

New Reactor, Construction, Commissioning and Transition to Operation. United Arab Emirates

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Outlines

- Introductory Facts
- Licensing of Barakah Nuclear Power Plants- Overview
- Decision Making – Operating License
- Challenges Commissioning
- Preparations for Oversight of NPP Operation
- Conclusions

Introductory Facts – Regulator/Developer

- Government Policy on the Evaluation and Potential Development of Peaceful Nuclear Energy adopted in 2008. Establishes following basic principles

Transparency

Highest standards of nuclear non-proliferation, safety and security

Working with the IAEA

Partnership with other nations and expert organisations.

Ensure long-term sustainability

- Federal Law Concerning Peaceful Uses of Nuclear Energy (Nuclear Law) issued in 2009 (based on the above Policy document)
- The Federal Authority for Nuclear Regulation, FANR, established in 2009 based on the above Law, and is the competent and independent federal nuclear regulator for nuclear and radiation safety, security and nuclear non-proliferation (safeguards).

Introductory Facts – Regulator/Developer

Emirates Nuclear Energy Corporation, ENEC established in 2009 to develop the peaceful nuclear energy program in the UAE.

Khalifa University assigned the responsibility to develop nuclear masters, and Abu Dhabi Polytechnic to develop engineers and technicians to the program.

ENEC contracted KEPCO for delivery of 4 APR-1400 PWRs to be commissioned by 2020.

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Introductory Facts - UAE Nuclear Power Plant

- Four units under construction at Barakah NPP
- Located on the Arabian Gulf approximately 300 km from Abu Dhabi.
- Korean Advance Power Reactor (APR 1400)
- Based on proven technology from the USA
- Reference plant at Shin Kori in Korea
- Supplied to Emirates Nuclear Energy Corporation (ENEC)
- Operated by Nawah Energy Co.



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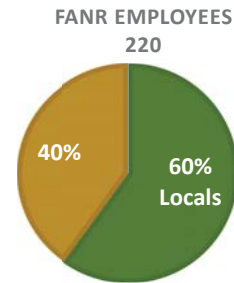
Introductory Facts – FANR Functions and Responsibilities

- ❑ FANR functions and responsibilities assigned by the Nuclear Law include:
 - Regulations and guides for safety, security and safeguards
 - Licenses to conduct regulated activities
 - Safety assessments
 - Inspection and enforcement regime
 - State system of accounting for and control of nuclear material
- ❑ Other agencies have relevant responsibilities: health, environment, emergency preparedness, customs, etc.
 - Article 7 of Nuclear Law requires FANR to cooperate with, provide information to and advise other agencies

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Introductory Facts - Regulatory Framework

- FANR was set up with Experienced nuclear experts to start to develop the regulatory framework in view of fast emerging nuclear energy program
 - Also, with emphasis to recruit and train locals in nuclear regulation
 - FANR regulates also medical, and industrial uses of ionizing radiation
- Today FANR employs 220 staff, 60% locals
- The regulatory framework is fully developed as of today including
 - Binding non prescriptive and performance based regulations and advisory regulatory guides,
 - Assessment and two step Licensing system, (Construction and Operating Licenses issued separately)
 - Inspection regime, with HQ and Resident Inspectors
 - Enforcement in case of non-compliances
 - All based on international best practices.
 - Policies, Processes and Procedures are developed in the Integrated Management System of FANR (based on IAEA GSR-2 Safety Requirements)



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Introductory Facts - Regulatory Framework

- What are the underlying approaches to nuclear regulation in FANR?
 - Applying the Policy principles of 2008, including the independence of FANR as a federal regulator
 - Taking benefit from international experience (but not copying any established regulatory regime)
 - Employing highly experienced nuclear experts from around the world to contribute to best practices
 - Building on IAEA standards and guides, in particular
 - IAEA Milestone approach including 19 infrastructure element
 - IAEA safety standards and guides
 - IAEA Security guidance
 - Utilizing IAEA expert and peer review services and workshops
 - Joining important International Conventions/agreements
 - Joining safeguards and additional protocol of the IAEA
 - Close cooperation with national stakeholders, and recognized foreign regulators
 - “Partnership” with Country of Origin (Korean) regulatory bodies
 - Taking advantage of the reference plant concept, and previous design certification and licensing
 - Development of some unique approaches to manage licensing and oversight

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Introductory Facts – Training of Emiratis FANRs Capacity Building And Emiratization Strategy

- Currently a strong cadre of senior and experienced professionals in nuclear safety and radiation protection through:
 - staffing by senior expatriate staff to deal with short-medium term needs;
 - capacity building and development of Emiratis to ensure long-term sustainability.
- Development of young Emiratis are provided through:
 - Formal education such as undergraduate and post graduate scholarships at national and international academic institutions;
 - Competency-based training programmes;
 - Mentoring by experienced staff.

