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JORDAN WATER SYSTEMS AND SERVICES MANAGEMENT

PROJECT NUMBER 278-0259

FIRST INTERIM EVALUATION

AND

CONSTRUCTION SUPERVISION

BASELINE SURVEY

Agency for International Development

IQC OTR-1406-I-00-1132-05

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DAVID B. BIRD
Vice President

May 17, 1985

Mr. Gerald Gower
Mission Director
USAID/Jordan
Amman, Jordan

Dear Mr. Gower:

We are pleased to submit 12 copies of our report on the First Interim Evaluation and Construction Supervision Baseline Survey of Three Jordanian Firms Capabilities. This report by John D. Knoll, Jr., Project Team Leader and the undersigned is based on our findings during our trip to Jordan from March 1 to 21, 1985.

This study and evaluation is the result of a request by the Mission in January 1985. The work was undertaken under Work Order No. 8 of Indefinite Quantity Contract OTR-1406-I-00-1132-05, as authorized by the Office of Contract Management, AID, Washington, D.C.

It was a pleasure working with the Mission on this study and evaluation. We look forward to the opportunity to working together again in the future.

Very truly yours,

David B. Bird

David E. Bird

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EXECUTIVE SUMMARY

BACKGROUND

The United States Agency for International Development has traditionally emphasized the importance of technology transfer as an integral part of their projects. The Terms of Reference for the Jordan Water Systems and Services Management Project went beyond the previous normal practices. They called for special emphasis on the technology transfer by requiring the Jordanian firms to be the prime contractors with the US firms acting in the role of subconsultants. The projects for the design of water distribution, sewerage collection and treatment and storm drainage systems for ten cities in Jordan were divided between three associations: Arabtech Consulting Engineers and CH2M Hill International; Consulting Engineering Center and Black & Veach International; and Jouzy and Partners Consulting Engineering Bureau and Engineering Science Inc.

Due to the emphasis placed on technology transfer, a series of evaluations were designed into the project at preselected milestones for various capabilities. The Baseline Survey Evaluation was conducted at the beginning of the project to evaluate the in-house capabilities of the firm at that time. An interim evaluation to was be conducted near the completion of the design phase to measure their increased capacity to design a similar type project. Because these same three associations were to provide the Construction Services during construction of the facilities, they were to be evaluated on a similar basis and frequency to determine their capabilities in this area. An evaluation of the construction contractor(s) is also scheduled to determine their capabilities to properly construct water and wastewater facilities. The Baseline Survey Evaluation of the sanitary design capabilities of the three Jordanian firms was conducted in February and March of 1984. Included in this evaluation was the formulation of a uniform objective system of rating the firm's capabilities which reduced to a single pure number - termed the Overall Capability Index (OCI). This OCI number was not designed to compare two or more firms. The purpose of the OCI is to show changes in capabilities, and indicate the transfer of technology, within a single firm relative to time.

OBJECTIVE

The objective of the First Interim Evaluation is to determine the progress of the three Jordanian firms in developing improved capabilities to complete sanitary engineering design projects. Secondary objectives are to identify, or indicate, the technology transfer; define and evaluate the mechanisms used in the transfer; and to recommend means of improving the mechanisms for the technology transfer.

Data was obtained through the review of available references. Numerous discussions were held with the Project Managers and project related personnel from the Jordanian firms, the Project Coordinators of the Water Authority of Jordan, the Ministry of Planning, and USAID/Jordan. In addition, there were discussions and/or correspondence with the Project Managers and project related staff from the US firms. These U.S. personnel have all returned to the United States.

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The evaluation system utilized in the First Interim Evaluation was the system developed and used in the Baseline Survey Evaluation. This is consistent with the project design and will produce results which are themselves consistent and comparable. The differences in the two evaluations should be the results of improved capabilities and also be indicative of technology transfer during the design phase.

MEANS AND METHODS

All three of the associations used virtually the same means for the transfer of technology during the design phase of this project. The differences came about more in the degree of application of the methods, the time exposures for transfer and the areas of technology transfer. The transfer for purely technical matters included the use of lectures (in varying degrees of intensity and topics), special seminars by long term and short term US personnel, provision of reference materials, and one-on-one training as the opportunities arose during the design process.

In addition to transfer on purely technical matters, two of the associations undertook the transfer of management technology and techniques. The third association made a conscious decision not to include this area, based on the desires of the Jordanian firm. In the instances where the project management was addressed, the general approach was strikingly similar for both associations. The US subconsultant was instrumental as the lead in defining and instituting the project management organization and philosophy. The lead responsibilities were then shifted to the Jordanian firm. In one case this was done with an informal approach with the US counterpart playing a low key but highly supportive role as needed. In the other case a rigidly defined chain of command was established and scrupulously adhered to in conducting the project activities. Both of the Jordanian firms felt comfortable with these two differing approaches. They felt they had learned valuable lessons from these two approaches even though they were different in application.

Each of the associations did something a little different in the technology transfer process. Examples of individual activities which were utilized include: field trips within Jordan to visit existing systems for a better understanding and appreciation of the application of the theoretical knowledge, an extensive participatory workshop using a case study and group problem solving approach, lectures and seminars by outside experts, and a combination project review and training trip to the office of the US consultant.

EVIDENCE OF TECHNOLOGY TRANSFER

All three of the Jordanian firms show evidence of technology transfer and increased capabilities in the following common elements;

- o All have developed, or expanded, their library of reference materials such as textbooks, technical publications, periodicals and catalogs.
- o All have acquired, or added to existing, general and technical specifications for sanitary work.

- All have acquired, or added to existing, standard details for sanitary design work.

- All have gained experience and confidence in the design of sewerage treatment plants.

- All have gained a greater appreciation of the needs of projects financed by international lending agencies.

Additional evidences of increased capabilities and technology transfer within the firms are as follows:

Arabtech	-	recognized level of competency in the design of water distribution and sewerage collection systems, a plan check procedure, project management concepts being emplcyed on new major projects, project cost accounting and reporting systems, project scheduling and planning techniques, ability to do redesigns with minimal US input.
CEC	-	recognized level of competence in design of water distribution and sewerage collection systems, a plan check procedure, new project management concepts, project cost accounting and reporting systems, project scheduling and planning techniques, and ability to do redesigns with minimal US input.
Jouzy & Partners	-	in-house computer program for the design of sewerage collection systems.

INFLUENCES-EFFECTIVITY OF TECHNOLOGY TRANSFER

The influences can be divided into internal and external as follows:

Internal Influences	-	individual desires of the Jordanian project personnel to gain new technology, the committment levels of the firms and their willingness to provide corporate support for technology transfer, the individual personalities of the Jordanian and US project related staffs.
External Influences	-	the major external influence during the design phase was the change from the WSC to the WAJ and the multiplicity of WAJ Project Coordinators. This no doubt actually enhanced the technology transfer even though it may have had adverse impacts on scheduling and costs.

Virtually everything that was tried to effect technology transfer was successful, in varying degrees. The least effective approach was reading, or studying, outside the normal work environment. The next least effective method was the lecture approach unless closely tied to the design aspect and immediately followed by hands-on applications. The field trips, the participatory workshops and seminars were very effective methods for transferring technology. As might be expected, the most effective means of technology transfer was the one-on-one working opportunities.

RECOMMENDATIONS AND COMMENTS

1. Major technology transfer efforts, especially in non-technical areas, should be continued to be grant funded. It is difficult for a newly developing country to hold to the long view and commit scarce financial resources to training. This may appear to benefit a few in lieu of meeting immediate critical needs of the masses for such essential items as potable water supplies.

2. AID should try to obtain agreement from the host country to add the needed funding and manpower to any planned project. This will allow for the technology transfer in addition to the completion of the other project elements. It is possible for a critically tight project schedule to cause adverse effects on the technology transfer activities if they are only an adjunct to the main project activities.

3. Define the Scope of Work for the technology transfer activities and require a planned approach with scheduled milestones and deliverable items.

4. Encourage the use of participatory workshops and seminars as training tools.

5. Continue the requirement for the provision of all lecture, seminar and workshop notes for future reference of the host country personnel. This should be matched with a continued, or increased, level of supplies of reference materials and equipment under the contracts. These items will remain and be useful long after the US consultants have departed.

6. Attempt to schedule lectures linked to ongoing project work activities and to be followed by practical application in problem solving.

7. Increased use of field trips on a selective basis within Jordan, the Region or to the US. These should be working trips, for qualified personnel, to observe and understand the design and operational concepts as they are applied and practiced. Such training will provide a better appreciation of the relationship between the theory and the practical.

8. The short range gains under this project have been real and identifiable. How well the newly gained technology will be retained and applied by the firms and individuals involved in this project will depend on the ability of the firms to obtain additional sanitary design projects. If additional opportunities are not provided to utilize, reinforce and adapt this new

technology, it may be lost. If new sanitary projects are obtained, this new technology will improve and reinforce the capabilities of these Jordanian firms for sanitary design.

RESULTS OF THE FIRST INTERIM EVALUATION

The OCI's of each of the three firms for both the Baseline Survey Evaluation, (B.E.) and the First Interim Evaluation, (F.I.) are listed below, by categories and totals, for comparative purposes. As stated before, the OCI's are not intended to be used as a comparison between firms, but as a means of determining changed in-house capabilities in a given firm with respect to time.

COMPARISON OF OVERALL CAPABILITY INDICES

		Arabtech		CEC		Jouzy	
	Category	B.E.	F.I.	B.E.	F.I.	B.,E.	F.I.
I.	Experience	15.0	25.0	27.5	30.0	45.0	47.5
II.	Past Performance	30.0	30.0	30.0	30.0	30.0	30.0
III.	Staffing/Personnel	33.0	36.0	27.0	21.0	15.0	21.0
IV.	Project Management	0.0	21.0	3.0	24.0	12.0	24.0
V.	Available In-House Resources	4.0	16.0	12.0	20.0	12.0	12.0
VI.	Financial Indicators	12.0	12.0	12.0	9.0	12.0	12.0
	Overall Capability Index	94.0	140.0	111.5	134.0	126.0	154.5

All three firms increased their OCI's between the baseline evaluation and the first interim evaluation. These increases correlate with the observed increases in capabilities and evidence of technology transfer. The only firm to reduce points in any single category was CEC which had a lower point total in both the Staffing/Personnel and Financial Indicators categories. They are the smallest of the three firms and most sensitive to a reduction in personnel and a lowering of total fees. The reduction in total fees was due to a cash accounting basis and the impact of this one major project. Neither of these regressions are material, nor will they affect their capabilities.

CONSTRUCTION SUPERVISION BASELINE EVALUATION

This was an extra item of work that was mutually agreed upon between the Implementation Committee and the Project Team. The general contracts between the Jordanian firms and the WAJ call for the firms to undertake the construction supervision on these ten cities. The project paper envisioned a baseline survey of the construction supervision capabilities of the firms to be used as the point of reference to identify the increased capabilities and indicate the technology transfer during the construction phase.

The construction supervision contracts had not been finalized at the time this report was prepared, but all three firms have submitted cost proposals and negotiating discussions are underway. Although the project people have not been selected yet and the agreements with the US subcontractors have not yet been finalized, it was decided that it would be cost effective to begin the construction supervision evaluations. The objective evaluation was undertaken as part of this study. The more subjective evaluations will take place at the time of the baseline evaluation of the Jordanian contractors when all agreements have been signed and the project people will be in place.

The objective evaluation is based on a system developed along the same lines as the evaluating format for sanitary design capabilities. The Construction Supervision Development Index (CSDI) also reduces to a single pure number that is a useful indicator of the variance in the capability of a firm in construction supervision over time.

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ABBREVIATIONS

AID	-	Agency for International Development
AWSA	-	Amman Water and Sewage Authority
Arabtech	-	Arabtech Consulting Engineers
BVI	-	Black & Veatch International
CEC	-	Consulting Engineering Center
CH2M Hill	-	CH2M Hill International
CSDI	-	Construction Supervision Development Index
ESI	-	Engineering Science Inc.
GOJ	-	Government of Jordan
IQC	-	Indefinate Quantity Contract
JMM	-	James M. Montgomery, Consulting Engineers Inc.
Jouzy & Partners	-	Jouzy and Partners Consulting Engineering Bureau
MOP	-	Ministry of Planning
OCI	-	Overall Capability Index
Project Team	-	JMM Personnel Involved in the Evaluation Study
US	-	United States of America
USAID/Jordan	-	United States Agency for International Development Mission in Amman, Jordan
WAJ	-	Water Authority of Jordan
WSC	-	Water Supply Corporation

ACKNOWLEDGEMENTS

This study and set of evaluations would not have been possible without the full support and cooperation of the United States Agency for International Development (USAID) Mission in Amman, the Water Authority of Jordan, the Ministry of Planning, and the six participating consulting engineering firms: Arabtech Consulting Engineers and CH2M Hill, Consulting Engineering Center and Black & Veatch International, and Jouzy and Partners Consulting Engineering Bureau and Engineering Science, Inc.

The guidance and assistance of the Project Implementation Committee were most welcome and of direct benefit to the Project Team in conducting this study. Our thanks to: Mr. Bernard Donnally, Mr. William Libby, Mr. Ray Romano, Mr. James Hanks, Mrs. Nancy Carmichael Hardy and Mr. Abdallah Ahmad. The extra efforts of Mr. Abdallah Ahmad in assisting the Project Team contributed greatly to the success of this study and were appreciated and recognized.

The Project Team would like to express their gratitude to all of the many individuals who cooperated and assisted in this undertaking. It was an assignment made easier and personally rewarding as a result of your efforts.

