



**Participating UN Organization Programme Proposal
COVER SHEET**

Participating UN Organisation: United Nations Development Programme	Cluster: Cluster 4 Infrastructure & Housing
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Programme Title: Rehabilitation of Unit 1 of Mussaib TPS - Stage II	Programme Location: Mussaib TPS, Babylon Governorate
Programme/Project Number: C4-15	Programme/Project Costs: UNDG ITF: US\$ 33,000,000 Government Input: Other: Total: US\$ 33,000,000
Programme Description: Continuation of stage I rehabilitation/repair works of Unit 1 controls, boiler and balance of plant as well as Station common systems	Total Programme Cost: US\$ 33,000,000
	Programme Duration: 24 months
Govt of Iraq Line Ministry Responsible: Ministry of Electricity	
Review & Approval Dates: Cluster Review Date: Jan 05 Cluster Manager Group Review Date: Steering Committee Approval Date: June 8, 2005 ISRB Approval Date:	

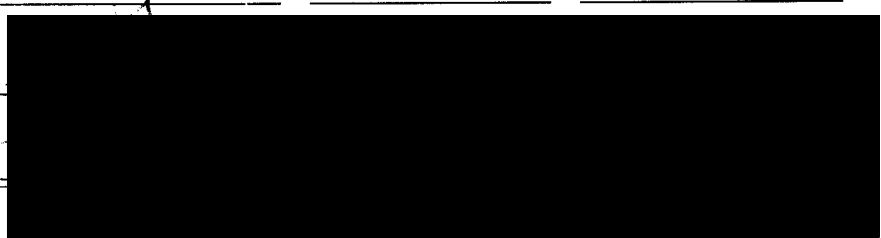
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Date

Name/Title

UN Agency Name:
Acronym is sufficient

Chairman UNDG ITF
SC:



Development Goal and key immediate objectives:

To respond to the immediate humanitarian needs of the war-affected Iraqi people by ensuring the supply of reliable and safe electricity to permit operation of essential humanitarian services such as water supply, hospitals, schools, sewage treatment plants and other community services.

The immediate objective is to bring Mussaib Power Station Unit 1 to greater output and reliability reflecting its design capacity (300MW). Under Stage II, which follows the condition assessment and preliminary refurbishment done in Stage I, the previously identified rehabilitation/repairs of the Unit controls, boiler, balance of plant, and common systems impacting Unit 1 operation will be completed.

Correction of the identified problems will increase the generating capacity of the Unit and improve its reliability and efficiency. In addition, under Stage II, the technical capabilities of the plant staff will be upgraded to not only operate and maintain the unit once rehabilitated but also to assess the requirements for rehabilitation of other units and to undertake repair and maintenance works with minimum international supervision. MoE capacity for these undertakings will be supported by modern maintenance management software and installation of a mobile video/audio system for plant equipment condition assessment.

The overall project will contribute to minimizing load shedding and blackouts of the national electrical grid. Stage II has been designed to bring back the Unit to reliable operation in late May 2007 and thus contribute to minimizing power shortages in particular during peak-demand seasons

Outputs and key activities:

- The project will contribute to the recovery of generation output from Mussaib Generating Station and the stability in the supply of power (fewer outages) from the grid to electricity users in Baghdad and Central Region (which depend on power imports from the north and south) and nationwide. Rehabilitation of Unit1 will add capacity to the national grid in the 60-80 MW range and permit the reliable and efficient operation of the unit. Mussaib is strategically located in Iraq's national grid.
- Rehabilitation will arrest further deterioration of Unit 1, which is running under operational conditions of stress and lately at about 2/3rds capacity (May 2005). It will reduce the risk of frequent unit tripping which, as a result of thermal cycling, shortens the remaining useful life of critical components subjected to high pressures and causes economic losses from early replacement.
- Parts, materials and components for proper future maintenance and repairs of the Unit will be received by identifying needs based on the overall assessment of the Unit.
- Provision of modern maintenance management software and mobile video/audio system for condition assessment of plant equipment in the field and training of the plant staff on the operation of these systems.
- Enhanced skills of MoE staff is an integral part of the project. Training activities will address not only improved operation and maintenance of Unit 1 but also enable the plant staff to conduct condition assessment of other units and undertake rehabilitation and repair works utilizing modern utility techniques. After completion of training, the plant engineers and field personnel will be able to train other junior staff, thus expanding the capacity building benefits.

1. The Logical Framework

Objectives	Measurable indicators	Means of verification	Important assumptions
<p><u>Development Objective:</u></p> <p>To respond to the humanitarian needs of war-affected Iraqi people through ensuring reliable and safe electricity supply to permit the operation of essential humanitarian services and addressing human development priorities, and daily needs.</p>	<p>Standard utility industry indicators for generating equipment availability, reliability, efficiency (heat rate), etc.</p> <p>Availability of a reliable and secure electricity supply to all consumer categories but especially for essential humanitarian needs and community services that impact on the quality of livelihood.</p>	<p>Verification reports from the plant and the National Dispatch Centre in Baghdad</p>	<p>Continuing progress in the rehabilitation of electricity network elements -- such as substations, transmission lines and network communication systems, related to Mussaib Station.</p> <p>Security situation does not further deteriorate.</p>
<p><u>Immediate Objectives:</u></p> <p>1. The generating capacity, reliability, availability, and efficiency of Unit No.1 of Mussaib Thermal Power Station increased.</p> <p>2. Root causes limiting generating capacity, reliability, efficiency and sustainable operation of Unit 1 corrected or identified to be addressed at a future maintenance/overhaul cycle.</p> <p>3. Parts, materials and components for use in future Unit maintenance and repairs received.</p> <p>4. Plant staff able to conduct complete maintenance and full repairs of thermal units utilizing latest technology, modern tools, and state-of-art software for unit maintenance and overhauls.</p> <p>5. Core team of MoE staff specialized in the overall condition assessment of thermal units trained in the application of state-of-art maintenance management software for monitoring, recording, reporting and planning future maintenance of thermal units in the MoE fleet.</p>	<p>1. Energy recording instruments indicating an increase of generation output from Unit 1 after its rehabilitation. Generating unit performance monitoring data indicating improvement in selected parameters.</p> <p>2. Post-rehabilitation assessment of monitoring instrumentation and sensors found to be not operating or malfunctioning that were repaired or replaced.</p> <p>3. Lists of parts, materials and components required for future maintenance and repair works.</p> <p>4. Ability of the plant staff to undertake the condition assessment of a large thermal unit and its full maintenance and repair works in accordance with accepted standards in utility practices worldwide.</p> <p>5. Core team of MoE staff proficient in the application of software for maintenance planning and management able to train other staff in the software application for the optimal planning of maintenance of other units at Mussaib and at other stations.</p>	<p>1. Verification of power output from Unit 1 made by Mussaib TPS and NDC (National Dispatch Centre) staff in close cooperation with MoE and UNDP engineers, plus consultants and contractors.</p> <p>2. Post rehabilitation audit of inoperative or malfunctioning monitoring instrumentation and sensors found in Unit 1.</p> <p>3. Post rehabilitation audit of equipment and spare parts in stock for future maintenance and repairs..</p> <p>4. Assessment by UNDP engineers and international contractor specialists of the level of skills acquired by MoE staff for unit condition assessment and full maintenance and repair works.</p> <p>5. Assessment by UNDP engineers of the level of proficiency acquired by MoE staff for training other MoE staff on the application of maintenance management software to thermal unit condition assessment, repairs and planning of future maintenance or overhauls.</p>	<p>Security situation does not further deteriorate.</p>

