OFFICE OF THE SPECIAL INSPECTOR GENERAL FOR IRAQ RECONSTRUCTION

ABU GHRAIB DAIRY
ABU GHRAIB, IRAQ

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SIGIR

Special Inspector General for IRAQ Reconstruction

January 14, 2009

Abu Ghraib Dairy

Summary of Report: PA-09-172

Why SIGIR Did this Study

SIGIR is charged to conduct assessments of Iraq reconstruction projects funded with amounts appropriated or made available by the U.S. Congress. SIGIR assessed this project to provide real-time information on relief and reconstruction to interested parties to enable appropriate action, when warranted.

The objective of this project assessment was to determine if:

- project components were adequately designed
- construction complied with design standards
- adequate quality management programs were used
- project sustainability was addressed
- project results were consistent with original objectives

What SIGIR Recommends

SIGIR recommends that the Commander of the Gulf Region District:

1. Work with the contractor to develop specific details with respect to site utilities.
2. Continue oversight of the contractor's corrective actions to ensure that the facility, when completed, is structurally sound.

SIGIR also recommends that the TFSBO continue to work with the Director General of the Abu Ghraib Dairy to determine the status of any missing equipment and spare parts and the award of the contract to install and commission the milk line equipment.

Management Comments

The Gulf Region District and TFBSO concurred with the recommendations, cited corrective actions taken, and provided clarifying information for the final report.

Evaluation of Comments

Gulf Region District and TFBSO comments addressed our recommendations.

For more information, contact SIGIR Public Affairs at (703) 428-1100 or PublicAffairs@sigir.mil

What SIGIR Found

The overall objective of this $3.4 million Iraq Freedom Fund project was to rebuild the Iraqi State Company for Dairy Products – Abu Ghraib Dairy factory's production capability, satisfy the local market, and support the Ministry of Education's school nutrition program of providing Iraqi school children with pasteurized milk.

Equipment to reconstitute powdered milk, purchased by the then-Saddam Hussein government in 2002, had been sitting idle because the Iraqi the State Company for Dairy Products did not have the funding to construct a building to house and operate the equipment.

A cooperative agreement, funded by the U.S. Task Force for Business and Stability Operations (TFBSO), to construct a building and to set up and operate the milk line equipment was entered into by the Joint Contracting Command-Iraq/Afghanistan and the State Company for Dairy Products. SIGIR's review disclosed that the contractor's design drawings lacked significant details for water supply and treatment and sewage treatment. In addition, SIGIR identified significant deficiencies in the building's structural integrity.

On 12 April 2009, SIGIR visited the project site, which was approximately 30% complete. SIGIR observed construction deficiencies, such as inadequately protected anchor bolts, improper concrete masonry construction, poorly constructed floor slab, and deformation of several of the roof trusses.

SIGIR immediately brought these concerns to the attention of TFBSO representatives who promptly engaged the services of the Gulf Region Division of the U.S. Army Corps of Engineers to provide oversight of the contractor's corrective actions. The Gulf Region Division is determining the acceptability of proposed corrective actions and verifying implementation.

SIGIR, however, remains concerned about the state of the milk line equipment and whether it will be operational after sitting idle in a warehouse for over seven years.

A significant number of issues negatively affecting this project are a direct result of the use of a cooperative agreement versus a standard construction contract and the initial lack of U.S. government oversight. As a result of SIGIR recommendations, TFBSO indicates that it will now utilize standard construction contracts.

SPECIAL INSPECTOR GENERAL FOR IRAQ RECONSTRUCTION

January 14, 2010

MEMORANDUM FOR COMMANDING GENERAL, UNITED STATES CENTRAL COMMAND
COMMANDING GENERAL, UNITED STATES FORCES-IRAQ
COMMANDING GENERAL, JOINT CONTRACTING COMMAND-IRAQ/AFGHANISTAN
DIRECTOR, IRAQ TRANSITION ASSISTANCE OFFICE

SUBJECT: Report on the Abu Ghraib Dairy, Abu Ghraib, Iraq (SIGIR Report Number PA-09-172)

We are providing this project assessment report for your information and use. We assessed the design and construction work performed at the Abu Ghraib Dairy, Abu Ghraib, Iraq to determine its status and whether objectives intended will be achieved. 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.

Comments on a draft of this report from the Gulf Region District and the Task Force for Business and Stability Operations addressed our recommendations, cited corrective actions taken, and provided additional clarifying information for this final report. As a result, no additional comments are required.

We appreciate the courtesies extended to our staff by the United States Forces-Iraq and the offices of the Gulf Region District of the U.S. Army Corps of Engineers. If you have any questions please contact Mr. Brian M. Flynn at brian.flynn@sigir.mil or at 240-553-0581, extension 2485. For public queries concerning this report, please contact SIGIR Public Affairs at publicaffairs@sigir.mil or at 703-428-1100.

Stuart W. Bowen, Jr.
Inspector General

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Introduction

Background

Lack of Milk Affects Iraq

Three wars and international economic sanctions (embargoes) have resulted in a significant decline in the quality of the Iraqi diet. Specifically, Iraq's food markets and current nutritional levels have suffered from the effects of war, sanctions, instability, state mismanagement, low disposable income, and irregular electrical supply. For example, the United Nations Children's Fund noted a dramatic rise in child malnutrition following the 1991 Gulf War due to a lack of protein consumption (dairy products and red meat). Dairy products play an important role in the human diet for all ages, especially children because they contain a considerable amount of essential amino acids, minerals, and vitamins. Over the past two decades, doctors have noticed that almost a quarter of Iraqi children are either born underweight or are malnourished by age five.

Availability of Milk in Iraq

Milk is essential in a balanced diet, especially for a country like Iraq, with an increasing overall population, a large youth population, and a high fertility rate. According to the U.S. Agency for International Development (USAID), Iraq has a population of approximately 26 million, with 20% of its population under the age of 24 (and increasing), and a birth rate of 4.2 children per family. This increase in population will result in an escalating need for the production and processing of dairy products, especially milk. Traditionally, a young population consumes a large amount of dairy products, such as milk, yogurt, and processed cheese. However, Iraq does not have the resources necessary to provide dairy products to its increasing population. For example, according to the Iraqi Ministry of Agriculture, in 2008, Iraq had 1,064,404 head of cattle, 146,092 head of water buffalo, 13,793,789 sheep, and 645,662 goats, which produced approximately 165,000 tons of fresh milk annually[1]. This liquid "ready to drink" milk accounts for about a third of the total consumption while the remaining two-thirds come from reconstituted powdered milk[2].

USAID estimated that Iraq consumes between 120,000 – 200,000 tons of powdered milk per year[3]. The average per capita consumption of imported milk is estimated to be 55 liters[4], which is lower than the pre-embargo period's consumption of 60 liters, and significantly less than the 96 liters enjoyed by the Gulf Cooperation Council countries[5].

The availability of powdered milk is critical to Iraq for several reasons: first of all, as previously mentioned, Iraq does not have enough milk producing animals to satisfy the populations' demand. Second, Iraq, because of its insufficient and irregular electrical

[1] USAID, Inma Agribusiness Program, "Iraq Dairy Industry," January 2008.

[2] Powdered milk is a manufactured dairy product made by evaporating milk to dryness. One purpose of drying milk is to preserve it. Milk powder has a far longer shelf life than liquid milk and does not need to be refrigerated, due to its low moisture content.

[3] USAID, Inma Agribusiness Program, "Iraq Dairy Industry," January 2008.

[4] Of the 55 liters, only 5 liters are "liquid" milk.

[5] The Gulf Cooperation Council consists of Saudi Arabia, Kuwait, Bahrain, Qatar, the United Arab Emirates, and the Sultanate of Oman.

supply, lacks an efficient cold chain distribution[6] network/system to extend and ensure the shelf life of dairy products. Electricity is essential in the cold chain distribution network system for preserving milk from the time it is produced until it is consumed. Since Iraq's electrical supply is intermittent and unreliable, especially in urban and rural areas outside of Baghdad, generating electricity on farms, processing plants, and in homes is very expensive and adds to the overall cost of milk production and delivery to the consumer. As a result, Iraq is dependent upon powdered milk, which has a much longer shelf life than liquid milk. Powdered milk is an essential part of the Iraqi Public Distribution System (PDS), the largest public food program operating in the world. The PDS monthly basket of rationed goods includes 1 kilogram of powdered milk. Also, powdered milk is frequently used in the manufacture of baby formula, which is also included in the PDS monthly rationed goods basket.

As the security situation and electrical capacity in Iraq continue to improve, there will be a further increase in the demand for milk, yogurt, and cheese. Dairy products, especially milk, are traditionally a pillar of the processed food industry worldwide, regardless of disposable income and population.

Dairy Industry in Iraq

There are State-Owned Enterprises (SOEs) for dairy products in Iraq. The State Company for Dairy Products produces milk-based products, such as bottled milk, yogurt, cheese, cream, and butter. The State Company for Dairy Products is a holding company with three factories/plants:

- Abu Ghraib Dairy Plant
- Al Diwaniya Factory
- Al Mosul Factory

However, the State Company for Dairy Products suffered for years from lack of investment in new machinery or regular maintenance of the existing equipment, which resulted in the "newest machinery" being over 28 years old, a manual glass bottle filling machine is over 50 years old, and the homogenizer has been out of order for several years.

According to project file documentation, in 2007, the State Company for Dairy Projects claimed 7,000 workers with 6,000 workers assigned to the Abu Ghraib Dairy Plant. However, during a March 2007 site visit, U.S. government representatives documented only 200 workers at the Abu Ghraib Dairy Plant.

Purchase of New Milk Line Equipment

On 6 August 1991, after the Iraqi invasion of Kuwait, the United Nations (UN) Security Council adopted UN Resolution 661, which imposed economic sanctions on Iraq, providing for a full trade embargo, excluding medical supplies, food, and other items of humanitarian necessity, to be determined by the Security Council Sanctions Committee.

On 14 August 2002, with the consent of the UN Security Council Sanctions Committee, the then-Saddam Hussein Government of Iraq entered into a contract with a Lebanese company for the delivery and installation of new milk line equipment to produce 10 tons

[6] Cold chain distribution is a temperature controlled supply chain. An unbroken cold chain is an uninterrupted series of storage and distribution activities, which maintain a given temperature range for perishable items.

per hour of milk in high density polyethylene bottles[7]. This equipment, earmarked for the Abu Ghraib Dairy Plant, was delivered in 2002 to a warehouse within the Ministry of Industry and Minerals (MIM) compound in crates.

The existing Abu Ghraib Dairy Plant was insufficient to house the new milk line equipment. However, before a new facility could be constructed, the 2003 Coalition invasion occurred and the equipment sat idle in crates at the MIM compound.

