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Regional, Educational & Strategic: the Gulf Nuclear Energy Infrastructure Institute (GNEII) in Year 5[a]

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INTRODUCTION

A growing interest in nuclear energy among an increasing number of Middle Eastern states has highlighted a regional need for educational, human, and technical resources necessary to aid in developing responsible nuclear energy programs. This interest emerged amongst a lack of mechanisms for indigenous nuclear energy infrastructure development. A regionally located institutional capability that integrates nuclear energy security, safeguards, and safety (3S) with nuclear energy infrastructure development and education helps bridge the gap between regional nuclear aspirations and capabilities.

Established in 2011, the Gulf Nuclear Energy Infrastructure Institute (GNEII) provides a regional mechanism for developing human resources for responsible nuclear energy programs with a vision to provide the Gulf, and surrounding region, with a continual source of indigenous nuclear energy professionals who can effectively partner with the global community to collaborate to achieve broader nuclear energy security and safety priorities. By combining 3S-centric education, technical demonstration and research, GNEII fulfills its mission of developing a responsible nuclear energy culture and institutionalizing key safety, security and nonproliferation norms in future decision-makers of Gulf-region nuclear energy programs through professional development and training.[1]

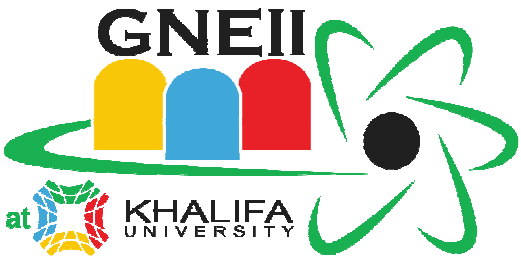

Fig. 1. Logo for GNEII

GNEII is affiliated with the Nuclear Engineering Department at Khalifa University of Science, Technology and Research in Abu Dhabi. UAE stakeholders include the Federal Authority for Nuclear Regulation (FANR), the Emirates Nuclear Energy Corporation (ENEC) and the Critical Infrastructure and Coastal Protection Authority (CICPA). U.S. sponsors include the US Department of Energy's National Nuclear Security Administration Office of Nonproliferation and International Security and the US Department of State's Partnership for Nuclear Security. GNEII's developers/implementers are Sandia National Laboratories (Sandia) and Texas A&M University's Nuclear Security Science and Policy Institute (NSSPI) on the US side and Khalifa University on the UAE side.

GNEII is predicated on three "pillars" that describe how the institute will complete its mission and reach its vision. The first pillar – **education** – moves beyond traditional, more narrowly focused training and provides a comprehensive understanding of the interacting technical, operational and political aspects of responsible nuclear energy programs (see more below). The second pillar – **technology demonstration** – provides opportunities to ground new insights in instruments, simulators, computer codes, and related technical tools potentially encountered in regional nuclear power programs. The third pillar – **research** – allows GNEII Fellows and other collaborators to examine technical, operational, and political aspects of 3S methodologies, nuclear infrastructure development and Gulf/Middle East nuclear interactions.[2]

These pillars are not intended to be independent, but rather were designed with the intent for frequent interaction. Development and evolution of each pillar has progressed at different rates, but the interdependencies between the three are regularly leveraged to enhance the experience of Fellows at the institute. Taken together, GNEII's primary functional elements – education, research, and technical capability – support the institute's key design features; reflect the institute's mission and vision; and serve the institute's regional relevance and sustainability.

GNEII's daily operations and management issues are handled by the GNEII Director. Additional operational support is provided in the form of the GNEII Faculty Coordinator who oversees the planning, preparation and execution of the GNEII Fundamentals Course. The institute's operations are managed between Khalifa University Department of Nuclear Engineering employees and are strongly supported by the U.S. implementers. At the strategic level, the GNEII Steering Committee (GSC) is responsible for setting goals, developing policy, and planning GNEII's overall direction.[3]

The remainder of this paper will describe the core values by which GNEII went from a back of the napkin idea in November 2009 to an institute prepared for a successful ownership transition at the 2016 GNEII Symposium.[b]

DESCRIPTION OF THE INSTITUTE

From its inception, GNEII has been developed based on three core values: **regional**, **educational** and **strategic**.

