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Evaluating the Educational Impact of the Gulf Nuclear Energy Infrastructure Institute (GNEII)'s Novel 3S Approach

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Outline

- Introduction & Background
- Methods & Data
- Analysis
- Summary

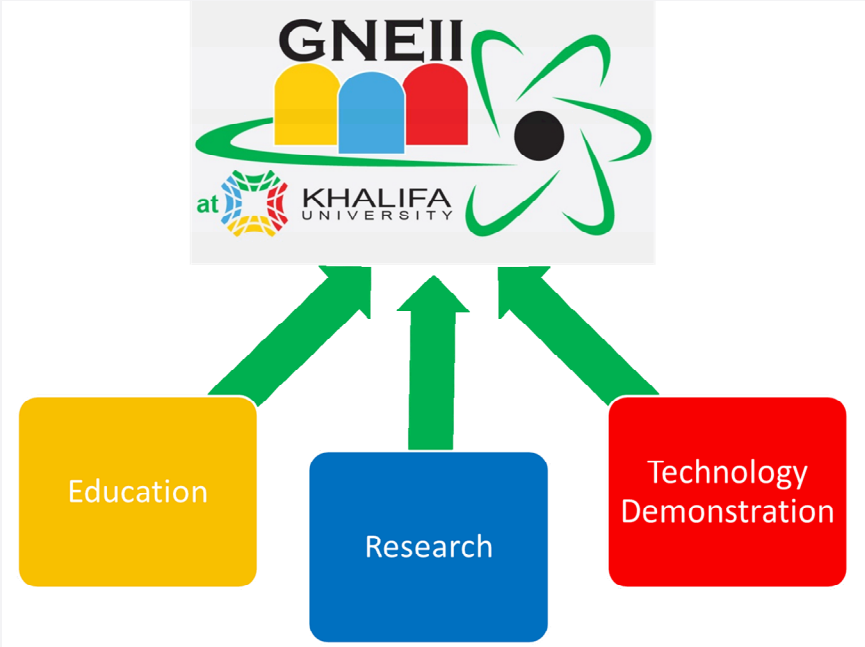
Introduction & Background

- Focus of this presentation is to summarize results from evaluating the educational impact of GNEII
- GNEII is:
  - A Gulf/Middle east regional human resource development capability
    - Hosted at Khalifa University of Science & Technology (Abu Dhabi, UAE)
  - An educational & research entity established in 2011
    - Beyond traditional training courses
  - A strategic partnership
    - Between UAE (KU, CICPA, ENEC, FANR, Nawah) & U.S. (DOE/NNSA, DOS/PNS, SNL & TAMU,) stakeholders
    - Key SNL Team Members:
  - A leader in '3S' & emergent nuclear energy infrastructure knowledge

