

Using zenon to support Saudi Arabia's power grid progression

Saudi Electricity Company: Transforming the electricity supply

To support Saudi Arabia's growing hunger for electric energy, the Saudi Electricity Company (SEC) is upgrading its medium-high voltage grid. To reduce maintenance expenditure and downtime, COPA-DATA Partner [Al-Ojami](#) used the zenon software platform to implement an automation system. Integrating remote legacy switchgear along the overhead lines with four regional control centers, this innovative system reduced the effort required to handle faults and shutdown time, consequently improving the grid's stability.

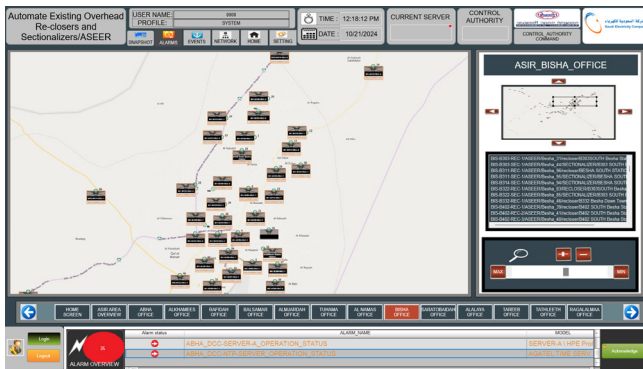


The Kingdom of Saudi Arabia covers most of the Arabian Peninsula and is home to nearly 37 million inhabitants. Like all modern societies, Saudi Arabia depends on a reliable supply of electricity, not least to support the vast electrification program of the Saudi economy. Under the ambitious Vision 2030 program, announced by Crown Prince Mohammad bin Salman Al-Saud in 2016, the largest economy in the Middle East is undergoing an unprecedented transition. Its main goal is to shift the economy away from fossil fuels, aimed at reducing greenhouse gas emissions by 45% by 2030 and reaching net

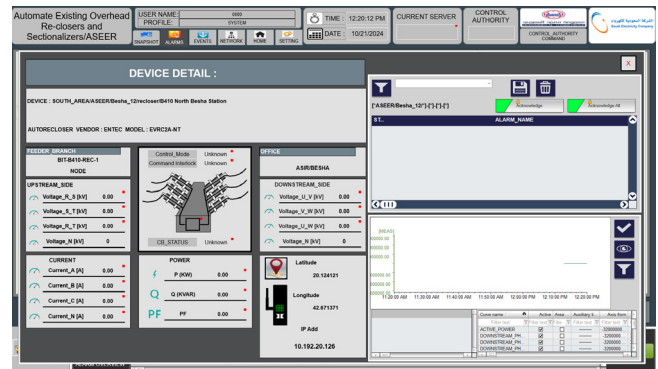
zero by 2050. This is necessary to achieve the Paris climate agreement's goal of limiting global warming to 1.5° Celsius.

PROVIDING A RELIABLE, NATION-WIDE ELECTRICITY SUPPLY

Whether electricity is produced using fossil fuels or more sustainable sources such as wind and sunlight, it needs to power a fast-growing multitude of consumers. These range from the household appliances, computers and machinery required by residents, tourists and businesses to public facilities such as



The default window displayed on the large screens in the control centers is a geographical overview displaying the location and status of each asset.



For more detailed information, SEC staff at the control centers can dig deeper into the information about individual assets. The system reports all failure incidents so control center staff can instantly isolate the failure origin and fix the issue rapidly.

Saudi Arabia's growing network of high-speed rail and metro lines and security systems. All of these require an uninterrupted electricity supply.

Supplying electricity across Saudi Arabia according to the highest reliability standards is the remit of the Saudi Electricity Company (SEC). The country's main provider of electricity is subdivided into separate generation and transmission companies for the central, eastern, western, and southern regions, a distribution organization and National Grid Saudi Arabia (NGSA), which ensures efficient distribution of electricity to cities, towns, and villages throughout the kingdom.

GRID MAINTENANCE IS DIFFICULT OVER LONG DISTANCES

Saudi Arabia's medium voltage distribution network features thousands of re-closers, sectionalizers and circuit breakers for 33 kV and 13.8 kV from several manufacturers, installed over more than a decade. These are spread out along the overhead lines across a wide geographical area, far from any of SEC's control and operations centers.

Until recently, the re-closers, sectionalizers and circuit breakers operated in an isolated fashion, without any connection to information technology (IT) systems. Consequently, SEC's staff had no information about the condition of this equipment nor any means to react to changing loads in the grid. Abnormal operational behavior of the equipment, such as repetitive opening and closing, often went unnoticed. For information about malfunctions, SEC relied entirely on reports from customers.

Maintenance was time-consuming, dangerous and costly, as technicians had to travel to the affected individual asset. Even locating an error was difficult, as failure reports indicated the area affected but not the exact location of the individual causal fault. In view of the vast distances, this often required maintenance engineers to drive for several hours through the deserts simply to identify the item of faulty equipment. It frequently took SEC electricians several hours to locate and resolve network failures and restore regular operation after power outages.

