UAE Nuclear Power Programme Development

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Introduction

- **High interest** for the introduction of nuclear power
- Most developing countries lack critical **infrastructure** required to support nuclear power program deployment.
- The common challenges for the introduction of nuclear are mostly associated with the **nature of nuclear energy and its development requirement**s :
  - Major planning efforts
  - Large capital investment
  - Importance of long term sustainability for safety and commercial considerations
  - High level political decisions and international framework
  - long term commitment

- UAE has adopted and implemented an approach for the evaluation and implementation of peaceful nuclear energy program based on UAE needs, IAEA recommendations and guidance, and international support for the program

Developing a National Position

- Developing a positive national position to introduce nuclear energy program is challenging process in most states :
  - Nuclear Power is a **sensitive subject** politically
  - Decision making process differs from country to country, a challenging process in most countries.
  - The decision is not a pure political decision ,**many factors are involved**
  - Availability of advanced **energy planning** and technical capabilities is essential to develop the national position
- National position :
  - Demonstrates Government support and commitment
  - Safety, security and non-proliferation needs
  - Defines a national strategy and the implementing organization(s)

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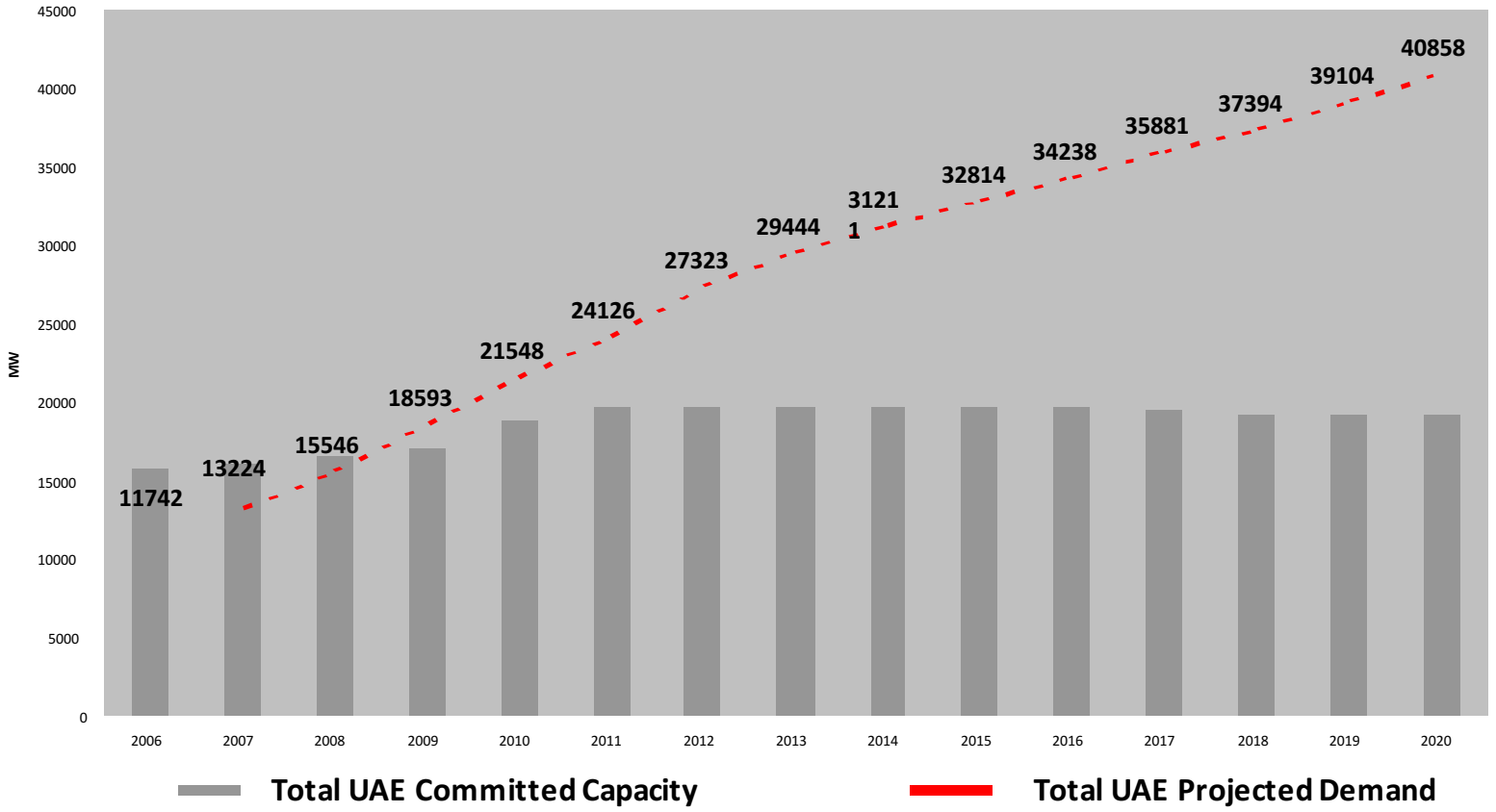
Background on Developing National Position: UAE Electricity Demand