<p>Outputs:</p> <p>1. Mussaib Thermal Power Station Unit 1 rehabilitated and demonstrating 60-80MW greater capacity, reliability, availability and efficiency by June 2007.</p> <p>2. Observation data and test results collected from Unit 1 to be used in root-cause problem identification and planning of Unit 1 repairs plus extrapolation of findings to estimate condition of other units.</p> <p>3. Comprehensive set of selected and essential spare parts supplied to Mussaib TPS, which will be available in stock for emergency repairs and routine maintenance; in order to sustain Unit 1 future generation and reliability.</p> <p>4. Thirty-four (34) plant staff trained in Unit 1 rehabilitation skills suited for erection, calibration, testing and commissioning</p> <p>5. Core Team of MoE staff proficient in the application of maintenance management software and able to train other junior technical personnel to enlarge MoE in-house capabilities in maintenance management, planning, monitoring and record keeping.</p>	<p>1. Use of energy output recording instrumentation to measure generation from Unit 1 after its rehabilitation.</p> <p>2. Inventory of monitoring instrumentation and sensors in Unit 1 found to be not operating or malfunctioning that were repaired or replaced.</p> <p>3. Warehouse inventories of spare parts delivered in Stage I or targeted for procurement in Stage II.</p> <p>4. Ability of staff to undertake the full maintenance and complete repair works of thermal units in accordance with standard utility practices.</p> <p>5. Ability of Core Team dedicated to the application of state-of-art maintenance management software with demonstrating suitable proficiency for training other MoE staff in the use of the software at other at Mussaib units and at other stations.</p>	<p>Careful assessment and verification made by Mussaib TPS and NDC staff in close cooperation with MoE and UNDP engineers (plus consultants and contractors) of rehabilitation results including:</p> <p>1. Improved production and performance demonstrated by Unit I.</p> <p>2. Number of inoperative instrumentation and sensors repaired or replaced in Stage II.</p> <p>3. Inventory of goods for future maintenance/repairs received in Stage II.</p> <p>4. Proficiency of plant staff trained in proper unit maintenance and full rehabilitation works.</p> <p>5. Proficiency of plant staff trained in the application of maintenance management software.</p>	<p>Security situation does not further deteriorate</p>
<p>Activities:</p> <p>1. Finalization of the list of equipment, parts and relevant components with their detailed technical specifications to be provided based on assessments of the unit</p> <p>2. Finalization of contractual arrangement for the provision of required equipment and training of plant staff</p> <p>3. Unit repair and rehabilitations works conducted by plant staff under contractor guidance.</p> <p>4. Implementation of the relevant training overseas for unit rehabilitation works and the training on maintenance management software in Amman, Jordan.</p>	<p>Timely commitment and disbursement of allocated project funds for Mussaib TPS Unit 1 rehabilitation works implementation, parts procurement and staff training.</p>	<p>Schedule maintained for contract award, dispatch of plant staff for training, adherence to milestones in implementation of rehabilitation tasks, and timely delivery of parts or materials for future maintenance as planned by UNDP engineers</p>	<p>1. Timely availability of funds allocated for the project</p> <p>2. Timely provision of inputs by all stakeholders (staff, equipment, trainees, operational and logistical support, etc)</p> <p>3. Security situation does not further deteriorate</p>

2. Project Justification

2.1 Background

1. Approach and Stage II Linkage with Stage I

Both stages of the Mussaib project are positively interlinked. Rehabilitation of a medium-to-large size thermal unit, which is operating, is both a complex and dynamic undertaking. Complex because equipment and systems need to be assessed for repair/replacement decisions including components (e.g. boiler pressure parts), which require extra-long lead times for materials sourcing, manufacture and delivery. Dynamic because as the assessment and procurement take place, the operational stresses on the unit provide an increasingly clear perspective on components that surely need to be replaced, whereas other components require fairly sophisticated techniques to estimate remaining useful life (RUL) and arrive at repair/replacement decisions.

For the above and other reasons, UNDP / Infrastructure decided that the most prudent approach for Mussaib Unit 1 rehabilitation was by stages.

Stage I is designed to undertake a detailed condition assessment of the unit to define the detailed scope of work to undertaken during stage 2 and procure extra-long lead time parts/equipment that have already been identified as being required. Specialised training is also included for the MoE staff to undertake the condition assessment.

Stage II will cover the procurement of parts/equipment identified as a result of the condition assessment undertaken in Stage I. Additional training is also provided for to cover such aspects as the installation of the replacement parts/equipment and the operation and maintenance of equipment incorporating new technologies.

2. Power Sector Situation

(a) Iraq's Electricity Sector – Historical Summary

In 1990 prior to the Gulf War, the total installed generating capacity in Iraq was 9295 MW with a peak demand of about 5100 MW. During the 1991 Gulf War the electricity system suffered severe damage. Several transmission lines were put out of service, substations were damaged, and the power generation equipment was severely affected. The available capacity was reduced to 2325 MW. Following the war, from 1991 to the start of Oil-for-Food Programme (OFFP) in 1996, Iraqi engineers were able to repair some of the damaged units, either with available spare parts or by cannibalizing other damaged units. The generation level rose from 2325 MW to about 4000 MW. However, the state of the power generating units remained precarious due to the limited and makeshift nature of the repairs and general lack of proper maintenance due to the scarcity of spare parts. While repairs under the OFFP corrected some of the damage of the 1991 war and about 4500 MW of generating capacity became available by the end of 2002, power supply remained insufficient and unreliable. Programmed load shedding and unplanned power outages were frequent. After the most recent conflict (1993), the situation deteriorated again.

(b) The Present Situation – Post 2003 War

Although the power system was not significantly affected by the last conflict, its capacity was reduced to approximately 3300 MW by a combination of further breakdowns, lack of spares, interruption of major maintenance cycles and post war looting. The balance between generation versus demand during the season of peak demand (summer) as reported on 18/7/04 by the PCO (Agency responsible for Coalition projects following the exit of CPA) was as follows and has not changed significantly as of 2005.

- Daily Electricity Demand : 6,400 MW
- Daily Average Output: 4,470 MW

The above demand figure does not take into account peak summer demand, which is estimated to be in the range of 6800 – 7500 MW. In other words, 35 to 40% of the summer peak demand could not be satisfied at peak demand in 2004. This is a highly unacceptable situation considering the summer temperatures that exist in Iraq, the present-day security conditions (that keep people indoors, whereas before they were able to move out more freely to open areas to escape the heat) and the pressing need of electricity for basic services and economic development. In addition, lack of electricity tends to affect more severely the most vulnerable groups of Iraq's society (newborns, elderly, etc) increasing their morbidity and mortality. The status quo is certainly not acceptable. Ongoing efforts need to be maintained and new actions taken to increase electricity supply.

To compound the problem, significant delays have been occurring in the reconstruction work that is underway and more security related bottlenecks are expected. Thus, the effects of the ongoing projects will not be significantly evident until after the 2005 peak demand season and beyond. Baghdad, a city of 6 million (representing 1/3 of Iraq's population) is still subjected to programmed load shedding on a rolling basis (roughly 3 hrs on 3 hrs off at best – and often much longer). It often experiences unplanned power outages, which exacerbate the inconveniences to its citizens.

