human resource development (HRD) programs has been made by implementing four (4) main tasks, i.e., consultation on upgrading nuclear engineering curriculum, intensive courses on nuclear power engineering, education and training for professors. In addition, a core simulator, a plant analysis simulator, and radiation experimental kits are provided to establish nuclear engineering laboratory at universities. The international nuclear engineering HRD workshop has been held every year to deal with issues related to strengthening nuclear engineering education programs and shared experiences gained from nuclear programs in Korea.
Through upgrading nuclear education programs of new comer countries, self-sustainable nuclear engineering education programs at universities of newcomer countries are developed to breed human resources with capacity to apply practical technology to nuclear power projects. A systematic international cooperation scheme is established among developing countries by sharing knowledge of nuclear curricula and R&D programs as well as experiences in Korean nuclear programs.

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IMPLEMENTATION OF A KNOWLEDGE MANAGEMENT PROGRAM IN A NEW BUILD NUCLEAR POWER PLANT ORGANIZATION

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Nuclear Knowledge Management at the project, organizational and national levels is an integrated and systematic approach applied to all stages of the knowledge cycle, including its identification, sharing, protection, dissemination, preservation and transfer. Knowledge management systems support nuclear organizations in strengthening and aligning their knowledge. Knowledge is the nuclear energy industry's most valuable asset and resource, without which the industry cannot operate safely and economically. . Nuclear knowledge management practices enhance and support traditional business functions and goals such as human resource management, training, planning, operations, maintenance, projects, innovation, performance and risk management, information management, process management, organizational learning and information technology support. Egypt is currently in the planning phase of its nuclear power program with cooperation ROSATOM company, with the first unit targeted to be operational in 2028. Training of nuclear power plant (NPP) staffs are usually long and rigorous due to the complexity and safety aspects of nuclear power. It is essential that Nuclear Power Plant Organization prepares early in developing its human resource and nuclear expertise as a potential NPP owner-operator. A utility also has to be prudent in managing its work force efficiently and effectively, while ensuring that adequate preparations are being made to acquire the necessary nuclear knowledge with sufficient training lead time. There are several approaches to training that can be taken by a utility company with no experience in nuclear power. These include conducting feasibility studies and benchmarking exercises, preparing long term human resource development, increasing the exposure on nuclear power technology to both the top management and general staff, and employing the assistance of relevant agencies locally and abroad. This paper discusses the implementation of Nuclear knowledge management program in a new build nuclear power plant organization.

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Nuclear projects globalization versus HR challenges Bureau Veritas lessons learnt

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Nuclear projects are more and more complex and the internationalization of the supply chains reinforces this complexity due to:

- Diversity of reactor technologies
- Different safety approaches & construction codes
- Multi-regulatory frameworks
- Digitalization
- HR trends, consisting in massive retirement of knowledgeable engineers and recruitment of much less experienced young engineers.

Bureau Veritas focuses on conformity assessment processes of complex international nuclear projects and faces to this complexity and associated HR challenges.
In this context BV has developed a strong knowledge management experience on the basis of its experience with complex international nuclear projects:

- Capitalization of Lessons learned in international recent nuclear projects, all resulting in a very quick ramp up of recruitment processes (Olkiluoto 3 – Finland-, Flamanville 3 –France-, Atucha 3 –Argentina-, Sanmen/Haiyang – China-,ITER –Japan-US-Korea-India-China-France. . .)
- Implementation of innovative sourcing & subcontracting strategies
- Strong learning capacity regarding national design review and inspection processes, cascaded down in a systematic and structured training and qualification processes of BV Staff

- Development of a strong international network, including through Joint Ventures with local companies in some countries, –(Turkey, India, China, US, Korea, Japan, Ukraine, Russia. . .), enabling to develop a complementary and sustainable know how
- Development of a project management office aimed at progressively implementing standards and good practices for project management of BV nuclear project as well as supporting local project managers
- Development of an ambitious digital strategy, including through the implementation of collaborative platform to ease workflows and sharing of information

The presentation will illustrate this knowledge management experience through recent case studies from BV Nuclear international project.

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Role of collaboration approaches for sustainable developing of nuclear workforce

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The innovative development of the modern nuclear industry, the transition of many Member States from the economy of technology to the economy of knowledge and innovation, necessitates the preparation of an innovative-oriented nuclear labor force, which causes the formation of a new type of intelligence, thinking, attitude to the changing production, economic and information realities. The growth of these requirements leads to the fact that science, education, production and business can no longer effectively develop and adapt to changes independently of each other. They need their interaction, which is objectively beneficial to each of the participating parties - research, education and innovation. Sustainable development of nuclear workforce is directly related to the formation of nuclear educational networks and nuclear knowledge triangle (NKT): the synergy of education, research and innovation areas. An abstract scheme for knowledge triangle (identification: angels content, potential outputs, interaction approaches); NKT challenges; requirements for the functioning of the knowledge triangle; information picture of existing knowledge triangle; brief description of the most significant existing legal, institutional, financial and human framework conditions of the knowledge triangle; description of national practices in accordance with the structure; identification of barriers for the development of “knowledge triangle"; identification of risks related to the integration processes are developed. The interaction of universities at the national, regional and global levels has become an important element of nuclear education and training. The challenges of nuclear educational networks and examples of network interaction are described. Presented collaboration approaches are an important tool for the sustainable developing of nuclear workforce.

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New Approach for Site Selection of New Nuclear Power Plant

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Site Selection is the first step in a long process of identifying, qualifying and characterizing a location for the construction and operation of an NPP. The EPRI Siting Guide describes a sequential process for site selection involving reduction of the area under consideration from a Region of Interest through Potential Areas, within which are identified Potential Sites, Candidate Sites, and ultimate identification of a Preferred Site and an Alternate Site. This general process has been recommended by the IAEA. In this process, the relative strength or “fitness” of site suitability factors are identified and importance to site suitability for the project (or weighting factors) are applied. In addition to providing a process for identifying suitable nuclear power

plant sites, the approach is designed to satisfy environmental and nuclear authority requirements for the consideration of alternative sites to ensure that the selected site is among have more feasibility for the project and start of the Environmental Impact Assessment.

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From Nuclear Education & Training to Employment- Strengthening Channels to Secure Human Resource Requirements of Expanding Nuclear Power Operating Organization

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PAEC is on course of expanding its Nuclear Power from existing 1482 installed MWe Capacity to planned 8800 MWe by the year 2030. Two units of 1100 MWe are already under construction, one with similar capacity is near approval for construction and few others are in advance stages of planning. The requirement of high quality nuclear workforce forms the backbone of the scheduled expansion program whereby several hundreds of a significant variety of personnel, in terms of education, skills and training, are required to safely, effectively, and efficiently undertake the projects. PAEC has over half a century experience of Education & Training and it continues to invest in HR capacity building initiatives and has made steadfast progress in strengthening its Human Resource Development Institutes (HRDIs) to fulfill the workforce requirements of the expanding nuclear power programme. This paper describes and presents the discipline wise landscape of the human resource requirements with varying lead time requirements to ensure that " the right number of right people are in the right place at the right time" for the existing, under construction and future planned Nuclear Power Plants in Pakistan. It also shares the Human Resource Development Strategies of PAEC to Attracting, Education & Training, and hiring through its recruitment channels. Additionally, it introduces the HRDI's of PAEC and the various disciplines and programs offered by these to meet both the degree and technical diploma level nuclear workforce requirements.

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Proposing a New Worker Mental Health Assessment (Using Bio-signals) to Enhance the Safety and Security of Nuclear Industries

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Existing Fitness-For Duty (FFD) programs predominantly focus on assessing a worker's drug and alcohol use and sleep deprivation. However, there are a number of important psychological parameters that can affect a worker's performance and attitude. For example, a growing number of workers in Nuclear Power Plants (NPPs) close to the Fukushima accident have suffered from depression and anxiety about the future and have exhibited a loss of motivation. The concern is, these psychological manifestations may contribute to human error or promote an insider threat. FFD programs are key to the effective NPP operation. Thus, the objective of this study is to suggest incorporating a new mental health assessment, based on human bio-signals, into FFD programs. Based on a literature review, this study investigated a variety of human reliability programs currently incorporated into FFD programs to identify their benefits and limitations. To overcome the identified limitations, a new mental health-check-up program using Electroencephalogram(EEG), Electrocardiogram(ECG), and Galvanic Skin Response (GSR) is proposed based on the results of our previous studies. Using Multi-Criteria Decision Making (MCDM) analysis, the proposed additions to the mental health check-up program were validated. This program will be helpful in assessing the reliability of the nuclear workforce and useful to improve the nuclear security culture.

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INCORPORATING LEADERSHIP IN THE REVISION OF BAPETEN MANAGEMENT SYSTEM

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Leadership is a process of creating clarity and consistency of direction and making that direction important, exciting, and worthy to others. Based on Safety Fundamental SF.1 stated that efecctive leadership and management for safety must be established and sustained in organizations concerned with, and facilities and activities that give rise to, radiation risk. Leadership as a part of management system have to develop in order to enhance capability of human resources in nuclear industries. Capacity can be defined as the ability of humans, institutions and societies to perform successfully, to identify and reach their goals, and to change when necessary for sustainability, development and advancement purposes . Capacity development is very much related to the ways organizations operate.
BAPETEN, as nuclear regulatory body, to conduct its performance job has issued a Manual called BAPETEN Management System under BAPETEN Chairman Regulation No. 14 Year 2014. BAPETEN Management System has been created based on GSR 3. As we already know that in GSR 3, there is a gap showed that leadership for safety are not taking into account. Meanwhile the leadership has a big challenges in organization triggered from inside and outside organization. There is a difference between leadership and management for safety, both equally important. Managers and leaders have opportunities to influence individuals in order to reach safety culture in every action during their performance.
The IAEA has issued GS-R Part 2 published in June 2016 supersedes GS-R-3 and establishes requirements for a safety focused, Management for safety, Leadership for safety and safety culture. BAPETEN will make a BAPETEN management system revision based on GS-R Part 2 to supports achievement of general aims of management for safety.

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DEVELOPING NUCLEAR WORKFORCE THROUGH THE STRATEGIC ROLES OF NUCLEAR OUTREACH PROGRAM FOR NUCLEAR POWER PROGRAM – MALAYSIA EXPERIENCE

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Due to the rapid fall of number of students applying for science, technology, engineering & math (STEM) stream in past few decades, the Malaysian government foreseen inevitable outcome for their future nuclear endeavour; insufficient human power to run it. Through several pioneering outreach programs, Nuklear Malaysia has been the spearhead in engaging students while promoting nuclear science particularly and science in general. By collaboration and partnership with several key stakeholders such as the Ministry of Education, IAEA, AELB and nuclear communicators, the nuclear outreach program has been evolving since its first conception to meet the growing needs and demanding challenges. Nuklear Malaysia pioneered in Nuclear Outreach Program with adopting schools to run collaborative programs. Later, it came out with other programs such as Jelajah Ikon Saintis (Scientist Tour), 3V Camping, and radiation workshop through Nuclear Science & Technology for Secondary School (NST4SS). These wide ranges of programs cover primarily on secondary students as well as science teachers in Malaysia. Students are the primary target audience as it is of paramount importance to set forth initial influence over in order for them to select STEM stream. Teachers are targeted as they are influential to students

and therefore may recommend students to choose STEM stream. This paper will emphasize on the educational program and courses implemented by Nuklear Malaysia in order to develop and support future nuclear workforces. Among notable topics discussed are related process and procedures, stakeholders and shareholders involved, challenges and outcomes, feedback received and the way forward for future undertaking for Nuclear Outreach Program.