GNEII's developers and implementers have used these core values to derive the physical manifestation and operational details of the currently operating institute. These core values are clearly interwoven into the fabric of the growing institute – and in many ways are the determinants of its current level of success.

Regional

From its first sketch on the back of a napkin, this institute was never intended to only serve the host entity or the host country. GNEII's early developer's dedicated early efforts on identifying potential host organizations and host nations that had two vital characteristics: (1) be a technological center for the surrounding area and (2) be a central and logistically straightforward travel destination. When organizations were considered as potential hosts for the institute, the inability to meet these characteristics was a nonstarter for institute developers. In light of these desired traits to enhance the 'regionality' of the institute from its early conception, Khalifa University and Abu Dhabi in the United Arab Emirates (UAE) have been excellent hosts for GNEII. In addition, every aspect of GNEII's early development was designed to support regional participation and collaboration. From the novel curriculum to course structure to core research areas to management and oversight, providing numerous, clearly identifiable mechanisms for regional participation in all aspects of GNEII was paramount.

Efforts to achieve this core regional mandate began fairly quickly after GNEII's initial launch in 2011. The speed at which regional outreach and expanded participation occurred is based in large part on the strength of the Fundamentals Course and supported by the strategic partnership in place between GNEII developers, implementers, stakeholders and sponsors (for more, see **Strategic** below).

Table I. Summary of GNEII Fundamentals Course Fellows 2011-2015

Year	ENEC	FANR	CICPA	Non-UAE	Total	Countries Present
2011	4	5	1	0	10	UAE
2012	3	9	2	8	18 (22)[i]	UAE, Kuwait, Saudi Arabia, Qatar, Jordan
2013	4	6	3	7	20	UAE, Saudi Arabia, Qatar
2014	6	3	3	0	12	UAE
2015	7	4	5	2	18	UAE, Jordan
Total	**24**	**27**	**14**	**17**	**78**	**5**

[i]Due to modular structure of the 2012 course not all participants were able to finish all required modules because of the travel restrictions

Building off the experience of the 2011 Pilot Fundamentals Course [3], plans were developed and implemented to invite Fellows from nuclear-related entities from the surrounding region. As indicated in Table I, GNEII's Fundamentals course has an increasingly strong history of including regional participants – totaling 78 (including 17 non-UAE) graduates from five regional countries. Further, the inclusion of regional Fellows provides unique opportunities for multi-national perspectives to emerge during the end of the Fundamentals Course applied research project. These group projects have seen Fellows from a range of nuclear-related organizations (e.g., regulator, security or policy entities) work together to address regionally relevant issues regarding responsible nuclear energy programs.[2]

As GNEII moves beyond its first five years of operation, efforts toward and opportunities for regional outreach will be increased. The first focal point is to develop a more formalized process for admitting and supporting regional students. This includes, but is not limited to, a coordinated regional entity outreach strategy and timeline; streamlined travel and lodging logistics (e.g., visa paperwork) support; and easier to use admission protocols. GNEII will also seek to expand the area in which the outreach strategy will be implemented, re-emphasizing efforts to engage countries with GNEII experience (e.g., Saudi Arabia and Jordan) and re-igniting efforts to engage countries without GNEII experience (e.g., Bahrain and Morocco). Likewise, plans are in motion to develop and extend mechanisms by which interested and relevant regional and international entities can collaborate with the institute. Efforts here will begin by broadening the set of guest instructors invited to support institute activities. To date, this list includes Oak Ridge National Laboratory (ORNL); the World Institute for Nuclear Security (WINS), the United Kingdom's Department of Energy & Climate Change; the International Atomic Energy Agency (IAEA) and the Middle East Scientific Institute for Security (MESIS). Other options in consideration include partnering on collaborative research projects, expanding membership on GNEII's Steering Committee and creating a stand-alone International Partner's Council.[4]

Increasing and sustained regional participation across GNEII's three pillars is vital to both its current and future success.

