

PIPELINE RIVER CROSSING
AL FATAH, IRAQ

SA-05-001
JANUARY 27, 2006

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SPECIAL INSPECTOR GENERAL FOR IRAQ RECONSTRUCTION

January 27, 2006

MEMORANDUM FOR COMMANDER, GULF REGION DIVISION, U.S. ARMY
CORPS OF ENGINEERS AND DIRECTOR, PROJECT
AND CONTRACTING OFFICE
COMMANDER, JOINT CONTRACTING COMMAND-
IRAQ/AFGHANISTAN
DIRECTOR, IRAQ RECONSTRUCTION MANAGEMENT
OFFICE

SUBJECT: Report on Special Assessment of the Pipeline River Crossing, Al Fatah,
Iraq (Report Number SIGIR-SA-05-001)

We are providing this project assessment report for your information and use. We assessed the in-process construction work being performed at the Al Fatah Pipe River Crossing in Al Fatah, Iraq to determine its status and whether intended objectives 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. The assessment team included an engineer and an auditor.

We discussed the results of this project assessment with Project and Contracting Office and U.S. Army Corps of Engineers representatives who concurred with our conclusions. This report includes no recommendations that required management comments. Details are provided in the Conclusions section of this report.

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

A handwritten signature in black ink, reading "Stuart W. Bowen, Jr." with a stylized flourish at the end.

Stuart W. Bowen, Jr.
Inspector General

Special Inspector General for Iraq Reconstruction

SIGIR-SA-05-001

January 27, 2006

Special Assessment of the Pipeline River Crossing Al Fatah, Iraq

Synopsis

Introduction. This special project assessment originated in response to a hotline referral that questioned the use of horizontal directional drilling (HDD) despite predictions from a geological analysis that soil conditions underneath the Tigris River may not be conducive to drilling. The HDD project was paid from Development Fund for Iraq (DFI) funds which were approved on July 1, 2003. The construction contract was issued to Kellogg Brown and Root (KBR) by the US Army Corps of Engineers (USACE) Southwest District Contract #DAACA63-03-D-0005, Task Order (TO) #6 on December 8, 2003.

Project Assessment Objectives. This special assessment was performed to determine why the HDD project achieved only 28% of the pipeline throughput planned for the Al Fatah River crossing. The objectives of this special assessment were to gain an understanding of the processes used to: arrive at the HDD decision; award the subcontract; and manage the project in a manner that failed to achieve its objectives. This special assessment was conducted in accordance with the Quality Standards for Inspections issued by the President's Council on Integrity and Efficiency.

Conclusions. The project failed because subsurface geologic conditions, such as loose, unconsolidated gravels and cobbles, made it impossible to retain open boreholes for large diameter pipelines. Unfortunately, warnings that these conditions existed were contained in the consultant's desktop study before awarding the drilling subcontract. Neither the US Army Corps of Engineers (USACE) nor the general contractor, KBR, acted on the consultant's recommendation to perform additional research that should have prevented the failure.

In addition to ignoring the geologist's recommendations, there were a number of issues that contributed to the project's failure, including: a flawed construction design, a subcontract that had no performance requirements, a compartmentalized project management structure that impeded communications, and inadequate oversight by the USACE and KBR.

Because the government and the contractor failed to adequately research, plan, design, and manage the project, \$75.7 million allocated to the project was exhausted while only 28% of the drilling scope was completed. The HDD project was discontinued in August 2004 and replaced with a contract awarded to Parsons Iraqi Joint Venture (PIJV) at a cost of \$29.7 million; the Special Inspector for Iraq Reconstruction (SIGIR) considers this the cost overrun for the project. Additionally, the hostile environment under which the project is being performed has extended the personal risk to contractor and government personnel working in the vicinity by more than one year. Finally, failure to complete the project may have been instrumental in losing more than \$1.5 billion in potential oil revenues critical to the Iraqi government. .

Recommendations. This report does not contain recommendations; therefore no written response to this report was required.

Management Comments. Although not required, the Commander, Gulf Region Division, responded concurring with the report without comment.

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Introduction

Task Force - Reconstruct Iraqi Oil

a. Mission

As Operation Iraqi Freedom became more likely, the Department of Army was assigned the mission to be prepared to extinguish all oil fires and restore oil facilities damaged during the war. The mission, called “Task Force–Reconstruct Iraqi Oil (TF-RIO)” was assigned by the Army to the Corps of Engineers Southwest District (SWD) in Dallas, Texas. To support the mission, TF-RIO awarded a non-competitive cost-plus award fee Indefinite Delivery Indefinite Quantity (IDIQ) contract, #DAACA63-03-D-0005, to Kellogg, Brown and Root (KBR), a subsidiary of Halliburton. KBR’s selection from three qualified contractors was based on the infrastructure it already had available in country on the Logistics Civil Augmentation Program contract which provided a base from which they could best respond to the urgency of the situation.

