Webinar #1

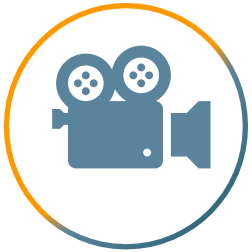
Governing New Nuclear Power Programmes: Newcomers success stories

UAE experience

Q&A poll

IAEA Nuclear Infrastructure Development

Housekeeping



The webinar is recorded

Materials and recording will be posted on the webinar web-page

Q&A button for all questions

QR code for polls (already open)

Our speakers today

Christer Viktorsson
FANR

H.E. Mohamed Al Hammadi
ENEC

Eng. Ali Al Hammadi
Nawah

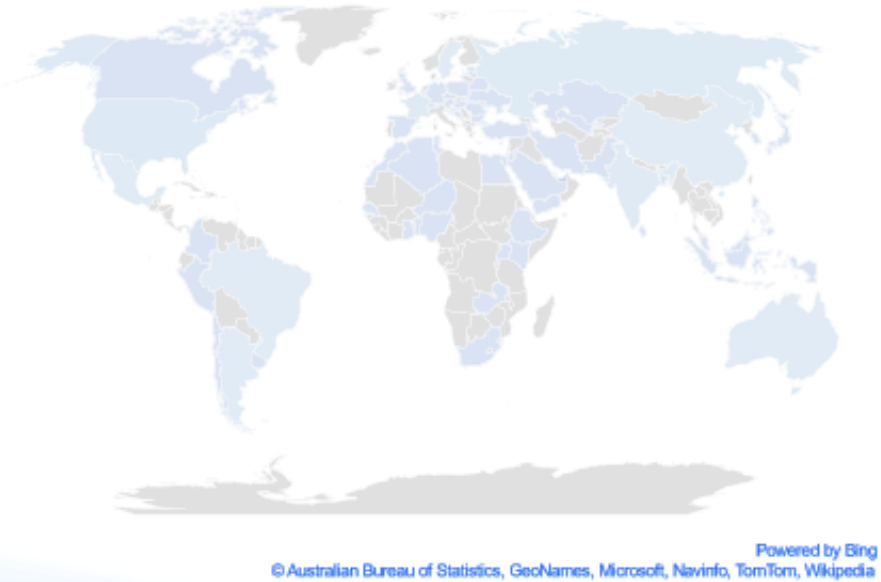
Nasser Al Nasseri
Barakah One Company

Dr. Ahmed Alkaabi
Khalifa University

Newcomers success stories in the nuclear infrastructure development: UAE experience

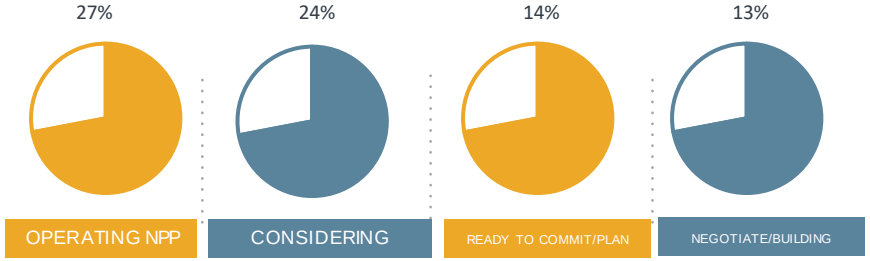
IAEA

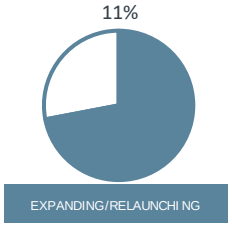
Our participants today



72 countries from 6 continents

In different phases of development and a variety of organisations involved, including ministries, NEPIO, regulatory body, owner/operator representatives as well as academia, research institutions and NGOs.





Mr Christer Viktorsson

- Director General, Federal Authority for Nuclear Regulations
- Over 40 years of extensive experience in
  - nuclear regulation and safety
  - nuclear policies and in the bilateral and international negotiations
  - preparation and application of national regulations, international standards and peer reviews
  - nuclear emergency preparedness, nuclear waste management, radiation protection, security and safeguards
- Since 2015 – Director General of FANR

FANR
الهيئة الاتحادية للرقابة النووية
Federal Authority for Nuclear Regulation

Newcomers success stories: UAE experience
-
Establishing the Independent Nuclear Regulator

Christer Viktorsson Director General
Federal Authority for Nuclear Regulation
IAEA webinar on 29 April 2021

Federal Authority of Nuclear Regulation (FANR)

Regulates and Oversees the **safe, secure and peaceful** nuclear and radiological activities taking place in the United Arab Emirates.

UAE has established the needed nuclear infrastructure to allow the nuclear program to develop from construction to operation safely and securely

The UAE issued the "Policy of the United Arab Emirates on the Evaluation and Potential Development of Peaceful Nuclear Energy"

IAEA Integrated Nuclear Infrastructure Review (INIR) Mission (Phase 1 & 2)

Construction Licence Barakah NPP U3&U4

IAEA INIR Mission (Phase 3)

FANR issued operating license for unit 2 in March

2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021

- Nuclear Power Program launched
- Site Selection Licence at Barakah NPP

Construction Licence Barakah U1&U2

IRRS

IAEA International Physical Protection Advisory Service (IPPAS) Mission

Operation Licence Barakah NPP Unit 1 Issuance

UAE as a nuclear newcomer country

A nuclear energy programme is a serious undertaking requires political will, long-term commitment, financial resources, and implicit responsibility to ensure that the necessary infrastructure is in place.

