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Iraq

Forward Electricity Strategy

by

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for

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of the United Kingdom

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Executive Summary

Introduction

All Iraqi industries, such as oil and gas, and essential services, such as water, sewerage and health services, depend upon reliable electricity supplies. A national electricity network ensures that power generated in the regions, where developed hydro and fossil fuel sources are located, are transmitted nationally to a load centre situated in Baghdad, the largest single centre of population.

There is currently a significant shortfall of generation to meet demand. In addition, damage to the transmission systems has been and will continue to prevent a more equitable sharing of power resulting in power cuts in Iraq.

The last power station, or improvement to the network, was completed in 1989. At this stage the population of Iraq was approx 16 million people. Today there are about 26 million Iraqis. There has been an increase of 10 million in the population without any improvement in the supply of power.

The Iraqi system is notable for the huge variation in the demand for power in summer (for air-conditioning) and winter, where there is no offsetting demand for power: irrigation, industry and alternative domestic uses (such as heating or cooking) barely exist. This variation can be as much as 100 percent, creating major problems for system management.

At present, Iraq's generating of between 4000MW and 4500MW remains some way off the target of 6000MW by June 30, 2004, set by the Coalition Provisional Authority (CPA). The current demand is estimated at 6500MW. Therefore, the Iraqi power system is supplying about two thirds of the demand.

Before the 1991 Gulf War, Iraq had installed capacity of 9000MW and was generating enough power to satisfy a demand of 7500MW. Pre-Operation Iraqi Freedom 2003, generation levels varied but were around 4400MW, sometimes reaching 5000MW. This had been built up since the 1991 Gulf War, from a capacity of 2325MW in 1991.

Most of the generating units in Iraq have been in operation for more than 15 years. The policy of obtaining electricity by any means available, has kept the system operational, but not at an optimal level. Most generating "units" are in poor condition and many are being operated well beyond their useful life.

An Iraq with a standard of living comparable to Kuwait will have to look towards a system with a capacity close to 20,000MW. To reach 20,000MW calls for an investment of somewhere between US$ 8 -16 billion over a 5 to 10 year period. This is almost equivalent to the PCO budget for the next three

years. By May and early June 2004 the different governorates in Iraq had between 8-13 hours of power, with load-shedding and power cuts to maintain network stability because of the un-met demand.

Situation Analysis

Industrial demand is down, because of the slump in the normal Iraqi economy. Residential demand is growing rapidly as a result of increased incomes and access to imports following the collapse of the previous regime and the end of the trade embargo. Iraq is currently experiencing a growth of at least 10 percent and some estimates put growth at 20-40 percent. Domestic load alone has doubled in the last year.

The demand for Basrah province at present is about 700MW. This will rise over the three months of June, July and August to approx 750/800MW. The allocation to Basrah is today about 450MW. 150MW is consumed by industry and critical infrastructure as hospitals etc leaving about 300MW for domestic consumers. As the heat of summer diminishes, with the ongoing increase in the use of white goods, the demand will possibly fall back to a range between 600 to 650MW. In the meantime, the balance off supply and demand is being maintained by supply outages.

Generation in Southern Iraq is mainly by crude oil. Sabotage against pipelines has reduced the supply of oil requiring problematic tanker truck supply. Much of the new capacity is high speed diesel engine. Diesel fuel is not only in short supply but tankers are subjected to hi-jacking and absconding.

The loss of the 400KV lines severely reduced the capability to provide power from the main generation plants to the main population centres. Baghdad represents 40 percent of the total Iraqi demand for electricity, yet the main generation plants are in the North and South. The Transmission situation has improved because the completion of the rehabilitation projects will help stabilize the network.

Industry and habitation of Iraq are dependent of the interaction of three resources: oil, water and electricity. Oil is important as a source of wealth and electricity. Electricity is essential for the delivery and processing of oil and water. Water is essential for the generation of electricity and the refining of oil. Economic growth and development will be optimised when these three are in a sustainable balance.

In addition to a shortage of electricity, the lack of oil refining capacity constrains Iraq's development. Typically, a modern refinery produces benzene, kerosene, diesel and LPG with no waste left over. In the obsolete Iraqi plants, for one barrel of crude oil the refineries recover only one half of a barrel of refined product. The remaining waste product is known locally as 'mazoot.'

The crude oil and mazoot burning plant is also capable of burning HFO, but lack of crude oil refining capacity means Heavy Fuel Oil (HFO) for combustion is limited. Iraq is unable to use or store the quantity of mazoot available so it is exported and processed in modern refineries, in other countries.

Mazoot is currently being exported at US$ 13 a barrel. Diesel is currently being imported for US$ 70 a barrel. Iraq is missing out twice: it is getting less refined product and money from its oil than it should and it is using scarce export proceeds to import refined product from other countries. 50 percent of refined distillate products consumed in Iraq are being imported.

Fuel supplied through the state owned refineries is retailed very cheaply at US$ 0.00.3 per litre for diesel. This leads to inefficient use and criminal activity. Lack of investment also means that the refineries cannot produce LPG from the natural gas associated with the oil fields. At a time of acute gas shortage for generating power, virtually all gas is flared and LPG is imported.

Iraq will gradually shift from burning mazoot and crude and instead will burn gas (probably with its LPG stripped out). Improved refining technology will help resolve the shortage of diesel and produce more refined distillates for the local market and export thereby reducing the need to import them. Enhanced water supplied for both electricity and refining will also have a positive spin off for the local community.

Addressing the Emergency

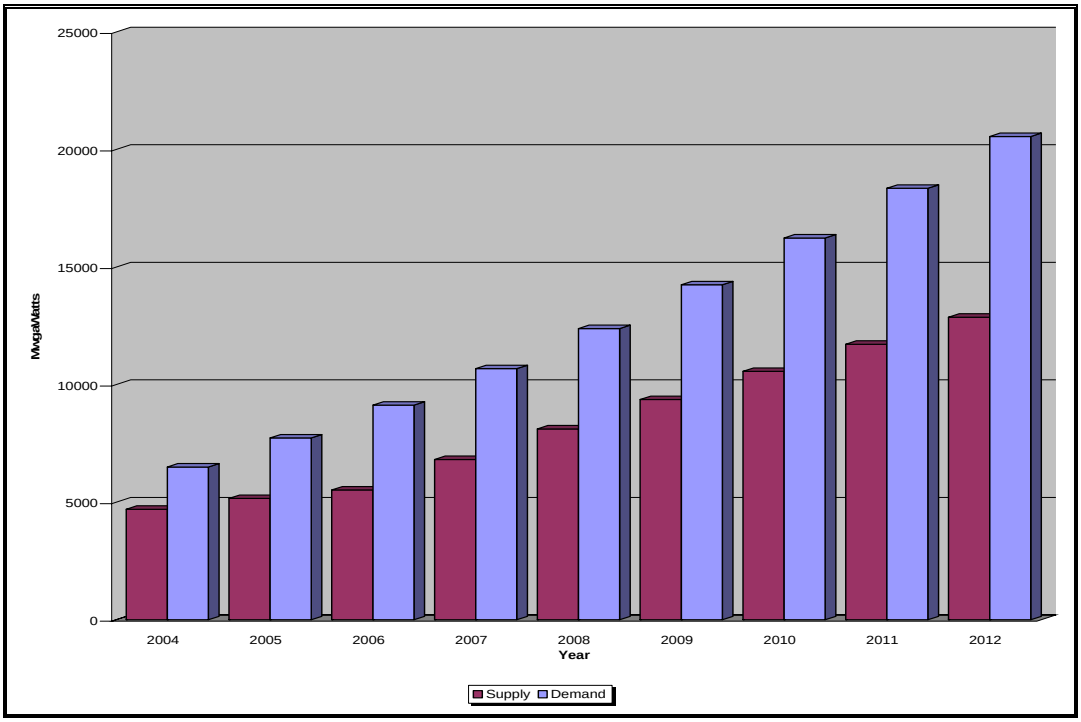
To set about repairing Iraqi infrastructure, the CPA, South inaugurated an Emergency Infrastructure Programme aiming to repair of national and regional 400 kV and 132 kV lines, increasing power plant efficiency, repair distribution, by improving and increasing substations, provide point generation to improve supplies in remote localities and provide spares.

Most transmission lines are now in operation and the work has been done using Iraqi contractors and security guards. Power Plant work has resulted in more capacity becoming available. The distribution work has contributed to improvements in stability and is largely complete. Point Generation using diesel fuel in short supply moved the crisis from power to the oil sector. Slow speed diesels that can use low quality fuel or gas, would have been better.

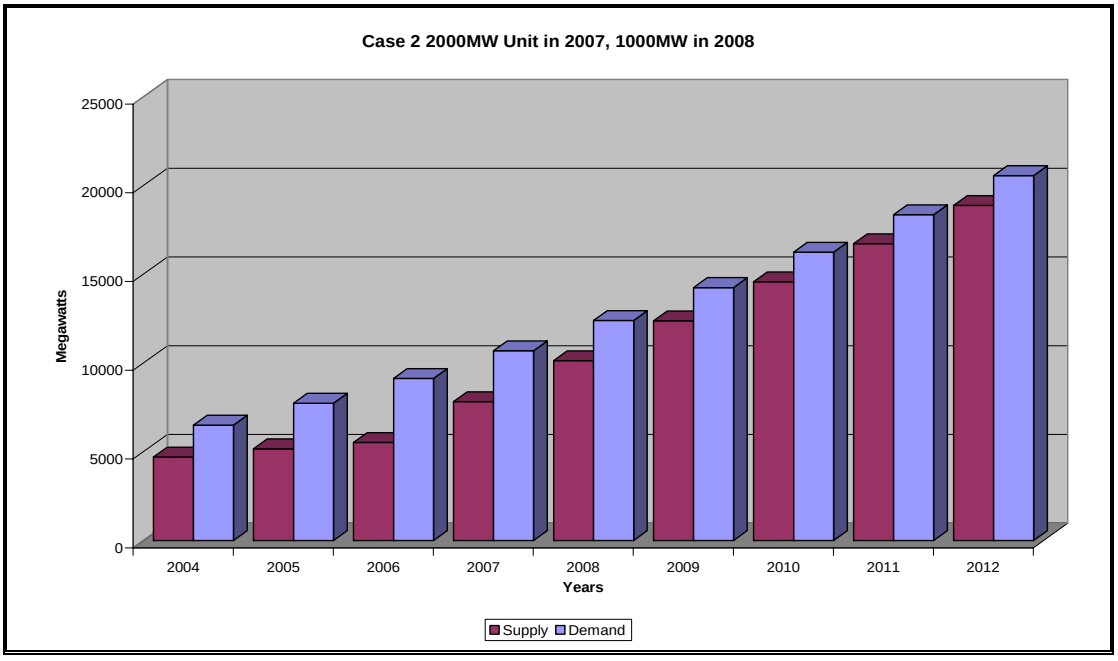
Forward Investment Programme

In a simple model of forward demand and supply of generation the current reported level of demand of 6500MW was assumed as a base and it was assumed that the current annual increase, around twenty percent, peaks in 2004. From then it tails off to an annual increase of 12 percent by 2012. The tailing off could be triggered by a policy of realistic electricity charges, for example.

Six 1000 MW units 2007-2012



2000 MW 2007-2012



The result is that a significant shortfall will remain every year until 2012 and beyond. Given exactly the same demand assumptions, only if a 2000MW unit is commissioned every year between 2007 and 2012 will supply match demand, at around 20,000MW.

This very simple analysis suggests that even if demand is curtailed to more normal levels (by realistic pricing and other measures); production will only keep pace with demand by the commissioning of

plants of between 2000MW and 3000MW, every year from 2007-2012.

The consultant has not discovered evidence of an effective mechanism in place to ensure that forward planning is being done. In the meantime there must be a programme to address the exponential increase in demand.

This distribution of PCO resources suggests that the urgent needs in transmission and distribution have been recognised. There is an urgent need to address the issue of demand management. A critical aspect of demand management is charging for power at an appropriate price. Currently, power prices are like petrol prices, ridiculously cheap and since the war domestic consumers are seldom charged for power. There needs to be a phased programme of getting people used to the idea of paying more for electricity. There must be links between:

- paying and getting service,
- improving the quality of service and the amount that is paid, and
- maintenance of infrastructure and the quality of service.

There is a need to create meaningful financial incentives to save power when it is in high demand and use it when the demand is low.

Investment Plans

Large CPA contracts have been let for work in the electricity sector. Apart from the refurbishment contracts already in place, only three electricity projects have currently been let by the PCO. Bechtel is managing a US$ 158 million contract of Operation and Maintenance (O and M) training (including the materials to be used). Perini has a US$ 17.168 million contract for the Basrah Distribution Network and a further US$ 6 million contract has been let for work in Um Qasar. As far as can be ascertained, no large, Greenfield, ST is proposed under any of the above programmes.

Investing in appropriate technologies is one of the factors required to improve the functioning of the Iraqi electricity sector. ST units will increase the length of time to install, as the plant is much heavier in construction, but will deliver a much more responsive unit for the electrical system. The attraction of GTs is the relatively rapid construction time, of about 18 months. The danger is that there will be too much reliance on GTs in the Iraq system (making it difficult harmonise the electrical characteristics of STs and GTs).

Until the petroleum products sector is reorganised there will not be sufficient appropriate fuel available for GTs, even with imports. GT's don't operate very well on Heavy Fuel oil, mazoot or crude. The GT's really need gas or distillate

(diesel) to operate efficiently. There is flared gas available, but the petroleum products sector is unable to collect and deliver it to power stations at present.

By contrast, ST plant can utilise the HFO/mazoot/crude as its primary fuel. As mazoot is currently a 50 percent product of the refining process this is the best way to dispose of it. Using mazoot will allow the refineries to maximise production of higher specified products. When the petroleum products industry is reorganised and can deliver more gas, appropriately designed STs can burn it.

New, large, plant, sooner rather than later will make the biggest impact in relieving the current shortfall and gives time (but not a lot) to replace the current ageing plant with newer and more efficient equipment.

Commercial private investment from world sources will be required. The cost of capital, rates of return and credit rating of the country will all be considerations, maybe with the support of ILOs to offset the country risk.

Short Term Investment Objectives

Short-term, the objective of investment in the power sector is to manage existing resources and those likely to come on stream within the next two years, to maximise output and minimise load shedding. To achieve these objectives, the following are priorities:

In the Short-Term in Southern Iraq, the maximum early payoff can come from the proposals to either refurbish or replace Hartha generation station. It will make approximately 400MW capacity available for use in Southern Iraq, sufficient to cut load shedding in 2005 while maintaining exports at current levels. This is a short-term measure but could add a degree of flexibility to the Southern Region system and seems likely to be the largest payoff for the amount of effort involved.

The second priority, for the South, is the ongoing programme of distribution rehabilitation and refurbishment in Basrah. As the major political and business centre of the region its functioning is a high priority for the whole region. Success is dependent upon:

- an intensive programme to prioritise projects as identified by the Iraqi power sector, and
- the rapid set up and operation of the PCO,
- sufficient funds to carry out the necessary remedial, safety and quality improvement work (from PCO or other sources).

The third priority is to build on existing consultation exercises and develop a forward looking, ongoing engagement between the PCO and the local and national Iraqi agencies responsible for the power sector.

It is anticipated that the relevant Iraqi planning agencies will function better with capacity building and institutional strengthening. Processes need to be mapped, reviewed and strengthened, particularly linkages to the work of the PCO.

Medium Term Investment Objectives

The calculations of forward power demand show:

- if construction commences **immediately** on a 1,000MW GT plant or a 1-3,000MW ST plant, widespread load shedding will be an ongoing feature of the Iraq power sector through to 2007,

- even with the construction of several 1000MW ST stations and using the lowest forecast demand profiles, demand will remain ahead of supply, possibly with the need for **longer periods** of **load shedding** across the whole country, depending on the location of new plants,

- **poor service quality** of this magnitude is likely to be a dampener on economic growth and recovery of Iraq (and to be fair it will also dampen demand), and

- even with **five new 2000MW power plants** commissioned between 2007 and 2012 there is a probability that even if prices rise rapidly, **load shedding could remain a problem** although at a reduced level,

The whole sector wants to move out of the era of load shedding and power cuts. Doing so depends not only with successful rehabilitation and construction in the electricity sector but also on a parallel investment programme in the petroleum products sector. Issues and Priorities

The biggest single issue confronting the Iraqi power sector is to get underway an investment programme to address Iraq's demands for electric power. The cost of this programme is so huge that the resources of the Iraqi state, the ILOs, donations from friendly nations and the participation of the private sector will all be required.