Educational

In order to meet the institute's mission and vision, GNEII needed to provide a deeper, more rigorous mechanism for knowledge transfer than more traditional training or professional development courses. This aspect of the institute began with the development of a novel curriculum designed around nuclear energy safety, security and safeguards (3S).[1,5,6] This curriculum centers around a systems-theory based 'responsible nuclear energy program (RNEP)' framework. As such, safeguards, security and

safety (and their interactions – 3S) are viewed as system level properties that seek to reduce the potential for damage to people, infrastructure or the environment (i.e., system constraints) while supporting the ability of nuclear energy programs to generate low cost, low carbon electricity (i.e., system objective). Because GNEII's intellectual standard requires a deeper conceptual understanding of this underlying framework, education will continue to be the institute's knowledge transfer paradigm.

As introduced in the previous section, the Fundamentals Course is currently the institute's primary knowledge transfer mechanism. This course is an intensive, semester-length hybrid program that blends the advantages of professional development short courses (e.g., hands on exercises and world-class subject matter expects as guests lecturers) and traditional university courses (e.g., applied research project and higher intellectual standards). Table I., above, summarizes a sustained level of demand for the Fundamentals Course – suggesting GNEII's educational emphasis is being well-received. Per the overarching RNEP framework described above, the Fundamentals Course is composed of the following topics: (1) RNEP fundamentals (why nuclear power; critical and systems thinking; introduction to 3S; nuclear and reactor physics); (2) RNEP policy and operations considerations (nuclear power plant operations and systems; nuclear fuel cycle technologies and issues; nonproliferation policy); and (3) RNEP 3S interactions (technical, operational and interactive elements of safeguards, security and safety). As depicted in Fig. 2., all topics are introduced in reference to the RNEP framework – with discussions focusing both on the individual topic itself and its interactions within an RNEP.

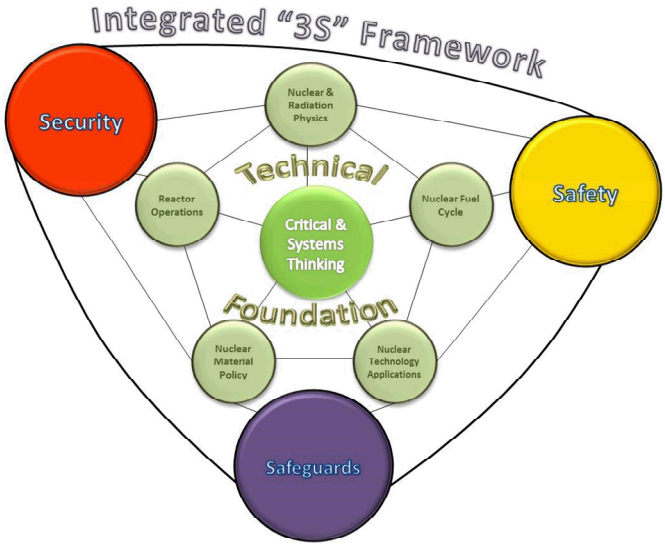

Fig. 2. Responsible Nuclear Energy Program systems-theory framework for GNEII's novel 3S curriculum

Perhaps the most tangible evidence of GNEII's educational emphasis is the Fundamentals Course Capstone Project. The Capstone Project requires GNEII Fellows to apply the knowledge gained from the novel curriculum in a practical way – to problems generated from their home organization management, UAE stakeholder or Khalifa University faculty. Fellows are appreciative of this requirement as it crystallizes the education to their real professional responsibilities and allows them to demonstrate their increased performance capacity. Stakeholders and supporting organizations value the Capstone because it helps them solve real problems faced on a regular basis. The Capstone Project is a departure from traditional training or professional development courses, and it provides a new metric by which to evaluate the GNEII's success – and that of its graduates. As outlined in [2], Capstone Projects support GNEII's research pillar – itself designed to reinforce the institute's educational core value. Table II. summarizes Capstone Projects completed to date as categorized by GNEII's research focus areas.