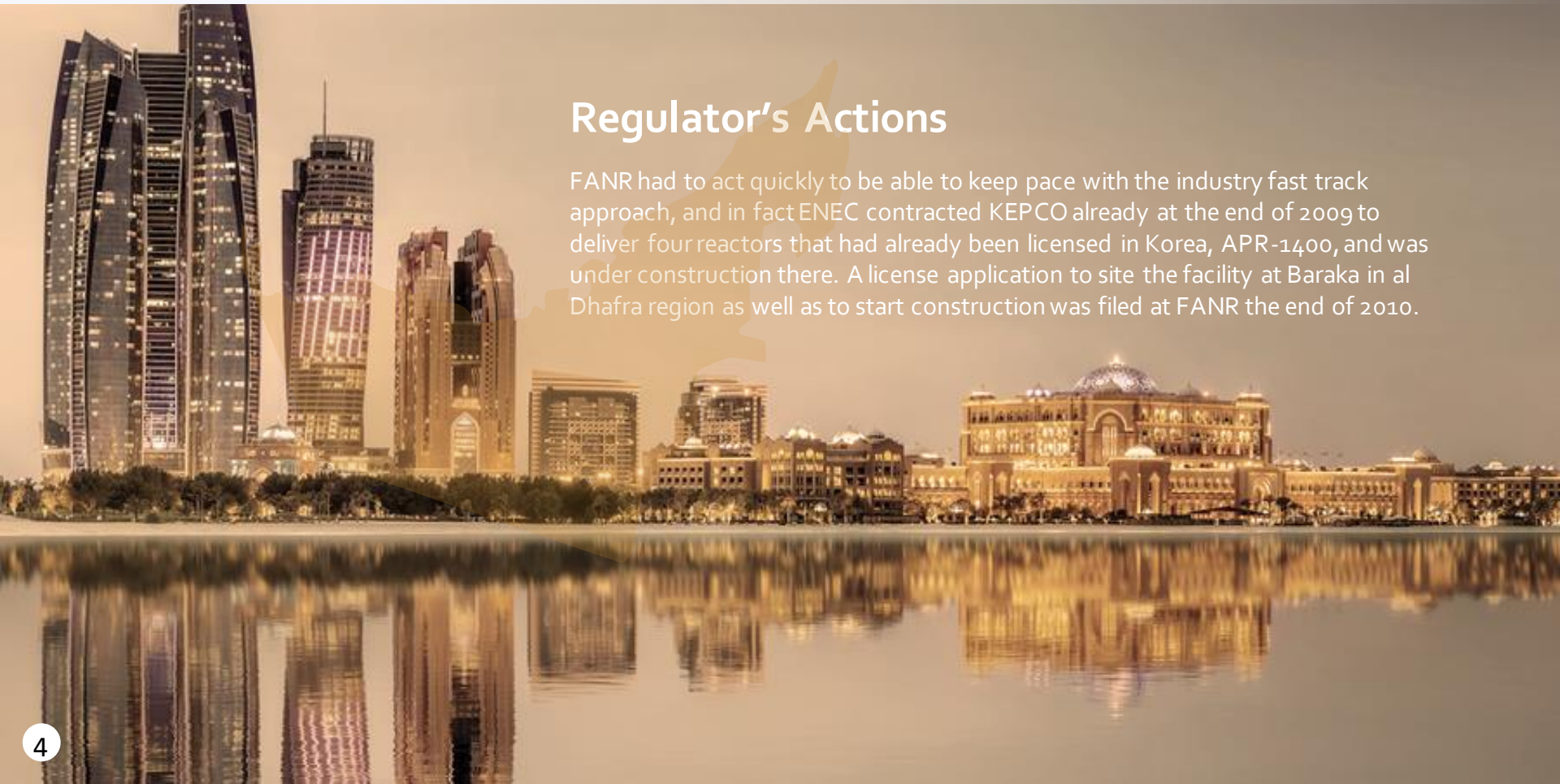
2008

Nuclear policy from 2008 demonstrated those undertakings and was based on in-depth feasibility study. It provided the strategy and the institution building to allow the safe, secure and peaceful programme.

The Policy identifies six key principles: Operational transparency, the highest standards of nuclear non-proliferation, safety and security, working directly with the IAEA, partnership with responsible national and experts and building long term sustainability. All those principles have been guided FANR in its establishment. The policy also defined the standards and obligations to be followed and concluded, and all have been followed through.

2009

The legal bases came into place in 2009 establishing an independent regulator named FANR to regulate the nuclear and radiation in the entire UAE.



Regulator's Actions

FANR had to act quickly to be able to keep pace with the industry fast track approach, and in fact ENEC contracted KEPCO already at the end of 2009 to deliver four reactors that had already been licensed in Korea, APR-1400, and was under construction there. A license application to site the facility at Baraka in al Dhafra region as well as to start construction was filed at FANR the end of 2010.

The First Major Regulatory Infrastructure was built in the first few years.