3. Relevant experience of the organization

(a) Pre- War involvement in the sector

UNDP involvement in Iraq's electricity sector prior to the last war (2003) has been extensive. In the 15 governorates of the Centre and South of Iraq, the UN observation team based in Baghdad, comprising 13 international electricity sector specialist observers from UNDP and other agencies (plus Iraqi technical and support staff), regularly inspected the overall electric system of Iraq as part of its OFFP monitoring and verification role. During the last two years prior to the war, some 400 visits of Iraq's facilities (including 22 power stations, 7 power-plant construction sites, transmission lines, substations, 15 distribution centres, 4 power-related manufacturing industries, and a number of warehouses for electric goods) were conducted. These activities generated a significant database on the electricity sector infrastructure, its operating track record and principal assets. In addition, the UN team acquired in-depth knowledge on the condition of the physical assets and became well acquainted with the staff responsible for the planning, development, operation and maintenance of these assets.

In the three Northern Iraqi governorates, UNDP administered and implemented major infrastructure rehabilitation projects (totalling \$700 million) through the Electricity Network Rehabilitation Programme (ENRP). A comprehensive project team was assembled to investigate, plan and implement works to rehabilitate the electricity network. UNDP developed extensive experience in the management and execution of complex engineering projects through its work on the ENRP where its team of more than 300 national and 70 international employees worked with a local workforce of around 3000.

(b) Post War involvement in the sector

Following the requirements of Security Council resolutions, UNDP was assigned the lead role in the post-war (2003) processing of contracts and delivery/storage logistics of major equipment for the electricity sector of Iraq. Under this mandate, UNDP successfully processed in 2003 over \$ 1 billion worth of electric equipment and supplies for Iraq's electricity sector. In the technical area, UNDP played a key role in preparation of the 2003 Needs Assessment report for Iraq's electricity sector. This was followed in 2004 by UNDP becoming the implementing agency for rehabilitation of the electricity infrastructure with UNDG provided Donor funds. UNDP is currently undertaking the activities listed below in consultation and collaboration with Iraq's MoE and the approach to be

followed in this project would adhere to the procedures/policies already developed for the ongoing projects:

- Programs of emergency repairs, replacement and additions to Iraq's infrastructure including systems for the supply of power to satisfy basic humanitarian and developmental needs in Iraq. This normally follows the deployment of rapid assessment teams to determine the specific needs.
- Assistance in the development of a Distribution Sector Master Plan to guide the rehabilitation, strengthening and growth of the distribution network to better supply electricity to consumers.
- Rehabilitation of the National Dispatch Centre (i.e. Central Operation Control facility) of the Ministry of Electricity to manage the power system stability and control the power flow in the grid. This includes installation of a new Supervisory Control and Data Acquisition (SCADA) and Remote Terminal Units (RTUs).
- Programs of training and capacity building for institutional development across the electricity sector of Iraq.
- Programs to increase power generation capacity by rehabilitating facilities such as Hartha, Mussaib, Taji and Mosul power stations.

2.2. Programme/project approach

1. Problems being addressed including prior assessments

The problems being addressed include lack of sufficient electricity to meet the demand by consumers in Iraq, in particular at the time of summer peak demand and problems at generating units that cause unreliable supply. UNDP has conducted significant assessments of power demand, supply systems and alternatives in the past.

(a) General Approach

All power plants in Iraq are damaged/deteriorated to one extent or another and need rehabilitation/replacement or at least technical intervention. Based on the findings of the UN / World Bank Needs Assessment and other assessments undertaken by UNDP and the Ministry of Electricity some power generating units/plants were identified for replacement while others were selected for rehabilitation. The criteria on which option to follow would be the technical status of each unit/plant, their operational life time, availability of spares in the international market and the economic aspect of value for money for following either options. The rehabilitation/ replacement approach is supported by some key donor/contributors in the sector, in particular for emergency situations.

Unit 1 of the Mussaib Power Station was selected for overhaul/rehabilitation by the Ministry of Electricity, which announced on 27 July that it was assigning this unit to UNDP. The project planning for the rehabilitation process started immediately after the announcement and it is being carried out under stage I of this project. However, this document constitutes a proposal for implementing Stage II of this project to complete the rehabilitation works.

(b) Historical information on the plant and statistical data on Unit 1:

Mussaib TPS (4 x 300 MW units) was commissioned in 1987 with major portions of the plant equipment supplied by Hitachi, Japan, including boilers for the four units, Instrumentation and Controls system, HP & LP Heaters, substations, etc. Hyundai Engineering and Construction Co. Ltd. was the main contractor. In 1991 during the 1st Gulf war, and four years after its commissioning, Musayab TPS was subjected to heavy missile attacks and aerial bombardment, which inflicted severe damage to the plant. Units 1 & 2 main control room and Unit 1 main transformer were completely

destroyed, putting both units out of service for many years. Units 1 & 2 were rehabilitated utilizing equipment and supplies from the Oil for Food Programme and resumed operation in 2000 and 2001, respectively.

Although Units 3 and 4 were not affected by bombardment (2001), lack of spare parts and inadequate or insufficient execution of the necessary maintenance resulted in considerable de-rating of these units. The generation level of the Mussaib units 1 to 4 has fluctuated around 200 MW in the two years preceding the last war. After the war, and from October 2003 to the first half of 2004, all the Musayab TPS units were operating at best with output in the range of 200 to 230 MW per unit or with a total plant output of roughly 65 % of the Station's rated capacity. The table below compares the unit output over the last few years and summarizes the maintenance activity observed during inspection visits.

Capacity of Mussaib Units as Observed During Plant Visits – Historical Summary

Generating Capacity Observed at Time of Plant Visits	Unit # 1	Unit # 2	Unit # 3	Unit # 4
18 Nov'01	260 MW	0*MW	100 MW	220 MW
5 Feb '02	0 MW	0 MW	100 MW	220 MW
21 Apr '02	230 MW	0 MW	0 MW	0 MW
31 July '02	230 MW	200 MW	220 MW	250 MW
26 Nov '02	0 MW	200 MW	230 MW	230 MW
Feb '04	0 MW	200 MW	220 MW	0 MW

(*) 0 MW = Indicates the unit is on scheduled or unscheduled outage

Mussaib Unit 1 Maintenance Activity Records (Noted During Assessment missions)

Date of Assessment of Unit 1	Maintenance Activity Described at Time of Visit
5/2/02	Unit HP heaters out of service, condenser tubes plugged, leakage of boiler tubes. *BOP -- Feed water contamination in condenser causing high blow down
31/7/02 & 21/4/02	HP heaters out of service, condenser tubes plugged BOP -- Cooling water pumps corrosion
26/11/02	Replacement of condenser tubes, checks of turbine & auxiliary system, tuning of unit controls, defective BFP control valves. BOP -- Cooling water pumps corrosion
26-28/2/04	Controls not reliable, field instruments need replacement, BMS & boiler controls condition of concern, water wall clogged and overheating, leaky fuel oil heaters.

