AKKUYU NPP: Key Project Aspects

- First NPP project in Turkey
- Project cost = $20 bln (CAPEX)
- Construction terms: 2011-2023
- Implementation scheme: Rosatom BOO
- Power unit: Project NPP-2006 modified
- Total capacity: 4,800 mW (4 units)

- Legal framework – intergovernmental agreement on cooperation in the sphere of construction and operation of nuclear power plant as of 12.05.2010
- Term of Power Purchase Agreement (PPA) – 15 years, fixed. average weighted price conditions- 12.35 cents / kWh
- Possibility of involving foreign investors in the project (up to 49% of possession of property of AKKUYU NPP)
Turkey plans to build a home-grown nuclear industry over the next decade as it seeks to cut reliance on costly imported oil and gas, even though the nuclear newcomer outsourced its first two nuclear power plants to foreign firms.

Turkey’s first nuclear plant, AKKUYU, under ownership of Russia’s Rosatom, aims to be operational in 2020-2023. Rosatom Corp. has invited EDF to help build the power plant as the Russian state atomic power company seeks partners for its new reactors.

In this extensive project analysis, we asked Rosatom four key questions concerning the planned project stages at AKKUYU, the project costs, the technology and design specifications, and Turkish public opinion towards the establishment of nuclear power.

I hope you find the following valuable to your business plans.

Kind regards,

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Q. What are the recent project developments, and what are the planned stages to finish the project?

Developments within last year

- Engineering investigations of preconstruction and projecting phase finished at NPP construction site
- Works on receiving the independent evaluation of seismicity of "Akkuyu" NPP site finished
- Works on drawing up of consolidated report of seismic hazard evaluation of "Akkuyu" NPP site continue (planned termination period – end of May)
- "Extended report on justifying the selection of the reference NPP" accorded with TAEK. Novovoronezh NPP-2 taken by TAEK as a reference NPP.
- Primary documents on station referential for "Akkuyu" NPP elaborated and submitted to the state regulatory authorities of Turkey.
- According to the terms of the site license, the "Updated basic report on the site selection" elaborated and passed to TAEK.
- License base of the "Akkuyu" NPP project prepared and coordinated by TAEK.
- Fundamental negotiations held with TEIAS on coordination of power distribution scheme and connection of NPP to power system of Turkey.
- Negotiations on the Power Purchase Agreement (PPA) have begun with MENR/TETAS.
- On 29.03.2012 the Ministry of Environment and City Planning holds public consultations on the environment impact assessment in the NPP construction region.
- Developed: Master plan and Construction organization plan of the preparatory period of the NPP construction.

Developments in 2011

- The project company was given the NPP construction site with current license for site and license validity conditions
- Design and survey works of the preparatory period have begun
- According to the requirement of the Ministry of Communications, all the necessary applications for the receiving of licenses have been submitted.

Goals of 2013

- Elaboration of projects documents and beginning of installation and construction works of the preparatory period.
- It is planned to finish the works on the environment impact assessment in the second quarter of 2013 and in the third quarter of 2013 it is expected to receive a favorable conclusion on the environment impact assessment report.
Q. What is the cost of the project works?

CAPEX for four units is estimated at USD $20 bln. The CAPEX structure is as follows:

- Construction and Assembly Work (CAW) 43%
- Equipment 36%
- Commissioning 6%
- Design and Engineering 6%
- Project Management 5%
- Misc 4%
Q. What design improvements will be implemented in light of the Fukushima accident? What new and modern technology will be used?

- 3+ generation reactor
- Most demanded power sector, suitable for different energy systems – 1200 mW
- Service life of basic equipment: 60 years
- Complies with all international safety standards, including IAEA standards
- Constantly improved in terms of safety
- Complies with safety standards “after Fukushima”
- Principle of defense in depth
- Self-protection principle of reactor facility
- Safety barriers
- Multiple duplication of safety channels
- Use of passive safety systems
- Concept of safety providing not only means of accident prevention, but also means for consequence management of off-design accidents, providing the localization of radioactive substances within hermetic membrane
- Safety culture at all phases of the life cycle: from the selection of the site to decommissioning

Modern safety systems to manage off-design accidents

- Many-level system of accumulators
- Passive system of hat rejection from steam generator
- Hotmelt localization system
- Double containment
- Other

The concept uses the principle of many-level system of physical barriers:

- Fuel matrix
- Fuel membrane (fuel rod)
- Hermetic reactor cooling system (1 outline)
- System of hermetic volume with double containment.

Safety systems existing at the NPP provide and maintain protective barriers. The project uses both active and passive safety systems. The active safety systems operate using electric power, and the passive safety systems do not depend on external electric power sources and do not require the intervention of the operation personnel.

To control the integrity of the barriers at the “Akkuyu” NPP, an automated radiation monitoring system was installed.