- Hiring key staff with extensive experience of regulation, operation and various technical disciplines.
- developed regulations and guidance, in particular the key ones for the start of the program, e.g. on integrated management systems, siting, requirements for construction application, design…all conforming to the latest international standards, and accordance with the needs of the industry. Ensured support from national authorities.
- built the safety/security assessment and licensing system, 2 tier system suitable to the UAE and the state of readiness of FANR, leveraging the experience from ROK, the country of origin.
- Established security and nonproliferation arrangements in cooperation with other national authorities with FANR being the SSAC
- contracting TSO support, to assist permanent staff in reviewing the license application
- agreeing support from Korean regulators, in training and in getting all appropriate regulatory framework and licensing documents issued by the Korean regulators.
- requested IAEA advisory and review missions.
- support from other countries by concluding MoU based on bilateral agreements on nuclear energy.
- Benefitted from strong governmental support including the advice from International Advisory Board, IAB

FUKUSHIMA DAIICHI ACCIDENT

Lesson Learned

- FANR requested from the operator to add further design enhancements to ensure safety even in highly unlikely situations.
- Following our inspection and assessments, FANR approved 31 design changes for the Barakah plant to further enhance safety and fulfill the requirements for earthquake and tsunami safety.

International Review Mission

11

FANR received 11 international review missions led by IAEA. It covered **nuclear infrastructure, legal and regulatory system, nuclear safety, nuclear security, nuclear non-proliferation, and emergency preparedness.**

FANR also received advisory missions on site suitability, best practices in operator qualification, and on the issuance of operating licenses.

FANR built a comprehensive radiation safety infrastructure in the UAE

- Secondary Standard Dosimetry Laboratory (SSDL).
- Radiological Environmental Monitoring programme.
- UAE National Strategy for Education and Training in Radiation Protection.
- FANR Emergency Operations Center, and Simulator

Human Recourses

17

- FANR has gone from 17 staff in 2009 to 245 today.

245

- FANR has in place programmes to build and manage Emiratis' knowledge in the nuclear sector. Some 30 graduated from its flagship Developees Engineers Programmes. FANR has scholarship and secondments programmes in cooperation with national and international entities.

31

- FANR employs nuclear expertise, consisting of 31 nationalities, with strong record in nuclear safety, security, and non – proliferation.

- FANR developed Emirati capacities and expertise in nuclear safety, security, safeguards, radiation protection and emergency preparedness.

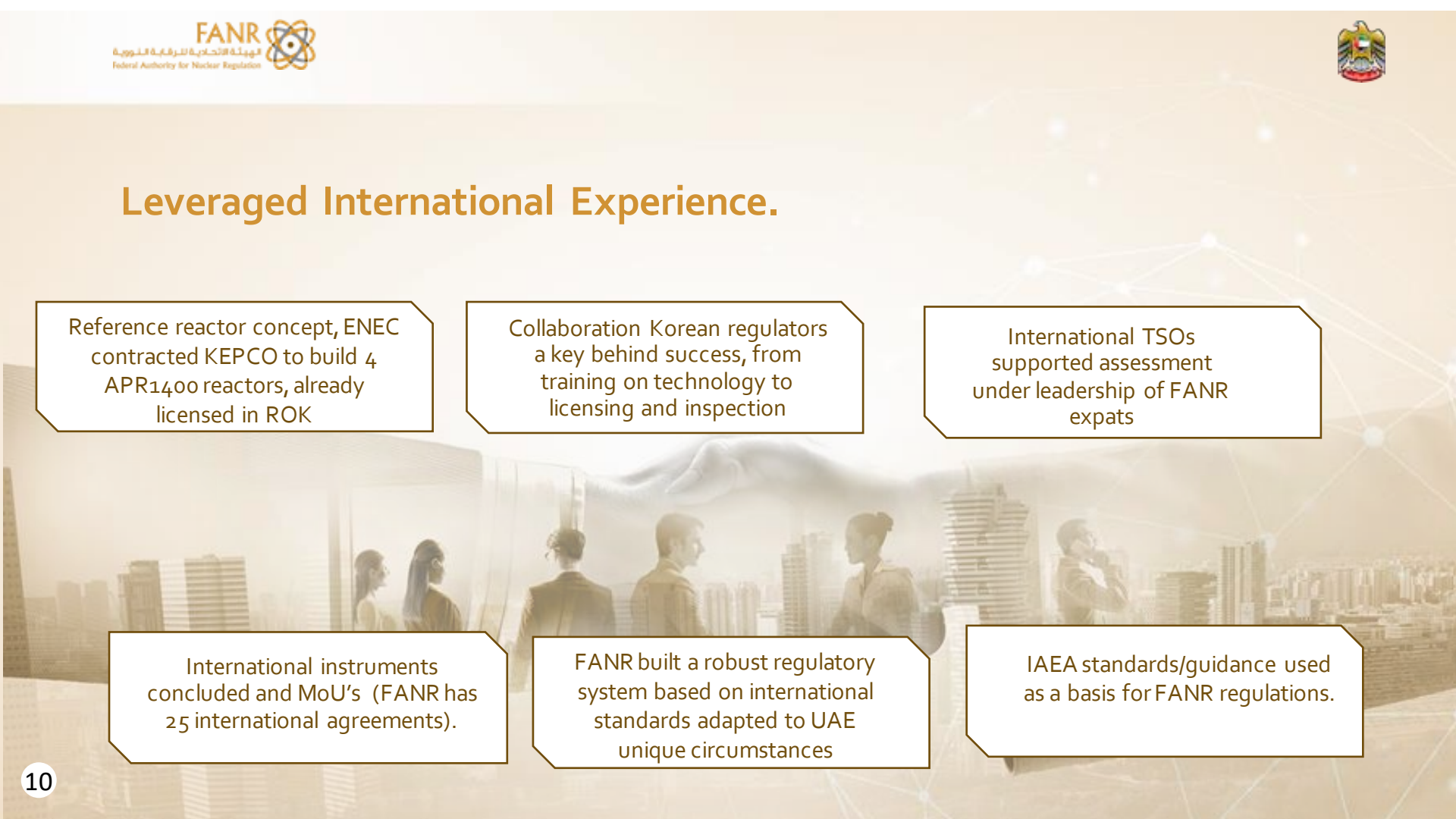
TODAY  **245 Employees** |  **68% Emiratis**

Leveraged International Experience.

