

MOSUL AIR TRAFFIC CONTROL
TOWER AND NAVIGATIONAL AIDS
MOSUL, IRAQ

SIGIR PA-06-034
APRIL 25, 2006



SPECIAL INSPECTOR GENERAL FOR IRAQ RECONSTRUCTION

April 25, 2006

MEMORANDUM FOR COMMANDING GENERAL, MULTI-NATIONAL FORCES -
IRAQ
COMMANDING GENERAL, GULF REGION DIVISION,
U.S. ARMY CORPS OF ENGINEERS
DIRECTOR, IRAQ RECONSTRUCTION MANAGEMENT
OFFICE

SUBJECT: Report on Project Assessment of the Mosul Air Traffic Control Tower and
Navigational Aids, Mosul, Iraq (Report Number SIGIR-PA-06-034)

We are providing this project assessment report for your information and use. We assessed the in-process construction work being performed at the Mosul Air Traffic Control Tower and Navigational Aids, Mosul, Iraq, to determine their status. This assessment was made to provide you and other interested parties with real-time information on a relief and reconstruction project underway and in order to enable appropriate action to be taken, if warranted. The assessment team included an engineer and an auditor.

This report does not contain any negative findings. As a result, no recommendations for corrective action are made and management comments on this report are not required.

We appreciate the courtesies extended to our staff. This letter does not require a formal response. If you have any questions please contact Mr. Brian Flynn at (703) 343-9149 or brian.flynn@iraq.centcom.mil or Mr. Andrew Griffith, P.E., at (703) 343-9149 or andrew.griffith@iraq.centcom.mil.

A handwritten signature in black ink that reads "Stuart W. Bowen, Jr." followed by a period.

Stuart W. Bowen, Jr.
Inspector General

Special Inspector General for Iraq Reconstruction

SIGIR PA-06-034

April 25, 2006

Mosul Air Traffic Control Tower and Navigational Aids Mosul, Iraq

Synopsis

Introduction. This project assessment was initiated as part of our continuing assessments of selected Facilities and Transportation sector reconstruction activities. The overall objectives were to determine whether selected sector reconstruction contractors were complying with the terms of their contracts or task orders, and to evaluate the effectiveness of the monitoring and controls exercised by administrative quality assurance and contract officers. We conducted this project assessment in accordance with the Quality Standards for Inspections issued by the President's Council on Integrity and Efficiency. The assessment team included a professional engineer and an auditor.

Project Assessment Objectives. The objective of this project assessment was to provide real-time relief and reconstruction project information to interested parties in order to enable appropriate action, when warranted. Specifically, we determined whether:

1. Project results were consistent with original objectives;
2. Project components were adequately designed prior to construction or installation;
3. Construction or rehabilitation met the standards of the design;
4. The Contractor's Quality Control plan and the U.S. Government's Quality Assurance program were adequate; and
5. Project sustainability was addressed.

Conclusions. The assessment determined that:

1. The Mosul Air Traffic Control Tower and Navigational Aids project results are consistent with the original project objectives. The quality of the contractor's workmanship coupled with the effective management of the project by the USACE should result in an operational air traffic control tower and navigational aids at the Mosul Airport. If current construction practices are continued, the project will provide significant improvements to air operations at the Mosul Airport.
2. The design package was sufficiently complete and specific to construct the Mosul Air Traffic Control Tower and Navigational Aids. The contractor's comprehensive design containing over 260 drawings and a 362-page specifications book, provided adequate construction and installation details and standards to construct the project. Further, before approval, the design was reviewed by the U.S. Army Corps of Engineers Mosul Resident Office staff, and the U.S. Army Corps of Engineers Transportation Systems Center.
3. The U.S. Army Corps of Engineers Resident Engineer and Quality Assurance Representatives provided appropriate oversight on a daily basis to ensure the construction work was carried out in a manner consistent with the design. Based on the review of U.S. Army Corps of Engineers on-site construction photos, the daily

Quality Control site reports and our site inspection, the work completed to date, appeared to be consistent with the task order plans and specifications. Accordingly, the project construction should result in an operational air traffic control tower and navigational aids at the Mosul Airport.

4. The contractor's Quality Control plan, including daily report submissions, met the contractual requirements. The plan addressed the Quality Control organization, inspections, nonconforming items, testing, submittal procedures, reports and records, material handling and storage. It also included a list of the definable features of work. In addition, the contractor prepared daily reports documenting work activities and inspection checklists for each definable feature that was scheduled to be worked on each day.

A significant positive factor contributing to the high quality workmanship and materials on the air traffic control tower facility included the contractor's concrete operations. The contractor utilized their own batch plant, adjacent water well, and a concrete materials testing lab, which resulted in the production of high quality structural concrete for the air traffic control tower facility.

The U.S. Army Corps of Engineers Resident Office maintained an active and effective Quality Assurance program. Quality Assurance report documentation was submitted into U.S. Army Corps of Engineers' Resident Management System. One of the Quality Assurance Representatives maintained a daily logbook that also served as a deficiency log. The Quality Assurance Representatives were on site every day in managing the project, spending a significant amount of their time at project sites, interacting with the contractor, and observing construction activities. Although much of the project work was taking place on or near the active runway and taxiway, the Quality Assurance Representatives closely coordinated with airport operations personnel to ensure the contract work could proceed with minimal impact to air operations.

