

## South Korea - a serious supplier

A South Korean consortium has won the fiercely contested \$20bn deal to build nuclear reactors in the United Arab Emirates (UAE). **Korea Electric Power Corp (Kepco)** was selected over rival offers from established nuclear suppliers in France, Japan and the US.

This will be the first export of a nuclear power plant (NPP) by South Korea, which gave notice some time ago that it planned to compete on the international market.

The newly-formed **Emirates Nuclear Energy Corp (Enec)** valuation of the deal for four 1,400MWe reactors at about \$20bn was significantly less than earlier estimates suggested. “We look forward to a long and productive relationship as we work toward powering the future growth of the UAE with low-carbon, peaceful nuclear energy,” says Enec CEO **Mohamed al-Hammadi**.

The Korean consortium includes **Samsung, Hyundai and Doosan Heavy Industries**. Japan’s **Toshiba Corp** and its **Westinghouse** subsidiary will also be involved. The UAE plans to begin construction on its nuclear plants in 2012 and Enec expects the first reactor to begin providing electricity in 2017, with the remaining units coming online by 2020.

Although the UAE is one of the world’s largest oil exporters, it must import natural gas to run many of its existing power plants. It says its energy needs are expected to almost double by 2020.

Al-Hammadi refused to comment on the losing bids, saying all three finalists made “excellent” offers. These included a US-Japanese team with **General Electric Co** and **Hitachi Ltd** and a French consortium comprising **Electricite de France, GDF Suez, AREVA** and **Total**. Gulf energy expert **Robert Bryniak**, CEO of **Golden**

**Sands Management Consulting** in Abu Dhabi, says South Korea’s team most likely offered the lowest price, noting that the UAE made its decision “based on the economics and the merits of the proposal, rather than on politics”.

### An ongoing relationship

The order is part of a “fleet of power plants” planned by the UAE, according to al-Hammadi. South Korea is optimistic that it will pick up some of this business. “This industry has just started to grow, and there’s strong growth potential for the next two decades,” says **Lee Jin Woo**, a fund manager at **KTB Asset Management Co** in Seoul, which manages the equivalent of \$8.5bn. “There are expectations for winning additional orders.”

South Korea’s ministry of knowledge economy expects the deal to be worth about \$40bn including construction of the reactors and participation in their operation. It is the biggest single contract South Korea has ever won overseas. “We can now stand shoulder to shoulder with the US, Japan, France and Russia in our advance into the international market,” says president **Lee Myung-bak**.

South Korea first introduced nuclear power in 1978 and now has 20 reactors in operation, which provide about 40% percent of its electricity. While the early plants were built under licence to western suppliers, Korea now builds and designs its own reactors and is now actively marketing its OPR-1000 and APR-1400 power generation units in Middle East and North African countries.

Designer **Korea Power Engineering Company (Kopec)** saw a 44% boost in its share price after its first day on the stock

Uranium Prices			
Spot	02-Nov	30-Nov	11-Jan
\$	46.50	45.50	44.50
€	31.47	30.31	30.67

Source: Ux Consulting (uxc.com)

Future	Jan-10	Feb-10	Mar-10
Nymex	43.75	43.75	44.00

Source: Nymex

WNA Nuclear Energy Index (total return)			
	Oct-09	Nov-09	Dec-09
In US \$	2,951.41	2,968.13	3,054.96
In Euro €	1,781.11	1,760.30	1,895.89

index: 1000 = Dec 2001

Regional nuclear power overview			
	No. Units Installed	Under Con	Planned
Europe	196	13	22
N.America	124	3	15
S.America	4	1	2
Asia	103	33	88
M.East	-	1	6
Africa	2	-	3
<b>Total</b>	<b>429</b>	<b>51</b>	<b>136</b>

	Capacity (MW) Installed	Under Con	Planned
Europe	171,303	11,200	25,740
N.America	115,081	2,680	18,200
S.America	2,836	692	1,985
Asia	76,718	31,501	92,755
M.East	-	915	7,400
Africa	1,842	-	3,565
<b>Total</b>	<b>367,780</b>	<b>46,988</b>	<b>149,645</b>

	Generation TWe (2007)	Uranium Needed 09 (t)
Europe	1,155.1	28,151
N.America	907.0	20,779
S.America	20.8	430
Asia	465.0	14,868
M.East	-	143
Africa	12.7	303
<b>Total</b>	<b>2,560.6</b>	<b>64,674</b>

Source: Derived from WNA data

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market in December and earlier gained a key accreditation for component export. Some 20% of its shares were put up for public sale by Kepco which still owns 78% of the company.