Introduction & Background

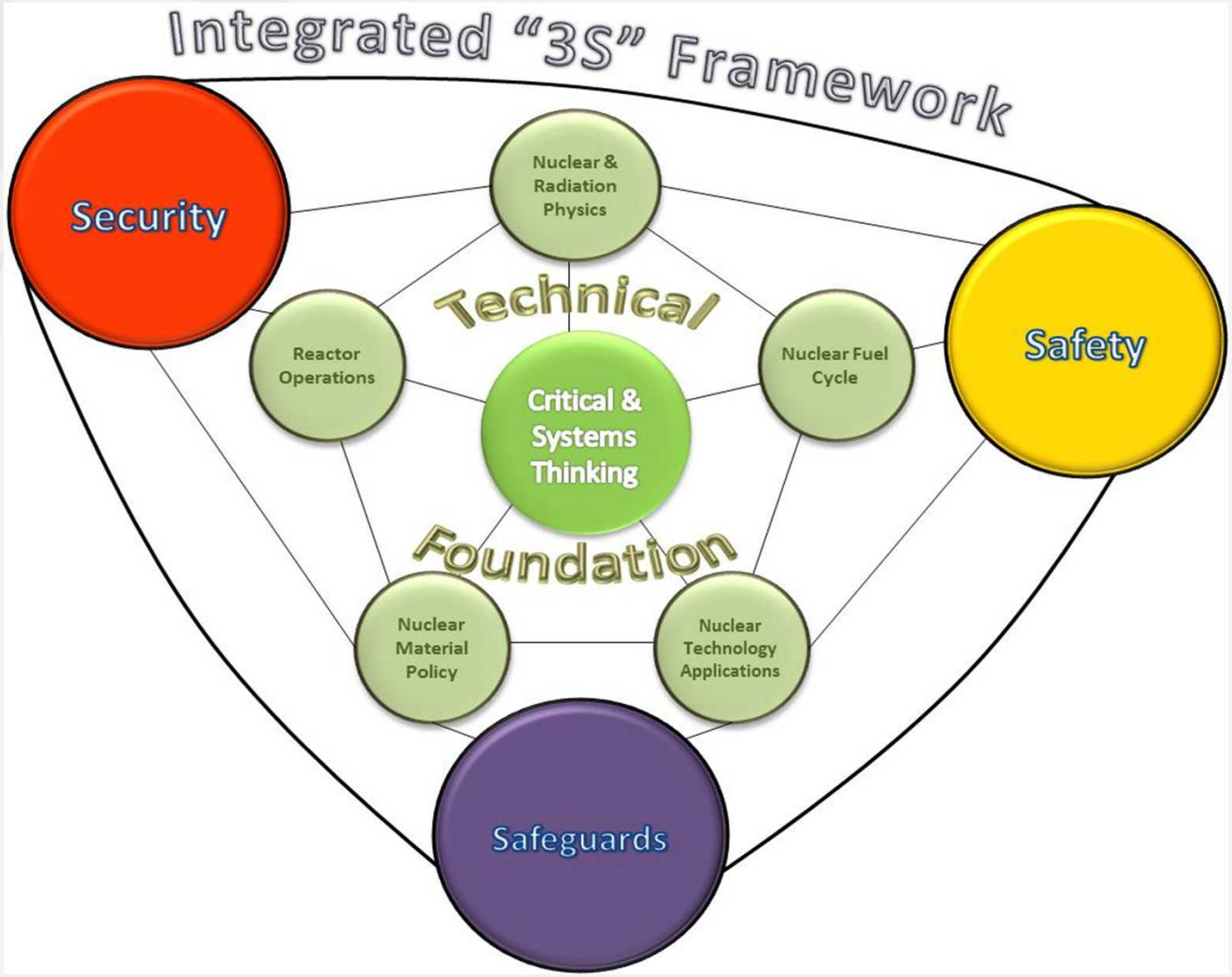
- GNEII's mission:
  - develop a responsible nuclear-energy culture and institutionalize safety, security and safeguards norms in decision makers from Gulf-region nuclear-energy programs

- 3 Foundational Pilla
  - Education
  - Research
  - Technical Services



Introduction & Background

- GNEII novel, integrated '3S' educational paradigm for responsible nuclear energy programs



Introduction & Background

- From 2011 to 2016, GNEII offered a semester long 'Fundamentals Course'
  - Included experts from the UAE, U.S. and international collaborators across a range of nuclear energy infrastructure topics
- In total 99* Fellows completed the rigorous Fundamentals Course

Year	# UAE Fellows			# Non-UAE Fellows	Yearly Total	Countries Represented
	ENEC/ Nawah	FANR	CICPA			
2011	4	5	1	0	10	UAE
2013	4	6	3	7	20	UAE, Saudi Arabia, Qatar
2015	7	4	5	2	18	UAE, Jordan
TOTAL	26	43	17	17	99	5

Methods & Data

- Mixed methods analytical design
  - Incorporate different data sources/types
  - Triangulate findings

- 2 analytical focal points
  - (1) understand the extent to which the 3S pedagogical approach improved the learning process for the Fellows
  - (2) understand the depth & breadth of the Capstone projects to evaluate applied knowledge of the Fellows

Methods & Data

- Focal point 1: Data
  - Weekly topical feedback forms from 2011 & 2016
  - Feedback forms based on 5-point Likert Scale

- Because of slight variations in the course structure, the data were collapsed into 3 major categories:
  - Instructor effectiveness
  - Course structure effectiveness
  - Overall topic effectiveness

