Akkuyu Nuclear Power Plant – Progress To-date and the Way Forward

Akkuyu NPP Power Generation JSC
## Why BOO? Pros and Cons

### What is BOO?
Build-own-operate – under this scheme, the company, which builds the NPP, also is the owner of the NPP, responsible for its operation and power sales, as well as attracting investments for the NPP construction. BOO is frequently used in the thermal power generation, including in Turkey.

### Why BOO?
- Potential profit from power sales – high dynamics of GDP and power consumption in Turkey
- Forecast for growth of power consumption and capacity deficit
- Electricity market liberalization and electricity price growth in Turkey
- Turkish power market investment attractiveness
- Turkish market in general is attractive for investors
- Availability of grid infrastructure and possibility to export power to Europe and the Middle East
- Government support of the project in Turkey and Russia

### Pros
- Profit from electricity sales after pay back period
- Fixed price PPA (weighted average 12.35 cent/kwh) and fixed quantity - (70% of Units 1 and 2 output and 30% of Units 3 and 4 output accordingly) – revenue guarantee for the investor

### Cons
- Need to forecast long-term electricity price – high probability of error and change in long-term electricity price.
- The Project Company bears all the risks
- Possibility of unpredictable growth of the construction costs, economic and political force majeure
- Difficult to find an investor («long» money)
Akkuyu NPP is the First Rosatom BOO Construction Project Outside Russia

### Akkuyu general parameters

- First NPP in Turkey
- First Rosatom BOO (build-own-operate) project. Under the IGA, Rosatom is responsible for engineering, construction, operation and maintenance of the plant.
- Legal basis: Intergovernmental Agreement, May 12, 2010
- Project design: AES-2006 (VVER-1200)
- Number of units: 4
- Total capacity: 4,800 MW
- Construction period: 2011-2023
- Power Purchase Agreement for 15 years, fixed price terms
- Support of the Russian and Turkish Governments
- Maximization of Turkish personnel involvement in construction and operation of the plant.
Turkey is One of the Most Dynamic World Economies with Strong Growth Potential

Top world economies GDP dynamics (annual average growth rate), 2002-2011

- Turkey is rated the 18th world economy based on GDP ($775 B in 2011)
- Turkish government reforms targeting further integration with EU standards will result in the investment climate improvement

Forecast of top world economies GDP dynamics (annual average growth rate), 2013-2017

Turkey GDP dynamics ($B)

Sources: The World Bank, World Economic Outlook - IMF, October 2012
Electricity Consumption and Generation Growth Rates in Turkey are Comparable to the World’s Emerging Economies

**Power Generation and consumption dynamics in Turkey (bln kWh)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Generation</th>
<th>Consumption and Losses</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>13.1</td>
<td>6.9</td>
</tr>
<tr>
<td>2001</td>
<td>6.9</td>
<td>6.2</td>
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<tr>
<td>2002</td>
<td>6.1</td>
<td>6.1</td>
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<tr>
<td>2003</td>
<td>4.5</td>
<td>4.3</td>
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<tr>
<td>2004</td>
<td>3.6</td>
<td>3.6</td>
</tr>
<tr>
<td>2005</td>
<td>2.7</td>
<td>2.7</td>
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<tr>
<td>2006</td>
<td>1.9</td>
<td>1.9</td>
</tr>
<tr>
<td>2007</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

CAGR ~6%

**Electricity generation dynamics, 2000-2010 (annual average rate)**

- China: 13.1
- Indonesia: 6.9
- Korea: 6.2
- India: 6.1
- Turkey: 6.1
- Brazil: 4.5
- Singapore: 4.3
- Spain: 3.6
- Mexico: 2.7
- Russia: 1.9
- Italy: 1
- USA: 1

**Electricity consumption dynamics, 2000-2010 (annual average rate)**

- Unlike other countries, Turkey did not experience electricity consumption drop as an outcome of the world economic crisis.

**Per capita consumption (kWh per capita), 2010**

- China: 12563
- Indonesia: 9463
- Korea: 8002
- Turkey: 7865
- USA: 6070
- Japan: 5796
- Russia: 5291
- Spain: 5072
- UK: 2716
- Italy: 2342
- Germany: 2338

**Sources:** EIA DOE US, The World Bank
In order to Join Top-10 of the World Most Developed Countries by 2023, Turkey Needs Electricity Consumption to Grow 8 % Annually

Government plans for 2023:
- Increase export to 500 $B.
- Reach average per capita revenue of $25,000
- Reach GDP growth up to $2 trln
- Join the top 10 world economic states.

- This will lead to the deficit of generation capacities.
- Besides, Turkey attempts to reduce energy dependency on imported fuel and decrease gas share in its power generation mix.
- Turkey’s commitment to CO₂ reduction also requires reduction of coal and gas generation, and increases its cost.

Decrease of the gas generation share is one of the objectives of the 2009 Power Strategy. Turkey plans to increase renewables’ share to at least 30% by 2023 (including hydro) and to build up to 3 nuclear power plants (up to 5% of total power generation).