Reference reactor concept, ENEC contracted KEPCO to build 4 APR1400 reactors, already licensed in ROK

Collaboration Korean regulators a key behind success, from training on technology to licensing and inspection

International TSOs supported assessment under leadership of FANR expats



International instruments concluded and MoU's (FANR has 25 international agreements).

FANR built a robust regulatory system based on international standards adapted to UAE unique circumstances

IAEA standards/guidance used as a basis for FANR regulations.

Leveraged International Experience.

Involved selected IAEA resources early on, Utilized good features of the IAEA program

Used concepts from other countries but adapted them accordingly

"Construction in accordance with requirements", and "organization readiness" reports together with the SER formed the basis for the OL decision

Fukushima lessons learnt, EU stress tests, MDEP to review

FANR Assessment having significant focus on site suitability, severe accidents, management system, vendor oversight, and in general to ensure compliance with FANR regulations .

Ensuring crucial public support

Public acceptance

Public acceptance and stakeholder support are key factors in the UAE nuclear programme. For example, regulations developed or revised by FANR are being published on the authority's website for stakeholder and public comments.

Positive perceptions

Public perception of benefits and risks associated with nuclear power are indispensable for the successful deployment of a nuclear programme.

Enhancing awareness

Public awareness helps build and maintain trust in regulatory competence and efficiency.

Transparent processes

Transparent and participative processes at all stages of a nuclear power programme are crucial for fair and consistent decision-making, as well as for harnessing the full potential of the nuclear sector.

Here's our future

- Transiting our work from licensing to regulatory oversight
- Continuous improvements and update of regulations
- Continuous systematic staff development based on competency framework
- Radioactive waste management and spent fuel management
- Nuclear regulatory innovation
- Strengthening national & international cooperation

Some lessons learnt

FANR has gone from TSO dependence to independence of TSO support in licensing and inspection

FANR developed Emirati capacities and expertise in nuclear safety, security, safeguards, radiation protection and emergency preparedness.

Established early on IMS to support the staff in doing things "the FANR way"

Implemented efficiency gains based on lessons learnt from licensing of unit I to licensing of unit 2

FANR licensing has authorized regulated activities on a time line and in a manner that is consistent with the readiness and needs of the owner/operator as it has progressed through siting, construction, receipt of nuclear material, and finally to operations.

Some concluding remark

- Importance of having a strong national strategy in place before embarking on establishing the nuclear program and its regulatory infrastructure.
- The development of the legal, regulatory and support infrastructure to follow a project management approach tuned to the NPP development plan.
- The adaptation of the regulatory framework to country specific conditions, and that technical and regulatory competence are built in the country.
- Continuing dialogue and coordination with the implementer needed throughout the development, as well as transparency towards the public and international community.

Unit 1 vs. Unit 2 Statistical Overview

Unit 1		Unit 2
1840	Request for Additional Information (RAIs)	59
267	Conducted Inspections	223
463	Issued Findings	92
~5 Years	Overall Project duration	~8 Months

FANR
الهيئة الاتحادية للرقابة النووية
Federal Authority for Nuclear Regulation

Thank You

H.E. Mohamed Al Hammadi

- Chief Executive Officer, Emirates Nuclear Energy Corporation
- Since 2009 has lead ENEC in delivering the UAE Peaceful Nuclear Energy Program and the Barakah Nuclear Energy Plant.
- Strong background in power and utility projects over the past 25 years, including management, construction, finance and administration