SECTION 1

INTRODUCTION

1.1 BACKGROUND

The background for the project titled "Jordan: Water Systems and Services Management" (WSSM) as taken from the Background Section of IQC Contract No. OTR-1406-I-00-1132-05, Work Orders No. 5 and 8 is as follows:

> During 1983, AID financed a Water Systems and Services Management Project in Jordan which, among other things, is providing for preparation of final designs for new water and sewerage systems in ten small Jordanian Cities. Three Jordanian consulting firms have been contracted and have begun work on the design for these cities in three dispersed areas of Jordan. Each Jordanian firm is being assisted by a subcontracted US consulting engineer.
>
> The goal of the project is effective development, management, conservation, protection and utilization of Jordan's scarce water resources. The broad purposes of the project are to develop and improve the institutional capability of private and public Jordanian organizations; to conserve and manage Jordan's water resources; and, as part of that effort, to extend and improve certain municipal water distribution and wastewater collection and treatment facilities.
>
> In that context, the ten-cities' design work is a vehicle for the training and strengthening of the long-term capability of the three Jordanian consulting engineering firms to independently design and supervise construction of municipal water and wastewater facilities. To that end, the subcontracted US partners are expected to provide significant managerial and technological upgrading to their respective Jordanian partners during the execution of final design and, later, supervision work.
>
> The baseline survey of the capabilities of the three Jordanian firms was made during February/March 1984, by James M. Montgomery, Consulting Engineers, Inc. (JMM). A copy of the JMM report covering this survey is available at AID Washington (NE/PD/MENA, AID/W) and at the AID mission in Amman (USAID/Jordan).

1.2 OBJECTIVES - FIRST INTERIM EVALUATION

The primary objective of this study was to conduct the First Interim Evaluation of the three Jordanian firms. The First Interim Evaluation was compared with the Baseline Evaluation to determine the degree of project success in improving the technical and project administrative capabilities of the Jordanian firms through the transfer of technology.

Related secondary objectives of this study were to:

- define the various approaches and means of technology transfer utilized in these projects,
- define those mechanisms which were effective, and why; and those mechanisms which were not effective, and why not,
- define the factors which influenced the technology transfer,
- define the evidence of technology transfer under this project, and
- suggest any improvements to the mechanisms of the US subconsultants transferring technology to the Jordanian prime consultants.

1.3 CONSTRUCTION SUPERVISION BASELINE EVALUATION

During the course of the study, USAID/Jordan requested the Project Team to conduct the Construction Supervision Baseline Evaluation. This additional work was mutually agreed upon based on the supplemental proposal submitted by the Project Team on 8 March, 1985. The Work Order was later amended with the approval of AID Contracts on 7 May, 1985.

The primary objective of the Construction Supervision Baseline Evaluation was to assess the baseline capabilities of the three Jordanian firms to undertake construction supervision. These are the same firms which completed the design phase. This baseline assessment is to be used, for comparative purposes, in conjunction with anticipated future assessments. The analyses of these various assessments will be useful in determining if the project was successful in achieving capability enhancement through the transfer of technology.

1.4 AUTHORIZATION

This study was undertaken by JMM on 15 February, 1985 by means of Work Order No. 8. Indefinate Quantities Contract OTR-1406-I-00-1132-05, Work Order No. 08, as authorized by the AID Office of Contracts Management in Washington, D.C. The Work Order was ammended as per the additional Work Order authorized 7 May, 1985, by the AID Office of Contracts Management in Washington, D.C.

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SECTION 2

TECHNOLOGY TRANSFER - METHODS AND PROCEDURES

2.1 GENERAL

The methods and procedures employed by each of the US consulting firms to transfer technology to their local associated Jordanian consulting firms are described in this section. It should be noted that each firm used a somewhat different approach to comply with their contractual obligations regarding technology transfer. It is presumed that technology transfer techniques incorporated were a function of the experience of the US firms in this field, their project personnel and the technical competence, experience and size of the local firm.

2.2 ARABTECH CONSULTING ENGINEERS / CH2M HILL INTERNATIONAL

Arabtech designed the water distribution system, sewage collection and treatment facilities, and stormwater drainage systems for the cities of Tafila and Ma'an, all located in the southern portion of Jordan.

2.2.1 Background

Arabtech is a privately owned company that is well regarded by its competitors. Their reputation has been built on successful highway and building design and construction services projects. Historic experience includes the design of major highways throughout Jordan, the design of government office buildings, low cost housing developments, hospitals, schools and industrial complexes. They also have an excellent reputation in the area of construction supervision. One of Arabtech's major clients in this area is the Ministry of Transportation.

Until this project, Arabtech had only limited experience in sanitary engineering. Their experience in this area had been limited to the structural design of water and wastewater treatment facilities.

Arabtech historically did not use a structured project organization concept or project manager to manage their projects. Each discipline, within the project, was the responsibility of the discipline head. The coordination of the entire project was dependent upon the ability of the project personnel to coordinate their designs amongst themselves.

Because of the USAID requirements for technical transfer from the US subconsultant to the Jordanian firms, assistance in the proper techniques in project management as well as designing the water and wastewater facilities, an organized and structured approach was employed using a project manager.

CH2M Hill had three people in Jordan for various periods of time. A project manager whose main efforts were the project and instructing and assisting the project manager in effective project management techniques. He also provided technical assistance on a range of topics. CH2M Hill also provided the services of a civil engineer for two months during the preparation of the Ma'an predesign report, their first task. He was responsible for instructing survey crews on data collection, and sewer collection and water distribution network design assistance for the design personnel. The third person was a wastewater process design specialist who stayed in Jordan for a total period of three months. He, in association with the Arabtech engineering staff, was responsible for the design criteria and preliminary layouts for the wastewater facilities for the their two cities.

2.2.2 Project Startup

CH2M Hill used a relatively informal approach to technology transfer during the project. They assisted in setting-up the project team and provided managerial and technical assistance, as needed, to ensure the adequacy of the design. No special efforts were made to provide a detailed explanation on how the project should be implemented. Their goal was to provide assistance so that Arabtech learned as much as possible in both the technical and administrative areas.

2.2.3 Formal Lectures

A limited number of formal lectures were conducted on this project. The lectures were mainly in the technical fields associated with wastewater process design and plant layout. Emphasis was instead placed on informal one-on-one training instead of lectures.

2.2.4 Management Training

The management training consisted mainly of one-on-one and informal training concerning project management. This included working with the project manager and providing assistance in implementing the project organizational structure, filing system, and project accounting system. Other areas and subjects included the importance of proper record keeping, written minutes of meetings, adequate design calculations and references, delegation of responsibility, preparing work plans and budgets, and the importance of keeping records of labor and expenses.

The CH2M Hill staff provided informal training continuously during their involvement with the project. Initially they directed project management and gradually shifted that responsibility to Arabtech's engineers. Arabtech's staff were encouraged to become involved. They came to feel it was their project and their decisions would determine its outcome.

Towards the end of the project, before the design submittal to the client, a formal review of the project design was performed in the home offices of CH2M Hill. At that time, a limited amount of formal lecture type training was conducted for the two persons who traveled to the US.

Workshops were used by the CH2M Hill civil engineer as a forum for making most decisions. This technique was used for both managerial as well as the technical subjects and concepts.

2.2.5 Design Technology Transfer

The transfer of technical knowledge was mainly accomplished through informal training, although limited formal presentations were made. The informal technical training consisted of explaining in detail the theory involved in the individual design unit. Much of this was done on a one-on-one basis. Arabtech staff were instructed on methods of computation and the criteria necessary for the computations. Computations were checked by the CH2M Hill staff with mistakes or misunderstandings explained and corrected. Question and answer sessions were encouraged.

2.2.6 Field Trips

Field trips were to wastewater treatment plants were used as training when possible. Visits were made to two plants in Jordan and at a number of municipal secondary treatment plants in the US using a variety of treatment processes. The visits in the US were limited in participation to the two engineers who visited the home office of CH2M Hill during the final design review.

Visits to the project sites were made by the project personnel on numerous occasions to see how design decisions related to topography and land use and development.

2.3 CONSULTING ENGINEERING CENTER / BLACK AND VEATCH INTERNATIONAL

Consulting Engineering Center (CEC) designed the water distribution system, sewage collection and wastewater treatment facilities, and stormwater drainage systems for the cities of Madaba and Karak, located south of Amman. Black and Veatch International (BVI) was the American subconsultant to CEC.

2.3.1 Background

CEC is a relatively small, privately-owned firm. It was founded as a soils investigation and testing company. It only recently expanded into sanitary and highway engineering, with some capabilities in building design. CEC's first project of any consequence in sanitary engineering started about 1979. It has since participated in a number of projects as a subcontractor to different American firms for both sewage systems studies and design projects. Until this project, CEC's experience has been mostly related to sewage collection and water distribution systems with limited experience in sewage treatment process.

CEC is generally considered to be a reputable firm that does quality work despite its limited size. CEC was not previously considered as a major competitor by other firms. It is presumed that the reason for this is its relative small size and its past history of specializing in soils engineering and testing.

Because of CEC's small size, mechanical and electrical engineers are hired only on an "as-needed" basis. CEC does retain structural and sanitary engineers as well as designers and administrative personnel.

For this project, BVI had two engineers in Jordan. A project manager and a wastewater process engineer. They also provided an organizational management consultant for a one week management organizational workshop and two relatively short visits by a civil/process oriented checker to review and check the quality of the drawings. BVI felt they would be involved in a significant amount of the design work due to CEC's limited design experience and the time constraints of the schedule.

The project manager remained in Jordan until September 1984, shortly after the initial contract document submittal date. The process engineer had departed from Jordan two or three months earlier.

2.3.2 Project Startup

At the very beginning of the project BVI made it a point to explain in detail exactly how a project of this type and magnitude would be done in their home office. This included the responsibilities of all project personnel, the types and estimated number of drawings, and the standards and procedures to be followed. The purpose of this detailed explanation was to impart to the CEC project team a feeling of what to expect and the amount and type of work to be completed during the contract time limitations.

BVI developed, with CEC, a project organizational structure at the project inception. It listed the project team members, their responsibilities and chain of command. The BVI team claimed they rigidly enforced the line of command. They stated that if the supervisor of the person asking a question did not know the answer, both must proceed through the line of command until they jointly reached the BVI advisor; who would then, and only then, respond. Both BVI and CEC felt that only in this manner would everyone learn, eventually respect and use the organizational structure. It should be noted that in the traditional Arab culture, everyone has direct access to their leader and vice versa.

2.3.3 Formal Lectures

BVI conducted formalized lectures on a variety of subjects throughout most of the project. The initial plan called for three lectures a week, each on a different topic, i.e. treatment process, technical, management and drafting. As the project progressed, the frequency varied. The average frequency was estimated to be about two lectures per week. Whenever possible, BVI had one of CEC's people give the lecture.

2.3.4 Management Workshop

BVI used an in house management training specialist to conduct a one week workshop in Jordan. The workshop included all management level personnel assigned to the project. The procedure utilized by the instructor stressed group problem solving to force the participants to work together. This included such problems as classifying the cars in the parking lot with only very limited guidelines and establishing the procedures to construct a building of wooden blocks. The participants soon appreciated the need and were forced to jointly develop organizational structures, responsibility assignments, schedule, critical path diagrams, and resource allocations to complete the assigned tasks within the alloted times. It was reported that by the end of the one week workshop the participants understood and accepted the concepts. The BVI project personnel indicated the CEC project personnel were required to develop, and follow, schedules to complete all project activities. They also indicated that a certain amount of peer pressure developed within the group through having the activity schedules and task assignments displayed openly. A certain amount of pride of accomplishment was apparent when the respective persons could demonstrate completion of their assigned task.

2.3.5 Design Technology Transfer

The concept used by BVI to transfer technology to CEC incorporated an extensive list of lectures, one-on-one training of all project personnel and, whenever possible, field trips to show first hand how treatment facilities are constructed.

A series of lectures were outlined that were designed to cover all aspects of the project. Initially the subjects were limited to the more basic subjects such as materials, pipes, pipe joints, pipe corrosion, valves, basic equipment and pumps. Later in the project, the level of subject difficulty was raised as the project personnel learned and applied their acquired technology. Only after starting the design of the wastewater treatment plants were any lectures conducted on such subjects as criteria, treatment process and plant layout. Emphasis was placed on explaining the subject and working through example problems. It was felt most effective to have the students work example problems immediately following lectures. This helped the personnel to understand and retain the subject matter better. The BVI personnel pointed out that the most effective mechanism was to have the project design applications follow the example problems and lectures. For this reason BVI scheduled their lectures to coincide with the project schedules and involvements. Another effective tool was to have technically competent CEC personnel conduct lectures whenever possible. The thrust was to force that individual to thoroughly know the subject and demonstrate to their fellow employees the level of in-house competence.

Because of the contractual time constraints, BVI elected to do the process design of the first of the two treatment plants with the help of CEC. CEC would then design the second plant with BVI providing only guidance as needed. It was their idea that the lectures and "one-on-one" working relationship during the design of the first treatment plant would serve as an example for the design of the second treatment plant.

The U.S. concept of using standard drawings, details and specifications in Jordan was not CEC's practice. Because CEC did not have any standard specifications or drawings, BVI provided these for adaptation and use, as needed. One person was assigned the responsibility of preparing the project specifications. It was reported that this person had a good working knowledge of what is needed to assemble a complete project specification and the specifications by the end of the project.

At the beginning of the project the drafters were basically tracers, according to the BVI personnel. This is to say that they were capable of copying sketches but not capable of laying out drawings. Another factor that affected their productivity appears to be a social factor. The drafters would not correct another drafters drawing. They would instead completely redraw the drawing and, in the process, possibly alter the layout to something they thought may be better. This problem had been somewhat improved but not fully eliminated by the end of the project.

2.4 JOUZY AND PARTNERS / ENGINEERING SCIENCE

Jouzy and Partners prepared the designs and specifications for the six northern cities, Ramptha, Mafraq, Anjara, Ajloun, Ein Janneh and Kufranjeh. The designs were for the water distribution systems, wastewater collection and treatment facilities and stormwater drainage systems. Ultimately, one wastewater treatment plant was designed to serve the four cities of Anjara, Ajloun, Ein Janneh and Kufranjeh.

2.4.1 Background

One sanitary engineer from ESI was in Jordan for more than a year from the beginning of the project until early February 1985. He was assisted by two short-term experts; one in the area of water reuse and the other in the area of wastewater treatment process design. Both of these experts conducted lectures and provided input on the design of the treatment facilities. Another process engineer and an instrumentation engineer reviewed designs and provided technical assistance in Jordan on a short-term basis.

Technical transfer from ESI to Jouzy and Partners was limited to technical and engineering matters. No transfer was provided in the area of project management, project cost accounting or any non-engineering matters. Jouzy and Partners is a fairly large firm and did not feel they needed any assistance those areas related to project management.