Task Force for Business and Stability Operations

In June 2006, the Department of Defense (DoD) established the Task Force for Business and Stability Operations (TFBSO) to aid in the revitalization of Iraq's economy and in creating jobs for the Iraqi people. Specifically, DoD wanted to accelerate reconstruction operations in Iraq since "economic development and job creation in Iraq are critical success factors to build a stable country."

One of the TFBSO's major efforts has been to revitalize Iraqi SOEs. SOE factories played an important role in Iraq's pre-war economy. According to DoD, prior to 2003, Iraq employed more than 200,000 people through approximately 200 SOEs, including cement, chemical, construction, dairy, industrial, and textile operations. After the war, most of the SOEs sat idle and the workers were left unemployed. By 2005, military commanders were encountering economically motivated violence as unemployment exceeded 50% in most areas of Iraq[8].

Congress and DoD authorized a total of $103 million over fiscal years 2007 and 2008 to revitalize the SOEs. TFBSO focused on initiatives to restore the core industrial capability of a state's economy, including foreign direct investment, banking and financial networks, industrial revitalization, corporate development, Iraq private sector development, procurement assistance, and agriculture revitalization.

Abu Ghraib Dairy Plant

According to TFBSO representatives, Multi-National Division – Baghdad (MND-B) representatives approached them in 2007 with the request to support a project at the Abu Ghraib Dairy Plant. MND-B representatives advised them that new equipment existed in a warehouse; however, the State Company for Dairy Products did not have any funding to construct a facility to house and operate the equipment. MND-B representatives stated that this equipment could be used to update and increase the production capacity of the plant; while at the time employing local Iraqis in a predominantly Sunni area who were committing acts of violence against coalition forces.

In September 2007, TFBSO sought to rebuild the production capability of the Abu Ghraib Dairy Plant by utilizing the previously purchased milk line equipment sitting idle in a warehouse at the MIM compound since 2002. Since this required the construction of a new facility to house the milk line equipment, TFBSO representatives were confident that employment opportunities would be immediately available to local laborers in the area (to help construct the facility) and later to more skilled workers to operate the equipment.

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[7] High density polyethylene plastic bottles offer a mildly stiff impact resistant bottle, with a great moisture barrier.

[8] See the discussion of the SOE program in "Boosting Iraq's Manufacturing Base", page 304 of Hard Lessons, The Iraq Reconstruction Experience (U.S. Government Printing Office)

According to TFBSO representatives, prior to recommending this project, neither MND-B nor the Abu Ghraib Dairy tested the milk line equipment to determine if it was operational.

Objective of the Project Assessment

The objective of this project assessment was to provide real-time information on relief and reconstruction projects to interested parties to enable appropriate action, when warranted. Specifically, the Special Inspector General for Iraq Reconstruction (SIGIR) determined whether:

1. Project components were adequately designed prior to construction or installation;
2. Construction or rehabilitation is in compliance with the standards of the design;
3. Adequate quality management programs are being utilized;
4. Sustainability was addressed in the contract or task order for the project; and
5. Project results were or will be consistent with their original objectives.

Pre-site Assessment Background

Contract, Costs and Payments

On 2 September 2007, using the Iraq Freedom Fund[9], the Joint Contracting Command – Iraq/Afghanistan (JCC-I/A) entered into cooperative agreement[10] (W91GY0-08-2-2001), in the amount of $3.0 million, with the State Company for Dairy Products - Abu Ghraib Factory. Under the terms of the agreement JCC-I/A contracted Al Balagh Investments to construct a building and install equipment to reconstitute powered milk purchased by the then-Saddam Hussein government in 2002. The period of performance for this project was 180 calendar days from the date of the cooperative agreement. Consequently, the project was to be completed by 1 March 2009. This cooperative agreement had one modification.

Modification P00001, dated 25 January 2008, increased the total project cost to $3.4 million.

Project Objective

The overall objective of this project was to rebuild the State Company for Dairy Products – Abu Ghraib Dairy factory's production capability, satisfy the local market, and be able to support the Ministry of Education's school nutrition program of providing Iraqi school children with pasteurized milk.

TFBSO wanted to capitalize on the previously purchased new milk line equipment to revitalize the SOE and increase employment in this predominantly Sunni area of Baghdad.

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[9] The Iraq Freedom Fund is a special account providing funds for additional expense for ongoing military operations in Iraq, and those operations authorized by Public Law 107-40 (September 13, 2001), Authorization for Use of Military Force, and other operations and related activities in support of the Global War on Terrorism.

[10] A legal instrument used to enter into the same kind of relationship as a grant, except that substantial involvement is expected between the Department of Defense and the recipient carrying out the activity contemplated by the cooperative agreement.

Pre-construction Description

The Abu Ghraib Dairy Plant is located within the Ministry of Industry and Minerals compound, approximately 25 kilometers west of Baghdad. The Abu Ghraib Diary Plant was established in 1958, with a single line for bottled-sterilized milk, through the support of the United Nations Children's Fund as a gift for Iraqi children. A new plant was constructed in 1970 by Alfa-Laval (Swedish company), consisting of the following production lines:

- milk reception
- sterilized and flavored milk lines
- butter production line
- yogurt production line
- soft and process cheese lines
- cream production line

The sterilized milk production line had a capacity of 5 tons per hour.

Alfa-Laval and two German companies supplied the machinery and equipment for the plant. In 1989, the plant's production lines were expanded to include Mozzarella, Gouda, and Edam cheeses.

The plant produced milk in glass bottles for approximately 35 years. However, by 2007, the bottled-sterilized milk line was no longer operational due to "marginally maintained" machinery and equipment. According to project file documentation, the "existing facilities environment are well below dairy processing standards." Currently, limited production continues in a two-day-a-week operation with yogurt, butter, and both hard and soft cheese.

In February 2003, monitors from the UN Monitoring, Verification, and Inspection Commission[11] made a surprise visit to the Abu Ghraib Dairy Plant in search of signs of biological weapons. The monitors took samples from the dairy plant equipment, but did not report finding any biological weapons at the dairy plant site.

Statement of Work

The Statement of Work (SOW) required the following:

- preparation of the building, construction and installation of the milk processing line
- purchase, installation, and training of/for facility systems, including:
    - electricity generation and distribution
    - water (plumbing, connection to water treatment plant)
    - upgrade/repair of the water treatment plant
    - heating and cooling systems (boilers/chillers)
    - climate control systems (heating, cooling, filtration)
    - air compressors

[11] UN Monitoring, Verification, and Inspection Commission monitors were responsible for verifying then Iraqi President Saddam Hussein's compliance with its obligation not to reacquire weapons of mass destruction prohibited to it by the UN Security Council.

Project Design and Specifications

JCC-I/A provided SIGIR the contractor's design drawings for the construction of the dairy. The design documentation contained information conveying the scope and intent of the project; however, detailed specifications did not accompany the drawings to direct the contractor as to the methods, materials, and construction procedures required to complete the project.

For a majority of the U.S.-funded reconstruction projects in Iraq, the U.S. government awarded standard construction contracts, which required the contractor to provide design submittals and specifications, warranty clauses, and quality control. In addition, the U.S. government was directly involved in the oversight of specific projects to ensure that planning, design, and execution were adequate.

In this instance, the TFBSO, primarily an economic task force without significant construction or engineering expertise, allowed JCC-I/A to award a cooperative agreement for the construction of the facility. The cooperative agreement did not include detailed specifications for construction of the facility. It stipulated that any specifications used in the project should be forwarded to JCC-I/A. Specifically, Section B.10 (a) (1) stated the following:

> *"The grantee/recipient will furnish to JCC-I/A upon preparation: Any plans, specifications, procurement or construction schedules, contracts, or other services to be financed under the Agreement, including documentation relating to the prequalification and selection of contractors and to the solicitation of bids and proposals. Material modifications in such documentation will likewise be furnished to JCC-I/A on preparation of modifications."*

The cooperative agreement essentially states that if plans or specifications are used in construction, they must be forwarded to JCC-I/A; however, there is no requirement that plans and specifications must be formulated for all project components. In addition, there is no provision for JCC-I/A to determine the suitability of any plans or specifications that are forwarded by the contractor.

Consequently, the cooperative agreement did not provide specific requirements to the contractor regarding design submittals and specifications; while also not requiring the U.S. government to review the design submittals and specifications for accuracy and completeness. The lack of design submittals and specifications review allowed the contractor to begin construction with an inadequate design that lacked significant details.

Building

The contractor designed the construction of an approximately 2,900 square meter facility (Figure 1), including water and fuel storage tanks. The contractor provided detailed architectural plans for the project, including exterior renderings of the facility, exterior elevations, several interior cross sections, and floor plan information regarding building layout and room dimensions.

Site Utilities—Potable Water, Interior Plumbing, Electrical Generation and Distribution, and Sewage Treatment

Overall, the contractor's design drawings lacked significant details for site utilities, such as potable water system, water supply and treatment, and sewage treatment.

Figure 1. Rendering of dairy building and surrounding area (Courtesy of TFBSO)

For example, the SOW required "Water (plumbing, connection to water treatment plant)" and "the Upgrade/repair of water treatment plant." The contractor's plans do not address how these requirements are to be accomplished. The contractor's designs indicate that potable water will be stored in an underground tank and delivered to the facility via a booster pump; however, the location of the connection to the existing potable water supply is not provided. It is also unclear how power will be provided to the pump station. In addition, the location of the existing potable water supply is not shown on the plans. No details are provided for the connection to the existing system. Due to the lack of information available regarding the existing potable water system, SIGIR could not determine if the contractor has verified that the existing potable water supply can provide the required pressure and/or quantity of water needed for the facility. This should be verified prior to construction of the potable water system to determine if modifications are required or if an additional source of potable water must be secured. Further, the contractor did not indicate any lining for the proposed water storage tanks. Since this water will be used in the processing of products for human consumption, a lining should be installed to prevent contamination from groundwater leakage.

The contractor's plans for the facility's potable water supply and interior waste plumbing included the location, size, slope of pipes, and locations of fixtures. Based on the flow requirements of the equipment, it appears that significant water usage will be required in certain areas of the plant. The contractor's designs called for a gully trap[12] in the kitchen floor. The purpose of the gully trap is unclear; possibly anticipated as a wash down for this area. However, the accumulation of substantial amounts of water on the kitchen floor should be avoided because of its location over the "powdered milk storage area." Potential leaks through the floor could contaminate the powdered milk stock.

The quality of the water used in the production process is critical in preventing an outbreak of food-borne illness. The process used in manufacturing dairy products

[12] Wastewater from kitchens and bathrooms is piped to a gully trap before emptying into the sewer. A gully trap is a basin in the ground with a water seal to prevent foul odors of the sewer reaching the surface. Gully traps are buried in the ground with the tops or surround raised above ground level to prevent ground water entering into the sewer.

may eliminate harmful pathogens; however, some level of water pre-treatment should be performed to remove particulate matter prior to incorporation into the product. The absence of the required repairs and upgrades to the water treatment plant means that it cannot be determined if water pre-treatment will be performed.