In October the company received accreditation from the **American Society of Mechanical Engineers** to use its 'N-Stamp' on nuclear equipment. This is the global quality standard for making and installing pressure and safety-related components used in the hearts of nuclear power plants such as reactor pressure vessels, pressurisers, steam generators, main pumps, and coolant pipes.

Kopec has taken part in the construction of 20 nuclear power reactors, including six of its own design developed from Westinghouse units imported in the 1970s. Six more own-design units are under construction. It has overseen the development of a complete indigenous supply chain, based on major South Korean firms such as Doosan, and is now marketing its APR1400 pressurised water reactor to foreign buyers.

The UAE deal has given South Korea a foothold in the global market for nuclear power plants, and president Lee says he hopes it will help to win orders from Asia. South Korea is eyeing Vietnam, Thailand and Indonesia as well as Jordan and Turkey as potential clients. "We are in talks with Vietnam, Thailand and Indonesia to build nuclear power plants," says **Park Ki Chull**, head of state-run **Korea Hydro & Nuclear Power Co (KHNP)**. Jordan has already contracted South Korea to build a research reactor.

### Other Middle East prospects

Earlier in December, the **Jordan Atomic Energy Commission (JAEC)** selected a consortium of the **Korea Atomic Energy Institute (Kaeri)** and **Daewoo Engineering and Construction** to build a 5MWt research reactor at the **Jordan University for Science and Technology**. This marked the first ever overseas contract for a Korean reactor design. The \$173m facility is seen as a vital precursor for the kingdom's plans to build a NPP, providing training opportunities for nuclear scientists and engineers as well as producing radioisotopes for industry, agriculture and medicine.

South Korea has an impressive record in developing its own nuclear reactor designs, using reactors supplied under turnkey

projects as a starting point. Kaeri's Hanaro (High-flux Advanced Neutron Application Reactor) design is a 30MWt version of the Canadian Maple reactor. Unlike the ill-fated Maple project, Hanaro has been operating successfully since 1995. With 5MWt specified for the Jordanian project, Kaeri will clearly be supplying a much smaller Hanaro variant.

Korea's ministry of education, science and technology announced that construction of the Korean-design Hanaro research reactor is to begin in 2010, with completion planned for 2014. The Korean consortium was chosen over bids from Argentina's **INVAP**, **China National Nuclear Corporation (CNNC)** and **Atomstroyexport** of Russia. The deal should give South Korea a distinct advantage in bidding for the first Jordanian NPP. South Korea's deputy foreign minister **Lee Yong-joon** is visiting Jordan in January to discuss a possible NPP construction.

South Korea is also planning to bid for a major Turkish nuclear power plant construction project, according to foreign ministry officials. The Turkish government hopes to build four nuclear plants, each costing some \$5bn, along the coast of the Black Sea and the bids are expected to be called in the first half of next year.

### US interest

Reports suggest that the US is also interested in South Korean reactors, although Kepco says nothing has been confirmed. However, **Don Gillispie**, CEO of **Alternative Energy Holdings Inc (AEHI)**, recently met officials of plant-related firms including **Keecoin Seoul** to discuss a nuclear energy deal. The visit reportedly aimed at finalising negotiations to import the Korean advanced reactor, APR 1400, which would be built in Idaho and Colorado if the deal is completed.

"We expect the agreement to be similar to the one with the UAE; such technology should give AEHI a serious competitive advantage," Gillispie was reported as saying. AEHI began talks Kepco and the Korean government a year ago.

AEHI is the only publicly traded independent nuclear power plant developer in the US willing to build power plants in non-nuclear US states. Its ongoing projects include Colorado Energy Park, which will accommodate nuclear energy in power generation along with solar power.

