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OFFICE OF INSPECTOR GENERAL

AUDIT OF USAID/IRAQ'S ELECTRICAL POWER SECTOR ACTIVITIES

AUDIT REPORT NO. E-267-05-003-P
June 29, 2005

BAGHDAD, IRAQ

Office of Inspector General

June 29, 2005

MEMORANDUM

TO: USAID/Iraq Mission Director, Dawn M. Liberi

FROM: Regional Inspector General, Baghdad, Christine M. Byrne /s/

SUBJECT: Audit of USAID/Iraq's Electrical Power Sector Activities (Report No. E-267-05-003-P)

This memorandum transmits our final report on the subject audit. In finalizing the report, we considered your comments on the draft report and have included them in their entirety as Appendix II.

The report contains one recommendation for corrective action. In your written comments, you concurred with the recommendation and described action the Mission plans to take to address the auditors' concerns. Based on your comments, we consider that a management decision has been reached on this recommendation. Please coordinate final action with USAID's Office of Management Planning and Innovation.

I want to express my sincere appreciation for the cooperation and courtesies extended to my staff during this audit.

U.S. Agency for International Development
USAID/IRAQ/RIG
APO AE 09316

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SUMMARY OF RESULTS

Since the end of the conflict in Iraq, USAID has been directly involved in the reconstruction effort to rebuild and rehabilitate the country's critical infrastructure. One of the most high-profile topics during this period has been the restoration of Iraq's electrical power supply. Years of minimal repairs and no regular maintenance, coupled with fuel shortages and vandalism, have left Iraq's national electrical system with limited power-generating capacity for homes and businesses. To address this problem, USAID has been implementing an infrastructure reconstruction program which includes projects focusing on the construction and rehabilitation of Iraq's electrical power sector.

The Regional Inspector General in Baghdad, Iraq conducted this audit to determine whether (1) USAID/Iraq's projects to rebuild and refurbish Iraq's electrical network were achieving their intended outputs and (2) whether the Mission was addressing institutional capacity-building in these projects to ensure their sustainability. (See page 3.)

USAID/Iraq's infrastructure projects in the electrical power sector were not always achieving their intended outputs. Specifically, 7 of the 22 power sector projects reviewed (32 percent) either had not or were not achieving their intended output. The audit, however, determined that the underlying problems preventing planned outputs from being achieved were beyond the Mission's control. For example, two of the seven projects were impacted, either directly or indirectly, by the U.S. government's earlier efforts, in September 2004, to reallocate over a billion dollars in government-wide infrastructure funding from the electrical sector to security and other priority areas, resulting in the cancellation of the two projects. Likewise, several other projects were found to be experiencing major implementation delays, in one case stemming partly from delays involving a non-USAID contractor, while other projects were hampered by a lack of cooperation from the Iraqi Ministry of Electricity staff at the plants, the deteriorating security situation and other factors. Given the circumstances involved under these projects, a recommendation was not issued with regards to this finding. (See page 6.)

In addition, while the Mission was found to be addressing institutional capacity-building under its power sector projects through the provision of training and operational manuals, it is clear that much more needs to be done to address the existing problems and challenges in this area, both at the power plants and at the ministry level. With the Mission preparing to turn over several major power-generation projects—having a combined budget of over $600 million—to the Ministry of Electricity by the end of 2005, it is critical that steps be taken to address the problems to ensure the newly refurbished infrastructure is properly operated and maintained and not put at risk. (See page 15.)

This report contains one recommendation for USAID/Iraq to develop a multi-year strategy outlining its long-range plan of activities to strengthen the Iraqi Ministry of Electricity's institutional capacity to properly operate and maintain the electrical power infrastructure rebuilt or rehabilitated by the U.S. government. (See page 26.) Mission management concurred with the recommendation and was in the process of developing a 3-year (2006-08) transitional strategy to address the operations and maintenance issue. Based on the Mission's response, we consider a management decision to have been reached on this recommendation. See page 27 for our evaluation of management comments. Management comments are included in their entirety in Appendix II.

BACKGROUND

Under Saddam Hussein, the electrical network in Iraq deteriorated dramatically from one of the best in the Middle East to its present state where the power supply has become extremely unreliable. Years of neglect, resulting from sanctions and more recently from looting and sabotage, have left critical infrastructure in a shambles. The lack of spare parts, scheduled maintenance and capital investment over the past two decades have compounded the situation and caused major power-generation facilities to deteriorate and function at a fraction of their designed operating capacity. This, in turn, has resulted in frequent power cuts as demand for electricity continues to exceed production levels. After the conflict in 2003, for example, Iraq had a generating capacity of around 3,300 megawatts (MW), enough to supply power to satisfy only a portion of the total peak demand—estimated to be on the order of 6,500 to 7,000 MW.

One of the key components of the Coalition Provisional Authority's[1] (CPA's) strategic plan to restore full sovereignty to the Iraqi people was the restoration of basic infrastructure and services, including electricity. To finance the reconstruction, Congress appropriated $2.48 billion under the FY 2003 Emergency Wartime Supplemental Appropriations Act, signed on April 16, 2003, which became known as the Iraq Relief and Reconstruction Fund (IRRF I).

In support of this reconstruction effort, USAID/Iraq awarded two successive contracts under its Iraq Infrastructure Reconstruction Program (IIR). The first of these two infrastructure reconstruction contracts, valued at $680 million (later increased to $1.03 billion), was awarded to Bechtel National, Inc. (Bechtel) on April 17, 2003. This IRRF I-funded contract (referred to as Phase 1) was designed to repair, rehabilitate, or rebuild vital elements of Iraq's infrastructure, including the electrical power network. While covering several sectors, most of the funding under the contract was allocated to the electrical power sector in the areas of power generation, transmission and distribution. The contract's expiration date, which has been extended, is June 30, 2005.

On November 6, 2003, President Bush signed a second emergency supplemental appropriations act which authorized $18.4 billion in additional funding for the IRRF. Funding under this second supplemental (IRRF II) was intended to continue the reconstruction work in Iraq with a focus on the two areas of greatest concern—security and infrastructure. In response to this expansion in the reconstruction effort, USAID, at the CPA's request, awarded a $1.8 billion competitively bid contract to Bechtel on January 5, 2004 using the newly appropriated IRRF II funding. This 2-year contract (known as Phase 2) is scheduled to expire on December 31, 2005. As in the case of the Phase 1 contract, it was anticipated that a significant portion of the total funds budgeted under the Phase 2 contract would be allocated to projects within the power sector.

The original intent of the Phase 2 contract was to serve as a "bridge" between the reconstruction work funded under IRRF I and the bulk of the work that would eventually

[1] The Coalition Provisional Authority (CPA) is the name of the temporary governing body which was designated by the United Nations as the lawful government of Iraq until such time as Iraq was politically and socially stable enough to assume its sovereignty. The CPA began operations following the overthrow of Saddam Hussein in April of 2003 and continued until the CPA was dissolved on June 28, 2004 when Iraq became a sovereign nation.

be funded under IRRF II. Since Bechtel already had teams mobilized in-country carrying out projects under the Phase 1 contract, the Phase 2 contract enabled the CPA to continue to initiate new infrastructure projects, administered by USAID, with minimal delays until the planned Project and Contracting Office[2] (PCO), later established in May 2004, was in operation and could provide acquisition and management support over most of the remaining projects to be funded under IRRF II.

In administering the projects under both contracts, USAID/Iraq has had to operate in a complex environment requiring cooperation between several government entities working inside Iraq. For example, the Mission early on had to obtain prior approval from the CPA's Project Management Office (PMO) before initiating any new reconstruction projects. Following the official transfer of sovereignty back to the Iraqi government in June 2004, the CPA's role in the reconstruction was replaced by the U.S. State Department, which transferred the PMO's oversight role to the newly created Iraq Reconstruction Management Office (IRMO) which was tasked to oversee and allocate the funds used in executing U.S. assistance programs in Iraq. Presently, the Mission relies on IRMO to assign planned infrastructure projects, along with their approved budgets, to the Mission for implementation. Task orders are used to document the assignment of specific projects. Upon receipt, the Mission is authorized to implement these projects and will initiate them by issuing Bechtel job orders which contain a description of the scope of work to be performed.

In monitoring the implementation of these projects, USAID/Iraq relies on program officers and contracted management staff in its own infrastructure office while also working collaboratively with the U.S. Army Corps of Engineers whose staff of engineers provide technical oversight and evaluations over all active projects.

Of the approximately $2.8 billion in total funding originally authorized under both Bechtel contracts, an estimated $1.1 billion (excluding overhead) was budgeted for the electrical power sector projects that were included in our audit universe. (See Appendix III.) At the time of our audit, USAID was administering approximately 30 percent of the entire U.S. Government funding ($4.3 billion) budgeted in the electrical power sector. As of January 31, 2005, combined cumulative obligations and disbursements under both Bechtel contracts totaled approximately $2.4 billion and $1.0 billion, respectively.