The SOW included a section for "Electrical Generation and Distribution." The contractor's designs identified the locations of fuel tanks but did not provide any additional information regarding electrical generation. Due to the absence of specific details, SIGIR could not determine if the fuel tanks will be provided to supply fuel to a proposed generator or boiler. The designs do provide power requirements for the production equipment; however, without information regarding the proposed electric service and/or power generation, the adequacy of the electrical supply to the project cannot be determined.

The designs do not specify outlet locations or the power distribution for major pieces of equipment, including the manufacturing equipment, boiler, or heating, ventilating, and air conditioning (HVAC) equipment. In addition, the designs did not show how the facility would be connected to the existing grid, or whether automated switch gear would be installed to automatically disconnect the grid power and start any on-site generation.

Waste from processing operations of dairy products typically contains highly concentrated effluent that could create a significant load on the municipal treatment plant. The contractor's plans did not address any form of treatment for the sewage generated on site. Introduction of this waste into the municipal system without pre-treatment could create issues for the municipal plant.

Significant Concerns with Building Structure Plans

The contractor's designs contained general structural information and an overall framing concept. SIGIR reviewed the contractor's design calculations for the steel columns and continuous truss[13] of a typical building section. The contractor relied on computer modeling using Structural Analysis and Design (STAAD) modeling software to analyze the structure. The analysis was performed for a typical building bay without the mezzanine. The analysis included a determination of the forces in the truss members and a check of conformity with the American Institute of Steel Construction (AISC) code. SIGIR identified the following issues with the integrity of the structure:

- The allowable roof live load[14] used in the analysis is 8 pounds per square foot (psf). Although the cooperative agreement did not specify design criteria, the International Building Code requires a minimum live load of 12 psf for the design of roofs. Based on the size of the structure and the relative flatness of the roof, loads such as wind and ponding may exceed this minimum and have a considerable negative effect on the roof.

[13] Trusses are compound structures composed of members with exactly two pin-point joints at each end such that internal connections are only established through these pin-joints and the structure is attached to the ground by pin-joints, rollers, or short links. Loads of trusses are normally concentrated to the joints.

[14] The load exerted on a roof other than the roofing system and its supporting members; the live load on the roof.

- The calculations did not account for lateral loads on the structure, including high winds or seismic loading[15]. The calculations performed also did not account for load combinations to determine the maximum impact to the structure under varying conditions and circumstances.
- Based on the contractor's calculations, five members of the truss were designated as failing the AISC code check. Two of the members failed the code check by more than three times the allowable limit (Figure 2). Failing by a factor of this magnitude indicates that the members could yield and possibly fracture under the design load.
- The analysis did not consider the knee braces. The presence of the knee braces[16] will significantly affect the performance of the structure and may result in the failure of the lower truss chord[17].
- Based on the design drawings, the connections for the truss are welded. The contractor did not provide a design for the connections.

Contractor's Proposed Steel Column and Continuous Truss Construction

The contractor's proposed structural design consists of steel columns and continuous truss construction with sandwich panel cladding[18] for the roof and sidewalls. Roof loads are carried by the multi-span steel trusses, which have two configurations. The primary configuration has steel columns supporting the truss at the ends and at approximately one-third span (Figure 2). The columns are centered on a truss panel point (the location of intersecting truss members), which is appropriate. Based upon the contractor's drawings, it appears that the member sizes have been modified to accommodate the stress reversal[19] over only one of the interior columns.

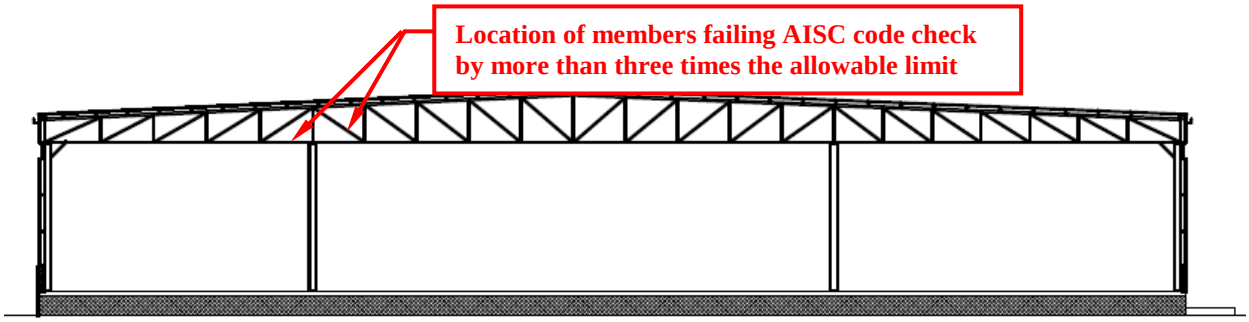


Figure 2. Primary truss configuration

In the area of the mezzanine, the plans show additional columns (Figure 3), which extend through the mezzanine to the underside of the truss. The additional bearing locations provided by these columns are not at a truss panel point. The resulting reactions from these columns will introduce bending into the lower chord of the truss. SIGIR is

[15] Seismic loading is one of the basic concepts of earthquake engineering which means application of an earthquake-generated agitation to a structure. It happens at contact surfaces of a structure either with the ground, or with adjacent structures.

[16] Knee brasses are small supports that are framed diagonally between a post and a beam.

[17] A truss chord is the horizontal bottom member of a truss that creates the ceiling on the interior of a structure.

[18] Cladding is the covering of one material with another, providing a protective covering for the outside of a building.

[19] The non-uniform distribution of dislocations in metals causes a material anisotropy that manifests itself through strain path dependency of the mechanical response. For example, an increase in stress magnitude followed by a reduction would be a stress reversal.

concerned that the members used in the lower chord of the truss are relatively light and do not appear to have the capacity to resist a significant amount of bending stress in addition to the compressive load that will result from the intermediate support.

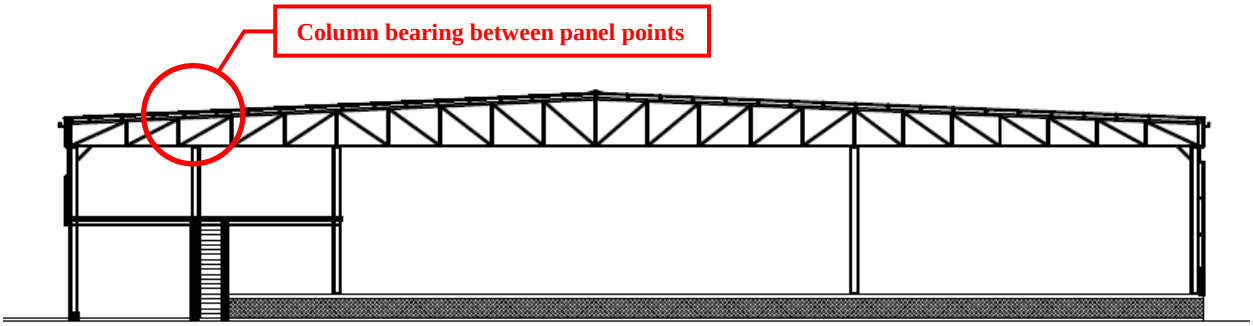


Figure 3. Truss configuration at mezzanine level

The contractor's design drawings do not address the method used to resist lateral loads parallel to the building's gable. It appears that the design incorporates diagonal cross bracing between several bays in the direction parallel to the ridge; however, there is no indication of bracing parallel to the gable (slope). In addition, the building's use of column and truss construction requires additional consideration of lateral loads. The only members that appear to be placed to provide lateral stability in the axis of the gable are the diagonal knee braces (Figure 4). These knees appear to be severely undersized, considering their location and configuration.

If the braces are used to resist lateral loads, the connection between the columns and truss would become, at least, partially fixed. This would introduce significant load into the lower chord of the truss, which appears to be already undersized. Fixing the truss/column connection would also introduce a lateral component into the column reaction; special consideration would then be required in the design of the foundation to resist this load.

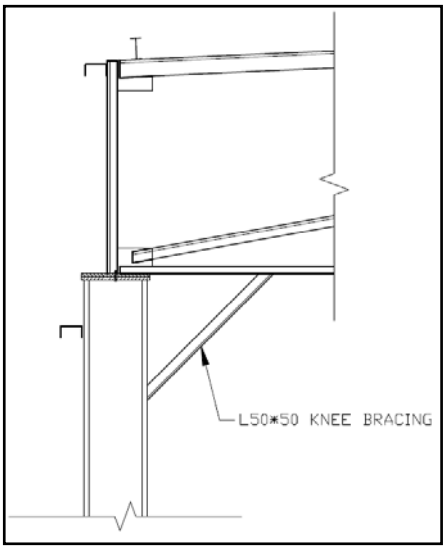


Figure 4. Knee brace detail

Foundation System

The project file lacked foundation system designs. The contractor is constructing a steel column and truss building with a span of approximately 46 meters (150 feet). The size of

this structure will result in a considerable load in the columns and require a significant foundation system. Based on the lateral bracing[20] method used, significant lateral load may also be present in the foundations.

This project required the installation of industrial machinery. Typically, industrial equipment with significant weight is placed on independent foundation slabs, which are thickened with additional reinforcements to resist the load of the equipment. The project file did not include any contractor designs for the equipment foundations.

In addition, based upon the layout of the facility, this project will require the use of material handling equipment and product storage areas. In facilities of this type, motorized pallet movers or forklifts are common; the contractor should have factored in the presence of this type of equipment in the design of the concrete floor. Due to the presence of industrial machinery and material handling equipment in the facility, the contractor should have created specific designs for the interior foundations and floor slabs; however, the project file did not include any contractor designs for either the interior foundations or floor slabs.

Codes

According to JCC-I/A, the contractor used the American Society for Testing and Materials (ASTM) and the American Concrete Institute (ACI) codes for this project. However, the ASTM standard is used to specify testing procedures for materials and systems; while the ACI is a structural design code for reinforced concrete, not a general building code. The ASTM standard is not a design code and would only apply to the quality control (QC)/quality assurance (QA) phases of the project; while the ACI would only apply to the reinforced concrete portion of the structure. Since the building is steel framed, the only reinforced concrete specified in the design is the footings and pedestals for the steel columns. The ACI code does not provide general design information, such as the requirements for structural loads, building systems, lateral stability, seismic loads, plumbing, HVAC, and egress.

TFBSO noted that JCC-I/A subsequently issued a modification to the cooperative agreement that requires that work be performed in accordance with international codes and standards, as approved by the contracting officer's representative.