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Human Resource Development Program on IT Security in Nuclear Regulatory Agency of Indonesia (BAPETEN)

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Information technology is used to conduct governmental activities in regulatory control of nuclear energy, with the online licensing application it easier for the permit holders to be able to apply permission of nuclear energy. The inspection application is used by the inspector to conducts supervisory inspections and also ensure compliance of the users with the safety regulations and provisions relevant to the permit conditions. The detection and monitoring of radiation has also been done by utilizing information technology for the delivery and presentation of the data. BAPETEN is a government institution, where the organizational structure and employees has a different background study and levels understanding of IT, therefore it is necessary to conduct research on employees to know the level of understanding related to the use of IT, by knowing the level of understanding of IT employees, will facilitate in terms of guidance and development of human resources, especially knowledge in the field of IT. To proposes human resource development program on it security in BAPETEN, we apply IAEA NSS23-G (Implementing Guide Security of Nuclear Information) and best practice from NIST SP 800-50 (Building an Information Technology Security Awareness and Training Program) Information security on nuclear security refers to the system, programme or set of rules in place to ensure the confidentiality, integrity and availability of information in any form. These are the main points must do when we want to propose the program : Analyze role and responsibly for all job classifications; Needs assessment for categorize IT security program; Design awareness and training program; Developing awareness and training material; Implementation awareness and training program; Monitoring, evaluation and feedback.

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Strategies for Acquisition and Development of High Quality Nuclear Workforce for Indian Nuclear Power programme

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Availability of qualified nuclear workforce with requisite functional expertise has always been of crucial importance to Nuclear Power Corporation of India Limited (NPCIL) for establishing and managing Indian Nuclear Power Plants (NPPs). However, acquisition and development of nuclear workforce have become more challenging in view of recent approvals by Government of India to increase the installed capacity to three-folds by establishing multiple projects of diverse reactor technologies. In other words, planned capacity addition of around 15,200 MW is to be completed by NPCIL in next ten to twelve years. Across-the-board approach has been adopted in NPCIL to strengthen the existing processes of workforce planning, their acquisition, induction training, qualification and continual training. Standard manpower models have been developed for twin-unit projects. Modular approach has been adopted for finalizing manpower models for various phases of NPPs i.e. design & engineering, construction & commissioning, operation & maintenance including for needed support & services workforce. The models for yearly forecasting of manpower requirement and acquisition plan (through fresh recruitment as well as gradual deployment of experienced manpower) have also been developed. Robust as well as simplified recruitment process has been adopted to ensure the large and quality intake in specified disciplines (typically large requirement of civil engineers for construction of concurrent

projects). Existing curriculum of foundation courses on nuclear engineering for fresh engineers has been revised to imbibe diverse reactor technologies. Organizational processes have developed to evolve and develop capability to conduct trainings of multiple batches with a common standard and uniform methodology to achieve the consistent performance. Training systems have been upgraded (revisiting systems approach, learning management system, automation of training management etc.) to enhance effectiveness of training and to maintain scholastic temperaments in fresh recruits & trainers. This paper describes methods adopted for acquisition and development of nuclear workforce.

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KHNP's Operator Re-training status and APR 1400 Simulator exercise

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Operator re-training'grounds is based on FSAR. MCR Operator should complete at least more than 50 hours per year for a period of two years. MCR Operator's training details are theory and simulator, such as general and systematic characteristics of plant operation. Field operator also should complete at least more than 50 hours per year for a period of two years. Their training programs are similar with license holders. Actual conditions of operator retraining shall be implemented at least once a year for two weeks or more[Theory : 18 hours, Practice : 35 hours)(Other hours excluding evaluation, etc.). The first week is the theoretical training for plant designs, etc. (MCR/LOCAL common), and the second week is the simulator practice(MCR operator), while the second week is LOCAL operator provides simulator practice, observation and system training.
APR-1400 Simulator training scenarios are mainly composed of the integrated operation(such as the startup and the shutdown of the plant, the power operation, etc.), the abnormal operation (based on the experience cases), and the emergency operation (design basis accident). n addition, digital facility failures were added to the training scenarios, taking into consideration the installation of the digital equipment.(Meeting the requirements for FSAR accident analysis) Failure details include Operator Console Fail, Operation at the Safe Console , CMF + DBA, and CPS Fail. Typically, training is conducted for 3 to 4 hours per scenario. The scenario progresses to abnormal conditions during the composite operation and ends with emergency operation. Instructors perform exercise and observation, final comments, suggesting procedural revisions and design change recommendations for problems found during practice. During the practice, the opponent watches the contents of the exercises and discusses the exercises with the instructor after the exercises.

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Attracting a High Quality Nuclear Workforce – Recollection of the NKM

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Filling the nuclear jobs with the high quality workforce, is a key importance to the prosperity of the nuclear society. When the NKM (Nuclear Knowledge Management) activities were formulated in the early 2000's, the nuclear society worldwide faced the massive retirements of the nuclear workforce, the declination of nuclear education and training institutes, lack of influx of young generation and the potential loss of nuclear knowledge. The IAEA acknowledged the urgency of the issues and formulated the NKM activities.
Almost two decades have passed since then. Now is the time to review what have been achieved so far regarding the issue. In the early stage of the NKM, we promised to give vision and hope to the young generation so that they can congregate and fill the nuclear jobs. But if we are still

considering the methods to attract the high quality workforce, we have failed to attract them and we have failed to provide them the vision of nuclear jobs. In that case, we have to review what and why have gone wrong and reformulate what we have done.

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15 YEARS OF THE EUROPEAN NUCLEAR EDUCATION NETWORK

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The European Nuclear Education Network (ENEN) was established in 2003 through a EU Fifth Framework Programme (FP) project, as a legal nonprofit-making body. Its main objective is the preservation and further development of expertise in the nuclear fields by higher education and training. This objective is realized through the cooperation between EU universities involved in education and research in nuclear disciplines, nuclear research centers and the nuclear industry. As of March 2017, ENEN has 53 members in 18 EU countries and has concluded Memoranda of Understanding (MoU) with partners beyond Europe for further cooperation, including organisations in South Africa, Russian Federation, Ukraine, Canada and Japan. ENEN also has good collaboration with national networks and international organizations such as the Belgian Nuclear Education Network (BNEN) and the International Atomic Energy Agency (IAEA). The main activities developed, and results achieved, within the first 15 years of the ENEN Association will be presented and discussed. These include, for example, the launch of the European Master of Science in Nuclear Engineering (EMSNE), the annual ENEN Ph.D. competition and the portfolio of more than 10 EURATOM projects dealing with nuclear education, training and knowledge management through development of teaching methods and materials, courses, and exchange of students and teachers within EU and beyond. Those projects were all supported by the European Commission with the ENEN Association acting as the coordinator or as a partner.

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The ENEN+ Project: Attracting, Retaining And Developing New Nuclear Talents Beyond Academic Curricula

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The ENEN+ project proposes cost-effective actions to attract, develop and retain new talents in nuclear professions. This is a contribution of the ENEN Association, supported by the European Commission, to the common strategic goal of all nuclear stakeholders: to preserve, maintain and further develop the valuable nuclear knowledge for todays and future generations. The ENEN+ project focuses on learners and careers in nuclear reactor engineering and safety, waste management and geological disposal, radiation protection and medical applications. This paper outlines the most important expected contributions of the project and the approaches designed to deliver them.

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Multi-layered Integrated education system to provide first class cohort of nuclear engineers forming alliance network within Korean establishments

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Often new comer countries experience lack of high caliber human resources to initiate its own nuclear technology development. Even higher education institutions struggle to find the way of their foremost dream becoming a world renowned school during rapid changing economic downturn. Singular tradition of academia tells teaching through apprenticeship can be achievable when formal education cannot furnace lifelong learning needs of studentship, however fast moving twenty-first century business environments frequently require both educators and learners are vigilant to engage into extended education programs. KINGS, KEPCO International Nuclear Graduate School of Korea was established in 2010 to nurture experienced nuclear professionals in line with Korea's nuclear export into UAE. Although KINGS is regarded as the world's first higher education institute specialized in nuclear industry itself, it has experienced compelling challenges. In this context, writers suggest new type of coalition structure making provisions of nuclear experts, technicians and skilled workers to nuclear industry with academic fulfillment. We summarize pedagogical purpose of existing academic institutions, survey historical background of establishing purpose.

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A Conceptual Study on Capacity Building System to Support National Nuclear Program in Indonesia

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Nuclear science and technology may be utilized to improve the welfare of people through a sound nuclear industry program. One of important factors for the existence a sound and sustainability is competence personnel. Therefore, development of human resources is an absolute requirement

to support efforts of nuclear power utilization so that the utilization of nuclear power contributes in improving the welfare of society. Capacity building is necessary for competence development of personnel on institutional and national level. A concept on capacity building developed by the International Atomic Energy Agency incorporates activities of education and training, human resource development, nuclear knowledge management, and nuclear network. This paper is dealing with a concept for capacity building to support national nuclear program in Indonesia. The National Nuclear Energy Agency (BATAN) as a national nuclear agency of Indonesia is developing a concept on comprehensive capacity building system to improve its effectiveness in institutional and national competence building program. The comprehensive capacity building system is developed taking into account the IAEA concept on capacity building. Education and training aspect is developed incorporating various education and training system modalities and deliveries, teaching materials repository, digital library, network of cooperation as well as learner community. This education and training system is also aimed for improving knowledge and capacity of stakeholders on nuclear science, technology and its application, and nuclear safety and security as well as management. Stakeholders may consist of universities, government agencies or institutions, industries, hospitals, and public. Human Resources Development is aimed for effective human capital management including development of information system on human resources and talent management system. Nuclear knowledge management is developed aiming for knowledge collection and harvest. A nuclear network among national, regional, and international institutions has been developed for information resource sharing, training materials exchange as well as exchange of experts.

