

The Next Steps for the Gulf Nuclear Energy Infrastructure Institute (GNEII)

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ABSTRACT

The Gulf Nuclear Energy Infrastructure Institute (GNEII) has a vision to be a regional centre for human resource development for peaceful nuclear power programs. To build on the success during its first six years of operation, GNEII is evolving and expanding as it successfully transitions to operational ownership by Khalifa University of Science and Technology in Abu Dhabi. In this manner, GNEII is enhancing its capacity to develop a responsible nuclear energy culture and institutionalize key nuclear energy safety, safeguards and security ('3S'), and nonproliferation norms in the future decision-makers of the Gulf-region nuclear power programs. In addition (and in close coordination with Abu Dhabi Polytechnic), GNEII is developing a modularized applied Master's degree program that is flexible enough to meet the wide range of knowledge transfer needs to a diverse group of stakeholders with responsibilities in the nuclear '3S' areas. This conference paper will introduce the structure and summarize the curriculum for GNEII's applied Master's degree program in nuclear energy infrastructure, as well as describe the Emirates Skills compliance requirements for this vocational education and training curriculum that supported its application for educational accreditation. GNEII's plans for initiating this educational program to serve regional needs will also be discussed. This paper will also summarize other institute plans to leverage its role in helping Khalifa University recently being named an International Atomic Energy Agency (IAEA) Collaborating Centre for Nuclear Energy Infrastructure and Human Resource Development. This distinction validates the world wide recognition GNEII has accomplished over the past six years and provides a strong foundation for the institute to continue this work. Finally, this paper will describe GNEII's strategy on its quest to serve as a regional resource supporting the development and operations of responsible nuclear energy programs.

INTRODUCTION

The Gulf Nuclear Energy Infrastructure Institute (GNEII) was established in 2011 by a strategic partnership between Khalifa University of Science and Technology (KU), Sandia National Laboratories (SNL), and Nuclear Security Science and Policy Institute/Texas A&M University (NSSPI/TAMU). GNEII is physically located in KU main campus in Abu Dhabi city. The institute was initiated as a result of a growing interest in nuclear energy in the Middle East region, and the need for sustainable human resources development for responsible nuclear energy programs. GNEII is an educational and research entity that goes beyond traditional training courses. The institute focuses on institutionalization of safety, security, and safeguards (3S) norms in the future decision-makers of Middle East region's nuclear energy programs through professional development [1].

GNEII is based on three main pillars, Education, Research and Technical Services (Figure 1) [2]. For the first pillar, GNEII education curriculum, is built as an integrated 3S educational paradigm for responsible nuclear energy programs. In the first six years of operation (2011-2016), GNEII offered a semester long ‘Fundamentals Course’ taught by experts from the UAE, U.S. and other international collaborators across a range of nuclear energy infrastructure topics. Currently, the institute is transitioning from its previous curriculum to a more structured degree-based program which is discussed below. The second pillar focuses on ongoing research projects with national and international partners, and the possibility for new research opportunities. This includes signing of the second Memorandum of Understanding (MOU 2.0) between GNEII within KU and the United States Government (USG) stakeholders; namely SNL and Texas A&M Engineering Experiment Station within TAMU to establish a framework for continuing collaboration with a research emphasis. This pillar also concentrates on research projects and publications that are integral to GNEII’s ongoing success, and to create a mechanism for GNEII to propose, initiate, conduct and publicize research in its core competency areas. Thus, the main goal for this pillar is to provide a mechanism to ensure that regional research on nuclear matters are shared with global nuclear energy community. The third pillar comprises technical services provided to the different stakeholders which aims to leverage KU’s Nuclear Engineering Department capabilities. This pillar also provides opportunities for practical exercises, hands-on instruction, and real-life scenario simulations, for example GNEII provided a reach back service for Abu Dhabi Customs at Khalifa port for activity detected by the installed portal monitors and verified by HPGe gamma monitors.