(*) BOP = Balance of Plant

(c) Project Justification

Without the rehabilitation work (e.g. continuation of Unit operation with inoperative or malfunctioning equipment and sensors), the deterioration of Unit 1 will not be arrested and may result in long-term damage of the remaining operating components of the unit in addition to greater frequency and duration of operational outages of the unit. The rehabilitation will bring about an extension of the Remaining Useful Life (RUL) of deteriorated components of Unit 1, in particular the boiler, which will be done in Stage II. This will contribute to system reliability and assist MoE in meeting the middle to longer-term electricity demand of the nation

2. Project Objectives, Activities and Outcomes

(a) Objectives

The immediate objectives are to obtain greater power output from Mussaib Power Station Unit 1, considering its design capacity of 300MW, and to eliminate/minimize problems that cause unreliable operation. In order to best utilize the funds available for the rehabilitation of this unit a two stage rehabilitation process was planned.. Under Stage I some basic equipment and sparse are to be

procured, training of the plant technical staff in addition to a detailed technical assessment of Unit 1 which will identify the exact requirements for a complete overhaul of the unit..

In brief, the overall Project Approach for Mussaib TPS-Unit 1, Stage II includes the following essential components:

- Rehabilitation (i.e. repairs or replacement) of components of Unit 1 boiler, controls, balance of plant and common systems the details of which will be identified under the already ongoing stage I of the project.
- Provision of a selected comprehensive set of spare parts necessary for the maintenance or emergency repair of Unit 1 for at least 2 – 3 years of its operation in the future.
- Provision of technical training to plant personnel focused on thermal unit condition assessment, the implementation of large scale rehabilitation works, the post-rehabilitation commissioning of a mid size thermal unit and the application of state-of-the-art maintenance management software for future uses. This will not only benefit the works proposed under this project but will enable the plant staff to undertake assessments and advanced maintenance of the other units as well.

Thus the project will contribute to the recovery of the design capacity of Unit 1 and extend its life span and operational reliability. In addition, spare parts will be procured and the project will address, through carefully designed training programmes, previously identified training needs by the plant personnel in areas that will benefit the whole fleet of thermal units of Iraq in future years.

(b) Activities and Outputs

The plan of activities for execution of Unit 1 rehabilitation under Stage II includes:

- Procurement of remaining equipment requiring long manufacturing periods under Phase A of Stage II
- Finalization of the technical specifications and procurement of equipment and spares under Stage II, Phase B, based on the findings of the technical assessment of Unit 1 that is to be carried out under Stage I of the project.
- Negotiations with the main contractor for the rehabilitation works for Stage II. Issuance of a contract covering the overall scope of works (parts supply and services agreements, training of MoE staff, etc) required to achieve the project objectives.
- Monitoring of the manufacturing of equipment procured for Mussaib through factory inspections.
- Coordination and monitoring of the delivery of equipment to site (secured warehouse and power station) through the UNDP National Consultant based in Iraq..
- Coordination of the implementation of training programmes for the overall rehabilitation erection works and on specialized areas.
- Monitoring of the implementation of the contracted equipment repairs/replacement tasks at Mussaib Station through the UNDP National Consultant based in Iraq.
- Facilitating and monitoring the technical assistance to the MoE staff by the main contractor and subcontractors in the implementation of the works through meetings in Amman and videoconferencing.
- Providing project management and related assistance to MoE management at Mussaib Power Station, GDEP Directorate for Production in Hilla, and MoE units in Baghdad through UNDP specialists, as required.
- Coordinating and integrating all project efforts with the objective of commissioning the Unit in May 2007, after rehabilitation, to utilize it in the grid during the Summer 2007 peak demand season

(c) Relationship of Project Outputs with UN Strategic UN Planning Document

The project outputs could be categorized under the following outcomes as stipulated in the UN

Strategic Planning Document (SPD), i.e. UN-Iraq Assistance Strategy 2005-2007, dated: January 2005:

SPD Outcome: “Improved electricity situation in the central and northern Iraq and more reliable supply to cover the load demands of essential humanitarian facilities and the population as well”

3. Essential Features of the Programme/Project’s Operating Environment

(a) Technical

As stated above, following the damage suffered in the 1991 war, Musayab Unit 1 was re-commissioned in 2000 utilizing for its rehabilitation goods from the “Oil for Food Programme”. The Unit’s main controls were re-manufactured by Iraqi own resources. The analog/binary main control system, Boiler Management System (BMS) and various control modules were reverse-engineered by Iraqi technicians based on the original control system design. Some features of the re-engineered hardware could not be brought to original design although their intended function was to operate as per original design. The limitations brought by these efforts have caused the Unit to be, in general, not reliable and power production is significantly impacted by the controls problem.

Considering the main (i.e. capital intensive) equipment of the unit, it should be noted that both the boiler and turbine/generator of Unit 1 are relatively new by utility standards that consider the useful life for these equipment to be about 30 years. In addition, of the 17 years that have elapsed since Unit 1 was originally commissioned, there were about 9 years where the unit had to be “mothballed” (not operating) because of the damage to the controls. Accordingly, by utility standards, the unit should be a good candidate for rehabilitation. Thus beyond the correction of the controls problem of Unit 1 and assessment of turbine/generator problems for planning future repairs/maintenance, the rehabilitation of the boiler will take precedence.

In addition, there are various Unit-1 related plant areas that will be corrected. These include rehabilitation of the unit electrical systems, condenser, fuel supply system, water treatment plant and other elements of the balance of plant and common systems that limit output and reliability of Unit 1. However, a major output of Stage II will be completion of the boiler rehabilitation. This is expected to correct problems such as: low temperature of fuel oil heaters, soot blowers out of service, scale deposits on drum and down comer areas, flue gas leakage, frequent leakage of boiler tubes, incorrect air register and boiler flame profile, poorly operating safety valves in boiler area requiring overhaul or readjustment, etc.

(b) Economical, Institutional, Social and Political

Beyond the economic opportunity of rehabilitating a mid-size thermal unit (which provides desirable inertia and limits stability problems in the grid) and the savings from less investment in new thermal unit construction, there are institutional, social and political aspects to the rehabilitation of a unit at Mussaib. This is because Mussaib Station will likely remain as the largest station in Iraq’s grid amounting to 1700 MW (i.e. 1200 MW from the units commissioned in 1987 plus 500 MW being installed by CPA/PCO). Consequently, Mussaib is expected to receive continuing institutional interest and attention by MoE and the relevant authorities in Iraq.

In regard to social and political aspects, Mussaib Station (located 70 km southwest of Baghdad) is in the central region of Iraq, which has the highest population density (and therefore electricity demand) in the country. It is noteworthy that the central region of Iraq is a net importer of power from the north and south regions. Transmission constraints affecting power imports from the north and south, exacerbated by insurgent activity downing transmission lines, result in additional power shortages and interruptions in the central region. This problem would be partially offset by additional generation in the central region.

4. Alternative Approaches Considered

Existing MoE plants requiring rehabilitation, such as Mussaib TPS, are important resources of Iraq. Thus the alternative of not doing rehabilitation should be considered in the context of an opportunity being missed.

As mentioned above, without the rehabilitation work (i.e. continuation of Unit 1 operation with inoperative or malfunctioning equipment, components and sensors), the deterioration of Unit 1 will not be arrested and may result in long-term damage of the remaining operating/operatable components of the unit (with the attendant economic losses) in addition to greater frequency and duration of operational outages of the unit.

It should be noted that on 27 July 2004, the Ministry of Electricity assigned the rehabilitation of Mussaib Unit 1 to UNDP.