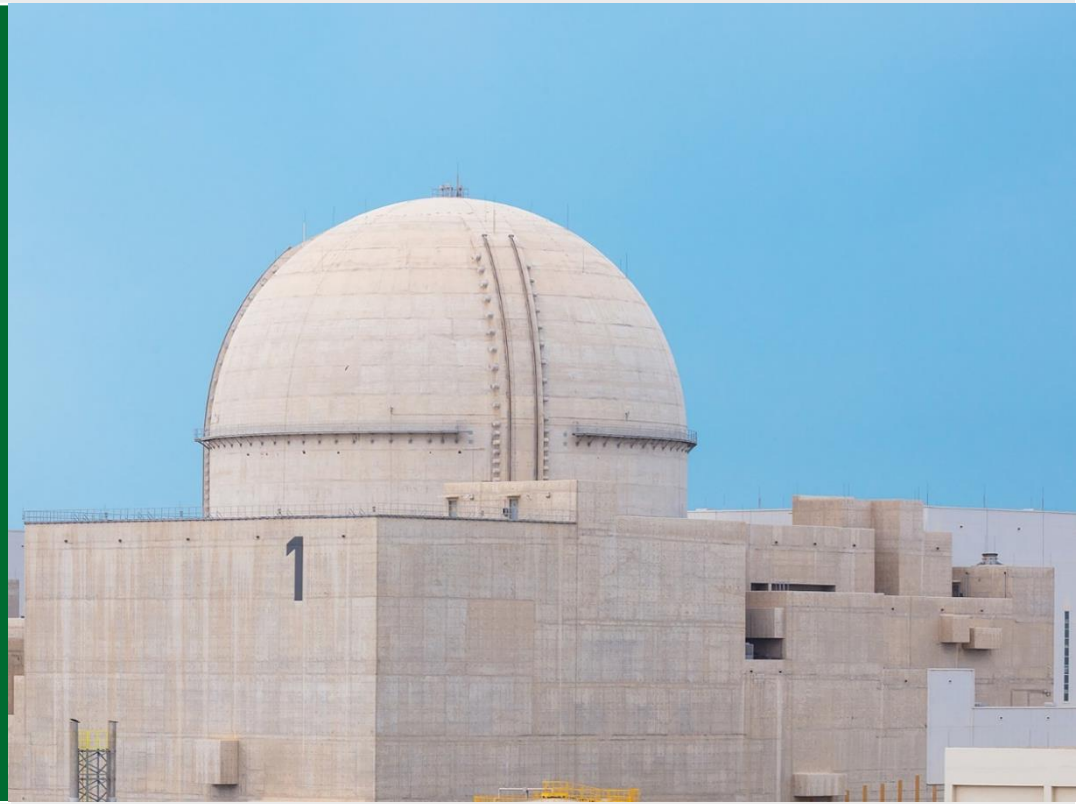
UAE Peaceful Nuclear Energy Program

مؤسسة الإمارات للطاقة النووية
Emirates Nuclear Energy Corporation

شركة براكة الأولى ش.م.خ
Barakah One Company PJSC

شركة نواة للطاقة
Nawah Energy Company

In April 2021, Barakah Unit 1 became commercially operational – generating thousands of megawatts of electricity 24/7

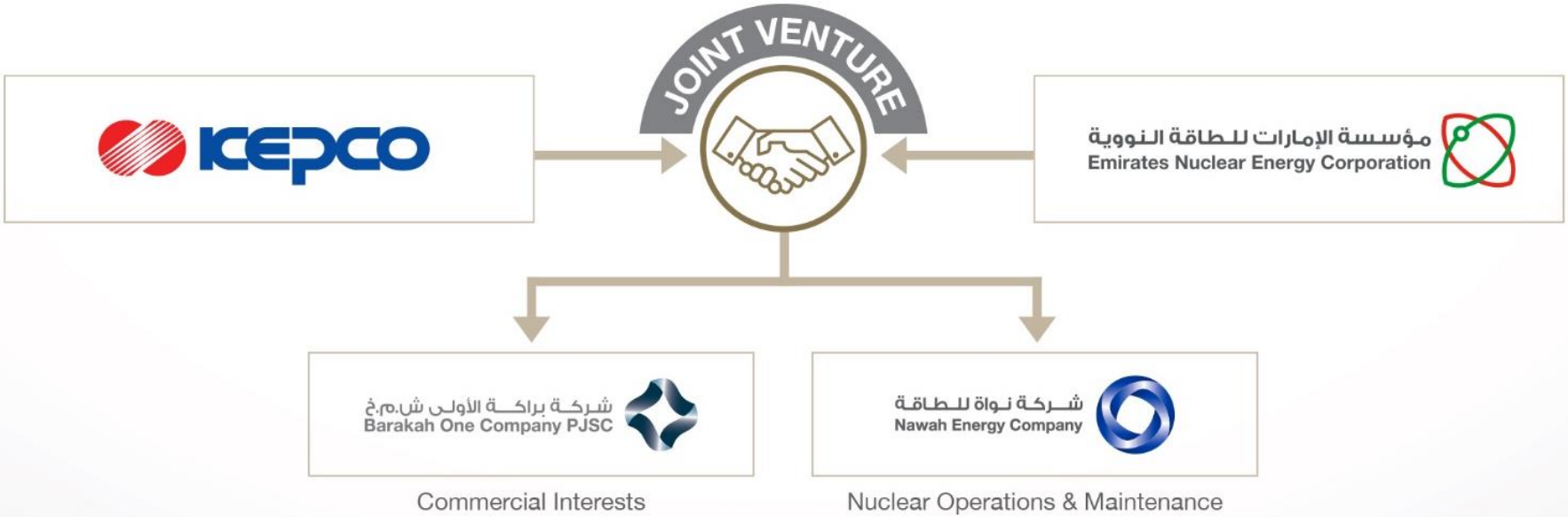


The single largest electricity generator in the region, producing 1,400 MW of clean electricity for our nation

Barakah is leading the largest decarbonization project of any industry in the UAE.

Four Key Elements to Success


United Arab Emirates
الإمارات العربية المتحدة
Policy of the United Arab Emirates on the
Evaluation and Potential Development of
Peaceful Nuclear Energy



Strong Community Support

Eng. Ali Al Hammadi

- Chief Executive Officer, Nawah Energy Company
- Key responsibilities:
  - Leads Nawah's team in operating and maintaining the four units of the Barakah Nuclear Energy Plant
  - Enhance human capacity and technical capabilities across the organization, in adherence to the highest standards of nuclear safety, quality and security
- As Nawah's Chief Program Transition Officer was responsible for leading the transition of the Barakah Nuclear Energy Plant - from the construction phases to operations
- Previously Chief Engineering & Construction Officer at ENEC
- Strong background in Oil & Gas industry

شـــركـة نـواة للـطـاقـة
Nawah Energy Company

Over
350
scholarships graduates

72
SROs and ROs

Over
50
Nationalities

2,000
UAE Nationals have worked on the program since inception in 2009

Certified Operators


30 OCTOBER - 1 NOVEMBER 2017
ABU DHABI, UNITED
MIRATES
NEA
NUCLEAR ENERGY AGENCY
FANR
IAEA
60 Years
NEA
NUCLEAR ENERGY AGENCY
FANR
Official Use Only (FOUO)
MIKHAIL CHUDAKOV
TOD LAURSEN


