

## SUMMARY

This is the final report of the study entitled *Updated Generation Planning for the Saudi Electricity Sector*, (CER2272, Phase II), started on May 1, 2005. The study is being conducted by The King Fahd University of Petroleum & Minerals (KFUPM), Dhahran, Saudi Arabia. The project consists of six tasks, namely, data collection, development of planning basis, development of electricity demand forecast, development of generation plan, development of generation cost estimates and reporting. The study was carried out by a project team from King Fahd University of Petroleum & Minerals (KFUPM), Dhahran, Saudi Arabia.

The purpose of this study is to prepare a plan for the expansion of electricity generation in the Kingdom of Saudi Arabia. The main objectives of this study are to develop a demand forecast for the Kingdom for the coming 15 years (2008 to 2023) and accordingly develop a viable Electricity Generation Plan for the same period.

This study presents a plan for the expansion of Electricity Generation in the Kingdom of Saudi Arabia. A demand forecast for the coming 15 years (2008 to 2023) is developed to determine the generation requirements in the Kingdom. The demand forecast is based on the multiple regression analysis method. The historical annual energy and economic data, namely, population and gross domestic product (GDP) are used to determine customer elasticities. The peak demand forecast for the four operating areas: EOA, COA, WOA, and SOA, as well as the different isolated areas were calculated for high, most likely, and low growth scenarios.

The demand scenarios indicate that there is clear need to develop generation plans that meet the expected load. The plan has to provide additional generation requirements with adequate supply reliability and within reasonable costs. It has also to take into consideration the economic life of the existing generating units. The generation planning process is developed based on the information of the existing power system, the committed plans, the developed load forecast, and the available supply options. Data was collected for the Kingdom from the Ministry of Water & Electricity, Ministry of Planning, Electricity and Cogeneration Regulatory Authority (ECRA), Saudi Electricity Company, Saline Water Conversion Corporation (SWCC), and Independent Power Producers (IPP).

A Multi-Area Reliability Analysis Program (MAREL) was used to develop the generation plan. For the reference plan, the total generation additions, excluding the IWPP & IPP, are 34,454 MW. The figure includes 2,289 MW needed by the isolated power systems within the Kingdom. The cumulative present worth of capital investment to January, 2005 at the base discount rate of 5 percent is MSR 44,811. A number of sensitivity analyses were carried out to study the impact of changing the discount rates on the reference generation plan. When the discount rate is changed to 3 percent, the investments change to MSR 55,024. The corresponding figure for a 10 percent discount rate is MSR 28,010. The effects of the capital escalation of 3% on the investment requirements of the reference generation plan are also considered. The cumulative present worth of capital investment to January, 2005 at the base discount rate of 5 percent is MSR 61,600. When the discount rate is changed to 3 percent, the investments change to MSR 76,378. The corresponding figures for a 10 percent discount rate are MSR 37,590. Additional sensitivity scenarios were also studied; the

cases considered are the increase and decrease in the unit capital costs by 10 and 20% at 3, 5 and 10 percent discount rates. When the unit capital cost is increased by 10 and 20%, the total investment requirement is MSR 49,292 and MSR 53,773 respectively at 5% discount rate. In case of decrease of the unit capital cost by 10 and 20% the requirement is MSR 40,330 and MSR 35,849 respectively.

The study then developed generation plans when further transmission interconnections between SEC operating areas were proposed. Interconnection links between the COA & WOA, WOA and SOA and an additional link between COA & EOA were considered. This is referred to as the unified generation plan. The total plant additions under this plan are 31,175 MW. This is reduction of 3,279 MW. The cumulative present worth of capital investment to January, 2005 at the base discount rate of 5 percent is MSR 41,210. When the discount rate is changed to 3 percent, the investments change to MSR 50,874. The corresponding figures for a 10 percent discount rate are MSR 25,451. The effects of the capital escalation 3% on the investment requirements of the interconnected generation plan are also considered. The cumulative present worth of capital investment to January, 2005 at the base discount rate of 5 percent is MSR 57,120. When the discount rate is changed to 3 percent, the investments change to MSR 71,213. The corresponding figures for a 10 percent discount rate are MSR 34,411. Additional sensitivity scenarios were also studied; the cases considered are the increase and decrease in the unit capital costs by 10 and 20% at 3, 5 and 10 percent discount rates. When the unit capital cost is increased by 10 and 20% the total investment requirement is MSR 45,331 and MSR 49,452 respectively at 5% discount rate. In case of decrease of the unit capital cost by 10 and 20% the requirement is MSR 37,089 and MSR 32,968 respectively.