The Role that donors can play in this is helping the Iraqi authorities build up the capacity to plan and advocate the case for this investment to the new leadership of the country, to ILOs, organisations such as the UNDP and to the private sector power providers who may be persuaded to invest in Iraq.

As soon as the ILOs, such as the World Bank, become active in the Iraqi power sector they will, need to put in place a "least cost development plan" as an indicative planning tool, before they can mobilise Bank funds for major projects.

To prepare a least cost development strategy realistic load forecasts and analysis of the transmission and distribution system will be required as well as clear data on what is happening in the petroleum products industries.

The electric power sector as a whole does not operate like a "sector." It is a collection of confrontational empires run by relatively benign sole managers. The directors, mostly, are able and highly qualified, but facing enormous pressures to favour particular firms, localities, tribes and even family groups.

Favours to particular groups detract from sensible decision making and increases the centrifugal pressures on the sector. This is one feature of the ongoing problem in Iraq with the previous regimes neglect of the Shia South's needs and hostility to the Kurdish North. It has bred a feeling among Southerners that they are forced to share scarce power with a hostile Baghdad.

Power sectors around the world are being reorganised so that Strategic Functions are each the responsibility of separate agencies. Policy, Regulation, Business Management and Ownership are generally made the responsibility of different agencies.

In Iraq there will be particular value to boards of directors rather than sole managed organisations. With the leaders of ministries, utilities and State Owned Enterprises coming under enormous pressure to favour his own region and tribe to boards can cushion this pressure. With a board of directors there to monitor all decisions, this can reduce the pressure by balancing the interests of the wider community against special pleadings and allowing for checks and balances.

If the overall regulatory environment for business is not an enabling environment, the corrupt players will be the enablers. Corruption is an enabling device and under the Ba'ath regime corruption became a way of life because so much activity that would be regarded as legitimate in most countries was not allowed.

Forward Looking Strategies

Deciding which policy to pursue under most of the above headings cannot and should not be determined by foreigners. The ILOs and friendly governments can propose, suggest and negotiate with the Iraqis if they are lending money or providing guarantees on specific projects.

Crucial strategic issues need to be resolved at a political level and soon. Foreigners can best help the process of making decisions by ensuring that all concerned are well aware of the facts. Decisions have to be taken to ensure:

- commitments are made to an integrated investment plan,

- there is a mix of short-term and longer term investments that will allow mazoot to be used, while it exists and have the flexibility to move to gas when refining capacity is enhanced,

- a commitment to funding development by a mix of public sector and private sector funding, supported and assisted by ILOs,

- a commitment to structural reform of the electricity sector to enable the introduction of private sector investment and management, and

- a commitment to the introduction of economic considerations so that resources can be used in an economically sensible and sound way.

The fundamental fact is that population growth has outstripped electricity supply and that it takes 4-5 years to build a new power station. This simple idea can be understood by anyone and if this key message is repeated in every official communications eventually people get the message. Forward strategies must recognise:

- it will be a while before an adequate planning process will be in place,

- keeping the existing plants running has been an achievement in itself,

- load shedding will remain a feature until at least 2007 and beyond,

- there needs to be a major programme of construction begun immediately (reviewed annually),

- the programme targets must be coordinated with the reforms to the petroleum products sector,

- Iraq cannot finance the construction programme alone,

- investment in electric power is justified only where a customer will pay for the power,

- emphasis should be given to the role pricing plays in synchronising the demand and supply for power, even in emergency situations, and

- whatever the official resources mobilised to address power shortages, they will be dwarfed by the resources available in the private sector.

These principles may smooth the transition to the next stage as Iraqis take control in an environment friendly to initiatives and to activities focused on the needs of the citizens of Iraq.

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Glossary of Terms

Bechtel	Bechtel Corporation of the US, a major contractor
BIL	Basic Insulation Level
Bremer	Paul Bremer – Head of the Coalition Provisional Authority
Closed cycle	Generation system where water is cleaned and reused
CoE	Electricity Commission
CPA	Coalition Provisional Authority
CCGT	Combined Cycle Gas Turbine
Disco	Distribution company
EIP	Emergency Infrastructure Programme
EPSS	Electricity Production Security Service
FDG	Director General
GT	Gas Turbine are also known as Open Cycle Gas Turbines (OCGT) or Combustion Turbines (CT).
HFO	Heavy Fuel Oil
HRSG	Heat Recovery Steam Generator
ILO	International Lending Organisations
IRFFI	International Reconstruction Fund for Iraq
MoE	Ministry of Electricity
MND	Multinational Division (Coalition Military in Southern Iraq)
MW	Megawatt = 1000 kilowatts
NGO	Non-government organisation
Natural Gas	A Bye Product from the oil production process.
OCGT	Open Cycle Gas Turbine
OEM	Original Equipment Manufacturers
PCO	New name for the Project Management Office
PMO	US Project Management Office (now called PCO)
PPAs	Power Purchase Agreements
Scada	Power System Control System, used in most countries
ST	Steam Turbine
UN	United Nations Organisation
US Aid	United States Aid Agency

1. Introduction

1.1 Overview

Electricity is vital to the future of Iraq. All other industries, such as oil and gas, and essential services, such as water, sewerage and health services, depend upon reliable electricity supplies. A national electricity network ensures that power generated in the regions, where developed hydro and fossil fuel sources are located, are transmitted nationally to a load centre situated in Baghdad, the largest single centre of population. The configuration of the power sector at December 2001 is illustrated in Figure 1. Nationally there is currently a significant shortfall of generation to meet demand. In addition, damage to the transmission systems has been and will continue to prevent a more equitable sharing of power resulting in power cuts in Iraq.

This report addresses the issues of how current efforts should be assessed, the situation now, in the South, how the situation will change during the next few months and assesses proposed forward looking strategies. It looks at the prospects for the summer peak electricity demands in August 2004 and 2005. It also discusses the strategy for influencing the availability of power supply and delivery in the medium term (until 2012). It explores strategies to remedy the situation in the longer term and how the power sector can contribute to the stability and prosperity of Iraq.

1.2 Background to Energy Sector Iraq

The Iraq energy sector relies on a combination of oil, gas and hydroelectric generating plants interconnected on 400 kV national and 132 kV regional grids. There are three principal generation technologies used. Steam Turbine (ST) is a thermal plant using boilers fuelled on various types of fuel, solid (coal etc.), liquid (oil and its derivatives or gas to produce steam at high pressures which then drive a steam turbine to produce electricity. Because of the range of fuels they are very flexible but they are generally designed for solid or liquid or gas but can be made to operate on the other fuels with some modifications. Combustion Turbine (or Gas Turbine - GT) is essentially a jet aircraft engine adapted to generate electricity and are also known as Open Cycle Gas Turbines (OCGT) or Combustion Turbines (CT).

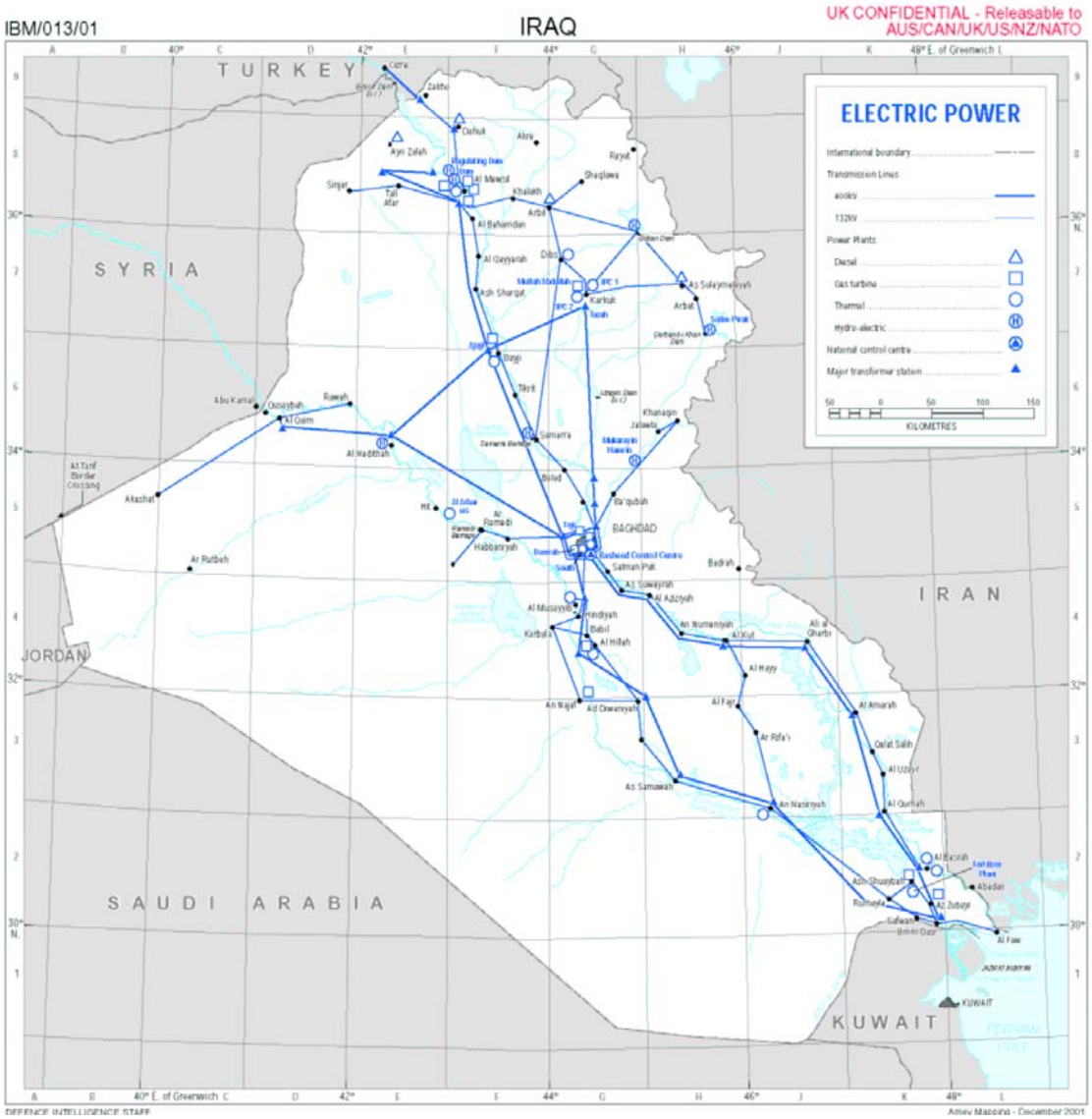
The open cycle relates to the cooling water for the condensers where water is used once in the condensers. The water is lost to the system, whereas the cooling towers of the Closed Cycle allow the water to be recycled after evaporation in the cooling tower has brought the temperature down to a level where it can be used again to cool the condenser, with a small amount of make up to replace the water lost through evaporation.

This is quite separate from the steam cycle where there is the need for high quality water that is the feed stock for the water treatment plant for producing very high quality boiler feed water in order to prevent deposition within the steam boiler and steam turbine.

Combined Cycle Gas Turbine generation reuses the exhaust gas from a GT to run an associated ST plant, greatly increasing the efficiency of fuel use. In the heat of Iraq both GT and ST have to be down rated, below their designed capacity. GT also is slower to respond to load in a hot climate, as is ST, but not to the same extent

Electricity in Iraq is generated, transmitted and distributed by a state-owned Electricity Commission (CoE) made up of a number of regional generating, transmission and distribution organisations, known as companies. In the South these are organised into sole managed “Directorates.” The Iraqi electricity sector requires substantial investment and institutional strengthening to improve the existing poor service to customers. Support into the sector for both Emergency and Long Term is extensive.

Figure 1 The Iraqi Power Sector



Outside assistance to strengthen the sector has been divided into two categories: Emergency Infrastructure Programme (EIP)[1] (EIP was initiated in about Sep 2003, with most work to be completed by December 2003. It was very soon realized that timescales were slipping and contracts continued right up to June 2004), which is either complete, or shortly to end, and Long Term (beyond June 2004). The EIP has been in operation for 18 months.

The Projects and Contracts Office (PCO, formerly called the Projects Management Office PMO), responsible for the longer-term is beginning work now. Late June 2004 is seen as a particularly important target as this is the beginning of the very hot summer period when customer demands reach a peak and is also when sovereignty passed from the Coalition to an interim Iraqi Government. During the summer period in 2003 there was widespread rioting in protest over quality electricity services.

[1] For Projects under the EIP see Appendix 2

1.3 Electric Power

Iraq's electricity network was originally well-designed and built, with sufficient capacity to deliver permanent power to all areas. The last power station, or improvement to the network, was completed in 1989. At this stage the population of Iraq was approx 16 million people. Today there are about 26 million Iraqis. There has been an increase of 10 million in the population without any improvement in the supply of power.

Currently, there are, 33 power stations in Iraq (excluding the 3 Northern Governorates):

- 8 thermal (steam),
- 17 GT,
- 8 hydro-electric (in the North)

The power is generated in these proportions

- 56 percent thermal
- 22 percent gas
- 18 percent hydro-electric – although this proportion drops during the summer

The Iraqi system is notable for the huge variation in the demand for power in summer (for air-conditioning) and winter, where there is no offsetting demand for power: irrigation, industry and alternative domestic uses (such as heating or cooking) barely exist. This variation can be as much as 100 percent, creating major problems for system management.

At present, Iraq is generating between 4000MW and 4500MW with the seven-day average (May 29 - June 4) of peak electricity production reported to be 4,144MW[2]. This remains some way off the target of 6000MW by June 30, 2004, set by the Coalition Provisional Authority (CPA). On average, across the country, one MegaWatt will supply the needs of about 1000 homes. The current demand is estimated at 6500MW. Therefore, the Iraqi power system is supplying about two thirds of the demand.

Before the 1991 Gulf War, Iraq had installed capacity of 9000MW and was generating enough power to satisfy a demand of 7500MW. There had been continuous investment and development of the power infrastructure and the systems used were modern for the time. About 70 percent of Iraq's installed generating capacity was damaged or destroyed during the 1991 Gulf War. All major power stations, such as Hartha, Mussayyib, Baghdad South, Doura, Nassiriyah and Bayji were damaged. Nearly 80 percent of the GTs units were affected. Pre-Operation Iraqi Freedom 2003, generation levels varied but

[2] Administrator's Weekly Report Essential Services, May 29-June 4, 2004

were around 4400MW, sometimes reaching 5000MW. This had been built up since the 1991 Gulf War, from a capacity of 2325MW in 1991[3].

The current combined "installed capacity" of the power stations is nearly 9000MW, the theoretical maximum that they can generate. With the exception of the Thermal Power Stations, Mussayyib (South of Baghdad) and Bayji (North of Baghdad), most of the generating units in Iraq have been in operation for more than 15 years. The Ba'ath policy of obtaining electricity by any means available, has kept the system operational, but not at an optimal level. Most generating "units" are in poor condition and many are being operated well beyond their useful life.

Incomplete maintenance, prolonged operation with worn-out original parts, in some cases total unavailability of spare parts, has resulted in down-grading of the system. Some spares are not available due to technological obsolescence and developments in the field of power distribution. Frequent shutdowns, start-ups and unscheduled maintenance contribute to the shortening of equipment life span.

Climatic factors, which can not be ameliorated because of the lack of resources, have added to the degradation of the equipment and corrosion of conductors, wiring, poles and other susceptible material installed in the open. Significant improvements in maintenance practices, in the last decade, have remained largely unavailable to Iraq. Professional standards have, therefore, slipped, resulting in low standards that subject equipment to unsafe or unreliable work. To add further complications, many power sub-stations have been subjected to acts of sabotage, looting and vandalism after the recent war.