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Key Attributes of a Successful Organizational Culture

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Culture is a set of behaviors and expectations that are common to a group. An organization's culture is a reflection of common behaviors and expectations. Consequently, an organization's culture will determine its success or failure. The challenge for most organizations is to develop its own culture, rather than to watch as it evolves. To develop an organizational culture, the organization's leadership must understand the key attributes of culture, and how they relate to their mission and vision. The first step it to identify the key attributes of organizational culture. There are 12 key cultural attributes that should be considered, and then developed:

- Mission Clarity
- Standardization
- Fully Empowered Employees
- A High Integrity Workplace
- Strong Trust Relationships
- Highly Effective Leadership
- Effective Processes
- Responsiveness to Internal Customers
- Effective Communications
- A High Degree of Adaptability
- High Accountability Standards
- Emphasis on Recruiting/Retaining the Best Employees

Each cultural attribute must be defined, and then be applied to help the organization meet its vision and mission. Policies and programs must then be developed and applied to ensure the organization's culture is created and managed, rather than allowing it to evolve. Because cultural attributes are not easily quantified, a subjective scale will need to be developed, which

can then be applied to compare a) trends in the organization's culture over time, and b) to allow the culture to be compared to external organizations. This paper will discuss the 12 key organizational cultural attributes, describe why they are needed for an organization to be successful, and provide examples of strong and weak organizational cultural elements at selected nuclear energy programs.

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Project Base Team Learning and Team Teaching in Practical NPP Engineering Education

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KEPCO International Nuclear Graduate School (KINGS) is dedicated to nurturing leadership-level professionals in nuclear power plant (NPP) engineering. KINGS have designed curriculum based on two philosophies. First, we balance aspects of discipline engineering, specialty engineering, and management engineering in the framework of systems engineering. Second, KINGS have designed the curriculum so that students can learn and experience the know-what, know-how and know-why level knowledge of NPP engineering and management. Nuclear safety is not confirmed through theoretical knowledge. Practical on-time application to real situations is important. Enhancement of problem solving capability based upon strong scientific knowledge and decision making capability based upon the Conceive-Design-Implement-Operate (CDIO) framework are necessary. The specialization programs are opened during the 2nd year for 3 trimesters and those are a process of learning through practical project courses. The specialization programs were designed as project based team learning and team teaching course. The participating students become a member of the team-project (Subject Unit) which is a temporary working system that are constituted by temporary teams to accomplish specific tasks under time constraints. Interdisciplinary cooperation where each professor with different specialty provides a unique strength to the team-project is performed in the team project. Team-learning working in a team collaboratively and socially, not competitively and isolative is applied for the operation of team project. This paper will presents the KINGS specialization programs and the effects and the challenges of 'Project base team learning and team teaching program' based on experience and review results.

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KHNP Leadership Pipeline and Executive Coaching & Effective Team Communication Programs

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This presentation will cover the following 3 topics;

1. KHNP Leadership Pipeline was disigned to develop the employees' job-related KSA and specific leadership competencies including communication, feedback, coaching skills, conflict mananement, negotiation, influence, change management and etc., based on each position level's job requirements.
2. 1:1 Executive Coaching program was successfully run for 8 KHNP executives to understand their leadership skills, behaviors and self-awareness and to develop their leadership competencies during six months period by professional cerfified coaches in 2017.

This is the first attempt to provide an executive coaching program for the KHNP executives and also a first challenge among 330 Korean governemtn organizations.
It results in expanding the coaching services in 2018 for more top management levels who might have been under heavy work-related stresses at KHNP nuclear power plants.

1. KHNP Effective Team Communication program has been delivered to 92 teams(among 691) and 1,002 members(among 12,300) for 2 years and it imporves positive team culture and increases team effectiveness through understanding each member's behavioral styles and charactereistcs using the DiSC assessment tool. It has a 5-yeras roadmap to cover 50% of total KHNP teams by 2020.

This KHNP Effective Team Communication program can be desicribed as the first team dimensional training practice among 330 Korean government organizations including KHNP.

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The Future of Human Resources Management in BATAN: Challenges and Actions

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BATAN is a government institution in Indonesia that has duties and functions in the field of research, development, and engineering of nuclear technology. Until now the utilization of nuclear technology has been developed in various fields. Many important factors that play a role in the development of nuclear technology, one of which is human resources. The safe use of nuclear technology requires a number of experts in specific nuclear fields. Therefore, a need to secure a sustainable group of experts. The knowledge gap between senior and junior staff is one of the obstacles in research and development of nuclear technology. The existence of the Indonesian government policy to restrict the recruitment of government employees, it also has an impact on human resources in BATAN. These factors have led to the need for effective strategies and policies for knowledge management. Several steps to build knowledge management have been done, one of them is by sharing knowledge and make portal knowledge management. Implementation of knowledge management is still in the early stages and still needs to be developed. One of the challenges to knowledge management is how to institutionalize knowledge management and integrate it into established management systems. Another challenge faced is the lack of interest of young talents to choose a career in nuclear technology to be a challenge for BATAN. Therefore BATAN considers it necessary to increase interaction with academics, universities, and schools to make career choices and present the challenges and opportunities offered by the nuclear sector. Batan has made various efforts to address human resource-related challenges. This paper discusses the human resource management challenges of the future and what actions are taken to address those challenges.

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Human Resource Needs to Initiate a Nuclear Energy Program in a Developing Country

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Human resources to analyze the energy situation and possibly offer the nuclear option in the national energy mix are lacking in many developing countries. Technical assistance and training offered by the International Atomic Energy Agency (IAEA) in the fields of energy planning, nuclear energy and nuclear science and technology, constitute opportunities exploited successfully by the Member States of the Agency. However, the leadership of projects at the national level is not always guaranteed in this case. A critical mass of national experts is essential to design and conduct a sustainable nuclear energy projects. The regional networks of institutions of specialized training and nuclear regulators are reservoirs of expertise that can be mobilized to supplement the lack of local competencies. The Africa Regional Cooperative Agreement for Research Development and Training related to Nuclear Science and Technology - Networking Nuclear Education and Training (AFRA-NEST) and the Forum of Nuclear Regulatory Bodies

in Africa (FNRBA) are typical examples of such regional networks. Also, the advent of online education of some disciplines can provide broad knowledge to the members of the national team responsible for the design and implementation of nuclear energy program of the country.

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An Assessment of Safety Culture in Nuclear and Industrial Facilities in Ghana: Perceptions and Trends

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Ghana is preparing to add nuclear power to its electricity generation mix in order to tackle its perennial electricity problems and stimulate rapid industrialization and growth of national economy. In addressing the workforce management issues, promotion of a strong culture for safety is one of the requirements. Effective management system must be used to foster strong leadership and culture for safety. Therefore, this presentation will discuss the Ghana Nuclear Power Programme Oganisaton's (GNPPO) effort towards strengthening culture for safety. This paper will discuss the GNPPO concept of fostering a strong safety culture based on the following: 1) evaluation of the status of the safety culture in various Ghanaian organizations, 2) identification of good practices in safety culture 3) seeking expert's advice in nuclear safety culture from IAEA experts and 4) building a strong safety culture for Ghana nuclear power programme that incorporates both local and international best practices. To achieve the above, a questionnaire is currently being piloted in association with the Ghana Institute of Safety and Environment (GhISE). The results and trends observed from the survey would be presented in the paper. Another activity being planned is the hosting of a national conference on safety culture to be held in Accra, Ghana in October 2018. The conference is being organized in collaboration with the Ghana Institution of Engineering (GhIE) and the GhISE. This conference will bring together various international (including IAEA experts) and national experts on occupational safety and safety culture to discuss the status of the safety in critical organizations in the country.

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Overview on CNESTEN Human Reliability Program

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Development and implementation of an Human Reliability Program (HRP) can greatly strengthen both safety and security cultures in a nuclear facility. In this purpose, the National Centre for Nuclear Energy, Sciences and Technology (CNESTEN) launched officially its HRP since June, 2016. The objective of CNESTEN's HRP is to ensure a high level of safety and security during the operation of CNESTEN facilities and the conduct of its own activities. The process of lunching CNESTEN' HRP program is being supported by bilateral cooperation with the US Department of State through Partnership of Nuclear Security (PNS).
The concept of CNESTEN's HRP has been implemented following the five important steps below: 1. Establishing requirements for critical positions 2. Identifying critical functions and positions 3. Assessing regularly the compliance with the above mentioned requirements 4. Maintaining a certification system 5. Reviewing periodically the HRP program

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KHNP Human Performance Tools and Techniques

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The purpose of this paper is to introduce the human performance tools and techniques under operation in KHNP, the largest electric power company in Korea. KHNP is also applying human performance tools and techniques that are applied at overseas nuclear power plants and complements the tools and techniques through a benchmarking. The tools and techniques are based on human performance documents issued by INPO or WANO, which is recognized as an industrial standard. The human performance program of KHNP is divided into tools for preventing human errors and for improving human performance. In addition, KHNP runs several training and training programs that enable plant personnel to properly acquire and use the human performance tools and techniques. The education and training are operated by both off-line and on-line courses. First, the on-line course consists of things that the plant personnel needs to know or understand prior to acquiring a specific technology, and the off-line contains with more detailed or in-depth course. The typical on-line training is the course for human error prevention tools, and the off-line includes the course for human performance experts to learn human error analysis skills. In this paper, we will describe KHNP's education and training programs to help plant personnel learn human performance tools and techniques and improve their human performance.

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A Concept on National Nuclear Personnel Certification System in Indonesia

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Research, development and utilization of nuclear science and technology in Indonesia is implemented through a nuclear program for peace full purposes. Application of nuclear technology has been done on global industries such as petroleum, aviation, petrochemical and so on. One of the utilization is radiography testing which has been carried out from the first decade until now. The important point in radiography test is the inspector or personnel. The personnel involved in these nuclear activities has to be competent. This paper is dealing with a concept that is now being developed in the National Nuclear Energy Agency of Indonesia (BATAN) for establishing a system for personnel certification in nuclear field to demonstrate personnel competence according to ISO-9712. A personnel certification body has been established after getting a licence from KAN (National Accreditation Committee) with license number LSP - 010 - IDN in accordance with ISO-17024. This body will issue awards credentials to individuals that meet specific competence requirements relating to a profession, an occupation or a job in nuclear field. The certification body also follow the National Nuclear Regulation Act as safety requirements. The scope of certification body are Radiography Test Level-1 and Level-2. The requirements for personnel certification consists of psychology test, education, experience, training and examination. The psychology test and examination are done by Center for Nuclear Standardization and Quality, and Training personnel by Educational and Training of BATAN. For the future, BATAN is planning to improve these LSP - 010 - IDN with increasing scopes and sectors. The body will also arrange mutual recognition with other certification bodies of other industrial sectors in the country and abroad.
Keywords: nuclear personnel, personnel certification, mutual recognition

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EXPERIENCE OF A DEVELOPING COUNTRY IN STAFFING OF REGULATORY BODY

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ABSTRACT: Recruitment and selectin strategy, techniques and processes are fundamental key tools in development of human resources in general and specifically in high technology domain. Through our short experience of 15 years, we will try to carry out how we have been dealing with that issue: - Low N°02-053 of 16 December 2002 on general status of workers and; - its mechanisms to reward workers ; - other mechanisms - other experimented practices and, - thinking to create new mechanisms to strengthen existing mechanisms.

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Reinvigorating the next generation of nuclear professionals

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In recent years, countries around the world have witnessed a notable reduction in enthusiasm and registration for their respective nuclear energy education programmes. Such figures are an obvious threat to the nuclear energy sector and to its employers looking to recruit new, young talents.