AUDIT OBJECTIVES

As part of its fiscal year 2005 annual audit plan, the Regional Inspector General in Baghdad conducted this audit to answer the following objectives:

- Are USAID/Iraq's electrical power sector projects achieving their intended outputs?

- Is USAID/Iraq addressing institutional capacity-building in its projects to rebuild and rehabilitate Iraq's electrical power sector infrastructure?

Appendix I contains a discussion of the audit's scope and methodology.

[2] In May 2004, a temporary organization—the Project and Contracting Office—was established within the Department of Defense to provide acquisition and project management support to the Chief of Mission in Iraq following the transition of authority to the Iraqis.

AUDIT FINDINGS

Are USAID/Iraq's electrical power sector projects achieving their intended outputs?

USAID/Iraq's electrical power sector projects were not always achieving their intended outputs. Under the Mission's Iraq Infrastructure Reconstruction (IIR) Program, a total of 22 electrical projects were being implemented under two successive reconstruction contracts (Phase 1 and Phase 2) with Bechtel National, Inc. (Bechtel). Of the 22 projects, 7 (32 percent) were not achieving their intended outputs for reasons beyond the Mission's control. As a result, these projects will either not be able to generate electricity for Iraq's electrical network or will be unable to generate this additional power as planned due to delays. This issue is discussed further on page 6.

As of January 31, 2005, half of the power sector projects reviewed (11 out of 22) were already completed. Many of these projects, while often smaller in scope and funding level compared to those that were still active, resulted in outputs that helped to improve the reliability of power generation at Iraq's electrical power facilities and the repair of the country's transmission network. Listed below are a few examples.

- **Bucket Emergency Action Work Authorization** (JO-03-005): Under this project, approximately $745,000 was spent to provide a variety of equipment, supplies and services for a series of small-scale repair and maintenance activities at a number of power-generation plants within Iraq. Examples of some of the equipment and supplies procured under the project included turbine oil, chemistry lab equipment and analysis chemicals, oxygen for welding, small construction tools, and material to support repairs to power plant boilers. Technical support was also provided to repair a turbine gear at one power station and to service a turbine control system and align the turbines at another.

- **Heat Exchangers at Hartha, Shuaibah, Najibiyah and Khor Al-Zubayer** (JO-03-054): Power-generation plants rely on heat exchangers to make efficient use of the energy generated by their boilers and combustion turbines (e.g., to reheat the water used in steam turbine systems) and prevent the system from overheating. This $2.7 million project was designed to rehabilitate the heat exchangers at four power plants in southern Iraq. At each of these plants, the initial assessment found that over 50 percent of the internal tubing contained in the heat exchangers was clogged, forcing these plants to operate well below full capacity due to potential overheating concerns. As of January 31, 2005, this project was nearing completion and on track to be finished by its target completion date. At the time of the audit, Bechtel had replaced the heat exchangers at two of the four power plants and was in the process of completing the replacement of the heat exchangers at the third. Work at the fourth plant (Najibiyah) was not deemed necessary since the units there were found to be in good condition with adequate spare parts on hand. Although the audit was unable to ascertain the amount of additional electricity generated as a result of this project, at a minimum, the installation of the new heat exchange system improved each plant's ability to produce electricity more reliably.

- **400 Kilovolt (KV) Transmission Line** (JO-04-004): This $17.7 million project was intended to repair a large number of the transmission towers along the 205-kilometer Khor Al Zubayer–Nassiriyah Transmission Line corridor which services the southern Iraqi city of Nassiriyah. As of September 12, 2003, there were 155 towers down within this corridor with significant amounts of missing or cut cables. The project was later expanded when a field survey identified additional towers that either did not meet industry standards or showed signs of damage due to vandalism, resulting, in part, from a lack of continuous security along the line. The work under this job order involved the dismantling, refurbishing and installation of materials—including foundations, towers, conductors and other accessories—needed to restore the transmission line so that it can once again transmit electricity within this part of the country. The project was physically completed in June 2004 at which time the transmission line was accepted, synchronized and connected to the country's national grid for immediate use.

Photograph showing one of the 155 severely damaged transmission line towers along the Khor Al Zubayer-Nassiriyah corridor. USAID funded a project to refurbish these towers to permit the transmission of electricity through this corridor. (Photo furnished by Bechtel; undisclosed location in Southern Iraq; June 2003)

Photograph of one of the towers erected under USAID's transmission line project (JO-04-004) along the Khor Al Zubayer-Nassiriyah corridor in Southern Iraq. (Photo furnished by Bechtel; undisclosed location in Southern Iraq; undated)

A number of the USAID/Iraq's electrical power sector projects, however, were not as successful in achieving their intended outputs as described below.

Intended Outputs Were Not Always Being Achieved

Summary: USAID/Iraq's electrical power sector projects were not achieving their intended outputs for 7 of the 22 (32 percent) power sector projects reviewed. The audit, however, determined that the underlying problems preventing these projects from achieving their planned outputs were beyond the Mission's control. Two of the seven projects, for example, were impacted by the U.S. government's revised spending priorities and cancelled during implementation while several other projects were experiencing major delays or hampered by a lack of cooperation from Iraqi Ministry of Electricity (ME) plant staff, deteriorating security and other reasons. Because of these problems, some of USAID's projects will no longer be generating additional electricity to Iraq's national electrical grid while others will be seriously delayed and prevented from contributing much-needed electricity as planned.

The electrical projects carried out under Bechtel's two infrastructure contracts (Phases 1 and 2) were authorized through the issuance of Job Orders (JOs) by the Mission to Bechtel. The JO provides a description of each project's scope of work while also specifying the project's primary outputs, period of performance (e.g., completion date), terms of performance and an approximate cost estimate for the work to be performed. Since this information was needed to ascertain the intended output under each project, the JO was used as a basis in reviewing the projects included in our audit universe.

Our review disclosed that projects were not always achieving their intended output. Of the 22 projects reviewed, 7 (32 percent) either did not achieve or were not achieving their planned output for reasons beyond the Mission's control. (See Appendix III for a list of these projects.) For example, two of the seven projects were impacted, either directly or indirectly, by the U.S. government's earlier efforts, in September 2004, to reallocate over a billion dollars in government-wide infrastructure funding from the electrical sector to security and other priority areas, resulting in the cancellation of the two projects. In addition, several other projects were experiencing major implementation delays or hampered by a lack of cooperation from the Iraqi Ministry of Electricity (ME) staff, deteriorating security and other factors. Several examples are discussed below.

- **Bayji Thermal Power Plant** (JO-04-512): This $100.6 million project involved the rehabilitation of two of the turbines (units 4 and 5) at the Bayji Power Plant to maximize their output and reliability. The project was abruptly halted in late September 2004—three months after work began—at the request of the Iraq Reconstruction Management Office (IRMO). An official with this office claimed the project was cancelled due to cost concerns, but this was disputed by an official overseeing the project who indicated that the project's projected cost per kilowatt was relatively low. Coincidentally, around the time of cancellation, IRMO was in the process of conducting a strategic review which involved identifying resources under IRRF II that could be reprogrammed in order to raise the $3.46 billion (including $1.074 billion from the power sector) needed for security and other priority areas. The cancellation of this project resulted in net savings of approximately $135 million (including overhead), of which $126.5 million was deobligated from Bechtel's Phase 2 contract and made available to IRMO for reprogramming, representing USAID's contribution to this realignment process.

However, the cancellation of this project has also meant that Bayji's two turbine units will not be rehabilitated under Bechtel's contract and may not be rehabilitated at all in the immediate future since the ME reportedly lacks the financial resources to carry out the work itself. Presently, unit 4 is in operation, but only producing about 125 megawatts (MW), or 57 percent of its design capacity, whereas unit 5 is completely out of commission as a result of a boiler explosion. These two units have not operated at or near full load conditions for over 20 years. Upon completion of the project, both units were expected to provide a combined total output of up to 400 MW by the winter 2005 peak, or an additional 275 MW. As a result of the cancellation, however, no additional power will be realized from this project, which will still incur approximately $1.9 million in direct costs and an estimated $5.0 million in total costs, including overhead.

- **Natural Gas Development for Power Generation** (JO-04-513): The focus of this $381.4 million project was to use a fast-track approach in the development of a new power-generation facility using the natural gas resources in the Mansuria gas fields. As of January 31, 2005, however, the project was in the process of being phased out (i.e., cancelled) due to funding constraints imposed as a result of earlier efforts to reprogram IRRF II funding from the power sector.