In the longer term, an Iraq with a standard of living comparable to Kuwait will have to look towards a system with a capacity close to 20,000MW. A MW of power installed in Iraq, (with transport and security costs included) can be anything between US$ .5 million to US$ 1 million a MegaWatt (depending on how many layers of sub-contractors are involved). To reach 20,000MW calls for an investment of somewhere between US$ 8 -16 billion over a 5 to 10 year period. This is almost equivalent to the PCO budget for the next three years. By May and early June 2004 the different governorates in Iraq had between 8-13 hours of power, with load-shedding and power cuts to maintain network stability because of the un-met demand.

The policies of all stakeholders are supportive of the need for an Integrated Planning approach to restoring and improving service. This includes the Ministry of Electricity (MoE) and the Directorates, funding agencies (for example USAID), large contractors (e.g. Bechtel), NGO's and the Coalition Military. All are seeking coordination. However, coordination is patchy at

[3] It took many years to achieve power levels of 4400MW – not the few months that is sometimes alleged.

best. The situation, of huge increases in demand and an inability to match it quickly enough, will now be analysed.

2. Situation Analysis

2.1 Demand for Power

Demand for power is the amount of capacity that the nation, the Southern Region, or a sub-region such as Basrah province requires to fulfil all the power requirements of its citizens and industry. Industrial demand is down, because of the slump in the normal Iraqi economy. Residential demand is growing rapidly as a result of increased incomes and access to imports following the collapse of the previous regime and the end of the trade embargo. A large proportion of the rapid increase in demand is due to the increased number of white goods (air conditioners, refrigerators) and brown goods, (televisions, music centres and computers) that have entered Iraq since the end of the embargo.

Illegal electrical connections[4] further complicate projecting accurate residential demand and obtaining reliable data. However, it can be safely said that most countries experience a load growth of between 2-5 percent a year. Iraq is currently experiencing a growth of at least 10 percent and some estimates put growth at 20-40 percent. Domestic load alone has doubled in the last year.

The demand for Basrah province at present is about 700MW[5]. This will rise over the three months of June, July and August to approx 750/800MW. The allocation to Basrahh is today about 450MW. 150MW is consumed by industry and critical infrastructure as hospitals etc leaving about 300MW for domestic consumers. In the following three months demand will fall as the heat of summer diminishes. However it will not fall back to the current load. With the ongoing increase in the use of white goods, the demand will possibly fall back to a range between 600 to 650MW.[6]

In the meantime, the balance off supply and demand is being maintained by supply outages. This is being done in the absence of an approved and distributed plan from the Ministry Of Electricity/CPA. A public information and customer relations campaign has not yet been put in place. It is not technically possible to keep Basrah at the 18 hours supply promised to the governor in April 2004.[7]

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[4] Known locally as “Taps”

[5] See Appendix 1

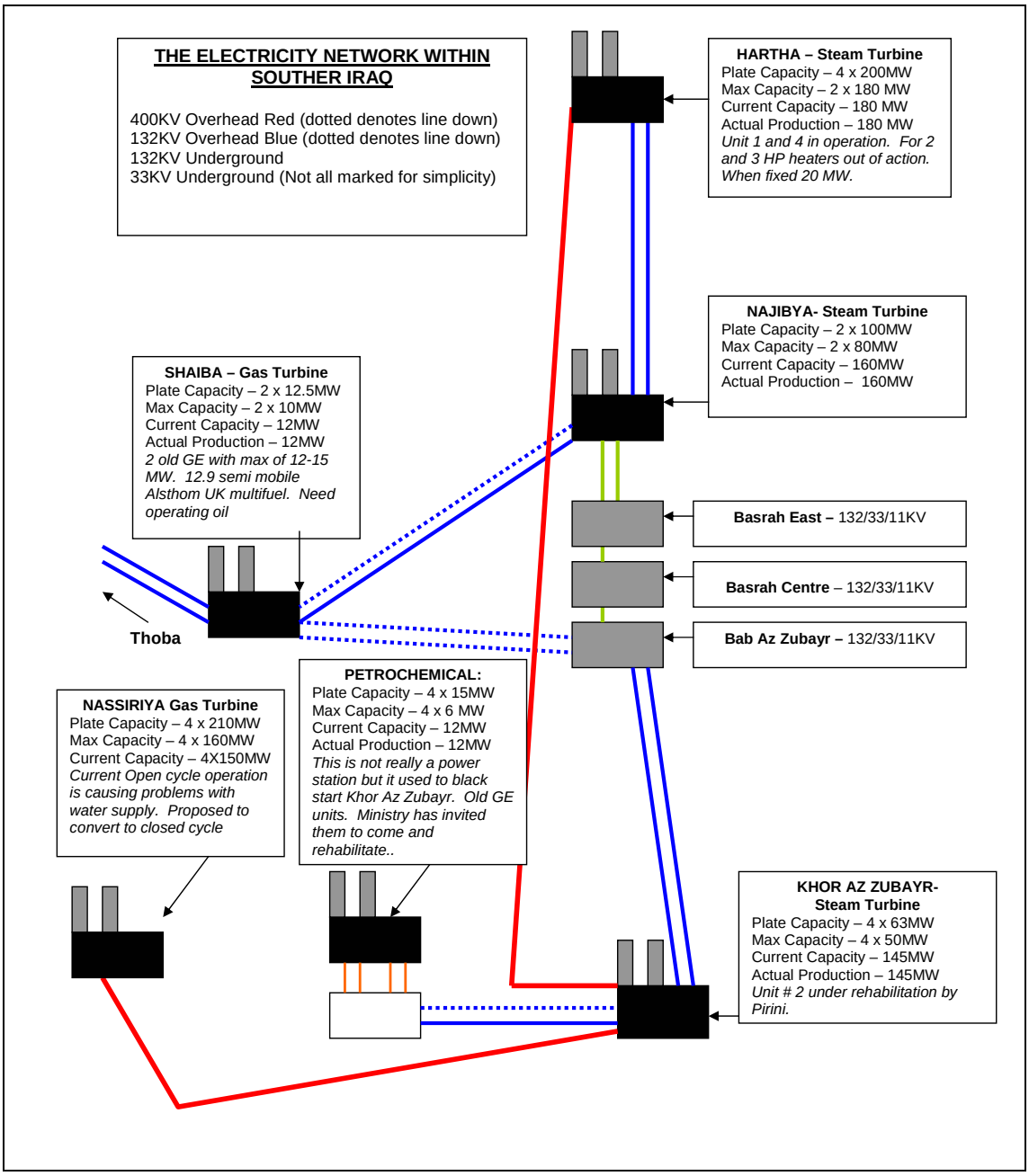
[6] Based on current estimates by MND Engineers

[7] A promise from Ambassador Bremer’s advisor, Jim Hicks – noted in a report to Headquarters: Multinational Division (South East)

2.2 Generation in Southern Iraq

All of Basrah Province's 5 power stations were built during the 1970s when Iraq's economy was booming. What was a fully functioning system during 1980s began to suffer from a lack of maintenance and investment as the cost of the Iran/Iraq War rose.

Figure 2 Diagram of Power System - Southern Iraq



Adapted from a Multi-National Division (MND) Report dated 1 June 2004

Allied bombing of key installations during the first Gulf War included a number of the Province's power stations, and although much of the damage was repaired immediately after the conflict the network was left significantly worse for wear. Economic sanctions further compounded the lack of investment and

at the turn of the century Basrah was well used to regular power cuts with 3 hours on and 3 hrs off being the norm during summer.

The principal features of the Southern Iraq power generation system are described in Figure 2. Generation in Southern Iraq is mainly by crude oil[8]. Running from North to South are the Hartha Generation Station (ST) that has two units currently in operation and two that need replacement boilers (repaired, these could give 400MW of additional generation capacity. These two units have also been severely cannibalized to keep the other two running, with the rotors being sat on 'axle stands' in the open air for over 10 years. They are essentially scrap. Najibiyah (also a ST) has 2 x 80-90MW units, one of which was repaired in mid 2003, both are currently in operation. Khor Az Zubayr had one unit repaired in mid 2003 and another restarted recently. Currently, it is producing 145MW.

Shaibah (GT) has 4 units operational at present, two being very old[9]. Shaiba's units 3 and 4 are trailer mounted semi mobile Alsthom UK Multifuel units (each putting out about 12.9 MW). Unit 3 has a compressor fault from installation and 1 and 2 have control problems. They run on diesel but, given the problems with availability of diesel it was decided to put in gas a line from the main station's supply. This decision overlooked that the Alsthom machines require very different gas conditions to the other units.

Shaiba is a critical generating station as it supplies the refinery which is nearby. The generation output is isolated from the system to ensure secure supply to the refinery, creating major security problems. A contract was awarded to GE for the overhaul of the Shaiba power and petrochemical units and preliminary work has begun. The Petrochemical Plant power units are the property of the Ministry of Industry and Minerals. They have 4 units[10] like Shaiba, 3 of these units were driven to destruction by the policy of "run to fail" leaving only one unit capable of running at present and that is generating up to 12MW. The load is currently being supported by 21 x 1MW fast diesel units based at Shaiba.

Nassiriyah has 4 units with capacity of 210MW each. Its output of approximately 150MW each machine is mainly exported from the region. It runs on heavy fuel oil or heavy oil. It is the station in the best condition in the south. Nassiriya station had a gas firing capability that was damaged during First Gulf War. Subsequent looting of its gas supply pipeline has seriously damaged the pipeline and consequently it would take a great deal of effort to repair. This station is ideal for firing HFO, and if necessary, crude oil.

The PCO plans 40 MW of GT plant at Nassiriyah. The additional facilities required will make the power produced very expensive. The station does not

[8] The discussion that follows is mainly from a discussion with Robert Apsley in Belfast, 5 June 2004, discussions with the Military and senior power sector figures.
[9] GE Frame 5, with a maximum output of 12-15MW
[10] Frame 5 GE

have experience of operating GT's. As only crude is available, the units' output will be reduced to 35MW and operating in high summer temperatures will only put out 26MW. It will also have a very low load factor (due to the extra maintenance of boilers firing on crude) and has no storage for the diesel it will require to enable crude firing. It should have been commissioned about the 10 June 2004 (unless they have run into problems).

There are many problems with the supplies of fuel. Natural Gas is a product from the oil production process. It needs further processing to remove some of the heavier condensates carried over during the separation process to give dry NG for GT operation. The condensates can be burned as a liquid in thermal plant.

Mazoot is the "waste" left from the Iraqi process of refining where the heavier fractions are left behind. HFO is the waste left after the refining process. Modern refineries with catalyst additives, etc. will produce more products from the process leaving less "HFO" containing a higher level of "solids" or particulate materials but it is much more difficult to burn.

Sabotage against pipelines has reduced the supply of oil requiring problematic tanker truck supply. Much of the new capacity is high speed diesel engine. Diesel fuel is not only in short supply but tankers are subjected to hi-jacking and absconding. All gas and steam generation plants require treated water to operate. Lack of maintenance to water treatment plants reduces the efficiency of heat exchangers, causing leaks and reducing output significantly.

Several new power plants were being built by the CoE (using equipment and construction services supplied under the UN-MOU of the Oil for Food Programme-661 Committee). Work stopped on these before the war and these sites have suffered from looting and sabotage. Since the operation of the CPA began, several new power plants have been proposed and construction initiated, but the capacity proposed will not make up for twenty years of neglect.

2.3 Transmission in Southern Iraq

Iraq's 400KV national transmission network covers the whole country. This network is a large ring main encircling the main part of the country with two crossing circuits. Essentially the 400KV network divides the country into three loops. Figure 1 illustrates how this is done. The majority of the 400KV lines were badly damaged with many pylons destroyed. Until early 2004 the work proceeded slowly and did not match the rate of continued sabotage until security was enhanced.

The loss of the 400KV lines severely reduced the capability to provide power from the main generation plants to the main population centres. Baghdad represents 40 percent of the total Iraqi demand for electricity, yet the main

generation plants are in the North and South. The 132KV lines have also been sabotaged but not to the same extent. They do not have the capacity to carry electricity between regions. For the Southern region there are two principal lines, from Hartha to Al Qut and from Khor Az Zabayr to Nassiriyah. The former line has been rehabilitated by the US GRS[11]. Security is 2/3 of the price of the contract and for which HART (UK) employs some 1600 people. This job was completed in March 2004 and essentially reconnected the South to the National Grid.

Khor Az Zabayr to Nassiriyah transmission has also been recommissioned. These two major lines were activated in mid June 2004. In addition to the above, the Omara to Buzurgan line has been the most heavily damaged. 127 towers were ripped down over a 6-8 week period in about October 2003. There were arguments between the Transmission Company and the Oil Company about who actually owned the line as it was a 'private line' solely supplying the oil fields. Eventually the electricity company said that they would do it, but they did not have enough resources to complete repairs quickly. EIP had a contractor tendered and lined up to do it for about US$ 10M, but USACE (or GRS) said that they would do it, but their contract came in at over $23M .

The Transmission situation has improved because the completion of the rehabilitation projects will help stabilize the network. Transmission's status remains vulnerable due to the neglect of improvements of transformers and sub stations. The South is now synchronised with the national grid.

2.4 Distribution

The distribution system in the Southern Area has suffered extensive degradation. A mixture lack of technical skills and management expertise has resulted in a lack of maintenance and some failures and damaged equipment. Further investment is required if there is to be a marked improvement in service. EIP Project P020[12], sub-station refurbishment, focused on restoring and rebuilding the principal substations in Basrah. This is the bare essential work required to keep the system in operation.

Whilst there are PCO distribution enhancement projects planned they will not transform what is a degraded system. Other small initiatives are proposed, but overall the distribution network will remain in poor condition. The consensus seems to be that the EIP and the on-going distribution work in Basrah will slightly strengthen the system but from the consumers' perspective will not contribute to any significant improvement in service this summer.

[11] GRS stands for Gulf Region South, which is the southern command of the US Army Corps of Engineers (USACE) in Iraq, which come under direct control of the DoD of the US government. It does not do the work itself but coordinates the work of multiple subcontractors. Its main contractors are Perini (US), Intermedics (Turkey), KEC (India) and Power Security.

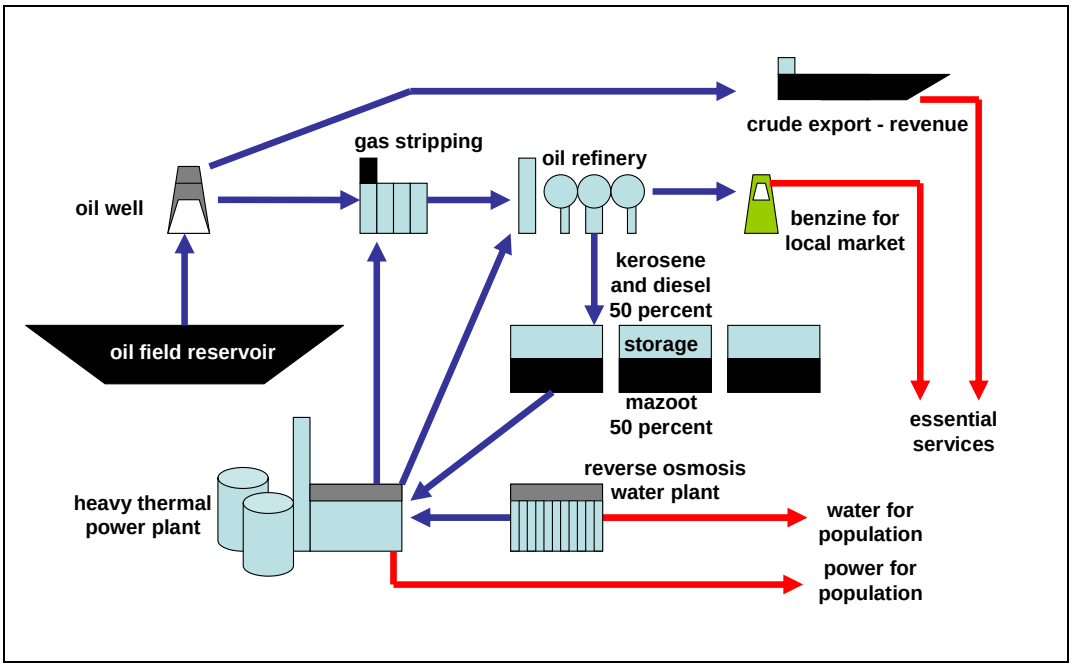
[12] Appendix 2

2.5 Inter-fuel Dependency

Industry and habitation of Iraq are dependent of the interaction of three resources: oil, water and electricity. Oil is important as a source of wealth and electricity. Electricity is essential for the delivery and processing of oil and water. Water is essential for the generation of electricity and the refining of oil. Economic growth and development will be optimised when these three are in a sustainable balance.