5. Sustainability was addressed in the task order requirements. The task order Statement of Work requires a commissioning process on the air traffic control tower systems (including the heating, ventilation and air conditioning system) and the navigational aids and supporting equipment. A 12-month warranty is also required on all equipment and operations. There is a requirement for classroom and hands-on training on the navigational aids and ground-to-air communications system. In addition, the contractor is required to provide as-built drawings, operations and maintenance manuals, and spare parts lists for installed equipment.

Recommendations and Management Comments. This report does not contain any negative findings. Although management comments were not required, the Commander, Gulf Region Division of the U.S. Army Corps of Engineers, provided comments concurring with the draft report and providing data which was used in the preparation of this final report.

Table of Contents

Synopsis	i
Introduction	
Objective of the Project Assessment	1
Pre-Site Assessment Background	1
Contract, Task Order and Costs	1
Project Objective	2
Description of Facility (preconstruction)	2
Scope of Work of the Task Order	3
Current Project Design and Specifications	3
Site Assessment	
Work Completed	5
Work in Progress	6
Work Pending	15
Project Quality Management	
Contractor Quality Control Program	16
Government's Quality Assurance Program	17
Project Sustainability	18
Conclusions	19
Recommendations and Management Comments	20
Appendixes	
A. Scope and Methodology	21
B. Acronyms	22
C. Report Distribution	23
D. Assessment Team Members	25

Introduction

Objective of the Project Assessment

The objective of this project assessment was to provide real-time relief and reconstruction project information to interested parties in order to enable appropriate action, when warranted. Specifically, we determined whether:

1. Project results were consistent with original objectives;
2. Project components were adequately designed prior to construction or installation;
3. Construction or rehabilitation met the standards of the design;
4. The Contractor's Quality Control (CQC) plan and the U.S. Government's Quality Assurance (QA) program were adequate; and
5. Sustainability was addressed.

Pre-Site Assessment Background

Contract, Task Order and Costs

The Mosul Airport Air Traffic Control (ATC) Tower – Navigational Aids (NavAids), Visual Aids and Electrical Renovation project (heretofore referred to as *Mosul ATC Tower and NavAids* project) will be completed under contract W916QW-05-D-0005, Task Order 0001. Contract W916QW-05-D-0005, dated 14 November 2004 is a design-build, indefinite-delivery/indefinite-quantity contract with a \$200 million ceiling. The contract was between the U.S. Army Corps of Engineers (USACE) Gulf Region Division (GRD) and EMTA Construction Company. Based on a review of the contract information provided by USACE, there have not been any modifications to the basic contract.

Task Order 0001, for \$10,329,474, was issued by USACE on 27 November 2004, to EMTA Construction Company. The USACE issued four contract modifications to the task order:

- Modification 01, effective 11 February 2005, added language to the contract addressing support services provided by the Government to the contractor. The modification was administrative with no change in task order funding.
- Modification 02, effective 14 July 2005, extended the project completion date to 27 December 2005 to accommodate delays in providing life support, final tower location, and security. The modification also added FAR Clause 52.211-12, "Liquidated Damages – Construction" to the task order. The modification also added language regarding life support. There was no increase or decrease in task order funding.
- Modification 03, effective 29 October 2005, authorized the issuance of DOD identification badges to seven listed contractor management personnel. The reason for issuing the badges was to minimize time losses while passing check points when traveling to the construction site. The modification was administrative with no change in task order funding.
- Modification 04, effective 18 December 2005, extended the period of performance by 22 days, from 27 December 2005 to 18 January 2006. The modification was administrative with no change in task order funding.

Based on discussions with USACE representatives, the projected completion schedule for major work is projected as:

- Mosul ATC Tower: 31 July 2006
- NavAids: 31 August 2006

The USACE anticipates issuing appropriate contract modifications to extend the period of performance and possibly for other work related issues prior to the final project completion date.

The Project and Contracting Office (PCO) identification number for this project is 12637. The reported completion based on the PCO database, dated 14 January 2006, was 46%. On 5 April 2006, GRD reported the project completion percentage was at 69%.

Project Objective

Based on the requirements provided in the task order, the overall project objective was to improve the operational capability at the Mosul Airport by upgrading existing facilities to an acceptable level of comfort, safety, and functionality. The specific project objective was to design and construct an ATC tower and install navigational and visual aids at the Mosul Airport. The ATC tower will consist of a 25-meter (m) tall tower structure with an operations room at the tower summit that will have 360 degree visibility. The facility will include other operation and administrative areas for a staff of 30 personnel. The objective of the NavAids and visual aids upgrades was to provide safe and reliable navigation to support military, commercial, or general aviation at the Mosul Airport by meeting the requirements for an ICAO Category I Certification¹. The objective also includes providing reliable electrical power for the ATC and airside electrical grid, NavAids, and airfield lighting systems by building in redundancy associated with the commercial power grid at the airport, and by providing back up electrical generators.

Description of the Facility (preconstruction)

The description of the facility (preconstruction) is based on our review of the task order and USACE provided documentation. There are multiple project site locations within the Mosul Airport. The airport was constructed before the Coalition Forces assumed control in 2003. Since then, the airport and existing air traffic control tower have been operated by the U.S.military. Prior to assuming control, the airport facilities had suffered from neglect, looting, and a general lack of maintenance leaving them in various degrees of disrepair or obsolescence.

The new ATC tower was sited in a vacant section of the airport between the airfield taxiway and main access road. The NavAids part of the project consists of the installation of new navigational and visual aid equipment that will be positioned at prescribed locations around the runway, taxiway, and approach areas.

