The right solution for Turkey's energy future

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Kurzfassung

Die richtige Lösung für die zukünftige Energieversorgung der Türkei

Das Bruttoinlandsprodukt der Türkei wird in den nächsten fünf Jahren voraussichtlich um fast 24% wachsen. Damit zählt die Türkei zu den am schnellsten wachsenden Volkswirtschaften der Welt. Dieses hohe Wirtschaftswachstum wird voraussichtlich zu einem Anstieg der Stromnachfrage von 290 TWh in 2017 auf 368 TWh im Jahr 2022 führen. Dies entspricht einem Anstieg von fast 24%.

Um mit diesem Energiebedarf Schritt halten zu können, wird erwartet, dass die Energieimporte der Türkei beträchtlich zunehmen werden, was sowohl die Energieversorgungssicherheit als auch die wirtschaftliche Entwicklung betrifft. Im Jahr 2016 wurden 33% des türkischen Stroms aus importiertem Erdgas erzeugt, die Hälfte davon aus Russland und mehr als die Hälfte des Stroms aus Kohle wird aus importierter Steinkohle erzeugt. Nur 16% des gesamten türkischen Stroms wurde mit heimischer Braunkohle erzeugt.


Powering Turkey’s growing economy

Turkey’s GDP is predicted to grow nearly 24% over the next 5 years, ranking as one of the fastest growing economies in the world. This high level of economic growth coupled to Turkey's strongly growing industrial base is expected to drive electricity demand growth from 290 TWh (based on 2017) to 368 TWh in year 2022, nearly a 24% increase over this same period of time.

To keep up with this insatiable need for power, Turkey’s energy imports are expected to grow considerably, causing both an energy security and economic burden concern with government leaders. In 2016, 33% of Turkey’s electric power was produced from imported natural gas, half of that from Russia and more than half of its coal and lignite power was from imported hard coal. Only 16% of Turkey’s total electric power was generated using local lignite.

The situation is even worst when looking at the total energy demand of the country. In 2016, Turkey imported its coal and lignite power from half of its coal power and lignite power was from imported hard coal.

Lignite is the key to Turkey’s energy future

Turkey has 17.2 billion tonnes of proven lignite reserves, enough to power its growing economy well into the future. But ironically, over the past five years, imported coal capacity grew 3.5 times more than lignite power capacity (4.9 vs. 1.4 GWe). Policy makers in Turkey want to change this to improve Turkey’s energy security while lowering its energy cost.

Tapping into Turkey’s massive lignite reserves is a key part of Turkey’s Vision 2023 energy plan, timed to mark the 100th anniversary of the founding of the Republic. The plan calls for increased use of lignite for meeting rising electricity demand while improving Turkey’s energy security. The plan calls for more than doubling domestic lignite power capacity over the next 10 years, amounting to 10 GWe of new power capacity from Turkey’s lignite.

The good news is that Turkey’s huge lignite reserves can solve its energy security problem. The bad news is that 68% of the total lignite reserves in Turkey have low caloric value (1,000 to 2,000 kcal/kg) which is a very challenging fuel for today’s conventional coal power plant technology. It is no coincidence that Turkey has not turned to its lignite reserves earlier in its history and you don’t need to look very hard to find power plants in Turkey that struggle every day to burn Turkey’s low quality lignite.

The right timing for the right technology

Today, the timing couldn’t be better for aligning the right technology to Turkey’s energy strategy. Over the last 40 years, circulating fluidized bed (CFB) combustion technology has grown in both scale and experience. Today, CFB has become the best choice for reliably and cleanly converting low quality fuels like Turkish lignite into power.

In a broader sense, CFB’s fuel flexibility and ability to control pollution during the burning process has caused many utilities, IPPs and developers to choose CFB technologies for their new coal, lignite, biomass, pet coke, and WTE plants. But for Turkish lignite, the key words are ash and moisture, since Turkey’s low quality lignite has the highest levels of them, in the 30-50% range. Moreover, the ash has very low melting temperatures making quite a slagging mess in conventional boilers.

In a conventional pulverized coal (PC) or PF boiler, this ash melts causing slagging and fouling throughout the boiler. These boilers are oversized, use a lot of soot blowing, and are frequently down for maintenance, resulting in elevated plant capital and operating costs and lower plant reliability.

