

Ensuring reliable electricity supply in a harsh environment with zenon

Saudi Aramco extracts treasures hidden beneath the desert

Saudi Aramco's Shaybah field is one of the world's largest oil and gas fields. Utilizing the zenon software platform, [Schweitzer Engineering Laboratories](#) (SEL) implemented a power management system (PMS) and power system automation (PSA). This helped improve the safety, reliability, and efficiency of the Shaybah electrical network.



Although there has been significant political commitment and the implementation of ambitious projects aiming to transition to renewable energy sources, the global demand for fossil fuels is unyielding. For crude oil alone, global consumption in 2022 was 53,000 Terawatt-hours (TWh), the equivalent of 35.5 billion barrels or 6.7 billion cubic meters (m³).¹

POWERING THE GLOBAL DEMAND

Saudi Arabia has emerged as a major supplier of fossil fuels to meet the energy needs of industrialized nations. [Saudi Aramco](#), the country's national oil and gas company, plays an integral role in exploration, transportation and refining. Headquartered in Dhahran, Saudi Aramco is recognized as the world's second largest public company by revenue (as of 2023).

Since commercial crude oil production began in 1938, Saudi Aramco has expanded exploration and now manages over one hundred oil and gas fields in the kingdom, producing five different grades of crude oil. The company has both the world's second largest confirmed crude oil reserves and the largest daily oil production of any oil-producing company.

In the easternmost corner of Saudi Arabia, near the border with Abu Dhabi, lies the Rub' al-Khali, the largest sand desert in the world. In this remote and untamed expanse with summer temperatures over 50 degrees Celsius and colossal sand dunes over 300 meters high, the world's largest oil and gas field was discovered in 1968. The field is approx. 13 kilometers wide and 64 kilometers long. Its overall production capacity is one million barrels per day of Arabian Extra Light crude oil.

¹ Data source: [Energy Institute Statistical Review of World Energy \(2023\)](#)



The Shaybah field is located at the northern edge of the Rub' al Khali desert known as the "Empty Quarter" in Saudi Arabia.

CONTROL OF POWER FOR EFFICIENT OPERATIONS

The Shaybah program includes 145 individual oil wells, 645km of pipelines, a power supply with 2GW of generating capacity, and a distribution system with 20 substations, making it electrically self-sufficient. For overall control and monitoring, Shaybah was equipped with a Distributed Control System (DCS).

Designed to monitor and control industrial processes, a DCS is not optimally suited to the tasks required for the real-time monitoring of electrical networks. Lacking the ability to monitor the power system in real time, the DCS could not fully monitor, manage, and control the power system to prevent the disturbances that can lead to power outages.

BOOSTING RELIABILITY AND EFFICIENCY

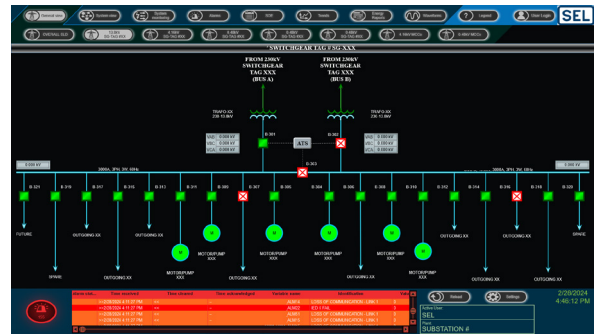
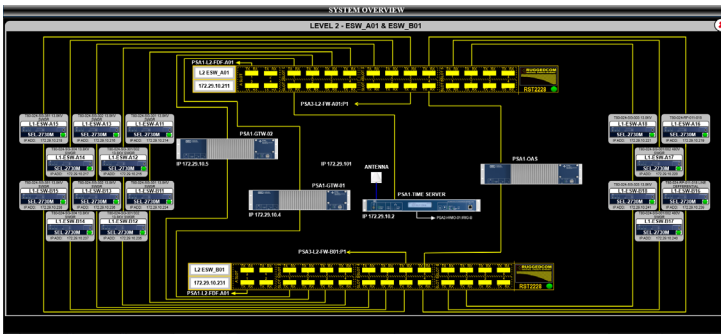
To make the operation of the Shaybah electrical system more reliable, secure and efficient, Saudi Aramco decided to invest in a Power Management System (PMS) with Power System Automation (PSA) for Shaybah. While the PMS would ensure network stability through generator control, fast load shedding, and voltage/frequency control, the PSA would provide operators and maintenance teams with the information they need to operate and maintain the electrical network safely and efficiently. As further development beyond its current state is planned for the Shaybah project, the systems needed to be scalable and flexible enough to easily adapt to future changes.