Manufacturing Equipment/Milk Processing Equipment

This project proposes using previously purchased milk processing equipment. According to the SOW, this equipment is crated and stored at an on-site MIM warehouse. Typically, a contractor includes specifications for the industrial equipment stipulating the requirements for erection, support, site preparation, utility connections, and other associated items. These specifications require the disinfection and testing of the equipment and process piping before use. The project file lacked contractor specifications for the milk processing equipment.

Site Assessment

On 12 April 2009, SIGIR performed an on-site assessment of the Abu Ghraib Dairy project. A TFBSO representative accompanied SIGIR during the site visit. The on-site assessment included a review of the project site and an inspection of the warehouse

[20] Lateral brasses are placed and connected at right angles to a chord of a truss to help the structure resist loads.

where the milk processing equipment is being stored. At the time of the site assessment, the project was approximately 30% complete.

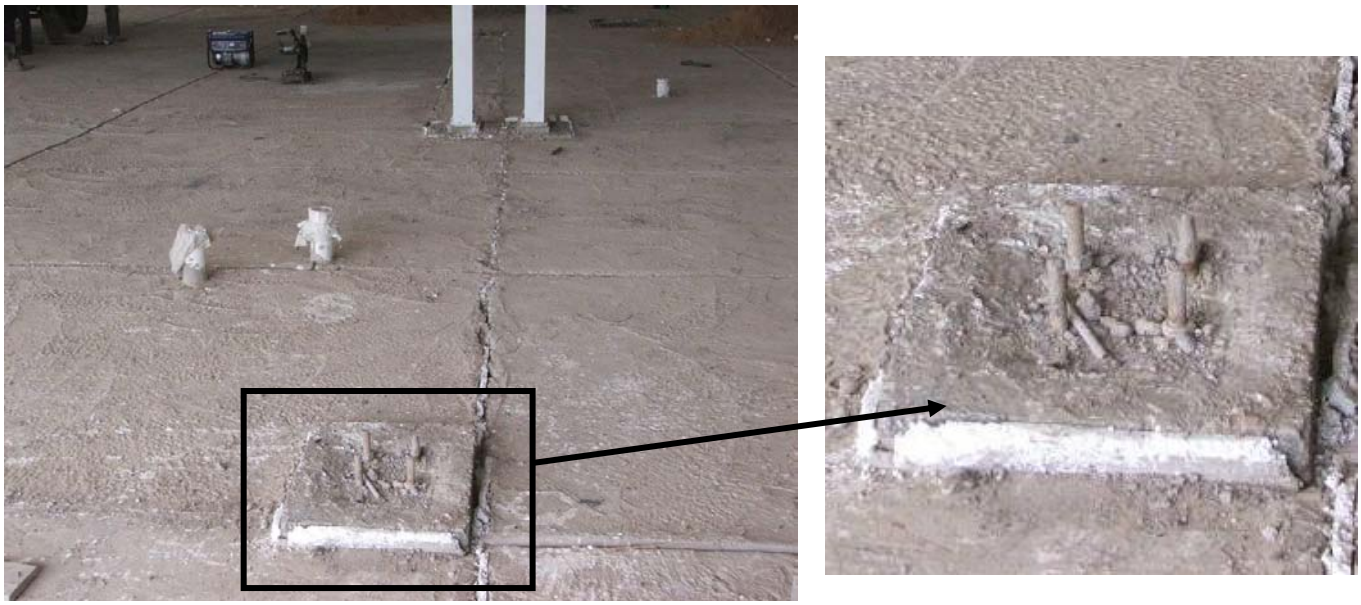
Foundations

At the time of the site visit, the foundations for the facility were installed. The foundation system appeared to be concrete pedestals with steel anchor bolts attached to the base plates of the steel columns (Site Photo 1). The foundation system also included spread footings to support the concrete pedestals and columns. Since the foundation was in the later stages of construction, only the upper portion of the foundation was exposed for inspection; consequently, SIGIR could not verify the construction of the foundation.

Site Photo 1. Typical foundation pedestal and anchor bolts

SIGIR observed no visible displacement of the foundation system; however, at the time of the site visit, the building was not complete and the footings were not fully loaded. Significant foundation settlement, if it were to happen, would not occur until after completion of construction.

SIGIR noticed several sets of anchor bolts not attached to structural columns (Site Photo 2). The contractor's project manager stated that these anchor bolts are intended to attach the mezzanine columns to the foundation. It appears that the contractor did not adequately protect the anchor bolts during construction of the concrete slab, since SIGIR observed bolts coated with concrete and, in some cases, bolts that had been bent. These bolts may be damaged to the point that the mezzanine columns cannot be placed over the bolts without modification to the base plate or re-bending the bolts. The concrete-coated bolts require cleaning, and if the underlying threads are damaged, they may require re-threading to accept a nut to secure the base plate.

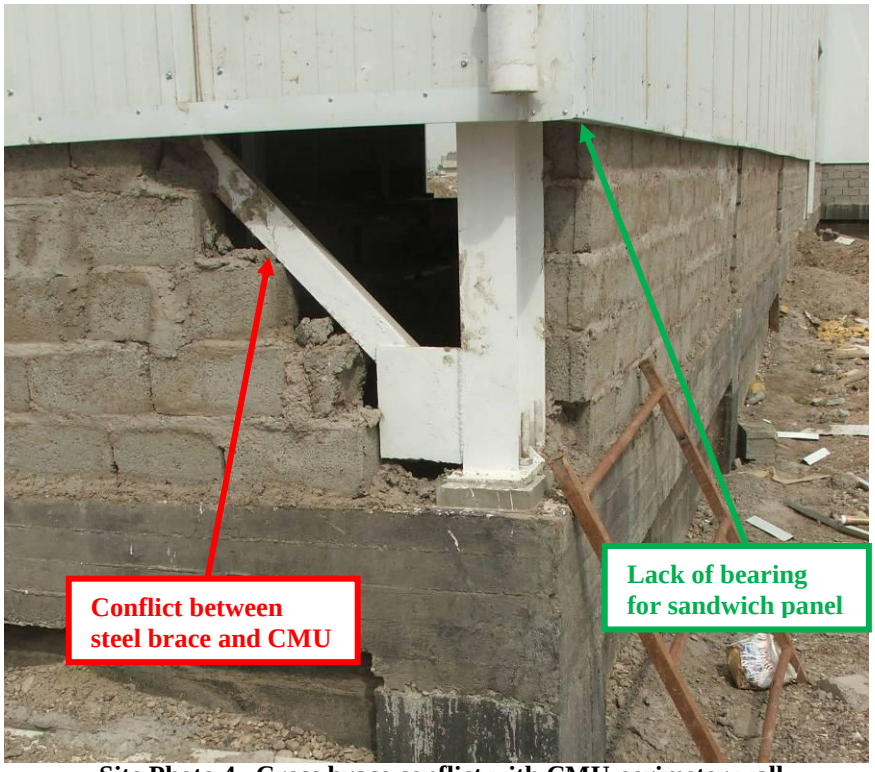


Site Photo 2. Unprotected, exposed anchor bolt group

The foundation system included a perimeter concrete masonry unit (CMU) wall (Site Photo 3), which acts as a grade separation barrier and contains the backfill beneath the floor slab in the building. Due to a construction error, the CMU wall was not constructed on the exterior of the steel framing; rather it has been constructed between the steel columns. This created several issues with the structure that need to be addressed.

Site Photo 3. Perimeter CMU wall

The CMU wall interferes with the steel cross bracing between several of the columns (Site Photo 4). It appears as if the contractor's solution to this issue was to lay the CMU wall around the bracing and coat the entire area with plaster. However, this approach may cause future problems as the steel bracing moves independently of the CMU wall causing recurrent cracking at the location.



Site Photo 4. Cross brace conflict with CMU perimeter wall

In addition, the CMU wall design detail indicated that the sandwich panel should be supported by the wall. However, SIGIR observed that the panel was unsupported and advised that support is required for the panels. Based upon the current configuration, the panel cannot completely bear on top of the CMU wall. Consequently, the contactor needs to consult with the designer to determine if the support for the wall is critical to the integrity of the panel.

SIGIR also noticed several areas where one course of CMUs was laid on their sides (cores horizontal) (Site Photo 5). The detailed plans did not show this type of construction technique and it is unclear why the contractor did this. SIGIR's concern is that CMUs are significantly weaker when placed in this orientation. If these CMUs are intended to support the weight of the loaded floor slab, additional reinforcement of this area is needed.

The CMU perimeter wall appeared to support the interior floor slab, which was partially completed at the time of the site visit. The contractor was constructing the floor slab in a series of small segments separated by construction joints. The location of the joints did not appear to follow any specific pattern, with segments varying in size and alignment.

The quality of the construction of the floor slab was very poor and appeared to have been poured without the correct tools or equipment. The slab has high and low spots in various places and raised tool marks from what appears to be preliminary leveling of the

Site Photo 5. Course of CMUs placed with cores horizontal

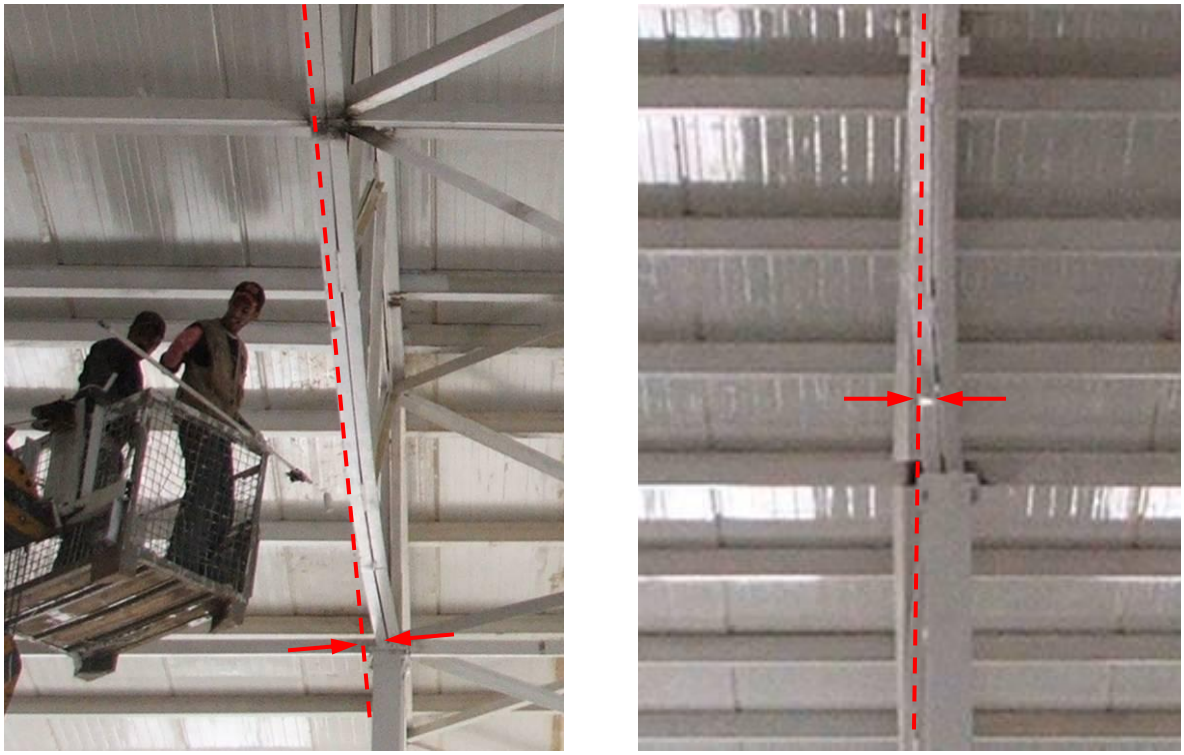
slab. There is no indication that final finishing was performed after preliminary leveling. The slab's inconsistency may create problems for forklift traffic and future equipment installation.