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Introductory Facts – Training of Emiratis

FANR Career Development Activities

Scholarship Program:

- KUST (MSc & PhD)
- KINS – KAIST
- Other international Universities

Secondment Program:

- US NRC
- IAEA
- Other International Regulatory Bodies

Competency Framework:

- Based on IAEA Tec Doc 1254.
- Reflects Job (Knowledge, Skills and Attitude)

In-house technical training against competency framework

- Inspector Training and formal qualification- 68 qualified inspectors
- Safety Assessor Training
- Safeguards training
- Nuclear fundamentals courses
- Nuclear energy courses for non-technical UAE staff
- Physical security awareness sessions for all staff

Developee Engineer's Programme

- 13 months rotation in Op's Division and other learning activities.

Leadership and Management Program.

- PMO
- ADNOC

- Coaching and Mentoring
- Knowledge Management
- Internship and collaboration with universities and stakeholders.
- Annual Training Plan

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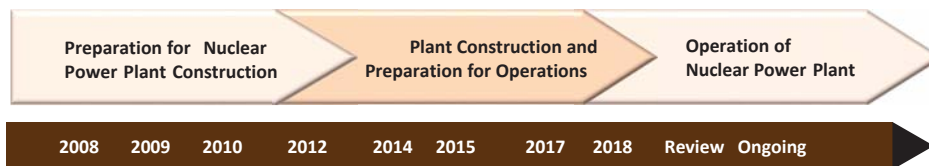
Introductory Facts – Inspections

- FANR has established a Construction Inspection Program for all the phases of the construction.
- FANR inspections are designed to verify licensee conformance to applicable requirements (Nuclear Law, FANR Regulations, and issued licenses).
- FANR conducts routine, planned inspections that cover vendors, site construction/commissioning and programmatic inspections
- FANR has deployed five Resident Inspectors (RI) at Barakah site for site regulatory inspections.
- Head Office inspectors carry out Inspection planning and participate in site/vendor inspections. TSO support is used in specific areas of expertise.



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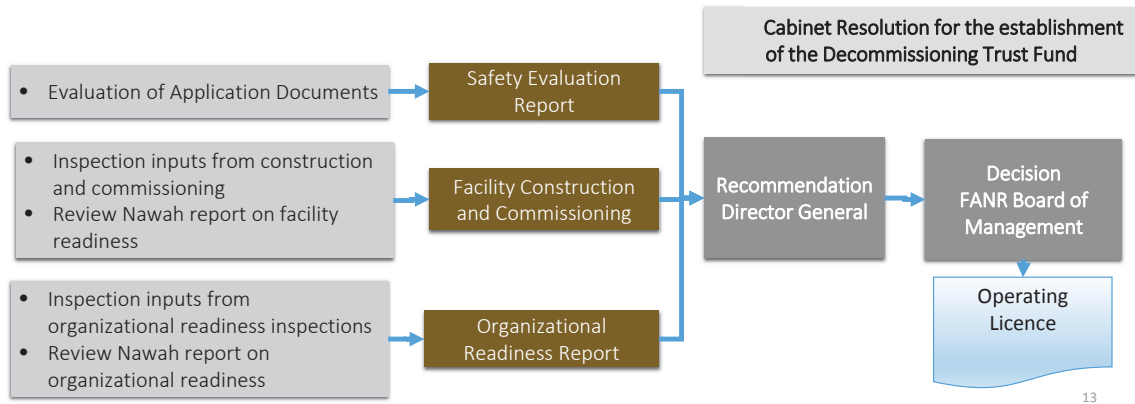
Licensing of Barakah Nuclear Power Plants- Overview



- Construction License Issued for Units 1 and 2 – July 2012
- Construction License Issued for Units 3 and 4 – Sep 2014
- ENEC applied for Operating licenses for Units 1 and 2 in 2015, and for Units 3 and 4 in 2017.
- Barakah Unit 1 is essentially completely built, technical verification and operational readiness actions in progress
- FANR issued license/authorization for Import, Transportation, and Storage of nuclear fuel for Barakah Unit 1 in December 2016
- Operating License Applications under review