The Mosul Airport is located in the southern part of the city of Mosul, west of the Tigris River. The topography of the airport is level; soils consist of alluvial deposits primarily silty-clays. Water and sewer systems are available at the airport. Electrical

¹ ICAO refers to the International Civil Aviation Organization, an agency of the United Nations that is responsible for establishing standards for air navigation.

power is available at the airport and is currently provided by the U.S. government supplied generators.

Scope of Work of the Contract

The task order Statement of Work (SOW) required the contractor to design and construct the facilities listed below.

1. ATC tower facility consisting of:
 - A 25-meter-tall tower structure that includes an operations room at the tower summit, elevator and stairs, and a bathroom one level below the operations room
 - Adjoining administration building with ground floor work areas, and first floor offices for a staff of 30
 - Connections to existing sewer, water, and storm drainage systems
2. An electrical distribution system consisting of:
 - New underground 11 kilovolt (kV) feeder and two substations
 - An AC power distribution system for the runway and taxiway lighting, as well as runway and taxiway lighting and associated lighting controls
 - Emergency power generators for the runway and taxiway lighting, NavAids, and ATC tower
3. Navigational and visual aids consisting of:
 - Doppler VHF Omni-Directional Radio Range (DVOR)
 - Ground-to-air radio communications systems
 - Glide-Slope/Precision Approach Path Indicator (PAPI) Lights
 - Wind Direction Indicator (lighted)
 - High Intensity Approach Lighting System (at each end of the active runway)
 - Sequential Flashing Lights (SFL) System (at each end of the active runway)
 - Runway End Identifier Lights (REIL) comprised of runway edge, threshold, and end lighting systems
 - Taxiway edge lights and taxiway signs
 - Runway and taxiway markings

Current Project Design and Specifications

The Statement of Work (SOW) required the following design submissions:

- On-site evaluations of the existing equipment or infrastructure, preparation of condition evaluation reports and construction cost estimates
- Preliminary design sketches, including site, civil, architectural, mechanical, and electrical work, for purposes of evaluating rehabilitation scope and costs
- Schematic design documents (30% design) within 17 days after notice to proceed or contract award
- Design development documents (60% design) within 40 days of contract award or 20 days after approved 30% design submission
- Construction documents including drawings and specifications (90% design) within 20 days after approved 60% design submission
- Final “as-built” design and construction documents at the end of the project

The contractor’s initial 30% design submission included schematic construction drawings showing architectural plans and tower elevations, as well as electrical one line power generation and distribution diagrams. The 30% design also included structural drawings showing reinforcing plans and an outline for the technical specifications. Based on the USACE review, the initial 30% design submission did not meet the SOW requirements. As a result, the USACE-GRN Administrative

Contracting Officer (ACO) informed the contractor in a letter dated 9 April 2005, of the deficiencies associated with the 30% design submission, noting:

“The design analysis has not been received. There have been no 30% drawings received for any of the airfield lighting and navigational aids, only catalog cut sheets on some of the lights and equipment. Drawings were received electronically for the control tower proper. No site plans, utility plans, etc have been received. There was to be an evaluation report for power systems submitted that has not been submitted. The construction specification outline that was submitted does not comply with the contract requirement that all specifications shall follow Construction Specification Institute numbering scheme.”

Subsequent to the 30% review and other later reviews conducted by USACE, the contractor submitted 90% construction documents that served as the plans and specifications utilized for constructing the project. These construction documents consisted of over 260 drawings, as well as a 382-page specification book, design reports and calculations. Design reports included an electrical power system analysis, a structural analysis, a heating, ventilation and air conditioning (HVAC) analysis, a foundation design report, and a soil foundation investigation report.

Construction drawings included plans, one-line diagrams and detail sheets on the airfield lighting systems, electrical distribution system, and substation buildings. In addition, the 90% design drawings contained details on airfield guidance signs and markings. The drawings also included structural, mechanical, architectural, electrical, and fire protection plans, elevations, wall sections and typical details for the ATC tower. Before approval, the design was reviewed by the USACE Mosul Resident Office staff and the USACE Transportation Systems Center.

The construction specifications were developed in Construction Specifications Institute (CSI) format as required by the task order. In addition to the specifications containing the 16 major divisions in accordance with CSI format, the specifications addressed quality control in a separate section in the General Requirements Division. Further, the specifications also addressed quality control and testing throughout the 16 divisions.

Based on our review of the 90% plans and specifications, they appeared to be complete and consistent with the contract's requirements.

Site Assessment

On 21 January 2006, we performed an on-site assessment of the Mosul ATC Tower facility and NavAids project. At the time of our assessment, the project was reported as 46% complete. The project was behind schedule, due in part to inclement weather and periodic delays associated with moving the contractor's foreign workers onto the Mosul Airport from their off-site compound.

The on-site assessment included a site visit and inspection of the work being conducted on the ATC tower facility and one of the two substations under construction, as well as an inspection of the airfield lighting work along the taxiway. In addition, we also toured the contractor's concrete batch plant and testing lab located on an adjacent Coalition Forward Operating Base (FOB). During the site assessment, we were accompanied by the two USACE Quality Assurance Representatives for the project. The contractor's project superintendent and quality assurance manager were also on site during the inspection tour.