Sources: Turkish Electricity Transmission Corporation, 2011, EPDK. Mercados
Major Milestones of the Project

1 stage
Preparation
- 03/2011: Start site survey

2 stage
Construction
- 2013: NPP construction license
- 2014: First concrete
- 2015: Electricity generation license
- 2020: Commissioning
  - 1 unit: 2021
  - 2 units: 2022
  - 3 unit: 2023
  - 4 unit: 2023

3 stage
Operation and maintenance

4 stage
Decommissioning
- 2080
Project Organizational structure

- **Rosatom State Corporation**
  - Project Sponsor
  - Responsible for the project implementation and realization of objectives

- **«Akkuyu» NPP**
  - Akkuyu NPP JSC
    - «Akkuyu NGS Elektrik Üretim Anonim Şirketi»
    - Investor - Owner of the NPP and electricity generated
      - JSC was incorporated in Turkey. Plays the role of investor, license applicant, NPP owner, and GR coordinator in Turkey

- **Atomstroyexport**
  - General contractor
  - Engineering surveys
  - Construction and assembly work
  - Equipment and materials supply

- **Rosenergoatom**
  - Project engineering design
  - Developing preliminary, basic and detailed design documentation
  - Technical acceptance of equipment and services at all stages of the project commissioning

- **InterRAO**
  - Electricity sale
  - Electricity wholesale strategy development and implementation; power export-import activities

- **Atomenergoproject (AEP)**
  - Principal designer

- **Gidropress Design Bureau**
  - Nuclear island principal designer

- **Kurchatov institute**
  - Scientific advisor

- **VNIIAES JSC**
  - System integrator
  - Automatic process control system principal designer

- **TVEL JSC**
  - Fuel supply

- **TETAS (Turkish Electricity Trading and Contracting Company)**
  - Purchasing electricity from the NPP and trading at the Turkish market
Project Financing and Equity Structure

Akkuyu Equity Structure

- Investor
- Owner of the NPP and the power generated

The Russian side provides Initial funding. Later 49% of the stocks to be sold to investors

- Total cost: ~ $20 B.
- Construction time: 11 years
- Operational lifetime: 60 years
- Guaranteed PPA for 15 years from the date of operation of each of the four units by TETAS
- Generation output: 33.1 bln. kWh/year (for four units)

Akkuyu NPP JSC

- 3.5%
- 30%
- 66.3%
- 0.1%
- 0.1%

100%

Akkuyu CAPEX structure, %

- 34%
- 39%
- 12%
- 5%
- 7%
- 3%

Construction and assembly work (CAW)
Equipment
Commissioning
Design and engineering
Project management
Misc
Akkuyu NPP Reactor Characteristics

AES-2006 characteristics

- The leading-edge reactor technology: Generation 3+
- Advanced safety systems
- The most popular capacity 1200 MWe
- The lifetime of the main equipment: 60 years
- Is in line with all the international safety standards, including the IAEA standards
- Is in the process of constant improvement from the safety standpoint
- Is in line with “post Fukushima” standards

Design reference: AES-2006 design is used for construction of Novovoronezh-2, Leningrad-2 NPPs, Baltiyskaya NPP
How AES-2006 Safety is Ensured?

- Defense-in-depth
- Self-defense of the reactor
- Safety barriers
- Multiple duplication of the safety channels
- Active and passive safety systems
- Safety concept, including not only accidents prevention but beyond design basis accidents consequences prevention, ensuring localization of the radioactive instances within the containment vessel
- Safety culture for all the lifecycle stages: from selecting the site up to decommissioning
Akkuyu Chronology

1955
An Agreement on peaceful use of the atom signed with the U.S.

1956
Atomic Energy Committee begins its work

1965
Studies on the construction of the NPP begin

1972
The Department of Atomic Energy created

1974-1975
A study on choosing the location site of the first NPP conducted

1976
A license for the Akkuyu site on the Mediterranean coast obtained

1981
Agreement on cooperation with the IAEA signed

2008-2009
Bids on building 4 units in Turkey held

May 2010
Signing the Intergovernmental Agreement between the RF and the TR

July 2010
The Law ratifying the IGA enters into force in Turkey

December
“Akkuyu” NPP Power Generation JSC (AKKUYU NGS ELEKTRIK URETIM ANONIM SIRKETI) is registered in Turkey

2011
Preliminary engineering survey; start of the preliminary design works, licensing and Environmental Impact Assessment process, generation license application

29.03.2012
Environmental Impact Assessment Hearings (EIA)
# Project Cooperation Between Russia and Turkey Covers a Wide Range of NPP Related Construction and Operation Issues