2.4.2 Formal Lectures

Lectures dealing mainly with various aspects and types of wastewater treatment were conducted by the ESI technical advisor assigned to work with Jouzy and Partners. The frequency of the lectures ranged from one per week to as few as one every two or three weeks. The lectures were coordinated to coincide with the facilities design and schedule. The lectures were directed to the four sanitary engineers assigned to the design project from Jouzy and Partners.

Lectures were also conducted by Dr. Gloyna, a wastewater treatment expert and consultant. He is a special consultant and was specifically contracted for this project. Dr. Gloyna was in Jordan for a short period of time. However, he gave lectures to the Water Authority of Jordan and to the Jordan Engineers Association, and did not limit his expertise solely to the project personnel.

Lectures were also conducted by Dr. Sheikh, an employee of ESI. Dr. Sheikh is an expert on water reuse. Water reuse was an important consideration in this project because of the limited national water resources in Jordan. Dr. Sheikh was in Jordan for approximately one month during which time he gave lectures on the subject and devoted time to the water reuse element of this project.

2.4.3 Design Technology

The transfer of technical knowledge was chiefly accomplished through one-on-one training. The major portion of this type of transfer was undertaken by the long-term design engineer in Jordan. A lesser amount was transferred to the drafting disciplines because of the already existing capabilities of these people.

There was some technology transfer from the short term experts, however, due to the limited time these persons were in Jordan, and their primary objective of design review, only limited technology transfers were accomplished.

SECTION 3

EVIDENCE OF TECHNOLOGY TRANSFER

3.1 ARABTECH CONSULTING ENGINEERS

As a result of this project and the technical and administrative assistance provided by CH2M Hill in the areas of wastewater treatment process design and project administration, the following items show the most evidence of positive technology transfer.

3.1.1 Tangible Benefits

Project Management
Prior to this project, the project organizational concept was not used on any of their projects, however, the project manager had worked for another firm where it was used. Arabtech has now implemented the concept of project organizational structures on their most recent projects of significance.

Project Cost Accounting

A project cost accounting system has been implemented, at least on all new projects. The result has enabled Arabtech to track those projects and more accurately estimate the costs of the various project activities. Additionally, they have improved their cost estimates for upcoming projects on which they have submitted proposals.

Standard Details

Development of standard details and drawings. Now that the project is complete, the standard drawings and details will be redrawn on standard size sheets and assembled in drafting standards books.

Standard Specifications

Arabtech was exposed to, and used equipment and construction specifications acceptable to USAID funded projects. The basic specifications were developed by BVI and at the request of WAJ, all three associated consulting groups reviewed and developed one standard specification and format to be used by all.

Technical Confidence

Technical confidence to defend their designs. At the end of the original contract time period, the CH2M Hill project representative returned to the US. At about the same time WAJ insisted that drawings of all sewage house connections be prepared. Also the design criteria for the wastewater treatment plants were revised. This resulted in a contract amendment, and required the Arabtech project staff to undertake the redesign and to defend their designs to WAJ and their project coordinators without the assistance of their (Arabtech) U.S. advisor. WAJ had a total of 15 different project managers for Arabtech's two projects, each with full authority to change the project design criteria. This frequent changing of the project coordinators made it necessary for the Arabtech engineers to defend their designs, on a relatively frequent basis, to avoid additional and costly redesign.

Standardized Drawing Checking Procedure

Adopted a standardized procedure for checking design drawings. Before this project Arabtech did not use any set procedure to verify the accuracy and adequacy of their drawings.

Project Cost Reduction Concepts

Arabtech is placing increased emphasis on developing in-house production and reducing design costs. Two of the observed cost saving procedures were modifying the size and layout of the standard sewer and water pipe profile sheets to a size to fit their in-house photocopying machine and standardizing pipe connection details eliminating the need for detailed drafting of every pipe connection. The first procedure reduced the cost of reproduction from one-tenth to one-twelfth the cost of the previous procedure. Another cost saving procedure was standardizing the design procedure and field data collection for house connections. Initially one team of field people could collect the required data for 6 to 8 houses per day. By the end of the project, the same team could collect the data and design from 18 to 20 house connections per day.

3.1.2 Intangible Benefits

The following items noted during the interview with the project manager are more intangible in nature.

Technical Confidence

Arabtech possesses a level of confidence to design similar type projects. They also appreciate and respect both their capabilities and limitations. This was made evident by statements to the effect that, although they could design most of the systems, they would need technical assistance in such areas of process design. All treatment plants are required to treat sewage with different characteristics, and no two plants will be exactly the same. It was estimated that the technical assistance could be reduced by fifty or more percent depending on the project.

Technical Recognition

They were referred to a private industry, by WAJ, as a consulting firm qualified to design treatment facilities. As a result of this reference, Arabtech was invited to submit a proposal.

3.2 CONSULTING ENGINEERING CENTER

3.2.1 Tangible Benefits

Project Management

Following the project management workshop conducted by BVI, the project was organized and conducted according to acceptable project management practices by the CEC Project Manager. For each task, such as the design of the water distribution of one of the cities, a project activity schedule was developed. This schedule included all the activities needed to complete the task, time limitations for each activity and activity assignments. CEC demonstrated their understanding and acceptance of the organizational structure and project scheduling activities on numerous occasions to the subconsultants. It should be noted that at the beginning of the project, and until the project management workshop, the project staff did not appreciate these concepts. This was best demonstrated through the results of a test conducted for the management consultant at the beginning of the workshop. The test consisted of having everyone present their solution to a project management problem. When all the solutions were presented to the participants of the workshop, a vote was taken to select the best. Everyone voted for his own, without giving recognition to the merits of other and possibly better solutions. Through a series of simple workshop problems, involving group activities, the participants came to appreciate the need to work together in a coordinated effort to schedule and to complete project activities within predetermined time schedule.

Technical Knowledge

Due to time limitations, BVI developed the project criteria and did the majority of the design for the first city. For the second city this responsibility was given to CEC, who completed the design with limited assistance. Their technical knowledge was further confirmed when WAJ changed the design criteria for one of the wastewater treatment plants and CEC redesigned it. This occurred after their US subconsultant had left Jordan. However, they later reviewed CEC's designs. CEC feels they are fully qualified to design similar facilities with minimal technical assistance.

Reference Library

The size of CEC's reference library has been significantly increased as a result of this project. It includes equipment and materials catalogs, textbooks and standard specifications in adequate quantity and quality to design water and wastewater treatment systems.

Standards

A complete set of standard specifications and details were provided by their US subconsultant. These are standards that were developed by BVI, and used by them on their projects to maintain uniformity, quality standards and minimize time and costs in preparing drawings and specifications.

Drawing Checking Procedure

A drawing check procedure was adopted by CEC. The procedure involves the use of different colors to indicate that the drawings have been checked, and the error and correction status.

Project Cost Accounting

A project cost accounting system was implemented by CEC for this project. It is their intention to continue to use it on all future projects. No similar type accounting system was used prior to this project.

Drawing Quality

A marked improvement in the quality of the drawings was noted. The draftsmen and the engineers laid out and prepared drawings under the guidance of the US subconsultants. They were required to use standard details, learn proper drafting standards and increase their productivity.

3.2.2 Intangible Benefits

General Interest

A genuine interest of the engineers and draftspersons of CEC to learn was noted by all of the US subconsultants personnel. This interest was in both management and technical areas. This may have been due in part to the emphasis placed on technology transfer by the owner of CEC who wants his people to learn how to properly design sanitary projects.

Individual Development

Only three of the engineers that worked on the project were still with CEC at the time this evaluation was prepared. Another four had left. Two left to accept positions with WAJ; one a female engineer got married and left to be with her husband; and the fourth left to accept a position on a project in another middle east country. Although these latter four people are no longer with CEC, they did increase their personal skills. These skills will be use in the area and, hopefully, transmitted to others.

3.3 JOUZY AND PARTNERS

3.3.1 Tangible Benefits

Technical Standards

The Jouzy and Partners engineers were exposed to, and used, equipment and construction specifications acceptable for use on USAID funded projects. The basic specifications were developed by BVI, but at the request of WAJ, were used by all three design firms. Each firm has now used these standard specifications to prepare project specific specifications.

Reference Library

Jouzy and Partners had a fairly complete and extensive reference library. It was expanded and improved by ESI, who provided additional reference materials.

Standard Drawings

ESI provided Jouzy with additional standard drafting drawings and details to augment their manuals. Prior to this project, Jouzy and Partners already had many of these details for water systems and wastewater collection and treatment facilities as a result of their previous projects with other US consultants.

3.3.2 Intangible Benefits

Design Skills

Jouzy and Partners state that through their exposure to preparing designs, specifications and tender documents they developed the technical skills to design similar type facilities without the assistance from foreign firms.

Computer Skills

A computer software package developed ESI for designing sewage collection systems was made available to Jouzy and Partners. Jouzy and Partners, using the software as a basis, revised and adapted it to serve their needs. They gained the software and improved their technical skills in designing sewage collection systems using a computer.

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SECTION 4

TECHNOLOGY TRANSFER - INFLUENCES AND EFFECTIVITY

4.1 INTRODUCTION

This section attempts to identify the principal factors that had an influence on the technology transfer processes and their results. An attempt has also been made to define the results in such a manner that the reader can judge the effectivity of the technology transfer.

The approaches taken by each of the Jordanian consulting firms and their US subconsultants differ, as did their subcontract agreements and the technology transfer goals of the local firms. Other factors that influenced the amount of technology transfer were the personalities of the local and foreign project staff, individual and company motivations, and the impacts of the WAJ. The impacts of the WAJ, although unanticipated, had major influence on the designs of the facilities themselves and the amount of technology transfer to the local project staff.

4.2 LONG RANGE GOALS OF USAID TECHNOLOGY TRANSFER PROGRAM

USAID has for a number of years promoted technology transfer and included this in Invitations for Proposals. For this project, a more concerted effort was made to really have the local consulting firms learn from their US subconsultants. The goal was to eventually develop enough in-country expertise to be fully capable of designing water distribution networks, sewage collection systems and wastewater treatment plants.

The degree of effectivity of a long-range program is a function of adequate involvement and direction during the program goal setting, the proposal evaluation and contract negotiation periods as well as during the actual execution of the program. The following items should be completed and incorporated into the project documents to maximize the effect of the technology transfer effort.

- Jointly with WAJ, develop a detailed and complete long-range plan. It should include such items as how many firms or people will be trained; and to what level they will be trained in design, project management, design preparation and construction supervision.

- The role of US consulting engineering firms in achieving these goals, needs further definition. Whether these firms provide technology transfer services throughout the program, or only at specific times, e.g., during the design, construction contract negotiations and construction supervision. If technical assistance is not provided during all of these phases, major and costly design and construction errors could be made until such a time that the local consultants are as experienced and qualified as the US subconsultant.

In this case, each of the consultants increased their technical skills and according to all persons interviewed, are fully qualified to design water distribution and sewage collection systems, but will need limited outside technical assistance to design even similar wastewater treatment plants. This is due to the high level of technology involved and the fact that the treatment process is directly related to the characteristics of the sewage.

The technology transfer thus far agreed upon by USAID and WAJ only goes through the design phase, although it is the intent that those same firms provide the construction supervision, if WAJ and the local consultants reach an agreement. A weakness of this procedure is that post design and preconstruction services are neglected. One of the local firms has recognized their weaknesses in the treatment area and wants to have a technical representative of his US subconsultant present at the preconstruction bid conference to answer any technical questions beyond the technical limits of their personnel. Unfortunately the contract with the US subconsultant terminates at the end of the design phase and does not include any provisions for extra assistance. WAJ has taken a position that they will not fund any extra costs. Technical issues or clarification requests invariably are raised during prebid conferences. Incorrect or incomplete answers will affect the understanding of the potential contractors. Their bids could be adversely affected and this may result in additional costs and a poor working relationship between the contractor, the consultant and the client during the construction of the facilities.

4.3 PROJECT SCOPES OF WORK

The proposals submitted by the three Jordanian consulting firms and their US subconsultants all differed in regard to technology transfer. They ranged from somewhat detailed programs to merely "motherhood and apple pie" statements. The role of the subconsultant was not clearly defined and this was further affected by the intentions of the personnel assigned to work on the project. In the initial phases of the project, the technology transfer was a function of the preconceived project schedule developed by the consultants and how much the local consultants really wanted to learn. Fortunately, in two cases, either the preconceived plan or the motivation of the Jordanian firm, resulted in a fairly comprehensive program of technology transfer.

Several months after the beginning of the project, the WAJ was formed combining AWSA, WSC, and other GOJ agencies. This resulted in a change of personnel including the project coordinators. The project coordinators were changed a number of times during the design phase of the report. Each project coordinator had complete authority to alter the project criteria and this authority was periodically exercised. Frequent changes were made at the request of WAJ. This initially resulted in discontent between the consultants and the client, and was aggravated every time the project coordinators were changed.

The net result of the change from WSC to WAJ, the different project coordinators, changing of the project criteria and requests for work outside the original Scope of Work, was in the long-range point of view, positive. It required the local consultants to restudy their projects, defend their designs to the project coordinators and in some cases redesign some elements of the projects. The changes to the Scope of Work created delays in the delivery schedule so some of the milestone dates were extended. The Jordanian personnel were forced to assume a greater role in the project decision making process without the continued presence of the U.S. subconsultants. These unforeseen changes by the client forced the local consultants to be more familiar with their projects, and created more technical transfer than would have occurred had not the additional demands of the client been made.

4.4 TECHNOLOGY TRANSFER GOALS OF THE JORDANIAN CONSULTANTS

Each of the three local firms differed, in size, experience, and motivation on the part of the firm's management and personnel assigned to the project.

4.4.1 Arabtech

Arabtech is a well respected firm with a fairly large staff. They want to develop a reputation in the area of sanitary engineering. Arabtech had the good fortune to select a highly motivated young project manager and a competent sanitary engineer. The US subconsultant provided mainly advisory assistance and returned to their home office generally in accordance with their original schedule. This resulted in the Arabtech engineers learning a great deal through a combination of the programmed technology transfer and being forced to design and defend their designs to the client.

4.4.2 Consulting Engineering Center

CEC is a small firm with a good reputation but not capable of maintaining a large staff of qualified personnel. The technology transfer program provided by their US subconsultant was extensive, both in subjects and in depth. This coupled with the fact that the owner appears to be trying to develop the abilities and knowledge of the project manager, his oldest son, created an atmosphere well suited for technology transfer. The end result was a small staff of well trained people. Unfortunately, due to the size of the firm, CEC will lose a portion of this capability as some people leave due to lack of work in their specific field. This will weaken the in-house capabilities of the firm, but distribute the knowledge in Jordan.