In addition to a shortage of electricity, the lack of oil refining capacity constrains Iraq's development. There are 3 major refineries in Iraq, but there is only one operating in the southern region at present. Typically, a modern refinery produces benzene, kerosene, diesel and LPG with no waste left over. In the obsolete Iraqi plants, for one barrel of crude oil the refineries recover only one half of a barrel of refined product. The remaining waste product is known locally as 'mazoot.' Mazoot is a cross between Crude Oil and HFO and consequently has a higher combustion temperature than HFO.

Figure 3 Energy Interdependence Iraq



The crude oil and mazoot burning plant is also capable of burning HFO, but lack of crude oil refining capacity means Heavy Fuel Oil (HFO) for combustion is limited. Iraq is unable to use or store the quantity of mazoot available so it is exported and processed in modern refineries, in other countries. Mazoot is currently being exported at US$ 13 a barrel. Diesel is currently being imported for US$ 70 a barrel. Iraq is missing out twice: it is getting less refined product and money from its oil than it should and it is using scarce export proceeds to import refined product from other countries. 50 percent of refined distillate products consumed in Iraq are being imported, mainly petrol

and diesel. Current exports finance imports sufficient for maintenance of activity, but there is no surplus. Currently, there is no money and no plan for green-field additional refining capacity, although some refurbishment is planned.

Petrol & diesel retails at about 3 cents per litre, but the electricity company buys it at a special rate of 0.3 cents per litre for generation purposes. Crude oil for generating purposes is about 0.003 cents per litre. Diesel for point power generators run by the electricity company was bought at 0.3 cents per litre, but the ordinary tankers of diesel to supply fuel stations were costing 3 cents per litre. This leads to inefficient use and criminal activity. It has been reported that a tanker of diesel obtainable under the still existing pricing structure (US$ .03 cents a litre) could fetch seven times as much across the border and further down the gulf, sixteen times as much[13]. Retail and distribution of diesel has been liberalised but there is an insufficient supply. The refined fuels have to be brought in by road tankers, which have to be protected by military convoys as they are prime targets for anti-coalition insurgents.

Lack of investment also means that the refineries cannot produce LPG from the natural gas associated with the oil fields. Consequently, at a time of acute gas shortage for generating power, virtually all gas is flared and LPG is imported. As the oil and gas industry is refurbished Iraq will gradually shift from burning mazoot and crude and instead will burn gas (probably with its LPG stripped out). Improved refining technology will help resolve the shortage of diesel and produce more refined distillates for the local market and export thereby reducing the need to import them. Enhanced water supplied for both electricity and refining will also have a positive spin off for the local community.

Currently the PCO is committed to an investment of US$ 533 million in oil and gas and there is a target of US$ 865 million. However, this is slightly less than a US$ 1 billion and will barely keep current production going. Significant progress will require the attraction of other, probably private capital, into new, modern refineries.

3. Addressing the Emergency

3.1 Emergency Infrastructure Programme

To set about repairing Iraqi infrastructure, the CPA, South inaugurated an EIP, which began with five objectives for the power sector:

- repair of national and regional 400 kV and 132 kV lines,
- increasing power plant efficiency,

[13] Informal comment CPA Official

- repair distribution, by improving and increasing substations,
- point generation to improve supplies in remote localities,
- provision of spares.

3.1.1 National and Regional transmission

In the South, the 400kv lines were dealt with largely outside the EIP, only the 132kv lines came within its responsibility. There was in existence a transmission directorate, but they had no money, nor the necessary equipment essential for erecting towers (for example a single 70 ton crane). EIP workers asked Iraqi transmission officials to define priorities. They identified 7-8 vital lines and scoped out how many pylons, conductors etc would be required. The Iraqi priorities became the EIP pylon programme and the Iraqis did the work[14]. Cranes were hired by EIP. The other equipment arrived in February 2004.

Coalition military worked with the Directorate staff to organise the scheduling of repairs, planning for the organisation of teams and an allocation of equipment for each team. The work is now all but complete. It has not prevented load shedding, but has given the system much greater stability that has enabled 24 hour power to be provided to essential services such as hospitals. It has also maintained power for the distribution of water supplies.

3.1.2 Increasing Power Plant Efficiency

Increasing power plant efficiency has been mainly the task of the US Corps of Army Engineers and US Aid/Bechtel. Good work has been done and is ongoing.

P024 (see in Appendix 2) was for a new generator for Khor Az Zubayr power station. At Hartha a contract to replace the boilers with Russian double boilers, under the Oil for Food Programme, was let in the 1990s. Construction reached an advanced stage before it was abandoned. Bechtel is now engaged by PCO to review rebuilding according to the original design (creating 400MW of additional generation potential for US$ 300 million). The CPA had earlier recommended replacing the 60 year old technology with modern open cycle GT. In 18 months a GT could have been operational. An option to add heat recovery steam generators and ST (making the plant a Combined Cycle Gas Turbine (CCGT)) would have existed. As refurbishment is underway, replacement will come later, if at all.

It is proposed to convert Nassiriyah to a closed cycle plant (where the water is cleaned and reused) and cooling towers are were built for this purpose. The cooling towers were built in the 1980s, but ran into technical problems with the vapour shorting out the adjacent sub-station equipment, so they were taken out of service. A contract was let to the a Russian firm to refurbish the

[14] (see Projects P010, P012, P021, P022 and P033 in Appendix 2

cooling tower system and put it all back into operation and convert the station to a closed loop system. This was nearing completion in late May 2004, but ran into technical problems as the quality of work is atrocious and the system may never work. Bechtel /Alsthom are now working on rehabilitating Unit 4. Unit 2 is being rehabilitated by Perini.

3.1.3 Distribution

There was no time for the EIP to do a complete distribution survey, so survey work was confined to Basrah. Four cable test vans were bought for the local directorate (1 for each governorate)[15]. Priority was given to replacing substations. It was realised that some necessary substations do not exist, and some are damaged, but the EIP only had US$ 10 million and that was not enough to address all the problems. Under Project P020 three Basrah Substations were due for completion on 7 July 2004.

3.1.4 Point Generation

Point generation stations were stand-alone mini-power stations of about 10MW (typically 5 x 2MW diesel sets) to be owned and operated by the electricity generating company to provide power to an entire town or region that was suffering due to the transmission system being looted. At Al Fao and As Sibah, the generating stations were outside the town feeding directly into the 33kV sub-station as the 132kV lines were missing. They came on stream 3-4 months late and are expensive to run, requiring diesel fuel that is very valuable on the black market and subject to heavy losses.

3.2 Analysis of EIP

The Regional transmission work seems to have been largely successful. Most lines are now in operation and the work has been done using Iraqi contractors and security guards. Looting has been reduced and the lines are in operation.

The work on the Power Plants is proceeding and has resulted in more capacity becoming available. The Southern Region can now self supply generation (3 hours on and 3 hours off) and exports power to the national grid. As of the 22 June capacity reached 1118MW, of which about 500MW is transmitted and consumed outside Basrah itself.

The distribution work suggested by the Mott-MacDonald report on sub-stations, (P009) has contributed to improvements in stability and is largely complete. It was always recognised that the sub-station work was only a down payment. More needs to be achieved and there is a particular

[15] Necessary because power sector workers couldn't find faults so were unable to make repairs and the system kept degrading. The only way to address that was a complete rebuilding of the system, for which there was no money.

bottleneck in the poor state and quality of transformers. Distribution remains a bottleneck and additional work and investment is required in this area.

Point Generation was envisaged as a response to the failures in the transmission and distribution systems. The latter two have been addressed more quickly than installation of point generation. The installation of high speed diesels was too late to alleviate the initial crisis. They do not contribute to a long-term solution because high speed engines use diesel fuel. There is a shortage of diesel fuel in Iraq, so the point generation moved the problem from power to the oil sector. Slow speed diesels that can use mazoot quality fuel or gas, would have been more appropriate. Mazoot burning machines are bigger, heavier and not generally available 'off the shelf'. Fuel heating would have to be employed and fuel handling becomes a problem. If time was not a problem, gas or mazoot burning machines would have been considered.

The initial emergency appears to have been handled well. However, in the medium term period, with long delays, activity became less focused and there was insufficient reliance on the Iraqi officials, to define priorities. Probably the biggest omission was the absence of a parallel medium to long-term programme so the EIP could close sooner.

The absence of the longer term perspective resulted effort wasted on point generation and a number of activities that are really outside the scope of the EIP. Often mentioned is the Al Muthanna generator[16]. This was promoted as providing power to a nearby cement works thus creating some 2000 jobs. Long-term it may be a viable project, although there are problems with the identified fuel source, as the gas pressures locally are very low, and employment creation is not a direct objective of the EIP. There were two 'Al Muthanna' generators in the early days of the EIP. One was to be at the cement factory and the other was to be for the main town of Samawah. The EIP board merged the two and the generator was to be sited at the town of Samawah to strengthen the grid and feed the town in the event of shortages of power from Nasiriyah. All technical problems with the fuel supply were sorted out before the project went ahead. This generator is as technically feasible as the 'Buzurgan' one, but has faced 'resistance' from those that favoured the cement factory location. This project remains controversial.

There does not appear to have been a plan to remove the causes of the emergency the EIP was dealing with. The EIP was to ensure continued operation of water, telecommunications and other sectors, but in many respects service continues to decline because additional refining capacity and large new power stations are needed, but these are outside the remit of the EIP.

[16] (P028), a second hand GE Frame 6 GT plant being imported from Australia

4. Forward Investment Programme

With the wind up of the PCA's efforts, focus is now moving to the proposed work of the PCO. Appendix 3 lists PCO Projects as of December 2003 and Appendix 4 list the current investment proposals from the PCO[17].

4.1 Generation

As noted in paragraph 1.3, to restore Iraq's living standards to a level comparable with Kuwait, it will need from 20GW of generation (about 1000MW is required per one million people). The US supplemental budget for PCO had approximately $2.5B for generation projects in Iraq. Even if all this is spent on new generation it will only produce about 5000MW (assuming a cost of US$ .5 million per MW) or about a third of the new, **additional** capacity that will eventually be needed. International Lending Organisations (ILOs), Iraqi and foreign government and private sources will have to fill the gap. Ultimately the loans and investments will have to be serviced by consumers.

The $0.5M per MW[18] cost of generation is conservative and will apply only to larger plants of 50MW and above. For smaller units, less that 1 MW, the unit costs are much higher. In Iraq, one third to one half (or more) of all project costs are for security. The smaller the project, the higher the percentage of the budget devoted to security and project management. Enormous mark-ups experienced in Iraq[19] add to the cost. Focusing on larger units could encourage original equipment manufacturers (OEMs) to enter the market as prime contractors, cutting out layers of agents and bringing costs down.

4.1.1 Modelling Demand and Supply

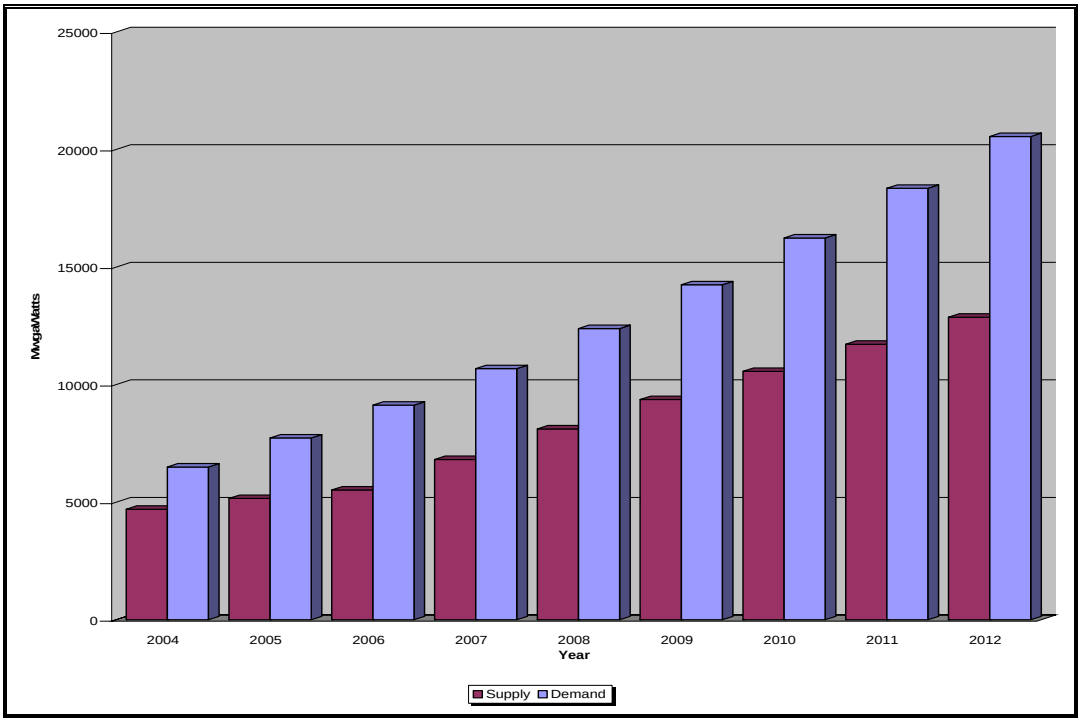
There is widespread agreement among the military, Iraqis and Coalition authorities that Iraq needs a major programme of ST generation investment to replace worn out plant and to meeting rising demand. In the absence of other projections, the consultant undertook a simple exercise to model forward demand and supply of generation. The calculation took the current reported level of demand of 6500MW as a base and assumed that the current annual increase, around twenty percent, peaks in 2004. From then it tails off to an annual increase of 12 percent by 2012. The tailing off could be triggered by a policy of realistic electricity charges, for example.

[17] As of 18 June 2004

[18] Figure proposed by CPA Energy Team Basrah

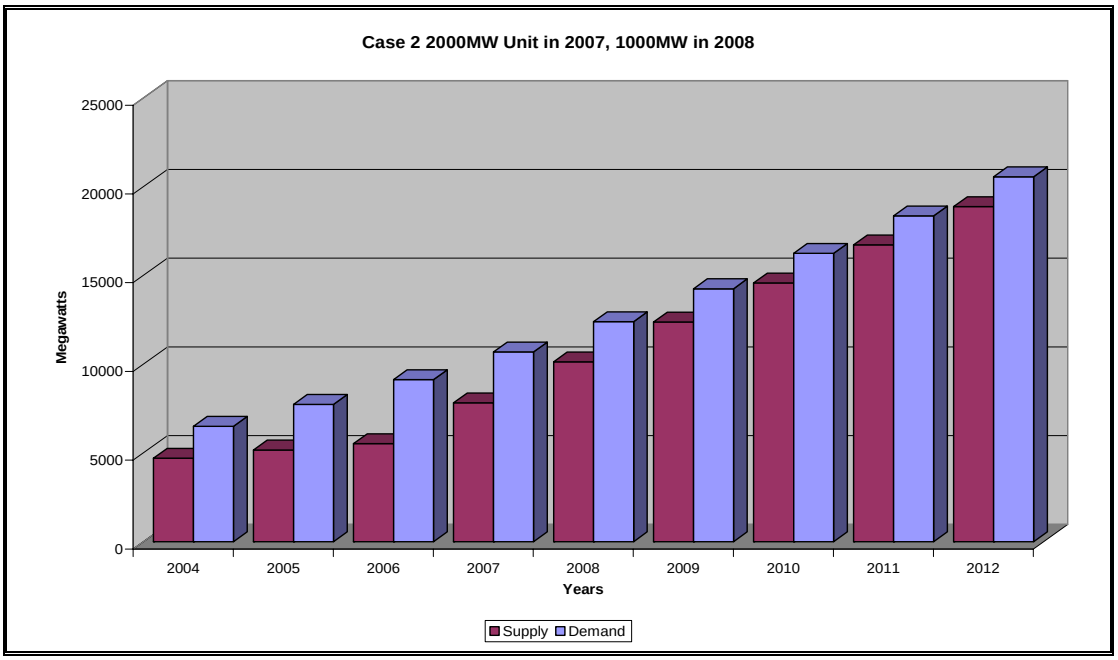
[19] One comparison from the PCO showed that equipment obtainable from OEMs directly would cost US$ 9 million and a comparable basket of equipment purchased through contractors would cost US$ 33 million.