The CFB technology avoids all these pitfalls, since the ash doesn’t melt due to its flameless low temperature combustion process. Instead, the ash is circulated throughout the boiler, cleaning the boiler’s heat transfer surfaces and evenly spread-
molten ash particles. The fuel is instantly converted to a hot gas and the process has no thermal inertia since the steam capacity. In contrast, the PC burning process allows wide variations in fuel properties, making the combustion process very stable, providing a large thermal inertia. This characteristic is particularly advantageous because it enables the vessel to stay in the CFB hot loop for as long as 30 minutes as compared to a PC with a burning time of only 3 to 4 seconds.

Compared to other areas of the power plant and mine, the CFB process is the most diverse in terms of fuel. Therefore, its operation requires less sophisticated fuel dryers, pulverisers, conduits, or soot blowers. Instead, the fuel needs to be only coarsely crushed and dropped into chutes as 30 minutes as compared to a PC with burning times of only 3 to 4 seconds.

Combustion stability and efficiency is another area where CFB excels. Since the CFB circulates the fuel over and over in a bed of hot solids, it completely burns all fuels, even the most difficult low volatile fuels, like anthracites and petcoke. Fuel particles can stay in the CFB hot loop for as long as 30 minutes as compared to a PC with burning times of only 3 to 4 seconds.

Further, the bed of hot solids in the CFB provides a large thermal inertia. This makes the combustion process very stable, allowing wide variations in fuel properties without upsetting boiler emissions or steam capacity. In contrast, the PC burning process has no thermal inertia since the fuel is instantly converted to a hot gas and molten ash particles.

The Soma Kolin Project

The new Soma power plant is located in Soma Basin, 135 km north of Izmir. The owner, HIDRO-GEN Enerji Ithalat Ihracat ve Ticaret A.S. is a subsidiary of Turkish construction company Kolin Hold-

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Building a lignite-burning power plant in the Soma region makes good economic and fuel security sense, but the challenge was finding the right technology to fire this very low quality lignite with a higher heat value of 6,770 kJ/kg (1,618 kcal/kg), containing 23.3% moisture, 42.9% ash and 1.2% sulphur. Each CFB is a natural circulation steam generator with reheat rated at 255 MWe (545 MWth). Main steam conditions of the CFBS are 173 bar abs/565°C with reheat conditions of 53 bar abs/565°C. The CFB boiler design includes steam-cooled solid separators and special INTREX heat exchangers, which are utilized as the final superheating stage. Due to the high ash content in the fuel, the CFBS are equipped with high capacity drum coolers which drop the bottom ash into redundant drag chain conveyors.

Emission flexibility

Since Turkey’s government has been considering accession to the European Union (EU), flexibility in plant emissions was important to the Kolin Group, the owner of the plant. They wanted to have the flexibility to achieve a wide range of stack emissions, while at the same time allowing a wide range of fuel sulphur contents expected from the lignite mine over the long term.

Currently, Turkish environmental regulation is based on Europe’s large combustion plant directive (LCP) with SOx/NOx/PM emission limits of 200/200/30 mg/Nm³. But current EU environmental rules are based on EU’s Industrial Emission Directive (IED) levels which recently have been updated by the BREF BAT document. The BREF lowers yearly SOx limits down to the 10-75 mg/Nm³ range, NOx down to the 50-85 mg/Nm³ range and PM down to the 2-5 mg/Nm³ range for large new coal and lignite plants. In addition, the BREF adds strict limits in the 1-3 mg/Nm³ range to several new pollutants, such as, HCl, HF, Hg, and NH₃.

For this flexibility, a CFB “polishing” scrubber (CFBS), was added behind the CFB boiler for the Soma Kolin plant (Figure 4). This will allow the CFB ash to be used as a reagent in the CFBS to reduce emissions while also reducing the use of expensive reagents such as hydrated lime. Two ash hydrators on site, will condition the recycled fly ash before injection into the absorber. The CFBS will also capture HCl, HF, Hg, and NH₃ so the plant will be able to comply with the EU’s strict BREF limits providing multi-pollutant emission control very economically.

An example for others

The Soma Kolin project is very important to Turkey as well as other countries with large resources of low quality coals and lignites. CFB technology is the best choice for tapping into Turkey’s vast lignite reserves, as underscored by the Soma Kolin project. The success of Soma Kolin will encourage countries, such as India, Germany, Thailand and Pakistan to reconsider their plans for using their low quality indigenous fuels for secure, affordable and clean power.

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