  In December 2004, after successive requests by USAID/Iraq to initiate new projects were denied by IRMO, it became apparent to the Mission that the Phase 2 contract was not going to be funded further for the entire $1.8 billion and that obligations would likely remain at or near their current level of approximately $1.4 billion. This prompted Bechtel to perform a financial analysis to "re-crunch" the numbers, factoring the new ceiling into account, since its original cost estimates were based on Bechtel receiving the entire $1.8 billion in funding. Based on this analysis, Bechtel determined that implementing its current portfolio of projects under the Phase 2 contract to completion would result in a deficit of about $242 million. In light of this projected deficit, the Mission notified IRMO which, in turn, made the decision to phase out this project, effectively canceling it, in an effort to close the funding gap. Given the size of the project ($381 million) and the security concerns associated with its implementation, the project was considered an appropriate candidate for cancellation. On March 31, 2005, an amended JO was issued, which drastically de-scoped the project and reduced its budget to $69.4 million, resulting in net savings totaling approximately $312 million.

  Although the net savings enabled Bechtel to close its funding gap, the project is still expected to incur $69.4 million in costs despite the fact that little has actually been achieved. While the construction of the power-generation facility had been removed from the project during the de-scoping, Bechtel had already ordered the two combustion turbine generators (which were still at the factory awaiting delivery at the time of our audit) and other supporting equipment (e.g., transformers) that were to be installed in the facility. This equipment had a total estimated cost of approximately $51 million, including freight charges. Since the new turbines and other equipment would no longer be required, arrangements were made to hand them over to the ME, which planned to install them at one of its power plants in southern Iraq at some future time. Both turbines, once installed, were expected to each generate up to 108 MW of electricity or a total of about 216 MW of additional power. With the cancellation of the project, unfortunately, this additional power will not be generated under this contract.

- **Doura Power Plant Rehabilitation Units 5 & 6** (JO-03-037): Under this $90.8 million project, Bechtel was tasked with the rehabilitation of two of the four steam turbines at the Doura Power Plant, one of the main power plants supplying electricity for the Baghdad area. Although the two turbines being rehabilitated had a designed output rating of 160 MW each, they had been poorly maintained and had not been in use for several years. Work under this project began on August 1, 2003 and was originally planned to be completed by April 30, 2004. The project's completion date, however, has been amended several times to account for additional work determined to be necessary during the course of the project, resulting in an expanded scope of work. As of January 31, 2005, the approved project completion date was May 1, 2005—a year beyond the original completion date. Due to implementation delays, however, the project was not expected to be completed by this date either or by the date the contract under which this project was funded was set to expire (June 30, 2005).

  One of the problems behind the delays has been the fact that this project was integrated with other projects and activities being carried out concurrently by the ME and another (non-USAID) contractor, with the latter two responsible for upgrading some of the many systems supporting the two turbines being rehabilitated. As a result, the completion of the project by Bechtel, which required that the rehabilitated turbines be placed back into operation, depended on both the ME and its contractor completing their respective areas of work. However, according to the Mission, the U.S Army Corps Of Engineers (USACE) and Bechtel staff, the ME has not been effectively managing and coordinating this process to ensure that the work on these other areas, to be carried out by either the ME staff or its contractor, was being completed in a timely manner. This, in turn, has hampered Bechtel's efforts to complete its work.

Photograph showing one of the two turbines that Bechtel National, Inc. was refurbishing at the Doura Power Plant in Baghdad (Baghdad, Iraq; March 2005)

One area, in particular, which has been a source of delays involved the work performed by the ME's contractor hired to replace the boiler system connected to the turbines Bechtel was rehabilitating. The boiler repairs were already in progress at the time the USAID project commenced and were being carried out under a separate project funded by the United Nations Development Program and managed by the ME. This work, however, was experiencing serious delays that were compounded when the contractor staff carrying out the boiler repairs departed from the site for the holidays in December 2004—halting work for a period of at least 6 weeks. While staff eventually returned to the site, progress continued at a slow pace, preventing Bechtel from proceeding with the start-up of the turbines until the ME's contractor finished its work on the boilers and the ME completed its tasks on the other systems supporting the turbines.

To address this problem, a decision was made to phase out the original project since funds were running low and the project was approaching the contract's expiration date and to establish a new project funded under the Phase 2 contract. An additional $30.3 million was allocated to this follow-on project, which was designed to provide management services and technical support, along with parts and equipment, to assist and advise the ME in coordinating the remaining work that both the ME and its contractor were responsible for completing before the rehabilitated turbines could be brought back to operation.

While it remains to be seen whether this action will lead to the start-up of the turbine units, the work will certainly not be completed during the summer of 2005 as earlier planned. Bechtel's latest projection, as of May 2005, was for the first turbine unit to be completed by October 31, 2005, with the second unit to be completed in the following months. Meeting these milestones, however, will be contingent on the ME ensuring that a series of work items, covering different systems, are completed properly and according to schedule. If this is not done, it may be a while before the two newly rehabilitated turbines at Doura are back on-line and producing electricity once again. With Baghdad desperately needing the additional power and the amount of funding under this job escalating from $34.1 million to $121.1 million during the two years of implementation, much is at stake.

Photograph showing two of the four smokestacks at the Doura Power Plant which will remain dormant until the two turbine generators for units 5 and 6 are put back into operation. (Baghdad, Iraq; March 2005)

- **Kirkuk Substation Combustion Turbines** (JO-03-060): This $174.2 million project involved the installation of two new gas combustion turbines, a 65-MW unit (V64) and a 260-MW unit (V94), and related auxiliary equipment at an electrical substation located in northern Iraq. The project commenced in August 2003 with the intent of providing additional electricity in time for the summer 2004 peak demand period. The project, however, has been seriously delayed with only one of the two units (V64) in operation as of February 2005 and the other unit (V94) not scheduled to become operational until mid-September 2005—two and a half months after the Phase 1 contract expires.

  Since the beginning, the project has undergone a number of changes and encountered an assortment of problems that together have resulted in major implementation delays. For example, given the economies associated with using larger units, the original scope of work was modified several months after the project started, replacing the three 40-MW turbine units specified in the original job order with the much larger V94 and V64 units.

Photo showing the new V64 turbine unit installed by Bechtel at an electrical substation located outside of Kirkuk in northern Iraq. The unit was installed in early February 2005 and added 65 MW to the national grid. (Furnished by USACE; Kirkuk, Iraq; April 2005)

The deteriorating security situation within the country also played a role as it affected the movement of goods and materials and the mobilization of essential management staff. And there were logistical challenges as well, as illustrated by the difficulties and delays experienced with the delivery of the V94 turbine unit.

This gigantic unit—weighing over 600 tons—was initially shipped to a port in Syria where, in late January 2004, it began its long overland trek toward the Iraqi border. En route to the border, however, the Syrian Government refused to grant permission for the heavy cargo to cross a dam situated within the country. Denied passage across the dam, the turbine unit remained in Syria for almost 5 months, from April to September 2004, before the cargo was forced to be rerouted south to the Jordanian border. There it sat idle for another 6 months,

from September 2004 to March 2005, waiting while contractors could affect the necessary repairs and upgrades to shore up some of the bridges along the new route into Iraq so that the bridges could support the heavy load. Then, in March 2005, the turbine unit finally set out, escorted by 300 military personnel in a 30-vehicle convoy, on the 640-mile journey from the Jordanian border through the often hostile western region of Iraq before arriving at the substation in April 2005.

Photograph of the large V94 turbine generator after its arrival at a substation near Kirkuk. Upon its installation in the fall of 2005, the unit is expected to generate an additional 260 MW of electricity for the national grid. (Furnished by USACE; Kirkuk, Iraq; April 2005)

Although this project was making progress at the time of our audit, with the smaller V64 completed in February 2005 already in operation, Bechtel forecasted that the V94 would not be completed until mid-September 2005. Because of this delay, it is unlikely the V94 unit will be on-line and generating electricity in time to alleviate the heavy peak demand during the summer of 2005, with the project only contributing the 65 MW generated from the V64 by this time frame, rather than the full 325 MW expected from both turbines.

The delays and revisions to the project's scope have also resulted in a sharp escalation in the total estimated costs under this project with total overall costs rising from $99.1 million to $174.2 million and forecasted to rise even further as a result of the delivery delays. According to Mission officials, Bechtel anticipated receiving claims from its subcontractor relating to the delivery of the V94 unit for an additional $54 million. While the final amount of these claims was not yet known and was expected to be subject to negotiation, it is clear that the delivery delays will have major cost implications. Mission records, for example, indicated that the subcontractor had already submitted an initial claim for $10 million for the failed transit through Syria.

- **Mussayab Thermal Power Station** (JO-04-504): Under this $22.9 million project, Bechtel provided technical and managerial support to the Mussayab Power Station, located 50 kilometers south of Baghdad, to enable the facility to operate at near full capacity and increase its average daily production from 435 MW to 675 MW, or an additional 240 MW. Although the project provided services and parts that were used to repair existing equipment and restore 300 MW of electricity, these inputs did not result in an increase in the facility's average daily generation level which, in fact, decreased to 425 MW during the project's initial 11 months, from March 2004 through January 2005.