Figure 4 Six 1000 MW units 2007-2012



The model shows the effect of 1000MW units being commissioned in every year between 2007 and 2012. The result is that with these demand assumptions and an assumption that the rate of increase in demand will slow down from 20 percent to 12 percent a year, a significant shortfall will remain every year until 2012 and beyond. This result is shown in Figure 4.

Figure 5 Five 2000 MW 2007-2012



Given exactly the same demand assumptions, only if a 2000MW unit is commissioned every year between 2007 and 2012 will supply match demand,

at around 20,000MW, as shown in Figure 5. The "tailing off" impact of charging for electricity remains unaltered.

These figures may seem large, but it is important to remember that in 1990 Iraq had a demand of 7500MW, and that was 14 years ago. The population has increased by about 60 percent since then and the Deputy DG of Electrical Transmission believes that actual demand in Iraq has already passed 8000MW[20]. These figures count all CPA current efforts as "incremental." The model makes some relatively optimistic assumptions in respect of the additional incremental generation available in each of the forthcoming years and projects a modest programme of decommissioning plant no longer able to be maintained.

If there is major additional load as steel and other heavy industries in Iraq return to production, given the increase in population, the level of suppressed demand, and the rapid recovery in economic activity in many parts of the country, it is not unreasonable to expect the rate of increase in demand during 2005 to rise closer to 40 percent. Further reworking the model, assuming an extreme 40 and 50 percent increase in 2005 and 2006 respectively, again with a rapid fall off when power prices come close to the cost of production, demand will come back to a steady 3 percent increase per year in 2012. However, to meet the demand projected by this case nearly 3000MW will be required in every year between 2004. On the most favourable possible assumptions the capital cost of such a programme will be US$ 14 billion for generation alone and could be up to US$ 28 billion.

This very simple analysis suggests that even if demand is curtailed to more normal levels (by realistic pricing and other measures), production will only keep pace with demand by the commissioning of plants of between 2000MW and 3000MW, every year from 2007-2012.

Current demand is being fuelled by reconstruction funds. In the medium term it may be sustained by investment from the UN–World Bank reconstruction programme. In the longer term demand will be sustained, by rehabilitation and expansion of the petrochemical and other industries. The position with new refineries appears to be similar. The consultant has not discovered evidence of an effective mechanism in place to ensure that forward planning is being done. It should be the MoE, but their planning capacity is reported to be very low[21]. In the meantime there must be a programme to address the exponential increase in demand. This will be addressed in more detail in paragraph 6.

[20] Dr Adnan Taha, interview 26 June 2004

[21] "Planning is one thing, execution is another." – Dr Adnan Taha, 26 July 2004

4.2 Transmission

The focus of investment in transmission is improving electrical security and reliability of the system along with the enhanced physical security system that is being put in place. The transmission losses in Iraq increase due to leakage currents caused by lack of insulators. Losses are in the range of 11 percent, or more, when they should be no more than 8 percent. Also, the insulation level of lines is degraded severely, leading to increased failures and faults.

Remedial work has been contracted out, with the requirement that it be done while the line is energized and under load, so as to minimize the system-wide impacts of this activity and reducing the need to wait for seasonal reductions in line flows. There are many instances where, damage to conductors reduces to the capacity of the line to the equivalent of a single conductor circuit. In the South the transmission system was surveyed to determine to what extent and where these situations existed and repair action was undertaken to remedy these defects. At transmission voltages the loss of a single circuit can have far greater impact than the loss of a distribution line.

Now that most pre-war 400kV lines have been restored to service, attention is moving to ensuring that the 400kV system is made more reliable through completion of redundant paths where they do not currently exist. Transmission South believes that at least four new 400kV lines are required[22]. System reliability and stability has been enhanced by rehabilitating the 132kV lines in place, upgrading circuits to greater capacity and adding circuits to single circuit paths. While many of these situations are not particularly critical under 'normal' conditions, they gain great significance under contingency conditions, after the system has been weakened by transmission or generation outages from whatever cause.

Tenders are currently in the market for a new National Dispatch Centre (NDC) in Baghdad under a UNDP project. Prior to the tender Fichtner of Germany did a design study for dispatching in Iraq. It was, however, limited to dispatching and did not cover the network itself. The Bearing Point Company (power planners), undertook a study of Transmission Peak Load 2004[23] (EIP P001 was subsumed into this study[24]), but it is still not finished. PCO contracts (taken over from CPA and the UNDP Oil for Food programme) will install new control centres in most of the critical locations in the country, taking care to avoid fragmentation of the generation and transmission system[25].

Better control of voltage and resultant var flows can be achieved by installing appropriate power circuit breakers and Scada controls, so that voltage profiles can be altered in response to short term requirements. This is a medium term

[22] Interview 26 June 2004
[23] Draft Iraq Transmission Study, Summer 2004 Peak Load
[24] See Appendix 2
[25] As opposed to a reasonable division of workload

investment consideration that needs to be harmonised with projected future increases in generation requirements. Until Scada control is in place the system cannot be controlled properly.

4.2.1 Security Arrangements for Transmission

The CPA let a contract to train its Electricity Security (EPSS) force for a more robust role. A training school has been set up NE of Baghdad and the main objective is to instil an ethos of duty into current guards and new recruits. 6,000 men will go through the school eventually over the next 2 years.

When fully organised the EPSS will be guarding power substations (that take 4-5 years to replace) and lines (that can take up to a year to replace). It is a necessary but very expensive operation. The Khor Az Zabayr to Nassiriyah line costs $ 1.3 million a month to patrol[26]. On the 16 June, the decision was taken that the "Task Force Shield," currently protecting the oil pipelines will be extended to the rail and electricity sectors too. The expectation is that this decision will gradually improve the quality of the work.

4.2.2 Medium Term Prospects

While there are some transmission and control centre projects in the lists provided by the PCO it is clear that they only scratch the surface of what is a large and rapidly growing need. Should the power demand forecasts outlined in paragraph 4.1 above prove to be close to the mark, there will be extensive addition transmission investments required.

4.3 Distribution

Of 101 PCO Projects identified in the Southern Region in December 2003, 84 were for distribution, substation replacement and rehabilitation and eleven were for power lines. This distribution of PCO resources suggests that the urgent needs in transmission and distribution have been recognised. The principal concern is that the PCO has a limited ability to carry through on these projects and there could be substantial delays while what is a new organisation finds its feet. Very few of the PCO projects have commenced so far.

The PCO has a list of projects agreed with the MoE. Once the list is agreed to by the US Congress funding of projects is supposed to be handled by the local offices of the PCO. The managers of Transmission and Generation in Southern Iraq say they have been involved in preparing the list of projects and are familiar with it but have grave doubts as the ability of the PCO to follow through[27].

[26] The contractor, the HART Company is reputed to have a robust SAS type approach to security, but in some cases even this is not enough and they need the backup of the Army.
[27] Conversation, Saturday 26 June 2004

4.4 Retail Supply

Assuming that the immediate needs of the distribution sector, rehabilitation, enhancement of the system and security can be addressed, there is an urgent need to address the issue of demand management. A critical aspect of demand management is charging for power at an appropriate price. Currently, power prices are like petrol prices, ridiculously cheap and since the war domestic consumers are seldom charged for power. The longer the situation persists the more difficult it will be to change it.

4.4.1 Community Consultation

There needs to be a phased programme of getting people used to the idea of paying more for electricity. This includes the industry consulting communities seeking their advice on how it should be done. The very fact of a consultative process taking place, led by the local industry, will help get across the facts regarding the growth in population since generation was last installed and the real cost of generating, transmitting and distributing electricity.

People in Iraq, have been collecting money for various levies, taxes and other obligations for thousands of years. Until April 2003 people were paying for power, albeit at very low prices. There are probably systems in place already and in any case there will be approaches that work and approaches that do not work in Iraq. The essential need is to tap into this accumulated experience and work out how it can be used to the benefit of the power sector. It also creates the opportunity for entrepreneurs, NGOs and others, to become involved.

4.4.2 Critical Linkages

There are important linkages that should be made part of the programme, if feasible. There must be links between:

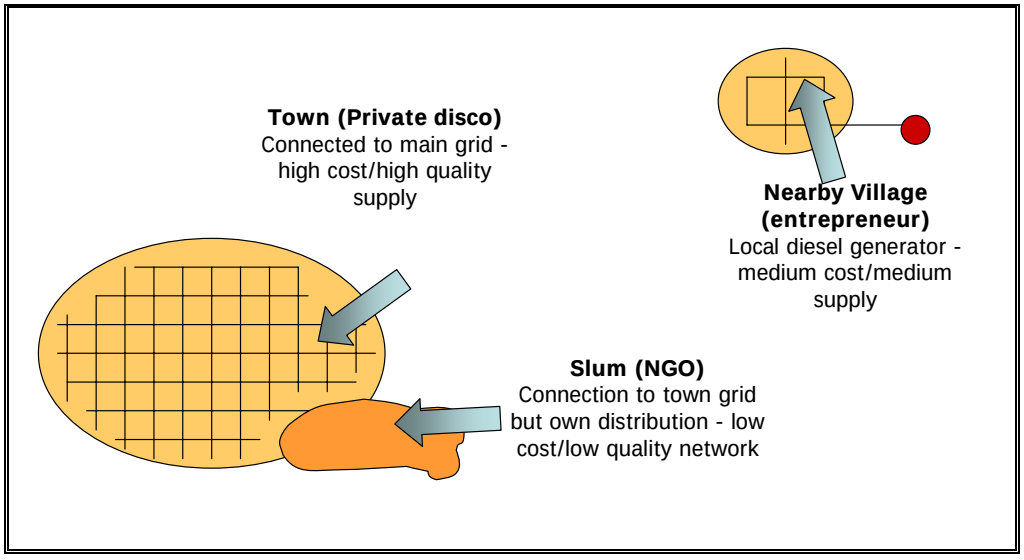
- paying and getting service (implies that there must be the capacity to disconnect customers who, after reasonable notice do not pay and given the prevalence of illegal connections, it may be more effective to impound equipment rather than to simply remove supply),

- improving the quality of service and the amount that is paid (if one suburb is getting 24 hour power and another 12 hour power it is unfair that they pay the same), and

- maintenance of infrastructure and the quality of service, with the local community taking some of the responsibility for catching those responsible for sabotage or theft.

Success is usually related to matching costs with the willingness to pay, by decentralising planning and operation. Eventually, new service providers can be introduced with incentives to collect money and earn bonuses for improving performance. An illustration of how a patchwork of agencies, each serving their community appropriately is illustrated in Figure 6. The distribution company (disco), NGO and the entrepreneur, each cater for needs of the communities they serve.

Figure 6 Revenue - Getting Others Involved



From: Mike Webb, Nairobi April 2003, Frontier Economics

There are also other important aspects to demand management. Financial incentives to persuade industrial users to shift heavy loads to off peak periods, or off peak seasons, persuading industrial and domestic users to switch off lights and appliances when they are not needed and bonuses for interruptible supply contracts are all important elements of a demand management programme.

4.4.3 Financial Incentives

The single unifying factor in all of these approaches is the need to create meaningful financial incentives to save power when it is in high demand and use it when the demand is low. Previously, in Iraq demand was suppressed by banning access to appliances (satellite dishes and computers) and low incomes. In the ongoing absence of these direct control methods, more sophisticated incentives need to be considered.

5. Investment Plans

On 4 April 2004, the CPA announced several major contracts had been awarded for electricity sector operations in Iraq. Contracts pertaining to the electricity sector including those set out in Appendix 3 and Appendix 4 are the projects that will be funded under these and subsequent contracts.

Apart from the refurbishment contracts already in place, only three electricity projects have currently been let by the PCO. Bechtel[28] is managing a US$ 158 million contract of Operation and Maintenance (O and M) training (including the materials to be used). Perini has a US$ 17.168 million contract for the Basrah Distribution Network and a further US$ 6 million contract has been let for unspecified work in Um Qasar.

Table 1 Electricity Related Contracts in Iraq

Iraq Infrastructure II	US$ 1.8 billion	6/1/04	Bechtel
Generation	US$ 98.8 million	6/2/04	Flour Intercontinental
Generation	US$ 33 million	6/2/04	Washington Int.
Generation	US$ 12.7 million	6/2/04	Dragados Solutions
Transmission	US$ 56.3 million	6/2/04	Flour Intercontinental
Transmission	US$ 51.4 million	27/2/04	Kellog Brown Root
Generation	US$ 500 million	11/3/04	Flour /AMEC
Distribution/Transmission	US$ 500 million	12/3/04	Washington Int.
Distribution/Transmission	US$ 500 million	12/3/04	Perini Corporation
Total	US$ 3,552.2 million		

It is not possible to reconcile Table 1 with the Tables in Appendix 3 and Appendix 4. For reasons of future commercial negotiations the PCO could release its estimates of the costs of the various projects it is promoting. Without these estimates it is not possible to discern the groupings of projects and contracts without going through the contracts on the ground. The Engineers of the MND are proposing to do this for the Southern Region, but the work has not yet begun.

Despite the large sums involved the analysis undertaken in paragraph 4.1 above shows that five or six new ST generators of 2000MW or above will be required to meet anticipated increased in demand. In the most case projecting the highest demand increase, the cost can conservatively be estimated at US$ 13 billion over the eight years 2012. As far as can be ascertained, no large, Greenfield, ST is proposed under any of the above programmes.

5.1 Planning Structures

It has not been possible to explore in any depth the process of long-term planning pursued by the MoE. There is in existence a Ministry Planning Directorate headed by Mr Mohammad Ali Jaber. The Consultant was advised

[28] Bechtel has contracted with another company to provide O&M oversight and training to all thermal and combustion turbine facilities in Iraq. There are 19 separate stations involved which will include over 114 separate operating units. The task is to provide complete facility assessments on condition as well as work processes and procedures, determine the level of training needed to meet the needs identified during the assessments of those facilities, develop training programs, both formal classroom and on-the-job, designed around the needs identified, and to conduct the programs.

that the PCO has been working with the Planning Directorate on projects within the Southern Region and these lists have been distributed to the local directorates.

There is a large degree of scepticism among the Directors as to when, if at all, the money for the listed projects will become available. It was stated that many of the plans have been created and existed over the last 20 years. However, little if anything has ever come of them. This is a credibility problem that the PCO must address with urgency.

5.2 Appropriate Technologies

Investing in appropriate technologies is one of the factors required to improve the functioning of the Iraqi electricity sector[29]. Generally speaking ST units will increase the length of time to install, as the plant is much heavier in construction, but will deliver a much more responsive unit for the electrical system. The attraction of GTs is the relatively rapid construction time, of about 18 months. The danger is that so much emphasis has been on installing GT units, there will be too much reliance on GT's in the Iraq system (making it difficult harmonise the electrical characteristics of STs and GTs). STs are required to stabilise the system.

The biggest draw back of GTs is that until the petroleum products sector is reorganised there will not be sufficient appropriate fuel available for GTs, even with imports. GT's don't operate very well on Heavy Fuel oil, mazoot or crude. They need to be shut down and washed every 4 to 5 days and washing takes about 4-5 days. The GT's really need gas or distillate (diesel) to operate efficiently. There is gas available, but the petroleum products sector is unable to collect and deliver it to power stations at present. As shown in Figure 3, gas is a by product of the oil industry and depends on the oil production rates achieved. Until the oil industry is refurbished with a higher proportion of the higher distillates produced, GT plant should only be installed where their specialised fuel requirements are available, or where it can accessed by sea transport.

