

VOLTAGE DIP STUDY IN JUBAIL INDUSTRIAL AREA

Prepared for

**Saudi Electricity Company,
Eastern Region Branch (SEC-ERB)**

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SUMMARY

This study has been conducted in response to a request from Saudi Electricity Company, Eastern Region Branch (SEC-ERB) dated 26 Jumada I, 1421H (26th August, 2000). The study started on 17th March, 2001 for a period of 10 working months. The overall objective of this study is to identify the causes of loss of load being fed at 230 and 115 kV in the Jubail industrial city (JIC) due to voltage dips and to give specific recommendations to eliminate or minimize the disruption of industrial equipment resulting from voltage dips.

The specific objectives are: (i) Provide an overview of the voltage dip phenomena, (ii) review international standards and practices, (iii) review the present and past power system contingencies in the Jubail industrial area, (iv) review practices followed by Saudi Aramco, (v) study the steady state and transient behavior of the SEC-ERB electrical network for the years 2001 and 2003, (vi) compare the results of voltage dips on SEC-ERB system with international standards and practices, (vii) conduct economic analysis, if required, to determine or compare costs of recommended ways and means to minimize the loss of load due to voltage dips and (viii) provide recommendations to both SEC-ERB and its industrial customers.

The study team carried out an in-depth literature survey on the phenomenon of voltage dip. The results of the literature search reveal that voltage dip phenomena are well documented, but there is no clear and formal international standard on the phenomenon. The study utilized some of the widely used international experiences of South African Electric Utility (ESKOM), Computer Business Equipment Manufacturers Association (CBEMA) and Information Technology Industry Council (ITIC) criteria. These criteria are used by many utilities world wide to measure the performance of their networks. System simulation studies were undertaken on the 2001 and 2003 SEC-ERB networks. The purpose was to determine the magnitude and duration of the dips following faults at selected locations. The dip magnitude and duration were to be compared to ESKOM, CBEMA, and ITIC criteria. An analysis of the incidents of voltage dip in JIC was also carried out.

The study result indicates that there is a marked reduction in the number of voltage dips in JIC. The majority of reported voltage dip incidents are caused by single line to ground (SLG) faults and the occurrence of a 3-phase fault is a rare event. The number of voltage dip incidents during the years 1997-2001, when compared to the ESKOM criteria, was found to be well below the acceptable number of events. Several industrial facilities have installed ride-through equipment. The SLG fault simulation results for the years 2001 and 2003 show that the system performance is acceptable when compared to the CBEMA, ITIC and ESKOM criteria.

Based on the study results there is no need for mitigation measures on the SEC-ERB system. The only recommendation to SEC-ERB it should continue to introduce fast relays and circuit breakers whenever the technology and cost permit. The recommendations to industrial customers in JIC are. (i) Carry out a detailed study on the operation of critical industrial processes following a voltage dip, (ii) conduct technical and economical studies about the application of ride-through equipment,

(iii) create a database for voltage dip incidents and their impact on production, (iv) install devices to help their critical equipment to ride-through voltage dips, and finally (v) incorporate voltage dip ride-through capability in the design and specifications for their new/addition equipment.