

EPE's System Studies Assure Safe, Reliable, and Efficient Operations in the Middle East

Background

EPE partnered with a premier independent laboratory that provides local third-party inspection, testing, and certification across industries. As an extension of their team, EPE engineers worked seamlessly with the lab to deliver mission-critical studies for a subsidiary of the Saudi Electricity Company in Dammam of Saudi Arabia. To ensure the safe, reliable, and efficient operation of the power grid, EPE conducted four simultaneous studies over a three-month timeframe, including:

- **Temporary Overvoltage (TOV)**
- **Switching Overvoltage**
- **Lightning Overvoltage**
- **Very Fast-Front Overvoltage (VFFO)**

Challenge

If not properly mitigated, any overvoltage event can severely and catastrophically impact equipment and overall grid stability. For this project, EPE needed to efficiently and meticulously analyze a Gas-Insulated-Substation (GIS) to meet industry certification standards, optimize system effectiveness, and ensure safe operations. EPE's in-depth system studies ensured the company used the right equipment terminals, surge arrestors, and switching scenarios at the right time and within industry standard margins.



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Approach

EPE conducted four studies spanning 29 scenarios. The team created a detailed model of the NGSA substation with all equipment and components, including transmission lines, conductors, surge arrestors, and tertiary windings. EPE used PSCAD for equivalent system modeling based on actual system data and equipment specification configurations to ensure accuracy and precise calculations.

Study	Scenarios	Simulations
TOV	7	Bus Faults Transformer Faults Longest Transmission Line Faults Load Rejections
Switching Overvoltage	8	Lines Energizing Terminating at Substation (including longest line) Lines Re-Energizing Terminating at Substation (including longest line)
Lightning Overvoltage	8	Shield Wire Strikes With and Without Open Circuit Breakers Conductor Strikes With and Without Open Circuit Breakers
Very Fast-Front Overvoltage	6	GIS DS Operation Energizing With 100% Trapped Charge SLG Fault on GIS buses

Outcome

The comprehensive reports assured the lab and end utility customer that proper equipment was operating within normal constraints at the NGSA substation. EPE was able to identify the locations where maximum TOV occurred and pinpoint an exact location for potential surge arrester failure. A Ferranti effect analysis revealed no significant overvoltage issues when an additional 10% voltage was applied.

The model simulations also found that transformer inrush current did not contribute to TOV during faults or other incidents and that surge arresters performed within normal limits during switching and lightning strikes. These detailed simulations helped ensure that the substation infrastructure was resilient against overvoltage events and that the company could expect long-term, reliable operations from the current equipment and configuration.

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