Yet why are millennials seemingly turning their back on the industry? How could we inspire, attract, and convince future generations that careers in nuclear are not only challenging and critical to a global energy future; but also, worthwhile and full of potential?

Figure 1 demonstrates the “Inspiration Model”, based upon the insights from the authors - three multinational, young nuclear professionals - on policy changes required to attract and retain the industry’s next generation.

Figure 1: Inspiration Model

1. Winning Hearts & Minds

Challenge public perception, educate and inform about nuclear as part of the transitional energy mix! By launching new grassroot campaigns – reaching out to children and young parents – prejudice surrounding nuclear waste and safety can be challenged, restoring the reputation of the nuclear sector.

2. Innovative, Ethical Career Opportunities

Innovation: Showcase disruptive innovation in R&D to demonstrate the industry’s willingness to create change! New talents want opportunities to stand out from the crowd.

Ethics: COP21 and the energy transition are at the forefront of the minds of young professionals. Yet how many of them know that NPPs produce negligible CO2? Show young talent that working in the nuclear industry is a way of getting involved in ethical energy production.

3. Millennials are looking for transverse, career perspectives

Offer young recruits a means to network with their counterparts and feel instrumental in developing the next generation through STEM programs. YGNs are this industry’s most numerous source of passionate ambassadors. Empower companies’ young employees, promote STEM opportunities and entrust them to create transverse, industrial links.

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National Commission for Nuclear Energy - CNEN Specialized Training Program for Qualification of the Nuclear Brazilian Workforce

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National Commission for Nuclear Energy - CNEN Specialized Training Program for Qualification of the Nuclear Brazilian Workforce

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Conceptual Design to Modernize the ANENT's Regional LMS For Supporting Capacity Building, Information and Human Resources Exchange

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The paper describes the conceptual design to modernize regional learning management system (RLMS) of the Asian Network for Education in Nuclear Technology (ANENT) for supporting capacity building, information and human resource exchange in the Asia and Pacific region, in accordance with the IAEA's capacity building concept. In the past, the sharing, exchange, and dissemination of information and experiences among communities have been implemented through the regional e-Learning Platform, ANENT Web, and LMS, hosted by the Korean Atomic Energy Research Institute (KAERI). The gaps that have been identified in general in some Member States in key areas include both the lack of personnel with the required level of aptitude, and the presence of personnel already deployed but with inadequate skill sets which need strengthening/upgrading. In 2016, a newly launched four-year IAEA Technical Cooperation project mobilized ANENT activities, strengthening NKM and promoting young nuclear scientists' increased public understanding of nuclear science and technology. Mainly, activities focused on the development of the modern ANENT web-portal and RLMS, organization of e-Learning courses, sharing and development of outreach materials, and promotion of Internet Research Reactor Laboratory (IRRL). In 2017, the RLMS operation changed from a physical server to 'cloud' service. The new system provides users improved accessibility, robust internet security and cost-efficiency in sharing materials and conducting training courses. The project is exploring the adoption of the semantic technology in the RLMS. New functionalities such as an Integrated Database (IDB) and a Thematic Comprehensive Learning Objects Repository (TC-LOR) are under development. They are intended to help sustain human resource development through the RLMS aligned with the Strategic Capacity Building Platform (SCBP) to Human Resource Development (HRD) that the IAEA's Technical Cooperation Asia Pacific (TCAP) Division has been undertaking.

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Why is cooperation between (1) academia and (2) industry and R&D critical to the education & training of a sound and skilled nuclear workforce and how to implement it

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Close cooperation between nuclear academia and industry and R&D is paramount to the education & training of a skilled nuclear workforce. This abstracts sums up a few reasons why we should encourage cooperation on both sides and how it can be implemented.

Why?

For academics:

- Having professionals on Advisory Councils & teaching classes enable students to learn the most up-to-date technologies with direct experience feedback from industry and R&D.
- Having strong relationships with industry and R&D is the best way to ensure students access to industrial and R&D facilities for education & training purposes.
- Getting funding from industry and R&D ensures better learning conditions.

For industry and R&D:

- By participating in the development of curricula & in teaching classes, industry and R&D ensure their own recruiting ground: they make sure students acquire the skills needed & required to work in industry and R&D and that they are fully operational after graduation.
- Recruiting students as interns for their Master's thesis can serve as a pre-recruitment period to test them before committing for a longer-term contract.

For students:

- Enhancing graduates' skills & employability.

How?

On the academic side:

- Involving professionals from R&D and industry on Advisory Councils and recruiting professionals as teachers.
- Setting-up apprenticeship programs where students can be trained part-time in school & part-time on the job.
- Placing internship periods in academic curricula where students have actual functions, missions, and learn by doing.

On the industry and R&D side:

- Having teams dedicated to academia-industry/R&D cooperation in HR departments.
- Enabling employees to take time off for teaching hours.
- Organize job fairs within targeted schools so recruiters can advertise job opportunities and students can find either internships or jobs.

Examples of best practices will be given in the presentation.

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Enhancing the Nuclear Safety and Security for Implementing the Nuclear Power Program

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Several Regulations, Conventions, Fundamentals and Recommendations have been establishing since the creation of the International Atomic Energy Agency aimed firstly to enhance at the international level the safety and the security of nuclear and radiological materials as well as the associated nuclear facility. Moreover, different legal instruments exists for cosmopolitan nuclear Safety and Security which should to be ratified by the state and became as legally binding in order to be integrated in the development of state's National Regulation. Through This pertinent instruments related to the both Safety and Security are : • For Safety : [U+F0FC] Convention on nuclear Safety ; [U+F0FC] Joint convention on the Safety of spent Fuel management and on the Safety of radioactive Waste Management ; [U+F0FC] Code of condact on the Safety of Research Reactors. • For Security : [U+F0FC] Convention on the Physical Protection of Nuclear Material (CPPNM) and its Amendement ; [U+F0FC] International convention for the Suppression of Acts of Nuclear Terrorism ; [U+F0FC] United Nations Security Council Resolution 1540 and 1373. However, nowedays the developement of several activities related to the use of nuclear energy in peaceful use is becoming necessary for state Wh provides an equivalence between maintaining provides an equivalence between maintaining of the legislative and regulatory Framework and the designation of an intelligent national regulatory Authority in order to enhance the Safety and the Security for nuclear power plant and associeted facility. In addition the Nulcear Safety and Security is considered as necessary concerns as a big challenges facing the international and national community especially after daichi's disaster on 11 March 2011, the Nuclear Safety is returned to the world conversations as the Nuclear Security which the two concept have the same objectif is to protect the people and the environment against harmful ionizing radiation.

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Estimating staffing needs and ensuring knowledge transfer of a skilled and experienced nuclear workforce after 40 years of operation

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After the first oil shock of 1973, France decided to turn to Pressurized Water Reactors for its global electricity production to ensure its energy independence. Ten years later, in the mid-1980s, France was building up to 6 PWRs per year. There were industrial and technical challenges related to this change but the biggest challenge turned out to be human resources. Between 1975 and 1985—and in spite of retraining people from coal and fuel—EDF recruited and trained 12,800 people to face this change and operate its newly built NPPs.

40 years later, the nuclear sector in France counts 58 PWRs, 220,000 direct jobs, and 190,000 indirect jobs. It is the third industrial sector in France in regard to turnover and employment. But a very large share of the people recruited back in the 1980-90s is now going or will soon go into retirement. A first recruitment wave took place from 2012 to 2014 to replace the generations which participated in the construction of the current fleet. Although it had the advantage of renewing the sector's staff with younger generations, it revealed a new need and led to the launch of large-scale knowledge & skills transfer plans.

In 2017, it was estimated that France would need to recruit between 6,000 and 8,000 technicians, engineers, and researchers per year for the 15 years to come for all 2,500 companies of the French nuclear sector. However, nuclear study paths & careers are concurrently facing a drop in interest in favor of renewable energies.

The presentation will explore how the French nuclear sector is dealing with its staffing and knowledge transfer issues after 40 years of PWR operation and the new policies it is implementing to attract the next generation and fulfill its staffing objectives.

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Accreditation of nuclear education programs or how to ensure academic programs meet the demands and requirements of industry

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In 2014, I2EN set up an accreditation system dedicated to nuclear education programs in France. The accreditation system aims at (1) making sure nuclear education programs provide students with the skills needed and required in industry and (2) making sure they comply with the criteria of academic excellence expected in the field.
The accreditation process is as follows:

1. Voluntary application comprising a self-study report produced by the Program Administrator;
2. Review and assessment of the program by a team of experts (including on-site discussions with the Program Administrator) based on two public sets of criteria established by the Institute: relevance of the program in regard to its objectives and the means implemented to achieve them.
3. Award of the accreditation upon acceptance by the High-commissioner for atomic energy.

In order to carry out the reviews, I2EN set up an independent Committee of 26 experts coming evenly from academia and industry. Each review is conducted by a team of two experts: one from academia and one from industry. This dual view is the essence of I2EN accreditation: it enables to review both the vocational and academic aspects of programs and thus to assess whether graduates are fully operational while having the academic fundamentals to perform their jobs. After the review & assessment, experts issue a report pointing out the strengths, weaknesses, and most importantly the opportunities for improvement.
This new accreditation system presents many positive side effects, such as:

- Urging Program Administrators to continuous improvement towards excellency;
- Providing HR managers from industry with a reliable recruiting ground in accredited programs;
- Making industry professionals and faculties work together in order to improve curricula on the basis of industrial feedback;
- Targeting the best programs for students to choose from and reassuring them in regard to future employment.

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Adopting a learning organization in nuclear research institute

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The purpose of this study is adopting a learning organization in nuclear research institute. KHNP-CRI(Korea Hydro and Nuclear Power co., LTD, Central Research Institute) is dedicated research institute of KHNP which is construction and management company. It has been 2 years since KHNP-CRI adopted learning organization conception. Creating the environment for learning is highly effective because it sustains a competitive advantage by continuing to offer a continuous study. KHNP-CRI started to build and design learning organizations since 2016. The Peter Senge's theory were applied when KHNP-CRI design the environment of a learning organization. Not only the theory but also other trainings were improved by adopting a learning organization. KHNP-HRDI(Human Resources Development Institute) which is the training center in KHNP. KHNP-CRI updated the training contents from the output of a learning organization. The visions of a learning organization are researchers to continually enhancing their capabilities and acquire what they want. The effects of a learning organization on organizational performance found from the seminar, reports, certificates, and etc. And KHNP-CRI creates and adds the technology transform on learning organization to improve the environment for continuous learning.