5. Expected Benefits

Currently the electricity supply in Iraq is adversely affected primarily by the shortage of generation supplied to the grid, which is not able to meet the demand of grid connected consumers. One should note that the biggest deficit occurs in the central part of the country and in the Baghdad area in particular (i.e. net importer of power from other regions in the country).

The MoE-designated Middle Region (excluding Baghdad) represents 32% of the grid connected consumers in Iraq. Adding Baghdad, representing 26% of the grid connected consumers, to the Middle Region figure, one can see that the bulk of consumers in Iraq are in the central part of the country. Further analysis in the past has shown that of the total energy consumption (Gigawatt hours/year) in Iraq in 2001/02 roughly 63% takes place in the combined area of Baghdad and the Middle Region. Similarly, considering power demand (MW) in 2002, the combined Baghdad-Middle Region represented 58% of peak demand in the summer.

The implementation of Stage I of this project will add significant capacity to the grid during the peak demand season of 2006. Completion of the rehabilitation program, including Stages I and II, will maintain the increment of added capacity to the grid for some years into the future

The rehabilitation of the Mussaib power plant will realize the following benefits:

- The project will contribute to the near-term recovery of generation output that is urgently needed, as assessed by numerous reports (World Bank, AID, CPA, UNDP, etc). Unit 1 will be generating at a consistent level over 260 MW. This capacity will be supplied to the grid for the duration of the peak demand season of 2007. This additional power will help meet the severe need for power observed at times of peak demand. Stage II of this project will firm up the reliability in the supply of this increment of power to users for years into the future.
- The project shows significant economic benefits relative to alternative ways to add power to the grid. Review of Unit 1 output observed during plant visits in 2002 (four occasions) or reports from plant in 2004 (two occasions) shows that the Unit has been generating between 0 to 230 MW on those occasions (Unit 1 was down on 20/6/04 and on 22/7/04, as examples of the reliability of this unit). Assuming an increment of roughly 100 MW achieved through rehabilitation, the ratio of cost per additional capacity (\$50 million for 100 MW) would be roughly two thirds of what it would cost to add new steam turbine generation for the same capacity. Adding new steam-unit generating capacity (at \$750 to 1050/kW installed), which permits burning crude oil or heavy fuel oil for which the plant is designed would cost \$75 to 105 million. Adding new gas turbine capacity (at \$500 to 550/kW installed) is not an option at this time, because there is no pipeline supplying natural gas to Musayab TPS.
- The project aims to utilize existing and relatively newly acquired assets as much as possible,

which results in the reduction of project costs. The project will demonstrate cost effectiveness through the utilization of existing equipment and supplies procured through the Oil for Food Programme (OFFP). A thorough and systematic inventory of assets received by MoE for Mussaib under the OFFP, in particular high value plant components, will be conducted early in the project. The thorough and systematic inventory of Unit 1 assets (equipment, spare parts, materials), before and after the overhaul, will lay the ground work for future maintenance management with the aid of specialized software for asset monitoring

- The project will help in capacity building of Iraqi engineers in thermal power plant unit condition assessment and maintenance skills. Thermal plants are the backbone of generation and this will help secure their long-term operational sustainability. The on-the-job training will acquaint the appropriate plant staff with the latest technology in assessments of plant equipment condition and large scale rehabilitation works.

6. Main Beneficiaries and Stakeholder Participation in the Project

The ultimate beneficiaries of the results from this project will be the population of Iraq, in general, and the consumers in the central part of Iraq, in particular. Iraqi citizens will benefit both individually, and as a nation, from the overall economic growth resulting from a more stable additional supply of electricity.

Project participants that are direct beneficiaries include the MoE and its staff, Mussaib Power Station and its staff, contractors and subcontractors (both Iraqi and international) and a variety of suppliers of goods and services in the Baghdad and Babylon Governorate region of Iraq.

7. Consideration of the Needs of Vulnerable or Marginalized Societal Groups

The project aims to achieve greater supply and reliability of power delivered to the grid. Although the consumers at the other side of the supply network represent various strata and groups in society, it should be noted that the most vulnerable that can not afford paying for private sector electricity supplied through diesel generators will benefit most from reduction in outages durations. In addition, the power grid in Iraq is the main supplier of electricity to essential services in communities across the country. Accordingly, vulnerable and marginalized groups that have access to essential services such as hospitals, schools, etc, will derive benefits from this project.

8. Participation of Beneficiaries in Programme/Project Development and Delivery

Involvement by the principal beneficiaries in the development and delivery of the project will be as follows:

- Staff of Mussaib Power Station, Middle Region Production directorate and the MoE will participate in the preparation of the technical specifications for the scope of rehabilitation and of the equipment to be procured. They will also participate in the planning and subsequent implementation of the works.
- Selected staff (34 to 44) from the plant site will attend specialized overseas training courses concerning unit condition assessment, thermal unit maintenance, rehabilitation works implementation and unit operation. The capacity and technical skills of the personnel will be upgraded through this offshore and “on the job” training. Their operation and maintenance skills will be significantly enhanced.

9. Gender Balance in Deriving Benefits from the Programme/Project

There are no gender inequalities resulting from the project, which aims to increase the production and delivery of electricity to the population and essential services.

10. Consideration of environmental Issues and Concerns

There are no major environmental impacts resulting from the direct rehabilitation works. Equipment will be disassembled, repair/replaced and reassembled. Used equipment and consumables will be disposed appropriately. The rehabilitation work crew will be trained offshore and their performance monitored by contractor personnel offsite, which has had rehabilitation experience in various locations worldwide. However, the rehabilitation will result in an improved performance of the unit subject of discussion. This will by all means increase its efficiency in terms of energy conversion and minimize the generation of unfriendly environmental by-products such as gas and oil fumes, In other words an indirect advantage of this project would be to decrease the current negative impact of the operating the unit on the environment.

11. Employment Creation Related to the Project

For the short term (e.g. 3 months during the rehabilitation works), it is estimated that there would a job creation of some 300 jobs. However, this would not represent new entrants to the labour market but rather a reassignment of personnel within MoE, the Middle Region Production Directorate and Mussaib Station.

Indirectly, additional power on the national grid, that this project will contribute in achieving, will assist production and service facilities to continue to function, thus ensuring that those already employed in these facilities will continue to have jobs .

12. Application of a right-based approach

Not applicable to infrastructure rehabilitation projects

13. Security Situation Related Issues

UNDP's approach to security in Iraq hinges on the arrangements and assistance that are available to contractors from the Multi-National Force (MNF) and other security institutions. This may include convoy protection for delivery of equipment, Medevac facilities in case of emergency etc

In general the project has be planed assuming that the security situation will not further deteriorate with some consideration for a scenario that the overall security situation may improve. . The implementation works will be handled, as much as possible, through the MoE designated project crews trained overseas, national (Iraqi) consulting companies, and selected national/ international staff of UNDP (provided that security conditions were to allow this at the time). An integral part of the security arrangements is the deployment of mobile video/audio system for plant equipment condition assessment supported by teleconferencing facilities at several sites. This will permit remote but effective monitoring of the plant assessment and rehabilitation works

Staff from the plant will be trained outside the country by contractor's specialists to undertake rehabilitation and replacement of equipment. The actual works will be further monitored and guided through video conferencing as indicated above.