As the primary objective of the project was to monitor and control the electrical system safely and in real time, Saudi Aramco expected the system to provide an easy-to-use-and-navigate Human Machine Interface (HMI) that would give operators and maintenance teams full visibility of the electrical network. By giving them easy access to the information they need, it would help them identify and respond to problems quickly. The goal was to improve the efficiency of the electrical network, reduce the risk of outages and other disruptions and generally improve the safety of the electrical network.

SYSTEM IMPLEMENTATION USING ZENON

Schweitzer Engineering Laboratories (SEL) won the contract to implement the PMS and PSA systems. The US-based company designs and manufactures embedded system products for protecting, monitoring, controlling, and the metering of electric power systems. SEL has three offices in Saudi Arabia that also cover Bahrain and Jordan.

To implement the PMS and PSA systems, SEL used zenon, a comprehensive low-code software platform from the Austrian software manufacturer COPA-DATA. zenon enables engineers to create highly scalable control, monitoring, and automation systems without programming, simply by parameter setting. With native interfaces to several hundred hardware products and third-party software systems, the zenon software platform makes the integration of existing installations easy.



Utilizing the zenon software platform, SEL implemented a power management system and power system automation for the Shaybah electricity supply.

Despite challenging circumstances, such as harsh weather conditions and Ethernet communication spanning long distances, the zenon implementation helped improve the safety, reliability, and efficiency of the Shaybah electricity supply.

“The seamless integration with diverse systems, centralized control features, real-time monitoring capabilities across the electrical network, and the provision of historical data for in-depth analysis collectively establish the PMS and PSA solution by SEL, complemented with a HMI built using zenon, as a significant advancement over the preceding DCS system.”

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SCHWEITZER ENGINEERING LABORATORIES (SEL)**

zenon is used in various industries from energy and infrastructure to food & beverage, life sciences & pharmaceuticals to the process industry and discrete manufacturing. In addition to automated engineering, the software platform provides extensive libraries of industry-specific functionalities, making best practices from various industries available to all others. Among these features are numerous functionalities specifically designed for the real-time monitoring and control of electrical networks. Compatible with power generation and distribution equipment from all relevant suppliers, zenon enables implementations of PMS and PSA systems which comply with all relevant standards to be delivered in a short timeframe.

OPTIMIZED DATA TRANSFER

SEL implemented the systems at four gas-oil separation plants (GOSPs) scattered around the vast site with ten to 25 kilometers between them as well as the onsite natural gas liquification

(NGL) plant. Additionally, an external site located 45 minutes away has been included in the solution.

Each location has its own control room, all of which are seamlessly integrated with the centralized control room (CCR). Overcoming the challenges posed by the vast distances and harsh weather conditions, backbone communication over the Ethernet network proved to be the main obstacle during commissioning.

Kotb Eldeihey, Engineering Services Manager at SEL, explains, “Despite the presence of fiber optic lines connecting the plants, ensuring fast and synchronized data transfer was critical for the immediate response to events such as load shifting under frequency. This was particularly difficult to achieve.”

SEL’s expertise and innovative approach successfully overcame the communication and integration hurdles, resulting in an efficient and interconnected control system for the distributed plants.



Shaybah also features a natural gas liquification (NGL) unit and a sizeable electricity supply and distribution installation, making it electrically self-sufficient.

SMOOTH IMPLEMENTATION

The implementation of the zenon software platform was less of an obstacle for SEL. “Our experts completed the engineering tasks in a few weeks, not least because we received excellent support from COPA-DATA,” SEL ES Saudi branch Manager Ali Safwan states. “The customer was impressed by the subsequent factory acceptance tests, which we carried out in real-time simulations along with hardware.”

“The seamless integration with diverse systems, centralized control features, real-time monitoring capabilities across the electrical network, and the provision of historical data for in-depth analysis collectively establish the PMS and PSA solution by SEL, complemented with a HMI built using zenon, as a significant advancement over the preceding DCS system,” said Kotb Eldeihey, Engineering Services manager.

HIGHLIGHTS:

zenon as a high-level energy automation system for the electricity supply at Saudi Aramco’s Shaybah oil and gas project:

- ▶ High operational reliability, safety and security
- ▶ Approved energy control and management system
- ▶ Rapid engineering without programming skills being necessary
- ▶ High degree of autonomy in operation and maintenance
- ▶ Standardized user interface developed for the client