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The educational meaning and learning process research of the KAERI practice learning community

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The purpose of this study is to explore the educational meaning and learning culture of KAERI(Korea Atomic Energy Research Institute) members' learning community activities. To achieve the purpose of this study, a case study was conducted for the participation group in the KAERI learning community. The results showed that learning communities were clearly divided into the learning-centered and learning and relationship-centered learning community. In the educational meaning of the learning community, it functions as a learning hub in KAERI, learning experiences in learning communities have shaped identity as KAERI members, and plays a role of a network that extends a learning network which individuals maintain. And they showed practical learning cultures to practice what they learned, and they have formed learning culture as coexistent community learning. The study discusses the further tasks for future activities of KAERI learning community, including that: First, a adequate professional and integrated support systems for the learning community should be established. Second, the learning community should be extended to the field of learning linked to the nuclear field. Finally, a learning community that is appropriate for the essence of learning group needs to be built.

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ISCN's experience in building up/maintaining a qualified workforce in the area of safeguards

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This paper considers the experience of the Integrated Support Center for Nuclear Nonproliferation and Nuclear Security (ISCN) of the Japan Atomic Energy Agency (JAEA) in building up a qualified workforce in the area of safeguards. It starts explaining the long and thorough experience accumulated by JAEA's former institutions and the reasons and mandate for the creation of ISCN under the JAEA. Then it describes some steps that preceded the establishment of the

Center that provided the conceptual and practical basis of its activities. Some of ISCN's most notorious accomplishments since its creation, including pertinent statistics and information are then explained. This paper also describes ISCN's recent efforts in preparing and conducting regional surveys on training needs and training providers. These surveys provide a needs analysis, identify potential gaps in the provision of training, and assist training providers to optimize their use of existing training capabilities to meet those needs, hence assuring that safeguards training activities satisfy the actual needs of Asian countries and therefore they help to build up a qualified safeguards workforce.

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Re-engineering in nuclear engineering education for adapting to the new climate regime

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Since 1955 when the first graduating class of the International School of Nuclear Science and Engineering at Argonne National Laboratory in U.S., nuclear education and training programs around the world have been evolving while incorporating societal and technological needs of the time. Accordingly the curricula were made into transition from highly science oriented to engineering applications by backfilling industrial practices along with regulatory directives. This led to confine the knowledge domain to a few commercial plant technologies. At present, nuclear energy is widely recognized as a low-carbon energy source notwithstanding, its worldwide preference as a future energy option splits into optimistic and pessimistic. And what's more, the purpose of nuclear engineering education becomes distinctive; the former for cultivating scientific knowledge preferentially and the latter for preserving experiential knowledge effectively. Requirements for education differ significantly between two purposes. In order to be prepared for coming of the new climate regime, now is the right time to revisit the fundamental question, 'What is the role of the nuclear engineer and how is it learned?', because the global nuclear community is to be better equipped to deal with an extreme all-in-one accident at Fukushima and to be bound to seek a symbiotic relationship with renewable energy. Re-engineering perspectives to answer the question are; firstly, domain of knowledge for reforming curricula and secondly, pedagogical skills for building interdisciplinary bridges.

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CORONA Academy - nuclear education and training

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The general objective of the project CORONAII is to enhance the safety of nuclear installations through further improvement of the training capabilities for providing the necessary personnel competencies. More specific objective of the project is to continue the development of a state-of-the-art regional training centre for VVER competence called CORONA Academy. The project contributes to pursuing nuclear research and training activities with an emphasis on continuous improvement of nuclear safety, security and radiation protection, notably to potentially contribute to the long-term decarbonisation of the energy system in a safe, efficient and secure way. Impact at European Level is expected by increasing the quality and participation of nuclear E&T community of VVER operating countries to the Euratom programme and by contributing to the development of the specific VVER knowledge. Impact at regional level is expected due to the harmonization of nuclear education and training programs which will allow increasing the quality of the process, to develop a common learning, teaching and training program and to provide expert support to the authorities regarding nuclear education and training policy and development. As a result the project CORONA II will unify the existing VVER related training schemes according to the IAEA standards and commonly accepted criteria recognized in the EU. One of the tasks of CORONA II project is to apply the set of activities towards pilot implementation of the European Credit system for Vocational Education and Training (ECVET). Furthermore this will aid to the

cross-border mobility within the EU contributing to the flagship initiatives within the Europe 2020 Strategy for smart, sustainable and inclusive growth.

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National strategy and challenges of human resource development for the nuclear power programme of a newcomer country: Tunisia's case

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Since 2007, Tunisia has decided to consider the nuclear power as a potential energy source to produce electricity. Thus, Tunisian Company of Electricity and Gas (STEG) is conducting a feasibility study to introduce a first nuclear power plant (1000MW) in the Tunisian electrical grid. The most important challenge for a newcomer country is to develop required workforce (on time, on number and with adequate skills) to implement safely and efficiently its first nuclear power programme.
According to the IAEA recommendations in the milestones approach, this poster focuses on the methodology used to size the required workforce for all the nuclear power programme stakeholders (NEPIO, operator, regulatory body, TSO, medical institutions, universities. . .) and its evolution in time. It presents, also, the first results of this study. And it finishes by the strategic actions undertaken to ensure that required human resource will be available in the right time and how to develop and maintain them and gives a glimpse of the challenges faced by the country after the revolution in 2011 and its impact on the national nuclear power programme and especially on the human resource development for such a long lifetime programme.

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WiN Korea Outreach Programs for Public Acceptance

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WiN Korea is designed to help women professionals working in the atomic energy industry to understand the nuclear and radiation field. WiN Korea has demonstrated the power of women-specific affinity and communication skills, to create and promote the understanding of nuclear energy. In order to achieve this objective, it is necessary to educate the next generation of nuclear power to enhance the understanding and improve the acceptance based on accumulated experiences and know-how for many years with the education system that WiN Korea has developed. Understanding programs for undergraduates include career exploration forums and mentoring programs. For youth, a nuclear experts' visit to nuclear knowledge classes, a science experiment concert, and nuclear competitions were held and 18,000 students from elementary, middle, high school and college participated. In addition, women's nuclear experts who have high emotional acceptance of the public and expertise in nuclear issues are invited to participate in nuclear energy symposiums, exchange meetings with residents of nuclear power plants, Workshops have been held to contribute to the diagnosis of internal and external problems in the nuclear energy system and to secure a base for understanding the nuclear power of the nation. In addition, it supports leadership education for inducing active social participation of women experts, improvement of expertise and ability to contribute to society, training of next-generation nuclear specialist teacher training, improvement of communication ability, and nuclear communication skills training.

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Priority Factors to be Considered for Nuclear Power Policy according to Perception of Leadership Groups in Korea

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At present, there are various social conflicts surrounding nuclear power,- Although numerous investigations on the public perception of nuclear power have been conducted, minimal efforts have been made to investigate the perception of nuclear power by social leadership groups, who are at the center of policy- making. Therefore, this paper analyzes of the pattern in the perception of nuclear power by the leadership groups in Korea,- in order to establish the necessary foundation for the directions for communication policy. To establish a foundation for the directions for communication policy concerning nuclear power, this study analyzes the pattern in the leadership groups' perception of nuclear power through quantitative and qualitative investigations involving five steps: (1) analysis of previous literature; (2) Surveys and interview questions; (3) expert consultation; (4) in-depth interviews of leadership groups and surveys; and (5) external evaluation. The most important considerations for domestic nuclear power policy appeared to be gaining social acceptance and national consensus, followed by energy security and economic development. Since, the success of policy is profoundly related to the happiness and quality of life of the policy consumers, a communication strategy to compensate for this must be developed. Risk perception can change even when the actual risk does not change, and it must be recognized that perception is reality in public policy-making areas. To ensure the functionality of nuclear power facilities, key issues must be communicated with the public, and an effective plan for gaining public consensus during decision processes must be devised.

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Nuclear power symbiotic theme pavilions

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Nuclear science museum is standard configuration for nuclear power plants. However, there are some unsolvable problems, such as outlying location, low user viscosity, expensive cost for operation and maintenance, and so on.

Therefore, we propose the construction of nuclear power symbiotic theme pavilions, which are based on the following concepts: one is integrating nuclear power into the crowd rather than bringing them into nuclear power, and the other is promoting practicality rather than security.

Nuclear power symbiotic theme pavilions are renovated from existing shops with nuclear power theme implanted, and then forms benign cooperation with existing merchants, who divide the whole responsibility and take the needs

Nuclear power symbiotic theme pavilions cooperate with existing shops located in crowded areas, modify the vacant space to increase thematic wall paint and interactive equipment, layout science exhibition board and shelves, and hold theme activities, etc.

Nuclear power symbiotic theme pavilions are more than pavilions. They are also homes for employees, places for efficient public communication and sites for small-scale activities like art exhibitions and sharing sessions.

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Gender Diversity Status of KHNP and Case Study on Improvement of Women Employee's Capacity and Leadership

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As of the end of 2017, the number of KHNP employdds was 11,323, with 1,388 female employees accounting for 12.26%. The ratio of women manager is 3.13%, and the percentage of female employee is 16.41%. Therefore, it is time to develop policies and methods to improve the capacity and increase their leadership in current male-major environment and lack of female role models at workplace. KHNP CRI has 61 female employees, 11.57% of the total 527. Since 2012, we have been carring out women-friendly institutional innovation projects through WISET(Women in Science, Engineering and Technology)support. Through this project, we increased the number of maternity protection rooms, and organized women mentoring, female cultural activities, women-led volunteer services and nuclear power outreach activities. Through this project, women workers became leaders in each sub-project, leading to the task, confirming the effect of strengthening responsibilities and building a human network through successful business complition. In addition, the alignment with women employees and the top manager has been getting stronger, and the management improvement effect is also emerged such as providing the management contribution ideas fo the minority female. The WISET project carried out by the CRI is mainly a project supporting research institutes. WiN(Women in Nuclear) is a group that can support this kind of activity in the nuclear field. WiN Global, which is composed of more than 35,000 people in 109 countries, and WiN Korea, a Korean branch, can form WiN KHNP and launch its own business. As the case of CRI case, we expect that WiN activities will not only improve women capacity and leadership in KHNP but also to promote the understanding of the general public acceptance about nuclear energy.

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Certified Programmes for demonstrating competence in nuclear security: The WINS Academy

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A sustainable national nuclear security regime supporting a nuclear power programmes requires human capacity for its continued effectiveness, especially at a time when nuclear power programmes may be subject to new and emerging threats based on advances in technology and increased capability of adversaries, including those motivated by violent extremist ideology.
The mission of the World Institute of Nuclear Security is “To be the leader in knowledge exchange, professional development and certification for nuclear security management”.
A number of States, private foundations, and the nuclear industry have supported the development of the World Institute for Nuclear Security (WINS) Academy that was launched in 2014, as an initiative to provide practitioners involved in nuclear security with opportunities to earn certification in Nuclear Security Management through a programme of self-study and successful completion of proctored examinations. Underpinning the program is certification in accordance with the ISO 9001 and ISO 29990 quality management standards. These standards provide an internationally recognized external benchmark of quality; demonstrate credibility, competence and professionalism; and give potential employers and others in the industry an objective measurement of participants’ knowledge.
Recognising the importance of competence in nuclear security for both regulators and operators, internationally, WINS has obtained political and industry commitments to expand its Academy initiative, and these efforts were recognised in a Joint Statement on Certified Training for Nuclear Security Management led by Canada and the United Kingdom. This Joint Statement, was published as INFCIRC/901, and commits signatory States to support the development of international certification through advocacy, peer review support, contributions or other means necessary. A national nuclear power programme demands the development of diverse and competent professionals that have a deep understanding of the principles and practices of nuclear security.

