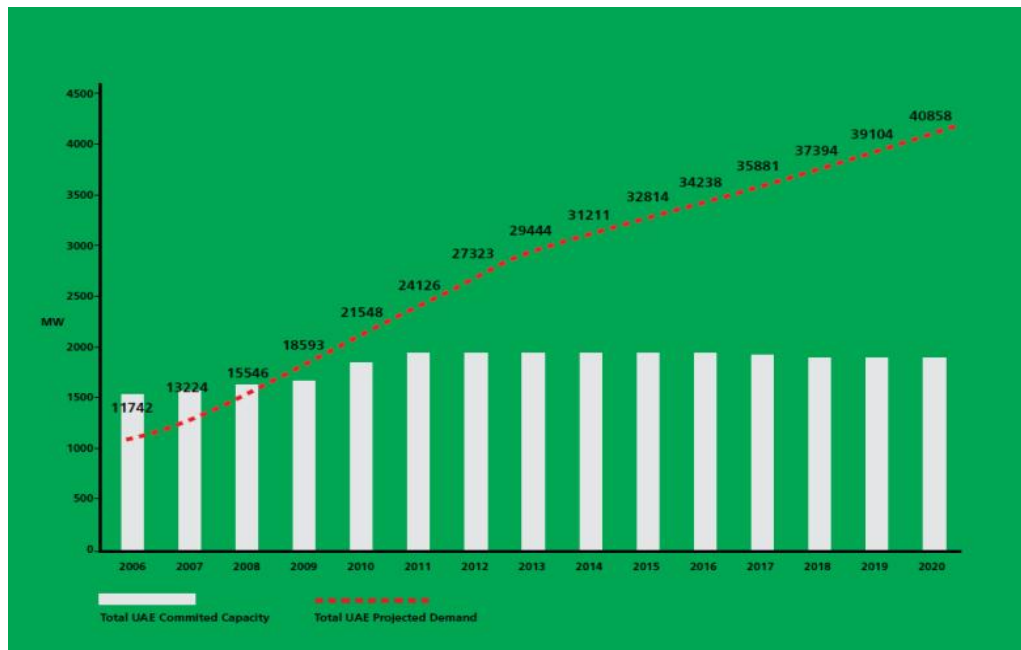


**CASE STUDIES ON FINANCING AND ELECTRICITY PRICE
ARRANGEMENTS
THE BARAKAH NUCLEAR POWER PLANTS,
THE UNITED ARAB EMIRATE**

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- The United Arab Emirates (UAE) were founded in 1971 and comprises seven states including Abu Dhabi and Dubai. The Abu Dhabi Emirates accounts for 87 % of the land area of the UAE and 95% of its oil.
- On 27 December 2009, UAE selected a consortium led by Korea Electric Power Corporation (KEPCO) to design, build and assist in operation and maintenance of four nuclear power plants of 1,400 MWe, APR-1400.
- Located at Barakah on the coast of 300 km West of Abu Dhabi city.



- Evaluation of Future Energy Source Options :
 In 2009, the UAE produced 88.2 TWh of electricity, 98 % of it from gas, for which it relies partly on imports. The UAE Nuclear Energy Policy (2008) stated that nuclear power is a proven, environmentally attractive and cost-competitive electricity-generation option.



- Nuclear Program Management Structure

- Federal Authority for Nuclear Regulation (FANR)
 - Established in 2009
 - Regulations, Licensing process, Inspection procedure in place
- Emirates Nuclear Energy Corporation (ENEC)
 - Established in 2009
 - resources and processes in place for NPP construction
 - Licensee for Barakah NPP, Construction on-going
- CICPA, Khalifa University, NCEMA, etc.

Strong partnership with the IAEA has been established since the beginning of the UAE nuclear program,

- Legal and Regulatory Framework
 - Consultations (e.g. nuclear law, physical protection, safeguard)
 - Benefit from IAEA standards and guidance in establishing FANR regulations.
- Peer Reviews
 - INIR (Integrated Nuclear Infrastructure Review) (January 2011)
 - IRRS (Integrated Regulatory Review Service) (December 2011)
- Infrastructure and capacity building in training, system/data bases, etc.

The UAE signed a bilateral nuclear energy cooperation agreement with USA in January 2009 and South Korea in June 2009. The UK, Japan, France, Canada, Russia, and Australia also have a nuclear cooperation with the UAE.

ENEC selected a Consortium led by KEPCO for four nuclear power plants in the UAE. KEPCO was to supply the full range of works and services for the UAE Civil Nuclear Projects including engineering, procurement, construction, nuclear fuel, and operations and maintenance support. The total value of the contract is USD 20.4 billion, with a high percentage of the contract being offered under a fixed-price arrangement.

