

Power Magazine Exclusive Article

SEIL Energy India: A Coal Plant Model for Performance and Sustainability



SEIL Energy India Limited, the only coal plant to win a POWER Top Plant award this year, stands out for its advanced supercritical technology, exceptional operational performance, and commitment to sustainability.

India, an established economic powerhouse, has been fielding enormous power demand growth in recent years—outpacing the global average several times over. In fiscal year 2023 (FY23, April 2022–March 2023), “India witnessed its highest ever year-on-year growth in power consumption,” marking a “remarkable increase of 9.6% per annum, reaching 1,512 [billion units (BU)] compared to 1,380 BU in FY22,” Raghav Trivedi, CEO of SEIL Energy India Limited, an independent power producer (IPP), told *POWER*. In FY24, demand spiked again to reach 1,627 BU. Some forecasts suggest demand could reach a staggering 2,474 BU within a decade—an increase of more than 50%.

The rapid increase is pegged partly to India’s robust gross domestic product (GDP) growth (of 7.2% per annum in FY23 and 8.2% in FY24), as well as scorching summer temperatures, such as those during the summer of 2022, Trivedi noted. At the same time, as in other countries, India has made leaps in achieving universal access to electricity and electrification, particularly for transportation. The power sector “has become a catalyst for various other sectors, including manufacturing, agriculture, healthcare, and education, fostering economic development and a better quality of life,” he said.



1. The SEIL Energy India Limited power plant, a 2.64-GW supercritical coal-fired facility in Andhra Pradesh, India, features four 660-MW units that deliver high operational efficiency, advanced emissions control, and innovative seawater cooling systems. Courtesy: SEIL

Demand growth, which is regionally determined, is set to soar, particularly in Andhra Pradesh, one of India's most rapidly developing states. According to state planning documents, the state's energy requirements will grow at a compounded annual rate of 6.64%, fueled by rapid urbanization and industrial growth driven by the expansion of Special Economic Zones (SEZs) like Kakinada SEZ and Sri City SEZ, alongside large-scale infrastructure projects such as the Vizag-Chennai Industrial Corridor. According to Trivedi, these conditions pose a significant opportunity for SEIL, a 2.64-GW coal-fired power plant (Figure 1) that is strategically located on the eastern coastline of Nellore district in Andhra Pradesh.

Leveraging Technology to Boost Performance

SEIL Energy India Limited's power plant stands out for its advanced features, which give it an edge over other coal plants in India. Developed in two phases—Phase 1 was completed in 2015, and Phase 2 was completed in 2016—the plant boasts four 660-MW supercritical coal-fired units that operate at higher temperatures and pressures to maximize energy extraction. Originally owned by Sembcorp, SEIL was acquired by Tanweer Infrastructure SAOC, an Oman-based infrastructure investment company, in 2023.

“SEIL is poised to lead responsibly by continuing to innovate and adapt to evolving energy needs. By maintaining our focus on sustainability and reliability, we aim to set new benchmarks in the provision of best-in-class energy solutions for India's future,” said Trivedi.

At the heart of the plant are two Dongfeng Electric-supplied coal-fired steam boilers outfitted with front and rear wall firing burners. Another two Harbin-supplied coal-fired steam boilers are equipped

with corner firing burners. The boiler system, outfitted with modern metallurgy designed for 600C at reheat, enables the plant to burn even low-grade coal with stable flame conditions. A key feature of the boiler system is the use of low nitrogen-oxide (NO_x) burners, which effectively reduce emissions to meet environmental standards. But, in addition, the system employs superheater spray tapping after the economizer coils, which allows for the recovery of heat from the flue gas and significantly boosts the plant's energy efficiency.

SEIL noted it collaborated with the National University of Singapore to develop its complex boiler model, using finite particle analysis to understand coal combustion behaviors for different grades of coal firing in blending. The model, which also includes erosion pattern analysis, combustion efficiency, and emission analysis, was used to upgrade SEIL's operation procedures for the most efficient firing.

The steam turbine configuration is a condensing tandem compound, single-reheat, 3,000-rpm steam turbine generator set. The design incorporates three casings: a high-pressure (HP) turbine, an intermediate-pressure (IP) turbine, and two double-flow low-pressure (LP) turbines. A key innovation contributing to the plant's performance is the Heater Above Reheat Pressure (HARP) cycle. "The advantage of the HARP cycle is that it allows optimizing the final feedwater heater temperature independent of the reheater pressure, which reduces moisture at the LP exhaust," SEIL explained, noting that the final feedwater temperature is 284C.

SEIL has also made significant strides in digitalization by developing and implementing various in-house, real-time monitoring tools aimed at enhancing plant efficiency and sustainability. The plant, for example, deploys Smart Performance Assessment (SMART), a real-time key performance indicator (KPI) tool developed in-house that leverages Microsoft Azure cloud-based software to monitor the plant's heat rate. SPARK provides real-time targets based on dynamic operating conditions and controllable losses, helping operators optimize performance, SEIL noted.

Additionally, SEIL's in-house-developed Energy Management System offers detailed insights at both the system and equipment levels so operators can monitor auxiliary power consumption in real time. VISTA, a critical tool developed by EPRI, simulates and analyzes various coal blends and identifies potential issues such as slagging, overheating, and steam/flue gas temperature imbalances. SEIL also notably continuously monitors and benchmarks its greenhouse gas emissions. The innovations, notably, won SEIL a National Award for Excellence in Energy Management in 2024 from the Confederation of Indian Industry (CII).