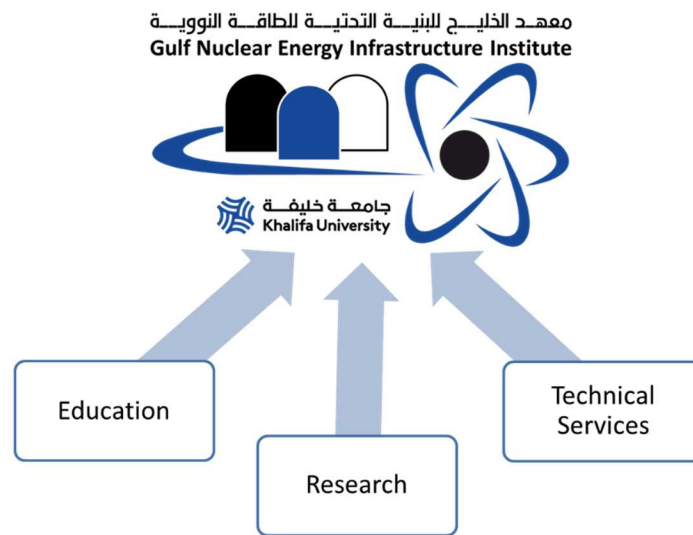


Figure 1. GNEII Foundational Pillars

GNEII EDUCATION CURRICULUM – PHASE I

For the first six years of operation, GNEII education pillar is based on GNEII Fundamentals Course which was the institute’s primary knowledge transfer mechanism. It was conducted as an annual intensive semester-long program. The Fundamentals Course combined the advantages of professional development short courses, such as hands-on exercises and world top practitioners as subject matter experts and lecturers, and traditional university courses (e.g., applied research project and higher

intellectual standards). GNEII Fundamentals Course was composed of the following topics: (1) nuclear energy fundamentals (why nuclear power; critical and systems thinking; introduction to 3S; nuclear and reactor physics); (2) policy and operations considerations (nuclear power plant operations and systems; nuclear fuel cycle technologies and issues; nonproliferation policy); and (3) 3S interactions (technical, operational and interactive elements of safeguards, security and safety) as shown in the 2016 Fundamentals Course Curriculum overview in Figure 2. During GNEII Phase I, 99 fellows representing 5 countries and 3 main stakeholders within UAE graduated from GNEII Fundamentals Course [3].

One of the unique aspects of GNEII Fundamentals Course is the requirement for all fellows to complete a Capstone Project. The Capstone Project requires GNEII Fellows to apply the knowledge gained from GNEII curriculum in a practical way – to research and develop solutions to problems identified by the UAE stakeholder and Khalifa University faculty. This requirement allows fellows to demonstrate their increased performance capacity and relates their education to real professional responsibilities. Stakeholders also value the Capstone because it helps them solve real problems faced on a regular basis. The Capstone Project requirement makes GNEII fundamentals course different from traditional training or professional development courses and provides a new metric by which the success of GNEII and its graduates can be evaluated. GNEII fundamental course culminates in annual GNEII Symposium where fellows present their projects and received feedback from their peers, representatives of UAE stakeholder, US national labs and universities, and a number of high ranking guests.

GNEII 2016 Fundamentals Course Curriculum			
17-Jan Week 1	Overview, Need for Nuclear, History, Components, Economics, Critical & System Thinking, Scientific Method, 3S System		
24-Jan Week 2	Nuclear & Radiation Physics, Neutron Interactions, Basic Reactor Theory, Radiation Effects, Nuclear Technology		
31-Jan Week 3	Reactor Operations, Power Plant Systems, Probabilistic Risk Assessment		
7-Feb Week 4	Nuclear Fuel Cycle, Nuclear Nonproliferation History & Policy		
14-Feb Week 5	SAFEGUARDS (2 weeks) State System of Accountancy Controls, Non-Destructive and Destructive Analysis, Bulk and Item Facilities		
21-Feb Week 6			
28-Feb Week 7	SAFETY (2 weeks) Safety Culture, Engineered Safety Features, Emergency Response Planning, Radiation Safety		
6-Mar Week 8			
13-Mar Week 9	SECURITY (2 weeks) Security Culture, Physical Protection Systems, Detect, Delay, Respond, Evaluate		
20-Mar Week 10			
27-Mar Week 11	Capstone Research & Preparation (2 weeks)		
3-Apr Week 12			
10-Apr Week 13	Capstone Preparation & Dry Runs <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td style="background-color: #4a7ebb; color: white;">SYMPOSIUM: Capstone Presentations & Certificates</td> <td style="background-color: #e6e6e6;"></td> </tr> </table>	SYMPOSIUM: Capstone Presentations & Certificates	
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Figure 2. GNEII 2016 Fundamentals Course Curriculum Schedule

SUSTAINABILITY AND TRANSITION

The growth and development of GNEII is a part of the strategic plan originated in the February 2011 Memorandum of Understanding (MOU 1.0) signed by Khalifa University, the Nuclear Security Science and Policy Institute/Texas A&M University and Sandia National Laboratories. This plan established 2017 as the year in which operational ownership is transferred from the US to UAE stakeholders. After the 2016 Fundamentals Course, formal GNEII handover took place at the 2016 Symposium. This resulted in decreasing the USG support for GNEII management and operational functions and pushed toward a transition, which primarily geared toward successful knowledge transfer [4]. The main objective of this transition is to develop a more structured degree-based curriculum with a focus on nuclear safety, security, safeguards, and management and leadership.