	Scope	Firms	Price (USD billion)
Construction/ Management	NSSS, Steam Generator & Other Major Components	Doosan (with Toshiba as subcontractor)	3.9
	Civil Engineering	Hyundai (prime constructor) and Samsung	3.1 and 2.5
	Technical Assistance and License	Westinghouse	1.3
	Eng. Procurement and Construction (EPC)	KEPCO/KHNP	unknown
Training	Training of UAE Staff	KHNP, KAIST	unknown
Design	Plant Design and Modification	KOPEC	unknown
NPP Launch and First Two Fuel Loads	Nuclear Fuel (2 loads)	KNF	1
	Initial O&M	KHNP & KPS	1.2
Cost of Capital	Project Financing	KEPCO	unknown

APR-1400 is an evolutionary advanced light water reactor (ALWR) developed in Korea in 2002. The design has evolved based on the experience gained throughout the development, construction, and operation of the 1000 MW Optimum Power Plant (**OPR-1000**) and advanced design features of **System 80+** whose design had been certified by the US NRC.

- A total of twelve OPR-1000 units are operating in Korea with very good operating results.
- The APR-1400 is intended to the next generation of nuclear power plants in Korea, following the OPR-1000. The first APR-1400 plants are located near the existing Kori site, where construction project for the two units, Shin-Kori 3 and 4 is in progress.

The design of the APR-1400 plant at Barakah is based on the design of the **Shin-Kori 3 and 4 units that serve as reference plants**, which are slated to begin commercial operation in 2013 and 2014, respectively.

Nevertheless, there will be a number of **design changes** mainly related to site-specific environmental conditions which are different from those at Shin-Kori such as :

- Seismic floor response spectra,
- Ultimate heat sink temperature
- Ambient air temperature
- 50 Hz electrical grid

After the Fukushima NPP accident, the updated Safety Assessment Report (SAR) **addressed lessons learnt from the accident and potential safety issues**, with the aim of improving the robustness of the units and mitigating **station blackout** and **loss of ultimate heat sink events**:

- Installation of water-proof gates for each of the auxiliary building,
- Alternate AC, diesel generator building,
- Emergency service water intake structure.

ENEC had announced the following schedule for the APR-1400 plants at Barakah

Plant	Construction start	Start Up
Barakah 1	7/2012	5/2017
Barakah 2	Mid-2013	2018
Barakah 3	2014	2019
Barakah 4	2015	2020

In April 2010, ENEC lodged **licence applications and an environmental assessment** for Barakah site and in December 2010 a **construction licence application** for unit 1 and 2.

- Approval of environmental management plan by Environmental Agency in July 2012.
- Construction licence for units 1 and 2 by FANR in July 2012.
- Major milestones for the Barakah 1 unit:
 - First concrete in July 2012, the setting of the reactor vessel by July 2014,
 - Obtaining the operating license and fuel loading by October 2016, and
 - Commercial operation by May 2017.

- The Emirates Nuclear Corporation (ENEC) is the organization charged with implementing all aspects of the UAE nuclear programme. ENEC itself answers directly to the President of the UAE.
- The initial financial volume of the project to construct four APR-1400 at Barakah is USD 20.4 billion. A high percentage of the contract is being offered under a fixed-price arrangement. In addition to the delivery of the four plants, ENEC and KEPCO have also agreed the key terms under which Korean investors will have an equity interest in the project.
- Bloomberg news on 28 November 2011, however reported that the joint venture might cost about USD 30 billion, with financing split into one-third equity and two-thirds debt.
 - Abu Dhabi would provide most of the USD 10 billion equity and
 - USD 10 billion of debt most likely come from the South Korea.
 - Remaining USD 10 billion be a mix of bank financing and sovereign debt.

- MEED News reported on 31 May 2013 that the project hoped to get the deal signed before the end of 2012, but the debt financing for the nuclear project was delayed.
 - Original Plan: US\$10 billion from the Export Import Bank of Korea (Kexim), US\$2 billion from the Export Import Bank of the US (US Exim), US\$6 billion in funding from the government of Abu Dhabi, US\$2 billion from commercial banks.
 - The amount that ENEC borrow to fund the scheme could be cut back as there are worries about the size of the interest bill due on the proposed \$20 billion 23-year debt package.
- The Abu Dhabi electricity market regulator (Regulation and Supervision Bureau) is the responsible body to issue the generation license for the Barakah NPP - which is currently in progress

- The Barakah nuclear plants will be based on the design of the Korean APR-1400 reactors, which is itself an evolution of the design of the OPR-1000 in Korea in addition with the advanced design features of System 80+.
- It is financed by a mix of equity contributed by the UAE government through ENEL and debt, which is secured to a significant share by the Korean Export-Import Bank.
- Electricity price arrangements are still under discussion. However they are unlikely to affect the financing in a major way as the latter ultimately relies on the implicit and explicit support of the UAE government.