Evaluation of future energy sources options :

After energy studies were conducted, nuclear power emerged as a proven, environmentally attractive and cost-competitive electricity-generation option.

Developing a National Position : Formulating UAE Policy

1. Determination that peaceful nuclear energy represents a potentially valuable option for the UAE
1. Development of guiding principles by UAE Government
1. In-depth study of international best practices
1. Wide consultation process
1. Formally endorse final policy

- Complete operational transparency
- Highest standards of non-proliferation
- Highest standards of safety and security
- Close cooperation with the IAEA
- Partnership with governments and firms of responsible nations
- Long-term sustainability

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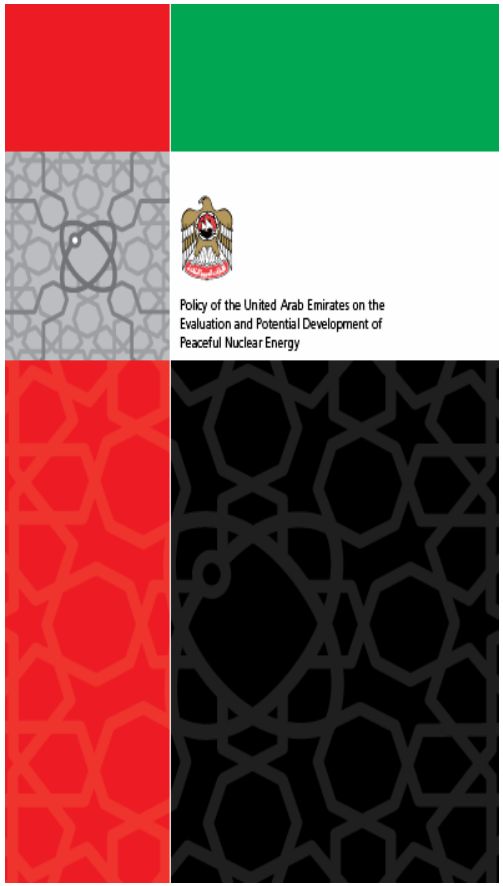
Development of the Infrastructure



مرسوم بقانون إتحادي رقم (6) لسنة 2009
في شأن الاستعمالات السلمية للطاقة النووية

نحن خليفة بن زايد آل نهيان رئيس دولة الإمارات العربية المتحدة.

- بعد الإطلاع على الدستور،
- وعلى القانون الاتحادي رقم (1) لسنة 1972 بشأن اختصاصات الوزارات ومصلاحيات الوزراء والقوانين المعدلة له،
- وعلى القانون الاتحادي رقم (8) لسنة 1984 في شأن الشركات التجارية والقوانين المعدلة له،
- وعلى قانون المعاملات المدنية الصادر بالقانون الاتحادي رقم (5) لسنة 1985 والقوانين المعدلة له،
- وعلى قانون العقوبات الصادر بالقانون الاتحادي رقم (3) لسنة 1987 والقوانين المعدلة له،
- وعلى قانون الإثبات في المعاملات المدنية والتجارية الصادر بالقانون الاتحادي رقم (10) لسنة 1992 والقوانين المعدلة له،
- وعلى القانون الاتحادي رقم (24) لسنة 1999 في شأن حماية البيئة وتنميتها والقوانين المعدلة له،
- وعلى القانون الاتحادي رقم (1) لسنة 2002 في شأن تنظيم ورقابة استخدام المصادر المشعة والوقاية من أخطارها والقوانين المعدلة له،
- وعلى القانون الاتحادي رقم (13) لسنة 2007 بشأن السلع الخاضعة لرقابة الاستيراد والتصدير والقوانين المعدلة له،
- وعلى المرسوم بقانون إتحادي رقم (11) لسنة 2008 بشأن الموارد البشرية في الحكومة الإتحادية،
- وعلى المرسوم الاتحادي رقم (38) لسنة 1996 في شأن انضمام دولة الإمارات العربية المتحدة لمعاهدة عدم انتشار الأسلحة النووية لعام 1968،
- وعلى المرسوم الاتحادي رقم (84) لسنة 2000 في شأن اتفاقية الحظر الشامل للتجارب النووية لعام 1996 والبروتوكول الملحق بها،
- وعلى المرسوم الاتحادي رقم (66) لسنة 2003 في شأن انضمام دولة الإمارات العربية المتحدة لاتفاقية الحماية المادية للمواد النووية،