At the time of our assessment, most of the tower structural frame had been completed up to the level that was to support the tower operations room at the top of the facility. None of the three major project components had reached a final stage of construction or installation at the time of our site assessment. Scaffolding shrouded the building in preparation for finishing work on the exterior walls. Hand holes² for the runway and taxiway lighting system were being constructed and stored at the contractor's pre-cast yard adjacent to the ATC tower site prior to installation. In addition to hand holes being installed for the runway and taxiway lighting, trenches were being excavated in preparation for routing conduit and electrical cable. Two substations were under construction and being prepared for installation of the electrical switchgear, transformers, and generator.

Work Completed

The structural foundation for the ATC tower was complete. Because of the poor soil conditions, the design required a steel pile-mat foundation for the tower. Eighty-one steel H piles, spaced 1.5 meters (m) apart, were driven into the existing soil. Test piles were driven to ensure adequate bearing capacity of the soil was obtained. After all piles were driven and the area around the piles excavated, graded and properly compacted, a reinforced concrete mat (pile cap³) was placed over the piles as the foundation for the tower structure.

Site Photo 1 shows the piles in place after completion of the pile driving operations. Site Photo 2 shows steel reinforcement positioned above the piles prior to concrete placement. Although we were not present to observe any of the foundation construction, which took place months earlier, our review of the site photos and daily Quality Control (QC) reports indicate the foundation was constructed properly in accordance with the contractor's design.

² For this project, a hand hole can be described as a reinforced concrete rectangular enclosure used for electrical cable splices/connections. When installed, the hand hole cover is flush with ground level and the surface of the hand hole is used as the base for the mounting runway and taxiway light fixtures.

³ The pile cap distributes the applied load to the individual piles which, in turn, transfer the load to underground strata with higher bearing capacities.



Site Photo 1. Foundation construction with steel piles
- Photo provided by USACE



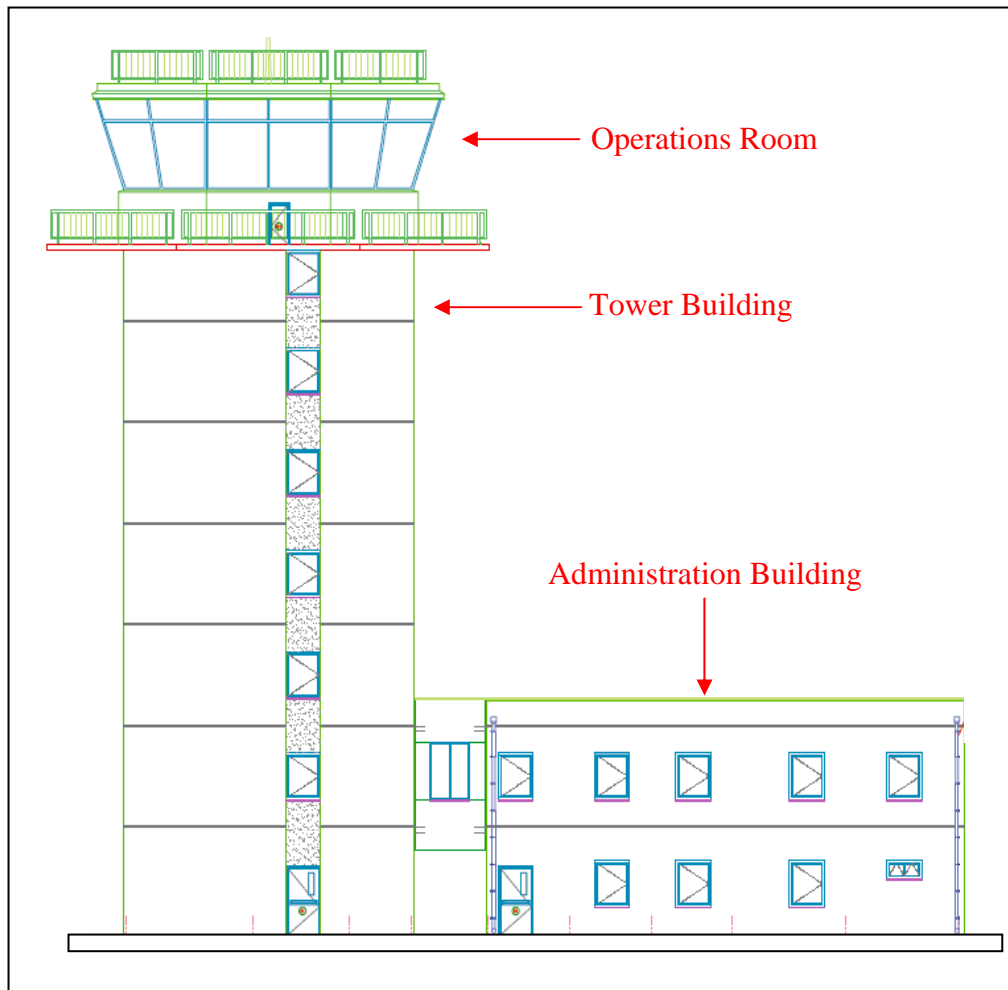
Site Photo 2. Reinforcement installation for foundation
- Photo provided by USACE

Work in Progress

ATC Tower Facility

The ATC Tower Facility is comprised of two components, the ATC tower building and an adjoining administrative building. The administration building, when complete, will contain office and workshop space for 30 people. The two buildings

are connected on the first floor⁴ by an enclosed hallway. Diagram 1 provides an exterior view of the two buildings and where they are connected.