Pennsylvania State University in 1955. The original 100kWt reactor (increased to 200kWt in 1960) consisted of a core of plate-type fuel elements mounted in a grid plate, suspended from a moveable bridge in an open water pool. In 1965, this was replaced with a TRIGA reactor core and control system with a maximum

steady-state power level of 1.1MWt and a pulse capability of 2,000MWt. A new analogue-digital control system was installed in 1991. PSBR is the world's second oldest operating research reactor. The oldest is the F-1 graphite pile reactor at Russia's Kurchatov Institute, which began operations in 1946.

## New Technologies

### INPRO on firm basis for 2010

The International Atomic Energy's (IAEA's) International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) enters 2010 on a more solid basis than ever before. Its membership has now expanded to 31 (including the European Union), budgetary support from the IAEA has been increased and the INPRO action plan for 2010-2011 has been approved.

INPRO also has a new policy co-ordinator, **Jong Kyun Park** (director of the IAEA's nuclear power division) who replaces **Akira Omoto**. Membership is still growing with new countries expected to join, including Israel and Malaysia.

The action plan comprises four main programme areas: nuclear energy system assessments (NESA); global vision; innovations in nuclear technology; and innovations in institutional arrangements, as well as two supporting areas (dialogue forum and policy co-ordination).

NESA is intended to help members to perform assessments using INPRO's detailed methodology to support long-term strategic planning. Global vision aims to develop global and regional nuclear energy scenarios using scientific and technical analysis. Innovation in technology will foster collaboration among INPRO members on selected nuclear technologies and related R&D, while innovations in institutional arrangements will investigate and support collaboration on institutional and legal arrangements for the use of innovative technologies.

"The last few years INPRO has seen some institutional changes," IAEA deputy director general **Yury Sokolov** told *MNB*. "INPRO's methodology was developed as a systematic tool for assessing nuclear energy systems. There are now 11 projects underway which offer the possibility of improving that methodology. It can be used by countries which have already established nuclear power and also by countries wishing to embark on a nuclear programme."

He points out that the methodology can also be part of the IAEA's Milestone approach which is designed to help newcomer countries. "An important element is the development of a national position and an understanding that a nuclear power plant (NPP) means a commitment for at least 100 years" he says. "It is a long term commitment and requires consideration of not just the first NPP but the entire nuclear energy system and an understanding of all the elements required for sustainability."

He believes INPRO methodology can be used by newcomer countries to help them take a wider view. "We are trying to implement this on many levels – for regional co-operation programmes and their implications and for specific projects, such as Belarus, to understand what infrastructure is needed to start a nuclear energy system."

INPRO's collaborative projects are co-ordinated research projects and earlier opposition by some members to these has given way to general support for them. "We have a good set of potential collaborative projects which the steering committee approved for 2010-11. There was no strong opposition to these projects – we have passed the point of disagreement on these project," Sokolov explains.

"Membership support for these projects varies from country to country depending on their interests and there are four directions precisely to take into account those different interests. The developed countries are most interested in global scenarios and consideration of institutional issues and INPRO is well positioned to help with this. Other countries such as India are more interested in technological co-operation."

India has offered to support a fellowship which would include an exchange of scientists and engineers within the context of a collaborative project. "We are considering how we can use this fellowship approach for additional activities within INPRO", says Sokolov.

"I think this is promising – by using the experience of others it is possible to avoid mistakes. We should not exclude technological co-operation. Only through this can we develop knowledge about the real use of nuclear energy. It is not possible to learn everything from books. This approach has been used by the agency with respect to agriculture and isotope production and we can now extend it to nuclear energy."

### France puts €1bn into future nuclear

Next-generation nuclear is to receive €1bn (\$1.5bn) from a French investment programme. Initial details of a spending plan worth €35bn were announced by president **Nicolas Sarkozy** in December to support development of new technologies in partnership with small and medium-sized companies.

Funded by loans from the international markets and the repayment of emergency loans by banks, the largest part of the spending is €7.7bn to establish centres of research excellence. The portion on sustainable development included €1.5bn to support and demonstrate new energy technology including carbon capture with geologic storage. Another €1bn is earmarked to bring together researchers and business in 5-10 public-private institutes.

The government announcement that there was equal investment for nuclear and renewables in its plans. Some €1bn was dedicated to generation IV nuclear power reactors. There are as yet no details of timescales or potential projects, but one possibility could be a demonstration of the Antares high-temperature gas-cooled reactor, which AREVA has previously proposed.