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**AN UPDATE ON THE GCC AND
PAN-ARAB INTERCONNECTION GRIDS**

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PART I: THE GCC INTERCONNECTION:

INTRODUCTION

Recognizing the benefits of interconnection of their power grids, the six Arab states of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE) had a study carried out in 1990 to define an Interconnection Project and to determine its feasibility. As a result, the study recommended an AC interconnection of the 50 Hz systems of Kuwait, Bahrain, Qatar, UAE and Oman with a back-to-back HVDC interconnection to the 60 Hz Saudi Arabian system. However, in its conclusion the study concluded that the recommended Interconnection Project for the GCC countries was technically feasible as well as economically and financially viable.

In pursuant of the recommendations contained in the 1990 study, the Gulf Co-operation Council Interconnection Authority (GCCIA) was established with the mandate to proceed towards implementing of the Interconnection Project.

In light of the time that has elapsed since the 1990 study and in view of the evolution of the power sectors in the GCC countries, it was decided in 2002 to update the studies that had been carried out and to re-confirm the feasibility of the interconnection project, carry out a market study, prepare a plan for the financing of the Project, develop the Agreements that have to be reached between the different countries, and prepare an implementation strategy and necessary mechanism in this regard. This work was completed in 2004 with all its pros and cons in consideration.

A decision has been taken to proceed with implementation of the project.

**EVOLUTION OF THE POWER SECTORS IN
THE GCC COUNTRIES**

In 1990 all the power utilities were government owned and vertically integrated. The governments in the region have realized the need of the time and in view of the benefits of the private sector's participation in the power sector, promulgated legislations in Oman, United Arab Emirates, Qatar and Saudi Arabia respectively allowing the construction and operation of private power and desalination (IWPPs) plants. Bahrain is expected to embrace private sector participation in the power sector shortly. Most of the GCC countries are in the process of unbundling their power systems into generation, transmission and distribution entities.

* Not included in the total, (East Region of Saudi Arabia is considered)

**BENEFITS OF THE INTERCONNECTION
PROJECT**

The principal benefits that can be achieved through Interconnection are as follows:

- Interconnections result in the requirement for a lower installed capacity in each of the systems (due to reserve sharing) while continue supplying the load with the same (or better) level of reliability.
- Interconnections can permit larger and more efficient generating units to be installed on the individual systems.

- Interconnections enable systems to share operating (spinning) reserves so that each system can carry less spinning reserve.
- Interconnections enable interchange of energy between systems resulting in a lowering of total operating costs.
- Interconnections permit assistance from neighboring systems to cope with unforeseen construction delays and unexpected load growth.
- Interconnections permit emergency assistance between systems to mitigate the effects of unforeseen contingencies such as catastrophic multiple outages.
- The Power Grid is a fundamental step leading to the liberalization of the power markets and promoting regional social, economic development and assuring environmental protection.
- The GCC Interconnection is the main gateway towards a Regional and Pan-Arab Power Pools that will provide the benefits firmly, as stated above.

The principal benefits due to the interconnection arise from the sharing of reserves between the systems and the consequential reduction in the installed generating capacity and associated operating and maintenance costs in the GCC countries.

Given the high differential between the price of gas and the price of crude oil (a ratio of almost one to four) there is a significant potential for economy interchange between the countries. However, there is a lot of uncertainty in whether or not such savings can be counted on towards the economic justification of the Project. Nevertheless, the studies showed that there is an opportunity for the countries to trade as well as realize substantial benefits as a spin-off.

THE INTERCONNECTION PROJECT

The feasibility study recommended that the grid system interconnection between the GCC states, as shown diagrammatically in Figure 1, is feasible from all technical and financial considerations and

recommended the project be carried out in three phases.

Figure 1: Approximate route and layout of the GCC Interconnection



- Phase I: Interconnection of the Northern Systems (Kuwait, Saudi Arabia, Bahrain and Qatar) in 2008.
- Phase II: The internal interconnection of the Southern Systems (UAE and Oman) to form the UAE Grid and the Oman Grid.
- Phase III: Interconnection of the Northern and Southern Systems in 2010.

The Interconnection Project consists of the following principal elements:

Phase I:

- A double-circuit 400 kV, 50 Hz line from Al-Zour (Kuwait) to Ghunan (Saudi Arabia) with an intermediate connection at Fadhilli (Saudi Arabia) and ancillary substations.
- A back-to back HVDC interconnection to the Saudi Arabia 380 kV, 60 Hz system at Al-Fadhili.
- A double circuit 400 kV comprising overhead lines and submarine link from Ghunan to Al Jasma (Bahrain) and associated substations.
- A double circuit 400 kV line from Ghunan to Salwa (Saudi Arabia) and associated substations.
- A double circuit 400 kV line from Salwa to Doha South (Qatar) and associated substations.
- A Control Centre located at Ghunan.

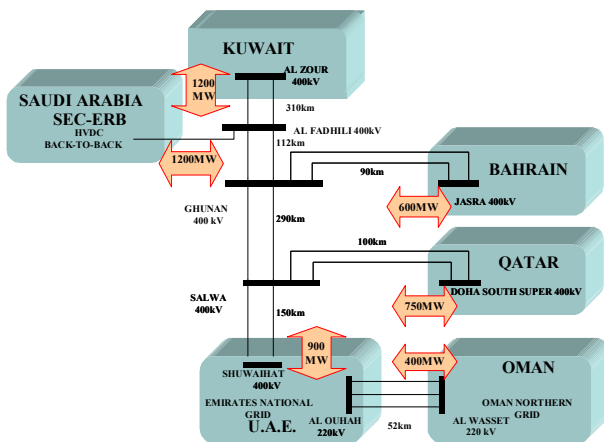
Phase II:

- A double circuit 400 kV line from Shuwaihat to Al-Ouhah (UAE) and associated substations.