**Diagram 1. ATC tower building on left and adjoining administration building
- Diagram provided by USACE**

Tower Building

Based on the design, the ATC tower building will consist of a seven-level reinforced concrete, 10 m by 10 m structure when constructed. The operations room at the summit (level eight) will be housed in a structural steel and glass enclosure. Site photo 3 shows the exterior view of the first seven levels of the tower construction at the time of our assessment.

⁴ In Iraq, the ground floor refers to (by U.S. nomenclature) the first floor, and the first floor in Iraq, refers to (by U.S. nomenclature) the second floor. The contractor's design utilizes the Iraq standard, and for consistency purposes, we also use the Iraq standard in our report when referring to a specific floor.



Site Photo 3. The ATC tower south elevation

The architectural design for the ground floor of the tower included a mechanical equipment room, an electrical equipment room, an elevator, mechanical and electrical chases, and a foyer with enough space for an installed metal detector. In addition, the floor plan included interior stairs to access all levels of the tower building. The design required concrete masonry unit (CMU) interior walls to be covered with gypsum wallboard, then taped, finished, and painted.

The floor plan for the tower first floor included office space. The office design required interior walls constructed with gypsum wallboard anchored to metal studs, with terrazzo floor tile, and a suspended acoustical ceiling. The floor plans for the second, third and fourth floors were essentially open administrative space with the same type finishes as the first floor. The fifth floor was designed to contain electrical equipment with raised flooring to accommodate cabling and hookup to installed equipment. The sixth floor included a briefing room, a male and female bathroom, and a separate shower. The seventh floor (level 8) is the operations room at the tower summit. The structural design for the operations room included a structural steel cab with insulated glass to provide a 360° panoramic view. The design called for the tower cab to be anchored to a reinforced concrete frame. In addition, the design included a reinforced concrete walkway circling the tower cab.

We inspected each floor of the tower. The architectural finish work had not started, nor had any of the finish work for the electrical, mechanical, or plumbing work. Electrical conduit and raceways installation were in progress.

For an example of the ground floor construction, refer to Site Photo 4, which shows the door opening into the ground floor electrical room. For an example of the interior construction on one of the upper floors, refer to Site Photo 5, which shows the reinforced concrete walls and ceiling slab typical of what we found in the tower.



Site Photo 4. Ground floor electrical room in the ATC tower building



Site Photo 5. Reinforced concrete walls, floor, and ceiling in the ATC tower

Site Photo 5 is representative of the high quality of workmanship of the reinforced concrete work in the ATC tower facility. The finish of the concrete surfaces was smooth and devoid of any noticeable defects such as segregation or honeycombing.

At the time of our site visit, the reinforced concrete base supporting a portion of the tower cab including the walkway was in place, but the cab had not yet been installed. Site Photos 6 and 7 show the concrete base for the tower cab and the walkway that will circle the cab. The reinforcing steel shown in each picture is part of the 1 m high reinforced concrete base that will support another part of the tower cab.



Site Photo 6. ATC tower concrete base



Site Photo 7. Concrete walkway

Administration Building

The administration building consisted of two floors of administrative space within a 16.4 m by 10 m structure to support 30 people. The ground level floor plan included a conference room and work shops, as well as bathrooms. The first floor consisted of office space for the staff supporting air operations. Site Photo 8 shows an exterior view of the ATC tower facility, with the administration building on the left.



Site Photo 8. The exterior of the ATC tower facility

The design for the administrative spaces required a reinforced concrete structural frame consisting of footers, floor slabs, columns, beams, and bearing walls that were infilled with exterior CMU walls. The interior finishes included painted gypsum board finished walls, with suspended acoustical ceilings, and terrazzo tile floors. For exterior walls and surfaces, the design required them to be finished with

a plaster coating and painted. At the time of our site visit, the structural frame and exterior walls had been constructed and the contractor was working on plastering the exterior. Electrical conduit and cable raceways were being installed in the interior. Site Photo 9 shows the CMU walls, reinforced concrete columns, beams and roof slab in the ground floor area. The photo also shows electrical conduit and cable raceways being installed and anchored to the concrete.



Site Photo 9. Ground floor in the ATC tower administration building

We also observed interior wall construction during the site visit. Site Photo 10 shows the metal studs in place for office walls located in the first floor.



Site Photo 10. Interior wall construction in the ATC tower administration building

We did not find any noticeable deficiencies in the construction of the ATC tower and adjoining administration building. Based on our review of the site photos documenting construction from project start through 16 January 2006, and our observations made during the site visit, the quality of workmanship exhibited by the contractor in constructing the ATC tower facility was excellent, particularly the concrete work. All observed work appeared to meet task order requirements for constructing the ATC tower facility.

Substations

The design required the construction of two substation buildings for providing and regulating electrical power to the ATC tower facility and the NavAids. One of the substations (designated in the design drawings as SS2) was located about 100 m west of the ATC tower and the other substation location (SS1) was in the southern part of the airfield. The design for each substation required it to contain the following:

- 11kV-416V transformer
- 11kV switchboard
- Medium and low voltage distribution panels
- Automatic transfer switch
- 416V, 250 Kilo Volt Amp (KVA) generator with fuel tank in SS1 and 416V, 800 KVA generator in SS2

The same building design was utilized for each substation. The substations were designed as a single level, 8.8 m by 16.5 m rectangular reinforced concrete structure with exterior and interior concrete block walls as shown in Site Photo 11.