Steel Structure

At the time of the site visit, all structural steel, with the exception of the mezzanine, had been erected. The steel structure for the dairy building consisted of continuous steel trusses supported by steel columns (Site Photo 6). The trusses at the ends of the structure and at either side of the expansion joints were braced with diagonal bracing in the plane of the upper and lower chord. The trusses are also braced transversely in the plane of the lower chord with steel braces running the length of the structure.

Site Photo 6. Lateral brace connection at column cap plate

SIGIR noticed deformation (buckling/bending) of several of the roof trusses near one of the interior column lines (Site Photos 7 and 8). Due to the limited time available on site and the lack of aerial access to the steel framing, SIGIR could not determine the magnitude of the displacement; however, the fact it could be detected visually from the ground level indicates that the displacement is significant.



Site Photos 7 and 8. Lateral bow in lower truss chords

Based on the contractor's calculations, the lower chord members adjacent to the interior column are overstressed and are unable to support the design load. The truss is a continuous truss, which results in compression loads in the members. A compression failure of the lower chord could result in buckling of the chord and lateral displacement. This corresponds with the behavior of the lower chord SIGIR observed. While the contractor's calculations indicate that the displacement may be indicative of the initial stages of truss failure, other factors may also have contributed to the misalignment, such as poor construction techniques used during the erection of the trusses or "adjustment" of the trusses during installation of the bracing. Either scenario could have further amplified any deformation of the trusses.

Lower bracing was welded to the column cap plate (Site Photo 9), which acts to resist lateral sway at the top of the column. Since the truss is continuous, loads from the roof will induce compressive stress in the bottom chord above the column. The compressive stress could produce buckling in the lower chord. The connection between the truss and the column is effectively a hinge point, and the lateral bracing is essential to resist this buckling and prevent movement of the column.

Lateral bracing is provided along exterior column lines of the structure. The bracing is provided as vertical steel cross-bracing along the exterior column line perpendicular to the steel trusses (Site Photo 10). As previously noted, the bracing interferes with the

CMU walls due to a contractor construction error. The bracing appeared to be completely installed at the time of the visit.

Site Photo 9. Lateral brace connection at column cap plate

To provide lateral bracing parallel to the trusses, diagonal braces were welded to the steel columns and the lower chord of the truss (Site Photo 11). SIGIR observed what appeared to be significantly undersized braces in place, which could lead to excessive bending in the lower chord of the truss.

Site Photo 10. Lateral cross bracing between columns

Site Photo 11. Diagonal brace from column to truss lower chord

Utilities

SIGIR observed sanitary sewer manholes in several locations in the floor (Site Photo 12). The sanitary manholes were constructed as cast-in-place reinforced concrete with polyvinyl chloride sewer piping cast directly into the manhole walls. The contractor failed to install a manhole on the interior of the building; instead the contractor installed a polyvinyl chloride elbow. This will result in future problems because the sewer line is not accessible for cleaning.

Site Photo 12. Cast-in-place sanitary sewer manhole

At the time of the site visit, no other utilities had been constructed. According to the contractor's project manager, the sanitary sewer was the only utility to be placed below the slab. All other utilities, including water, electricity, communications, and HVAC ducting would be run overhead (suspended from the trusses).

Since this is an industrial project, specifically a dairy, utilities are a significant portion of the construction. SIGIR is concerned about the lack of attention to most of the utilities within the building envelope[21]. The utilities should have been planned to coincide with construction of the equipment foundations, floor slab, and structural steel. However, since there was no utility construction completed inside the building envelope, SIGIR could not determine if there will be any conflicts with the building systems.

Water and Fuel Storage Tanks

At the time of the site visit, the contractor had substantially completed the construction of the reinforced concrete fuel and potable water storage tanks. The tank floors, walls, and lids had been poured, and the access hatches and ladders installed. In addition, the pipe penetrations to the tanks below grade appeared to be installed. SIGIR observed the contractor completing backfill around the tanks, installation of the above grade vent pipe penetrations, and coating of the tank interiors (Site Photo 13).

Site Photo 13. Chiseling tank lid for pipe penetration

The contractor did not cast the vent pipe penetrations into the tank lid at the time of construction; rather the contractor is attempting to install the vent pipes after completion of the lid. This construction technique requires chiseling of the concrete, cutting the

[21] A building envelope is the separation between the interior and the exterior environments of a building. It serves as the outer shell to protect the indoor environment as well as to facilitate its climate control.

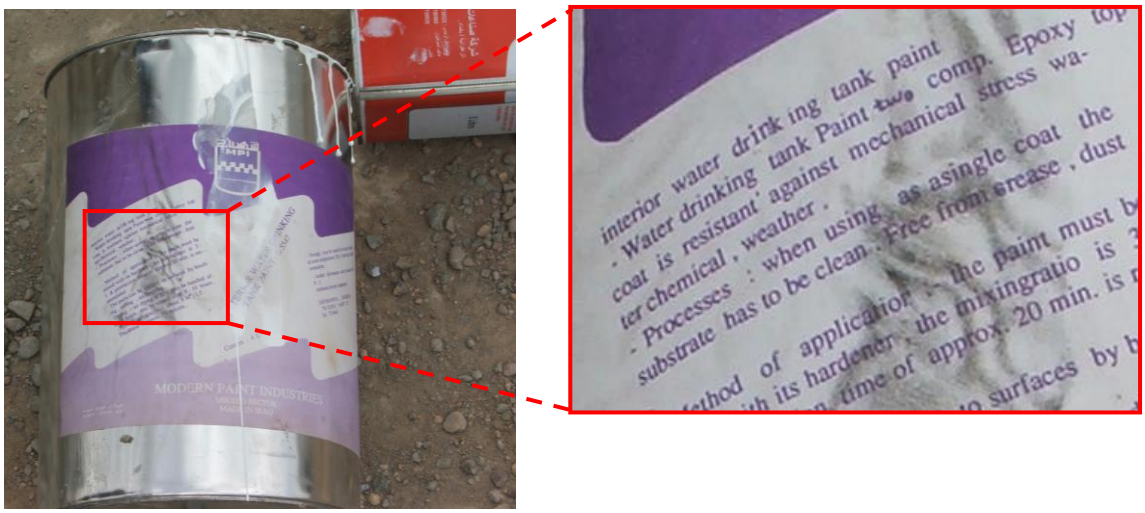
reinforcing steel, and grouting the pipe in place. This "modification" weakens the lid and creates increased potential for leakage.

SIGIR identified the installation of one vertical vent pipe with no cap. Vent pipes should be constructed with caps in order to prevent foreign materials from entering the tanks. In addition, screening material should be provided to prevent insects from entering the potable water tank.

Pumps were on site awaiting installation (Site Photo 14). According to the contractor, they are fuel oil transfer pumps, which will be placed in the pump vault[22] between the two fuel oil tanks.

Site Photo 14. Pumps for fuel oil transfer

SIGIR observed the contractor applying coatings to a liquid tank's interior. The labels on the coating containers (Site Photo 15) stated that the coatings were two-part epoxy and the material was compatible for use with potable water.



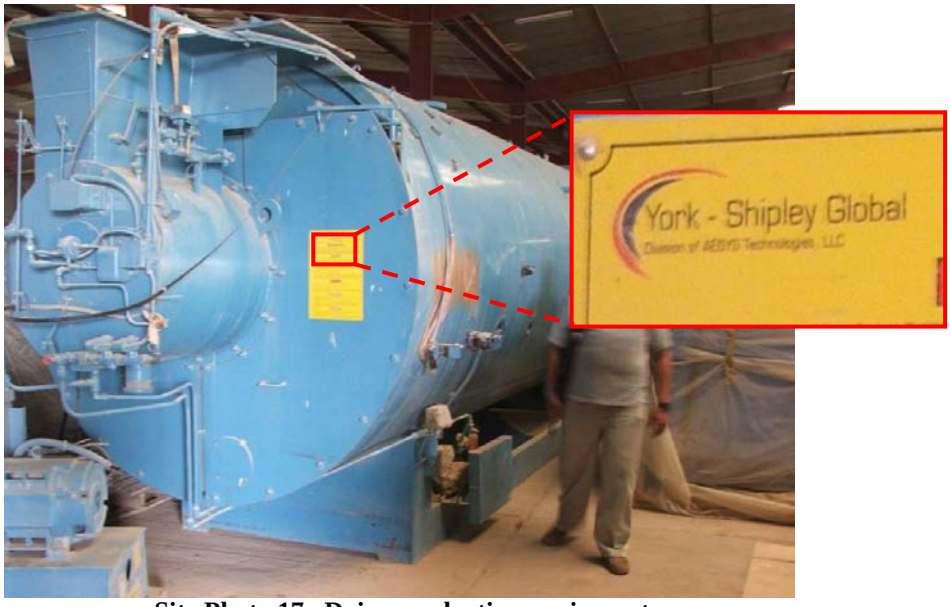
Site Photo 15. Coating for potable water tank

[22] A pump vault is a protective housing or enclosure for submersible pumps.

Dairy Processing Equipment (Off-site)

With the exception of one large piece of equipment already located inside the newly constructed facility, the milk processing and packaging equipment is stored inside a leaking warehouse[23] near the Abu Ghraib Dairy (on the Ministry of Industry and Minerals compound). SIGIR toured the warehouse and found most of the equipment in its original packaging and appeared to be in good condition. One of the pieces of equipment sustained some damage due to either improper storage or handling (Site Photo 16). SIGIR was able to identify several pieces of equipment with visible nameplates (Site Photo 17), and the remainder of the equipment was labeled with shipping labels.

Site Photo 16. Damaged dairy production equipment



Site Photo 17. Dairy production equipment

[23] It had recently rained and SIGIR observed a noticeable amount of water on the floor and on the equipment.