The TF-RIO team, consisting of military, civilian and contractor personnel, mobilized immediately after hostilities started in March 2003. Upon arriving in Iraq, the team discovered that the level of sabotage from the war was not as significant as expected; however, after the coalition forces advanced through the country, the Iraqis began massively looting unprotected oil facilities. The looting severely diminished the oil infrastructure that had already deteriorated from years of neglect and poor maintenance during Saddam Hussein’s regime.

In early April 2003, the TF-RIO commanders assembled a team of Iraq oil workers and KBR to assess the overall oil infrastructure with a goal to re-establish Iraq’s pre-war oil production capacity. By April 26, 2003, all oil fires were extinguished and production from the Rumaylah and Kirkuk oil fields was restarted. By May 5, 2003 the Coalition Provisional Authority (CPA) had re-established the Iraqi’s Oil Ministry naming the interim Iraqi Minister of Oil (MoO) and Directors General of the South Oil Company (SOC) and the North Oil Company (NOC). On May 24, 2003, the United Nations lifted oil export sanctions on Iraq, and on June 22, 2003, Iraq sold stored reserves in Ceyhan, Turkey.

b. Iraqi Oil Work plan

From July 6 to 9, 2003, more than 100 technical experts and managers from TF-RIO, KBR, US Agency for International Development (USAID), Bechtel, Inc., and 14 Iraqi oil companies under the MoO met at a workshop in Baghdad to prepare a detailed oil plan for the country. The resulting plan included 226 prioritized projects at an estimated cost of \$1.14 billion to be completed by March 31, 2004, when the TF-RIO mission would expire. Representatives from various oil segments (production, transportation, refining, etc.) organized into breakout groups and developed prioritized project lists that were considered necessary to bring the infrastructure for their respective areas back to pre-war

levels by March 2004. The groups responsible for the northern oil fields developed a prioritized list of 16 projects with the following top three priorities:

- BaBa re-injection involved a solution to eliminate re-injecting residual crude by-product remaining from the inefficient refining processes at Baiji. Previously the residual crude was mixed with other crude and transported to Turkey where more efficient facilities could refine the product. However sabotage to the Turkey pipeline required the by-product to be stored intermediately by re-injecting it into the Kirkuk wells; this was causing irreparable damage that could render the wells unproductive for years.
- The Al Fatah river crossing project recommended repairing the bridge to be used as a platform to route the pipes. The estimated cost for the bridge repair and pipeline construction was \$5 million; however, the solution was subsequently changed to use horizontal directional drilling at an estimated cost of \$28 million.
- The 50 kilometer pipeline project recommended restoring the 40" pipeline from Kirkuk to Al Fatah. The pipeline provides the main crude supply to the Baiji refinery and connects to the main pipeline used to export crude from Iraq to Turkey.

Project lists presented by each breakout group to the general conference membership were consolidated into a draft work plan which was modified and approved by the CPA Senior Oil Advisor, the Iraqi Minister of Oil and the TF-RIO Commander on July 23, 2003. Modifications to the draft work plan replaced the Al Fatah river bridge repair with horizontal directional drilling and increased the estimated cost from \$5 million to \$28 million.

Al Fatah Horizontal Directional Drilling Project

The project, located close to the town of Al Fatah, Iraq, replaces pipelines contained in a bridge over the Tigris River. The lines were severed when the bridge was attacked by Coalition bombing during Operation Iraqi Freedom. Site Pictures 1 and 2 show the damage to the bridge from the bombing. Among the severed lines was a major crude oil pipeline originating in Kirkuk which angles 100 kilometers southwest to Al Fatah, where it crosses the Tigris River to supply the Baiji Refinery (Iraq's largest) and the Baiji Power Plant. The pipeline also connects to the Iraq-Turkey Export Pipeline after crossing the Tigris River. Repairing the severed pipelines to provide crude to the refinery and the Iraq-Turkey pipeline was critical to Iraqi's oil production and export goals. It was expected to increase the flow rate from approximately 300,000 barrels of oil per day (bbl/day) to approximately 500,000 bbl/day. At a unit price of \$25/bbl, the potential daily increase in revenue for 200,000 bbl/day was \$5 million per day.



Site Photo 1: Bomb damaged bridge crossing the Tigris River at Al Fatah, Iraq



Site Photo 2: Bridge cross section showing the melted pipes from the bomb damage

a. Horizontal Directional Drilling Decision

Based on their June 8, 2003 site visit to the bridge, TF-RIO engineers in coordination with KBR, USAID, and Bechtel, Inc recommended the repair of the bridge and the re-routing of the pipelines across it. Engineers from the respective agencies and companies recommended that USAID contract with Bechtel Corporation to repair the bridge and KBR would accomplish the pipe repairs. The expected timeframe to complete the repairs and route the pipes was two months.