GNEII Steering Committee (GSC), during its 2015, 2016 and 2017 meetings, accepted recommendations to have a financial plan fully supported by all local and regional stakeholders, and a human capacity plan resourced from all local stakeholders. Also, GSC created the “Finance and Sustainability Subcommittee” that consists of representatives from all GNEII stakeholders, meet more frequently than the GSC, and is responsible for discussing and developing viable specific financial and human capacity plans for GNEII [4].

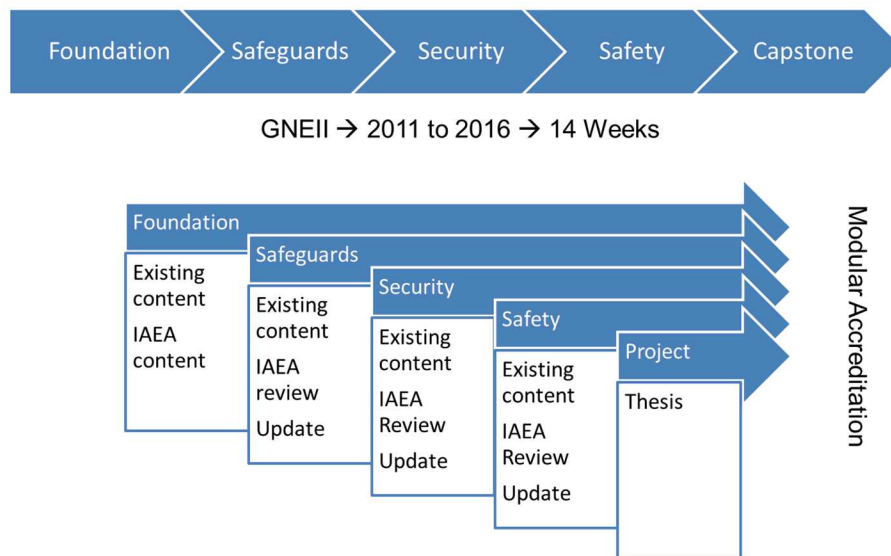


Figure 3. Transition of GNEII Education Curriculum

GNEII EDUCATION CURRICULUM – PHASE II

The main objective in Phase II of GNEII education curriculum is to re-structure the current GNEII fundamentals course in a format suitable for awarding the fellows graduate credits accredited by the Abu Dhabi Ministry of Higher Education and Academic Research. Typically, GNEII fellows do not have a Bachelor of Science in nuclear engineering or even an engineering major; however, historically an overwhelming majority of fellows had a Bachelor of Science degree in a technical subject such as mechanical, chemical, or civil engineering, physics, chemistry or material science. The course content

of the current GNEII program seems suitable for non-engineering graduate credits. As shown in Figure 3, the new modular structure for GNEII education curriculum is based on the main technical modules of the previous GNEII Fundamentals Course along with inputs from the Peer Review conducted by the IAEA subject matter experts in 2017.

In coordination with Abu Dhabi Polytechnic, GNEII curriculum restructuring reflects that a fellow has applied acquired knowledge and skills to the standard of performance required in the workforce. Also, the degree program is constructed so that the Diploma and Applied Master has a qualification level of 8 and 9, respectively, according to the National Qualifications Framework of the United Arab Emirates (QFEmirates) [5]. Figure 4 shows the proposed new Applied Master's degree model for GNEII. For starting the Diploma program, students must either finished the GNEII Fundamentals Course, or gained IAEA Certificate for either Nuclear Energy Management School (NEM) or Nuclear Infrastructure Development School (NID). Both certificates are based on a two-week intensive course (equivalent to 10 full working days) that consists of lectures, exercises, and hands-on experience by subject matter experts. If the fellow fulfills these requirements, he/she can be admitted to the Diploma program. Requirements for the Diploma are to finish 24 credits in total including four 3/4 credits core courses (15 credits), one 3 credits specialization course, and a 6 credits Capstone Project, if the student opts to take just the Diploma (Figure 4). Students who successfully completed the Diploma requirements and who have also completed four 3 credits elective courses in specialization of Nuclear Safety, Security, Safeguards, and Management and Leadership (12 credits), and finished a thesis research of 6 credits will be awarded the GNEII Applied Master's degree.