UAE Policy Formulation: Roadmap Strategy

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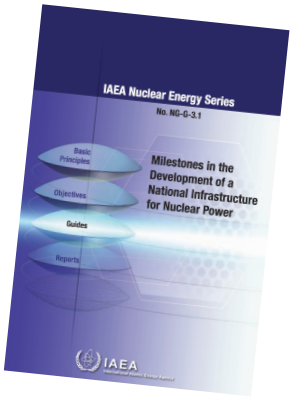
19 Elements assessed

- National position
- Nuclear safety
- Management structure
- Legislative framework
- Regulatory framework
- Financing
- Human Resource Development
- Safeguards
- Security and physical protection
- Emergency planning
- Radiation protection
- Nuclear Fuel cycle
- Nuclear Waste
- Environmental protection
- Site and supporting facilities
- Industrial involvement
- Procurement
- Electric grid
- Stakeholder involvement



A *Roadmap* document was designed to translate the milestones of a successful nuclear power program (as identified by the IAEA) into an implementation plan customized to meet the needs of the UAE

Defining a national strategy

National strategy was defined based on **extensive planning and involved all stakeholders** addressing the following topics:

- Defining and Managing the Overall Requirements for a Successful Commercial Nuclear Program;
- Program Schedule;
- Risk and Resources;
- Implementing an Effective Program Organizational Structure;
- Implementing a Comprehensive Network of International Agreements;
- Implementing a National Legal Framework to Support Nuclear Power;
- Developing an Effective Nuclear Safety Regulatory Agency;
- Effective Communications;
- Implementing a Rapid and Effective Procurement Strategy;
- Building a National Infrastructure to Support Nuclear Power;
- Selecting the Appropriate Site;
- Technology Selection;
- Developing the Nuclear Fuel Cycle and Waste Management Strategy.

Developing nuclear safety infrastructure

- Competent Nuclear Safety infrastructure is the corner stone for the successful implementation of nuclear program.

- Considerations :
  - establishing the appropriate legislation
  - difficulties in passing legislations and associated timeline
  - Ensuring the independence of regulatory body
  - how to “upgrade” or “replace” the existing safety and regulation framework where exists
- UAE Approach :
  - Amended previous concerned legislations, establish a new law for the applications of peaceful nuclear energy (**Nuclear Law of 2009**)
  - Establish a **new nuclear regulatory body** and merge previous responsible entities.
  - Safety Regulator is given the **power and protection to independently** regulate the nuclear sector .
  - Law **defined high level responsibilities** of operators , the regulator and other stakeholders.