Table II. Categorization of GNEII Capstone Projects by Core Research Competencies 2011-2015

Core Competency Research Area	2011	2012	2013	2014	2015
Integrated 3S Methodologies	1	1	4	4	2
Nuclear Infrastructure Development	0	6	4	4	4
Gulf/Middle East Regional Nuclear Interactions	1	4	3	1	4

Strategic

Lastly, this institute had always been envisioned by developers and implementers to be a long-term investment and regional capability. Once developed, GNEII was always intended to be a sustainable producer of strong, capable professionals ready to instill the principles of RNEP into regional nuclear energy programs. From the outset, the expectation for the institute has been for it to be demand-driven by regional interest and sustainable by regional funding and human resource capabilities.

Throughout its design and development, GNEII has been supported by a strategic partnership between U.S. and UAE developers/implementers (e.g., completing daily tasks to make GNEII operational), stakeholders (e.g., supporting logistical, financial and professional efforts) and sponsors (e.g., providing financial and professional support). The institute's foundation is a Letter of Intent to develop and establish GNEII that was signed by Sandia, NSSPI, KU, FANR and ENEC on March 17, 2010. GNEII was officially born on February 20, 2011 when Sandia, NSSPI and Khalifa University signed a Memorandum of Understanding (MOU) explicating roles, responsibilities, expectations and timelines

for the institute's first five years of operation. GNEII, from its inception, has operated on a shared services model between MOU signees in an effort to optimally employ the capabilities of each partner.

This strategic partnership has resulted in GNEII making significant inroads towards ingraining itself as a key regional capability for nuclear energy programs. The institute is increasingly becoming a part of UAE's nuclear energy strategic development plan and has been included in the training programs and human resource development programs of all UAE stakeholders. In addition, five early GNEII Fundamentals Course graduates have completed their Masters of Science degrees in nuclear engineering at Khalifa University – increasing their ability to introduce GNEII values into their host organizations. Similarly, Fundamentals Course graduates occupy a range of positions within regional nuclear energy programs – from interim security directors at national regulators to senior management at security organizations to safeguards policy developers at operators. GNEII's success in producing graduates with increased professional capabilities has also garnered interest from other regional and international organizations – suggesting future opportunities to further advance the institute's strategic core value.

As GNEII has increased its ability to instill its lessons in the daily operations of regional nuclear energy programs, it moves towards the goal of a fully indigenous regional institute by 2017. By design, as the United States' financial commitment has decreased over the life of the project, GNEII's UAE partners have assumed more responsibility for GNEII operations. This "indigenization" of GNEII from a primarily US-supported initiative to a UAE-supported institute is symbolic of the institute's strategic core value.

SUMMARY & CONCLUSIONS

Building GNEII on a solid foundation of regional, educational and strategic core values is responsible for the current level (and expected higher future levels) of institute success. GNEII's first five years have seen it evolve into a unique capability providing a useful mechanism for developing regional leaders instilled with the tenets of responsible nuclear energy programs. For updates on ongoing GNEII research activities and for contacting the institute for possible research collaboration, please see [7]. GNEII's next five years will see the expansion of these core values as the institute continues to grow into a leading entity through which Gulf and Middle East voices participate in and influence the global discourse on nuclear energy programs.

ENDNOTES

[a]**SAND2015**-XXXXC. Sandia National Laboratories is a multiprogram laboratory operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000. SAND2011-4041C.

[b]Tentative 2016 Symposium dates are mid-April 2016. Please see www.kustar.ac.ae/pages/gneii/7816 or contact gneii@kustar.ac.ae for more information.

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7. Please see www.kustar.ac.ae/pages/gneii/7816 or https://www.facebook.com/GNEII?fref=ts for more.