By contrast, ST plant can complement the needs of the petroleum products industry. It can utilise the HFO/mazoot/crude as its primary fuel. As mazoot is currently a 50 percent product of the refining process this is the best way to dispose of it. Using mazoot will allow the refineries to maximise production of higher specified products. When the petroleum products industry is reorganised and can deliver more gas, appropriately designed STs can burn it. For the same reason CCGT plant is not the answer at present. Any new GT's already installed can be retro fitted with ST, in effect making them a CCGT plant. But, CCGT plant depends on GTs to produce the heat for the ST units and run into the same problem of access to appropriate fuel.

[29] My thanks go to Jim McElnay for contributing most of this section

Conventional fossil ST plants give the range of fuels to support the oil/oil refining industry and to provide a stable electrical system. GT's meet the quick build and system response time and CCGT will eventually provide system stability, system response and efficiency in fuel. All have parts to play in providing a robust and stable system for Iraq that can operate on a range of fuels and where there is a back-up fuel available in the event of pipeline or oil/gas production difficulties. An appropriate mix of generation will support the petroleum products sector by initially using up mazoot and eventually providing a ready market for gas that is currently wasted.

The small plants currently being planned do not make a significant impact on the excess demand, cost substantially more in $/MW and need fuel that is currently in short supply. New, large, plant, sooner rather than later will make the biggest impact in relieving the current shortfall and gives time (but not a lot) to replace the current ageing plant with newer and more efficient equipment. In the very short-term a very large GT could be fitted into the system, but for the next 5-10 years mazoot burning STs, flexible enough to convert to gas, will be required.

With the expected demand for new plant of about 1-3000MW per year, plus massive investment required in refining, it is most likely that a 1 to 2 year order book in the machine vendors works will determine the actual power plant construction schedule. STs are required but there is a physical limit to how many and how fast they can be produced in the works (1 to 2 years), erected on site and to the number available in the pre-used market. The other essential requirement is the political will to commit to a large enough programme.

5.3 Sources of Capital

The current fuel costs are insignificant to the MoE, but soon it will have to compete for fuel with another option: oil sales to the outside world. At that point there will be a requirement to have high efficiency generators that will compete with world oil/gas prices and not the heavily subsidised Iraqi internal pricing. It will also allow the current oil/gas available to fuel substantially more of their more efficient plant and/or enable more oil sales externally to generate cash for rebuilding the infrastructure.

Due to the limits to the oil production/refining capacity, it is unlikely that the Iraqi income from oil exports will be sufficient to cover a budget for new power plants. Therefore, commercial private investment from world sources will be required. This means setting up a commercial market/system to entice investment into the Iraqi power sector. The cost of capital, rates of return and credit rating of the country will all be considerations, maybe with the support of ILOs to offset the country risk. Private investors will also need realistic prices (and/or ongoing subsidies through power purchase agreements

(PPAs) until Iraqi tariffs are closer to the cost of production. This is discussed in more depth in paragraph 7.1.

6. Short Term Investment Objectives

Short-term, the objective of investment in the power sector is to manage existing resources and those likely to come on stream within the next two years, to maximise output and minimise load shedding. Individual building and rehabilitation projects must be in harmony with the reconstruction efforts of three resource based sectors in Iraq: oil, water and electricity. To achieve these objectives, the following are priorities:

6.1.1 Generation

In the Short-Term in Southern Iraq, the maximum early payoff can come from the proposals to either refurbish or replace Hartha generation station. The contracts for its refurbishment are in place and much of the necessary equipment is on site (albeit in bad condition). It will make approximately 400MW capacity available for use in Southern Iraq, sufficient to cut load shedding in 2005 while maintaining exports at current levels.

This is a short-term measure but could add a degree of flexibility to the Southern Region system and seems likely to be the largest payoff for the amount of effort involved. Given that contracts have been let for refurbishment, construction of a new station at Hartha must now be seen as a medium term objective.

6.1.2 Distribution

The second priority, for the South, is the ongoing programme of distribution rehabilitation and refurbishment in Basrah. As the major political and business centre of the region its functioning is a high priority for the whole region. The success of the distribution programme is dependent upon:

- an intensive programme to prioritise projects as identified by the Iraqi power sector, and
- the rapid set up and operation of the PCO,
- sufficient funds to carry out the necessary remedial, safety and quality improvement work (from PCO or other sources).

The consultant has been advised that a PCO consultation exercise in the water sector completely shifted the focus from water treatment to reticulation. It is anticipated that a similar shift of focus, although perhaps not quite as dramatic, could occur in electricity with more attention being paid to transformers, safety and system redundancy (so that the distribution network can handle emergencies and install modern but basic safety features).

6.1.3 Engagement

The third priority is to build on existing consultation exercises and develop a forward looking, ongoing engagement between the PCO and the local and national Iraqi agencies responsible for the power sector. Projects pursued without the support of the Iraqi agencies will not be assured of cooperation and time will be wasted. This needs to be both a medium term and a long term engagement.

- all agencies involved in working with the power sector need to work from the same project list,
- the list should be devised, held and managed by the local power companies, but reviewed regularly jointly with the PCO and military reconstruction teams, and
- the PCO should keep in close touch and only issue contracts or work orders when the agreement of all parties has been reached.

There will be need for regular coordination and scope for executive action but within the guidelines agreed beforehand.

6.1.4 Capacity Building

It is anticipated that the relevant Iraqi planning agencies will function better with capacity building and institutional strengthening. The consultant gained only an outside perspective of how this process operates. It needs to be mapped, reviewed and strengthened, particularly its linkages to the work of the PCO. This too is a priority activity.

7. Medium Term Investment Objectives

The calculations of forward power demand made by the consultant are based on some broad assumptions, of current levels of demand, ongoing increases, the re-commissioning of industries that were closed down and on the ability of price increases to curtail that demand. However, if they bear any approximation to the real situation:

- even if construction commences **immediately** on a 1,000MW GT plant or a 1-3,000MW ST plant, widespread load shedding will be an ongoing feature of the Iraq power sector through to 2007,

- Figure 4 shows that even with the construction of several 1000MW ST stations and using the lowest forecast demand profiles, demand will remain ahead of supply, possibly with the need for **longer periods** of **load shedding** across the whole country, depending on the location of new plants,

- **poor service quality** of this magnitude is likely to be a dampener on economic growth and recovery of Iraq (and to be fair it will also dampen demand), and

- Figure 5 shows that even with **five new 2000MW power plants** commissioned between 2007 and 2012 there is a probability that even if prices rise rapidly, **load shedding could remain a problem** although at a reduced level,

The whole sector wants to move out of the era of load shedding and power cuts. Doing so depends not only with successful rehabilitation and construction in the electricity sector but also on a parallel investment programme in the petroleum products sector.

7.1 Issues and Priorities

The biggest single issue confronting the Iraqi power sector is to get underway an investment programme to address Iraq's demands for electric power. This is not only a programme of investment in generation but it will also reach into the petroleum products sector, oil exports as well as transmission and distribution enhancement (which could also cost as much as 30 to 40 percent of the cost of new generation, on top of the cost of generation itself).

7.1.1 Investment Capacity

The cost of this programme is so huge that the resources of the Iraqi state, the ILOs, donations from friendly nations and the participation of the private sector will all be required in measures much greater than anything attempted before.

The Role that DFID and other donors can play in this is helping the Iraqi authorities build up the capacity to plan and advocate the case for this investment to the new leadership of the country, to ILOs, organisations such as the UNDP and to the private sector power providers who may be persuaded to invest in Iraq. Fortunately, there seems to be a realisation among officials that Iraq's needs are so great that the traditional public sector model cannot cope all by itself.

In the medium-term at least Iraq will be a high risk investment destination. The mechanisms that the World Bank has developed to shoulder some of this risk from private sector investors, as a way of mobilising private sector investment, must be understood and developed so they can be applied in the Iraq context. The expertise that DFID has developed in Iraq over the past 18 months could be exceptionally useful to the World Bank in speeding up this process.

7.1.2 Development Planning

As soon as the ILOs, such as the World Bank, become active in the Iraqi power sector they will, under their own internal approval processes, need to put in place a "least cost development plan" as an indicative planning tool, before they can mobilise Bank funds for major projects. This planning process aims at extracting from the power sector the best possible value for the money spent on electric power. To prepare a least cost development strategy realistic load forecasts and analysis of the transmission and distribution system will be required as well as clear data on what is happening in the petroleum products industries.

As noted in paragraph 4.2 above a transmission study has already been undertaken by the Bearing Point Company and this will be a useful starting point. However, a least cost development programme looks at development from the point of view of the economics of development, as apposed to the technical requirements. A successful planning requires:

- transparency - objectives and impacts need to be carefully analysed and explained,
- participation - stakeholders (e.g. local meetings for consumers, information meetings and incentive packages for employees),
- commitment – from the government, government ministries and senior utility management, and
- consistency – economic criteria are important but must be in harmony with the technical needs of the system.

The objective is to having a surplus of production above demand in the medium to long term. This will be brought about by a mixture of making up for lost time on the generation hand and curtailing demand by appropriate pricing of power on the other, rather than by load shedding. In the meantime, a goal must be to gradually reduce the amount of load shedding. Urgent support from the World Bank, DFID and any other source to begin the planning process will facilitate cohesion, commencement and completion.

7.1.3 Cohesion

A critical issue that needs to be addressed as a matter of priority is that the sector as a whole is that does not operate like a "sector." It is a collection of confrontational empires run by relatively benign sole managers. The directors, mostly, are able and highly qualified, but facing enormous pressures to favour particular firms, localities, tribes and even family groups.

Favours to particular groups detract from sensible decision making and increases the centrifugal pressures on the sector. This is one feature of the ongoing problem in Iraq with the previous regimes neglect of the Shia South's needs and hostility to the Kurdish North. It has bred a feeling among

Southerners that they are forced to share scarce power with a hostile Baghdad.

This is believed to be a major factor in the so-called sabotage of power lines between the South and the Centre of the country. Cutting the supplies of power to Baghdad, from the South, makes no more sense that cutting the supplies of water from the Tigris at Baghdad, to the South. Electrons do not recognise regional borders. An energetic programme to improve service nationwide is the only real answer.

There are many issues where all parties have an interest in promoting a united front and engaging in a constructive dialogue with power consumers. Explaining to the general public the damage done by sabotage is one of the important tasks. An early example of the efforts in that direction is illustrated in Appendix 5.

7.1.4 Commercialisation

Cohesion does not mean the sector should be organised as a single vertically integrated organisation. Power sectors around the world are being reorganised so that Strategic Functions are each the responsibility of separate agencies. Policy, Regulation, Business Management and Ownership are generally made the responsibility of different agencies.

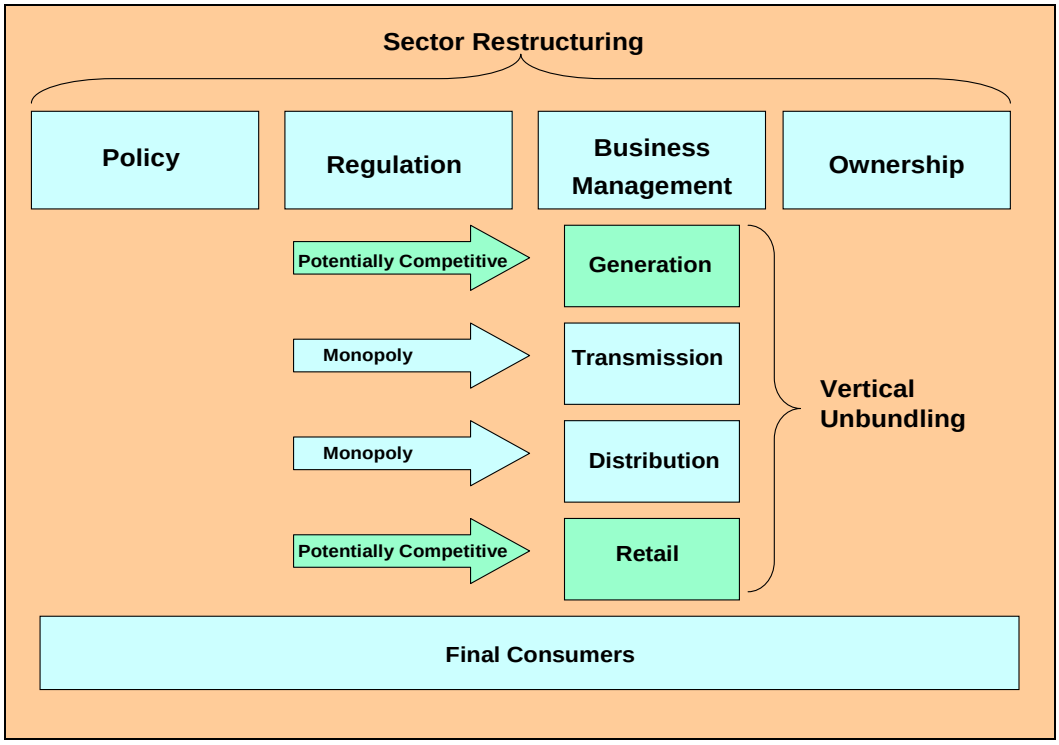
The Ministry, as the adviser the Minister is usually responsible for policy development. Regulation (essentially preventing the ownership of shared facilities from becoming a barrier to competition) is made the responsibility of a regulatory authority of some kind. Management of the business is made the responsibility of boards of directors (who appoint and monitor the work of the CEO). Ownership (i.e. the preservation of the value of the country's investment in the enterprise) is usually the responsibility of the Ministry of Finance. This unbundling of functions is often called either Sector Restructuring, or Horizontal Unbundling. Figure 7 shows how Restructuring can be organised.

A complementary process is called Vertical Unbundling. In this process potentially competitive functions (generation, retail and local supply) are separated from the largely uncompetitive functions (transmission and distribution). The costs, at each stage of the production and distribution chain, are revealed and similarly, the quality of service and profitability of each stage is easier to monitor and address.

Commercial structures, similar to those in Figure 7 are now being adopted around the World as a more satisfactory way to mange power utilities. Should the sector be privatised ownership moves to the private sector but otherwise the structure remains similar. Even before privatisation, boards, representative of the business and professional community can add layers of experience and knowledge to the management of a sector, which is

universally regarded as having poor economics because development has been supply driven, with engineering requirements dominating customer's needs.

Figure 7 Sector Restructuring



In Iraq there will be particular value to boards of directors rather than sole managed organisations. With the leaders of ministries, utilities and State Owned Enterprises coming under enormous pressure to favour his own region and tribe to boards can cushion this pressure. With a board of directors there to monitor all decisions, this can reduce the pressure by balancing the interests of the wider community against special pleadings and allowing for checks and balances.

Economic criteria introduced into planning and investment decisions, helps to economise on resource use and frees up money and time to put into other urgent priorities, such as rural services. In the current situation of the Iraqi power sector business and commercial planning will begin to ensure that the best use is made of all available resources. The power system in Iraq has suffered greatly from the absence of normal commercial capital investment and maintenance programmes.

Undoubtedly the wars, sanctions and the distorted investment priorities of the previous regime were contributing factors to the current position in Iraq, but many developing countries experience the same problems. Commercialisation is one of the most common prescriptions to tackle the problems of underinvestment and non-payment[30]. If the power utility has commercial

[30] In Kazakhstan, privatisation of power companies reduced non-payment from about 40 percent to less than 5 percent in one year.

obligations to customers, with penalty clauses attached to non-performance, these are powerful incentives for good performance. They are incentives totally lacking today.

7.1.5 Planning and Management

During the rehabilitation of the 132kV lines in Southern Iraq, the MND discovered a very low level of planning skills among the Iraqi power sector officials and workers. To meet this need, the MND used PowerPoint slides to illustrate the tasks and how they can be planned, scheduled, gangs formed and work carried out. While this process took a little time it was highly useful as a training tool. What is clear is that similar on-the-job training exercises have a useful role to plan in transferring planning and management processes that are taken for granted in the developed world.