Corrective Actions Taken Since Initial Site Visit

After reviewing the contractor's designs and calculations and conducting the initial on-site assessment, SIGIR identified several significant areas of concern:

- unsatisfactory allowable stress criteria (specifically, roof truss members 17, 18, 62, 67, and 86)
- inadequate roof truss deflections (some trusses were not installed in a consistent congruent fashion thereby voiding their structural integrity)
- poor bottom chord bracings
- insufficient information to thoroughly evaluate the lateral force considerations for the roof trusses and columns
- lack of bearing/strength for sandwich panel walls
- exposed cavities of CMU under the foundation

SIGIR immediately brought these concerns to the attention of JCC-I/A and TFBSO representatives. On 27 May 2009, JCC-I/A issued a partial stop work order to the contractor and on 16 June 2009 requested the contractor to submit a proposed plan to remedy the issues. On 29 July 2009, the contractor submitted revised calculations to address the above mentioned concerns.

TFBSO retained the U.S. Army Corps of Engineers (USACE) Gulf Region District (GRD) to provide oversight for the performance of the contractor's corrective actions and QA of ongoing construction. GRD reviewed the contractor's revised calculations and corrective actions for the following areas of concern:

- unsatisfactory allowable stress criteria for five roof truss members
- inadequate roof truss deflections
- insufficient lateral force considerations for roof trusses and columns
- over welding
- lack of bearing for sandwich panel walls
- exposed cavities of CMU under the foundation

GRD determined that the contractor's new calculations and corrective actions were acceptable and "verified these corrective actions taken as complete." GRD considered the "corrective actions as improvements to the existing conditions, which would provide additional safeguard to the overall structural soundness of the building." On 4 September 2009, in light of the corrective actions taken to improve the structural integrity of the facility, GRD recommended that JCC-I/A lift the temporary work stoppage order.

Additional Site Visit

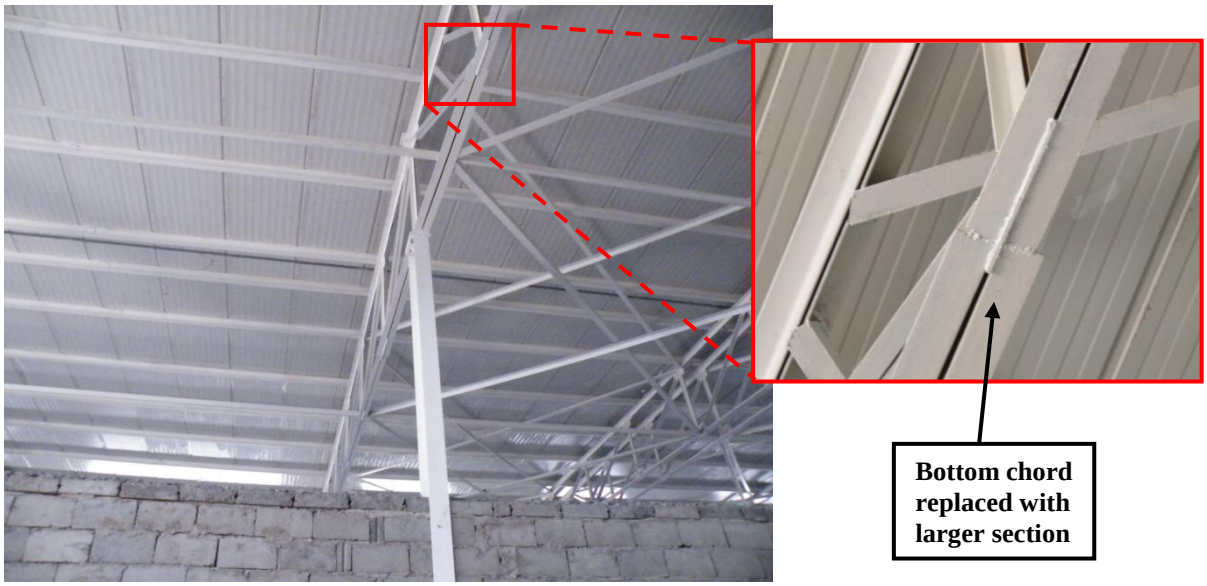
In order to verify that the contractor's corrective actions were taken, SIGIR made a second site visit to the Abu Ghraib Dairy project on 4 December 2009 with representatives from GRD and TFBSO. SIGIR found the facility to be approximately 35-40% complete[24].

Truss Modification

In order to remedy the deformation of the roof trusses SIGIR previously identified, the contractor's modification included the removal of the lower truss chord in the area where

[24] Construction completion advanced approximately 5-10% since SIGIR's site visit in April 2009.

it was inadequate and replaced it with a larger section. Aerial lift capabilities were not available at the time of the site visit; therefore, a hands-on inspection of the repair could not be made. However, SIGIR was able to verify that the trusses had a larger bottom chord section in the areas previously noted as deficient (Site Photo 18).



Site Photo 18. Contractor's truss modification

Cross Bracing Modification

Previously, SIGIR noted that due to the contractor's deviation from the design drawings, the steel cross bracing for the structure conflicted with the CMU perimeter wall. To correct this, the contractor removed the CMU wall, relocated the steel cross bracing to the interior of the wall, and reconstructed the wall (Site Photos 19 and 20).

Site Photos 19 and 20. Cross bracing located to perimeter CMU wall interior

Exterior Cladding Support

Another previously noted deficiency was the lack of support for the sandwich panels used as cladding for the building exterior. This lack of support was due to the contractor's deviation from the original design, which located the perimeter CMU wall to the interior of the steel framing. To remedy this situation, the contractor installed steel channels

around the perimeter of the building attached to the columns and supporting the panels (Site Photos 21 and 22).

Site Photos 21 and 22. Support channel for sandwich panel

CMU Foundation Backfill

Initially, the contractor incorrectly placed CMUs with their sides' horizontal along the foundation wall. This orientation significantly weakened the CMUs. The contractor corrected this deficiency by using concrete to fill the cores of the CMUs, which provides increased strength to the wall (Site Photo 23).

Site Photo 23. CMU cores filled with concrete

Project Quality Management

Department of the Army Engineering Regulation 1180-1-6, dated 30 September 1995, provides general policy and guidance for establishing quality management procedures in the execution of construction contracts. The regulation states, "…obtaining quality

construction is a combined responsibility of the construction contractor and the government."

Standard construction contracts generally require the contractor to perform QC throughout the duration of construction, installation, and testing and commissioning. QC programs require representatives to monitor field activities and prepare daily reports documenting work performed on site, testing performed, and construction deficiencies identified and corrective actions taken. Since the contractor is responsible for all testing at the project site, it is essential for QC representatives to be present for all significant testing and follow-up on the test results.

The cooperative agreement did not include a specific reference for oversight of the contractor's construction activities. Instead, the cooperative agreement included a section entitled "Monitoring and Evaluation," which required:

- systematic monitoring and reporting of progress on performance during the agreement period
- summary of the performance and development impact achieved as a result of this agreement

The "Monitoring and Evaluation" requirement was included to measure the progress of the construction, not the quality of construction. Consequently, a traditional QC program, a critical tool for identifying and correcting non-conforming construction practices, was not in place for this project.

Government Quality Assurance

The QA program is responsible for oversight of all QC activities. In addition, similar to the QC program, a crucial oversight technique is presence at the construction site.

Initially, TFBSO performed the QA function by employing local national Iraqi engineers as the on-site QA representatives responsible for visiting the project site and writing QA reports. The QA reports documented the number of workers on site and the work performed for the day. In addition, the QA reports included photographs from the project site. However, the QA reports did not identify construction deficiencies, such as inadequately protected anchor bolts, incorrect placement of the CMU wall, poorly constructed floor slab, and deformation of several of the roof trusses.

In addition, the QA representatives did not identify safety concerns. For example, during the first site visit, SIGIR detected harsh fumes from the use of two epoxy coatings for a liquid tank. SIGIR observed the workers applying the coatings to the tank's interior with no protective equipment or breathing apparatus. SIGIR is concerned that prolonged exposure to the fumes in the enclosed environment (of the tank) could lead to significant health problems.

U.S. Army Corps of Engineers

In June 2009, TFBSO retained the USACE GRD to provide oversight of ongoing construction activities. The local national QA representatives monitored field activities and prepare daily QA reports, which were reviewed by the GRD project engineer. The QA representatives supplemented the daily QA reports with detailed photographs that reinforced the information provided in the reports. SIGIR reviewed the daily QA reports and found that these QA representatives did an effective job identifying and correcting construction deficiencies at the project site.

SIGIR's December 2009 site visit confirmed that construction quality improved after GRD's involvement in construction oversight.

Project Sustainability

Standard construction contracts include a number of sustainability elements to assist the end user in the future operation of the project after turnover. The cooperative agreement did not include reference to ordinary sustainability elements, such as operations and maintenance support and spare parts. In addition, standard construction contracts include a warranty for the construction work for a period of at least one year from the date of final acceptance of the work. However, the cooperative agreement does not include this reference; therefore, there is no warranty for the construction work.

The cooperative agreement does require the contractor to provide training for the new milk line equipment. In addition, according to TFBSO and GRD representatives, the contractor will provide as-built drawings after construction is complete. The as-built drawings will show the construction as installed and completed by the contractor and will include all information shown on the contract set of drawings. The as-built drawings are critical since the contractor's original design submittals lack significant details.

Milk Line Equipment

As mentioned earlier, in August 2002, the then-Saddam Hussein Government of Iraq entered into a $7,551,398[25] contract with a Lebanese company to provide milk line equipment to produce 10 tons per hour of milk in high density polyethylene bottles.

The equipment was delivered in 2002 to a warehouse near the Abu Ghraib Dairy (within the MIM compound) where it has remained for the past 7 years. As stated earlier, this project was originally conceived as a way to use already existing equipment; however, this equipment was not tested prior to the issuance of the cooperative agreement to confirm that it was fully operational. SIGIR toured the warehouse and visually inspected the equipment. SIGIR cannot comment on the condition of the majority of the equipment, since it was either in crates or under tarps. However, SIGIR is concerned about the state of the equipment and whether it will be operational after sitting idle in a warehouse for over 7 years. For example, the seals on the equipment may be dry rotted and will have to be replaced. The state of the equipment will not be known until it is assembled and tested. SIGIR is concerned that the milk line equipment will not be operational, which will require procurement of new equipment or parts and further delay the opening of the Abu Ghraib Dairy. The milk line equipment will be assembled and tested inside the newly constructed facility (after being connected to all site utilities).

In addition, according to the Director General (DG) of the Abu Ghraib Dairy, the Lebanese company that sold them the dairy equipment did not provide an air compressor or compatible spare parts, both required under the contract. TFBSO representatives stated that the Abu Ghraib Dairy representatives are negotiating with the Lebanese company to provide the missing equipment; however, because this equipment is 7 years old, spare parts may not be available.