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Succession of Critical Positions Plan in Nucleoeléctrica Argentina S.A.

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Through its history, the organization has had a strong commitment with the safety operation of the stations, the development of new projects together with the technical and training issues which were solved according to the needs of the company. So that, with respect to planning, development of human resources and knowledge management in the nuclear activity, the organization developed isolated actions which do not correspond to an articulated and sustainable management system. Nowadays NASA faces the challenge of reviewing, diagnosing and planning future needs of human resources with specific nuclear expertise aimed at taking up key positions in the company. In view of such need, the Human Resources Department in partnership with other departments, designed and are currently implementing a systematic plan of critical positions succession.
The objective of the project is to develop a structured and formal process of succession of those positions considered critical, with the purpose of keeping the operation running while complying with the safety standards of the company.
The TSM was requested by NASA so that WANO's experts may assess the actions developed by the company with the objective of making further progress on the human capital management policy.
A Project of 5 (five) consecutive stages was created in order to plan and organize the actions. Stage N° 1: "Development of a map of critical positions and status thereof" Stage N° 2: "Classification and assessment of Successors according to their capabilities". Stage N° 3: "Preparation of Successors". Stage N° 4: "Transfer from the Predecessor to the Successor". Stage N° 5: "The predecessor steps aside – Assessment of the process."

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National Strategy for Human Resource Development in Emergency Preparedness and Response for a Nuclear Power Programme in Nigeria

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Nigeria has committed itself to embark on a nuclear power programme and is using the IAEA safety standards to build the necessary infrastructure. Establishing national arrangements and capabilities for emergency preparedness and response is one of the principal elements in the development of national infrastructure for a national nuclear programme. In this regard, Nigeria hosted EPREV Mission in 2015 to review its EPR arrangements. The Mission identified gaps in human resources needed to respond to nuclear emergencies. This paper aims at presenting Nigeria's strategies in addressing the for human resources needed to respond to nuclear emergencies. Information were obtained from secondary data using qualitative approach. Implementation of the national strategy will provide the necessary human resources for a sustainable emergency preparedness and response infrastructure in Nigeria.

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Experience on establishment of training program for the new NPP

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Starting the training program well in advance of NPP operation is important for the new nuclear units. Well organized training systems made up of qualified instructors, simulators, training materials, and assessment packages are necessary before start-up. Also, it is highly recommended the Systematic Approach to Training (SAT) should be implemented at an earlier stage.
This presentation is about our experience regarding the overseas training project (for Baraka NPPs in the UAE). This presentation will cover the following topics: 1) Description of how KHNP has prepared the training program for the new employees (securing qualified instructors, experts, and training materials based on the SAT). 2) Introduction to invaluable experiences, which helps the development of human resources for new nuclear units, (e.g. nuclear familiarization courses for college students). 3) Challenging issues such as language barriers and cultural differences between instructors and students when conducting initial training programs. 4) Lessons learned throughout the implementation of training courses.

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Non formal learning in nuclear energy: a way to engage with the complexity?

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Throughout the world, nuclear programs, either established or still to come in newcomer countries, faces common challenges dealing with high political content and sensitivity of the decisions regarding nuclear and also the complexity of the "nuclear web" with aspects as different as technology, safety, security and non-proliferation, time scales, public acceptance, opponents, economics, geopolitics, . . . Adding to the complexity, some of these items appear to be highly dependent of local cultural features and habits. Giving an overview of all these aspects through classical, formal training courses has proven to be a never-ending task. Training sessions are often too long, focusing is problematic as well as the adaptation of the messages to trainees exhibiting very different personal tracks, skills and cultural approaches. Although formal courses still remain essential for training individuals on focused skills, non-formal approaches have proven to be very efficient for giving the "broad picture" view to some selected people. Such non-formal approaches include: - Learning tours and visits; - topical seminars; - Internships or fellowships. Such programs allow to let the attendants develop their personal view of complex questions, in particular socio-technical issues, by viewing or listening to actual examples and practical approaches. French nuclear stakeholders have developed through time comprehensive non-formal learnings programs, both within bilateral and multilateral contexts. Examples of topical learning tours will be given, in particular learning tours focusing on Human Resources Development and on stakeholders involvement, also of short - 1 day -, sharply focused topical seminars such as those organized together with Polish Authorities. Far to be superficial promotion events, these programs has come to bring real value and efficiency when compared to their respective duration and cost.

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A Systematic Approach to Human Resource Development Plan for a New Nuclear Power Programme

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The Human Resource Development (HRD) plan for a new nuclear power programme should be developed as short term plan for the first Nuclear Power Plant (NPP) and long term plan (beyond first NPP). The short term plan should address the human resource requirements starting from pre-project phase to plant operation phase of various organizations like NEPIO, regulatory body, owner/operator organization, technical support organization, and education & training Institutes. The long term plan addressing the human resource requirements for future NPPs, R&D, nuclear fuel cycle organizations and other supporting organizations could be developed at a later stage.
Many of the IAEA guidelines for human resource, except TRS 200 and NG-T-3.10, are exclusively developed for specific organization while others cover either workforce planning, training or managing human resource for various organizations. The latest IAEA guideline NG-T-3.10 has satisfactorily addressed this issue but it is only limited to workforce planning. Apart from this, it has only given an idea on what factors to be considered and on how to get started for workforce planning; but not a complete idea for developing a HRD plan.
Proper planning of human resource is essential for successful implementation of the programme and for its long term sustainability. In this paper, a systematic approach to HRD plan, based on relevant IAEA guidelines, for a new nuclear power programme is presented in five simple steps i.e. Plan, Recruit, Train, Deploy and Manage. It primarily focus on human resource required for nuclear organizations based on its organizational structure, roles and responsibilities, qualification and skills, staffing requirement, their identification, recruitment, training, deploying and managing them throughout the entire programme. This paper will help the new comer countries as a guideline supporting IAEA guidelines to develop a HRD plan in an easy manner.

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Adopting with enhancements the IAEA's SARCoN Methodology as Competency Assessment Tool for both Regulatory and Non-Regulatory Technical Tasks

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The paper presents the prototype and the pilot implementation of the Web-based Competency Management System (WCMS) developed for the Philippine Nuclear Research Institute (PNRI), the current Regulatory Body of the Philippines. The system adopted the IAEA's Systematic Assessment for Regulatory Competence or SARCoN to apply for both regulatory and non-regulatory technical tasks. The system was upgraded from a spreadsheet format into a web-based platform. This improved infrastructure provides for a central database of assessments and allows for multi-use at the same time. And more importantly, the system is integrated into the PNRI's Institutional Information System, in particular to the Nuclear Knowledge Management Information System and the Human Resource Information System. The system was designed for implementation in a PHP CodeIgnitor platform, hosted in a Linux operating system with Apache as its web server and MySQL as its Relational Database Management System.
The application of the SARCoN methodology in PNRI is not new. The Nuclear Regulatory Division, the organizational group in PNRI who performs the regulatory tasks, has had many years of experience in using the tool. They had used the tool for self-assessment by its staff and informally used the results in determining the priority trainings of each staff. For the rest of PNRI, this current implementation included the development of the different KSAs for the different competences required by each job position and organizational unit. The experience in this undertaking is described, as well, in the paper. This included an IAEA Expert Mission who reviewed and provided enhancements of the KSAs. Finally, the paper describes the competency assessment process of PNRI including its role in the development of a Human Resource Development Program covering all staff, regulators, researchers, trainers, nuclear-allied service providers, and other technical support workers.

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IN DEFENSE OF AN EXHAUSTIVE INDIVIDUAL LICENSING SYSTEM AS A STRATEGY FOR CONSOLIDATING A SOLID NUCLEAR WORKFORCE. More than 60 years' experience of the Nuclear Regulatory Authority of Argentina

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The regulatory programme of the Argentine associated with the licensing of a nuclear activity, focuses on two processes that are carried out in parallel: licensing of the installation itself and licensing of the personnel that will work in the facility with different degrees of responsibility. The common objective of both processes is to assure that radiological safety of the public, of the occupationally exposed personnel and of the environment from the beginning of the activity to the end of its useful life and final closure is developed according with international standards..

In the process of licensing the installation itself, the required technical documentation is evaluated applying a graded approach that takes into consideration the radiological risk associated with it. The personnel licensing process takes into account the complexity of the installation and the responsibilities on safety of the function to be performed in order to establish different levels of requirements regarding the basic training, specific training, on-the-job training and re-training required.

The personnel licensing process, which is particularly comprehensive, is considered as strength of the Argentine nuclear regulatory system. By means of this approach, the conditions in the operation of the nuclear facilities are reinforced, assuring that the responsibility for the operation is assumed by personnel whose training and qualification, have been evaluated by the regulatory body and by peers, through consultation with an advisory council. The periodic retraining programs required are mainly oriented to the discussion and assimilation of the lessons learned from accidental situations and the updating of knowledge according to the state of the art.

This paper describes the personnel licensing system applied by the Argentine Nuclear Regulatory Authority in nuclear facilities and discusses their strengths, raising an open discussion with those who maintain that this system can be seen as an over-regulation.

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Establishment Working Permit and recruitment of NMAC Officer in the Nuclear Facilities Through Training and Examination - Indonesian Best Practice.

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ABSTARCT Training and Examination for Nuclear Material Officer. Indonesia has signed Safeguards agreement in 1980 and Additional Protocol to Safeguards agreement in 1999. By signing of agreements, the Republic of Indonesia shows its commitment and concern to maintain the world free of nuclear weapons and using nuclear energy only for peaceful purposes. Therefor all nuclear materials should be recorded and reported to the IAEA in a completely and correctly manner with the State System of Accounting for and Control of Nuclear Material (SSAC). To be able to maintain the nuclear material accounting system, it is required the competent of human resources, both for nuclear material officer in each facility and human resources for regulatory body. In order to ensure the competence and capability of human resources of nuclear material officer, BAPETEN as Regulatory body issues a working permit for nuclear installation and nuclear material officers. In this paper will explain the mechanism of training and qualifying-examination for nuclear material officer in order to obtain a working permit, which is valid in any nuclear facilities as well as in the future Nuclear Power Plant.

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The INSC project PH3.01/09: another example of successful assistance for enhancing the Philippines' capabilities on nuclear safety and radiation protection.