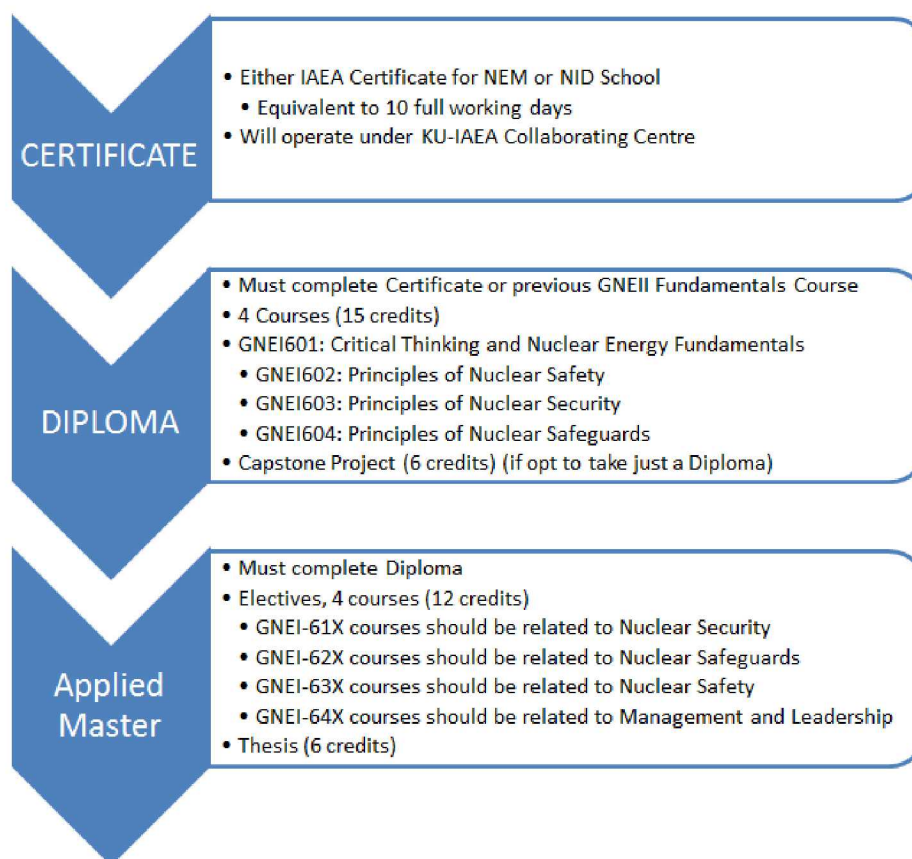


Figure 4. Proposed New Applied Master's Degree Model for GNEII

KU-IAEA COLLABORATING CENTRE

An agreement signed, in the margins of the *IAEA International Ministerial Conference on Nuclear Power in the 21st Century* held in Abu Dhabi in October 2017, designated KU as an IAEA Collaborating Centre. This centre is enabling enhanced sharing of the experience of the UAE in building its nuclear power infrastructure development with other embarking IAEA Member States. The agreement marks the beginning of a four-year period of close cooperation between KU and the IAEA on implementing activities in the field of nuclear power infrastructure and human resource development. In particular, KU will support IAEA activities on enhancing Member States' capabilities in building and assessing the infrastructure required for a nuclear power programme, as well as developing critical competences required for infrastructure development. This cooperation benefits professionals from embarking countries from the know-how which the UAE has developed by building the infrastructure, licensing and constructing its first nuclear power plant in line with the IAEA Milestones approach.

Under the agreement, KU, in collaboration with UAE nuclear stakeholders (ENEC and FANR) and the IAEA, will develop and implement specific courses, including modules for the GNEII programme, to train professionals from Member States in critical areas of nuclear power infrastructure development, such as nuclear safety, security, safeguards, stakeholder involvement, legal and regulatory framework and others. A fellowship programme, including mentoring, will help fellows to gain experience in specific areas of interest in embarking countries. In addition, KU will provide experts to support review missions, training courses and technical meetings organized by the Agency in the area of nuclear infrastructure development.

CONCLUSION

Current transition in the curriculum structure will support GNEII in providing the Gulf, and surrounding region, with a continual source of indigenous nuclear energy professionals with whom the global community can effectively collaborate to achieve broader nuclear energy security, safety and safeguards priorities. Signing of MOU 2.0 with the USG stakeholders established a framework for continuing collaboration and launched Phase II of GNEII operations with an emphasis on the evolution and expansion of peer-to-peer collaboration across the institute's education, research and technical demonstration pillars. Also, GNEII role is important in supporting KU recently being named an IAEA Collaborating Centre for Nuclear Energy Infrastructure and Human Resource Development through its different activities. Currently, GNEII is actively marching toward its mission of becoming a leading entity through which Gulf and Middle East voices can be introduced into global nuclear discourse.

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