The TF-RIO engineers estimated the cost for repairing the bridge and re-routing the pipes at \$5 million, which was included in the draft work plan. After the draft work plan was presented, USAID de-prioritized the bridge and postponed any repair plans for at least one year. The USAID decision, coupled with security concerns by the MoO and CPA, that routing the pipes across the bridge created an unacceptable security risk, caused the CPA to consider alternative solutions. In response, the CPA's Chief Oil Advisor asked the CPA's Oil Transportation Subject Matter Expert how they could repair three critically needed pipelines in two to four months, including the 40" crude line that transported oil from Iraq to Turkey.

After meeting with MoO and TF-RIO staff in Baghdad, the CPA's Oil Transportation Subject Matter Expert suggested they make temporary repairs of critical lines over the damaged bridge and use horizontal directional drilling (HDD) as a permanent solution. HDD was considered the best permanent solution because the pipes would be routed safely under the river, would require minimum long term maintenance, and could be installed quickly. CPA's Oil Transportation Subject Matter Expert also advised that bundling smaller pipes into a larger pipe would be the most efficient routing technique because fewer holes were needed. At the time the HDD concept was being considered, they had no available information indicating issues with soils or geology.

Alternative solutions considered were:

- Temporary pipelines of reduced dimensions laid on temporary repairs or superstructure placed on the bridge surface or hung on the side of the bridge towers. These options were originally rejected because they were temporary and would have to be redone when bridge repair started. At the time, CPA was advised that bridge repair would take place in about one year. If it took two months to construct the temporary supports and lay the pipeline, they would be tearing it out again in about ten months and would have no means to transport the oil while the bridge was being reconstructed. Also, the pipelines would be exposed, difficult to protect, and easily compromised by terrorists. The Iraqi Ministry of Oil personnel were strongly supportive of alternatives that were less susceptible to terrorist activity.
- Three permanent underwater solutions were: (i) attaching or bracing pipes against the base of the bridge underwater, (ii) trenching, and (iii) horizontal drilling. Laying the pipes underwater and secured against the bridge was dismissed because they would have to dredge a trench into which they would lay the pipes to keep them stable during high flows. The trenching option was

- rejected because they were advised that the trench would have to be encased somehow and it would probably be more expensive and take longer than horizontal drilling.
- A third option to construct a new pipeline bridge that would suspend the pipelines over the river was dismissed because an additional bridge posed essentially the same security problems as repairing the existing bridge.

b. HDD Planning, Design and Procurement

The CPA's Oil Transportation Subject Matter Expert was aware that Laney, Inc. (Laney) was one of the major HDD companies in the US and had recently bundled pipelines under the Houston Ship Channel as part of a USACE project. In late July 2003, the subject matter expert and the TF-RIO Commander phoned Laney to discuss the HDD concept. Laney's HDD Director suggested that a 40" crude pipe could be installed under the Tigris in as little as six weeks depending on soil conditions. Because the project was considered critical and the completion timeframe short, CPA's Oil Transportation Subject Matter Expert proposed that Laney be awarded a sole source contract to begin work as soon as possible. The phone discussion ended with the understanding that the CPA would fund a site visit from Laney's Drilling Director to further assess the feasibility of the HDD concept.

Within a few days after the conversation, CPA's Oil Transportation Subject Matter Expert was informed by CPA's Senior Oil Advisor that the CPA had directed KBR to commence a competitive procurement process for the HDD project to include coalition partners from Europe. Concerns that it would provide an unfair competitive advantage to Laney eliminated the opportunity for a company representative to assess the site.

While the decision to use HDD was being made in Baghdad, KBR and TF-RIO engineers in Kirkuk remained under the notion that the bridge repair decision was final. They were notified of the HDD decision during a site visit from TF-RIO Commander on July 25, 2003, when he announced that the Tigris River pipeline crossing must be completed in 2½ months using HDD. Rather than defend the bridge repair recommendation, the KBR chief engineer in Kirkuk advised his management that it was impossible to build a bridge in 2 ½ months and the only possible way to meet the time goal would be to use HDD. Working with the NOC, the TF-RIO team in Kirkuk coordinated with KBR engineers in Houston to plan the requirements and gather available engineering data, drawings and soil information. The KBR engineer also advised that they had limited experience in horizontal drilling and requested a drilling consultant to assist in developing the final plan.