Site Photo 11. Substation 1 during construction –Photo provided by USACE

The floor plan included a room for electrical switchgear, as well as separate rooms for controls, a transformer, and a generator. To accommodate the placement of electrical cables and connection to equipment, recessed raceways were located in the concrete floors. Site Photo 12 shows the raceways.



Site Photo 12. Recessed cable raceways in the substation

Our site visit included a tour of SS2. We did not go to SS1 because of time constraints. SS2 was partially completed. The building's reinforced concrete structure and the interior and exterior block walls were constructed. None of the electrical equipment was installed, but one of the distribution panels and the 11kV – 416V transformer were stored in their respective locations within the building. We also inspected the roof, which included a concrete block parapet. Based on our observations of SS2 and the electrical equipment on site, the completed construction met the standards of design.

NavAids

At the time of our assessment, none of the NavAid equipment was installed and operating. The current project work involved constructing and installing hand holes for the runway and taxiway lighting, and other NavAid equipment. The hand holes for edge lighting were located at the pavement edge to facilitate the routing and splicing of cable to each fixture. The hand hole specifications required them to be constructed as pre-cast reinforced concrete boxes and, when installed, to be flush with the pavement edge.

The contractor had set up a pre-cast operation at their equipment lay down yard adjacent to the ATC tower. Their operation appeared to be very efficient in producing large numbers of hand holes for the project. According to the USACE Resident Engineer, 312-hand holes were required for the runway and taxiway

lighting systems. Site Photo 13 shows the pre-cast operation for constructing the hand holes and Site Photo 14 shows a hand hole in place along the taxiway and also shows the mounting enclosure for the taxiway luminaries.



Site Photo 13. Pre-cast concrete hand holes being constructed



Site Photo 14. Hand hole installed along taxiway edge of pavement

The luminaries for taxiway and runway edge lighting were required to be installed onto breakaway mountings. The design also required the electrical cable connecting the lights and other NavAids to the power source to be encased in PVC conduit. Site Photo 15, provided by the USACE, shows the trenching and PVC conduit installation for various NavAids, including taxiway edge lighting.



Site Photo 15. Conduit installation for NavAids – Photo provided by USACE

Based on input from the USACE RE, approximately 75% of the hand holes and electrical distribution system manholes had been installed. At the time of our assessment, about 20% of the medium voltage electrical cable had been pulled through the underground conduit. The work to date on the NavAids portion of the project appeared to comply with the plans and specifications.

Work Pending

Major remaining work items to complete the ATC tower facility include the interior work consisting of: architectural finishes (walls, flooring and ceiling), plumbing, electric and fire protection, HVAC, elevator, doors, and windows. Other remaining work included exterior plastering and painting, placement of the tower cab, and connections to utility systems (electric, water, and sewer).

Required work in the substations included the installation and commissioning of the switchgear, distribution panels, transformers, and generators.

Pending work on the NavAids portion of the project included installation of the:

- Doppler VHF Omni-Directional Radio Range (DVOR)
- Glide-Slope/Precision Approach Path Indicator (PAPI) Lights
- Wind Direction Indicator (lighted)
- High Intensity Approach Lighting System (at each end of the active runway)
- Sequential Flashing Lights (SFL) System at each end of the active runway
- Runway End Identifier Lights (REIL) comprised of runway edge, threshold and end lighting systems
- Taxiway edge lights and taxiway signs
- Runway and taxiway markings

Project Quality Management

Contractor's Quality Control Program

The task order SOW required the contractor to perform all quality control (QC) based on their QC plan throughout the duration of design, construction, installation, testing, and commissioning.

The contractor submitted a QC plan that was approved by USACE on 29 December 2004. The plan addresses the QC organization, inspections, nonconforming items, testing, submittal procedures, reports and records, material handling and storage. The plan also included a list of the definable features of work. Based on our review, we determined the contractor's QC plan met the standards addressed in Engineering Regulation 1180-1-6 (*Construction Quality Management*) and PCO Standard Operating Procedure CN-103 (*Contractor Construction Quality Control Plan*).

The contractor's QC representative also submitted daily QC reports, which were reviewed by the USACE QAR and RE. These reports contained information such as work activity accomplished each day with the location, deficiencies and corrective actions, safety, labor distribution, instructions provided by the USACE, and testing. In addition, the contractor prepared daily inspection checklists for each definable feature that was scheduled to be worked on each day.

A significant component of the ATC tower facility included structural concrete. The amount of concrete needed to construct the facility necessitated the utilization of materials, equipment, and processes that could produce consistent mix proportions when batching concrete. To meet the demand for high quality structural concrete, the contractor erected a concrete batch plant near the construction site on an adjacent FOB. The batch plant, shown in Site Photos 16 and 17, included two cement silos, separate stockpiles for coarse and fine aggregate, a water storage tank, and automated controls for mixing materials.



Site Photo 16: Concrete batch plant



Site Photo 17. Aggregate stockpiles

In addition to a batch plant, the contractor had drilled and developed a well adjacent to the batch plant to provide a ready source of suitable water for concrete. The contractor also set up a lab for compressive strength testing and sieve analysis. The contractor's process controls at the batch plant and their on-site testing program have resulted in the production of high quality concrete used to construct the ATC Tower facility.