  These disappointing results were attributed to the lack of cooperation from the ME plant management and personnel. According to USAID infrastructure office staff and Bechtel status reports, plant management and personnel often refused to follow the advice offered by Bechtel's technicians. Part of the problem stemmed from the culture that existed at the plant where staff tended to put off routine maintenance and avoid necessary repairs until a critical failure occurred. Receiving little cooperation and support from the plant's staff, Bechtel found it difficult to change this situation and get staff to properly operate and maintain the plant's equipment so as to improve the performance of the plant's operations.

  In March 2005, prompted by the continuing difficulties with the ME plant staff and the need to trim costs under the Phase 2 contract to address a funding deficit, the Mission de-scoped the project and phased it out. This entailed a major reduction to the project's scope, including the removal of work to refurbish systems supporting the plant's four turbine units and assistance during the plant's spring 2005 maintenance outage, resulting in a decrease in the project's funding level from $22.9 million to $6.6 million. Consequently, Bechtel was unable to provide the extent of technical services called for under the job order, thus preventing the contractor from being able to keep the plant's four turbines running reliably enough to achieve the project's average production-level target of 675 MW—much less produce any increase to the existing level. In addition, because the plant did not receive support during the spring maintenance outage, the risk of unscheduled shut downs during the summer months will increase.

Photograph showing the Mussayab Power Plant where USAID funded a project providing technical and management support to plant staff. The project was terminated in March 2005 due partly to a lack of cooperation from the ME staff. (Mussayab, Iraq; March 2004)

By not achieving their intended outputs, these projects will either not result in the generation of additional electricity or will be seriously delayed and not able to contribute this electricity as planned. Five of the seven projects cited by our audit involved power generation activities that were expected to generate an estimated 1,394 MW of additional electricity for the country. Of this amount, we determined that at least 537 MW (39 percent) will no longer be generated due to the cancellation of two of the projects. Costs incurred to date under these two projects were estimated to total approximately $71 million (excluding overhead), which included $51 million spent to procure two turbines and related auxiliary equipment that will be handed over to the ME for installation at some future time. Meanwhile, the projects expected to generate the remaining 857 MW were experiencing significant delays and were not projected to be completed until the fall of 2005 at the earliest. As a result, these projects will not be completed in time to contribute additional electricity to help meet the high peak demand during the preceding summer months and, therefore, will be unable to alleviate the chronic shortages that frequently occur, particularly during that time of the year.

With daily electrical output remaining below prewar levels and demand continuing to increase, particularly as consumers purchase more appliances, production levels are not nearly enough to cover daily demand, a problem which will likely get worse during the summer months. In its daily power-generation report, dated April 17, 2005, the ME reported total electricity production that day of 77,359 megawatt hours (MWh) with a peak level of 4,009 MW—still below the prewar peak of 4,400 MW. This production level will need to increase substantially in order to meet the summer demand which is projected to rise to 150,000 MWh, according to one USAID power sector advisor. Although State Department figures forecasted production levels to increase to 125,112 MWh by the summer of 2005, this projection was contingent upon power plants receiving sufficient diesel fuel to operate during that period, a key assumption given the frequency with which turbines are out of service as a result of fuel shortages at the plants.

Unfortunately, the projects cited by our audit will not be able to fully contribute toward current efforts to increase the power supply in Iraq. Nevertheless, since the underlying causes preventing these projects from achieving their intended outputs were attributed to circumstances beyond the Mission's control, action by the Mission was not considered warranted. Therefore, we are not issuing a formal recommendation under this finding.

Photograph of new smokestacks under construction at the Baghdad South Power Plant where USAID was funding a $163.7 million power-generation project to install two new 108-megawatt turbines. The project, however, was found to be one of seven that was not achieving its intended outputs. (Baghdad, Iraq; March 2005)

Is USAID/Iraq addressing institutional capacity-building in its projects to rebuild and rehabilitate Iraq's electrical power sector infrastructure?

USAID/Iraq was addressing institutional capacity-building in its projects to rebuild and rehabilitate Iraq's infrastructure in the electrical power sector. However, much more needs to be done in this area to effectively address the wide range of problems and challenges associated with the improper operation and maintenance (O&M) of existing infrastructure which has resulted in its rapid deterioration and damage and has also put newly refurbished infrastructure at risk. This issue is discussed in detail on page 15.

To ensure that capacity-building activities were incorporated into projects to promote their sustainability, both of Bechtel's infrastructure reconstruction contracts (Phase 1 and Phase 2) included an institutional strengthening provision. Specifically, this provision required the contractor to "*involve, to the extent practicable, existing government institutions and utilities in the implementation of the repair and rehabilitation activities*" and "*provide technical assistance and training to build the capacity for effective operation and maintenance of the electric power systems*." The Phase 2 contract went further, requiring Bechtel to perform an assessment under each project to ascertain the level of training required and conduct the necessary training based on this assessment.

Based on available records, we verified that Bechtel, for the most part, was addressing this provision and performing an O&M training needs (i.e., readiness) assessment under each project to ascertain the level of training required and any operational manuals that needed to be provided. We also noted evidence that the Mission was reviewing and concurring with the results of these assessments. Although we were unable to verify whether all planned training and O&M operating manuals were actually being provided (since some projects were still active at the time of the audit), we determined that some form of training and/or manuals were either provided or planned under 80 percent of the projects in our audit universe (excluding two cancelled projects).

According to Bechtel's records, the contractor planned to provide a total of 19,477 hours of O&M training in connection with the power sector projects under its two contracts. As of February 24, 2005, Bechtel reported that it had to date provided a total of 14,186 hours of O&M training. Listed below are several examples.

- ✓ 1,453 hours of formal classroom training for staff at the Bayji Thermal Power Plant covering welding, safety and instruction on maintenance of equipment.

- ✓ 765 hours of training provided to staff at the Doura Power Plant in connection with the rehabilitation of two of the plant's turbine generators.

- ✓ 8,785 hours of training (and operating manuals) given to personnel at the Kirkuk Substation in connection with the replacement of two of the facility's combustion turbines. The training Bechtel provided at this project site reportedly covered almost two dozen pieces of equipment and plant systems.

- ✓ 1,036 hours of training for staff at the Baghdad South Power Plant which included a 30-day training period intended to teach Iraqi plant personnel the O&M practices necessary for operating combustion turbines.

In addition to the above activities, several of Bechtel's projects specifically focused on strengthening capacity and involved the provision of training (formal and informal), technical assistance and other inputs intended to promote effective O&M practices at Iraq's electrical power plants. Listed below are two examples.

- **Power Plant Maintenance Program** (JO-04-503): As part of this $80 million project, Bechtel was providing approximately 60,000 hours of O&M technical and management training for 239 ME staff who were divided into tiers corresponding to their management level with (i) 5 senior ME staff receiving instruction in leadership and strategy at an industry training center in the U.S.; (ii) 36 plant managers receiving management training at a U.S. university; (iii) 83 senior power plant staff receiving train-the-trainer instruction in the area of combustion plant and thermal plant operations at a university in Jordan; and (iv) 115 plant operators and technicians receiving technical training, also in Jordan, covering different aspects of power plant operations, including safety, maintenance, instrument calibration and control systems. The project also allocated funding to provide targeted O&M assistance to ME staff at the Doura Power Plant. Under this activity, a resident technical support team was assigned to the plant to provide coaching, mentoring, on-the-job training and general operating support to plant staff to assist them in carrying out the necessary work to facilitate the start-up of the two turbines at the plant currently being rehabilitated by Bechtel.

- **Mussayab Thermal Power Station** (JO-04-504): This $22.8 million project provided plant staff with direct, hands-on technical and managerial support to help ensure that the power plant operated at its full potential. In addition to technical services, parts and equipment were also provided to support the maintenance work performed in connection with this project.

While the above activities all contributed toward building capacity within the ME, much more needs to be done to effectively address the major problems and challenges that currently exist at Iraq's power plants to ensure that the benefits derived from USAID's electrical infrastructure projects are sustained. This issue is discussed in detail below.

USAID Infrastructure Projects At Risk of Sustaining Damage

Summary: USAID's newly refurbished infrastructure in the electrical power sector is currently at risk of sustaining damage as a result of improper O&M practices. Based on reports of damage frequently occurring to existing (non-USAID) equipment—all resulting from poor O&M procedures—it is difficult to imagine that USAID's infrastructure projects will be spared a similar fate after they are turned over to the ME. Unfortunately, the problems and challenges involved are numerous and complex and exist at both the power plant and the ministry level. And until these problems are effectively addressed and result in significant improvements in the O&M practices at the power plants, reports of damaged equipment and infrastructure will continue. This, in turn, will jeopardize USAID's billion dollar investment in Iraq's electrical network and prevent USAID-funded projects from delivering their full benefits to the millions of Iraqis who rely on this network for their electricity.