ENEC

Nawah Integrated Management System

Nasser Al Nasseri

- Chief Executive Officer, Barakah One Company
- Key responsibilities:
  - Oversee all commercial and financial aspects of the Barakah Nuclear Energy Plant project
  - Administers the Power Purchase Agreement with Abu Dhabi's utility company for the sale of electricity generated at the Barakah Plant
- Holds the role of Chief Financial Officer at ENEC
- Strong financial and business administration background

شركة براكة الأولى ش.م.خ
Barakah One Company PJSC

For Official Use Only (FOUO)

Public Release Information (PRI)

Dr. Ahmed Khalifa Alkaabi

- Assistant Professor, Department of Nuclear Engineering, Khalifa University
- Over 6 years of industrial experience
  - as a research engineer at the Abu Dhabi Water and Electricity Authority (ADWEA) in improving the solar energy produced electricity integration onto Abu Dhabi's main grid
  - leading the nuclear task force in coordinating all nuclear related agreements and contracts at ADWEA in preparation of the UAE to enter the list of countries using nuclear power for electricity generation
- Active member of the research projects in thermal hydraulics systems, nuclear reactor safety and nuclear reactor/thermal-storage coupling strategies

Nuclear Engineering Educational Programs and R&D Activities

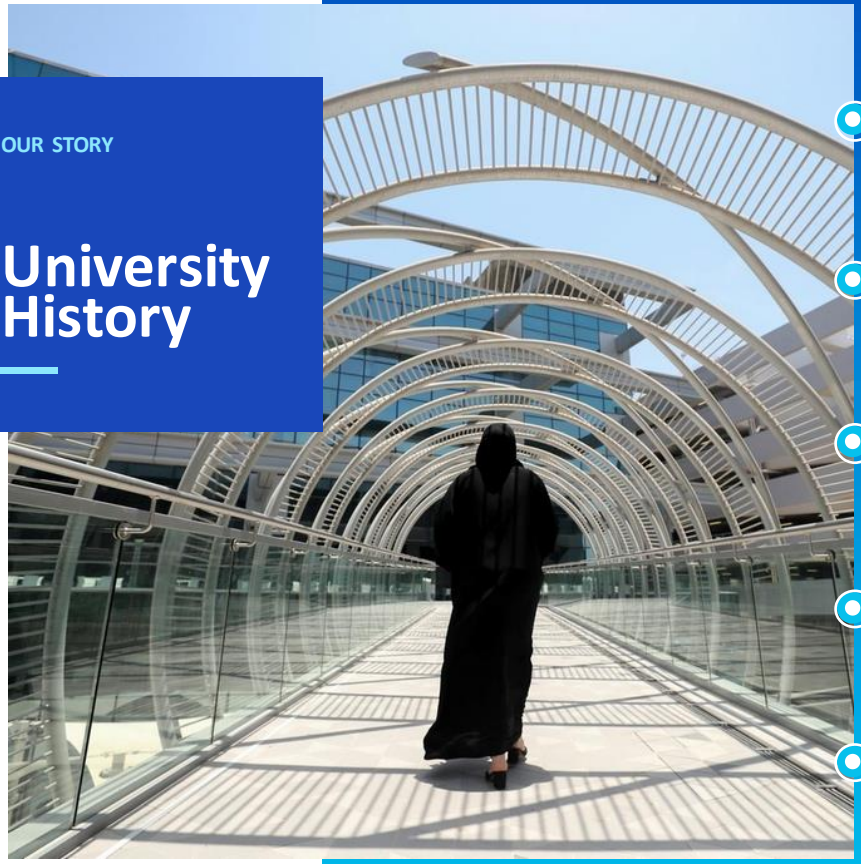
Dr. Ahmed Alkaabi

IAEA webinar on 29 April 2021

Nurturing tomorrow's leaders.
Growing the knowledge economy.

OUR STORY

University History



1989 The Etisalat college of engineering was established.

2000 The Petroleum Institute University and Research Center was established.

2007 The Khalifa University of Science, Technology and Research (KUSTAR) was established.

2007 Masdar Institute of Science & Technology (MI) was established.

2017 UAE President and Ruler of Abu Dhabi His Highness Sheikh Khalifa bin Zayed issued a decree to merge KUSTAR, MI and PI under one univeristy called the Khalifa University of Science & Technology.

MOMENTS OF GLORY

Rankings

2021

211th Globally

2021 QS World University Rankings

15th Overall

2021 QS Top 50 Under 50 rankings

176-200 Globally

2021 THE World University Subject Rankings (Engineering and Technology)

31st in Asia

2020 THE Asia University Rankings

KU Strategy Map

KU STRATEGY MAP 2018-2022

VISION

- To be a catalyst to the growth of Abu Dhabi and the UAE's rapidly developing knowledge economy
- An education destination of choice and
- A global leader among research-intensive universities of the 21st century

KU STRATEGIC PRIORITIES

01 WORLD CLASS EDUCATION

Prepare future leaders to an internationally recognized standard.