A Dynamic Fuel Management Strategy

But SEIL's reliability also relies on a dynamic fuel management strategy, which leverages a blend of local and imported coal to ensure continuous and efficient operations. The approach circumvents fluctuations in coal quality, a detriment affecting many coal generators in India. A crucial advantage SEIL leverages is its location on the southern Indian coastline (about 250 kilometers [km] from Chennai). "Subbituminous coal, purchased on the global market, is transported to the plant's transfer tower, from which it is distributed across the coal pile," the company explained.

The company notably uses drones to measure coal heap volume and photogrammetric mapping of coal yard way. The practice, which it pioneered in 2018, offers several advantages, including faster and more accurate data collection. It allows operations "to keep exact account of stockpiles and optimize coal blending operations. Furthermore, drones drastically reduce the risk and errors associated with manual measurements, thereby enhancing safety and accounting standards," Trivedi said.

To transport imported coal efficiently from the nearby port, the power facility utilizes a 15-km state-of-the-art pipe conveyor system, reducing transportation costs and minimizing environmental impact. “Being a coastal thermal power plant, SEIL has developed procedures to utilize domestic coal and imported coal in any blend to achieve the lowest fuel cost and improve top-line profitability,” he noted.

As an additional notable economic strategy, SEIL has secured commodity exposure for its power purchase agreements “through annual contracts for non-escalable energy components,” a move that guarantees stable and predictable returns, SEIL said. The strategy ensures SEIL’s revenue stream remains sustainable, even in a volatile market.

A Focus on Environmental Sustainability and Safety

Yet another specific innovation that stands out relates to its seawater cooling system, which significantly reduces freshwater consumption—a critical factor in a region where water scarcity is an ongoing concern. “The SEIL plant is one of the rare plants in India to use seawater cooling towers,” the company noted.

About 12,000 cubic meters/hour of seawater are supplied from a seawater makeup pumping station with siphon and submarine discharge pipe. “This pumping station also supplies seawater to the desalinization plants to produce boiler makeup water, firewater, potable water, service water, and water for other facility uses,” SEIL added. In addition, advanced demineralized water is produced by a “multiple effect” distillation system. “Desalinated water is next treated in a new demineralization plant using electro-deionization units to produce boiler-quality makeup water. Given the arid location, this water system is cost-effective and sustainable for a plant located close to the ocean,” it said.

While a major regional coal plant, SEIL also pursues a strong commitment to environmental sustainability. The plant, for example, has achieved 100% fly ash utilization, repurposing the byproduct for use in the construction industry. The fly ash is processed into raw materials for cement and other building products, a practice that both reduces waste and minimizes environmental impact. And, to further enhance its fly ash utilization and produce “value-added products” geared for exports, SEIL noted it has implemented bagging facility, storage sheds and container loading facilities. “A dedicated team, with direct reporting to the CEO, was formed to monitor and enhance ash utilization,” Trivedi noted. The gains have been tangible: So far, it has exported fly ash to 16 countries, including Australia, Saudi Arabia, and Sri Lanka. In addition, SEIL says it is the first Indian power producer to be approved for fly ash supply in the U.S.

In addition to efficient ash handling, SEIL is equipped with low-NO_x burners and tall stacks that help minimize NO_x emissions and keep the plant compliant with local and international environmental standards. Continuous emissions monitoring systems are also installed to track particulate matter and other pollutants in real-time.

As yet another facet of its environmental and community commitment, SEIL says it has planted over 1.1 million saplings on 900 acres, installed solar panels in local institutions, and provided solar streetlights for 730 households. The company also partners with Apollo Hospitals to offer medical services and operates reverse osmosis water plants in surrounding villages.

POWER POINTS

Winning Attributes

- ✓ SEIL's four 660-MW coal-fired supercritical units employ advanced technology that significantly enhances efficiency and reduces emissions.
- ✓ The project's plant load factor is consistently above 80%, and its annual availability rate is 92.79%.
- ✓ SEIL has implemented several sustainability initiatives, including an innovative seawater cooling system and 100% fly ash utilization.
- ✓ Real-time digital tools optimize plant operations and drive continuous improvements in performance.
- ✓ The plant has a stellar safety record.

Safety is another top priority at SEIL. Since its commissioning, the plant has logged an impressive 10.45 million safe man-hours, reflecting its strong commitment to operational safety. SEIL attributes this achievement to a "behavior-based" safety culture that extends to all its assets. The effort has earned SEIL recognition from numerous industry bodies, including the National Safety Council and the Golden Peacock Awards.

Trivedi said SEIL's plant load factor (PLF) consistently hovers above 80%, with an average PLF of 81.11%, demonstrating its ability to operate at high capacity while producing positive profit-after-tax results. "Among Indian IPPs, SEIL continues to be one of the most dependable power providers with an annual availability of 92.79% on a complex basis," he said. Trivedi attributes the stellar performance to dedicated teamwork and strong visionary leadership. But that, too, demands a carefully executed approach. "We developed an extensive integrated process to facilitate collaborative working between the coal and operations teams," he noted.

Looking ahead, "SEIL is poised to lead responsibly by continuing to innovate and adapt to evolving energy needs. By maintaining our focus on sustainability and reliability, we aim to set new benchmarks in the provision of best-in-class energy solutions for India's future," he said.

—**Sonal Patel** is a *POWER* senior editor ([@sonalcpatel](#), [@POWERmagazine](#)).

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