For deliveries of goods to the project site and coverage of security related expenses, plans are in place for close coordination with respective security authorities including DSS (formerly known as UNSECOORD) to ensure safe delivery of procured goods. The plans are as follows:

(i) Security Budget for Project (0.5%) – It is recognized that projects should budget 0.5% of project costs for security (including personnel, materials and services costs). This 0.5% is not meant to cover any direct project related costs. A higher percent (about 2%) has been budgeted for the Mussaib project to cover unforeseen expenses as mentioned in (2) and (3) below.

(ii) Responsibility for security on transportation of equipment from Iraq's border to Mussaib Station or Warehouse - At meetings in Amman on Sept '04, MoE stated that MoE (in coordination with the relevant security forces in Iraq) would be responsible for the security of transportation of project equipment from Iraq's border to point of use (or storage to time of use). However, we are leaving the additional 1.5% in the budget, should we find (based on initial results from the field) that the security arrangements for equipment transportation or other project related activities may need changes resulting in additional security-related expenditures.

(iii) Costs for security in equipment transportation/storage outside Iraq -- Costs for security on equipment transportation or storage outside Iraq are also not included in the 0.5%. Security and insurance costs must be included in agreements with the transport contractor or equipment supplier and is to be part of the additional 1.5% budgeted in the project.

(iv) DSS responsibility for equipment delivery and hand-over to client – DSS requires the designation of a MoE official responsible for security for security liaison purposes. Infrastructure will request MoE for such designated official and provide the contact details to DSS.

14. Programme/Project Relationships to Existing Ministerial Structures and their Capacity Building

MoE will play several roles in the project including:

(i) Collaborating with UNDP in planning the project, assisting in its implementation, and helping in problem solving. This will be done via liaison with MoE at the levels of Senior Advisor for Generation at MoE, Director General at GDEP/Euphrates Region in Hilla, and Manager of Mussaib Power Station.

(ii) Assigning specialist staff for training and work assignments throughout the project.

(iii) Implementing project tasks such as preparation of the unit for its rehabilitation, implementing erection works, and unit commissioning.

(iv) Providing facilities and utilities for the performance of the project

(v) Ensuring proper storage and utilization of the project equipment.

(vi) Keeping permanent records, issuing reports and releases, as may be required.

A tentative organization chart for MoE technical leadership of the project Stage II (based on what was agreed for Stage I) is enclosed as Annex 1.

The project will contribute in enhancing the technical capacities of the plant staff in undertaking major repair/rehabilitation works and also technical assessments of the conditions of similar plants/units. In addition the trainees that will be directly trained under this project will return to the country and train other technical staff, i.e. training of trainers concept. As a result the project will contribute to the overall capacity building programme of the Ministry of Electricity and strengthen their capacity to undertake similar jobs elsewhere in the future with minimum reliance on international expertise.

15. Lessons Learned from Previous Experience in Similar Programme/Project

A key lesson learned from implementing various projects inside of Iraq following the war in 2003 is the need for advance detailed planning of activities for the timely provision of inputs by the various players involved.

3. Management Arrangements

1. Programme/Project Implementation

(a) Management and Supervision Arrangements

UNDP's Direct Execution Modality (DEX), whereby UNDP is accountable for the attainment of the project objectives and is responsible for its overall management, will be adopted in the performance of the project. The project will be implemented in close cooperation with the Ministry of Electricity, Central Region Production Directorate and management/engineers/staff of Mussaib Thermal Power Station. Coordination will be maintained with the PCO. Relevant parties to the reconstruction of Iraq, such as Donors representatives, the World Bank and the MoE will be periodically briefed on progress and plans.

UNDP international engineers and specialists will work closely with the engineers of Musaib Thermal Power Station and representatives of Ministry of Electricity to finalize the scope of work for the various systems, overall plant requirements versus priorities, develop specifications for eventual contracts, and organize/monitor the implementation of the rehabilitation works. For those activities that could be undertaken outside the country, the Iraqi counterparts, will be invited to Amman/Jordan for coordination and consultation of project activities with UNDP staff. This will be done at UNDP offices or liaison facilities in Amman. Teleconferencing between UNDP in Cyprus/Amman, the contractor's offices overseas or in Amman, and MoE / Mussaib TPS will be utilized whenever necessary to address technical issues requiring multi-party direct input.

For the field work in Iraq, MoE staff from Mussaib Power Station with specialized skills (enhanced by training overseas) plus local Iraqi expertise will be utilized as much as possible. This will permit technology transfer, which will be beneficial in carrying out independently similar projects by Iraqi engineers in future.

For monitoring work progress and liaison of project activities inside Iraq, UNDP national staff, working from virtual offices inside the country, will coordinate with counterparts at the plant and Iraqi private sector contractors/ engineering firms that are conducting project-related activities. Coordination and consultation between national staff inside the country and international staff outside will be through video conferencing and electronic communication. Whenever possible, and if the security situation permits, border meetings and cross border operations will be organized from one or more of the neighbouring countries for international staff to be directly involved in coordinating and supervising specific project activities.

(b) Capacity and Experience of Organizations and Staff Involved

MoE – Senior engineering, operations, maintenance, construction and commissioning personnel will be involved. They will be assisted by junior personnel under their direct oversight.

UNDP – International personnel with extensive experience in major power sector and rehabilitation projects worldwide and in-country experience in Iraq will be involved. They will be supported by National Iraqi engineers with multiyear experience in Iraq's power sector. The proposed organization for UNDP Mussaib Project Team is enclosed as Annex 2. Highlights of the professional requirements relevant to the project team are as follows:

(i) Project Manager – Extensive (over 20 years) professional power-sector experience (including experience in Iraq) with significant experience conducting senior technical and management responsibilities within a major modern utility. This would help serve as a frame of reference relative to the power sector operations in Iraq.

(ii) Senior International Engineers – Extensive professional power sector experience (15-35 years).

Multi-country experience in major power sector projects in their areas of specialty. The following specialization areas have been identified for the project: Boiler, Instrumentation & Controls, Balance of Plant and Turbine Auxiliaries, Common Plant Systems, and Maintenance Management. Sample TOR is enclosed. These positions have been listed under the Consultants budget line because they involve specialized technical skills. Depending on project needs, the tenure of the personnel contracted for a specific phase of the project might be extended to longer terms.

(iii) Senior National (Iraqi) Engineers – National Electrical Engineer – Rehabilitation & Testing: over 15 years of experience in the power sector of Iraq. The National Engineer Consultant based in Iraq will be secured through a contract with an Iraqi consulting firm. TOR's are enclosed.

Contractors -- Senior engineering, design, procurement, operations, maintenance and construction personnel with experience in the Middle East and developing economies will be involved. They will be assisted by junior personnel under their direct oversight.

(c) Supplemental Training of MoE Staff on Rehabilitation Tasks

After completion of the Stage I training of MoE staff in Japan and Korea on unit condition assessment and proper unit maintenance/operation (and taking into consideration the already defined program of Overseas Training Preparatory to Erection Tasks, which will involve 44 MoE staff in Stage II), an analysis will be done of supplementary training requirements for project tasks. At this time, the following is envisioned:

- (i) Training of MoE Welders (technician / junior engineer level)
Because proper welding is a critical step in the rehabilitation process, MoE welders (10 persons for 2 to 3 weeks) will need to have training on welding (i.e. instruction on up-to-date welding techniques, welding of specialty steels, special procedures suited to welding plant components with complex designs, etc)
- (ii) Training on Water Processing (technician / junior engineer level)
Because proper water treatment is critical in a number of processes at the plant, MoE staff (3 persons for 2 weeks) will need to have training on water processing that needs to be upgraded at the plant ((water purification for steam production, steam quality control, waste water treatment, cooling water for fouling control, etc)
- (iii) Training on Combustion and Fuels Handling (technician / junior engineer level)
Because proper combustion is of fundamental importance at the plant, MoE staff (4 persons for 1 to 2 weeks) will need to be trained on combustion related processes at the plant (burner maintenance and monitoring of performance, fuel treatment to control furnace deposits, maintaining air/fuel ratio for efficiency, etc)
- (iv) Training of Principal Engineers in Specializes Areas (senior engineer level)
There is a need of in-depth training in certain critical areas to be identified with MoE. The objective is to develop highly skilled specialists as internal resources. Areas being considered include: Non Destructive Testing, Environmental Control and others.