The current construction contractor was originally contracted by the 2002 Government of Iraq with the responsibility for assembling the equipment and then commissioning and

[25] The total value of the contract was 7,660,950 Euros, which in August 2002 had an exchange rate of $0.9857.

testing. The contractor's current workforce is composed of construction laborers who do not have the technical capabilities to install, assemble, commission, test, and provide training. Further, SIGIR did not observe any operations and maintenance manuals for the milk line equipment within the warehouse. TFBSO representatives are working with Abu Ghraib Dairy and contractor representatives to determine if qualified personnel are available for installation and commissioning of the milk line equipment. Also, qualified personnel will be required to provide the cooperative agreement required training to Abu Ghraib Dairy personnel on the operation and maintenance of the milk line equipment.

In response to a draft of this report, TFBSO representatives also assured SIGIR that GRD, in coordination with the Abu Ghraib Dairy DG, is developing an installation, testing, and commissioning plan.

Additional Actions Taken

Task Force for Business and Stability Operations

TFBSO has weekly interaction (either via telephone or in person) with the Abu Ghraib Dairy DG to discuss the status of the project. According to TFBSO representatives, in December 2009, the Abu Ghraib Dairy DG stated that there is approximately $400,000 remaining from the original purchase contract with the Lebanese contractor. This amount represents the costs of the undelivered air compressor and spare parts and the installation and commissioning of the milk line equipment. The Abu Ghraib Dairy DG is in negotiations with the Lebanese company to provide the missing equipment and spare parts; if the Lebanese company is unwilling or unable to provide this equipment, the Abu Ghraib Dairy DG will use the remaining money to purchase it on the open market.

After further discussions with the construction contractor, TFBSO and Abu Ghraib Dairy representatives are not confident that the contractor has the technical capability to install and commission the milk line equipment. Therefore, at the request of TFBSO representatives, the Abu Ghraib Dairy DG is accepting bids for the installation and commissioning of the equipment, which will be paid for from the residual money left from the original contract.

Conclusions

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

   The contractor's designs and specifications were insufficient to adequately construct the facility and the various systems within the facility. Specifically, the contractor's design drawings lacked significant details for site utilities, such as potable water system, water supply and treatment, sewage treatment, and electrical generation and distribution. For example, due to the lack of information available regarding the existing potable water system, SIGIR could not determine if the contractor has verified that the existing potable water supply can provide the required pressure and/or quantity of water for the facility. This should be verified prior to construction of the potable water system to determine if modifications are required or if an additional source of potable water must be secured.

   SIGIR's review of the contractor's designs identified the following issues with the integrity of the structure:

- The allowable live roof load used in the analysis is 8 pounds psf. While the cooperative agreement did not specify design criteria, the International Building Code requires a minimum live load of 12 psf for roof design.
- The calculations did not account for lateral loads on the structure, including wind or seismic loading.
- Based on the contractor's calculations, five members of the truss were designated as failing the AISC code check. Two of the members failed the code check by a factor greater than 3 times. Failing by a factor of this magnitude indicates that the members could yield and possibly fracture under the design load.
- The analysis did not consider knee braces. The size and placement of the knee braces will significantly affect the performance of the structure and may result in the failure of the lower truss chord.
- Based on the design drawings, the connections for the truss are welded; however, the contractor did not provide a design for the connections.

In addition, SIGIR is concerned that the members used in the lower chord of the truss do not have the strength and capacity to resist a significant amount of bending stress in addition to the compressive load that will result from the intermediate support. Further, the contractor's design drawings do not address the method used to resist lateral loads parallel to the building's gable. It appears that the design incorporates diagonal cross bracing between several bays in the direction parallel to the ridge; however, there is no indication of bracing parallel to the gable. In addition, the building's use of column and truss construction requires additional consideration of lateral loads. The only members that appear to be placed to provide lateral stability in the axis of the gable are the diagonal knee braces. These knee braces appear to be severely undersized, considering their location and configuration. If the braces are used to resist lateral loads, the connection between the columns and truss would become, at least, partially fixed. This would introduce a significant load into the lower chord of the truss, which appears not to have been sized for this purpose. Fixing the truss/column connection would also introduce a lateral component into the column reaction; special alterations would then be required in the design of the foundations to resist this load.

The design and specification omissions occurred because the cooperative agreement did not require the review and approval of the contractor's submittal prior to construction. The project file lacked any indication the contractor's designs and specifications were reviewed. A thorough review of the contractor's calculations would have identified the failure of the five truss members.

SIGIR immediately brought these concerns to the attention of JCC-I/A and TFBSO representatives. On 27 May 2009, JCC-I/A issued a partial stop work order to the contractor and on 16 June 2009 requested the contractor to submit a proposed plan to remedy the issues. On 29 July 2009, the contractor submitted another calculation to address the above mentioned concerns.

TFBSO retained USACE GRD to provide oversight for the performance of the contractor's corrective actions and quality assurance of ongoing construction. GRD reviewed the contractor's re-submitted calculations and corrective actions. GRD determined the contractor's new calculations and corrective actions were acceptable and "verified these corrective actions taken as complete."

2. Determine whether construction or rehabilitation is in compliance with the standards of the design.

At the time of the first site visit, the project was approximately 30% complete; consequently, construction work on the Abu Ghraib Dairy was still ongoing. SIGIR observed construction deficiencies, such as inadequately protected anchor bolts, the CMU wall not constructed on the exterior of the steel framing, poorly constructed floor slab, and deformation of several of the roof trusses.

SIGIR discussed these deficiencies with the TFBSO; specifically the deformation of several of the roof trusses. TFBSO took immediate action by retaining USACE GRD to provide oversight of the contractor's corrective actions and quality assurance of ongoing construction. GRD representatives were on site to oversee the contractor's corrective actions to the previously identified construction deficiencies. GRD determined that the contractor's corrective actions were acceptable and "verified these corrective actions taken as complete." GRD considered the "corrective actions as improvements to the existing conditions, which would provide additional safeguard to the overall structural soundness of the building."

SIGIR's December 2009 site visit confirmed that the contractor had corrected several of the deficiencies SIGIR identified during the first site visit. In addition, the contractor's construction quality improved after GRD's involvement in construction oversight.

3. Determine whether adequate quality management programs are being utilized.

Standard construction contracts generally require the contractor to perform QC throughout the duration of construction, installation, testing and commissioning. QC programs require representatives to monitor field activities and prepare daily reports documenting work performed on site, testing performed, and construction deficiencies identified and corrective actions taken. However, the cooperative agreement did not include a specific reference to oversight of the contractor's construction activities; instead the cooperative agreement focused on construction progress, not the quality of construction. Consequently, a traditional QC program, which provides a critical tool for identifying and correcting non-conforming construction practices, was not in place for this project.

Initially, the government QA program was ineffective in identifying and correcting the contractor's construction deficiencies and safety issues. For example, the QA reports did not identify construction deficiencies, such as inadequately protected anchor bolts, the CMU wall not constructed on the exterior of the steel framing as required, a poorly constructed floor slab, and deformation of several of the roof trusses.

In June 2009, TFBSO retained the USACE GRD to provide oversight of ongoing construction activities. GRD employed local national QA representatives to monitor field activities and prepare daily QA reports, which were reviewed by the GRD project engineer. The QA representatives supplemented the daily QA reports with detailed photographs that reinforced the information provided in the reports. SIGIR reviewed the daily QA reports and found that the QA representatives did an effective job identifying and correcting construction deficiencies at the project site.

SIGIR's December 2009 site visit confirmed that construction quality improved after GRD's involvement in construction oversight.

4. Determine if sustainability is addressed in the contract or task order for the project.

Sustainability was not adequately addressed in the cooperative agreement for this project. Standard construction contracts include a number of sustainability elements to assist the end user in the future operation of the project after turnover. The cooperative agreement did not include reference to ordinary sustainability elements, such as operations and maintenance support and spare parts. In addition, standard construction contracts include a warranty for the construction work for a period of at least one year from the date of final acceptance of the work. However, the cooperative agreement does not include this reference; therefore, there is no warranty for the construction work when it is completed.

The cooperative agreement does require the contractor to provide training for the new milk line equipment.

In August 2002, the then-Saddam Hussein Government of Iraq entered into a contract with a Lebanese company to provide milk line equipment to produce 10 tons per hour milk in high density polyethylene bottles. The equipment was delivered in 2002 to a MIM warehouse near the Abu Ghraib Dairy, where it has remained for the past 7 years. SIGIR is concerned about the state of the equipment and whether it will be operational after sitting idle in a warehouse for over 7 years. For example, the seals are probably dry rotted and will have to be replaced. The state of the equipment will not be known until it is assembled and tested. SIGIR is concerned that the existing milk line equipment will not be operational, which will require the procurement of new equipment and further delay the opening of the Abu Ghraib Dairy.

In addition, according to the Abu Ghraib Dairy DG, the Lebanese company did not provide the air compressor or compatible spare parts, both required under the contract. TFBSO representatives stated that the Iraqi officials are negotiating with the Lebanese company to provide the missing equipment; however, considering this equipment is 7 years old, spare parts may not be available. However, recently, TFBSO representatives stated that the Abu Ghraib Dairy DG has funding available to purchase the necessary equipment and spare parts should the contractor not be able to provide them.

In response to a draft of this report, TFBSO representatives also assured SIGIR that GRD, in coordination with the Abu Ghraib Dairy DG, is developing an installation, testing, and commissioning plan.

5. Determine if project results are or will be consistent with their original objectives.

To date, the Abu Ghraib Dairy project results are consistent with the original cooperative agreement objective to rebuild the production capability of the dairy. TFBSO planned to use existing milk line equipment, which required constructing a building and ancillary systems to house the equipment and connect it to local utilities. Although SIGIR identified significant issues with the design and construction of the building, the contractor's corrective actions and GRD's construction oversight have resulted in additional safeguards to the overall structural soundness of the facility.

However, even after the completion of the building, the production capability of the Abu Ghraib Dairy will depend upon the condition of the equipment, which has been in storage in a leaking warehouse since 2002. The cooperative agreement was awarded prior to the testing of the equipment to confirm that it was fully operational. SIGIR is concerned about the state of the equipment and whether it will be operational after

sitting idle in a warehouse for over 7 years. The state of the equipment will not be known until it is assembled and tested. SIGIR is concerned that that the existing milk line equipment will not be operational, which will require the procurement of new equipment and further delay the opening of the Abu Ghraib Dairy.

Lessons Learned

A significant number of issues negatively affecting this project are a direct result of the use of a cooperative agreement and the initial lack of U.S. government oversight. The cooperative agreement did not provide specific requirements to the contractor regarding design submittals and specifications, warranty clauses, and quality control; while also not requiring the U.S. government to review the design submittals and specifications for accuracy and completeness or to provide construction oversight via a quality assurance program. The lack of design submittals and specifications review allowed the contractor to begin construction with an inadequate design that lacked significant details; while the lack of quality assurance allowed the contractor to continue construction without being required to correct deficient work.