4.4.3 Jouzy and Partners

This is a large firm, with its head office in Beriut, that has already developed a reputation in the sanitary engineering field. Because of its size and in-house knowledge, technology transfer was only provided in the technical area and did not include any project management training. This, coupled with the existing in-house knowledge, produced less of an impact than the training programs of the other firms. However, because of the size of Jouzy and Partners, and the number of engineers, the technical transfer was directed at four sanitary process engineers plus other engineers, rather than just one or two as in the other firms. The net result was positive, but could have been greater had the motivation of the smaller firms been present.

SECTION 5

RECOMMENDATIONS

5.1 INTRODUCTION

The procedure involved in collecting the data needed to evaluate the improved technical and administrative capabilities of the Jordanian engineering firms consisted mainly of interviews and discussions. These included the project managers and engineers from both the Jordanian and US engineering firms, WAJ, USAID and the Ministry of Planning. The interviews were conducted to obtain the information indicated on the questionnaires, included as an appendix of this report, and other information useful to get a more complete picture of the firms, the people involved, the technology transfer process and information concerning the client and working relationships between the client and the engineering firms. The interviews and discussions were informal in manner and discussion was encouraged on all matters pertaining to the project and the transfer of technology. Opinions and suggestions were encouraged.

One of the subjects specifically addressed during the discussion was what mechanisms worked and why; and what did not work and why not. From these, and from other topics of discussion, a series of techniques used for technology transfer emerged that appeared to work better than others. Also a number of procedures or steps were identified that would facilitate the transfer of technology, if agreed upon by both USAID and the client before the contracting of consulting firms.

This section is divided into two areas. The first section covers those techniques specifically related to the technology transfer process from the US firms to the Jordanian firms. The second section discusses a few steps USAID and the client agency should take to maximize the effectiveness of the overall technology transfer program on a long range basis.

5.2 TECHNOLOGY TRANSFER TECHNIQUES

The following is a discussion of the various technology transfer methods and procedures used by the US consultants and their effectiveness. It is the intent to describe factors affecting implementation and results in order to help improve the technology transfer process on future projects. Whenever possible, comments and suggestions are included on either methods that worked well, or in other cases what was not felt to be effective. This is not intended to be a complete list of what to do or now to best effect technology transfer. It is a summary of what the experiences were on this project and, to the extent possible, why. In many cases the effectiveness of a procedure was confirmed during interviews with persons from other firms who used similar procedures, or closely related variants.

5.3 PROJECT STAFF ORGANIZATION AND PROJECT ACTIVITY SCHEDULING

In many cases project staff organization and activity scheduling would not be such an important factor, but two of the three Jordanian firms had never used such a sophisticated organized staffing structure or activity scheduling procedure for a design project. Either the projects were too small, or they were subcontractors providing only personnel to be directed by others, or they completed the design with engineers all on an equal level working towards a common goal without an overall manager to coordinate the work of others.

In two cases, project staff organizational structures were developed with personnel assigned to fill the various positions. Both cases, forced the staff members to follow the "chain of command," but with various degrees of severity. The staff that was forced to work rigidly through the structure appeared to be more appreciative of the merits of the chain of command. In this case, if the immediate supervisor was not able to respond satisfactorily to a question of a subordinate, they jointly proceeded up the organization until it was adequately explained and answered. This approach forced the maximum amount of technology transfer within that organization and created an appreciation for the organizational structure. It eventually reduced the time needed to respond to the more common technical subjects and problems by the more senior persons and the advisors. The results of creating and adhering to the organizational structure was judged to be successful by both the US advisors and the Jordanian engineers who worked on the project.

One of the US subconsultants conducted a one week workshop to demonstrate the need for organizational structures and project activity scheduling. The workshop was conducted by a management specialist and consisted of close to 40 hours of classroom and study work. It was designed to force groups of people to collectively participate in a series of activities involving developing and organizing project activities. The objective was to demonstrate the need for an organized approach to project completion and show through implementation how to develop and organize project scheduling activities. This approach was considered to be very effective by the persons who participated and by the client who saw how effectively they completed subsequent project activities. The workshop was conducted several months after the beginning of the project. According to key project personnel, it should have been conducted earlier, shortly after the project organizational structure was developed. This would have permitted more time to use and improve managerial skills during the project.

The other two project teams did include providing advice and assistance on setting up project organizational structures and project activity schedules, but did not conduct management workshops. Both of the US subconsultants felt that although some progress was made toward improving managerial skills, they fell short of being fully adequate.

5.4 LECTURES

Formal lectures were conducted by all of the US subconsultants on technical subjects. The timing and subject matter varied as well as the level of expertise of the lecturers. Several factors were noted by both the advisors and the personnel

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who attended the lectures that should be considered to attain maximum effectiveness from lectures.

The timing of lectures should coincide with the application of the subject matter to the project. This permits the recipient of the information the opportunity to apply the subject matter while it is fresh. All of the Jordanian engineers indicated that if they could apply the technical subject matter immediately, they would retain it longer. If not, they would soon forget the subject.

All students should be supplied with lecture notes. This provides them with reference materials and will help the participants to recall and apply the information.

Emphasis should be placed on practical approaches to problem solving and providing and jointly working example problems. All of the engineers affirmed that they retained more information if lectures were followed by working example problems than if only lectures were given.

Encourage the lecturers to be local people when applicable, particularly on the less technical subjects, such as drafting techniques. This reinforces the technical knowledge of the lecturer, demonstrates the technical capabilities of the local personnel to their associates and develops a level of professional respect.

The use of internationally recognized or expatriate experts on specific subjects is beneficial. However, unless these people are working directly on the project, they may tend to be highly theoretical and slight the practical applications.

Assignments to be solved outside of the class atmosphere were not effective, except for the more senior level people. This could vary considerably from firm to firm, depending on the degree of motivation.

5.5 REFERENCE MATERIALS

As much reference material as possible should be provided. This includes text and reference books, equipment and material catalogs and other design tools available to assist the local engineers in accurate and efficient project designs. A substantial budget should be included to purchase and ship these materials. These items will remain after the US consultants leave. They are tools that will be useful in future design projects. Also, they improve familiarity with U.S. products and encourage the use of these products.

5.6 FIELD TRIPS

Field trips to other facilities were felt to be very beneficial when they were similar to those being designed, especially sophisticated and/or complex treatment plants. Another good example is construction sites to demonstrate construction techniques and problem solving. These trips should involve personnel responsible for design, as well as the operation, maintenance and administration of facilities.

5.7 OVERSEAS STUDY TOURS

Trips to the United States or other countries to visit the home office of the U.S. engineers and facilities similar to those being designed can be effective. They are particularly beneficial if the tours are designed as work/study trips for participants that are selected properly.

5.8 TECHNICAL INDEPENDENCE

The foreign technical advisors should assume a low profile and encourage the local engineers to take the lead role. This applies to all project matters including project management and dealing with the client. This procedure builds confidence and develops a better understanding of the project. It forces them to thoroughly investigate the subject, develop the criteria and alternative solutions, select the best alternative and present and defend it to the client. It will enable them to continue after the foreign advisors have left and provided the base for them to more quickly learn other technical subjects.

5.9 ONE-ON-ONE TRAINING

One-on-one training is the most effective means for transferring technology. It utilizes interactive communication between the instructor and the student not possible with lectures. However it is time consuming and should be limited to the more technically complex subjects whenever possible. This type of training should also be encouraged between technically qualified local trainors and local trainees.

5.10 QUALIFIED ADVISORS

The selection of expatriates to provide the technology transfer is of prime importance, although technically not a technology transfer method or procedure. The persons selected must be technically qualified and competent to train others. Secondarily, they must have the personality and sensitivity to work well with the local firm and the client.

5.11 PREPROJECT PLANNING

The planning and implementation of the projects by the client and the funding agency is as important as the training techniques in determining the amount of technology transferred to local personnel. The following are a number of factors that were discussed, or noted, during this evaluation. They are beyond the control of the local or foreign consultants but do affect the degree of technology transfer. Constructive comments and suggestions are included, whenever possible, with the idea of improving the technology transfer activities on future projects.

5.11.1 Scope of Work

The Scope of Work included in the Invitation For Proposal should clearly identify the role of the US consultant in those instances where the transfer of technology is the key element. The U.S. firm should be a subconsultant to the national firm and not directly responsible for the design element of the project. This input of the U.S. subconsultant should

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be limited to technology transfer through lectures, training and only providing technical assistance on matters beyond the technical abilities of the local firm.

The Invitation For Proposal should require that the proposals include a detailed description of the technology transfer program and the role of the subconsultant. It should include the proposed organizational structure and the responsibilities of each of the foreign advisors. The proposal should also detail, to a limited degree, the types of technology transfer activities and subjects to be covered.

5.11.2 Mid to Long Range Considerations

In cases where USAID is attempting to improve the technical capabilities of local firms that will provide future services to the client after the completion of a specific project, an agreement should exist that permits the local firm to solicit the technical advice of his US subconsultant throughout the project. Related costs for these services should be reimbursed by the client. On these projects, for example, the Jordanian consultant is expected to provide technical assistance to the WAJ for such things as the preconstruction bidders meetings. At these meetings all construction contractors who may choose to submit a bid are free to ask questions regarding the project. The consultant is often asked to participate and answer questions on technical matters. If the consultant is unsure and provides an incorrect or incomplete answer, the potential contractors may propose incorrectly resulting in delays, additional costs to the client, or facilities which do not meet the performance criteria. In cases such as this, where the WAJ has requested the Jordanian firms to provide continuing technical advice related to this project, the Jordanian firm should have the right to solicit additional technical advice from the U.S. subconsultant who provided the assistance and technology transfer services. These services should be reimbursible and not provided at the expense of the Jordanian consultants.

5.11.3 Selection of Local Firm

The selection of the successful local firms to design or construct facilities should emphasize technical abilities and quality rather than the bid price. Proper consideration should be given to past experience and success and the qualifications of the proposed project staff. Selection based on price alone should be strongly discouraged. In cases where cost is a major factor in the selection of a consultant, inexperienced and/or unqualified persons are frequently used. This can result in unsatisfactory projects with delays and changes costing the client more, in total, than if the originally higher priced firm had been was awarded the project.

SECTION 6

FIRST INTERIM EVALUATION

6.1 INTRODUCTION

This section is directed towards the First Interim Evaluation of the three Jordanian firms, as envisioned in the project paper. The Baseline Survey Evaluation was effectively completed based on the conditions at the beginning of the design phase of this project. The First Interim Evaluation is virtually at the end of the design phase, and prior to the construction phase of this project. A comparison of these evaluations will provide information and indications on improved capabilities of the Jordanian firms and the transfer of technology.

6.2 METHODOLOGY

The methodology employed in the First Interim Evaluation was virtually identical to the methodology of the Baseline Survey Evaluation.

Sources of information included: reviewing the available data and obtaining or developing such appropriate additional data as was available; conducting discussions with Water Authority of Jordan, USAID/Jordan, and Ministry of Planning; conducting discussions with the three Jordanian firms, specifically involving the project managers and appropriate project related staff; conducting discussions and/or correspondence with the US subconsultants project managers and other project related staff when possible.

The basic system utilized was the baseline evaluation system and rating format. Thus, the results of the First Interim Evaluation are consistent and comparable to the Baseline Survey Evaluation. The basic rating form is shown in Figure 6-1 Overall Capability Index - Sanitary Design Specific Rating Form. The definition of the rating categories and sub-elements are included in Table 6-1 Definitions of Sub-Elements and Ratings.

6.3 BASELINE EVALUATIONS

The Baseline Survey Evaluations from the original survey report are included for reference purposes. The format for the ratings and assessments consisted of a short summary assessment followed by the completed Overall Capability Index (OCI) rating forms, Figure 6-2 through 6-4. These references will be included for each firm in the following order: Arabtech Consulting Engineers, Consulting Engineering Center and Jouzy and Partners.

6.3.1 Summary Assessment - Arabtech Consulting Engineers

The following is the summary assessment for Arabtech Consulting Engineers.