In late July 2003, KBR initiated the competitive procurement process for the project. They qualified four potential bidders including two European companies: Land & Marine and Visser & Smit and two US firms: Michels Corporation and Laney, Inc. KBR also awarded a \$10,000 study contract to Fugro, Inc. to perform a geotechnical desktop analysis of the proposed drilling area. KBR assembled the technical information, including the Fugro report and borehole data obtained from the MoO, into a request for quote (RFQ) which was distributed to the four qualified firms in the third week of August

2003. The subcontract was awarded on September 19, 2003, to a team composed of Willbros, Inc and Laney Inc. The subcontract was a \$45,972,000 firm fixed price for six months of drilling effort and convertible to time and materials after the six month period expired.

The original planned period of performance listed in the RFQ was August 2003 to October 2003. Delays in completing the procurement moved the anticipated start date to mid-October and more realistic completion goals provided for a six month timeframe to March 2004. The subcontractor began mobilizing in early October 2003 but was unable to start work due to delays in constructing secured living quarters at Al Fatah. The contractor remained in Kirkuk on standby for over two months waiting for the site to be secured.

Two months after the HDD subcontract was awarded and mobilization well underway, the Army Corps of Engineers Southwest District issued task order #6 to KBR on December 8, 2003, for \$221,994,195. Specific requirements in the task order included:

- The river crossing pipeline project.
- A 50 kilometer section of replacement pipeline connecting Al Fatah crossing to 50 kilometers of new replacement pipeline completed by Iraq before the war.
- Generators to stabilize power for the oil fields and refineries.

The statement of work relevant to the HDD work required a plan to identify a course of action to construct the new river crossing pipeline using either a dedicated bridge or tunneling under the river. It also required a schedule and cost estimate for the two alternatives using time as the deciding factor in as much as the economic impact involved an increase in oil flow from 300,000 bbl/day to 500,000 bbl/day.

c. Project Performance

The HDD process involves drilling a small borehole through a planned trajectory from one side of the river bank to the other. The borehole is enlarged by a backreaming process that pulls successively larger backreamer bits back through the original borehole until it reaches the diameter necessary to accommodate the pipe. At that point, the pipe is then pulled through. The curvature of the borehole trajectory must be within certain tolerances to prevent breaks in the pipe string when it is pulled through the hole. The hole must also retain its shape in order to accommodate the pipe when it is pulled through. The biggest problem associated with retaining the hole shape is the consistency of the soil.

Porous soils such as sand, gravel and cobble pose structural problems which become more significant as the granularity of the soil becomes coarser and the size of the hole becomes larger. For example, large cobbles make it difficult to retain the borehole trajectory. Also when it is drilled, the hole is highly unstable and difficult to maintain. The analogy for drilling through cobble and gravel is poking a finger into a jar of marbles and expecting the hole to remain when the finger is removed. If the hole structure cannot

be maintained, backreaming becomes improbable. Site pictures 3, 4, and 5, taken from a progress report prepared by Laney, show the drilling rig and cobble encountered at Al Fatah.



Site Picture 3: HDD Rig with Backreamer



Site Picture 4: Example of cobble at the drilling location



Site Picture 5: Completed installation of 26" pipe

Drilling problems began immediately with the first borehole, started on January 30, 2004. Based on the subcontractor's December project plan, they expected to install a 30" pipe within 23 days after drilling commenced.

The first borehole was expected to be completed in four days, backreaming would take fourteen days after completing the borehole and pulling the pipe would take one day after the hole was reamed to the appropriate diameter. Problems with dulling and lost drill bits, structural voids, and cobble caused the first borehole attempt to be abandoned. After multiple attempts the first borehole was completed February 24, 2003, 25 days late.

Back reaming to enlarge the hole to accommodate a 30" diameter pipe started March 1, 2003. However a hole structure large enough to accommodate the 30" pipe could not be retained. The plan was changed to install a 26" line, which was completed March 24, 2003 -- 42 days late. The project continued experiencing similar problems with cobble, voids, and gravel until it was cancelled in August 2004, after only six pipes, representing 28% of the planned throughput, were installed.

In a lessons learned summary, KBR stated that unforeseen subsurface geologic conditions, particularly loose, unconsolidated gravels and cobbles, made it impossible to retain an open hole for the large diameter pipelines. They added that although means could be theorized to stabilize the gravels and cobbles to keep the hole open, the necessary equipment was not available in the region. To achieve any level of success and to eliminate construction of interconnecting manifolds on each side of the river, they modified the plan configuration by drilling smaller holes.