(d) Local Procurement and Contractors

The following local procurement and local contractors are envisioned (see budget for amounts):

- (i) Erection Contractor: An erection contract is to be issued by the main contractor to MoE (or properly qualified local Iraqi contractor) for performance of the rehabilitation works under the guidance of the main contractor.
- (ii) Logistics Consultant Contract: A contract with a local Iraqi firm to monitor deliveries to the site and advise on the logistics concerning equipment being delivered to Mussaib is envisioned.
- (iii) Erection/Commissioning Consultant Contract: A contract with a local Iraqi firm to monitor the erection work progress at the site and advise on foreseeable problems with impact on schedule, and confirm the completion of field work tasks at Mussaib is envisioned
- (iv) Local Iraqi Procurement: This is limited to procurement of common instruments, work tools and consumables (e.g. scaffolding) to be used in Stage II.

2. Delivery Mechanisms Reflecting Security Conditions

(a) In-Country Work Environment under Current Security Constraints

The timely execution of the program will depend on the security situation in the country and the timely availability of resources. UNDP would plan to proceed with a flexible plan of action to be able to effectively react to unforeseen events. Continuous consultation with all its partners including suppliers, government officials and local representatives will be necessary. Project implementation will be very dependent on the security situation on the ground.

The essence of the delivery mechanism planned for the project is the utilization of MoE designated plant assessment/rehabilitation crews trained overseas and/or national Iraqi subcontractors and consulting firms to implement the work in-country. Work performance will be coordinated by the contractor from offices in Amman, Jordan and monitored by the UNDP team based in Cyprus and Amman. With the present security phase in Iraq, there is no international staff in country, and the mobility of national staff is restricted.

As part of UNDP's extensive planning to meet urgent security concerns, the organization is currently preparing a Security Advisory that will be issued to bidders that will give them info on the current security situation, the arrangements that may be in place with relevant parties such as the MNF for convoy protection, Medevac arrangements and contacts for emergency on a regional basis. In addition, UNDP advisory arrangements will provide information on UNDP/UN security contacts as well as recommendations and precautions on security.

(b) AVT System for Monitoring and Guiding In-Country Work from Outside

The use of a mobile Audio/Video/Teleconferencing (AVT) system is planned to monitor and guide the work from outside Iraq. The AVT system will permit power plant observation, on-site assessment of equipment condition, and guidance of erection works by power sector equipment/system specialists and project management personnel operating from locations outside Iraq. The AVT is being procured through international competitive bidding. The original plan to procure this system in Stage II was advanced to Stage I to be better prepared for the assessment and light rehabilitation works to be done in Stage I. The AVT related procurement envisioned for Stage II has been reduced (see budget) with the remaining funds designated to cover the testing instrumentation that had to be shifted in the opposite direction (from Stage I to Stage II). The budgetary rearrangements resulted from the need to purchase long-lead items in Stage I (i.e. boiler pressure parts) based on new problems uncovered by MoE with Unit 1 as presented at project meeting in Amman in early 2005 (26/2 to 5/3/05).

(c) Maintenance Management Software (MMS) for Rehabilitation Management & Record Keeping

The computer software that will be procured under this project is required for tracking the performance of utility equipment/systems, systematically recording the maintenance/repair work on critical components, and trending of problem areas for future repair/replacement decisions. In the Mussaib project Stage I, per UNDP request, the prime contractor (Hitachi) and subcontractor (Hyundai) have generated "check lists" (and questionnaires) that will be used by the MoE staff during the condition assessment of Unit 1. Considering the number of critical components that need to be examined in the aggregate of equipment and systems of a thermal unit, this is best handled by computerized methods (Maintenance Management Software or MMS) as done by major utilities. In addition, taking into account that international specialist access to the unit in Iraq is not possible, the MMS application (plus the transmission of data for analysis to the UNDP offices in Amman and Cyprus, and contractor facilities overseas) was planned for the rehabilitation work in Stage II.

The training of MoE staff will permit the Ministry to improve the electric system reliability in the future starting with Mussaib Unit 1. It will provide ready access to the staff on problems identified and corrections undertaken within the project. In the future, based on problem trending, it will permit

the staff to implement routine procedures to control damage or deterioration of possibly capital-intensive new equipment; since damage often results from lack of timely and adequate maintenance. The pre- and post-rehabilitation (computerized) inventory of problems and repairs of critical equipment will lead to more effective use of MoE resources in the future. Annex 3 – Maintenance Management Software presents in schematic form the main attributes of MMS.

The MMS will be procured through international competitive bidding. The selected contractor will supply the software, required hardware, and training of MoE staff.

3. Ministry Counterparts and Extent of Cooperation

Staff from the Ministry of Electricity, the Middle Region Production Directorate and the Mussaib Power Station are the counterparts to the UNDP and contractor staff in this project. The Ministry, Directorate and Power Plant are fully aware of the approach in the implementation of the project and have demonstrated and confirmed their cooperation for the implementation of this project and successful completion.

4. Intra Cluster Cooperation

The project by nature does not require any inter-cluster/intra-cluster activities other than exchanging information and lessons learned from project implementation.

5. Timeframe, Work Plan and Schedule

(a) Timeframe

- **June '05** – Completion of preliminary specifications for Stage II Phase A, based on technical reviews involving MoE, Hitachi/Hyundai and UNDP
- **July '05** – Completion of negotiations with the main contractor for the rehabilitation works for Stage II and issuance of supply and services contracts to cover the whole scope of works that will assist in achieving the project objectives. This will include training programmes.
- **September '05** -- Finalization of the technical specifications of equipment and spare to be procured (Stage II Phase B) based on the findings of the technical assessment that will be carried out under Stage I of the project.
- **April-May '06** – Implementation of training in Japan and Korea for erection work at Mussaib site.
- **Sept '05-Sept '06** -- Follow up on the manufacturing of the equipment through factory inspections.
- **Dec '05-Dec '06** -- Coordination of equipment deliveries to site (from Stages I & II)
- **Sept-Oct '06** – Demolition of existing equipment at unit site
- **Sept '06-March '07** - – Implementation of the repairs/replacement tasks planned.
- **Feb-March '07** – Pre-commissioning technical and management assistance to the MoE staff by the main contractor and UNDP specialists in implementation of the works, as required.
- **April-May '07** -- Commissioning of the Unit at end of May 2007 for duty starting June '07 for the summer 2007 peak electrical demand season in Iraq.