FIGURE 6-1

OVERALL CAPABILITY INDEX
Sanitary Design Specific
Rating Form

Company ______________ Design Development Index as of ______________

Categories - Sub-Elements	Ratings 0	1	2	3	4
I. Experience					
a. Comparable sanitary projects-last 3 years		N/A		N/A	
b. Total sanitary projects - last 3 years					
c. Sanitary fees as % of total fees					
d. Comparable other projects - last 3 years					
e. Geographic locations of projects					
Category I Points ______ x 2.5 (W.F.) =	Sub Total I				
II. Past Performance					
a. Initiate projects on schedule					
b. Complete projects on schedule					
c. Complete projects within budget					
d. Professional reputation					
e. Relationships with clients					
Category II Points ______ x 2.0 (W.F.) =	Sub Total II				
III. Staffing/Personnel					
a. Sanitary engineers, permanent employees					
b. Avg. years of experience, full time eng'rs					
c. In-house disciplines					
d. % of fees paid to consultants					
Category III Points ______ x 3.0 (W.F.)	Sub Total III				
IV. Project Management					
a. Project managers with comparable experience					
b. Scheduling and planning techniques		N/A		N/A	
c. Management information systems		N/A		N/A	
d. Milestones, deliverable items		N/A		N/A	
Category IV Points ______ x 3.0 (W.F.)	Sub Total IV				

FIGURE 6-1

OVERALL CAPABILITY INDEX
Sanitary Design Specific
Rating Form (Continued)

Categories - Sub-Elements	Ratings 0	1	2	3	4
V. Available In-House Resources					
a. Equipment and facilities					
b. Standard specifications					
c. Standard drawings and details					
d. Reference materials					
Category V Points ______ x 2.0 (W.F.) =	Sub Total V				
VI. Financial Indicators					
a. Ratio of current assets/current liabilities		N/A		N/A	
b. Adjusted average annual growth rate		N/A		N/A	
c. Professional liability insurance		N/A		N/A	
Category VI Points ______ x 1.5 (W.F.) =	Sub Total VI				

OVERALL CAPABILITY INDEX ______
(Total of Sub Total I through
Sub Total VI)

Evaluated By: ____________________
____

Date: ____________________

TABLE 6-1

DEFINITION OF SUB-ELEMENTS AND RATINGS

Categories Sub-Elements	Ratings 0	1	2	3	4
I. Experience					
a. Sanitary projects comparable in size, complexity and technical specialty undertaken in last 3 years	0	N/A	1	N/A	2 or more
b. Total sanitary projects in last 3 years	0	1	2,3	4,5	6 or more
c. Sanitary fees as % of total fees for last 3 years	0	0-10	11-25	25-50	more than 50
d. Total projects comparagle in size, complexity and technical specialty undertaken in last 3 years	0	1,2	3 to 5	6 to 8	more than 8
e. Geographic location of past projects	none	area of Amman	limited to Jordan	work in Region outside Jordan	work outside the Region
II. Past Performance					
a. Ability to initiate projects as scheduled	never	sometimes	often	usually	always
b. Ability to complete projects on schedule	never	sometimes	often	usually	always
c. Ability to complete projects within the original estimated budget (of the firm)	never	sometimes	often	usually	always

TABLE 6-1

DEFINITION OF SUB-ELEMENTS AND RATINGS (CONTINUED)

Categories Sub-Elements	Ratings 0	 1	 2	 3	 4
d. Professional reputation of the firm	unaccept-able	marginal	acceptable	good	excellent
e. Relationships with clients	unaccept-able	marginal	acceptable	good	excellent
III. Staffing/Personnel					
a. Number of sanitary engineers who are permanent full time employees	0	1	2-4	4-8	8+
b. Average years of experience of engineers employed full time	less than 4	5-9 years	10-14 years	15-20 years	20+ years
c. Available in-house disciplines	civil, structural	+ sanitary	+ architects	+ mechanical	All disciplines
d. % of total fees paid to local consultants or specialists who are not full time employees	more than 20	15-20	9-14	5-8	0-4
IV. Project Management					
a. Number of Project Managers with experience managing comparable projects	0	1	2	3,4	more than 4

TABLE 6-1

DEFINITION OF SUB-ELEMENTS AND RATINGS (CONTINUED)

Categories Sub-Elements	Ratings 0	1	2	3	4
b. Project planning and scheduling techniques and systems	generally not used	N/A	available, but use marginal	N/A	available, monitored and used
c. Management Information Systems available to, and used by, the Project Manager	generally used	N/A	available, but use marginal	N/A	available, monitored and used
d. Production and monitoring of milestone events and deliverable items as management tool	generally not used	N/A	available, but use marginal	N/A	available, monitored and used
V. Available In-House Resources					
a. Equipment and facilities - owned by the company and available for use	virtually none	typewriters, copy machines, print machines	+ word processing equipment	+ computer	all listed plus additional applicable
b. In-house standard specifications for sanitary work	virtually none	partial, inadequate	complete, adequate for Jordan	adequate for the region	adequate for beyond the region

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TABLE 6-1

DEFINITION OF SUB-ELEMENTS AND RATINGS (CONTINUED)

Categories Sub-Elements		Ratings 0	1	2	3	4
c.	In-house standard drawings and details for sanitary work	virtually none	partial, inadequate	complete, adequate for Jordan	adequate for the region	adequate for beyond the region
d.	Reference materials - Books, periodicals, technical papers, catalogs, manufacturers information-relating to sanitary work	virtually none	textbooks, reference books	+ technical papers, int'l agency publications	+ catalogs and equipment manufacturers data	+ technical periodicals
VI.	Financial Indicators					
a.	Ratio of current assets to current liability	less than 0.8	N/A	0.8 to 1.5	N/A	greater than 1.5
b.	3 year annual growth rate of fees adjusted by the inflation rate of Jordan	negative	N/A	virtually zero	N/A	greater than one
c.	Professional liability insurance	none	N/A	project specific	N/A	coverage for all projects

FIGURE 6-2

OVERALL CAPABILITY INDEX
Sanitary Design Specific
Rating Form

Company Arabtech Design Development Index as of 1 Oct. 1983

Categories - Sub-Elements	Ratings 0	1	2	3	4
I. Experience					
a. Comparable sanitary projects-last 3 years	X	N/A		N/A	
b. Total sanitary projects - last 3 years		X			
c. Sanitary fees as % of total fees		X			
d. Comparable other projects - last 3 years			X		
e. Geographic locations of projects			X		
Category I Points 6 x 2.5 (W.F.) = 15	Sub Total I				
II. Past Performance					
a. Initiate projects on schedule				X	
b. Complete projects on schedule				X	
c. Complete projects within budget				X	
d. Professional reputation				X	
e. Relationships with clients				X	
Category II Points 15 x 2.0 (W.F.) = 30	Sub Total II				
III. Staffing/Personnel					
a. Sanitary engineers, permanent employees			X		
b. Avg. years of experience, full time eng'rs			X		
c. In-house disciplines					X
d. % of fees paid to consultants				X	
Category III Points 11 x 3.0 (W.F.) = 33	Sub Total III				
IV. Project Management					
a. Project managers with comparable experience	X				
b. Scheduling and planning techniques	X	N/A		N/A	
c. Management information systems	X	N/A		N/A	
d. Milestones, deliverable items	X	N/A		N/A	
Category IV Points 0 x 3.0 (W.F.) = 0	Sub Total IV				

FIGURE 6-2

OVERALL CAPABILITY INDEX
Sanitary Design Specific
Rating Form (Continued)

Categories - Sub-Elements	Ratings 0	1	2	3	4
V. Available In-House Resources					
a. Equipment and facilities		X			
b. Standard specifications	X				
c. Standard drawings and details	X				
d. Reference materials		X			
Category V Points 2 x 2.0 (W.F.) = 4	Sub Total V				
VI. Financial Indicators					
a. Ratio of current assets/current liabilities		N/A		N/A	X
b. Adjusted average annual growth rate		N/A		N/A	X
c. Professional liability insurance	X	N/A		N/A	
Category VI Points 8 x 1.5 (W.F.) = 12	Sub Total VI				

OVERALL CAPABILITY INDEX 94.0
(Total of Sub Total I through
Sub Total VI)

Evaluated By: John D. Knoll Jr.
David B. Bird

Date: 5 March, 1984

Reputation, Performance - Arabtech has a good reputation and their past performance has been consistent with their reputation. Projects are started on time and virtually always completed on time and within the client's budget. The quality of the design work has been consistently acceptable to good.

Experience - The majority of Arabtech's experience has been in highways, bridges and buildings; and not in sanitary engineering. They have performed well on comparable sized non-sanitary projects.

Arabtech has done a number of sanitary projects, primarily in the mid to late 1970's. They were associated with a British firm for a major project in Aqaba, but were mainly involved in pipelines and collection systems. Most of their sanitary work has involved water distribution, sewerage collection and surface drainage as it related to residential or commercial pro ects being designed by Arabtech.

Staffing, Project Understanding - Arabtech has a full range of in-house engineering disciplines and has been able to historically furnish required services with their own staff. As they tend to retain a high percentage of permanent staff, there have been periods when capacity exceeded work-loads. They have been able to hire qualified staff (either part time or full time) when workload exceeded capacity. They do have some needs for this specific project which cannot be met by their existing staff. These needs will be provided by their U.S. subcontractor and by acquiring additional staff.

The quality of the proposal was good and Arabtech did supply significant input, although it was done in the office of their U.S. subcontractor. With local exceptions, Arabtech displays a clear understanding of the services to be provided. The exceptions are areas of weakness or inexperience. In these areas, assistance is being provided by their U.S. subcontractor.

Financial Strength - Arabtech appears to have the financial strength to undertake this project.

6.3.2 Summary Assessment - Consulting Engineering Center

The following is the summary assessment for Consulting Engineering Center.

Reputation, Performance - CEC has a good reputation and their past performance has been consistent with their reputation. Projects are started on time and virtually always completed on time and within the client's budget. The quality of the design work has been consistently acceptable to good.

Experience - The majority of CEC's experience has not been in sanitary engineering. It is in highways, structures, materials testing and soils investigations. They have not been responsible for many comparable sized projects, but have performed well on the projects in which they have been involved.

FIGURE 6-3

OVERALL CAPABILITY INDEX
Sanitary Design Specific
Rating Form

Company CEC Design Development Index as of 1 Oct. 1983

Categories - Sub-Elements	Ratings 0	1	2	3	4
I. Experience					
a. Comparable sanitary projects-last 3 years		N/A	X	N/A	
b. Total sanitary projects - last 3 years				X	
c. Sanitary fees as % of total fees			X		
d. Comparable other projects - last 3 years			X		
e. Geographic locations of projects			X		

Category I Points 11 x 2.5 (W.F.) = 27.5 Sub Total I

Categories - Sub-Elements	0	1	2	3	4
II. Past Performance					
a. Initiate projects on schedule				X	
b. Complete projects on schedule				X	
c. Complete projects within budget				X	
d. Professional reputation				X	
e. Relationships with clients				X	

Category II Points 15 x 2.0 (W.F.) = 30 Sub Total II

Categories - Sub-Elements	0	1	2	3	4
III. Staffing/Personnel					
a. Sanitary engineers, permanent employees			X		
b. Avg. years of experience, full time eng'rs			X		
c. In-house disciplines		X			
d. % of fees paid to consultants					X

Category III Points 9 x 3.0 (W.F.) 27 Sub Total III

Categories - Sub-Elements	0	1	2	3	4
IV. Project Management					
a. Project managers with comparable experience		X			
b. Scheduling and planning techniques	X	N/A		N/A	
c. Management information systems	X	N/A		N/A	
d. Milestones, deliverable items	X	N/A		N/A	

Category IV Points 1 x 3.0 (W.F.) 3 Sub Total IV

FIGURE 6-3

OVERALL CAPABILITY INDEX
Sanitary Design Specific
Rating Form (Continued)

Categories - Sub-Elements	Ratings 0	1	2	3	4
V. Available In-House Resources					
a. Equipment and facilities				X	
b. Standard specifications		X			
c. Standard drawings and details	X				
d. Reference materials			X		

Category V Points __6__ x 2.0 (W.F.) = 12 Sub Total V

Categories - Sub-Elements	0	1	2	3	4
VI. Financial Indicators					
a. Ratio of current assets/current liabilities		N/A		N/A	X
b. Adjusted average annual growth rate		N/A		N/A	X
c. Professional liability insurance	X	N/A		N/A	

Category VI Points __8__ x 1.5 (W.F.) = 12 Sub Total VI

OVERALL CAPABILITY INDEX <u>111.5</u>
(Total of Sub Total I through
Sub Total VI)

Evaluated By: John D. Knoll Jr.
David B. Bird

Date: 5 March, 1984

Since 1979, CEC has been involved in a number of sanitary projects. These have included the studies and designs for Greater Amman Wastewater and feasibility studies for the Southern Cities. They were associated with three different American firms for these projects. CEC's involvement was mainly in data collection, field and soils investigations, and design of sewerage collection systems.

Staffing, Project Understanding - CEC has a limited range of in-house engineering disciplines. They have been able to furnish most of the required services with their own staff by concentrating their efforts in the areas of in-house capabilities. Through the use of part time, or temporary staff they have maintained a close balance between workload and capacity. They do have needs for this specific project which cannot be met by their existing staff. These needs will be provided by their U.S. subcontractor and by acquiring additional staff.

The quality of the proposal is good and involves significant input by CEC although it was done in the office of their U.S. subcontractor. CEC displays a clear understanding of the services to be provided in the areas in which they are experienced. Their U.S. subcontractor is providing assistance in areas of weakness or inexperience.

Financial Strength - CEC appears to have the financial strength to undertake this project.

6.3.3 Summary Assessment - Jouzy and Partners

The following is the summary assessment for Jouzy and Partners.

Reputation, Performance - Jouzy and Partners has a good reputation and their past performance has been consistent with their reputation. Projects are started on time and virtually always completed on time and within the client's budget. The quality of the design work has been consistently acceptable to good.

Experience - Jouzy and Partners has broad experience in the civil engineering field relating to highways, structures, planning and urban development and sanitary projects. They have work experience, and presently maintain offices, in the Region outside Jordan. They have performed well on comparable sized projects.

Jouzy and Partners have done a number of sanitary projects, principally in the mid 1970's and since 1980. They were associated with a U.S. firm for the study and design for Zarqa and Ruseifa and with another U.S. firm for the feasibility studies for the Six Northern Cities. They were also associated with a British firm for a study and design of immediate improvements to the sludge handling facilities at Ain Ghazal. Many of their projects have involved irrigation, drainage and flood control.

Staffing, Project Understanding - Jouzy and Partners has civil, architectural, and planning disciplines in-house, but does not have mechanical or electrical disciplines in house. Jouzy maintains excellent relations

FIGURE 6-4

OVERALL CAPABILITY INDEX
Sanitary Design Specific
Rating Form

Company Jouzy and Partners Design Development Index as of 1 Oct. 1983

Categories - Sub-Elements	Ratings 0	1	2	3	4
I. Experience					
a. Comparable sanitary projects-last 3 years		N/A		N/A	X
b. Total sanitary projects - last 3 years					X
c. Sanitary fees as % of total fees				X	
d. Comparable other projects - last 3 years					X
e. Geographic locations of projects				X	
Category I Points 18 x 2.5 (W.F.) = 45	Sub Total I				
II. Past Performance					
a. Initiate projects on schedule				X	
b. Complete projects on schedule				X	
c. Complete projects within budget				X	
d. Professional reputation				X	
e. Relationships with clients				X	
Category II Points 15 x 2.0 (W.F.) = 30	Sub Total II				
III. Staffing/Personnel					
a. Sanitary engineers, permanent employees			X		
b. Avg. years of experience, full time eng'rs		X			
c. In-house disciplines			X		
d. % of fees paid to consultants	X				
Category III Points 5 x 3.0 (W.F.) 15	Sub Total III				
IV. Project Management					
a. Project managers with comparable experience					X
b. Scheduling and planning techniques	X	N/A		N/A	
c. Management information systems	X	N/A		N/A	
d. Milestones, deliverable items	X	N/A		N/A	
Category IV Points 4 x 3.0 (W.F.) 12	Sub Total IV				

FIGURE 6-4

OVERALL CAPABILITY INDEX
Sanitary Design Specific
Rating Form (Continued)

Categories - Sub-Elements	Ratings 0	1	2	3	4
V. Available In-House Resources					
a. Equipment and facilities		X			
b. Standard specifications		X			
c. Standard drawings and details		X			
d. Reference materials				X	

Category V Points __6__ x 2.0 (W.F.) = 12 Sub Total V

Categories - Sub-Elements	0	1	2	3	4
VI. Financial Indicators					
a. Ratio of current assets/current liabilities		N/A		N/A	X
b. Adjusted average annual growth rate		N/A		N/A	X
c. Professional liability insurance	X	N/A		N/A	

Category VI Points __8__ x 1.5 (W.F.) = 12 Sub Total VI

OVERALL CAPABILITY INDEX __126.0__
(Total of Sub Total I through
Sub Total VI)

Evaluated By: John D. Knoll Jr.
David B. Bird

Date: 5 March, 1984

with a number of university professors and well qualified experts. Historically, they have been able to furnish required services either with their own staff, or in conjunction with "consultants," or temporary personnel. They have maintained a balance between workload and capacity with the use of part time or temporary personnel. The needs for this project, which cannot be met by their existing staff will be provided by their U.S. subcontractor, by acquiring staff, or by consultants.