Similarly, there is a great need to upgrade the out of date technical skills held by many power sector workers. These could be addressed in formal training. Probably more useful and economical would be short-term secondments to relatively well run power sectors in the region in countries such as Kuwait, Bahrain, Dubai and Jordan. One or two week postings in these countries for selected workers and officials could be followed by intensive training in these countries by leading power sector specialists from the region and the world. Seeing the latest practices in operation is a very effective learning tool.

7.1.6 Iterative Process

Planning is an iterative process. It may take many forms and operates on many levels. Iraq is accustomed to highly centralised forms of planning where a few people in leadership positions take all the decisions and responsibility. The limitations of this kind of approach are now well known, as are the limitations of systems that rely exclusively on private initiatives. Planning processes in most countries operate at several different levels.

- Policymakers — Determine the minimum service levels that are acceptable in urban/rural, business and household sectors, health, safety and standards, create an appropriate climate for investment to provide the needed services,

- Regulators — Lay down conditions that must be satisfied to participate in the generation and retail markets and access rules and the degree of structural separation required to guarantee access to transmission and distribution,

- Business Managers — Plan to operate the business to generate, or retail, at the lowest reasonable real cost, that guarantees the agree levels of reliability and quality, including commissioning of new plants, maintenance and operation and

decommissioning of obsolete or worn out equipment,
It is normal business practice to revise the business plan on at least an annual basis, so that although after several years the plan bears little relationship to the original plan, it has been adapted to the revealed needs of customers.

- Owner Representatives

If the industry is publicly owned the Finance Ministry (or State Property Committee etc) decide the acceptable rate of return in their investment as targets for business mangers. They must bear in mind the appropriate levels of depreciation and reinvestment necessary to maintain and enhance the value of their investment, commensurate with the demands of the population for service.

If the industry is privately owned, the boards of directors, not the Finance Ministry will perform this function on behalf of shareholders.

Each of these organisations will plan at its own level. If, for example, the ministry realises that the public sector cannot provide adequate generating capacity, it can develop policies to encourage additional generation from the private sector. It can offer parcels of generation for tender and pay a subsidy to the tendered that offers to provide the generation at the lowest cost.

If the Regulator is dissatisfied with the quality of participation in the market it can plan education programmes or launch legal action against non-performers. If a business is not meeting its target, its manager can plan a switch to more economical plant or identify other ways of cutting costs. Similarly, if the owner realises that the value of the asset is deteriorating, it can modify its demands for dividends and plan an increase in its capital investment.

One of the functions of the policy maker will be to bring these interests together in such a way that by performing their respective functions they promote the collective interests of the industry. In many countries, this coordination can be achieved by publishing information and by discussions. In many others, experiments with electricity markets are providing an indirect method of coordination. This should be a consideration for the longer term, but markets are best introduced where there is a power surplus and that will not happen in Iraq until at least 2010 – 2012.

7.1.7 Enabling Environment

If the overall regulatory environment for business is not an enabling environment, the corrupt players will be the enablers. Corruption is an enabling device and under the Ba'ath regime corruption became a way of life

because so much activity that would be regarded as legitimate in most countries was not allowed.

The critical difference between economic development in a pluralistic society, as opposed to that in a dictatorship, is that in a pluralistic society the presumption is that every business activity is legal, unless it is specifically prohibited. In a dictatorship, nothing is legal unless it is specifically authorised. If Iraq is to take advantage of private initiatives, it must be the former. The lesson to be learned is that the regulatory and political structures of the sector must allow initiatives to be taken. If they are not taken officially within the law, they will be taken outside the law, undermining the rule of law and the financial base of the sector. Enabling mechanisms must be factored into a plan to facilitate private sector participation in the power sector.

However, as a rule of thumb, given the current limitations on the availability of diesel fuel and gas, it would be appropriate to require that private initiatives in the power sector will be entertained only when an associated fuel strategy is proposed.

7.2 Long-Term Issues and Risks

The most efficient way to manage risks is to allocate them to those who are best able to manage them. This will generally entail allocating the risks to those that are least affected by the risk. Customers will be in a better position to face the risk of price shocks than power companies, because their cost of electricity forms a small proportion of each customer's total cost of living, but for a power company it is their business. There is no point in allocating risks to parties with no capability to manage them. Utility managers cannot be held accountable for the management of their utility if they are not allowed to hire or fire staff or if they are not allowed to adjust prices, order spares or manage supplies.

7.2.1 Demand Risks

At present, demand risks in Iraq are exceptionally low. Anyone able to produce electricity will find a ready market. The lack of supply will in the short-term dampen economic growth. Iraqis, who are used to 8 hours power a day, will see 16 hours as an improvement. Realistic pricing of electricity will also dampen demand (people will consider whether they really need the 5^{th} or 6^{th} air conditioner).

In the longer term there is a risk that a major capital investment programme can be implemented and realistic prices drive demand downwards more rapidly than anticipated. This emphasises the need to have a good balance of generation between base load thermal and the more flexible GT units. There is the ongoing problem in Iraq of the huge variation between summer and winter demand for electricity. In the longer term this difference can be addressed, at the margin, by demand side measures, such as seasonal

pricing, measures to encourage load switching and cross border sharing to smooth peak demands.

7.2.2 Supply Risks

The current cost of security in Iraq is phenomenal. As much as 65 percent of all costs are security. However, if projects are large and bundled (e.g. a new refinery and power station being built in the same locality using shared facilities, the costs start to tumble. One construction village and security force for two major projects can reduce the costs of security by half.

The supply of spares for old equipment, machines for proposed new power stations are two of the major risks to the proposed strategy. The installation of close to 15,000 megawatts over a 5-7 year period is large, when it is added on top of the fact that in China about 7,000 megawatts is being added annually and this represents a large proportion (possibly as much as 50 percent) of all new plant being installed around the world.

Financing the investment programme is a major problem, particularly considering the rudimentary nature of the newly emerging Iraqi banking system is only now beginning to adjust to the modern world.

7.2.3 Transmission Risks

A lot of work has been done on the transmission system to make it more reliable and it now has a dedicated security apparatus. However, it remains vulnerable for electrical reasons and as has been noted above in paragraph 4.2, the local directorates have a clear view as to how this problem should be addressed. However, addressing it will be some time in the future as it is unlikely there will be greenfield investment in transmission without a revenue source from retail through to generation that can assist in paying for it. All new plants will be built on the 400kV system which, within reason, can carry all the power needed. As new generating stations are built, the national grid must be strengthened to suit so that power can be directed to wherever it is needed and power stations can be built close to the fuel supplies.

7.2.4 Distribution Risks

The distribution sector remains one of the weakest links in the whole system. The consultant has been advised that even in a town like Basrah where lines to most dwellings are clearly visible, they are very old, in poor condition and frequently bypassed in an unsafe manner. It is unusual for investors to come into the distribution sector but revenue could be enhanced by taking an approach to collection such as that described in 4.3 above.

7.2.5 Financing and Construction Risk

As noted in paragraph 7.1.1 above some of the current political risks of investing in Iraq can be absorbed by ILOs as a way of encouraging private investment in the sector. Similar mechanisms can be employed on the construction side. These risks will be reduced as soon as the personal security level can be increased in the country.

Other construction risks remain, in Iraq. The construction industry has a lack of familiarity with modern technologies representing a barrier to using local labour and contractors. These risks are best addressed at the industry level and by providing and environment where is it in the interests of the Iraqis to upgrade their skills and in the interests of foreign contractors to assist them. This can be done in several ways. One possibility is to write contracts containing quality assurance but also requiring high levels of local participation.

7.2.6 Commercial and Operating Risk

In all developing countries the biggest risk for investors is that they will not be allowed to recover their costs and convert their earnings into international currencies. On top of these problems, Iraq has a basic banking system and low levels of skills, particularly international skills among core professional groups. These are anticipated to improve rapidly and will do so as foreign banks take up their banking licences.

Corruption is a major problem in Iraq. Because the Ba'ath regime was so inefficient, corruption was a major enabling device. In many developing countries a 2-5 percent level of corruption is anticipated, up to 10 percent is tolerated by many businesses as a fact of life. 10 percent is not even seen as corruption. It is 'accepted' as normal business practice. However, at present there are reports of 50 percent plus of each transaction being payoffs. This does not include the high profile examples among major contractors that have attracted the attention of the US Congress.

Addressing corruption is a difficult problem in Iraq because so much of the society was corrupted by the regime of Saddam Hussein. Artificially low fuel prices encourage cross border smuggling and as illegal channels open for one commodity, they remain open for others. The key to ending corruption is to remove many of the administrative rules and artificial prices that cause corruption. For example if the petroleum products industry is allowed to cover its costs, it reduces the benefits from smuggling as well as providing the sector with much needed revenue.

7.2.7 Political/regulatory risk

Political risks remain high in Iraq despite a relatively peaceful transfer of power and an apparent willingness by most Iraqis to give the new government

an opportunity to show what it can do. Again, it is probable that some form international insurance against political risks, by way of a guarantee, will be required to encourage the private sector to shoulder the purely commercial risks of involvement in the Iraqi petroleum products industry and power sector.

In all developing countries there are, in addition, concerns that regulators may come under pressure to keep prices low in order to help governments meet inflation targets, or as developing country governments seek to keep foreign exchange earnings under political control. In the WTO era, these risks are reduced, compared with the practices in the 1970s, but some of the least reformed countries are in the Middle East.

In Iraq there is also the ever present need to balance forces between the regions. While the South has had the largest group in the population, traditionally it has been looked down upon by the groups from the central regions for a mixture of religious, regional, social class and political reasons. Developments in the South of a significant character will always need to be matched by similar developments in the other regions.

7.2.8 Environmental risk

A generation build up as large as that proposed in this report will contribute to the increase in greenhouse gasses. Environmental concerns could become significant if several new power stations are commissioned with mazoot as their primary fuel source.

On the other side of the coin, old and inefficient power plants are invariably the worst polluters. Power plants designed from the outset to fire mazoot will be greatly preferable to plants are burning crude or mazoot but were designed for HFO. As the petroleum products sector manages to convert flared gas into commercial energy, mazoot burning plants will be progressively replaced with relatively clean gas fired plants. However, this is obviously a risk factor in the strategy that will need careful monitoring.

8. Forward Looking Strategies

The handover of power on the 28 June emphasises that from now on the Coalition powers will play a diminishing role in Iraq's power sector. Strategies have to be configured to adjust to this new reality.

8.1 Iraqi Leadership

Deciding which policy to pursue under most of the above headings cannot and should be determined by foreigners. The ILOs and friendly governments can propose, suggest and negotiate with the Iraqis if they are lending money or providing guarantees on specific projects.

There is a role for the PCO and DFID in ensuring that the Iraqis who make the decisions are fully briefed on the options and encouraged to seek optimal solutions in place of the traditional practice of flying by intuition.

The most appropriate approach is to expose the Iraqis, as much as possible, to modern practices[31], offer support and training where necessary, but let the Iraqis do the prioritising lending support to them in developing the political agenda for achieving the priorities defined.

8.2 Strategic Issues

Crucial strategic issues that need to be resolved at a political level and soon. Foreigners can best help the process of making decisions by ensuring that all concerned are well aware of the facts. Decisions have to be taken to ensure:

- commitments are made to an integrated investment plan that will see the power, petroleum products and water sectors moving in a consistent direction with complementary decisions,

- there is a mix of short-term and longer term investments that will allow the electricity sector to utilise supplies of mazoot, while these exist, and have the flexibility to move to gas powering when refining capacity is enhanced and mazoot is no longer available,

- a commitment to funding electricity development by a mix of public sector and private sector funding, supported and assisted by ILOs, such as the World Bank,

- a commitment to structural reform of the electricity sector to enable the introduction of private sector investment and management in what was previously an engineering dominated bureaucracy, and

- a commitment to the introduction of economic considerations into long-term planning so that resources can be used in the most economically sensible and environmentally sound way.

8.3 External Support

Despite the massive US commitment to Iraq and the fundamental damage to its credibility if its mission there fails, it is wrong to anticipate long term support for Iraq at current level. It is understood that the World Bank and the UNDP are now mobilising to address some of the longer term issues raised by this report.

[31] An appropriate mix of examples of privatised power sectors (such as Northern Ireland and UK) and countries, which like Iraq, face a large difference in seasonal demand (such as Kuwait and Dubai)

In the early stages of planning Iraq's reconstruction, a medium term perspective, allowing for major new investments has perhaps not been as strong as it should have been. Certainly, in the Southern Region major decisions were outside the scope and political clout of the people employed to work on reconstruction and it is not clear where, if anywhere, this responsibility rested.

An important part of closing the gap between expectations and reality is making the customers aware of the value of electric power and the costs incurred in its production and distribution. Until power is metered and paid for, this feedback mechanism is absent.

8.4 Appropriate Incentives

Enlisting customer support extends further than pricing. If people are warned of power cuts to come, they can display a capacity to adjust their behaviour. Iraqis for a whole generation have lived with intermitted power supplies. If the reasons for ongoing interruptions are explained and the measures to address them are outlined, Iraqis will appreciate that those in charge are doing their best to address the situation are sympathetic to the plight of those without service.

The fundamental fact is that population growth has outstripped electricity supply and that it takes 4-5 years to build a new power station. This simple idea can be understood by anyone and if this key message is repeated in every official communications eventually people get the message and appreciate that their intelligence being respected.

Much of the discussion of the Iraqi power sector overlooks the impact of incentives. One important incentive under the Ba'ath regime was simply to stay alive. Mistakes were equated to sabotage and imprisonment or worse, with dire consequences for loved ones, could follow.

There was also the need to improvise. Much of the "looting" stemmed not entirely from greed, or criminality. The confusion following the end of hostilities represented a once in a lifetime opportunity to access equipment that would enable families or businesses to improvise for services that were otherwise unavailable.

Another incentive that needs to be changed arose as a side effect of the centralised planning in the former regime and it was made worse by the trade embargo: the need to trade illegally. Whether officially sanctioned or not, smuggling was a survival technique with huge rewards attached.

A new incentive that has arrived with the generosity of the United States Government and people is the "rich cousin syndrome." If there is a rich cousin from across the ocean, who will replace old equipment with the best

available, there is a massive incentive to smash your old car in the expectation that the rich cousin will replace it with a Rolls Royce.

In the short term there may be no other alternative to low fuel and electricity prices, but in the longer term addressing incentives is an important part of increasing the stability and sustainability of the system.

9. Conclusion

This assignment has been in the nature of a review of the work undertaken in the reconstruction of Iraq, followed by an attempt to prioritise investments and actions to maximise the progress towards the objective of the new government to create a better life for the people of Iraq. Although the consultant's time in Iraq was limited and occurred at a time guaranteed to encounter more than the usual frustrations of foreigners working in that country, a number of conclusions can be drawn. These are summarised as follows:

- there was a need for long-term planning to proceed hand in hand with the emergency response to the fall of the Ba'ath regime, and there remains a need for an adequate planning process,

- planning has so far not resulted in plans that will overcome the enduring energy shortage in Iraq,

- load shedding will remain a feature of life in Iraq until at least 2007 and even beyond, depending on investments in supply and the demand for power,

- there needs to be a major programme of construction of 1-3,000MW plants begun immediately (reviewed annually) if load shedding is to cease any time before 2012,

- the programme targets must be coordinated with the reforms to the petroleum products sector, because currently the power sector will need access to surplus mazoot and when supplies of that are no longer available, the power sector will need access to gas,

- the needs of Iraq are so large that it could distort the World market for electricity generating equipment for several years,

- it is beyond the capacity of Iraq to finance the construction programme, imply a strong role for the private sector and ILOs,

- the principle that it is best practice and fundamental courtesy when assisting anyone to ask the local people to take the lead in defining

needs, where this has been done, success has been greatest, where it has been overlooked, problems are stacking up,

- emergency or military situations apart, no investment in electric power can be justified unless there is a customer willing to pay to use the power coming out of the lines,

- more emphasis could have been given to the role pricing plays in synchronising the demand and supply of electric power and even in emergency situations, thought should be given as to how incentives are going to operate and if these can be altered they can help resolve problems before they occur, and

- whatever the official resources mobilised to address power shortages, they will be dwarfed by the resources available in the private sector, provided there is an environment than enables the private sector to participate.