The results of the project compared to the plan are illustrated in the following schedule:

HDD Project Summary				
	Planned		Completed	
	Diameter (Inches)	Throughput (Square Inches)	Diameter (Inches)	Throughput (Square Inches)
Gas	24	453		
Crude	26	531	26	531
Crude	30	707	24	453
Crude	32	805		
Crude	40	1,257		
LPG	14	154	14	154
Fuel	16	201	12	113
Crude	20	314		
Natural Gas	8	50	8	50
Sour Gas	14	154		
Products	12	113		
Not Defined	16	201	16	201
Spare	8	50		
Not Defined	20	314		
Spare	12	113		
Total	292	5,418	102	1502
% completed	28%			

Current Status

The HDD project was discontinued in August 2004. On November 19, 2004, PIJV was issued TO 0014 on Contract W9126G-04-D-0002 to complete the project. The contract is an Indefinite Delivery Indefinite Quantity cost reimbursable award fee contract for the repair and continuity of operations of the Iraqi oil infrastructure. The initial task order scope was intended to be accomplished in three phases. The first phase was to perform survey and investigation work so that a project plan and an initial cost estimate could be developed. The second phase was intended to produce the basic engineering design and the last phase was the detailed design, construction, and commissioning of the project.

The replacement project provides for the installation of nine large diameter pipelines placed in a trench that was dredged across the river. The nine pipelines include a 14-inch Liquid Petroleum Gas (LPG) or sour gas, 20-inch, 30-inch, 32-inch, and 40-inch crude oil pipelines and four spare pipelines, 8-inch, 12-inch, 16-inch, and 20-inch. The project includes the tie-in of the six horizontal directional drilling (HDD) pipelines previously installed under the Tigris by Kellogg, Brown and Root (KBR) including a 16-inch fuel gas, 12-inch product, 8-inch natural gas, 26-inch crude oil, 24-inch dry gas, and 14-inch sour gas pipelines. A crude oil manifold will be installed on each site of the river to

connect to existing pipelines and to allow for operational contingencies. Site photo 6 shows the nine pipe stings that were staged on the east side of the Tigris River.



Site Photo 6: Pipes Staged on Tigris East Bank

The river site survey and investigation identified the crossing location, and where the nine pipelines were strung and welded on the east side of the Tigris. All nine pipelines placed in the river crossing trench were encased with concrete to increase their density so they remain submerged in the trench. Site photo 7 shows the encasing for one of the pipes that was laid in the trench.



Site Photo 7: Section of Pipe Encased In Concrete

The nine concrete encased pipelines were pulled across the river in December 2005 using an onsite winch. The pipelines were covered by river rock to stabilize them and to minimize the scouring affects of the river.

From late September to October 2005, SIGIR performed a project assessment of the PIJV river crossing project. Based on the field work performed during this assessment, we concluded that the PIJV project would accomplish the stated contract objectives. Following are excerpts from the site assessment report:

1. The completed project will meet and be consistent with original task order objectives because the project was adequately planned and designed. In addition, it is very likely that the project will be completed and constructed in accordance with contract specifications.
2. The design package was completed and approved prior to construction and appears specific enough to construct the project. For example, engineering and design investigations conducted prior to construction established that a trenching or dragline method could be utilized to effectively and efficiently install a pipeline below the river. In addition, engineering planning indicated that concrete coated pipe could be utilized for the crossing to ensure appropriate weighting. This occurred because the project was effectively planned and designed in accordance with contract Statement of Work requirements.
3. The construction and installation of the pipelines below the Tigris River will very likely meet the standards of the design because QM practices and line level construction supervision were effective. We observed that QM personnel and supervisors were engaged daily in construction activities to ensure construction quality.
4. The contractor's quality control plan and the U.S. Government's quality assurance program were adequate. For example, procedures in-place ensured that potential construction deficiencies were detected, evaluated, and properly corrected if necessary.
5. Key contractor/government managers conducted an end of business day meeting to discuss the day's accomplishments and problems. Participants always included the prime and sub-contractor's senior manager on-site; sub-contractor's construction superintendents and welding supervisor; prime contractor's logistics, security, and safety managers; and the Government's Resident Engineer and two Construction Representatives.

Conclusions

1. Important engineering studies were not performed.

SIGIR believes that the geological complexities that caused the project to fail were not only foreseeable but predicted. The lack of action by the US Army Corps of Engineers and KBR to perform adequate research and to compensate for these complexities caused the HDD project to fail. Specific weaknesses in the project management approach are discussed below:

Important engineering studies and analyses recommended by a geological consultant hired by KBR were not performed. KBR and the US Army Corps of Engineers ignored the geological research recommendations made by Fugro, Inc. in order to meet unrealistic completion goals. TF-RIO originally recommended repairing the bridge so it could be used as a platform for routing the pipes; this solution was expected to take from two to four months. Although the bridge repair option was replaced with HDD, the completion goal of 2 ½ months remained. KBR and USACE engineers stated that the 2 ½ month goal was unrealistic considering the logistics associated with constructing a secure work camp and shipping large and sophisticated equipment into the country. In order to expedite the project, KBR proceeded with a number of concurrent efforts that included qualifying HDD bidders, gathering available soil and borehole data from the MoO, awarding a geotechnical desktop study contract to Fugro, Inc and preparing the construction design.