Methods & Data

Overall Evaluation Category	Specific Course Evaluation Question: 2011	Specific Course Evaluation Question: 2016
Instructor Effectiveness	• The instructor was well prepared for the presentation? • The instructor demonstrated a thorough knowledge of the subject matter. • The instructor interacted well with the participants? • The instructor clearly expressed interest in addressing all questions raised by the participants? • The instructor's response to questions was clear and understandable?	• The instructor's activities/exercises and slides helped me achieve the learning outcomes • The instructor kept good discipline in the classroom • The instructor showed enthusiasm for the subject matter • The instructor was available for help outside of class • Assessment and feedback was fair and prompt by the instructor • The instructor include sufficient relevant examples
Course Structure Effectiveness	• The materials (handouts, on-screen visuals, videos, job aids, etc.) provided and reviewed were easy to understand? • The materials (handouts, on-screen visuals, videos, job aids, etc.) provided and reviewed offered valuable information that will help me in the future.	• The instructor presented material clearly and lectures were well organized • The instructor's activities/exercises and slides helped me achieve the learning outcomes • The instructor kept good discipline in the classroom • The instructor showed enthusiasm for the subject matter • The instructor was available for help outside of class • Assessment and feedback was fair and prompt by the instructor • The instructor include sufficient relevant examples • Overall I am fully satisfied with the module content
Overall Topic Effectiveness	• The materials (handouts, on-screen visuals, videos, job aids, etc.) provided and reviewed offered valuable information that will help me in the future. • The length of the presentations was sufficient to deliver the subject matter?	• The module was informative and helped me develop an interest in the subject • I believe I achieved the learning outcomes of the module • The content of this module is relevant to my needs/interests/job responsibilities • The instructor presented material clearly and lectures were well organized • The instructor's activities/exercises and slides helped me achieve the learning outcomes • The instructor kept good discipline in the classroom • The instructor showed enthusiasm for the subject matter • The instructor was available for help outside of class • Assessment and feedback was fair and prompt by the instructor • The instructor include sufficient relevant examples • Overall I am fully satisfied with the module content • Overall I am fully satisfied with the module delivery • Overall, I am fully satisfied with this module