Despite the ferocity of debate on the merits of the Coalition military action in Iraq, a lot of people have worked very hard to restore services to the people of Iraq. The thoughts above are designed to smooth the transition to the next stage as Iraqis take control in an environment friendly to initiatives and to activities focused on the needs of the citizens of Iraq.

Appendix 1 Typical Day in Southern Iraq 22 June 2004

Generation	Units	MW	MW
Hartha	2	180	360
Najibya	2	70	140
Khor Az Zubayr	3	48	144
Shaiba	1	12	12
Nassiriya	3	150	450
Petrochem	1	12	12
			1118
Demand			
Exports from Basrah (not including Nassiriya)			
Wasit		134	
Nassiriyah		30	
Amara		25	
Total Exports		189	-189
Essential Services		150	-150
Balance Available for Consumers			779
Load Shedding		120	120
Total Demand			899
Minus Exports from Nassiriyah			449
Output	1118		
Exports from Nassiriya	-450		
Basrah Demand			668
Basrah Consumption	668		
Exports Basrah	-189		
Load Shedding	-150		
Actual Basrah Consumption			329

Appendix 2 Emergency Infrastructure Programme

Ref	Description	Status and next Milestone	Complete	Comment
P001	**Transmission study**	**Project complete**	**28/03/04**	In fact this did not proceed. It was added to a national study.
P004	**Cranes and Equipment for system rebuild**	**Project complete**	**10/01/04**	Hired rather than purchased
P005	**Repair of communications building**	**Project complete**	**14/02/04**	
P006	**A/C for communications equipment rooms**	**Project complete**	**08/11/03**	
P008	**Generator for Al Sibah**	**Project complete**	**27/03/04**	
P009	**Sub-station review**	**Project complete.**	**27/12/03**	The basis of the distribution work
P010	**Materials for 132kV pylon rebuild BaZ-S**	**Project complete.**	**17/01/04**	
P012	**Materials for 132kV pylon rebuild BAZ-AAF**	**Project complete.**	**17/01/04**	
P015a	**Electrical spares and equipment for 132kV**	**Project complete.**.	**17/04/04**	
P015c	**Electrical spares for Transmission Company**	**Project complete.**	**17/04/04**	
P016	**Cable testing trucks for Distribution grid**	**Project complete.** Fourth van to be delivered under different programme on 19/06/04.	**17/04/04**	Mentioned 3.1.3
P017	Generator for Abu Al Kasib	Site works complete. **All equipment in Kuwait. Project completed by 21/06/04.**	**21/06/04**	
P018	**Generator for Al Faw**	**Project completed**	**28/02/04**	
P019	Generator for Safwan	RMUs delivered. **Project completed by 19/06/04**.	**19/06/04**	
P020	Sub-station refurbishment	**All** contracts placed. **3 Basrah s/s due for completion by 20/07/04.**	**30/09/04**	Follow on from P009
P021	**Materials for 132kV pylon rebuild SST-UQ**	**Project complete.**	**29/01/04**	
P022	**Materials for 132kV pylon rebuild AAF-F**	**Project complete.**	**29/01/04**	
P023	Electrical transmission rehabilitation	**Second delivery** of conductor received. Project to be completed by **03/07/04**.	**03/07/04**	
P024	Generator for Az Zubayr	Site works complete. RMUs being delivered on **30/05/04**.	**14/06/04**	
P028	Al Muthanna generator	**Generator being dismantled ready for shipping. Site works to start 16/06/04.**	**03/10/04**	This project has been widely criticised as being misconceived.
W001	**Comms equipment for pumping stations**	**Project complete**	**22/11/03**	Water Project
W003	**Repair clamps for water pipelines**	**Project complete.**	**17/04/04**	Water Project
W004	**Water pipe repair materiel**	**Project complete.**	**17/04/04**	Water Project
W005	Standby generators at pumping stations	**Final materials to replace lost items expected by 15/06/04**	**22/06/04**	Water Project
W006	**Secure compounds for materials storage**	**Project completed. Security guards to be contracted.**	**29/05/04**	

W007	**Protection of water mains**	**Project completed**	**03/01/04**	
W008	**Maysan irrigation**	**Project completed. Final accounts to be prepared.**	**04/06/04**	
W009	**Improve supplies to 20 rural communities**	**Project completed.**	**15/05/04**	
W010	**Water Authority buildings 4 Governorates**	**Project completed.**	**28/05/04**	
W011-014	Water and Sanitation Programme	**2nd Phase of Shatt al Arab Lift Pumps project to be obligated by 07/06/04.**	**31/07/04**	
F001	**Muftiyah diesel distribution**	**Project complete.**	**21/02/04**	
F002	**Al Amarah Fuel Distribution**	**Project complete.**	**13/03/04**	
F004	Refurbishment of petrol stations	All contracts placed. **First 4 stations completed 01/06/04.**	**02/07/04**	
F009	**LPG Bottling plant**	**Project completed. Trailers and tanker units all delivered.**	**10/06/04**	
G001	**Tradesmen tools for water and electricity**	**Project complete.**	**13/03/04**	

Appendix 3 Project List 10 December 2003

Project	Region	Municipality	Classification
Southeast Region Control Centre	Basrah	Basrah	
Basrah Distribution Control Centre	Basrah	Basrah	
Power Factor Correction Capacitors for 6000MW System	Basrah	Multiple	MND-Southeast
Al Hakimia Substation	Basrah	Al Hakamia	MND-Southeast
Al Hartha Substation	Basrah	Al Hartha	MND-Southeast
Al Seraji Substation	Basrah	Al Seraji	MND-Southeast
Hamdan Secondary Substation	Basrah	Hamdan	MND-Southeast
Basrah Substation Feeder	Basrah	Basrah	MND-Southeast
Basrrah Rehabiltation of Distribution Network	Basrah	Basrah	MND-Southeast
Basrah Power to New Village	Basrah	Basrah	MND-Southeast
Shimal Al Maaqai Substation	Basrah	Al Maaqai	MND-Southeast
Basrah New Central Warehouse	Basrah	Basrah	MND-Southeast
Basrah Rehab Old Housing Unit	Basrah		
Centre of Basrah Street Lighting	Basrah		
Main New Distribution Workshop	Basrah		
Al Abkar Substation	Wassit	Al Dejely	MND-Center South
Al Dalming Substation	Wassit	Al Dalmig	MND-Center South
Al Ezah Substation	Wassit	Al Kut	MND-Center South
Al Hay Substation	Wassit	Al Hay	MND-Center South
Al Karamah Substation	Wassit	Al Kut	MND-Center South
Al Muwafaqiyah Substation	Wassit	Al Muwafaqiyah	MND-Center South
Al Zuhowr Substation	Wassit	Al Kuwt	MND-Center South
Kilo 29 Substation	Wassit	Al Dejely	MND-Center South
Shaka Substation	Wassit	Al Dejely	MND-Center South
Shekh Saad Substation	Wassit	Shekh Saad	MND-Center South
Wassit 33kV Overhead Line	Wassit		MND-Center South
Al Kafaat Rehab of Old Network	Wassit		MND-Center South
Al Zubaidiya	Wassit	Al Subaidiya	MND-Center South
Wassit 33kV Underground Line	Wassit		
Mussaib New Power Station 160MW (2X80MW)	Babylon	Mussaib	MND-Center South

Project	Region	Municipality	Classification
Hilla, Maintenance of Gas Power Plant	Babylon	Hilla	
Mussaib Thermal Power Station Unit 2, Rehab	Babylon	Mussaib	MND-Center South
Nassariya Thermal Power Plant Maintenance Upgrade	Thi-Qar	Nassariya	MND-Southeast
400kV S/S Rehab at Wassit	Basrah	Basrah	
400kV S/S Rehab at Qurna	Basrah	Qurna	
400kV Line Rehab, Hartha-Khor No. 1	Basrah	Basrah	
132kV S/S Rehab at Toba	Basrah	Basrah	
132kV S/S Rehab at Harbour	Basrah	Basrah	
132kV S/S Rehab at Hammar	Basrah	Basrah	
132kV S/S Rehab at CPS 9	Basrah	Basrah	
132kV S/S Rehab at CPS 8	Basrah	Basrah	
132kV S/S Rehab at CPS 7	Basrah	Basrah	
132kV S/S Rehab at CPS 6	Basrah	Basrah	
Maintenance Building Spare Parts	Tameem		
132kV S/S Rehab at CPS 10	Basrah	Basrah	
132kV S/S New/Rehab at CPS 5	Basrah	Basrah	
132kV S/S New/Rehab at CPS 4	Basrah	Basrah	
132kV S/S New/Rehab at CPS 3	Basrah	Basrah	
132kV S/S New/Rehab at CPS 2	Basrah	Basrah	
132kV S/S New/Rehab at CPS 1	Basrah	Basrah	
Basrah Region Pilot Wire (40 substations)	Basrah	Basrah	
132kV Line New, Nejibiya-Hartha-Qurna-Amara 6GW	Basrah	Basrah	
132kV Line New, Nejibiya-Basra East-Basra Centre (cable) 6GW	Basrah	Basrah	
400kV Line New, Khor- Nasiriya No. 2 7.8GW	Basrah	Basrah	
400kV Line New, Qurna-Wassit No.2 7.8GW	Basrah	Basrah	
400kV Line New, Hartha-Qurna No.2 7.8GW	Basrah	Basrah	

400kV Line New, Hartha-Khor No.2 7.8GW	Basrah	Basrah	
Bozorgan_ Old Amara 1 + 2 132 KV Line (Amara)	Missan	Amara	MND-Southeast
132kV Substation Extension at Old Amara	Missan	Amara	MND-Southeast
132kV Line New, Nassiriya-Shatra 7.8GW	Thi-Qar	Nassriya	
400kV Line New, Nassiriya-Qadessiya No.2 7.8GW	Thi-qar	Nassriya	
132kV Line New, Nassiriya-Samawa 7.8GW	Thi-Qar	Nassriya	

Appendix 4 Projects Contemplated by PCO

Project	Region	Classification	
Basrah Substation Feeder	Basrah	Feeder	Install 60km 33kV overhead conductor, 50km underground cable.
Basrrah Rehabiltation of Distribution Network	Basrah	Feeder	Install (30km) 11kV overhead conductor, (40km) underground cable, (110km) 400V overhead line, (125) 250kVA transformers
Basrah Power to New Village	Basrah	Feeder Conductors	Install (40km) 11kV overhead conductor, (50km) 400V overhead conductor, (50) 250kV transformers
Basrah New Central Warehouse	Basrah	Warehouse	Build new central warehouse for region
Rehabilitate - Expand Warehouse in Samawa	Muthanna	Building	Rehabilitate and add new shed to existing warehouse
Samawa New Distribution Workshop	Muthanna	Building	Build new workshop building
wasit 33kV Overhead Line	wasit	Feeder	Install 85km of 33kV overhead line and poles in several location in Governorate
Al Kafaat Rehab of Old Network	wasit	Rehabilitation	Rehabilitate existing 11kV/400V network; install 17km 11kV cable and 22km 400V cable.
wasit 33kV Underground Line	wasit	Underground Line	Install 30km of 33kV underground cables in several location in Governorate

Project	Region	Classification	Funding /Contractor
Power Factor Correction Capacitors for 6000MW System	Basrah	Capacitors	New capacitors to be added for reactive power to utility system for 6000MW Generation.
Al Hakimia Substation	Basrah	Substation	New substation; install (2) 31.5MVA power transformers, 33kV switchgear, 11kV switchgear
Al Hartha Substation	Basrah	Substation	New substation; install (2) 16MVA power transformers, 33kV switchgear, 11kV switchgear
Al Seraji Substation	Basrah	Substation	New substation; install (2) 31.5MVA power transformers, 33kV switchgear, 11kV switchgear,
Hamdan Secondary Substation	Basrah	Substation	New substation; install (2) 31.5MVA power transformers, 33kV switchgear, 11kV switchgear
Shimal Al Maaqai Substation	Basrah	Substation	New substation; install (2) 31.5MVA power transformers, 33kV switchgear, 11kV switchgear
Power Factor Correction Capacitors for 6000MW System	Muthanna	Capacitors	New capacitors to be added for reactive power to utility system for 6000MW Generation.
Samawa Rehabilitation Old Residential Quarter	Muthanna	Feeder	Install (10km) 11kV overhead conductor, (25km) 400V overhead line, (110) 250kVA transformers; maintenance centre.
Al Majed Substation	Muthanna	Substation	New substation; install (3) 16MVA power transformers, 33kV switchgear, 11kV switchgear
Al Romitha Substation	Muthanna	Substation	New substation; install (2) 31.5MVA power transformers, 33kV switchgear, 11kV switchgear
Samawa Underground Feeder	Muthanna	Substation	Install 20km underground cable.
Power Factor Correction Capacitors for 6000MW System	wasit	Capacitors	New capacitors to be added for reactive power to utility system for 6000MW Generation.
Ahrar Substation	wasit	Substation	New 33kV/11kV substation; (2) 16MVA transformers; 33kV and 11kV switchgear inside control building
Al Abkar Substation	wasit	Substation	New 33kV/11kV substation; (2) 10MVA transformers; 33kV and 11kV switchgear inside control building
Al Dalmig Substation	wasit	Substation	New 33kV/11kV substation; (2) 10MVA transformers; 33kV and 11kV switchgear inside control building
Al Ezah Substation	wasit	Substation	New 33kV/11kV substation; (2) 31.5MVA transformers; 33kV and 11kV switchgear inside control building
Al Hay Substation	wasit	Substation	Rehabilitate existing 33kV/11kV substation, install new 33kV/11kV (3) 16MVA transformers; 33kV and 11kV switchgear inside rehabilitated control building
Al Karamah Substation	wasit	Substation	New 33kV/11kV substation; (2) 31.5MVA transformers; 33kV and 11kV switchgear inside control building

Al Muwafaqiyah Substation	wasit	Substation	New 33kV/11kV substation; (2) 10MVA transformers; 33kV and 11kV switchgear inside control building
Al Zuhowr Substation	wasit	Substation	Rehabilitate existing 33kV/11kV substation, install new 33kV/11kV (2) 16MVA transformers; 33kV and 11kV switchgear inside rehabilitated control building
Kilo 29 Substation	wasit	Substation	New 33kV/11kV substation; (2) 10MVA transformers; 33kV and 11kV switchgear inside control building
Shaka 8 Substation	wasit	Substation	New 33kV/11kV substation; (2) 10MVA transformers; 33kV and 11kV switchgear inside control building
Shekh Saad Substation	wasit	Substation	New 33kV/11kV substation; (2) 16MVA transformers; 33kV and 11kV switchgear inside control building
Al Zubaidiya Substation	wasit	Substation	Rehabilitate existing 33kV/11kV substation, install new 33kV/11kV (2) 16MVA transformers; 33kV and 11kV switchgear inside rehabilitated control building

Project	Region	Municipality	Classification	Funding /Contractor
Basrah	Controls		in RCC & SCADA	People served by 68 Al Basrah Gov Distribution substations
Basrah	Controls		rehab bldg & SCADA	Southeast Region control
Country wide	Controls		country wide comms	National network control
Country wide	Controls		country wide comms	National network control
Country wide	Controls		country wide comms	National network control

Appendix 5 Effort at Customer Relations

Translation:

“To the responsible Law Abiding people of Basrah

You want law, order and security?
You want electric power?
You want a better future for your family?
However, the criminals continue to destroy electric power facilities!

While most Iraqis are working tirelessly to rebuild their country, the criminals are destroying what has been built. These criminals steal the copper transmission lines and destroy the Iraqi Infrastructure. By doing that, they are destroying your future for their selfish greed,

Iraq is your country and the process of development is your responsibility, and all Iraqis should help in this situation and do not let these criminals destroy the country’s infrastructure. They are criminals without conscience and their bad deeds keep our people in darkness!

Help us to build a good Iraq, more developed and modern. Tell the government about these criminals, tell what you know, anything at all about them. Destroying and stealing the public services is a crime, and the law punishes people who are doing that. So help us arrest the criminals, to punish them at put them in jail.

The stealing and destroying of infrastructure is a big and dangerous crime. Tell the provincial authority anything you know about criminals!”