<table>
<thead>
<tr>
<th>Russian responsibilities</th>
<th>Mutual responsibilities</th>
<th>Turkish responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPP engineering, design field supervision</td>
<td>Nuclear energy regulation and legislation development</td>
<td>Site allocation</td>
</tr>
<tr>
<td>Construction management/ supervision</td>
<td>Infrastructure development, including power grids</td>
<td>Construction and assembly work</td>
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<tr>
<td>Issuing project documentation</td>
<td>Operation and upgrades</td>
<td>Site infrastructure</td>
</tr>
<tr>
<td>Construction and assembly work</td>
<td>Physical protection</td>
<td>Provision of materials and equipment</td>
</tr>
<tr>
<td>Nuclear island and other special equipment and materials</td>
<td>Emergency planning</td>
<td>Participation in O&amp;M</td>
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<tr>
<td>Fuel supply</td>
<td>Public outreach</td>
<td>Grid connection</td>
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<td>Personnel training</td>
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<tr>
<td>Startup and Commissioning</td>
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<tr>
<td>Operation, maintenance and upgrade</td>
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<tr>
<td>Wholesale of electricity</td>
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<tr>
<td>Decommissioning and decontamination</td>
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<tr>
<td>Spent fuel treatment</td>
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</tr>
</tbody>
</table>

![Image of construction site]
Social Effect From NPP Construction

Jobs creation and infrastructure development

Infrastructure development of the nearby cities will lead to construction of the new roads, hospitals, schools, sport facilities and will end up in establishing of about 15,000 new positions for infrastructure facilities, including medicine, trade, transport.

The Turkish Party will partially do the construction and assembly work, as well as supplies of non-specialized equipment and NPP operation.

It is planned that 95% of the construction will be conducted by the Turkish companies; 40% of the assembly work will be conducted by the Turkish companies; 20% of the equipment and materials will be provided by the Turkish companies.

In addition to the construction experts (in the “peak years” more than 10,000 people will work on the construction site only), and more than 2000 operational personnel will work at the NPP and around 1200 will be involved during the planned outages.
2011-2012 Results. NPP Design and Construction

- Atomstroyexport has accomplished the first priority engineering surveys of the mobilization stage as well as the exploration for the Design stage on the NPP construction site.
- The Project Company has received the NPP construction site with effective site license and renewed licensing conditions.
- The infrastructure facilities are being transferred (under the Resolution of the State Power Generation Company - EÜAŞ).
- The first priority documentation for Akkuyu NPP has been developed and transferred to the Turkish Federal Regulatory Agencies.
- Public Hearings have been held.
- The Service Contract for consulting during the licensing stage awarded to WorleyParsons.
- Independent engineering surveys have been completed in order to get an independent assessment of the Akkuyu NPP site seismicity.
- Arrangements are being implemented to restore the operability of the transferred infrastructure facilities at the Akkuyu NPP site with the involvement of the Turkish companies.
- The Power Generation License application has been filed.
- The EIA Application Dossier has been prepared and filed. The EIA Report is being prepared.
- The design work is underway, the NPP General Layout has been developed, the Terms of Reference for NPP engineering design is being concurred.
- The “Summary report on justification of the reference NPP selection” has been agreed upon with TAЕК.
- Interaction with the system operator (grid company) is underway to develop the power delivery system.
- The Information Center has been opened in Büyükeceli and Mersin.
- Under the terms of the Site License the “Upgraded Basic Site Report” has been developed and submitted to the Turkish Atomic Energy Committee (TAЕК) on May 22, 2012. Its concurrence is at the closing stage.
- The hydro-engineering modeling of off-shore structures is being performed.
- Concurrence and transfer of the regulatory documentation required for the NPP construction have completed.
NPP Design and Construction. Tasks for 2013

- Launch of the CAW of the mobilization stage
- Completion of the EIA Report development and obtaining the EIA Positive Conclusion
- Submission of the NPP Construction License
- Completion of the “Design” stage development
- Start of building the first priority facilities of the construction infrastructure
- Obtaining a Limited Work Permit
- Building of a construction and assembly base
- Interaction with TAEK in Working Groups
- Agreeing on the scheme of power delivery and the NPP connection to the Turkish grid system.
Personnel Training is One of the Important Tasks of the Project

It is planned to train about 600 Turkish personnel in the coming years

• In the last two years, about 125 Turkish students started education programs in the Russian National Research University (MEPhI).
• On-the-job training is planned at the operating NPPs in Russia
• These students will join Akkuyu operational personnel after graduation
Welcome to the site of Akkuyu NPP JSC!
The Akkuyu nuclear power plant (Akkuyu NPP) will be built in Turkey, at Mersin Province on the Mediterranean coast. An agreement on this was signed between the governments of Russia and Turkey in Ankara on May 12, 2010. The NPP will have four power units of 1200 MW each. After construction, Akkuyu NPP is expected to produce about 35 billion kilowatt-hours per year. Akkuyu NPP is a serial project of the NPP-2006 nuclear power plant based on Novovoronezh NPP-2 (Russia, Voronezh Oblast). The life cycle of Akkuyu NPP is 60 years. On this site, you will find complete information about implementation of the Akkuyu NPP project in the Republic of Turkey.

Nuclear industry news

Frequently Asked Questions

28.11.2012 Young specialists are interested in

Why is electrical energy needed?

Photogallery

Speech by Taser Yıldız at the International Economic Forum in Russia 21.06.2012

Visit of the power corporation of Republic of

Two Public information Centers Opened
Thank you for attention!

www.akkunpp.com