The Fugro report described highly complex and variable subsurface stratigraphy near the site and emphasized that field exploration and laboratory testing must be carried out prior to developing the final design. Rather than taking the precaution to further analyze the geological conditions at the site as recommended by Fugro, KBR included the report in the request for quote package. KBR said they did not consider themselves experts in HDD and left interpretation of the geological data up to the bidders who were the experts. KBR included language in the RFQ that the soil conditions in the drilling area were expected to be clays, silts and sandstones. These conditions, which are considered suitable for HDD, conflicted with the Fugro study and borehole logs. The subcontractor representatives said they recognized the conflict between KBR's soil description of the conditions cited in the Fugro report and accepted KBR's representations over the Fugro report. However, the subcontractor mitigated its financial risk by requiring a six month firm fixed price contract with no performance requirement to complete any holes.

KBR's effort to quickly proceed with the construction procurement bypassed important research and engineering analysis that could have confirmed the high risk involving HDD and the selection of a more viable solution.

2. Project construction design impeded flexibility.

While the HDD procurement was underway, KBR and NOC engineers in Kirkuk coordinated with KBR in Houston to prepare the construction design. Based on statements made by the subcontractor and the CPA subject matter expert who recommended the HDD concept, KBR's project design did not provide the necessary flexibility to support HDD. It also conflicted with the security issues that overturned the original decision to repair the bridge. Specifically, the design included valve manifolds located above ground on each side of the river to provide flexibility for routing product through different lines. Placing the manifolds at designated locations on both sides of the river fixed the drilling area and the underground trajectory for the boreholes. Unfortunately the geological conditions in this particular area were the same as those cited in the Fugro report and not conducive to HDD.

CPA's subject matter expert for oil transportation noted that although KBR and the NOC had limited experience in HDD, they worked independently on the construction design and did not coordinate with the CPA and MoO management. When the subject matter expert saw the preliminary design in August 2003, he questioned the success of the project and advised KBR's Houston engineers in August and September 2003 that the project would probably fail in the manner that they were proceeding.

On two occasions the subject matter expert requested design reviews on behalf of the MoO but was refused by KBR. He recalled a February 11, 2004 meeting when KBR presented the final design to the MoO's Director General for Planning in Baghdad. In the meeting, the Director General disagreed with the design because the manifolds were insurgent targets and the design did not allow for use of any lines until they were all installed. The Director General was disappointed that the design had progressed to a point of no return since materials had been ordered and work was underway without any review by MoO in Baghdad. The subject matter expert expressed his concern in the February meeting that the probability of success appeared very low because the design restrictions provided no flexibility to accommodate site conditions.

The KBR/NOC team's inexperience with HDD should have been recognized by the USACE, who should have required design reviews and approvals by appropriate technical management to insure the work could be accomplished. Excluding formal design reviews and approvals imposed a technical risk to the project that was not recognized and resolved.

3. Performance requirements omitted from the HDD subcontract conveyed absolute management responsibility and technical risk to the government that was not adequately assumed by KBR and the US Army Corps of Engineers.

The terms and conditions of the subcontract were firm fixed price (FFP) of \$45,972,000 to provide horizontal directional drilling and other pipeline construction

services for a period of six months after which it converted to time and materials at the following daily rates:

Activity Rate	Rigs	Pipe Crew	Drill Crew
Working	2	\$78,000	\$95,000
Working	1	\$78,000	\$52,000
Standby	2	\$54,600	\$45,000
Standby	2	\$54,600	\$28,000

Progress payment milestones for the FFP effort were based on the time spent by the contractor in country according to the following schedule:

Payment	% of Contract value	Milestone completion
1	5%	Mobilization
2	15%	Month 1
3	15%	Month 2
4	15%	Month 3
5	15%	Month 4
6	15%	Month 5
Final	20%	Month 6

If the project was completed before the six month period, the final payment was due at the time the work was completed. The only performance requirement in the subcontract was to attempt to drill holes on a daily basis. There was no requirement that the subcontractor complete any holes.

Because the terms and conditions of the subcontract did not impose reasonable performance requirements on the subcontractor, KBR and USACE's project management responsibility became significant. For example, the USACE and KBR management team should have phased the project into segments that would have increased the probability of success or confirmed the Fugro warnings prior to full scale mobilization.

Phases, including a thorough geological analysis consistent with the Fugro recommendations and a detailed construction design and project work plan, should have been reviewed and approved by the USACE and MoO before KBR awarded the HDD subcontract. Excluding these important phases and proceeding directly to the subcontract award exposed the government to unnecessary technical risk that was not resolved.