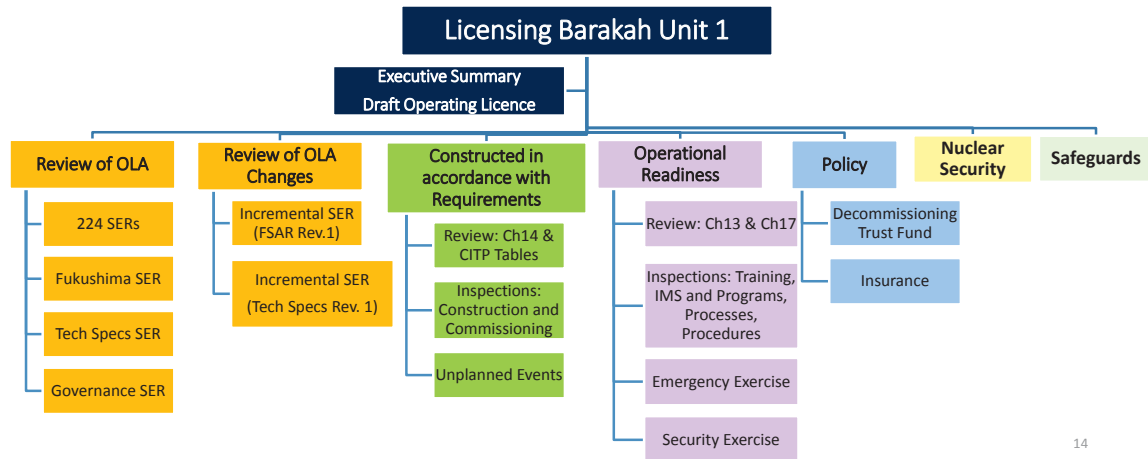
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Decision Making – Operating License



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Barakah Unit 1 – Licensing Decision



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Challenges Commissioning

- First Nuclear Power Plant Construction in UAE (lacking previous nuclear infrastructure). Need to establish
 - Clear framework of regulatory controls for commissioning (Regulations, Regulatory Guides, License Conditions, Internal procedures and inspection instructions to ensure objectivity and consistency)
 - The Controls Necessary for commissioning prior to fuel load and following fuel load
 - Technical as well organizational readiness for operation before first fuel load
- Licensee and contractors need to understand the established regulatory controls

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FANR Regulatory Elements - Commissioning

- Construction License included authorization of commissioning
 - Required detailed safety assessment of controls and processes for commissioning prior to fuel load
 - Established set of parameters under strict regulatory control by license condition
 - Routine reporting of parameters under strict control by license condition
 - Implemented inspections of commissioning execution
- Operating License will authorize commissioning following fuel load through full power operation

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Construction Inspection Test Plan (CITP)

- CITP tables are required for non-nuclear commissioning as part of the construction license review.
- The CITP tables document require testing for key safety related structures, systems and components.
- For SSCs in the CITP Tables, the licensee was required to identify:
 - Key safety functions to be verified during commissioning
 - The test procedures where the functions would be verified and the source of the design requirement for the functional parameters.
 - The licensee is required to report on the results of completion of CITP items as a license condition requirement of the construction licenses

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Preparations for Oversight of NPP Operation

- FANR's role will shift to regulatory oversight of plant operations.
- FANR will continue to use its core regulatory functions and skills to verify the safety and security of facility operation.
- FANR will address international operating experience and have the necessary capability for emergency preparedness and incident response.



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Conclusions ...

- UAE has made many advances in implementing its civil nuclear energy programme since the adoption of the national policy on peaceful uses of nuclear energy. In 2008.
- The UAE experience may serve as a model for other states who wish to gain international support in deployment of peaceful nuclear energy options.
- The UAE has operationalized a plan which includes international agreements, a legal framework, an independent regulatory body and an implementing organization, technology procurement skills, human resource development and capacity building.
- The issuance of construction licenses and regulatory oversight of construction have been successful and provided a foundation for developing regulatory skills and practices.

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Conclusions ...

- FANR has now reached another transition point, from construction oversight to nuclear commissioning and operations.
- Managing this transition will require continued diligence and commitment to safety culture
- The UAE is committed to continuing the actions necessary to build and sustain a world-class nuclear safety culture
- Licensee has to manage nuclear safety – FANR manages regulation! Basic principle to keep in mind.

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Thank you



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