Photo showing the deteriorating condition of existing equipment at the Bayji Power Plant (Furnished by USACE; Bayji, Iraq; September 2004)

One of the objectives under USAID's IIR Program, in addition to the successful reconstruction of Iraq's electrical network, is to promote the sustainability of its projects through the provision of technical assistance and training to build capacity and ensure the effective operation of the infrastructure turned over to the ME. The need to strengthen O&M capacity and emphasis on sustainability has received increased attention in recent months. For example, in its April 2005 quarterly report to Congress on the reconstruction, the U.S. Embassy in Baghdad reported the reprogramming of funds to provide for better O&M on projects funded under IRRF, reflecting a shift from a long-range, "design-build-turnover" project orientation to a systems one that emphasizes training and capacity-building "to ensure that the U.S. investments made in Iraq could be sustained and maintained to realize a good measure of their potential."

There were clear indications, however, that USAID's projects to refurbish the country's electrical power infrastructure may not be sustained due to improper operations and/or maintenance practices within the ME. In a memo issued to the Mission in December 2004, Bechtel stated that it regularly received reports of major equipment damage, in some cases involving new units installed since the war, resulting from errors in operation and neglect of equipment. Bechtel stated further: "*These reports cover projects in all sectors and are most disturbing because literally minutes of improper operation can destroy thousands of hours of work, capital assets and make unserviceable a critically needed facility for weeks or even months, depending on the damage*."

An example of this was seen during a recent USAID-funded maintenance inspection at the Al Qudas Power Plant, site of an earlier USAID project to reactivate two of the plant's turbines that were left inoperable after the plant was looted during the war. The work under this $3.6 million project involved servicing the turbines to allow them to operate on heavy crude oil, a more abundant fuel, to ensure their continued operation. Upon completion in July 2004, the two turbines were generating at or near their rated capacity (for crude) of 104 MW each, according to one USACE technician overseeing the project.

However, a subsequent inspection of the turbines in the spring of 2005 revealed that the units had not been properly maintained. For example, one USACE employee stated that the inspection team noted the blades on one of the turbine units had residue caked on from the crude oil, with some blades either being replaced or requiring longer than normal time to service and clean. Although the crude oil used to fuel the turbine was being treated with chemicals (inhibitors) intended to minimize residue buildup within the system, the inspection team found the power plant was using poor quality chemicals that were not effective in treating the oil, causing higher levels of residue to accumulate. The team also found that the fuel lines leading to the turbine unit were clogged with this residue while deposits were seen forming on some of the turbine blades (see photos below) and in other parts of the system, causing reduced output. Bechtel estimated a 45 to 65 percent reduction in the output of each of the plant's two turbine units.

And there were other maintenance problems identified, according to USACE staff. The inspection team, for example, noted that the automatic protection controls, designed to disable systems exceeding normal operating conditions to protect the equipment, had been manually bypassed (i.e., jumpered) at 23 separate safety points.

One USACE technician also stated that, during a recent visit to the plant, he observed clear signs that a fire had taken place within the large metal structure housing one of the turbine units as evidenced by peeling paint and soot on the structure's walls. According to the technician, this event was not surprising given the accumulation of oil and debris often found on the floor underneath the turbine unit from prior maintenance work, with little effort by staff to clean it up. He also pointed out that the fire protection system was not functioning since key parts were missing from the system preventing the carbon dioxide canisters from being able to disperse the chemical at the time of the fire. Plant staff, meanwhile, denied a fire even occurred despite clear evidence to the contrary.

With no further USAID-funded inspections planned for this plant in the near future, continued neglect of these units will ultimately result in additional damage, possibly requiring even more extensive repairs and further reductions in output.

(Left): Photo showing sludge buildup resulting from poor fuel treatment in a fuel line leading to one of the turbines at the Al Qudas Power Plant; (Right): Photo showing a crack and crude oil deposits accumulating inside the turbine. (Furnished by USACE; Al Qudas, Iraq; April 2005)

This appears to already be the case at the Bayji Thermal Power Plant in northern Iraq, where USAID funded a $26.8 million project involving the partial rehabilitation of four of the plant's steam turbine generators, including supporting boilers and auxiliary equipment. Despite this work, which was completed in August 2004, one of the turbine units serviced under the project was already out of operation by mid-January 2005, as a result of a broken rotor and was still not back on-line 4 months later in mid-May 2005.

Evidence of poor maintenance was also observed first hand while the audit team was visiting the Doura Power Plant in Baghdad. During a tour of the plant in May 2005, the visitors saw a feeder pump, which pumps water into the boiler so that it can be heated to run the turbines, that was leaking water profusely from the connecting pipes and the pump itself, causing water to accumulate on the plant floor with nowhere to drain to while also creating a safety hazard. According to Bechtel staff at the site, the ME plant personnel performed maintenance repairs on the pump several months earlier to repair the leak. But they apparently did a poor job since the repairs only lasted a few months before the leak returned—and in force. One Bechtel employee at the site explained that such leaks can result in serious damage to the system. Specifically, the problem can cause the pump to eventually breakdown since this piece of equipment is pressure-sensitive and replacing it would involve a lengthy shut down of the system. The leak also forces the plant to constantly replenish the system with additional water to keep the boilers operating. If this water is not properly treated with chemicals, it can contaminate the system and cause corrosion to the pipes, not to mention to the boiler itself.

Photograph of water leaking from pipes connected to a feeder pump supporting one of the boilers at the Doura Thermal Power Plant. ME plant staff had performed maintenance work on the pump to repair the leak several months earlier but failed to adequately address the problem. (Baghdad, Iraq; May 2005)

The power plant has also experienced a series of thefts involving various instruments, including some provided under USAID's current rehabilitation project at the plant. Most recently, in April 2005, the plant had 46 pressure transmitters, valued at $1,800 to $3,000 each, stolen from the turbine units USAID was in the process of rehabilitating. This follows an earlier incident involving 13 instruments stolen in January 2005.

Unfortunately, the problems noted at the above power plants are not unique. During its work, Bechtel has reported numerous cases of damage found at other plants involving existing (non-USAID) equipment, all resulting from improper maintenance and/or operations practices. Examples of some of the damage reported included the following:

- ✓ **Destroyed forced draft fans** (one plant): Damage attributed to plant staff failing to maintain the fan bearing oil levels.

- ✓ **Boiler explosions** (two plants): At one plant, an explosion resulted from plant staff bypassing the gas control valve system.

- ✓ **Substandard welding work** (one plant): Work had to be performed to redo literally thousands of welds in the boilers at one plant because the existing welds were so poorly done in the past.

- ✓ **Turbine bearings ruined** (two plants): Bearings were ruined when the emergency oil pumps, which pump lube oil into the system to prevent damage to the bearings, malfunctioned during a loss of power at the site. This occurred at one plant and then again several months later at a second plant where it happened twice—involving the same turbine unit.

- ✓ **Overheated and damaged motors** (two plants).

- ✓ **Turbine blade breakage** (two plants).

- ✓ **Gas re-circulating fans not operating** (various plants): Fans are frequently out of service, causing losses in power output.

In its December 2004 memo to USAID, Bechtel informed the Mission that in carrying out its numerous infrastructure projects, it had become apparent "*that the greatest challenge to providing Iraqis with sustained long-term benefits from these projects would come from the absence of a systematic program to maintain and operate them properly*."

In the past, there has been little emphasis on maintenance. A joint needs assessment on the power sector done by the United Nations Development Program and World Bank, in October 2003, reported that Iraq's power system had deteriorated to a situation where its power supply had become extremely unreliable and now suffers from a significant backlog of required maintenance, a lack of spare parts and little capital investment.

One official within IRMO stated that the U.S. government significantly underestimated the amount of damage done to the basic infrastructure and workforce capability caused by decades of neglect, despotic rule and warfare. After the handover of power in June 2004, it became clear to IRMO officials that the Iraqi ministries had limited ability to provide the resources needed for near-term reconstruction or even basic O&M.

And the absence of proper O&M practices in the plants continues to this day. In its December 2004 memo, Bechtel expressed its concerns to USAID regarding the lack of O&M in the plants. Based on its work at the project sites and assessments at six plants, Bechtel reported a series of systems deficiencies, which included the following:

- ✓ **Absence of O&M Systems**: Assessments found no evidence of (i) maintenance procedures; (ii) preventive maintenance schedules; (iii) maintenance logs; (iv) technical manuals showing how equipment was to be operated; and (v) periodic equipment testing. In addition, plants did not maintain a formal plan for shutting turbines down for scheduled maintenance (i.e., outage). Bechtel, in fact, observed examples where the plant manager was not being allowed to take a unit off line to perform badly needed maintenance as a result of pressure from the ME headquarters to keep the turbines operating and generating electricity.

- ✓ **Absence of Training**: There was also no evidence of formal training programs. Based on discussions with plant personnel, Bechtel identified gaps among staff in core job knowledge and skills, gaps that contribute to operator mishaps when problems arise. Without sufficient technical training, employees lack insight into how systems operate, causing them to be fearful when operating new systems.