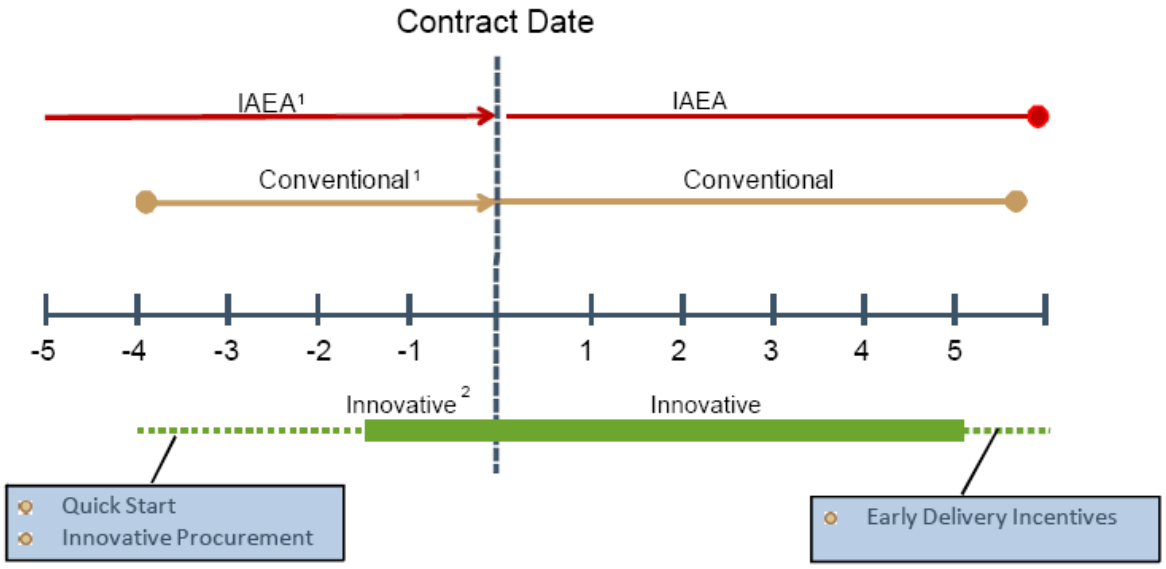
Developing Management infrastructure

- Management structure of the program changes as the program expands and stakeholder number increases
  - Ex: Moving from NEPIO to fully functioning regulator and implementing organization

- Considerations:
  - Ensuring all stakeholders plans and progress are aligned throughout all phases of the program ,
  - Defining responsibilities among stakeholders
  - Evaluating unique state ownership options
  - Availability of resources and capabilities to manage large projects
  - Lack of expertise and capabilities in managing large projects and specifically nuclear power plants constructions.
  - Contracting strategy should be defined to meet the requirement, the timeline and states policies.

Developing a Procurement Strategy

- Challenge : Procurement strategy to meet state requirements ,the timeline and viable from vendors point of view.
- UAE Approach: Innovative Procurement strategy to cut conventional procurement time.



- Program objective to safely deploy first plant by 2017
- This implies a first concrete in 2012
- Would represent one of the fastest deployment schedules

[1] Assumes the existence of a competent nuclear procurement organization.
[2] Assumes the creation of the Intelligent Customer.

Funding and Financing

- Lack of funding and financing options have put major international nuclear projects on hold in the past.
- Nuclear programs are **capital intensive** and would require strong Government backing.
- **Vendor countries** could be interested to support funding nuclear plant constructions in developing countries.
- Available **funding from Governments** is essential for long term sustainability of the program
- Strategies should be aligned to ensure long term funding for the goal of sustainability of the program
- UAE Approach
  - Government funds development of required infrastructure.
  - Strategies for long term sustainability of the program
  - Opportunities of equity share and foreign participation
  - Decommissioning and waste management funding early planning

Human Resources development

- Availability of sufficient qualified manpower throughout all phases of the program constitutes a major challenge.
- UAE Approach :

  - **Personnel with previous skills and experience** are being placed in the program
  - Appointment of a **Managing Agent** early in the program
  - Developed staffing plans, relationships with universities world-wide have been, and are continuing to be developed.
  - Nuclear operations **staffing model** was developed to calculate staffing needs from 2009 until 2022 for the UAE program
  - A plan to develop and maintain the human resources base in organizations for the operational phase was developed early in the process.
  - Plan implementation included establishment of **scholar programs** and arrangements with universities outside the UAE
  - **Venders** are required to participate in implementing training programs as part of contracted scope of work.

