

## Case Study

# Secondary engineering for 110 kV substations in Saudi Arabia

**Client:** SSEM, Saudi Arabia  
**Level:** 110 kV  
**Commissioned:** 2013  
**Scope:** Engineering Services

### Introduction

Saudi Services for Electro Mechanic Works Co., Ltd. (SSEM), established in 1977 in Saudi Arabia, is a leading electro-mechanical contractor specializing in power plants, substations, water treatment facilities, and industrial projects. Makkah, the holiest city in Islam and the birthplace of Prophet Muhammad, attracts millions of Muslims annually for the Hajj pilgrimage. To support this influx and ensure an uninterrupted power supply, four new grid stations were constructed. SSEM executed the EPC for these substations, while EPENAM provided complete secondary design, engineering, and interfacing.

### Problem Statement

The rapid expansion of the Makkah Holy Mosque and surrounding facilities necessitated a robust power supply infrastructure to accommodate the growing number of pilgrims and ensure uninterrupted services. The existing electrical grid in Central Makkah had become insufficient to meet increased demand during peak pilgrimage seasons, posing a risk of power outages that could disrupt religious activities and essential services. To address this critical need, SEC, the system operator, proposed four new 110/13.8kV substations and their interconnections with the central 380/110/13.8kV Bulk Supply Point (BSP) named Makkah Central BSP. These GIS substations were interconnected with underground cables, presenting significant design and interfacing challenges. Additionally, the project required a tight timeline and complex management of clients, system operators, EPC, contractors, site teams, and consulting engineers.

### Solution

To support the expansion of the Makkah Holy Mosque, four new 110/13.8kV substations and their interconnections were designed and established. This project included the creation of a new 380/110/13.8kV Bulk Supply Point (BSP) named Makkah Central BSP (MKC). The substations—Makkah Central, Library, Security Building, Bus Stand, and Service Station—were designed to conform to the IEC-61850 standard for Substation Automation Systems (SAS), enabling comprehensive remote and local control and monitoring. EPENAM completed the design and interfacing work, leveraging its extensive experience in grid schematics and SCADA interfaces.

The project scope encompassed the preparation of grid electrical system schematics, engineering of protection and control panels, CT/VT adequacy calculations, complete relay setting calculations, and development of interface/architecture drawings for the substations. Each substation featured detailed configurations of 110kV and 13.8kV components and SAS equipment. The work was divided into base design, detail design, and as-built design phases, with deliverables including SLDs, schematics, interconnection diagrams, cable schedules, and protection relay settings.

### Conclusion

EPENAM's extended design and engineering for new substations in Makkah ensured a reliable power supply for the millions of pilgrims visiting the Holy Mosque. The successful implementation of this project addressed the critical power infrastructure needs, minimizing the risk of outages, and supporting the uninterrupted essential services for pilgrims.



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