Phase III:

- A double circuit 400 kV line from Salwa to Shuwaihat (UAE) and associated substations.
- A double circuit 220 kV line from Al-Ouhah (UAE) to Al-Wasset (Oman) and associated substations.
- A single circuit 220 kV line from Al-Ouhah (UAE) to Al-Wasset (Oman) and associated substations.

Interconnection is shown in Figure 2.



PROJECT IMPLEMENTATION

The project has been divided into several work packages: substations, back-to-back HVDC converter station, submarine cable, overhead transmission line and a control centre. The work packages will be executed on an EPC basis. The services of an "Owners Engineer" have been retained to assist the GCCIA in the implementation of the Project.

TIME SCHEDULE FOR THE PROJECT

The project timeframe for the Phase-I interconnection project is as follows:

EVENT	DATE
Engagement of Consultant for Tendering & Adjudication	September, 2004
Availability of Document for Bidding	February, 2005
Invitation to Prequalified Bidders	February, 2005
Pre-Tender Meetings	March, 2005
Tendering Period	April, 2005
Bid Evaluation	May-August, 2005
Pre-Contract Award Meetings	September, 2005
Project Contract Award Ceremonies	November, 2005
Project Construction Commencement	December, 2005
Project Commissioning	1st & 2nd Quarter, 2008

OTHER DEVELOPMENTS

In parallel to the construction of the Phase-I project a Consultancy and engineering firm will provide professional services by supervising and overseeing the construction of the thirteen (13) lots. The Authority is currently evaluating tenders from world renowned international and local GCC consultancy firms for this project.

Other developments include the invitation of International and local GCC Management Consultancy firms to provide management consultancy services to the Authority. The Consulting firm, in coordination with GCCIA, will develop the most appropriate organization structure and management system for GCCIA catered to meet the requirements for the operation and maintenance of the interconnection and join the league of organizations for regional and global energy trading.

PART II: PAN-ARAB INTERCONNECTION:

INTRODUCTION:

Power systems in Arab countries are characterized by high growing rates, where the annual growth rates are between 5% and 12% during the last decade. The following table presents some statistics for the year 2004. It is expected that the growth rate will maintain the same level for the next two decades. Therefore, the connection between the Arab electrical systems will be an effective tool for reducing the huge investment required for new installations, as well as achieving great benefits for the power sector in the region.

THE HISTORICAL DEVELOPMENT OF ARABIAN ELECTRICAL CONNECTION PROJECT:

At early stages, projects of power connection between some Arab States were characterized by low voltage of connection lines and low line capacity. In most cases, their role was confined to feeding border areas and provision of support to the neighboring network in emergent cases. So, only small percentage of the required benefit from connection has been achieved, the most important of which was acquiring experience in dealing with operators from neighboring countries. Consequently, there emerged the necessity for conducting wide-scale & modern studies of Arabian power connection that should take into account the new development in each nation in terms of power sector. The following study was then conducted for Arab Eastern area:

The preliminary study:

This is the electrical connection study for Egypt, Jordan, Syria, Iraq, Lebanon, GCC countries & Yemen. Financed by the AFESD for Economical and Social Development (AFESD), the study was based on the fact that power connection was only for the purpose of relief and power transmission from one state to another in the event of emergency or power shortage due to outage of large unit or load increase.

The complementary study:

In 1992, a study was carried out for estimating the spanning reserve, for linking Saudi Arabia with the north of Arab eastern area via Jordan & Egypt, for using natural gas for power generation in Qatar and transmitting it to GCC states and Arab nations in Arab Eastern Area. In 1994, a study for costs & benefits of power connection to Arab eastern area was updated on the light of the actual cost of power project linking Egypt & Jordan.

- THE ARAB-EUROPEAN ELECTRICAL INTERCONNECTION PROJECT:

The hexagonal-connection countries and Arab Western area countries are linked with Europe on 400 KV via the following stages:

- (1) In East: Via Turkey after completion of the interconnection between Syria & Turkey.
- (2) In West: From Morocco to Spain via marine cable of 400 KV. Studies are currently taking place to support connection by constructing a new marine cable on 400 KV for increasing exchange between the two countries.

- FUTURE PROJECTS FOR CONNECTING ARAB COUNTRIES WITH EUROPEAN COUNTRIES:

Interconnection line for connecting Tunisia with Italy (under study):

There is intention to establish a generating plant of 1400 MW in Tunisia to take a benefit from the available natural gas in Tunisia and for exporting electrical power to Italy via a marine cable of 150 km long & 300 KV.

CONCLUSION & RECOMMENDATIONS:

- The technical and economical feasibility study for the GCC Interconnection and Pan-Arab interconnection has been proven.

- The Pan-Arab and the GCC Grids are fundamental step leading to the liberalization of the power markets and promoting regional social, economic development and assuring environmental protection.
- The GCC Interconnection will enhance the Power Systems of the GCC Countries, and will make it a significant part of the Pan-Arab Grid.
- When the GCC Interconnection is completed, it will be the main gateway towards a Regional and Pan-Arab Power Pools.
- The great expansion of Arab electrical interconnection requires every state to focus on completing and enhancing its internal grid, so as to enhance the capability of the Pan-Arab interconnection.
- The private sector must be encouraged to participate in Electrical Projects in Arab Countries, such as power production and transmission projects, where there are good opportunities for investors.
- Power projects in Arab countries suffer from lack and shortage of fund. Therefore it is its expected that the financial institutions will take the necessary measures for providing the required fund.

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