4. The project management structure impeded effective communications between the contracting parties.

The project organization appears to have compartmentalized the management team in a manner that may have severely impeded effective communications between the subcontractor, general contractor, and the USACE. Based on comments from

USACE and subcontractor representatives, KBR restricted subcontractor communications by requiring all communications be addressed to them. This restriction may have led to unresolved conflicts that impeded progress or prevented an early decision to terminate.

For example, subcontractor representatives said that after encountering cobble, they suggested alternative drilling sites, which were turned down by KBR. No one from the subcontractor's team was permitted by KBR to talk to representatives from the Army Corps of Engineers. Laney's on-site manager said KBR criticized him on at least two occasions when he went out on his own to gather supplies, pipe, fuel and military support that were supposed to be provided by KBR. Frustrated with KBR's communication restrictions, the team eventually spent the remainder of its time drilling in the designated area.

A USACE engineer stationed in Kirkuk noted that getting information from KBR on anything was a major struggle. When asked for cost reports, KBR's representative told him that detailed cost reports were not required by the contract. The engineer stated that problems between the subcontractor and KBR appeared to occur from the beginning.

A USACE geologist who assessed the HDD problem in July 2004 noted that while visiting the site on July 11, 2004, he spent about 20 minutes informally chatting with two men who worked for the subcontractor. In response to his question whether a 30-40" hole could be held open at Al Fatah, both indicated that it was improbable. When asked why they continued the attempts, they stated that they were just doing what KBR directed.

SIGIR recognizes that communication protocols between general and subcontractors are required to prevent unnecessary constructive modifications to contracts when discussions are improperly interpreted as direction. However, the critical nature of the project, combined with its technical complexities and KBR's lack of expertise with HDD, required expert input from all parties involved in the project. The project organization should have been structured with a management team composed of representatives from the USACE, KBR, and Willbros/Laney that fostered clear, efficient and formal communications that could have effectively identified and resolved technical problems.

5. USACE did not provide sufficient management oversight on the project.

USACE's responsibility for the project required the agency to provide necessary oversight of the general contractor's efforts to procure and manage the subcontract. Our assessment indicated that inadequate procurement and management oversight were significant factors in the project's failure.

a. Inadequate procurement oversight.

Clear and timely direction provided in task order statements of work eliminates ambiguity and demonstrates close management attention to projects. Our assessment disclosed that USACE's direction to KBR was neither adequate nor timely. Specifically, the first formal direction to KBR was provided in TO #6 on December 8, 2003, more than two months after KBR had already awarded the HDD subcontract. Additionally, the statement of work in TO #6 directed KBR to identify a course of action to construct the new river crossing pipeline using either a dedicated bridge or tunnel under the river and to provide a schedule and cost estimates for the two alternatives. The direction incorrectly implies that alternatives were still being considered. Additionally, there is no evidence that the USACE formally consented to the HDD subcontract awarded to Willbros.

Appropriate procurement oversight by USACE should have provided the direction necessary to mitigate the government's risk for the project. Contractual direction should have considered:

- Phasing the project into:
 - Formal engineering and geotechnical studies that would have provided details on the level of risk and recommendations for continuing with the HDD solution.
 - A detailed project design approved by the USACE and the MoO that would have been used as a basis for bidding of the project.
 - Including performance reporting requirements in the subcontract that demonstrate progress in relation to the plan baseline.
 - Formal program management reviews that identify and resolve performance issues.
- b. Inadequate technical management and oversight.
- USACE's on-site technical management did not comprehend the technical problems encountered by the drilling subcontractor, did not adequately surface the issues to USACE senior management and/or senior management did not take aggressive action to resolve problems.

Performance issues became apparent soon after drilling started on January 30, 2004. Voids were frequently encountered, causing drill bits to kick and become dull or lost. Gravel and cobble encountered from the beginning caused holes to cave in and required lining the holes with casing to retain their shape. The first borehole attempt was abandoned when the casing snapped and could not be removed. Drilling equipment frequently broke down and the four drill bits required in the subcontract were not sufficient.

The 30" diameter pipe was the first planned installation and was expected to take 23 days from beginning to end. The following schedule, comparing the actual results to the plan demonstrates the project had severe performance and schedule problems from the beginning. Additionally, geological conditions could not support a hole large enough to accommodate the 30" pipe which was replaced

with a 26” pipe. These problems predicted significant issues involving the capability of the subcontractor to complete the project.