- ✓ **Absence of Preventive Maintenance**: Bechtel also observed that no efforts were being made to use preventive maintenance practices to prevent equipment from failing, a problem Bechtel attributed to a culture that sees maintenance as reactive, rather than preventive. Although the repair of equipment is evident, this is only after the equipment or components have failed, a practice known to some as "breakdown maintenance," whereby maintenance is often put off until a critical failure occurs. One official at the Mission stated that major oversights in maintenance are frequent and often result in irreparable damage to equipment.

- ✓ **Improper Operations Practices**: Staff are routinely observed exceeding normal operating limits for equipment, often overriding safety controls or protective systems designed to prevent equipment damage under improper operating conditions, thereby placing the equipment, the facility and the personnel at risk.

- ✓ **Discomfort with New Systems**: Bechtel also reported that staff distrusted automatic systems—intended to prevent operation or equipment failures—and often tended to bypass them in favor of known manual processes.

Another key deficiency at the power plants, according to several power sector officials interviewed, is the lack of accountability that exists at the plant where plant employees are neither rewarded for demonstrating good quality work or improvement nor punished for poor performance. While the level of plant supervision was considered weak, with good operating practices not being enforced at the management level, Bechtel pointed out that within power plants "disciplinary actions are fraught with difficulty." For example, the plant manager's office at one plant was stormed by employees over the firing of an employee. Tribal threats have occurred at another plant over hiring practices. As a result, this has fostered an environment where employees have little incentive to demonstrate improved performance. This was supported by comments from several staff assigned to oversee USAID's power sector projects who observed that employees often displayed a lack of (i) initiative; (ii) maintenance ethic; (iii) willingness to take ownership; (iv) discipline; and (v) pride in their work (worker apathy).

The lack of proper O&M was also attributed to the ME's inability to establish ministry-wide systems essential to a successful O&M environment. A recent draft of a White Paper compiled in May 2005 by a joint working group of representatives from the State Department, IRMO, USAID and the Project and Contracting Office (PCO) concluded that the basic government infrastructure needed to create an environment of accountability does not presently exist and that the central ministries are not organized to manage and direct O&M resources in a timely and efficient manner.

Other deficiencies at the ministry level cited by power sector officials we spoke with included the following:

- ✓ **Lack of Inventory Systems**: The lack of spare parts at the power plants has been a chronic problem stemming, in part, from plants not having the expertise needed to order the necessary replacement parts. However, in those instances where parts have been ordered from the central ministry (since plants often lack the finances to buy their own spares), officials reported that procurement requisitions are sent to the ME's headquarters never to be heard from again. One problem is that there is presently no ministry-wide inventory system for identifying needed spare parts for specific plants and determining what spare parts are available and in stock around the country so that needed spares can be readily identified and delivered to those plants requiring them.

- ✓ **Lack of Support for Outages**: In addition to the difficulties in obtaining spare parts, plants were further discouraged from performing much-needed maintenance on its turbine generators (scheduled outages) as a result of pressure from the central ministry, as mentioned earlier, not to shut down the turbines to ensure that the turbines continued to generate electricity.

- ✓ **No Employee Incentive Plans**: The ME does not maintain a pay incentive system that rewards staff for good O&M practices.

- ✓ **Lack of Personnel Systems**: The ME also lacks personnel systems which include an evaluation process that would enable management to identify appropriate staff for particular positions.

- ✓ **Lack of Fuel Strategy**: In addition, the ME needs a rational fuel strategy for ensuring that plants maintain adequate inventories of fuel on hand to operate their turbine generators. One IRMO official estimated that approximately 600 MW of additional electricity could be added to the grid immediately if the appropriate fuel was available. Because the ME cannot secure the proper fuel (natural gas, light fuel oil, diesel fuel) to operate all of its power plants, it is forced to use heavy crude oil at many plants. Unfortunately, using crude oil increases maintenance costs by a factor of three, decreases the life-span of the generators by 60 to 70 percent, and requires more frequent maintenance by plant personnel.

- ✓ **Lack of Training**: O&M training has not been viewed by the ME as a high-priority activity. Until it is, according to Bechtel, plants will not be staffed with people who are properly trained to run and maintain them. A power advisor for USAID commented further that the need for O&M training, while paid lip service, is not readily accepted and often preempted in favor of parts replacement.

Despite these deficiencies, which appear to be systemic, there has been little emphasis since the start of the reconstruction effort on building the capacity of the Iraqis to maintain their newly rebuilt and refurbished electrical infrastructure projects. According to one former Mission official, government planners originally believed that the Iraqi government would have the resources to fund their own institutional-strengthening activities and assumed that other governments and nongovernmental organizations would provide the support for those activities the Iraqis could not perform themselves. However, the need for these activities far exceeded the ability of the fledging Iraqi government, and the other donors never materialized due partly to the security situation.

Photograph of fuel tanks under construction at the Baghdad South Power Plant. These tanks will be used to store fuel oil used to operate the power plant's new turbines which USAID was installing under a $163.7 million project. (Baghdad, Iraq; March 2005)

Although USAID was able to provide some input during the initial reconstruction period, it did not have control over the macro-level budget decisions concerning the allocation of funds. When the IRRF II supplemental appropriations bill was approved in November 2003, the bill developed into a "laundry list" dominated by large construction projects. A senior Mission official stated that the Mission pushed for a comprehensive approach that would incorporate activities designed to rebuild the institutions supporting its projects, but these efforts resulted in limited success. For example, at the time the budget request for the supplemental was being developed, USAID/Iraq stated that it had asked that funds be included for capacity-building in the energy sector. The President's budget request included $25 million in this area, funds that were later eliminated by Congress. Thus, USAID had to limit its capacity-building activities to addressing low-level O&M issues, such as providing basic equipment training at newly refurbished plants.

The lack of emphasis on capacity-building was also attributed to the CPA's Project Management Office (PMO), IRMO's predecessor, which, according to one official overseeing USAID's infrastructure effort, focused the U.S. government's resources on hardware (equipment) rather than on developing the skills the ME staff needed to operate and maintain the expensive (and complex) equipment being installed.

One project, in particular, impacted by this focus on hardware was the Power Plant Maintenance Program Project (JO-04-503), one of the projects funded under Phase 2. This $80 million project involved (i) performing detailed assessments at all 19 of Iraq's power plants to evaluate the condition of each facility, identify areas needing rehabilitation and provide recommendations for improvements; (ii) developing a plant-specific training program, based on a needs assessment, for providing O&M training; and (iii) providing materials and services needed to perform critical maintenance work. The project was designed to establish the foundation for an O&M program in each plant.

Although the Mission received initial approval for this project, there were subsequent efforts by the PMO and its successor (IRMO) to re-scope the project and reallocate funds for spare parts. At one point, the Mission received a letter from the ME requesting that the project be discontinued. Staff overseeing USAID's infrastructure projects, however, pointed out that while the ME sent the letter (and preferred spare parts over this project), the letter was based on a similar letter sent to the ME earlier by a former IRMO official who worked closely with the ministry and reportedly wanted to have the project cancelled so that the project's funding could be reallocated for spare parts.

After further negotiations with IRMO, in an attempt to avoid having the project cancelled and recognizing how critical this project was to the sustainability of its investment in the power sector, the Mission significantly redesigned the project's scope of work with major components dropped and replaced by items requested by either the ME or IRMO. Assessments, for example, were sharply curtailed and outage support was dropped while funding allocated for spare parts was increased three-fold, representing over a quarter of the project's $80 million budget. These modifications, while providing inputs to address more immediate priorities, resulted in a radical shift in the focus of the project that undermined the original project's intent—to lay the foundation for establishing an O&M program at each of the country's power plants. Instead, the project essentially evolved into a training and spare parts activity, thereby reducing the potential long-term benefits that could have been derived from this project.

Photograph of one of the new transformers that Bechtel will be installing in each of the distribution substations that are being refurbished and constructed in the Baghdad area under one of the Mission's infrastructure projects. (Furnished by USAID/Iraq Mission; Baghdad, Iraq; February 2005)

Despite this set back, the Mission continued to request additional funding for capacity-building. After the CPA transferred responsibility for managing the reconstruction effort to the U.S. Embassy in June 2004, the State Department began to reassess the government's reconstruction priorities. As part of this strategic review, USAID/Iraq requested $25 million for capacity-building activities in the energy sector. This request, however, was not approved or reflected in the Embassy's final proposed numbers.