Based on our review of the contractor's Quality Control plan, daily site reports, interviews with USACE QARs, and our observations of the construction sites, we concluded that the contractor's management of quality control fulfilled the task order requirements.

Government's Quality Assurance Program

On this project, the USACE utilized two QARs to ensure quality and compliance with contract requirements. One QAR primarily focused on the ATC tower construction and the other QAR was utilized for project work taking place on the airfield, specifically the NavAids installation.

In addition, based on the task order, the Federal Aviation Administration (FAA) will perform periodic QA/QC inspections and has authority to stop project work if it does not meet FAA and ICAO standards.

The QARs reviewed and approved the contractor's daily QC reports that documented any deficiencies noted at the site. The USACE RE also retained a "Submittal Log" that listed significant documents submitted by the contractor for approval. Data such as drawings, test results, product data, and certificates were listed by date submitted, approved, and approving authority.

The QARs were on site every day in managing the project, spending a significant amount of their time at project sites, interacting with the contractor, and observing construction activities. Further, they ensured that potential construction deficiencies were detected, evaluated, and properly corrected, in a timely manner. Although much of the project work was taking place on, or near the active runway and taxiway, the QARs closely coordinated with the airport operations personnel to ensure the contract work could proceed with minimal impact to air operations.

Both QARs input their QA report information into USACE's Resident Management System (RMS). One of the QARs maintained a daily logbook that also served as a deficiency log.

Based on our review of the contractor's Quality Control plan, daily site reports, interviews with USACE QARs and our observations of the construction project work, we concluded that the Government Quality Assurance program was effective in monitoring the contractor's Quality Control program for the Mosul ATC Tower and NavAids construction project. In addition, QA activities were sufficiently and accurately documented. This condition occurred because of the efforts of the USACE staff responsible for managing the project.

Project Sustainability

The task order requires the contractor to prepare a commissioning plan and submit it to the USACE RE or Project Engineer for review and approval. The contractor is also required to startup, test, and operate all equipment and machinery as recommended by respective manufacturers. Further, the task order requires that after successful startup of all elements, the entire facility is to be integrally operated to simulate peak operating conditions and left in operation for a minimum of forty eight (48) consecutive hours while both the contractor and USACE representatives monitor air handlers, electrical load centers, lighting and other such systems that might be affected during peak facilities operation. The contractor is required to document the facilities startup and commissioning process in a report.

In addition to commissioning, the contractor is required to provide both classroom and on-the-job training. The task order requires a minimum of two weeks of classroom training at 48 hours per week. The on-the-job training consists of a full 30-day month at 48 hours per week. The training coursework is to ultimately provide preventative maintenance and user certification for the people specified for each of the following:

- NavAids - (ILS & D-VOR/DME) for 10 people
- Ground to Air Communications for 10 people

The task order also requires the contractor to provide and certify warranties in the name of the appropriate Ministry, for all equipment, which includes any mechanical, electrical and/or electronic devices, and all operations for 12 months after issuance of the Taking-Over-Certificate. The contractor is also required to submit final "as-built" design and construction documents, as well as operations and maintenance manuals, and spare parts lists.

Conclusions

Based upon the results of our site visit, we reached the following conclusions for assessment objectives 1, 2, 3, 4, and 5. Appendix A provides details pertaining to Scope and Methodology.

1. Determine whether project results were consistent with original objectives.

The Mosul ATC Tower and NavAids project results were consistent with the original project objectives. The quality of the contractor's workmanship coupled with the effective management of the project by the USACE should result in an operational ATC tower and NavAids at the Mosul Airport. If current construction practices are continued, the project will provide significant improvements to air operations at the Mosul Airport.

2. Determine whether project components were adequately designed prior to construction or installation.

The design package was sufficiently complete and specific to construct the Mosul ATC Tower and NavAids. The contractor's comprehensive design containing over 260 drawings and a 362-page specifications book provided adequate construction and installation details and standards to construct the project. Further, before approval, the design was reviewed by the USACE Mosul Resident Office staff, and the USACE Transportation Systems Center.

3. Determine whether construction met the standards of the design

The U.S. Army Corps of Engineers Resident Engineer and Quality Assurance Representatives provided appropriate oversight on a daily basis to ensure the construction work was carried out in a manner consistent with the design. Based on the review of USACE on-site construction photos, the daily QC site reports, and our site inspection, the work completed to date appeared to be consistent with the task order plans and specifications. Accordingly, the project construction should result in an operational ATC tower and NavAids at the Mosul Airport.

4. Determine whether the Contractor's Quality Control plan and the Government Quality Assurance Program were adequate.

The contractor's QC plan, including daily report submissions, met the contractual requirements. The plan addressed the Quality Control organization, inspections, nonconforming items, testing, submittal procedures, reports and records, material handling and storage. It also included a list of the definable features of work. In addition, the contractor prepared daily reports documenting work activities and inspection checklists for each definable feature that was scheduled to be worked on each day.

A significant positive factor contributing to the high quality workmanship and materials on the ATC tower facility included the contractor's concrete operations. The contractor utilized their own batch plant, adjacent water well, and a concrete materials testing lab, which resulted in the production of high quality structural concrete for the ATC tower facility.

The USACE maintained an active and effective QA program. QA report documentation was submitted into USACE's RMS. One of the QARs maintained a daily logbook that also served as a deficiency log. The QARs were on site every day

in managing the project, spending significant amount of their time at project sites, interacting with the contractor, and observing construction activities. Although much of the project work was taking place on or near the active runway and taxiway, the QARs closely coordinated with airport operations personnel to ensure the contract work could proceed with minimal impact to air operations.