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As part of the Instrument for Nuclear Safety Cooperation (INSC), the European Commission financed a project aimed at assisting Philippines on the efforts for developing their capacity building on the subjects of nuclear safety and radiation protection. The main technical assistance covered by the project for review, improvement and training were on the aspects of regulatory framework, the regulatory oversight process for radioactive practices, the deterministic and probabilistic safety assessments and the review of the Human Resources Development Plan and Training Programme (HRDP&TP) for the Philippines Nuclear Research Institute (PNRI). The combination of training sessions, workshops, technical meetings and on-the-job trainings allowed an effective knowledge transfer and let at obtaining successful results which were used as feedback for improving the updated version of the HRDP&TP. This paper summarizes the whole process from the selection and definition of the subjects and objectives in the Terms of Reference until the results obtained at the end of the project. In particular, the paper provides examples of the learning methods used while showing the impact of their combination for achieving the results.

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The Use of IAEA SARCoN Tool in Workforce Planning and Development in the Nigerian Nuclear Regulatory Authority

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The Federal Government of Nigeria in 2005 expressed political commitment to harness nuclear energy for electricity generation. The Nigerian Nuclear Regulatory Authority (NNRA) was established in 2001 to ensure safe application of nuclear technology in the country. The NNRA is charged with the responsibility for nuclear safety and radiological protection regulation. Since 2010, the NNRA has intensified its efforts in capacity development program preparatory to licensing the first set of NPPs in Nigeria. This paper describes the various strategies in workforce planning and human capacity development to fulfill NNRA statutory functions. The initial training, continuous training and education programme initiatives are discussed. The NNRA in 2013 conducted a Training Need Assessment for nuclear safety with competency gap analysis for Junior, Intermediate and Senior staff level positions in respect of the core mandate of the Authority. This was conducted using the IAEA-TECDOC-1254 and the IAEA SARCoN tool. In 2017, an IAEA Workshop on Competency Development in Nuclear Safety, Security and Safeguards for regulating NPP was held. The NNRA is currently applying the IAEA Safety Reports Series No. 79 and latest version of IAEA SARCoN for competency assessment in Nuclear Safety, Security and Safeguards for regulating NPPs. This is being carried out by identifying the regulatory functions, tasks based on the required competencies and the associated KSAs. The National Institute for Radiation Protection and Research is the Technical Support arm of the NNRA and it offers training and education programmes in Radiation Protection. Many NNRA Officers and Operators have been trained at the Institute. The NNRA also leverages on its collaboration with different international organizations for the training and education purposes. The challenges of the planning and developing the requisite competence are due to insufficient resources for this. This calls for prioritizing allocation of resources to fill the identified gaps.

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Guidelines to Think about a Human Capital Development Policy to Comply with the Strategic Plan at the Argentine Atomic Energy Commission

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CNEA is an autarchic government agency established in 1950 with the purposes of advising the Executive on the definition of the nuclear policy and of undertaking related research and technological developments. In 2006 a rebirth of the nuclear plan was announced. As from this rebirth, there has been an increase in personnel together with a boost for collaborative process in the organization which ended with the elaboration of the Institutional Strategic Plan 2010-2019 in order to orient the nuclear activity towards its last update in 2015-2025. This organization is highly complex due to the multidisciplinary approach it has. In this sense, the Institutional Strategic Plan boosted an internal order to fulfill institutional objectives. The main thematic areas were defined, those related to the nuclear activities and the main ones, such as those that provide support to the former ones. The determination of institutional strategic objectives is the result of a planning participative process. It has required knowledge preservation due to the generational gap and also widening of such knowledge, along with the work skills which strengthen the mission accomplishment in the institution. In conclusion, an analysis is presented of the quantity and quality of the personnel from the thematic areas to delimit the steps for knowledge transfer in order to preserve this knowledge. Moreover, the relation between this preservation, widening and skill development is explained through a path career plan necessary to retain the personnel and increase the organizational performance in order to meet the requirements from the Institutional Strategic Plan 2015-2025.

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Leveraging Modern Media for Rapid Nuclear Knowledge Access

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From the beginning of nuclear power generation, nuclear organizations typically stored accumulated knowledge and expertise in hard copy file cabinets followed by computerized filing systems organized in similar manner to paper archives. Nuclear personnel relied on alphabetical or topical indexing and later key word search to search for and access important information.
Successful searches depend on the quality and consistency of data entry for hard copy or computer files. Today's newer and younger nuclear professionals are not accustomed to time-consuming searches by topic or keyword. Rather, their first instinct is to reach for any online device and conduct a google search. To obtain key knowledge regarding a topic or concept, they are often directed to or search YouTube. A great deal of nuclear knowledge can be found in detailed design basis documents, specifications, drawings, vendor information etc. Knowledge workers new to the nuclear industry need to quickly comprehend higher-level concepts, such as an answers to the questions: What are the regulations and standards pertaining to nuclear fire protection, and which ones are my plant required to meet? To meet this need and provide instantaneous access to the answers, a "Just In Time" videos concept has been developed. Currently under development, this video library will contain hundreds or even thousands of concise, logical videos on a wide range of nuclear power topics. The content of all videos will be full-text searchable and each video will contain hyper-links to more detailed, relevant information. The intent of the library is to provide rapid access to high level information using mechanisms familiar to all generations. The purpose of this paper is to gather feedback on this video library concept and ask for ideas and contributions to develop new videos.

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Developing National Inspectors for Safeguards in Malaysia

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Under the Atomic Energy Licensing Act 1984, Atomic Energy Licensing Board (AELB) is the nuclear regulatory authority in Malaysia that ensures the safe and peaceful use of nuclear technology. One of AELB's key functions is to perform obligations arising from conventions or treaties relating to nuclear matters or atomic energy to which Malaysia is a party to; hence obligations under the Comprehensive Safeguards Agreement (CSA) concluded by Malaysia with the IAEA in 1972 falls under the responsibility of AELB. To effectively carry out its function of maintaining the State System of Accounting for and Control of Nuclear Material (SSAC) in Malaysia, AELB needs to develop and sustain qualified and competent staff.
Currently AELB does not have a formal certification programme for inspectors in safeguards. New officers responsible for safeguards implementation in AELB are given basic training through classroom lectures and on the job training by senior officers at Safeguards Section, Nuclear Installation Division. IAEA SSAC training courses are the main source of training platform for AELB officers in safeguards. With the aim of developing a self-sustaining training programme for inspectors in safeguards, AELB has been cooperating with NNSA-USDOE under the International Nuclear Safeguards Engagement Program (INSEP) in organising training courses tailored for national inspectors in Malaysia. Two such workshops were held in 2015 and 2017 which involved expert trainers from IAEA and USDOE. These workshops covered all phases in an inspection from planning to report writing which were given through lectures and hands on exercises; a mock safeguards inspection exercise was conducted during the workshops to allow the participants to apply what they have learnt immediately.
With lessons learnt from the workshops, AELB is working towards developing a more structured training module in safeguards inspection that will include the fundamental concepts in safeguards and common inspection techniques.

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Introduction of KEPCO-KPS HRD program

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1. Introduction of our vision and right people
2. Basic course for deveploping of human resource
3. Total system regarding to KEPCO-KPS HRD
4. Fundamental course for training and education
5. Build-up leadership
6. The internal system of qualification and certification
7. Introduction of self-development program
8. Basic skill-up prgram for new employees

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Development of Individuals and Team within the Organizations

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For a nuclear company, it is important to secure strong and motivated experts and align them to team mission and ultimately company goal. As a state-owned company, which guarantees hiring until legal age limit and put higher values on cooperation rather than competition, motivation is not always easy especially for lower level employees. KHNP is using MBO as a tool for performance evaluation Assessment Center for capability evaluation. We also introduced CDP and IDP for career development. With MBO we are moving towards performance oriented evaluation rather than seniority oriented evaluation which is typical to state owned company. By screening uncapable employees through Assessment Center, we are now able to selected more balanced and objectively proven management level employees. CDP and IDP makes under management level employees to plan their future career systematically and we can expect and fine tune development plan for each employees and company as a whole. Each teams reward is linked to its KPI aligned with company goal. These days, we are facing some challenges and limitations at certain field, which is engineering and maintenance. After bribe scandal on 2012, some employees in that field are fired and supervision got strict and emplyees morale nose dived. We are trying to overcome these difficulties.

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Doosan HR System Introduction

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This session will cover the following topics 1) Overview of Doosan Group & businesses 2) DHI Business Fields & Organization 3) PEOPLE PHILOSOPHY & HR STRATEGY 4) HR PROGRAM FOR DOOSAN PEOPLE 5) HRD STRATEGY & STRUCTURE

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Challenge to nurture global talents and team capacity extending competitive edge over rivals

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In order to extend organizational longevity or sustainable growth not losing competitive edge in indefinite struggling business environment, most of forerunner companies in nuclear industry are focusing on how to develop superior team structure. During recent adverse public sentiment period, after Fukushima accident in 2011, Korean nuclear operator, KHNP has exerted its human capacity into global top level from domestic leading player position. UAE Barakah nuclear power plant new build project, the only example of Korean nuclear technology strength over other foreign cohorts, has shown that KHNP would provide long term exportable human resources into new comer countries, even already nuclear experienced countries if KHNP has a good structural team management program. The foremost need to nurture world top class human resources are indispensable ingredients to increase internal competitiveness and motivation of workforces who usually adapt stringent hierarchical culture. Authors will show Korean implementation program to be beneficial for long term growth.

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Post-Fukushima's organizational culture

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Post-Fukushima's organizational culture

1. "5S" approach 3S (Traditional approach) = SAFETY + SECURITY + SAFEGURD, 4S=3S + Competency-based approach (SANITY) 5S=4S + Sustainable development concept (SUSTAINABILITY).

2. New paradigm: From risk management to risk governance. After the global financial and economic crisis of 2008-2009 and the accident at Fukushima Daiichi Nuclear Power Plant began the formation of a new paradigm of risk management. This paradigm involves a transition at each workplace from identifying the risks associated with the unpreparedness of staff in emergency situations to carry out their tasks, towards the modelling solutions to the problems in cooperation with competent stakeholders. And assessment of risks throughout the cycle of life nuclear power programme (NPP), particularly for insurance purposes, is subject to the choice of the optimal solution chains of problems. Leadership, according to the updated safety culture, implies the ability to lead and organize this work with the involvement of all necessary and available intellectual resources.

3. The potential of four generations of knowledge management technology The history of knowledge-based management as a discipline that uses the latest information and communication technologies (ICT) may be described in the four waves ..... Currently, the fourth wave approached the search formats of programmable systems. The use of artificial intelligence allows to ensure the circulation of knowledge in global scale within a single system solution with the mechanisms of intercultural translation, inter-organizational transfers and intergenerational transmission in a centuries-old range.

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Implementing Human Reliability Program for Nigerian Nuclear Industry

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The concept of nuclear security was formally introduced into the nuclear industry in Nigeria in 2011. Human Reliability Program (HRP) as an integral part of the nuclear security to mitigate the incidence of insider threat among the workforce. The Nigerian Research Reactor-1(NIRR-1) is one of the Miniature Neutron Source Reactor facility designed by China Institute of Atomic Energy that is cited outside China. It is one of the critical facilities in the Nigerian nuclear Industry that needs to be protected against the current emerging national and global threats. Development of programs such as the HRP is essential to protect the public and the environment from theft or sabotage of nuclear or radiological materials. In this work, we describe the development of HRP for NIRR-1 as the main critical facility in the country and modalities on how the program can be extended to a national program to enhance security of Nigerian critical infrastructure.