Since then, there has been renewed interest over institutional strengthening. Starting in December 2004, the Embassy began shifting the focus of IRRF-funded activities from new construction projects to the integrated management of existing projects. This shift in focus was reiterated in the Embassy's April 2005 quarterly report to Congress on the reconstruction in Iraq. Specifically, the report stated: "*the original estimate of the damage done to basic infrastructure from decades of neglect and warfare was significantly underestimated; as a result, more time and resources are required to stand-up and maintain systems than originally thought.*"

To fund this effort, IRMO has set aside $103 million from existing funding for O&M activities within the energy sector. In April 2005, USAID/Iraq proposed to use these funds to initiate a capacity-building project designed to provide long-term technical support to help the power plants improve their O&M practices and maximize electrical output. Funds would also be allocated for O&M training and test equipment, tools and spare parts to facilitate the maintenance work performed under the project. Although IRMO agreed in principle to the main components of this proposal, the office was still awaiting the ME's endorsement of the project as of May 2005.

While the increased focus on capacity-building and additional funding allocated to this area represents a positive step, on-going efforts are needed to address the major challenges cited earlier and effectively change the cultural environment that currently exists in the plants, particularly since current efforts are not proving sufficient.

Bechtel shared these concerns and expressed them in its December 2004 memo to the Mission in which it stated that while it noted several initiatives that touched on the needs in the water and electricity sectors, "*they do not encompass the programmatic issues in the timeframe necessary to ensure the facilities are sustained in the near term*."

Until the problems associated with the O&M issue are adequately addressed, the electrical infrastructure rebuilt and refurbished under USAID's projects will remain at risk of sustaining damage following their transfer to the ME. This, in turn, will jeopardize the U.S. government's large investment in Iraq's electrical network, with the possibility that some of this reconstruction will be wasted and not deliver the full benefits to the Iraqis who rely on the infrastructure for their electricity. As of March 2005, the 22 electrical power sector projects included in our audit universe had an estimated total budget of approximately $1.3 billion (including both direct costs and overhead).

In addition to the damage described earlier, the impact of the O&M problems can be seen in the inability to increase the level of electrical power generation in Iraq. Over two years after the end of the conflict, electrical generation remains at depressed levels. During the week ending April 24, 2005, for example, power plants reported an average peak capacity of only 3,984 MW—still below the prewar level of about 4,400 MW—while generating a total average of 80,195 MWh per day. These amounts are far below the

7,800 MW (and 150,000 MWh) which one power advisor at USAID projected will be required to meet the peak demand during the summer 2005—when temperatures often exceed 100-degrees—with some forecasting the demand to go as high as 8,800 MW.

Although Iraq's power plants have approximately 11,000 MW of designed operating capacity, they can generate only a fraction of this amount since the plants are not run properly, according to one senior USAID power official. Daily reports published by the ME show that, on average, thermal (steam) power plants in Iraq are operating at 38 percent of available capacity while plants with gas turbines are operating at 42 percent.

Power plants have also experienced frequent unscheduled shutdowns (i.e., forced outages) of their turbines, with the rate continuing to be very high—one of the highest in the world, in fact, according to IRMO. Normally, one would expect no more than 10 percent of the turbine units being out of operation at any one time for normal scheduled maintenance, according to one power advisor in USAID's infrastructure office. On March 27, 2005, however, the ME's daily power report indicated that 65 of the 123 gas and thermal combustion turbine units (53 percent) were out of operation that day.

Photograph showing the construction of two new 108-megawatt turbine generators at the Baghdad South Power Plant. This is one of several power-generation projects that are expected to be completed during the second half of 2005. (Baghdad, Iraq; February 2005)

During the second half of 2005, USAID is expected to complete and turn over to the ME up to four major electrical generation projects which are expected to generate a total of up to 857 MW in additional electricity. These four projects alone have a combined estimated budget of $604.3 million, representing approximately 53 percent of the total funding (direct costs only) for the 22 power sector projects reviewed under both Bechtel contracts. Given the importance of these projects to the Iraqi people and the level of funding invested, it is essential that the electrical infrastructure perform as intended as failure to do so will cause the country to continue to endure daily blackouts, not to mention reflect badly on USAID and undermine its long-term development efforts.

Without significant improvements, however, it may not make a difference how many new or refurbished power plants USAID turns over to the ME. If the equipment in the plants is not properly maintained, they will not be able to consistently produce a reliable supply of electricity and significantly increase the amount available on the national grid, as evidenced by the fact that power generation is still near pre-war levels despite the completion of a number of power-generation projects over the last two years.

In moving forward, it is crucial that USAID continue its ongoing efforts to ensure that its newly rebuilt and refurbished infrastructure is properly operated and maintained by helping the ME develop the capacity to assume responsibility for this infrastructure. But this will not happen overnight; it will only be accomplished over several years, according to several power sector officials.

In a recent May 2005 draft of a White Paper focusing on the O&M issue, an inter-agency working group concluded: "*There are no silver bullets. Experiences in other countries have demonstrated consistently that comprehensive efforts, at multiple levels are required to build the range of skills and resources necessary for sustainable delivery of essential services. This will be no less true in Iraq where large development needs are compounded by a high level of expectations*."

While we recognize that USAID/Iraq's ability to implement further O&M-related projects within the power sector is contingent upon funding availability and IRMO's approval of each project, we believe the Mission, at a minimum, should establish a strategy. Specifically, the Mission needs to develop a long-term, multi-year strategy outlining the short-term O&M capacity-building and long-term institutional-strengthening activities that are needed to lead to the proper management of the USAID-refurbished plants. Such a strategy will not only enable the Mission to prioritize and program its limited resources with a long-range perspective, but may also serve as a basis for future projects as further funding becomes available. Therefore, we are recommending the following:

> **Recommendation No. 1:** ***We recommend that USAID/Iraq develop a multi-year strategy outlining its long-range plan of activities to be implemented, subject to funding availability, to strengthen the Iraqi Ministry of Electricity's institutional capacity to ensure the proper operation and maintenance of the electrical power sector infrastructure rebuilt and refurbished by the U.S. government.***

EVALUATION OF MANAGEMENT COMMENTS

In response to our draft report, USAID/Iraq concurred with the audit recommendation and described actions it was taking to address the auditors' concerns. Specifically, in response to Recommendation No. 1, Mission management stated that it had already initiated corrective action and was in the process of developing a 3-year transitional strategy (covering fiscal years 2006 to 2008) to address the operations and maintenance issue. Specifically, the Mission stated that this strategy will seek to (i) strengthen the Ministry of Electricity through technical assistance and training on "best" practices and (ii) provide power sector and plant-level training on operations and maintenance.

Based on the above response by the Mission to address the auditors' concerns, we consider the recommendation to have received a management decision.

Management's Comments are included in their entirety in Appendix II.

SCOPE AND METHODOLOGY

Scope

The Regional Inspector General in Baghdad audited USAID/Iraq's electrical power sector activities in accordance with generally accepted government auditing standards. The purpose of the audit was to determine whether (1) the Mission's infrastructure projects to rebuild and rehabilitate Iraq's electrical power infrastructure were achieving their intended outputs and (2) the Mission was addressing institutional capacity-building in the implementation of these projects.

USAID/Iraq's electrical power sector projects were being carried out under the Mission's Iraq Infrastructure Reconstruction (IIR) Program through two successive infrastructure reconstruction contracts with Bechtel National, Inc (Bechtel). The first contract, valued at $680 million (later increased to $1.03 billion), was awarded on April 17, 2003 and is currently set to expire on June 30, 2005. On January 5, 2004, USAID awarded a second contract to Bechtel valued at $1.82 billion, which is scheduled to expire on December 31, 2005. The primary focus of both contracts is to design, rehabilitate, upgrade or reconstruct vital infrastructure in areas such as electricity, water, sanitation, roads and airports, with a significant portion of the total funding under both contracts being allocated for projects within the power sector. The contracts also included an institutional capacity-building component which directed Bechtel to provide training and technical assistance to build capacity for the effective operation and maintenance of Iraq's newly rebuilt and refurbished electrical power system. As of January 31, 2005, combined cumulative obligations and disbursements under both contracts totaled approximately $2.4 billion and $1.0 billion, respectively.

The audit focused on determining whether the electrical infrastructure projects carried out by Bechtel under both of its USAID-funded contracts had achieved or were achieving their intended outputs as of the audit cut-off date (i.e., January 31, 2005). Our audit universe consisted of a total of 22 projects with a combined funding level of approximately $1.1 billion as of the cut-off date. Of the 22 projects, 16 were being performed under Bechtel's initial contract while the remaining 6 were funded under the second contract. Our review of the 22 projects involved an assessment of whether completed projects had achieved their intended output and active projects were on track to be completed by the contract expiration date. These assessments were based, in part, on final inspection records, progress reports issued by Bechtel and other pertinent documentation as well as on input provided by the power sector staff in the Mission's Infrastructure Office and engineers for the U.S. Army Corps of Engineers (USACE) who were responsible for providing technical oversight. With respect to our second objective, we performed an analysis of actual (and planned) institutional capacity-building activities carried out under the 22 projects to assess whether operations and maintenance (O&M) capacity-building was being addressed.