The quality of the proposal is good anl did involve some input from Jouzy's U.S. subcontractor. Jouzy displays a clear understanding of the services to be provided, although assistance is being provided by their U.S. subcontractor. This assistance is related primarily to the treatment of sewage.

Financial Strength - Jouzy and Partners appears to have the financial strength to undertake this project.

6.4 FIRST INTERIM EVALUATIONS

Using the same techniques as the Baseline Evaluation, the OCI for each of the three firms was derived as of March 1985. The OCIs reflect the evaluation of each firm as of that time. The First Interim Evaluations are shown as Figure 6-5 through 6-7.

The questionnaires utilized in the data collection process are in Appendix C. They were developed specifically for interviews with the Jordanian engineering firm, their US subconsultants and GOJ agencies.

6.4.1 Summary Assessment - Arabtech Consulting Engineers

The findings of the first interim evaluation of Arabtech are summarized in the following paragraphs.

Reputation, Performance

Arabtech had a good reputation as an engineering firm at the beginning of this project, but was essentially without experience as a sanitary engineering firm. They maintained their reputation and were able to develop respect as a sanitary engineering firm, based on their performance on this project. WAJ expressed satisfaction with their performance and indicated they would recommend Arabtech to other clients as a competent sanitary engineering firm.

The favorable performance by Arabtech on this project, in the opinion of the WAJ project personnel, was mainly due to a limited number of people which included their project manager and their principal sanitary engineer.

Experience

At the time of the First Interim Evaluation, the design of the sanitary facilities and systems for the cities of Tafila and Ma'an were the only sanitary engineering projects of any magnitude completed by Arabtech. Their experience in the sanitary field consists essentially of this project. However, the magnitude of this project and their numerous other projects of similar size and complexity, make it one of the few consulting firms in Jordan with equivalent experience.

One of the main reasons Arabtech has not undertaken similar sanitary engineering projects is the size of the market. Very few design projects were undertaken in Jordan during the twelve month period prior to the First Interim Evaluation. The competition for the few design projects was intense.

Staffing, Project Understanding

Arabtech reinforced its staff of technical personnel during the project with what appears to be technically qualified personnel. However, they did not necessarily increase their total number of employees. It appears

FIGURE 6-5

OVERALL CAPABILITY INDEX
Sanitary Design Specific
Rating Form

Company Arabtech Consulting Engineers Design Development Index as of March 1985

Categories - Sub-Elements	Ratings 0	1	2	3	4
I. Experience					
a. Comparable sanitary projects-last 3 years		N/A	X	N/A	
b. Total sanitary projects - last 3 years		X			
c. Sanitary fees as % of total fees				X	
d Comparable other projects - last 3 years			X		
e. Geographic locations of projects			X		

Category I Points 10 x 2.5 (W.F.) = 25 Sub Total I

Categories - Sub-Elements	0	1	2	3	4
II. Past Performance					
a. Initiate projects on schedule				X	
b. Complete projects on schedule				X	
c. Complete projects within budget				X	
d. Professional reputation				X	
e. Relationships with clients				X	

Category II Points 15 x 2.0 (W.F.) = 30 Sub Total II

Categories - Sub-Elements	0	1	2	3	4
III. Staffing/Personnel					
a. Sanitary engineers, permanent employees				X	
b. Avg. years of experience, full time eng'rs			X		
c. In-house disciplines					X
d. % of fees paid to consultants				X	

Category III Points 12 x 3.0 (W.F.) = 36 Sub Total III

Categories - Sub-Elements	0	1	2	3	4
IV. Project Management					
a. Project managers with comparable experience		X			
b. Scheduling and planning techniques		N/A	X	N/A	
c. Management information systems		N/A	X	N/A	
d. Milestones, deliverable items		N/A	X	N/A	

Category IV Points 7 x 3.0 (W.F.) = 21 Sub Total IV

FIGURE 6-5

OVERALL CAPABILITY INDEX
Sanitary Design Specific
Rating Form (Continued)

Categories - Sub-Elements	Ratings 0	1	2	3	4
V. Available In-House Resources					
a. Equipment and facilities		X			
b. Standard specifications			X		
c. Standard drawings and details			X		
d. Reference materials				X	
Category V Points 8 x 2.0 (W.F.) = 16	Sub Total V				
VI. Financial Indicators					
a. Ratio of current assets/current liabilities		N/A		N/A	X
b. Adjusted average annual growth rate		N/A		N/A	X
c. Professional liability insurance	X	N/A		N/A	
Category VI Points 8 x 1.5 (W.F.) = 12	Sub Total VI				

OVERALL CAPABILITY INDEX 140
(Total of Sub Total I through
Sub Total VI)

Evaluated By: John D. Knoll, Jr.
David B. Bird

Date: March 1985

that Arabtech made a conscious effort to select a few technically capable project people that would remain with the firm. As stated earlier, Arabtech's people were able to acquire sufficient technology in project management, sanitary engineering, drafting and other areas. They earned the respect of the project coordinators of WAJ who rated Arabtech fully competent to undertake essentially similar type projects.

It was evident from our interviews and discussions with the Arabtech project staff, that they were technically competent on subjects directly related to this project.

Project Management Capabilities

Prior to this project, Arabtech had not incorporated the project manager concept to coordinate the project activities to meet project schedule and cost constraints. They utilized the leaders' technical disciplines to complete the projects in an unstructured fashion. No mechanism existed to coordinate the various project elements or control project costs.

For the design of the sanitary system for the two cities, a mechanical engineer was selected as the project manager. He was selected based on his ability and interest rather than his technical expertise. The result was very positive. The project manager appeared fully capable of scheduling project tasks, monitoring their progress, developing cost savings and control activities and dealing with WAJ on project matters.

Arabtech indicated they intend to utilize the project manager concept on all future governmental or industrial projects involving more than one technical discipline. The concepts and procedures will have to be transferred to other Arabtech personnel. They appear capable of accomplishing this in order to broaden their project management skills and capabilities.

Financial Strength

Arabtech appeared to be financially strong. This fact was confirmed by the fact that they, as well as the other two firms, were required to support a high level of project activity for a lengthy initial period before receiving reimbursement for services rendered.

6.4.2 Summary Assessment - Consulting Engineering Center

A summary of the findings of the First Interim Evaluation of CEC are listed below.

Reputation - Performance

At the beginning of the project, CEC was one of the few engineering firms in Jordan with sanitary engineering experience. They are a small firm, but enjoyed a respected reputation in the sanitary engineering field. They had designed a number of wastewater collection systems and small wastewater treatment facilities without any assistance of international

FIGURE 6-6

OVERALL CAPABILITY INDEX
Sanitary Design Specific
Rating Form

Company Consulting Engineering Center Design Development Index as of March 1985

Categories - Sub-Elements	Ratings 0	1	2	3	4
I. Experience					
a. Comparable sanitary projects-last 3 years		N/A	X	N/A	
b. Total sanitary projects - last 3 years				X	
c. Sanitary fees as % of total fees				X	
d. Comparable other projects - last 3 years			X		
e. Geographic locations of projects			X		
Category I Points 12 x 2.5 (W.F.) = 30	Sub Total I				
II. Past Performance					
a. Initiate projects on schedule				X	
b. Complete projects on schedule				X	
c. Complete projects within budget				X	
d. Professional reputation				X	
e. Relationships with clients				X	
Category II Points 15 x 2.0 (W.F.) = 30	Sub Total II				
III. Staffing/Personnel					
a. Sanitary engineers, permanent employees		X			
b. Avg. years of experience, full time eng'rs		X			
c. In-house disciplines		X			
d. % of fees paid to consultants					X
Category III Points 7 x 3.0 (W.F.) = 21	Sub Total III				
IV. Project Management					
a. Project managers with comparable experience			X		
b. Scheduling and planning techniques		N/A	X	N/A	
c. Management information systems		N/A	X	N/A	
d. Milestones, deliverable items		N/A	X	N/A	
Category IV Points 8 x 3.0 (W.F.) 24	Sub Total IV				

FIGURE 6-6

OVERALL CAPABILITY INDEX
Sanitary Design Specific
Rating Form (Continued)

Categories - Sub-Elements	Ratings 0	1	2	3	4
V. Available In-House Resources					
a. Equipment and facilities				X	
b. Standard specifications			X		
c. Standard drawings and details			X		
d. Reference materials				X	

Category V Points 10 x 2.0 (W.F.) = 20 Sub Total V

Categories - Sub-Elements	0	1	2	3	4
VI. Financial Indicators					
a. Ratio of current assets/current liabilities		N/A		N/A	X
b. Adjusted average annual growth rate		N/A	X	N/A	
c. Professional liability insurance	X	N/A		N/A	

Category VI Points 6 x 1.5 (W.F.) = 9 Sub Total VI

OVERALL CAPABILITY INDEX 134
(Total of Sub Total I through
Sub Total VI)

Evaluated By: John D. Knoll, Jr.
David B. Bird

Date: March 1985

engineering firms. On large sanitary projects in Jordan, CEC was always a subcontractor to a foreign firm. CEC built its' reputation in the area of soils testing and geology.

The quality of the work done by CEC for the water and wastewater system for the Cities of Madaba and Karak was very good. They received substantial help from their U.S. subconsultant during the beginning of the project, but as time went on, CEC assumed more and more of the design responsibility. By the end of the project, the U.S. subconsultant had left Jordan. CEC was fully responsible for the final design and redesign work required to satisfy the requirements of WAJ.

Experience

CEC has now participated in the study and design of a number of sanitary engineering projects in Jordan. They are one of the leading firms in Jordan in terms of the numbers sanitary project on which they have participated, either wholly or either as the prime contractor with a subcontractor, or as a subcontractor. Their largest weakness is their size and the number of permanent staff.

Staffing, Project Understanding

CEC increased its staff for the design of the water and wastewater systems and facilities for the cities of Madaba and Karak. Now that the project has been completed, they are unable to maintain the staff. A number of the engineers have left to accept jobs with other firms or agencies. They were, however, able to keep the project manager, designers, and two additional technical people.

The people retained have an indepth understanding and knowledge of the wastewater treatment process, plant layout, civil and structural engineering, drawing layout and details and project management. They appeared capable of successfully completing similar projects with minimal outside assistance. CEC would need to acquire additional technical expertise to fill these areas vacated by the technical staff who left at the end of the project.

Project Management Capabilities

As a result of specific management, financing, and project coordination assistance provided by their U.S. subconsultant, CEC made substantial gains in their in-house project management capabilities. Prior to this project CEC utilized a very loose type of project coordination, which was adequate for their previous projects. The design of these systems and facilities was much more complex than anything previously completed. The end result was quite positive. At approximately the mid point in the project, CEC's project manager was in complete control of the project and quite involved in directing the efforts of the project team to meet their time schedule. CEC appears capable of condinating any type or size of project within their technical capabilities.

Financial Strength

CEC appears to be quite strong financially, despite their small size. Their strength was demonstrated during the project, by being able to maintain their full staff despite a very delayed schedule of reimbursement for technical services rendered.

6.4.3 Summary Assessment - Jouzy and Partners

Jouzy and Partners is the largest of the three firms with considerable sanitary engineering experience. Their main office is in Beirut, Lebanon, and the Amman office is the next largest office. A summay of the findings from the First Interim Evaluation are listed below.

Reputation - Performance

Jouzy and Partners is a large firm that is well respected for their engineering capabilities. They had a good reputation at the beginning of the project and maintained that reputation throughout the project. They have designed a multitude of facilities including highways and other major civil engineering facilities in addition to sanitary facilities. They have previously participated either as a subcontractor or prime contractor on a number of sanitary projects in Jordan.

Experience

Jouzy and Partners have completed a number of sanitary projects in Jordan. At least two of them were major projects involving the design of wastewater collection and treatment facilities. They are probably the firm with the most sanitary engineering experience in Jordan.

Staffing, Project Understanding

New employees were not needed for this project due to the size of Jouzy and Partners. They already had enough people on their staff to fill all the project positions. For some engineering activities such as electical and mechanical, the work is subcontracted to other local firms. This practice is common and, not necessarily, a negative factor. Rather it is a cost effective measure to undertake projects as they arrive without having to maintain a staff with a low direct or billable time ratio.

As a result of Jouzy & Partners experiences, they had a fairly good understanding of the project. They lacked depth and knowledge in the area of wastewater treatment process engineering and this was provided by the U.S. subconsultant. They had four sanitary engineers on their staff at the end of the project that received the bulk of the technology transfer, along with the drafting staff.