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KHNP Recruitment & Manpower Training System

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This session content is about what KHNP's vision is and what process it takes to hire and train employees to achieve their vision. KHNP's vision is " Trusted Global Energy Leader." And the five core values that KHNP employees must have are 'Technology', 'Respect', 'Ultimate safety', 'Social responsibility' and 'Timeless integrity'.
KHNP's HRD vision is 'foster future energy leader with core values in mind', which is set to meet the company's vision and core values. KHNP is making efforts on employee's HRD to secure and foster outstanding human resources based on the belief that 'Human' is the most important asset to achieve an organization's vision.
KHNP selects a new employee through a three-step process to recruit a right person who meets the KHNP's standard and has the job qualifications. In the first phase, NCS job competency tests are conducted to verify applicants have the ability to perform their duties. In the second phase, job performance interviews, creative interviews, English interviews, and personality tests are conducted In the third phase, interviews are conducted to verify applicants' basic skills, values and attitudes, and compliance with KHNP's standard.
Employees who enter the company through such procedures will be trained to grow into future energy leaders according to KHNP HRD vision. KHNP has implemented competency training based on the CDP.
KHNP's training structure is composed of three competences: common competency, leadership competency, and job competency. Common competency training is an education to internalize KHNP's mission and core values. Leadership competency training is a specialized education for each level from new employees to executives according to their job roles and responsibilities. Job competency training is an education consisting of the behaviors, knowledge and expertise necessary to produce higher performance.

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Lessons learned: Short summary of Rosatom experience of HRD and WF planning with the Partner countries – negative and positive outcomes.

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Rosatom has a long history of international cooperation on construction and commissioning of nuclear facilities – both research reactors and NPPs.
Allocation of any nuclear facility as well as its' further successful and sustainable operation by a country-recipient require high level of Rosatom attention to the quantity and quality of relevant qualified Human Resources that country a) has available and/or b) can assign for specific education and training. This statement is even fairer for the newcomer countries, which have additional difficulties to determine the first steps in Human Resource Development and Workforce Planning for the newborn atomic industry.
Giving respect to the power and value of Nuclear Knowledge Management system Rosatom accumulated and analysed own positive and negative experience on HRD and WFP-related projects with the partner countries. The summary was shaped up in the methodology of HRD country planning to make nuclear HRD integration go more smoothly and progressively. This methodology, of course, cannot be considered as a "magic pill" for everyone and should be tuned carefully and respectively for the realities and demand of each country in particular with deep

involvement of its' authorized representatives. However, it compliments to Rosatom best practices and mitigates common risks with high probability of facing.
During the presentation the authors will demonstrate some HRD cases and lessons learned from the recent Rosatom past, highlight "pain spots" that are usually shadowed by the bigger challenges but have all means to spoil the game as well as pay attention to prescription of abovementioned methodology.

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New challenges & requirements for workforce & engineers. Atomskills championship.

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ROSATOM proactively contributes to the development of a system for training workers and engineering personnel based on WorldSkills methodology. In 2016 and 2017 we hosted two editions of WorldSkills – AtomSkills professional industry championships. Having started with 10 competences in 2016, we reached a total of 19 competences in 2017, with most of them representing unique industry-focused skills that have crucial importance for our sector. More than 1,700 people took part in these two championships.
A pool of more than 600 industry experts has been created. Many of them are certified professionals under WorldSkills methodology, as well as specialized programs offered by the leading professional associations. Over this period of time, more than 80 industry experts benefited from various training programs in specialized organizations in Russia, Finland and Germany. More than 230 experts took part in national and international championships.
For ROSATOM, promoting and facilitating the implementation of single training standards based on the best global practices is an essential element for industry development. Experts possess unique competencies and can act as tutors for young talented workers. Workers seek to boost their profile by becoming experts, while for the corporation in general training experts is a way to ensure continuity in the transfer of unique skills, a critical feature for knowledge preservation and transfer within the industry. This has special significance for high-technology companies like ROSATOM, since this mechanism serves as a foundation for training a new generation of workers and engineers.
WorldSkills does not boil down to holding captivating national and international competitions, but also implies consistent, system-wide efforts to develop a personnel training system under international standards with the view to ensuring ROSATOM competitiveness. Industry-specific centers of competence are expected to carry this momentum forward.

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Leadership of Top Managers in Safety Culture Matters: Experience of Electric Power Division of Rosatom

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Safety is the highest priority in the nuclear industry. Any managerial decisions shall be made based on consideration of a totality of legislative and regulatory provisions, standards and rules in the fields of atomic energy use, labour protection, industrial, fire, environmental and other types of safety, and shall ensure continuity of the safety performance improvement process. Senior managers' leadership attitude towards development and enhancement of safety culture is demonstrated by the following. They: • have assumed personal obligations (going beyond their KPI on LTIFR and reduction of severity of injuries) with regard to safety culture fostering based on the SMART principle; • are personally responsible for safety culture factors (such as processes and policies, training, equipment, a role-based model of a group, role-based model of a leadership

team, plans and safety); • are personally involved in activities on auditing safe behaviours of their staff; • are developing communications and tools for personnel motivation towards safety culture enhancement; • provide for sharing and replication of best practices within both the Division and nuclear power industry as a whole.

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The role of HR function in the digital era: business expectations and HR potential

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We are in the era of digitalization, where Rosatom aiming at keeping its leading position, preserving high standard of operational safety, production and services. The key issues are to seek for talented engineers and to develop the leaders of the future, capable to bring Rosatom in the world leaders among high technology companies. Successful team is the key element in the competition, and the key success factor in the innovation. That means that Rosatom has to have incorporated system of attraction and support of talents starting from till kindergarten till his/her recruitment in the company and further development of his/her potential.

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Rosatom approach for workforce planning challenges to assure NPP construction roadmap in a decade perspective.

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Rosatom has secured the world's largest portfolio of high capacity nuclear power plant construction contracts for 12 years into the future. At the same time, building a nuclear power plant involves a complicated technological chain, stretching over a period of about 10 years: from surveying, design, construction, equipment making, to the adjusting and startup procedures, and preparation of the infrastructure and personnel for the new facility. All this requires a large number of qualified Rosatom personnel with various competencies. This is why it is so important to have the necessary human resources and to ensure that they are properly trained. How do you estimate the number of people needed at each stage of construction, what competencies should they have and when should they start? How do you eliminate the staff shortage and train the right staff for the right time? For this purpose, Rosatom has developed an automated model of human resources planning and an automated process of making strategic plans for human resourcing. Even today, Rosatom knows who will be building its power plant in 2030. We will tell you how we can automatically calculate the required number of staff by year and for different types of units; what makes these numbers change; what strategic plans for human resourcing are all about; what business decisions we have to make in the process of planning human resources; and what errors should be avoided.

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The pace of Rosatom: the system of work with next generation in Russia to save the competitiveness in industry

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The work with the next generation as a tool for the company's competitiveness 1. What we do to understand how many young professionals we will need in 1,2 and 10 years' time? 2. What are

the components of the system of work with the next generation to meet our company's needs for highly qualified young professional? 3. Development of the expertise of HR managers, line managers and mentors in their work with the next generation 1. Planning. Rosatom consists of different companies which need highly qualified employees in different areas. In order to support continuous employees pipeline Rosatom has developed a special online platform which collects and analysis data and foresees the demand for graduates in the industry. As result Rosatom can inform the Ministry of Education about the quantity of professionals the industry will need in 5 or 10 year's time. 2. Attraction, selection and development. The components of the system of work with the next generation to meet our company's needs for highly qualified young professionals. Work with schoolchildren, students and young specialists. 3. Generational bridge.

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Raising leaders of the future: programs of leadership potential development - from young specialist to top management.

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1. Program consistency. There is a critical need to grow talents from within. Rosatom applies holistic systematic approach to the way it develops its leaders. From the very beginning of their management careers leaders of Russian nuclear industry are put in a well-balanced learning environment which offer on-the-job and in-class learning interventions, coaching, mentoring, action learning, shadowing and a lot of self-reflection.
2. Skills, competencies and knowledge of the future industry leaders. As one of the global technological leaders Rosatom keeps in focus both technical/nuclear capabilities and soft skills of its leaders. Being put in a highly volatile, unstable and complex environment we apply 'two-components' approach: (1) we provide the skills that are in demand here and now as even the most future-oriented companies have to deal with management tasks and (2) we develop the future skills that allow us to feel more confident in unknown future.
3. Leadership programs as an instrument of talents engagement in the key tasks/challenges of the nuclear industry. The pool of 'the agents of change' Rosatom engages its talent-pool into solving of real business challenges. Each of development program's participants is involved into a project fitted in one of three strategic goals: (1) to increase share on international markets; (2) to reduce production costs and the lead time; (3) to develop new products for domestic and international markets. Rosatom has a unique approach on how to identify the capabilities for each of the managers, which allows to apply the best of the individual talent to help Rosatom to become a leader in the global nuclear industry.

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Successful career development and succession planning in Rosatom

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In developing its career planning and continuity system, Rosatom set two goals: 1. To increase employees' involvement in choosing a career path 2. To decrease personnel risks by preparing high-potential employees to assume key leadership positions This system involves developing a range of career paths, so that each employee could choose the next career step and match competencies with the next position's requirements. For convenience and ease of use, this

process was automated. Over a few years, we managed to increase employees' career opportunity engagement factor from 29 to 61 points. To provide opportunities for high-potential employees to move up, and prevent their superiors from hiding them away, we have opened up access to their profiles to all industry leaders. In doing so, we needed to develop clear rules of the game to avoid conflict. Teaching everyone to share human resources was a major challenge. After opening up opportunities for employees and giving them a choice, we faced a problem of people being overly selective about career opportunities and some vacancies remain open for a long time. In our presentation, we will explain how we approach continuity to ensure that there is trained personnel for managerial positions and to minimize personnel risks.

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Engineering education - how we will learn and teach in the digital future?

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The pilot program HES-MEPhI 2017-2018 1st September of 2017 we have launched a pilot Master degree program "Engineers for the Digital Economy", there are 5 teams each consisting of 4 students studying in different majors (1 software engineer + 1 design engineer + 1 physicist + 1 system engineer) who work jointly to solve the practical tasks of the company. This activity shall result not only in the students' master's theses and the implementation of solutions developed by students in cooperation with the ASE staff, but also will lead to build-up of new competencies in the company. We take HES students to work in the ASE from the first day of their training. The size of their income is directly related to their entry points in the exams. Later, depending on their academic performance or desire to work more, they have the opportunity to increase their income. During their training together with a mentor from the ASE they work on the project which is a challenge to the technical competencies in the company, and this work should be completed with the mandatory commissioning of the developed solution. Example project assignment for a group: Development and implementation of an integration solution between the calculation complex "Thermal hydraulic calculations of heat networks - Zulu Thermo" and the information model of nuclear power plants