In addition to the above, although not directly related to the audit objective, the audit included an examination of management controls relating to the monitoring of activities performed under both contracts. Specifically, these controls included:

- Attending weekly meetings with Bechtel and Ministry of Electricity officials to keep abreast of specific projects and critical issues and to give direction.
- Reviewing Bechtel's weekly and monthly progress and financial status reports.
- Performing periodic field visits to the project sites to observe work achieved.
- Working with the USACE staff responsible for assisting in the monitoring by providing technical oversight and evaluations.
- Reviewing documentation prepared by Bechtel documenting its efforts to identify, plan and implement appropriate capacity-building activities under its projects.
- Examining and certifying Bechtel's public vouchers.

The audit also involved interviews with technical staff at the USAID/Iraq Mission and engineers with the USACE, as well as with officials with Bechtel and the U.S. Embassy's Iraq Reconstruction Management Office (IRMO), all located within the International Zone in Baghdad, Iraq. The audit fieldwork was performed from January 20, 2005 to June 5, 2005 and was limited to interviews with key technical staff and review of relevant performance and financial documents. In addition, site visits were made to two electrical power plants in the Baghdad area. The audit team was not able to visit additional project sites due to security restrictions at the time of the fieldwork.

Methodology

In answering the two audit objectives, we reviewed available program documents for the 22 projects in our audit universe furnished by the Mission and contractor (Bechtel) and obtained from the USACE's Iraq Reconstruction Tracking System database. This documentation included copies of contracts, job orders and amendments, photos, final inspection records, correspondence, Bechtel weekly and monthly performance reports, and USACE weekly status, site visit and quality assurance reports. In addition, we obtained further information through interviews with Mission, USACE and Bechtel staff on the status of individual projects and clarification on reported problems and performance issues. These interviews were conducted either in person or via e-mail.

In assessing whether the 22 projects were achieving their intended outputs, we reviewed the status of each project as of the audit cut-off date (January 31, 2005). For those projects that were completed as of this date, we determined whether the primary output under each project had, in fact, been achieved. For projects that were still active, we relied on a review of pertinent documentation and interviews with USAID and USACE staff in determining whether the projects were on track to be completed, if not by the latest approved project completion date, then by the expiration date for the contract the project was funded under. Whether on track or not, we kept abreast of any further developments subsequent to our cut-off date impacting on our initial conclusion. With regards to projects that were cancelled or phased-out during implementation (after incurring direct costs), which involved 2 of the 22 projects reviewed, we concluded that these projects had not achieved their intended outputs and ascertained the circumstances prompting their cancellation and the overall impact to the program.

Our materiality threshold for this audit was established at 10 percent. For example, if 90 percent or more of the activities reviewed were determined to be achieving their intended output as of our audit cut-off date, we would conclude that the Mission's electrical power activities were achieving their intended outputs.

Our review to assess whether the Mission was addressing institutional capacity-building in its electrical power sector projects involved a review of available documentation and a series of analyses to (i) verify whether Bechtel was assessing the need for O&M capacity-building activities under each project and documenting the results and (ii) assess the extent of O&M capacity-building inputs (e.g., training, operating manuals) planned and actually provided under Bechtel's two contracts.

As part of our initial planning work, we also examined a prior audit performed by the USAID Office of Inspector General covering an earlier phase of the Mission's infrastructure program, to identify any problems that may be pertinent to the design of this audit. In addition, we performed a limited assessment of the procedures and management controls in place at the Mission for monitoring its two infrastructure contracts to gain an understanding of the Mission's systems and determine the extent of testing required.

USAID
FROM THE AMERICAN PEOPLE

Date: June 18, 2005

TO: Christine M. Byrne, Regional Inspector General Baghdad

FROM: Dawn Liberi, USAID/Iraq Mission Director /s/

SUBJECT: Audit of USAID/Iraq's Electrical Power Sector Activities

REF: Audit Report No. E-267-05-00x-P

On behalf of USAID/Iraq, I would like to thank your office for the conscientious and professional audit report on the Mission's Electrical Power Sector Activities. The findings and accompanying recommendation will be extremely helpful to the Mission as we work to ensure that our administrative and programmatic operations are in full compliance with USAID policies and regulations, and that our resources are managed in the most efficient manner possible.

Through this memorandum, USAID/Iraq concurs with the audit findings below, and provides additional comments for consideration:

- The audit found that the electric power sector activities were not always achieving their intended outputs. Specifically, of 22 audited activities, seven (32 percent) had not achieved their intended outputs. As noted in the report however, the reasons why the Mission could not achieve those outputs were beyond its control.

- Furthermore, the audit found that the Mission was addressing institutional capacity-building in its electric power sector projects through the provision of training and operational manuals. In this regard, the Mission would like to stress that each electric sector project has an operations and maintenance (O&M) component already built into it.

- The Iraqi Ministry of Electricity (ME) asked USAID in September 2004 to discontinue its stand-alone O&M program. Recognizing how critical this program is to the sustainability of its investment in the electric power sector however, USAID was able to convince the ME to accept a redesigned program that best suits the ME's needs.

U.S. Agency for International Development
Iraq Mission, APO AE 09316
Fax +1(202)216-6276

- USAID is administering approximately 30% ($1.3 billion) of the entire U.S. Government budget ($4.3 billion) in the electric power sector.

Finally, the Mission concurs fully with the audit's recommendation and has already initiated corrective action. It is developing a three-year (2006-08) transitional strategy to address the issue of O&M. Specifically, the Mission will seek to: a) strengthen the ME through technical assistance and training on "best" practices and b) provide power sector and plant-level O&M training.

Again, USAID/Iraq would like to express its appreciation to the Regional Inspector General's Office for its professionalism, and for the valuable information and recommendation included in the subject report.

Cc: Amy Fawcett, USAID/Iraq Controller

List of Electrical Power Sector Projects Reviewed
(Audit Universe)

Item #	Contract	Project Title	Job Order #	Approved Funding Level (as of 1/31/05)	Projects Not Achieving Their Intended Outputs
1	Phase 1	Boiler Water Chemicals for Baghdad Plants	JO-03-002	$239,142	
2	Phase 1	Bucket Emergency Action Work Authorizations	JO-03-005	$745,354	
3	Phase 1	Transmission Line Repair Parts and Test Equipment	JO-03-006	$305,036	
4	Phase 1	Power Station Water Treatment	JO-03-011	$9,364,000	
5	Phase 1	Doura Power Plant Rehab Units 5 and 6	JO-03-037	$90,790,100	$90,790,100
6	Phase 1	Air Conditioning for Power Generating Stations	JO-03-046	$414,665	
7	Phase 1	Baghdad Area Emergency Parts and Materials	JO-03-047	$1,660,000	
8	Phase 1	Bayji Power Plant Units 1, 2, 3, 4, 6	JO-03-053	$26,766,347	$26,766,347
9	Phase 1	Crude Oil Treatment Systems at Al Qudas and Bayji	JO-03-057	$3,924,000	
10	Phase 1	UNDP Program for Electrical Power System	JO-03-061	$998,892	
11	Phase 1	Generation Support Program	JO-03-062	$5,770,000	
12	Phase 1	Outage Support Program	JO-03-063	$691,402	
13	Phase 1	Kirkuk Substation Combustion Turbines	JO-03-060	$174,244,000	$174,244,000
14	Phase 1	Heat Exchangers at Hartha, Shuaibah, Najibiyah, and Khor Al-Zubayer	JO-03-054	$2,690,000	
15	Phase 1	South Baghdad Generating Plant	JO-04-005	$45,697,815	$45,697,815
16	Phase 1	400 KV Transmission Line	JO-04-004	$17,702,120	
17	Phase 2	Baghdad South New Generation Phase II Equipment	JO-04-501	$117,949,000	
18	Phase 2	Power Plant Maintenance Program	JO-04-503	$80,000,000	
19	Phase 2	Mussayab Thermal Power Station	JO-04-504	$22,857,000	$22,857,000
20	Phase 2	Baghdad Distribution Substations	JO-04-506	$147,501,000	
21	Phase 2	Natural Gas Development for Power Generation	JO-04-513	$381,363,000	$381,363,000
22	Phase 2	Bayji Thermal Power Plant	JO-04-512	$1,898,410	$1,898,410
			Totals	**$1,133,571,283**	**$743,616,672**

(1) Phase 1 refers to USAID's initial infrastructure reconstruction contract, valued at $680 million, awarded to Bechtel National, Inc. (Bechtel) on April 17, 2003 under the Iraq Infrastructure Reconstruction Program. Phase 2 refers to the second contract, valued at $1.8 billion, awarded to Bechtel on January 5, 2004.

(2) Amounts shown reflect approved funding levels under each project for direct costs only (excludes overhead) as of January 31, 2005 per the latest job order amendment. These amounts are unaudited.

USAID/IRAQ/RIG
APO AE 09316
Tel: (202) 216-6276, extension 1036
Fax: (202) 216-6276
www.usaid.gov