02 INFLUENTIAL RESEARCH

Produce world-class research with local relevance and international impact

03 CATALYST FOR ECONOMIC DEVELOPMENT

Enrich the national economy through innovation and research commercialization

KU Colleges & Institutes

Institutes

جامعة خليفة
Khalifa University
معهد الذكاء الاصطناعي
Artificial Intelligence Institute

جامعة خليفة
Khalifa University
المعهد البترولي
Petroleum Institute

جامعة خليفة
Khalifa University
معهد مصدر
Masdar Institute

Colleges

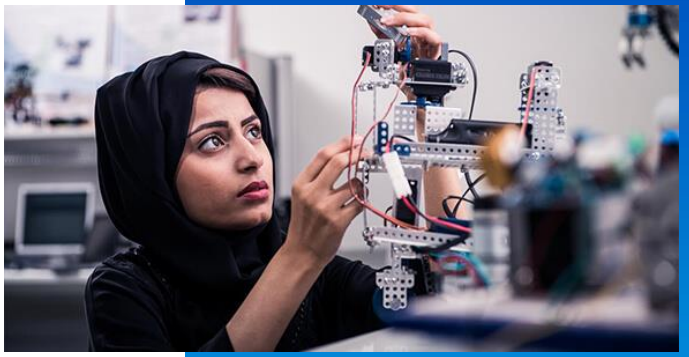
جامعة خليفة
Khalifa University
كلية الهندسة
College of Engineering

جامعة خليفة
Khalifa University
كلية الطب والعلوم الصحية
College of Medicine and Health Scienecs

جامعة خليفة
Khalifa University
كلية الآداب والعلوم
College of Arts and Sciences

COLLEGE OF

Engineering



Degree programs

- Aerospace Engineering
- Biomedical Engineering
- Chemical Engineering
- Civil Infrastructure and Environment Engineering
- Electrical and Computer Engineering
- Industrial and Systems Engineering
- Mechanical Engineering
- Nuclear Engineering
- Petroleum Engineering

DEPARTMENT OF

Nuclear Engineering

Overview

The Nuclear Engineering Dept. was launched in September 2010 to serve the UAE's peaceful nuclear energy program that started in December 2009 with the acquisition of four APR1400 MW nuclear power reactors from the Republic of Korea.

Programs

- Minor in Bachelor Engineering Programs
- MSc in Nuclear Engineering
- PhD in Engineering (nuclear concentration)

Areas of Expertise

- Thermal Hydraulics
- Materials and Chemistry
- Reactor Physics
- Radiological protection
- Nuclear Fuel Cycle

Main Stakeholders

- Federal Authority of Nuclear Regulation (FANR)
- Emirates Nuclear Energy Corporation (ENEC)
- Nawah

Number of Graduated Students

As of September 2020

	Female	male
PhD	2	1
MSc	15	24
Undergraduate	6	25
Total	23	50

Minor Program

Overview

The Minor in Nuclear Engineering is designed to provide undergraduate students from other appropriate engineering programs (mechanical, electrical, chemical etc.) with the fundamentals of nuclear physics and engineering theory and practice, necessary to equip them with a sound understanding of the nuclear engineering.

Courses

- NUCE Radiation Science & Health Physics
- NUCE Mechanics & Thermal-hydraulics Principles for Nuclear Eng.
- NUCE Evaluative Methods for Nuclear Non-proliferation and Security
- NUCE Introduction to Nuclear Reactor Physics
- NUCE Introduction to Nuclear Systems and Operation

MSc Program

Overview

The MSc program is aimed to provide students with deep knowledge and specialization in nuclear engineering and enables them to relate nuclear engineering theory to practice. The program is intended to equip graduates with design, problem solving and research skills in nuclear engineering concentration which will prepare them for careers as nuclear engineering professionals.

Core Courses

- ENGR Seminar in Research Methods
- NUCE Thermal Hydraulics in Nuclear Systems
- NUCE Nuclear Materials, Structural Integrity and Chemistry
- NUCE Nuclear Reactor Theory
- NUCE Radiation Measurements and Applications

PhD Program

Overview

The PhD in Engineering is designed to provide students with advanced research level capability and interdisciplinary skills. It has a common format across the main engineering specializations within the university while allowing the students to focus on their chosen concentration.

Technical Elective Courses

- NUCE Advanced Computational Methods of Particle Transport
- NUCE The Reactor Core Design Analysis for LWR
- NUCE Nuclear Systems and Materials/Accident Analysis
- NUCE Nuclear Criticality Safety Assessment

Other Programs

MEng in HSE

The Master of Engineering in Health, Safety, and Environmental Engineering program (radiological protection concentration) aims to produce graduates as qualified experts in the radiation protection field.

MSc in Medical Physics

The Master of Science in Medical Physics program (under approval process) aims to build human capital for medical physicists in the UAE with the appropriate level of qualifications.

KU Masdar Institute (2021)

جامعة خليفة
Khalifa University
معهد مصدر
Masdar Institute

Clean And Renewable Energy

- Research Center for Renewable Energy
- Mapping and Assessment (ReCREMA)
- Advanced Power and Energy Center
- Emirates Nuclear Technology Center

Water And Environment

- Sustainable Bioenergy Research Consortium (SBRC)
- Center for Membranes & Advanced Water Technology
- Research and Innovation Center on CO_2 and Hydrogen

Emirates Nuclear Technology Center

مركز الإمارات للتكنولوجيا النووية
Emirates Nuclear Technology Center

Sponsored by:

جامعة خليفة
Khalifa University

FANR
الهيئة الاتحادية للرقابة النووية
Federal Authority for Nuclear Regulation

مؤسسة الإمارات للطاقة النووية
Emirates Nuclear Energy Corporation

ENTC Overview

National Agenda

- **Serve** the national nuclear technology agenda to become a center of excellence and R&D hub
- **Develop** intellectual capital in nuclear technology relevant to the energy, health, industrial, agriculture, security, and forensics sectors