Project Management Capabilities

The project manager for this project was provided by one of Jouzy and Partners senior personnel. He was already experienced in project and

FIGURE 6-7

OVERALL CAPABILITY INDEX
Sanitary Design Specific
Rating Form

Company Jouzy & Partners Design Development Index as of March 1985

Categories - Sub-Elements	Ratings 0	1	2	3	4
I. Experience					
a. Comparable sanitary projects-last 3 years		N/A		N/A	X
b. Total sanitary projects - last 3 years					X
c. Sanitary fees as % of total fees					X
d. Comparable other projects - last 3 years					X
e. Geographic locations of projects				X	
Category I Points 19 x 2.5 (W.F.) = 47.5	Sub Total I				
II. Past Performance					
a. Initiate projects on schedule				X	
b. Complete projects on schedule				X	
c. Complete projects within budget				X	
d. Professional reputation				X	
e. Relationships with clients				X	
Category II Points 15 x 2.0 (W.F.) = 30	Sub Total II				
III. Staffing/Personnel					
a. Sanitary engineers, permanent employees			X		
b. Avg. years of experience, full time eng'rs			X		
c. In-house disciplines			X		
d. % of fees paid to consultants		X			
Category III Points 7 x 3.0 (W.F.) = 21	Sub Total III				
IV. Project Management					
a. Project managers with comparable experience					X
b. Scheduling and planning techniques		N/A	X	N/A	
c. Management information systems	X	N/A		N/A	
d. Milestones, deliverable items		N/A	X	N/A	
Category IV Points 8 x 3.0 (W.F.) = 24	Sub Total IV				

FIGURE 6-7

OVERALL CAPABILITY INDEX
Sanitary Design Specific
Rating Form (Continued)

Categories - Sub-Elements	Ratings 0	1	2	3	4
V. Available In-House Resources					
a. Equipment and facilities		X			
b. Standard specifications				X	
c. Standard drawings and details				X	
d. Reference materials				X	

Category V Points __10__ x 2.0 (W.F.) = 20 Sub Total V

	0	1	2	3	4
VI. Financial Indicators					
a. Ratio of current assets/current liabilities		N/A		N/A	X
b. Adjusted average annual growth rate		N/A		N/A	X
c. Professional liability insurance	X	N/A		N/A	

Category VI Points __[illegible]__ x 1.5 (W.F.) = 12 Sub Total VI

OVERALL CAPABILITY INDEX __154.5__
(Total of Sub Total I through
Sub Total VI)

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office management. Essentially no technology transfer was provided in the project management area.

Financial Strength

Jouzy and Partners is a major international consulting firm. It appears to be quite strong financially and was able to maintain full project activities despite a delay in receiving reimbursements for services rendered.

6.5 COMPARISON OF BASELINE AND FIRST INTERIM EVALUATIONS

A summary comparison of the OCI's for the Baseline Survey and First Interim Evaluation for the three Jordanian firms is included in Figure 6-8. The purpose of this figure is to quickly show the overall improvement in each firm's capability to perform sanitary engineering design projects.

An item by item comparison of each of the three Jordanian firms is included in Figures 6-9 through 6-11. The categories and sub-elements of the comparisons are identical to the OCI evaluation formm, categories and sub-elements.

In all cases the firms improved their ability to design similar projects, demonstrating the positive impact of the techaology transfer effort.

For one of the firms, CEC, the rating for three sub-elements dropped instead of increasing. This was true even though their OCI increased and they demonstrated a significant improvement in their in-house capabilities. The three sub-elements are:

- Staffing/Personnel
  - a. Sanitary engineers, permanent employees
  - b. Avg. years of experience, full time eng'rs.
- Financial Indicators
  - b. Adjusted average annual growth rate.

Each of these indicators are affected to a great extent by the size of CEC. They are a very small firm. At the time of the baseline survey the project was underway and they had staffed up. At the time of the first interim evaluation the project had already essentially ended. Several of their sanitary engineers had left to accept other positions because CEC had not gotten any new sanitary projects. Thus, the number of sanitary engineers had been reduced along with the average number of years of experience. Because CEC had not gotten any new projects, their fees from sanitary projects had dropped.

FIGURE 6-8

OVERALL CAPABILITY INDICES
SANITARY DESIGN SPECIFIC
RATING COMPARISON FORM

Evaluation Title	Evaluation Date	OCI
Arabtech Consulting Engineers		
Baseline Survey	October 1983	94.0
First Intrim Evaluation	March 1985	140.0
Net OCI Improvement		45.0
Consulting Engineering Center		
Baseline Survey	October 1983	111.5
First Interim Evaluation	March 1985	134.0
Net OCI Improvement		22.5
Jouzy and Partners		
Baseline Survey	October 1983	126.0
First Interim Evaluation	March 1985	154.5
Net OCI Improvement		23.5

FIGURE 6-9

OVERALL CAPABILITY INDEX
Sanitary Design Specific
Rating Form

Company Arabtech Consulting Engineers Design Development Index as of October 1983 / March 1985

Categories - Sub-Elements	Rating Values		
	Baseline Survey	First Interim	Variance
I. Experience			
a. Comparable sanitary projects-last 3 years	0	2	2
b. Total sanitary projects - last 3 years	1	1	0
c. Sanitary fees as % of total fees	1	3	2
d. Comparable other projects - last 3 years	2	2	0
e. Geographic locations of projects	2	2	0
Category I - Weighting Factor 2.5	15	25	10
II. Past Performance			
a. Initiate projects on schedule	3	3	0
b. Complete projects on schedule	3	3	0
c. Complete projects within budget	3	3	0
d. Professional reputation	3	3	0
e. Relationships with clients	3	3	0
Category II - Weighting Factor 2.0	30	30	0
III. Staffing/Personnel			
a. Sanitary engineers, permanent employees	2	3	1
b. Ave. years of experience, full time eng'rs	2	2	0
c. In-house disciplines	4	4	0
d. % of fees paid to consultants	3	3	0
Category III - Weighting Factor 3.0	33	36	3
IV. Project Management			
a. Project managers with comparable experience	0	1	1
b. Scheduling and planning techniques	0	2	2
c. Management information systems	0	2	2
d. Milestones, deliverable items	0	2	2
Category IV - Weighting Factor 3.0	0	21	21

FIGURE 6-9

OVERALL CAPABILITY INDEX COMPARISON
Sanitary Design Specific
Rating Form (Continued)

Categories - Sub-Elements	Rating Values		
	Baseline Survey	First Interim	Variance
V. Available In-House Resources			
a. Equipment and facilities	1	1	0
b. Standard specifications	0	2	2
c. Standard drawings and details	0	2	2
d. Reference materials	1	3	2
Category V - Weighting Factor = 2.0	4	16	12
VI. Financial Indicators			
a. Ratio of current assets/current liabilities	4	4	0
b. Adjusted average annual growth rate	4	4	0
c. Professional liability insurance	0	0	0
Category VI - Weighting Factor = 1.5	12	12	0
OVERALL CAPABILITY INDICES (Totals of Category 1 through Category VI)	94.0	140.0	46

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Date: March 1985

FIGURE 6-10

OVERALL CAPABILITY INDEX COMPARISON
Sanitary Design Specific
Rating Form

Company Consulting Engineering Center Design Development Index as of October 1983 March 1985

Categories - Sub-Elements	Rating Values		
	Baseline Survey	First Interim	Variance
I. Experience			
a. Comparable sanitary projects-last 3 years	2	2	0
b. Total sanitary projects - last 3 years	3	3	0
c. Sanitary fees as % of total fees	2	3	1
d. Comparable other projects - last 3 years	2	2	0
e. Geographic locations of projects	2	2	0
Category I - Weighting Factor 2.5	27.5	30	2.5
II. Past Performance			
a. Initiate projects on schedule	3	3	0
b. Complete projects on schedule	3	3	0
c. Complete projects within budget	3	3	0
d. Professional reputation	3	3	0
e. Relationships with clients	3	3	0
Category II - Weighting Factor 2.0	30	30	0
III. Staffing/Personnel			
a. Sanitary engineers, permanent employees	2	1	(1)
b. Avg. years of experience, full time eng'rs	2	1	(1)
c. In-house disciplines	1	1	0
d. % of fees paid to consultants	4	4	0
Category III - Weighting Factor 3.0	27	21	(6)
IV. Project Management			
a. Project managers with comparable experience	1	2	1
b. Scheduling and planning techniques	0	2	2
c. Management information systems	0	2	2
d. Milestones, deliverable items	0	2	2
Category IV - Weighting Factor 3.0	3	24	21

FIGURE 6-10

OVERALL CAPABILITY INDEX
Sanitary Design Specific
Rating Form (Continued)

Categories - Sub-Elements	Rating Values		
	Baseline Survey	First Interim	Variance
V. Available In-House Resources			
a. Equipment and facilities	3	3	0
b. Standard specifications	1	2	1
c. Standard drawings and details	0	2	2
d. Reference materials	2	3	1
Category V - Weighting Factor = 2.0	12	20	8
VI. Financial Indicators			
a. Ratio of current assets/current liabilities	4	4	0
b. Adjusted average annual growth rate	4	2	(2)
c. Professional liability insurance	0	0	0
Category VI - Weighting Factor = 1.5	12	9	(3)
OVERALL CAPABILITY INDICES (Totals of Category 1 through Category VI)	111.5	134.0	22.5

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David B. Bird

Date: March 1985

FIGURE 6-11

OVERALL CAPABILITY INDEX COMPARISON
Sanitary Design Specific
Rating Form

Company Jouzy & Partners Design Development Index as of October 1983 March 1985

Categories - Sub-Elements	Rating Values		
	Baseline Survey	First Interim	Variance
I. Experience			
a. Comparable sanitary projects-last 3 years	4	4	0
b. Total sanitary projects - last 3 years	4	4	0
c. Sanitary fees as % of total fees	3	4	1
d. Comparable other projects - last 3 years	4	4	0
e. Geographic locations of projects	3	3	0
Category I - Weighting Factor = 2.5	45	47.5	2.5
II. Past Performance			
a. Initiate projects on schedule	3	3	0
b. Complete projects on schedule	3	3	0
c. Complete projects within budget	3	3	0
d. Professional reputation	3	3	0
e. Relationships with clients	3	3	0
Category II - Weighting Factor = 2.0	30	30	0
III. Staffing/Personnel			
a. Sanitary engineers, permanent employees	2	2	0
b. Ave. years of experience, full time eng'rs	1	2	1
c. In-house disciplines	2	2	0
d. % of fees paid to consultants	0	1	1
Category III - Weighting Factor = 3.0	15	21	6
IV. Project Management			
a. Project managers with comparable experience	4	4	0
b. Scheduling and planning techniques	0	2	2
c. Management information systems	0	0	0
d. Milestones, deliverable items	0	2	2
Category IV - Weighting Factor = 3.0	12	24	12

FIGURE 6-11

OVERALL CAPABILITY INDEX
Sanitary Design Specific
Ra'ing Form (Continued)

Categories - Sub-Elements	Rating Values		
	Baseline Survey	First Interim	Variance
V. Available In-House Resources			
a. Equipment and facilities	1	1	0
b. Standard specifications	1	3	2
c. Standard drawings and details	1	3	2
d. Reference materials	3	3	0
Category V - Weighting Factor = 2.0	12	20	8
VI. Financial Indicators			
a. Ratio of current assets/current liabilities	4	4	0
b. Adjusted average annual growth rate	4	4	0
c. Professional liability insurance	0	0	0
Category VI - Weighting Factor = 1.5	12	12	0
OVERALL CAPABILITY INDICES (Totals of Category 1 through Category VI)	126	154.5	28.5

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Date: March 1985

SECTION 7

CONSTRUCTION SUPERVISION BASELINE EVALUATION

7.1 GENERAL

The primary objective of the Construction Supervision Baseline Evaluation is to establish the baseline data, for three Jordanian consulting firms, at the beginning of the construction supervision phase of this project. This data will then be used as the reference point of origin for comparisons with the results of future evaluations.

Numerous sources of information were utilized in providing the basis for this baseline evaluation including:

- Available reference materials

- The actual proposals submitted for this project by the firms

- Data supplied by the individual firms and agencies

- Input received during numerous discussions with the personnel from the firms and agencies.

It was not possible to achieve as all-encompassing an evaluation as the project needs deserve. The firms, agencies and individuals were most cooperative and helpful. It was only external factors which precluded the desirable complete solution.

The prime inhibiting factors were that the construction supervision work has not yet been contracted by the Water Authority. All three firms, in association with their respective US subconsultants, have submitted proposals.

A subjective evaluation will need to be undertaken when the construction supervision services and project personnel are defined. Such an evaluation can be properly and economically included with the baseline evaluation of the construction capabilities of the Jordanian contractors selected for this project.

Efforts have been made to develop the objective evaluation of the construction supervision capabilities of the three Jordanian consulting firms. The format is similar to the format developed previously by the Project Team for use in the baseline evaluation of sanitary engineering design capabilities. If followed in subsequent evaluations, this format will produce consistent and comparative results. It is anticipated that this objective evaluation will be supplemented at a later date by a more subjective evaluation which will include project personnel.

7.2 CONSTRUCTION SUPERVISION BASELINE EVALUATION

The objective evaluation is composed of the following elements:

7.2.1 Criteria

The criteria considered in developing the objective evaluation included:

OBJECTIVITY - The evaluation format must minimize, or eliminate, subjective results and be as purely objective as possible. Future evaluations are anticipated during the life cycle of this project. The results of these various evaluations must be consistent and comparable regardless of differing personalities which may be involved in the evaluations.

APPLICABILITY/FLEXIBILITY - The system must be applicable in determining, or indicating, construction supervision baseline capabilities and the transfer of technology. It must apply to project specific needs throughout the life of the project. The system must apply to projet specific and firm specific evaluations. Yet it must retain the flexibility to apply to general construction supervision projects or other firms with little, or no, modification.

DETAILED DOCUMENTATION - The system must be clearly detailed and fully documented. The detail is needed to provide a clear understanding of the initial evaluation as well as providing the direction for future evaluations. The documentation will provide a rational means of adjusting previously completed evaluations should the system be modified in the future.

7.2.2 Approach

The primary motivation in developing an evaluation system was to incorporate features that would, in some fashion, quantify increased capabilities and also show evidence of technology transfer. At the same time, the system had to be capable of producing consistently objective evaluations over time with the possibility of differing evaluators.

The approach used involved the selection of general catagories under which the various elements applied in evaluating the baseline capabilities could be logically grouped. These categories were defined as: Staffing and Personnel, Management Tools and Techniques, Experience, Past Performance, Available In-House Resources and Financial Indicators.

Following the identification of the general categories, the sub-elements of each general category were defined. The various sub-elements were considered and selected for inclusion on the basis of:

o Applicability to both the project sepcific considerations and to larger general field considerations.

o Ability to objectively define both the sub-element and the boundary conditions used in rating the sub-element.

o Reasonable availability of information relating to each sub-element. The information should not be burdensome for the

Jordanian firm to gather or prepare, nor must it be confidential in nature.