QUALITY IMPROVEMENT BY AUTOMATION

In an effort to increase the reliability, profitability and safety of the large grid, SEC decided to automate the existing overhead re-closers, sectionalizers and circuit breakers. The aim was to enable network operators to remotely monitor and operate the equipment. This would eliminate the need for lengthy trips and improve service quality by reducing the duration of local power outages. The project scope included integrating this equipment in a network of control centers, one for each of the 13 provinces of the kingdom.

For the southern provinces of Asir, Al-Bahah, Jazan and Najran, the project was awarded to Al-Ojaimi Energy Services. This subsidiary of the Mohammed Al-Ojaimi Group (Al-Ojaimi), an engineering, contracting and manufacturing company established in 1976, offers professional expertise in testing and commissioning, maintenance and troubleshooting, engineering and high-quality automation.



To make maintenance of electrical network assets along the power lines easier and less time-consuming, Al-Ojaimi connected the equipment with the control centers over the public mobile phone network.

SEAMLESS INTEGRATION OF REMOTE HARDWARE

This ambitious SEC project included a centralized, redundant server base and four control centers, one in each of the southern provinces. The control centers are equipped with engineering workstations, operator workstations and a set of wall-mounted control monitors forming a large screen. The project also involved integrating 2,400 overhead switchgear installations distributed across an area of about 350 km², serving a population of roughly 3.4 million.

To implement this comprehensive monitoring and automation project, Al-Ojaimi connected the overhead reclosers, sectionalizers and circuit breakers with the control centers over the public mobile phone network. As this equipment typically only comes with serial interfaces, Al-Ojaimi staff had to install communication devices such as Modems and 4G routers at each of the locations.

This work was aided by support from SEC's SOA control center department. Aside of providing geographical data for the equipment and its status and defining and customizing required signals and connection parameters, they also coordinated the retrofit operations with other manufactures and vendors. The SOA control center department also provided logistical support for supplies to remote areas and technical support required to configure the exiting devices.

AN INDEPENDENT LOW-CODE SOFTWARE PLATFORM

Al-Ojaimi used zenon to implement a comprehensive control and automation system for this wide-area overhead switchgear automation network. This open, low-code software platform is the main product of COPA-DATA, a leading independent software vendor for industrial automation based in Salzburg, Austria.

"zenon provides native support for over 300 communication protocols and interfaces relevant to the electrical power industry as well as all the relevant standards," announces the main control center department of Saudi Electricity. "This made it easy for our team to integrate the heterogenous legacy equipment and implement a comprehensive, easy-to-use control, visualization and reporting system."

The user-friendly low-code software platform also eliminates the need for complex programming skills while ensuring a standard-driven, futureproof approach. It enables the end user to do the required engineering to keep the system up to date as well as to add and integrate new interfaces. This is one of the main reasons why zenon is the sole hardware-independent control and automation solution platform officially approved by SEC.

“Using the zenon software platform made it easy for us to integrate the heterogenous legacy equipment and implement a comprehensive, easy-to-use control, visualization and reporting system.”

MAIN CONTROL CENTER DEPARTMENT OF SAUDI ELECTRICITY

A CLEAR VIEW OF THE DISTRIBUTED EQUIPMENT

With valuable support from COPA-DATA, Al-Ojaimi implemented the system using zenon to create operational templates and reports for all the distributed equipment. In the control rooms, the zenon-based visualization displays all kinds of information on the condition of the grid on an array of monitors. These range from situational awareness overviews to historical and trend reports.

“Using HTML5-based zenon visualization, we designed screens according to the user’s desire, standardizing the human-machine interfaces of all re-closers, sectionalizers and circuit breakers,” says the Al-Ojaimi automation manager. “This way, SEC staff enjoys a uniform view of the equipment regardless of the individual hardware installed.” zenon also provides users with state-of-the-art security features as well as a great variety of convenient modules such as a zenon Worldview and map integration. Accordingly, user acceptance was high from the very start.

Using the zenon-based system, operators in the four regional control centers enjoy a single, easy-to-use interface to control and monitor all types of assets and overhead devices. On a large screen covering the better part of a wall, the default window is a geographical overview displaying the location and status of each asset. When requiring more detailed information, operators can dig deeper into the individual asset using various windows or sub-screens.

FACILITATING FAST REACTIONS, IMPROVING THE GRID

The system reports all failure incidents and stores them in a data log. Staff present at a control center can therefore isolate the origin within mere seconds. If required, a service team can

commence its mission to the pinpointed location, equipped with the required knowledge, tools and spare parts to fix the issue in very short time.

“With a better view of the issues within the wide-area network of electricity transmission assets, SEC was able to reduce the effort required to handle faults and shutdown time,” says the Al-Ojaimi automation manager. “This, in turn, led to improvements across the network and increased the grid’s stability.”

HIGHLIGHTS:

zenon as a high-level energy automation system for Saudi Electrical Company:

- ▶ Four control centers
- ▶ Integrated legacy overhead re-closers, sectionalizers and circuit breakers along the power lines
- ▶ Rapid engineering process that does not require programming skills
- ▶ Improved electricity supply reliability
- ▶ Facilitates fast reaction to failures
- ▶ Minimized downtime
- ▶ Enhanced operational safety by reducing the need for onsite maintenance