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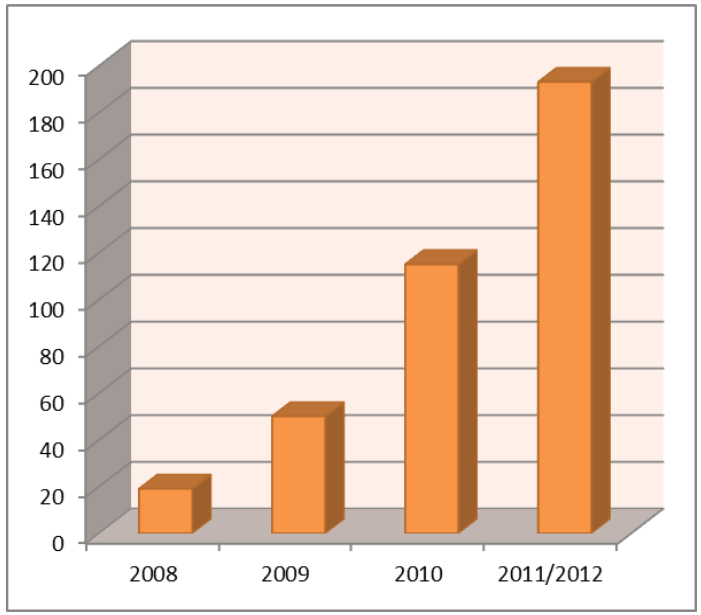
UAE Programme Development

Nuclear Policy → **Creation of Nuclear Regulator, Nuclear Operator, adoption of Federal Nuclear Law, Prime Contractor Selected** → **Construction of Unit 1 begins** → **Construction of Unit 2 begins** → **Construction of Unit 3 begins** → **Commissioning of Unit 1, followed by other Units**

2008 2009 2012 2013 2014 2017

Development of Infrastructure : Establishment of FANR

- Article (2) of the Nuclear Law established the Federal Authority for Nuclear Regulation ("**FANR**") as the **regulatory body of the UAE Nuclear Sector with independent legal personality, full legal capacity and financial & administrative independence**



•Received, Assessed and Approved **Construction License for Barakah Units 1 and 2** in July 2012

•Received, Assessed and Approved **Construction License for Barakah Units 3 and 4** in September 2014

• Full operation in inspection and regulating construction work

•Currently assessing operation license for unit 1 and 2

Establishment of the Emirates Nuclear Energy Corporation and Progress to date

- Established in December 2009
- ENEC specializes in the safe deployment, ownership and operation of nuclear power plants within the UAE

In December 2009, ENEC announced the selection of a consortium led by the Korea Electric Power Corporation as the winning bidder for the UAE first batch of nuclear power plants

The contract calls for KEPCO to design, build and jointly operate four APR1400 nuclear power plants.

Implementing International Instruments

The UAE has **concluded all relevant international agreements and conventions**.

✓In 2014, the UAE joined the **Convention on Supplementary Compensation for Nuclear Damage.**

- ✓**nuclear liability conventions**
- ✓Nuclear safety convention
- ✓Safeguards and non-proliferation including the additional protocol ,
- ✓Physical protection

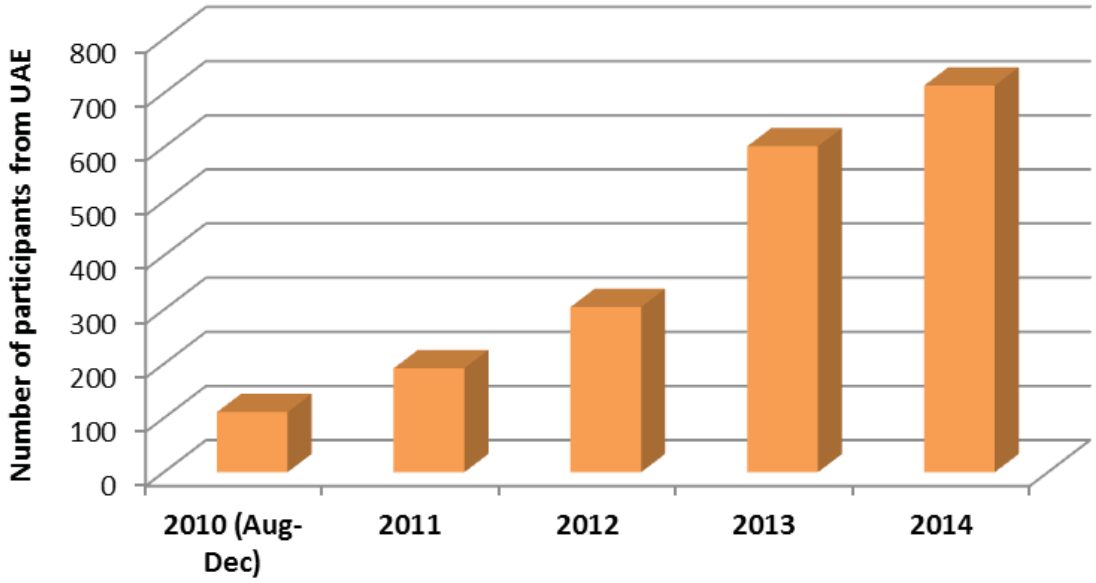
✓UAE Implements all its international requirements under the nuclear related conventions