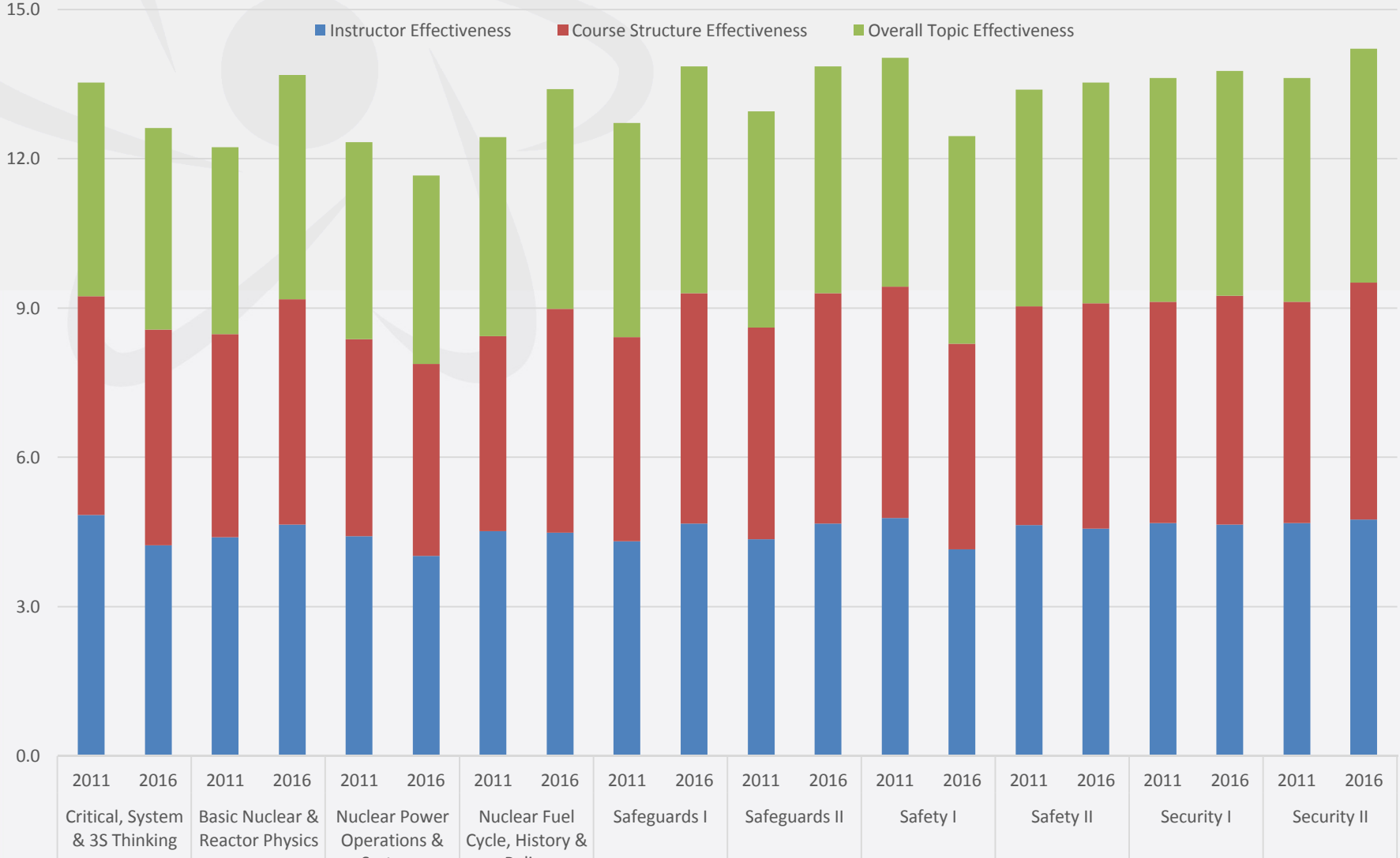
Methods & Data

2011	Integration of Nuclear Safety, Security & Safeguards
	Effects of the Environmental on Nuclear Power Plant Operations
2012	SBO Roles and Mitigation Plan
	The UAE Export Control Laws
	Project Control of NPP Construction
	Impact of NPP/Desalination on Gulf
	MIMIS on APR1400 Reactor
	APR1400 Liquid Source Terms
	UAE Strategy for HLW Management
	Transportation of Fresh Nuclear Fuel
	Radioactive Dose Pathway Modeling
	Transparency in Nuclear Security
	Emergency Preparedness for NPP
2013	Pyrochemical Reprocessing
	A Qualitative Assessment of Fuel Fabrication Options in the UAE
	The Suitable Mobile Lab for the UAE Condition
	Emergency Preparedness Plan for Radioactive Material
	Safety, Security, and Safeguards Challenges for Building a Final Repository for Spent Fuel in the UAE
	Use of Microfinned Steam Generator Tubes in NPP
	The Role of Management Systems in Protecting the Environment from RNEP
	Filling the Gaps Between Safety and Security
	Emergency Preparedness Plan
2014	Survey of the Current Spent Nuclear Fuel Storage Technologies & Assessing Safety Approaches of Existing Systems for BNPP
	Development of Recommendations for the Nuclear Security Culture in the UAE
	Evaluation of Security and Safeguards Measures for the Transportation Security in the UAE
	Evaluation of Safeguards and Security Options for the Dry Cask Storage in the UAE
	Synergy between Safeguards and Security at an NPP
	An Initial Radiation Baseline Study of Urban Environment in Abu Dhabi
	Effective Enhancements for Integrated Safety and Security Control Systems in BNPP
2015	Thermal-hydraulic Studies on Design Extension Condition of Prolong Station Black Out with Additional Failures
	Overview of Molten Core – Concrete Interaction (MCCI) and Mitigation Actions
	Needs of Atmospheric Dispersion Models in Emergency Situations
	Investigation on the Sensitivity of UAE Domestic Agricultural Production to Radiological Contamination Following a Hypothetical Severe Nuclear Accident at Barakah NPP
	Evaluation of Threats by Drones to a Nuclear Power Plant
	Evaluation UAE Security Culture – Insider Threat
	Operational Security and Information Protection in the Areas of 3S
	Analysis of the Safeguards Measures for the Nuclear Fuel Cycle Back-End Options in the UAE
2016	Review of Accident Tolerant Fuel Concepts for Light Water Reactors – A Qualitative Assessment of Current Technology
	Evaluation techniques for degradation of reactor containment building
	Evaluation of Cosmic-Ray Dose in the UAE
	Measurements of radionuclides concentration in UAE cucumber
	Safeguards and Security approach to final spent fuel repository
	Mitigation of national cultural differences effects during safety, security emergency at an NPP site
	Neutron activation of living insects for safety and security applications

- Focal point 2: Data
  - 45 Capstone Projects
  - Generated by GNEII Fellows from 2011 to 2016

Analysis: Focal Point 1

Analytical results from the evaluation categories for the GNEII Fundamentals Course 2011 & 2016 weekly topic feedback forms



Analysis: Focal Point 1

- All averaged responses across 3 evaluation categories range from 3.8 to 4.8

- For the **instructor effectiveness**, scores:
  - Were *static* for NFC Policy/History, Safety I, Security I
  - *Increased* (by an average of 0.275) for Basic N/R Physics, Safeguards I &II, Security II