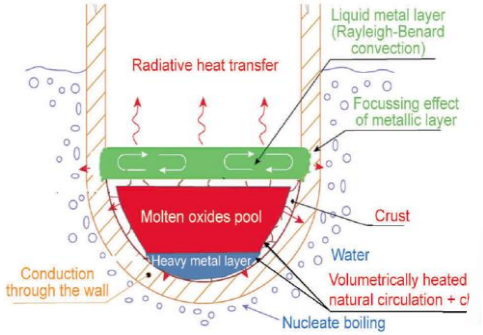
Industry

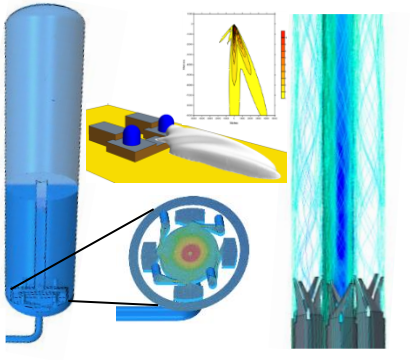
- **Develop** national integrated nuclear technology model and capabilities across UAE
- **Focus** on strategic disruptive technology and research applications to support R&D and innovation

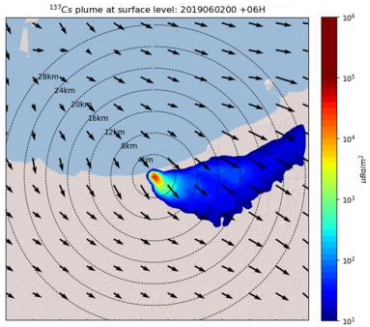
Academia

- **Build** scientific research literature specific for the UAE nuclear technology sector challenges
- **Create competences** in development of nuclear technology simulation, modelling, experimentation, policy research, and disruptive technology analysis
- **Train** UAE students in applied nuclear fields

ENTC Research Focus Areas







Theme-1

Nuclear Systems and Safety

- **Aim** to assess the thermal-hydraulic safety analysis codes
- **Identify and validate** the dominant thermal-hydraulic phenomena occurring in NPPs

Theme-2

Materials and Chemistry

- **Deal** with the integrity of components and structures in Nuclear Power Plants (NPPs)
- **Identify** degree of the degradation depends on the operational conditions

Theme-3

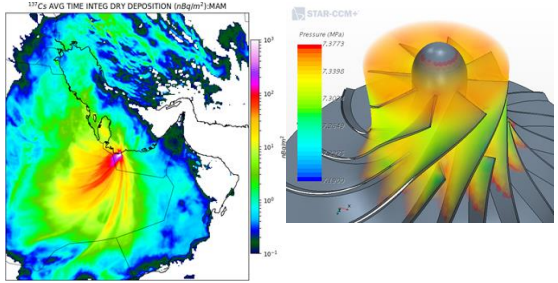
Radiation Safety and Environment

- **Cover** radiological environmental impact analyses (simulations and experimental) in the Gulf regions.
- **Provide** the numerical and experimental analytical data needed to map the ecosystems in the Gulf region.

Research Oriented…

Research at BSc Level

Research at MSc Level



PhD Level & Beyond..

KU-IAEA Collaborating Center

Main Objectives

- **Develop** and implement specific courses in its field of activity in collaboration with IAEA
- **Provide** the suitable infrastructure for courses and workshops
- **Share** UAE's experience and expertise in nuclear infrastructure development.
- **Dispatch** experts to support expert missions or training courses and consultancy meetings organized by IAEA

Main Activities

- **Train** professionals recommended by the IAEA in the field of nuclear power infrastructure
- **Develop** and **implement** training and workshops to address specific issues relevant to newcomer countries.
- **Develop** work-plans for the fellows proposed on specific areas of interest for embarking countries.

Concluding Remarks

- Establishment of nuclear engineering educational and scholarship programs at the initial stage of NPP construction is key to support the training and capacity building.
- Continued education and training constitute a cornerstone of the critical infrastructure necessary to sustain a nuclear power program.
- Establishment of focused national research centers supports the safe operation of NPPs.
- External collaboration is important to assist newcomers in building their R&D capabilities.

Thank You

Q&A session

Christer Viktorsson
FANR

H.E. Mohamed Al Hammadi
ENEC

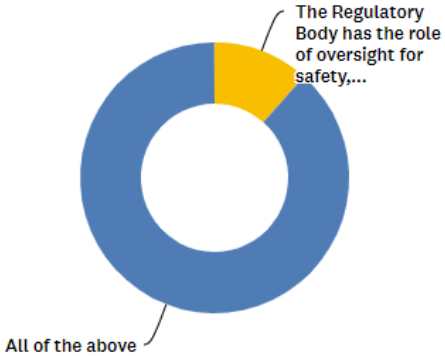
Eng. Ali Al Hammadi
Nawah

Nasser Al Nasseri
Barakah One Company

Dr. Ahmed Alkaabi
Khalifa University

Q&A poll results

What are the key principles embedded into the Nuclear Safety Convention?



- Government has overall responsibility for safety
- 12%: The Regulatory Body has the role of oversight for safety, authorisation and enforcement
- The prime responsibility for safety lays with the Operating organisation
- 88%: All of the above

Webinar Series on Governing New Nuclear Programmes: Newcomers Success Stories

A decade of integrated IAEA support to embarking countries

Quarter 3 2021

The materials under the current webinar series are available under https://www.iaea.org/newcomers-success-stories-webinars