Partnership with the IAEA

- **Legal and Regulatory Framework**
  - Consultations with the Agency (e.g. nuclear law, FANR regulations on physical protection, safeguards)
  - Benefit from IAEA standards and guidance in establishing FANR regulations and guides
- **Licensing**
  - Direct support and advice, e.g. site assessment mission in 2011
- **Infrastructure and capacity building**
  - Training events within or outside TC cooperation
  - Expert advice in variety of areas
  - Provision of technical support, e.g. monitoring, laboratory equipment
  - Use of IAEA systems/data bases, IRS, ITDB, ..
  - Security infrastructure, INSSP
- **Peer reviews**
  - INIR Review (January 2011)
  - IRRS (December 2011
- **UAE contributes to IAEA**
  - Safety/security standard committees
  - Host international conferences (2010, 2013)
  - Contribute our experience as a new comer country

Cooperation with the IAEA

- The **Integrated Work Plan** for the UAE, enables all IAEA departments to address the schedule and needs for implementation of the UAE nuclear power programme.
- Through the Technical Cooperation projects delivered by the IAEA, the UAE has been **receiving useful training** to establish national capabilities
  - A significant increase in number of UAE participants in IAEA activities



IAEA Peer Review Services

To date, the UAE has received many review services including :

➢**IAEA Integrated Nuclear Infrastructure Review** (INIR) mission in January 2011
➢**IAEA Integrated Regulatory Review Service** (IRRS) mission in December 2011 and follow up in 2015
➢**IAEA Safeguards Advisory Service** (ISSAS) mission in May 2014
➢**EPREV (2015)**
➢**More are planned for 2016/2017**

Human Capacity Building

UAE is building its nuclear cadre through nuclear education and training , for example :

➢Scholarship programmes (ENEC and FANR)
➢Nuclear-related workshops, courses, programmes (eg. GNEII)
➢Hosting IAEA Nuclear Energy Management School and training
➢Cyber Learning Platform (CLP4NET) installed at Khalifa University in Abu Dhabi

Total number of scholars:	375
Higher Diploma in Nuclear Technology:	196
Master of Nuclear Engineering:	171
PhD in Nuclear Engineering:	1

- In May 2014, the first batch of **13 local operators** returned from South Korea after completing specialized training programmes.

- In September 2014, ENEC celebrated the **graduation of 46 students** from ENEC's scholarships programme, including Bachelors, Masters and HDNT

Additional Training on-site

•In April 2014, ENEC inaugurated the **Simulator Training Centre** at Barakah, a second Training Simulator was opened in 2015.

•The simulator replicates the actual conditions and environment that reactor operators would experience in a real time situation

•Each student requires more than 800 hours of advanced simulator training to receive the SRO certification, which FANR controls and issues