First Hole Installation Schedule									
	Planned			Actual			Variance		
								Schedule	
Action	# Days	Start Date	Finish Date	# Days	Start Date	Finish Date	Performance Efficiency	Start	Complete
Run Pilot Hole	4	1/20/04	1/24/04	25	1/30/04	2/24/04	21	10	31
Backream	18	1/24/04	2/10/04	24	3/1/04	3/23/04	6	37	42
Pull Pipe	1	2/11/04	2/11/04	1	3/24/04	3/24/04	0	42	42
Total Days	23			50			27		

Daily site reports submitted by KBR and USACE technical personnel located at the site constantly noted performance issues and delays. Monthly contract performance reports submitted by Willbros constantly showed negative performance and schedule variances. Technical recommendations made by the cognizant on-site managers were denied. For example, in January 2004, before drilling commenced, the Senior Engineer for the USACE Northern Area Office recommended to USACE Management Headquarters in Baghdad that they reconsider running lines over the damaged bridge because of escalating security issues and high probability of unforeseen problems with the HDD. His recommendation was denied and he was told that his suggestion had already been considered and the decision to go with HDD was final.

KBR and USACE management allowed problems to continue unabated by ignoring valuable data from available performance reports, daily site reports, and recommendations from on-site technicians and managers. As performance continued to decline, KBR and the USACE took no action to formally review the project and assess the capacity to meet its stated goals. Instead, mid-course corrections reduced the requirements by eliminating pipelines 30” and over because the gravel and cobble could not retain the hole size for any pipe over 26”.

Recommendations.

This report does not contain recommendations; therefore, no written response to this report was required.

Management Comments.

Although not required, the Commander, Gulf Region Division responded concurring with the report without comment.

Appendix A. Scope and Methodology

We performed this project assessment from October 2005 through January 2006 in accordance with the Quality Standards for Inspections issued by the President's Council on Integrity and Efficiency. The special assessment team included an auditor.

In performing this Project Assessment we:

- Reviewed contract and subcontract documentation, to include the Scope of Work, Terms and Conditions, and contract modifications;
- Reviewed correspondence involving the decision, procurement, and management of the project;
- Reviewed drawings, schedules, and performance reports submitted by the general and subcontractors;
- Interviewed technical, contracting, and management personnel from USACE, KBR, Laney, Inc., Willbros, Inc., Fugro, Inc., the subject matter expert for the CPA, and PIJV; and
- Reviewed audit and assessment reports by Defense Contract Audit Agency, and SIGIR.

Appendix B. Acronyms

Bbl/day	Barrels per day
CPA	Coalition Provisional Authority
HDD	Horizontal Directional Drilling
KBR	Kellogg Brown and Root
LPG	Liquid Petroleum Gas
MoO	Ministry of Oil (Iraq)
NOC	Northern Oil Company (Iraq)
PIJV	Parsons Iraq Joint Venture
PCO	Project and Contracting Office
RFQ	Request for Quote
SIGIR	Special Inspector General for Iraq Reconstruction
TF-RIO	Task Force Reconstruct Iraqi Oil
TO	Task Order
USACE	U.S. Army Corps of Engineers
USAID	U.S. Agency for International Development

Appendix C. Report Distribution

Department of State

Secretary of State

Senior Advisor to the Secretary and Coordinator for Iraq

U.S. Ambassador to Iraq

Director, Iraq Reconstruction Management Office

Inspector General, Department of State

Department of Defense

Deputy Secretary of Defense

Director, Defense Reconstruction Support Office

Under Secretary of Defense (Comptroller)/Chief Financial Officer

Deputy Chief Financial Officer

Deputy Comptroller (Program/Budget)

Inspector General, Department of Defense

Department of the Army

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

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

Deputy Assistant Secretary of the Army (Policy and Procurement)

Director, Project and Contracting Office

Commanding General, Joint Contracting Command – Iraq/Afghanistan

Assistant Secretary of the Army for Financial Management and Comptroller

Auditor General of the Army

Commander, Gulf Region Division

Commander, Corps of Engineering, Southwest Division*

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 Defense Organizations

Director, Defense Contract Audit Agency

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, Health and Human Services
Inspector General, U.S. Agency for International Development

Congressional Committees and Subcommittees, Chairman and Ranking Minority Member

U.S. Senate

Senate Committee on Appropriations
 Subcommittee on Defense
 Subcommittee on Foreign Operations
Senate Committee on Armed Services
Senate Committee on Foreign Relations
 Subcommittee on Near Eastern and South Asian Affairs
 Subcommittee on International Operations and Terrorism
Senate Committee on Homeland Security and Governmental Affairs
 Subcommittee on Government Efficiency and Financial Management
 Subcommittee on Financial Management, the Budget, and International Security

U.S. House of Representatives

House Committee on Appropriations
 Subcommittee on Defense
 Subcommittee on Foreign Operations, Export Financing and Related Programs
House Committee on Armed Services
House Committee on International Relations
 Subcommittee on Middle East and Central Asia
House Committee on Government Reform
 Subcommittee on Government Efficiency and Financial Management
 Subcommittee on National Security, Emerging Threats and International Relations

Appendix D. Project Assessment Team Members

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

Timothy P. Baum