(b) Work Plan

Please refer to the project latest schedule (Annex 4, enclosed), which was reviewed jointly by MoE, the project main contractor (Hitachi) and subcontractors (Hyundai and Al-Rook) at meetings in

Amman on 23-28/May/05. The previous schedule was updated to address procurement of parts requiring long lead times (over a year) necessary for the materials sourcing by the contractor, manufacture at their facilities, and shipment of the equipment to the Mussaib site. A summary work plan for the Mussaib Rehabilitation Project Stage II follows:

- Under Stage II, there will be two project phases (A & B). Stage II, Phase A has been adopted to accommodate the extra-long lead times required for procurement of certain equipment, which are already known to be required for Unit 1 (based on the Station latest reports and with the concurrence of the main contractor and OEM).
- Stage II, Phase B will follow the condition assessment done in Stage I. This Phase includes the procurement of equipment identified as needed via the unit assessment in Stage I, plus the main rehabilitation/repair works on the Boiler, Unit Instrumentation and Controls (I&C), Balance of Plant (BOP) such as unit condenser, and Common Systems (e.g. water treatment plant) which impact Unit 1 operation.
- The rehabilitation work in the field will be done by MoE staff under the guidance of the main contractor. The progress of the work in the field will be followed by a National Consultant operating in Iraq and reporting to UNDP. Power-sector specialist staff from UNDP will monitor the overall progress/performance of the project from the UNDP Cyprus Office. Periodic coordination meetings will be held in Amman involving MoE, UNDP, its main contractor and subcontractors.
- The MoE staff to be assigned to work in the field will receive training in rehabilitation erection work in Japan and Korea prior to initiation of the work in the field. Specialized training (e.g. welding of specialty steels) will be conducted at various times in the project.
- Based on training in Stages I and II, the technical capabilities of the Mussaib plant staff will be upgraded to not only operate and maintain a thermal unit once rehabilitated but also to assess the requirements for rehabilitation of other thermal units in the MoE fleet and to undertake full unit repair/maintenance and erection works with minimum international supervision, as may be required for major units rehabilitation in the future.
- MoE capacity for these undertakings will be supported by state-of-the-art maintenance management software (used by utilities for systematic trouble-spot record keeping and equipment problem trending among other tasks) plus the use of a mobile audio/video/teleconferencing system (for plant observation and parts condition assessment by equipment/system specialists and project management operating from locations outside Iraq).

The overall project will contribute to minimizing load shedding and blackouts of the national electrical grid. Stage II has been designed to bring back Unit 1 to reliable operation in late May 2007 and thus contribute to minimizing power shortages in particular during peak-demand seasons. The overall objective is to bring Mussaib Power Station Unit 1 to greater generation output and improved reliability reflecting its original design capacity (300MW).

(c) Schedule

Please see Annex 4 presenting the overall project schedule for Stages I and II.

6. Procurement Arrangements and Value for Money

UNDP regular procedures including reporting, financial controls and auditing procedures will be applied. Procurement, both international and local, will be subject to UNDP Financial Regulations and Rules ensuring cost-effectiveness, transparency and competitiveness.

Contractor costing is analyzed and compared with market conditions prior to contractual agreements. Performance of contractors is secured through performance guarantees. The contractors are also obliged to provide comprehensive insurance for the works.

Where applicable a waiver of competitive bidding may be sought on the basis of proprietary products

or services (e.g. equipment to be rehabilitated comprising 50% or more from one manufacture /supplier source

In order to safe guard against over payment and ensure “Value of Money” UNDP has been adopting the following procedure, which shall be maintained in this case as well:

- Ask for independent quotation for some representative items from different suppliers.
- Request the supplier to provide references of previous contracts of similar items in Iraq or elsewhere.
- Engagement of a recognized international consultant that would be tasked to carry out the independent project verification and price justification

7. Financial Tracking, Quality Control and Impact Assessment

Project financial management and tracking is provided through the Atlas electronic global system. For construction progress monitoring, quality control and impact assessment typical practices including software, methods and performance indicators used in the utility industry and infrastructure construction areas are utilized.

In regard to monitoring and certifying project progress and completion of tasks in the field, please refer to Section 3. Management Arrangements, paragraph (1.d) above describing the use of local (in Iraq) consultants. These consultants (2) will be hired (through contracts with Iraqi companies) to monitor the logistics and progress of equipment deliveries and erection/commissioning works through completion of the works in the field. The consultants will provide daily reports to UNDP and meet weekly with a designated representative from GDEP/Euphrates and the Mussaib Station to appraise them of the consultants observation on progress, which is to be reported in written form and co-signed by the GDEP and Mussaib Station representatives. The weekly reports together with signed minutes of meetings on project progress involving GDEP, Mussaib Station, Consultant and UNDP in Amman, will be used to certify project implementation.

4. Analysis of Risks and Assumptions

1. DSS (UNSECOORD) Assessment on Security Environment

The project management will keep DSS, formerly known as UNSECOORD, informed during all stages of the project implementation and progress. In addition DSS advice will be sought before certain critical events such as missions, deliveries, etc. take place. The counterparts will also be requested to coordinate with security institutions on ground to ensure a secure and reliable environment for project implementation.

2. Assessment of Other Potential Causes of Failure

The only potential unforeseen risk in the context of Iraq is the deterioration of the security in the plant or its close vicinity to a degree that implementation could not be continued. In such case delivery of equipment could be delayed or redirected to other sites until such time that the situation permits. The only situation that might arise and have a long term affect on work progress is if the unit subject of discussion sustains serious damage resulting from sabotage or military action. In such case the scope of work has to be revised and changed depending on the degree and nature of the damage.

3. Options considered to Mitigate/Minimize Potential Risks

Noting that because of security reasons, rehabilitation experts (representing equipment manufacturers, suppliers of engineering services, and diagnostic analysis providers) cannot go inside Iraq, UNDP has approached the problem of works implementation and monitoring as follows:

- Training the Iraqi Engineers in the manufacturer's premises on the equipment being contracted for use in the rehabilitation, who would then install the equipment at the plant. At a later stage, the trained engineers, in turn, would provide the training for junior engineers/specialists at MoE.
- Appointment of (Iraqi) National Consulting Engineering Companies with adequate company and individual experience for implementing the project works. Prequalification documents have been already floated and an encouraging response has been received. Specific contracts would be already in place before the material for the subject works starts coming in.
- Providing video conferencing facilities to the specific locations to discuss the problems encountered and to provide solutions. This facility will be used for daily communication between UNDP staff in Cyprus/Amman and the power plant. UNDP also intends to install a similar facility at other sites (including MoE) to enable arriving at prompt decisions and technical follow up and guidance to the plant staff while undertaking the works under the project.

4. Undertakings or Agreements Made with Partners which Impact Project Implementation

The project will be implemented under the UNDP Direct Execution Modality (DEX) under which UNDP will directly execute contractual agreements with the main contractor(s) and other entities for the performance of the project. The contractual modalities under consideration include parts supply only (for the initial phase of the project), service contract (for training) and EPC agreement (with the main contractor for the works). In parallel, other contracts will be executed for the provision of supplemental training including specialized software for maintenance management, and systems for remote assessments of plant equipment conditions and technical decisions via teleconferencing.

An agreement has been reached between the UNDP and the Ministry of Electricity on the timing for taking Unit 1 of the plant on outage (i.e. out of operation) for both assessment and rehabilitation work periods under this project. This timing has been carefully agreed on to avoid peak load season (summer) during which the operation of the unit is very much needed to cover for power deficit on the national grid.