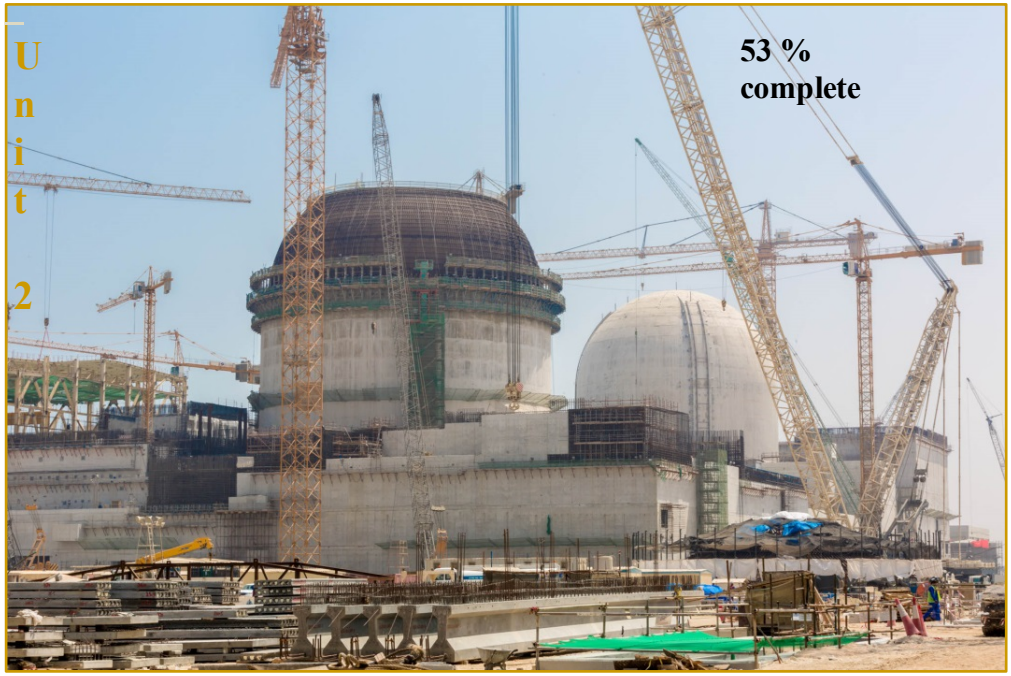
Outreach and Public acceptance

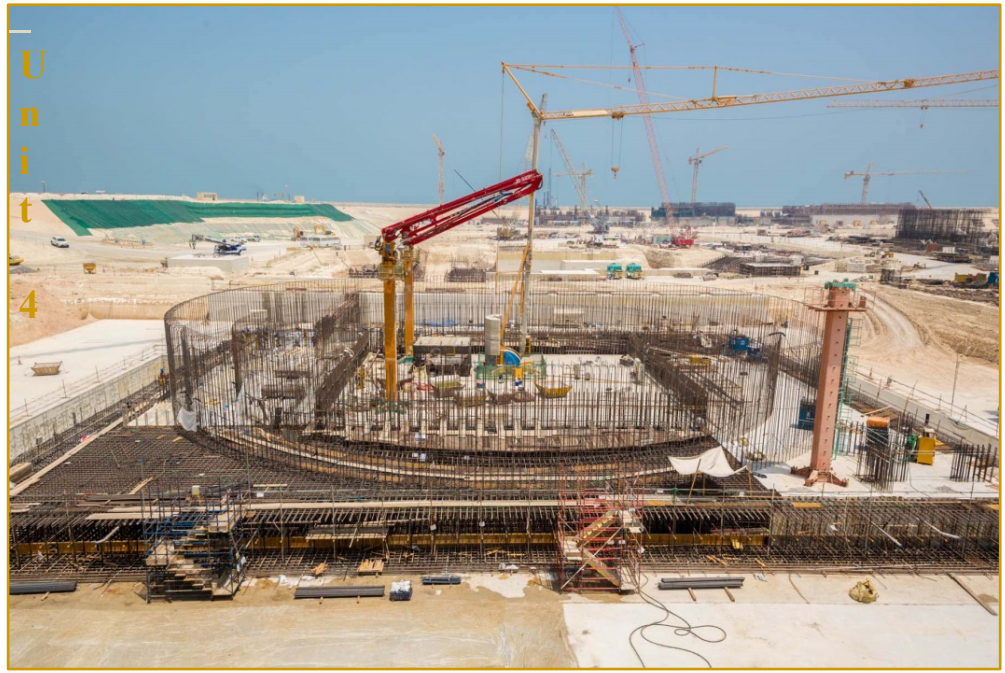
UAE communicates transparently on a constant basis with its residents, employees, government agencies and the international community through:

- ENEC and FANR Public Forums
- Social Media: Twitter, YouTube, Instagram and Flickr
- Monthly electronic Newsletters
- UAE Permanent Mission official website
- UAE nuclear energy programme exhibitions worldwide

82% of UAE residents are positive and in favour of nuclear energy in their country

Construction progress of UAE Nuclear Power Plant





Overall the Barakah Nuclear Power Plant construction completion rate for **Units 1-4** is at **50%** .

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Thank you!