The project uses new and improved safety systems, which include, apart from those traditionally used at PWR reactors, including the following:

- Reactor emergency shutdown system
- Accumulators
- Sprinkler system
- Hydrogen recombiners
● Core spray system
● Passive systems of heat rejection from reactor core
● Diesel-generator
● Emergency situations cooling systems

Differences between NPP-2006 and Fukushima NPP

- First generation of reactors
- Boiling-water reactors have single-loop steam cycle
- There is reactivity not only in the reactor, but in the whole turbine and condenser system as well
- SNF swimming pool beyond hermetic volume. There is no additional containment for radioactivity localization in case of accident
- Small hermetic volume with limited possibilities for risk management at hydrogen accumulation or core melting of reactor in case of severe accident
- Active safety system
- Cannot function without external power source
- Use of active systems requires intervention of operator

- 3rd generation reactors
- PWR reactor have two-loop steam cycle
- Radioactivity is restrained inside the reactor
- SNF swimming pool is within the hermetic volume which ensures the localization of potential radioactive emissions
- Large volume of hermetic package with double containment, with passive systems of hydrogen recombination and holding of melted reactor core in case of severe accident
- Active and passive safety systems
- Use of passive systems does not require external power source and intervention of operator

The site for the NPP is selected in over 20 parameters. Karst rocks with cavitations, landslides, flood zones are excluded. The seismotectonic setting in the location of the NPP is taken into account first of all.
Q. How popular is nuclear power development in Turkey? How positively is it received and how much is it supported by public opinion?

There is an understanding that nuclear power engineering has no alternatives. The main driver of this understanding is the support of development of nuclear power engineering by the government of Turkey. One of the goals of the energy strategy of 2009 is reducing the share of gas generation by increasing the share of RES (up to 30% by 2023, including hydro generation) and in-feed of NPP power (up to 5% by 2023). It is planned to construct three NPP – “Akkuyu”, “Sinop” NPP and one more NPP plant (possibly in Igneada).

The government supports the construction of NPP due to the following reasons:

- Rapid growth of energy consumption in Turkey, outpacing the growth of the commissioning of new capacities in the next few years - if appropriate measures are not taken – this will lead to shortage of electric power
- Plans of the government by 2023:
  ♦ increase exports up to USD 500 billion,
  ♦ reach the average income of USD 25.000 per person
  ♦ achieve GDP growth of up to USD 2 trillion
  ♦ enter the top ten largest economies in the world.
- Energy consumption per capita lags behind developed countries and has strong growth potential
- Besides, Turkey aspires to reduce dependence on imports and change the generation structure by reducing the share of gas generation (42% in 2011).
- The requirements to reduce CO2 emissions lead to the reduction of the share of coal and gas generation and the increase of its cost
- Nuclear power engineering are new technologies and the possibility for the development of high technology in the country
- As distinct from RES, nuclear power engineering provides reliable production of energy in base load
- Low potential of price change on electric power compared with the prices on fossil fuels, and the reduction of Turkey’s dependence on foreign fossil fuels due to the relatively low cost of fuel per 1 kW·h of produced electric power leads to the stabilization of energy prices

There is also an understanding that the construction of nuclear power engineering is also the creation of a new industry, existing capacity utilization and the creation of new working places.

It is expected that Turkish companies will actively participate in the construction works, erection works and the supply of equipment and materials required for the NPP project.

Participation in the construction project of the “Akkuyu” NPP will provide additional revenue for Turkish companies of up to USD 7.8 billion and will create over 15,000 working places (loading of enterprises and providing services) - plus the existing capacity utilization. Employment opportunities for the local population are being created, unemployment is being reduced. The participation of Turkish contractors, boosting employment in the region and improving the living standards of the local population by
increasing the level of income and infrastructure development leads to the improvement of the business climate in the region.

Among the constructors, whose number is at the peak of construction, can reach 12,500 people, most of which will be Turkish workers.
In addition to the working places created during the construction of the plant, additional services will be developing, such as shops, banks, hospitals, and others; all of this will create additional employment opportunities.

Both working places directly and indirectly created during the construction of the plant will have a positive impact on the income of the population, which is expected to increase. Tax revenues to the state budget will also increase as a result of the increase of income.
The main social and technical infrastructure of existing settlements should be improved for the implementation of the project and the accommodation of people working on the construction.

‘AKKUYU NPP will provide additional revenue for Turkish companies of up to USD 7.8 billion and will create over 15,000 working places’

Rosatom also holds training of Turkish students - future operating staff of the plant station. By 2023 it is planned to train about 600 Turkish specialists that make up to 30% of the operation staff of 4 energy units of the plant. In 2011, 50 people were enlisted to study in NRNU MEPhI (National Research Nuclear University "MEPhI" (Moscow Engineering Physics Institute)), and their training has already begun. In 2012, another 70 people were enlisted for training, in 2013 it is planned to hold examinations for the enlistment of a new group of students. Thus, a completely new high-tech sphere - nuclear power engineering – will be created in Turkey. In addition, it is planned to transfer part of the training of students to Turkish higher education establishments, which will contribute to the creation of a new discipline in Turkish higher education establishments and the empowerment of Turkish higher education establishments in training of highly knowledgeable specialists.

The “Akkuyu” NPP project is deemed to be a socially significant project. AKKUYU NPP JSC is actively working with the public, providing information about the project, discussing problems with local people and providing appropriate support.

Two information centers were recently created - in Buyukedgeli village and the city of Mersin. It is planned to create an information center in Istanbul. AKKUYU NPP JSC created a web-site that provides the latest information on the project.

Charity events are being held. All of this contributes to the creation of a positive perception of the development of nuclear power engineering in the country as a whole, and the construction project of “Akkuyu” NPP, in particular.

For more information on the 4th Annual Nuclear Construction Conference, MENA (24-25 September, UAE location TBC), download your complimentary brochure by following: www.nuclearenergyinsider.com/mena/conference-event-brochure.php