5. Determine if project sustainability was addressed.

Sustainability was addressed in the task order requirements. The task order SOW requires a commissioning process on the ATC tower systems (e.g., HVAC), and the NavAids and supporting equipment. A 12-month warranty is also required on all equipment and all operations. There is a requirement for classroom and hands-on training for 10 people on the NavAids and ground to air communications system. In addition, the contractor is required to provide as-built drawings, as well as operations and maintenance manuals and spare parts lists for installed equipment.

Recommendations and Management Comments

This report does not contain any negative findings. Although, management comments were not required, the Commander, Gulf Region Division of the U.S. Army Corps of Engineers, provided comments concurring with the draft report and providing data which was used in the preparation of this final report.

Appendix A. Scope and Methodology

We performed this project assessment from January through March 2006, in accordance with the Quality Standards for Inspections issued by the President's Council on Integrity and Efficiency. The assessment team included a professional engineer and an auditor.

In performing this Project Assessment we:

- Reviewed contract documentation to include the following: Contract, Task Order, Task Order Modifications, contract documentation, and statement of work;
- Reviewed the design package (drawings, specifications, design reports and calculations), Quality Control Plan, Contractor's Quality Control Reports, USACE Quality Assurance Reports, and Construction Progress Photos;
- Interviewed the two U.S. Army Corps of Engineers Quality Assurance Representatives assigned to the project; and
- Conducted an on-site assessment and documented results at the Mosul Air Traffic Control Tower and Navigational Aids project in Mosul, Iraq.

Appendix B. Acronyms

ACO	Administrative Contracting Officer
ATC	Air Traffic Control
CMU	Concrete Masonry Unit
CQC	Contractor Quality Control
DVOR	Doppler VHF Omni-Directional Radio Range
ER	Engineering Regulation
FOB	Forward Operating Base
GRN	Gulf Region North
ICAO	International Civil Aviation Organization
KVA	Kilo Volt Amp
m	Meter
PAPI	Precision Approach Path Indicator
QA	Quality Assurance
QAR	Quality Assurance Representative
QC	Quality Control
RE	Resident Engineer
REIL	Runway End Identifier Lights
SFL	Sequential Flashing Lights
SOW	Statement of Work
USACE	United States Army Corps of Engineers

Appendix C. Report Distribution

Department of State

Secretary of State

Senior Advisor to the Secretary and Coordinator for Iraq

U.S. Ambassador to Iraq

Director, Iraq Reconstruction Management Office

Mission Director-Iraq, U.S. Agency for International Development

Inspector General, Department of State

Department of Defense

Secretary of Defense

Deputy Secretary of Defense

Director, Defense Reconstruction Support Office

Under Secretary of Defense (Comptroller)/Chief Financial Officer

Deputy Chief Financial Officer

Deputy Comptroller (Program/Budget)

Inspector General, Department of Defense

Director, Defense Contract Audit Agency

Director, Defense Finance and Accounting Service

Department of the Army

Assistant Secretary of the Army for Acquisition, Logistics, and Technology

Principal Deputy to the Assistant Secretary of the Army for Acquisition,
Logistics, and Technology

Deputy Assistant Secretary of the Army (Policy and Procurement)

Director, Project and Contracting Office

Commanding General, Joint Contracting Command-Iraq/Afghanistan

Assistant Secretary of the Army for Financial Management and Comptroller

Chief of Engineers and Commander, U.S. Army Corps of Engineers

Commanding General, Gulf Region Division

Auditor General of the Army

U.S. Central Command

Commanding General, Multi-National Force-Iraq

Commanding General, Multi-National Security Transition Command-Iraq

Commander, Joint Area Support Group-Central

Other Federal Government Organizations

Director, Office of Management and Budget

Comptroller General of the United States

Inspector General, Department of the Treasury

Inspector General, Department of Commerce

Inspector General, Department of Health and Human Services

Inspector General, U.S. Agency for International Development

President, Overseas Private Investment Corporation

President, U.S. Institute for Peace

Congressional Committees and Subcommittees, Chairman and Ranking Minority Member

U.S. Senate

Senate Committee on Appropriations

Subcommittee on Defense

Subcommittee on State, Foreign Operations and Related Programs

Senate Committee on Armed Services

Senate Committee on Foreign Relations

Subcommittee on International Operations and Terrorism

Subcommittee on Near Eastern and South Asian Affairs

Senate Committee on Homeland Security and Governmental Affairs

Subcommittee on Federal Financial Management, Government Information and International Security

Subcommittee on Oversight of Government Management, the Federal Workforce, and the District of Columbia

U.S. House of Representatives

House Committee on Appropriations

Subcommittee on Defense

Subcommittee on Foreign Operations, Export Financing and Related Programs

Subcommittee on Science, State, Justice and Commerce and Related Agencies

House Committee on Armed Services

House Committee on Government Reform

Subcommittee on Management, Finance and Accountability

Subcommittee on National Security, Emerging Threats and International Relations

House Committee on International Relations

Subcommittee on Middle East and Central Asia

Appendix D. Project Assessment Team Members

The Office of the Assistant Inspector General for Inspections, Office of the Special Inspector General for Iraq Reconstruction, prepared this report. The principal staff members who contributed to the report were:

Andrew Griffith, P.E.

Timothy Baum