- For the **course structure effectiveness**, scores:
  - *Increased* (by an average of 0.33) for Basic N/R Physics, NFC Policy/History, Safeguards I &II, Safety II, Security I & II

- For the **overall topics effectiveness**, scores:
  - Were *static* for Safety II, Security I
  - *Increased* (by an average of 0.36) for Basic N/R Physics, Safeguards I &II, Security II

- *Decrease* (average of 0.35) in all 3 effectiveness categories for
  - 'Critical, Systems & 3S Thinking'
  - 'Nuclear Power Operations & Systems'
  - 'Safety I'

Analysis: Focal Point 1

- The **instructor effectiveness** scores → Fundamentals Course instructors were able successfully adjust to Fellow concerns and suggestions
- The **course structure effectiveness** scores → materials and delivery mechanisms of the Fundamentals Course successfully transferred knowledge
- The **overall topic effectiveness** scores → approach successfully transferred knowledge across this broad set of topics and improved over time
  - One possible cause for this categorical decline in the effectiveness of these three weekly topics is the **increased expertise** and **experience** of the Fundamentals Course Fellows between 2011 and 2016
- This indicates a both a high level of consistency across the three evaluation categories—instructor, course structure and overall topic effectiveness
- Evidence that GNEII's novel, integrated '3S' pedagogical approach is both **useful** and **beneficial**

Analysis: Focal Point 2

- Clear increase in the **technical complexity** & **methodological sophistication** of these research efforts
  - 2011→ Basic conceptual mapping of topics of interest
    - 'Integrations of Safety, Security & Safeguards' (2011)
    - 'Transparency in Nuclear Security' (2012)
  - 2013/2014 → Topical literature surveys
    - 'A Qualitative Assessment of Fuel Fabrication Options in the UAE' (2013)
    - 'Survey of the Current Spent Nuclear Fuel Storage Technologies & Assessing Safety Approaches of Existing Systems for Barakah Nuclear Power Plant (BNPP)' (2014)
  - 2015/2016 → Real data collection & experiments
    - 'Mitigation of national cultural differences effects during safety, security emergency at an NPP site' (2016)
    - 'Measurements of radionuclides concentration in UAE cucumber' and 'Neutron activation of living insects for safety and security applications' (2016)

Analysis: Focal Point 2

- Data support the ability for the Capstone Projects to support GNEII's core research areas
  - Integrated 3 S Methodologies
    - 'Evaluation of Safeguards and Security Options for the Dry Cask Storage in the UAE' (2014)
  - Nuclear Infrastructure Development
    - 'Evaluation techniques for degradation of reactor containment building' (2016)
  - Regional Nuclear Interactions
    - 'An Initial Radiation Baseline Study of Urban Environment in Abu Dhabi' (2014)

Core Competency Research Area	2011	2012	2013	2014	2015	2016
Nuclear infrastructure development	0	6	4	4	4	3

Analysis: Focal Point 2

- Additional key insights:
  - 2 topics iteratively revisited
    - Nuclear security culture
      - Conceptual mapping in 2014 to interviews/surveys in 2016
    - 3S Interactions
      - Basic conceptual analysis in 2011 to thoughts on application to the NFC in 2013 to active integration into operations in 2015
  - Several Capstones provided the 'seed' for further research:
    - 'Evaluation of Threats by Drones to a Nuclear Power Plant' (2015) → GNEII published article in *Security Journal*
    - 'Investigation on the Sensitivity of UAE Domestic Agricultural Production to Radiological Contamination Following a Hypothetical Severe Nuclear Accident at Barakah NPP' (2015) yielded
      - Presentation at the 2015 'International Conference on Energy, Water and Environmental Sciences'
      - Published article on natural occurring radioactive material (NORM) in date palms in *Health Physics Journal*

Summary

- Data from both Fundamentals Course weekly topic feedback forms & Capstone Projects provide evidence of the **utility** & **benefit** of GNEII's novel, integrated '3S' pedagogical approach during Phase I operations
  - Efforts are underway to more fully characterize GNEII's institutional impact, including a survey of past GNEII Fellows.

- Signing of the MOU titled 'Establishing a Framework for Continuing Collaboration with the Gulf Nuclear Energy Infrastructure Institute (Sandia MOU Number 16-2-706)' launched Phase II of GNEII operations
  - Emphasis on the evolution and expansion of peer-to-peer collaboration across the institute's education, research and technology demonstration pillars.

- 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