TFSBO reported that the cooperative agreement was at the recommendation of JCC-I/A. It was TFSBO's understanding that the cooperative agreement would allow for sufficient oversight, while accelerating the project's completion. It was also believed that the cooperative agreement could help develop the project management capability of the Abu Ghraib Dairy management personnel.

Following discussions with SIGIR, TFBSO realized the above mentioned limitations of the cooperative agreement and the impact of limited oversight of a construction project. TFBSO representatives informed SIGIR that in the future cooperative agreements would not be used for construction projects. Consequently, when the TFBSO recently awarded a contract for an open air market in Basrah, TFBSO representatives stated that the contract contained specific requirements for design submittal and specifications. In addition, construction oversight will be enforced through the use of an external entity, such as USACE GRD, to promote quality construction.

Recommendations

SIGIR recommends that the Commander of the Gulf Region District take these actions:

1. Work with the contractor to develop specific details with respect to site utilities.
2. Continue oversight of the contractor's corrective actions to ensure that the facility, when completed, is structurally sound.

SIGIR also recommends that the Task Force for Business and Stability Operations continue to work with the Director General of the Abu Ghraib Dairy to determine the status of any missing equipment and spare parts and the award of the contract to install and commission the milk line equipment.

Management Comments

SIGIR received comments on the draft of this report from the Gulf Region District and the Task Force for Business and Stability Operations concurring with the recommendations, citing corrective actions taken, and providing comments for clarity and

accuracy of the report. The complete texts of the Gulf Region District's comments are provided in Appendix C. The complete texts of the Task Force for Business and Stability Operations' comments are provided in Appendix D.

Evaluation of Management Comments

SIGIR appreciates the concurrence by Gulf Region District and the Task Force for Business and Stability Operations with the draft report's recommendations. Their comments addressed our recommendations, cited corrective actions taken, and provided additional clarifying information for this final report. As a result, no additional comments are required.

Appendix A. Scope and Methodology

SIGIR performed this project assessment from February 2009 through December 2009 in accordance with the Quality Standards for Inspections issued by the Council of Inspectors General on Integrity and Efficiency. The assessment team included two engineers/inspectors and two auditor/inspectors.

In performing this Project Assessment SIGIR:

- Reviewed documentation to include the following: cooperative agreement, modifications, Statement of Work, and quality assurance/quality control reports;
- Reviewed the design package (plans) and photographs documenting construction progress;
- Interviewed U.S. Army Corps of Engineers Gulf Region District and Task Force for Improve Business and Stability Operations personnel; and
- Conducted two on-site assessments and documented the results of the Abu Ghraib Dairy project in Abu Ghraib, Iraq.

Scope Limitation. Due to security concerns, the time allotted for the two site visits was approximately 60 minutes each. Consequently, SIGIR performed an expedited assessment of the areas available; therefore, a complete review of all work completed was not possible.

Appendix B. Acronyms

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ASTM	American Society for Testing and Materials
CMU	Concrete Masonry Unit
DG	Director General
DoD	Department of Defense
GRD	Gulf Region District
JCC-I/A	Joint Contracting Command – Iraq/Afghanistan
HVAC	Heating, ventilating, and air conditioning
MIM	Ministry of Industry and Minerals
MND-B	Multi-National Division – Baghdad
PDS	Iraqi Public Distribution System
psf	Pounds per Square Foot
QA	Quality Assurance
QC	Quality Control
SIGIR	Special Inspector General for Iraq Reconstruction
SOEs	State owned enterprises
SOW	Statement of Work
TFBSO	Task Force for Business and Stability Operations
UN	United Nations
USACE	U.S. Army Corps of Engineers
USAID	U.S. Agency for International Development

Appendix C. GRD Comments on Draft Report

DEPARTMENT OF THE ARMY
GULF REGION DISTRICT
ARMY CORPS OF ENGINEERS
APO AE 09342

REPLY TO
ATTENTION OF

CETAG

27 December 2009

MEMORANDUM FOR Special Inspector General for Iraq Reconstruction, US Embassy Annex II, Room 1013, APO AE 09316

SUBJECT: Draft SIGIR Audit Report – Abu Ghraib Dairy (SIGIR PA-09-172)

1. This memorandum provides the U.S. Army Corps of Engineers, Gulf Region District response to the subject draft audit report.

2. The Gulf Region District reviewed the subject draft report and generally agrees with the facts as presented in the report. Gulf Region District provided additional comments for clarity and accuracy in the enclosure.

3. Thank you for the opportunity to review the draft report and provide written comments for incorporation in the final report.

4. If you have any questions, please contact Mr. Robert Jones at (540) 678-2996 or via email Robert.A.Jones@usace.army.mil.

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Appendix C. GRD Comments on Draft Report

GULF REGION DISTRICT
COMMAND REPLY
to
SIGIR Draft Audit Report – Abu Ghraib Dairy
(SIGIR Project PA 09-172)

Recommendations:

Recommendation 1. Continue oversight of the contractor's corrective actions to ensure that the facility, when completed, is structurally sound.

Response: Concur. Gulf Region District maintains oversight of the construction as outlined in the revised project management plan (PMP) dated 4 May 2009. The project management plan gives Gulf Region District Contracting Officer's Representative (COR) oversight. The oversight includes contract monitoring, performance reporting, and performance remedies. It gives USACE the authority to communicate with contractor personnel on matters relating to the contract provision, the quality of construction and other aspects of the contractor's on-site activities. Further, the PMP authorizes District personnel to confirm that construction workmanship meets contract requirements.

Recommendation 2. Work with the contractor to develop specific details with respect to site utilities.

Response: Concur. Contingent upon the customer or end user providing funding for the additional requirements; the District will work with the contractor to develop specific details for site utilities and the utilities' connection to the city.

Appendix D. TFBSO Comments on Draft Report

DEPARTMENT OF DEFENSE
Task Force for Business and Stability Operations—Iraq
MNF-I, APO AE 09342

January 7, 2010

MEMORANDUM FOR Office of the Special Inspector General for Iraq Reconstruction

SUBJECT: Draft Report on Abu Ghraib Dairy, SIGIR PA-09-172

1. Reference the Special Inspector General for Iraq Reconstruction Draft Report on Abu Ghraib Dairy.

2. TFBSO concurs with the findings and recommendations of the report. TFBSO has taken corrective actions to address the identified construction deficiencies in order to ensure the structural integrity of the building. TFBSO appreciates the involvement of SIGIR in identifying the construction deficiencies. TFBSO is taking steps to develop an installation, commissioning, and testing plan while construction remains ongoing.

3. TFBSO management comments to the draft report are provided in Enclosure A. TFBSO management comments to the audit recommendation are provided in Enclosure B.

Regina Dubey
Director of Operations

ENCLOSURES
Enclosure A: General Comments
Enclosure B: Specific Audit Response

Appendix D. TFBSO Comments on Draft Report

DEPARTMENT OF DEFENSE
Task Force for Business and Stability Operations—Iraq
MNF-I, APO AE 09342

ENCLOSURE A

GENERAL COMMENTS, CLARIFICATIONS, AND TFBSO MANAGEMENT COMMENTS TO AUDIT FINDINGS

General Comments and Clarifications

1. TFBSO concurs with the finding that the use of a cooperative agreement versus a standard construction contract contributed to the lack of significant details in the contractor's design drawings, which negatively affected the implementation of the project. TFBSO used cooperative agreements at the recommendation of Joint Contracting Command-Iraq (JCC-I). It was the understanding of TFBSO that cooperative agreements would allow for sufficient government oversight, while accelerating the project's completion. It was also believed that cooperative agreements could help develop the project management capability of the Abu Ghraib Dairy management personnel.

TFBSO Management Comments to Draft Report Findings

The draft report findings, by findings section, and associated TFBSO management comments, as applicable, are detailed below.

Project Design and Specifications

2. TFBSO concurs with the finding that the design drawings lacked significant details for the construction of the building and site utilities.
   - USACE, GRD, has reviewed the contractor's designs on the building structure and site utilities. Comments were issued to the contractor, resulting in a modification to the contractor's designs based on those comments.
3. TFBSO concurs with the finding that the American Society for Testing and Materials (ASTM) and the American Concrete Institute (ACI) codes do not provide general design information.
   - JCC-I subsequently issued a modification to the contract that would require the work be performed in accordance with international codes and standards, as approved by the Contracting Officer Representative.

Project Sustainability

4. TFBSO concurs with the finding that the milk line equipment may have operational problems during installation due to the equipment sitting idle for 7 years.
   - USACE, GRD, in coordination with the Abu Ghraib Dairy Director General, is developing an installation, testing, and commissioning plan.

2

Appendix D. TFBSO Comments on Draft Report

DEPARTMENT OF DEFENSE
Task Force for Business and Stability Operations—Iraq
MNF-I, APO AE 09342

ENCLOSURE B

RECOMMENDATION AND TFBSO COMMENTS

Recommendation: We recommend that TFBSO continue to work with the Director General of Abu Ghraib Dairy to determine the status of any missing equipment and spare parts and the award of the contract to install and commission the milk line equipment.

Response: TFBSO, in coordination with USACE, GRD, has established a working group with the Abu Ghraib management to plan, coordinate, and implement the installation, commissioning, and testing plan. USACE, GRD will also coordinate with Abu Ghraib management to ensure the requirements of the site utilities---potable water, interior plumbing, electrical generation and distribution, and sewage treatment utilities-are accomplished.

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Appendix E. Report Distribution

Department of State

Secretary of State
- Senior Advisor to the Secretary and Coordinator for Iraq
- Director of U.S. Foreign Assistance/Administrator, U.S. Agency for International Development
  - Director, Office of Iraq Reconstruction
- Assistant Secretary for Resource Management/Chief Financial Officer, Bureau of Resource Management

U.S. Ambassador to Iraq
- Director, Iraq Transition Assistance 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
Under Secretary of Defense (Comptroller)/Chief Financial Officer
- Deputy Chief Financial Officer
- Deputy Comptroller (Program/Budget)

Deputy Assistant Secretary of Defense-Middle East, Office of Policy/International Security Affairs
Inspector General, Department of Defense
Director, Defense Contract Audit Agency
Director, Defense Finance and Accounting Service
Director, Defense Contract Management Agency

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)
- 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
- Chief Financial Officer, U.S. Army Corps of Engineers

Auditor General of the Army

U.S. Central Command

Commanding General, Multi-National Force-Iraq
- Commanding General, Multi-National Corps-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 of Peace

Congressional Committees

U.S. Senate

Senate Committee on Appropriations
Senate Committee on Armed Services
Senate Committee on Foreign Relations
Senate Committee on Homeland Security and Governmental Affairs

U.S. House of Representatives

House Committee on Appropriations
House Committee on Armed Services
House Committee on Oversight and Government Reform
House Committee on Foreign Affairs

Appendix F. 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:

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