The final step in the approach was to devise a method for rating the sub-elements and actually quantifying construction supervision capabilities. The selected method utilizes a numeric rating of 0 to 4 for each sub-element. Each category has been assigned a weighting factor. The numeric ratings for each sub-element are multiplied by the categorical weighting factor and then added to produce a weighted category sub-total. The category sub-totals are then added together to produce a single number. This pure number has been termed as the Construction Supervision Development Index (CSDI).

It is appreciated that the individual categories and sub-elements selected by the Project Team for inclusion in this system may not be universally agreeable. However, they were selected, and included, after due consideration of the project specific objectives, criteria, conditions existing at the time of the study and the time constraints present in preparing the study. Continued or widespread usage will introduce change and permit the system to grow in response to varying needs and conditions.

7.2.3 Construction Supervision Development Index

7.2.3.1 General Concepts

The Construction Supervision Development Index (CSDI) is designed for objectivity with the purpose of eliminating subjective influences. The intent is to quantify the construction supervision capabilities of a particular firm, in some fashion, at any given point in time. Continued use of the CSDI throughout a series of evaluations will produce a series of truly comparable values. This will occur as a result of the objective and rigidly defined rating system.

The CSDI is a single dimensionless number which is derived as the sum of the weighted category sub-totals. Each category is divided into sub-elements which are individually rated. Thus, comparisons between any two different evaluations can be made on the whole (using just the CSDI), on any specific category or on individual sub-elements.

7.2.3.2 Rating Format

A standardized matrix format has been selected for the rating form itself. Rating opportunities, and point values, have been limited to only five possible choices. Actual numeric rating values can vary only from 0 to 4. This will eliminate the need for, and the possibility of, finely shaped judgemental distinctions.

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The majority of the sub-elements can be rated with a choice of any of the five rating values. Howver, certain of the sub-elements are more appropriately rated through a range of only three choices of values.

A single rating form having five rating options was selected as the standard format rather than having two different rating formats on two separate forms. Those sub-elements which require only three choices are limited to ratings of 0, 2 or 4. Rating values of 1 and 3 are redundant in these instances and are shown as N/A (not applicable) for clarification.

7.2.3.3 Category Weighting

The relative weights assigned to the general categories were subjectively designated by the Project Team. They involved consideration of the conditions prevailing at the time of the study, the project specific needs, overall balance and the relative values of the categories.

Staffing and Personnel, Management Tools and Techniques and Experience were judged to be the more critical areas. These categories were given emphasis with higher weightings. Following in descending order of importance are Past Performance, Available In-House Resources and Financial Indicators.

Past Performance was given lesser weighting thatn the first two in this evaluation since there is not a plethera of historic projects with truly comparable conditions. It is still a very reliable indicator of the general attitudes, capabilities and method of operations for the individual firms.

Availale in-House Resources are more easily acquired than the other general categories. Further the individual interest and expertise of the project personnel may partially offset the absence of such resources.

Financial Indicators must considered only in relation to the firm's ability to undertake the project or to acquire needed personnel and/or in house sources.

7.2.3.4 Rating Forms and Rating Definitions

A typical Construction Supervision Development Index rating form is shown in Figure 7-1.

Definitions of the individual sub-elements and the related possible rating choices are shown in Table 7-1.

7.2.3.5 Uses

The Construction Supervision Development Index was formulated as a useful tool to quantify construction supervision capabilities

PRELIMINARY

FIGURE 7-1

CONSTRUCTION SUPERVISION DEVELOPMENT INDEX

Company ______________________ CSDI as of ______________

Categories - Sub-Elements	Ratings 0	1	2	3	4
I. Staffing and Personnel a. Construction personnel, full time employees b. Ave. years of experience, full time C.S. personnel c. Project managers with comparable experience d. Available in-house disciplines					
Category Points ____ X 3.0 (W.F.) = __ Sub Total I					
II. Management Tools and Techniques a. Project activity scheduling b. Project documentation systems c. Construction supervision manual - policies and procedures					
Category Points ____ X 3.5 (W.F.) = __ Sub Total II					
III. Experience a. Total construction superv. projects - last 3 years b. Comparable construction supervision projects c. Construction superv. fees as % of total fees d. Geograhpic location of projects for construction superv. e. Construction superv. on projects designed by others					
Category Points ____ X 1.8 (W.F.) = __ Sub Total III					

PRELIMINARY

FIGURE 7-1

CONSTRUCTION SUPERVISION DEVELOPMENT INDEX (CONTINUED)

Company ______________________ CSDI as of ______________

Categories - Sub-Elements	Ratings 0	1	2	3	4
IV. Past Performance a. Timely initiation of preconstruction activities b. Complete projects within budget c. Professional reputation d. Relationships with clients, contractors and designers					

Category Points _____ X 1.75 (W.F.) = __ Sub Total IV

V. Available In-House Resources a. Equipment and facilities b. Reference materials c. Standard forms and reports d. Test equipment and facilities					

Category Points _____ X 1.25 (W.F.) = __ Sub Total V

VI. Financial Indicators a. Ratio of current assets to current liabilities b. Adjusted ave. annual growth c. Professional liability insurance					

Category Points _____ X 1.5 (W.F.) = __ Sub Total VI

CONSTRUCTION SUPERVISION DEVELOPMENT INDEX ______

Evaluated By: ______________________

____

Date: ______________________

TABLE 7-1

DEFINITION OF SUB-ELEMENTS AND RATINGS

Categories Sub-Elements	Ratings 0	1	2	3	4
I. Staffing and Personnel					
a. Construction personnel, full time employees	0	1-2	3-4	5-8	9+
b. Ave. years of experience, full time construction personnel	less than 3	4-6	7-9	10-15	16+
c. Project managers with comparable previous experience	0	1	2	3-4	5+
d. Available in-house disciplines	Civil structural	+ mechanical	+ sanitary	+ architects	All disciplines
II. Management Tools and Technology					
a. Project activity scheduling	Generally not used	N/A	Available but used marginally	N/A	Available monitored and used
b. Project documentation systems	Generally not used	N/A	Available but used marginally	N/A	Available monitored and used
c. Construction supervision manual	Generally not used	N/A	Available but used marginally	N/A	Available Monitored and Used

TABLE 7-1

DEFINITION OF SUB-ELEMENTS AND RATINGS (CONTINUED)

Categories Sub-Elements	Ratings				
	0	1	2	3	4
III. Experience					
a. Total construction supervision projects last 3 years	0	1	2-3	4-5	6 or more
b. Comparable construction supervision projects	0	N/A	1	N/A	2 or more
c. Construction supervision fees as a % of total fees	0	1-10	11-25	26-50	50+
d. Geographic location of construction supervision projects	None	Area of Amman	Only in Jordan	Only in Middle East	Worldwide
e. Construction supervision on projects designed by others	0	1	2	3-4	5 or more

TABLE 7-1

DEFINITION OF SUB-ELEMENTS AND RATINGS (CONTINUED)

Categories Sub-Elements	Ratings 0	1	2	3	4
IV. Past Performance					
a. Timely initiation of pre-construction activities	Never	Sometimes	Often	Usually	Always
b. Complete projects within budget	Never	Sometimes	Often	Usually	Always
c. Professional reputation	Unacceptable	Marginal	Acceptable	Good	Excellent
d. Relationships with clients, contractors and designers	Unacceptable	Marginal	Acceptable	Good	Excellent
V. Available In-House Resources					
a. Equipment and facilities	None	Basic Office equipment	+ Word processor	+ computer	All plus additional equipment
b. Standard construction supervision reports and forms	None	Textbooks, reference books inspectors manuals	+ Tech papers & int'l publications	+ Catalogs & equip mfgrs data	+ Technical periodicals
c. Standard construction supervision reports and forms	None	N/A	1-5 Forms Daily Diary	N/A	6 or more + Daily Diary

TABLE 7-1

DEFINITION OF SUB-ELEMENTS AND RATINGS (CONTINUED)

Categories Sub-Elements	Ratings 0	1	2	3	4
d. Testing equipment and capabilities	None	N/A	Minimal equip (sieves screens, scales, Slump cone	N/A	Complete line of inspection tools and equipment
VI. Financial Indicators					
a. Ratio of current assets to current liabilities	Less than 0.8	N/A	0.8 to 1.5	N/A	Greater than 1.5
b. Adjusted average annual growth rate	Less than -1.0	N/A	-1.0 to 1.0	N/A	Greater than 1.0
c. Professional liability insurance	None	N/A	Project specific	N/A	Coverage for all projects

and indicate the transfer of technology. Some emphasis was given to sanitary engineering projects, but it does have application to construction projects in general. Since the CSDI was developed for this project it is somewhat project and site specific. However, with minor modifications broader applications will be possible.

Comparisons of evaluations of the CSDI, for any given firm, conducted at different times will be meaningful. The comparison may be as straightforward as comparing the CSDI numbers. An increasing CSDI implies an increasing capability and indicates the transfer of technology. Conversely, a decreasing CSDI implies a regression in capability and no transfer of technology. While it would be difficult for capabilities to degenerate within the span of a single project, it could reasonably occur over longer periods of time.

More detailed comparisons are possible by comparing the individual categories sub-totals, or individual sub-element ratings. These comparisons would show general, or specific, areas of capability enhancement or regression Such comparisons would also pinpoint target areas for additional detailed study, if so desired.

Since the CSDI is general in nature it cannot, and should not, be used to select a firm for a specific project. The CSDI does not evaluate or quantify project specific considerations such as; the firms existing workload verses the firms capacity, the specific experience and availability of personnel for the project and the level of committment by the firm to a specific project.

The main use of the CSDI is to indicate the change in capability and to indicate the transfer of technology in a given single firm over time. The highest valued CSDI does not infer that the firm possessing same is the "best" for any construction supervision project. The CSDI is not a means to compare and rank various firms for projects.

7.3 RATINGS AND ASSESSMENTS

The format for the ratings and assessments will consist of a short summary assessment followed by the completed Construction Supervision Development Index rating forms, Figures 7-2 through 7-1. This format will be used for each firm in the following order; Arabtech Consulting Engineers, Consulting Engineering Center, and Jouzy and Partners.

7.3.1 Arabtech Consulting Engineers

The following is the summary assessment for Arabtech Consulting Engineers.

Reputation, Performance - Arabtech has a good reputation as a Consulting Engineering Firm and their past performance has been

PRELIMINARY

FIGURE 7-2

CONSTRUCTION SUPERVISION DEVELOPMENT INDEX

Company Arabtech Consulting Engineers CSDI as of March 1985

Categories - Sub-Elements	Ratings 0	1	2	3	4
I. Staffing and Personnel					
a. Construction personnel, full time employees					X
b. Ave. years of experience, full time C.S. personnel			X		
c. Project managers with comparable experience				X	
d. Available in-house disciplines					X
Category Points 13 X 3.0 (W.F.) = 39.0	Sub Total I				
II. Management Tools and Techniques					
a. Project activity scheduling		N/A		N/A	X
b. Project documentation systems		N/A		N/A	X
c. Construction supervision manual - policies and procedures		N/A		N/A	X
Category Points 12 X 3.5 (W.F.) = 42.0	Sub Total II				
III. Experience					
a. Total construction superv. projects - last 3 years				X	
b. Comparable construction supervision projects		N/A		N/A	X
c. Construction superv. fees as % of total fees				X	
d. Geograhpic location of projects for construction superv.			X		
e. Construction superv. on projects designed by others					X
Category Points 16 X 1.8 (W.F.) = 28.8	Sub Total III				

PRELIMINARY

FIGURE 7-2

CONSTRUCTION SUPERVISION DEVELOPMENT INDEX (CONTINUED)

Company Arabtech Consulting Engineers CSDI as of March 1985

Categories - Sub-Elements	Ratings 0	1	2	3	4
IV. Past Performance					
a. Timely initiation of preconstruction activities				X	
b. Complete projects within budget				X	
c. Professional reputation				X	
d. Relationships with clients, contractors and designers				X	
Category Points 12 X 1.75 (W.F.) = 21.0 Sub Total IV					
V. Available In-House Resources					
a. Equipment and facilities		X			
b. Reference materials				X	
c. Standard forms and reports		N/A	X	N/A	
d. Test equipment and facilities		N/A	X	N/A	
Category Points 8 X 1.25 (W.F.) = 10.0 Sub Total V					
VI. Financial Indicators					
a. Ratio of current assets to current liabilities		N/A		N/A	X
b. Adjusted ave. annual growth		N/A		N/A	X
c. Professional liability insurance	X	N/A		N/A	
Category Points 8 X 1.5 (W.F.) = 12.0 Sub Total VI					

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Date: March 1985

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FIGURE 7-3

CONSTRUCTION SUPERVISION DEVELOPMENT INDEX

Company Consulting Engineering Center CSDI as of March 1985

Categories - Sub-Elements	Ratings 0	1	2	3	4
I. Staffing and Personnel					
a. Construction personnel, full time employees				X	
b. Ave. years of experience, full time C.S. personnel				X	
c. Project managers with comparable experience		X			
d. Available in-house disciplines			X		
Category Points 9 X 3.0 (W.F.) = 27.0	Sub Total I				
II. Management Tools and Techniques					
a. Project activity scheduling		N/A	X	N/A	
b. Project documentation systems		N/A	X	N/A	
c. Construction supervision manual - policies and procedures	X	N/A		N/A	
Category Points 4 X 3.5 (W.F.) = 14.0	Sub Total II				
III. Experience					
a. Total construction superv. projects - last 3 years					X
b. Comparable construction supervision projects	X	N/A		N/A	
c. Construction superv. fees as % of total fees				X	
d. Geographic location of projects for construction superv.			X		
e. Construction superv. on projects designed by others					
Category Points 9 X 1.8 (W.F.) = 16.2	Sub Total III				

PRELIMINARY

FIGURE 7-3

CONSTRUCTION SUPERVISION DEVELOPMENT INDEX (CONTINUED)

Company Consulting Engineering Center CSDI as of March 1985

Categories - Sub-Elements	Ratings 0	1	2	3	4
IV. Past Performance					
a. Timely initiation of preconstruction activities				X	
b. Complete projects within budget				X	
c. Professional reputation				X	
d. Relationships with clients, contractors and designers				X	

Category Points 12 X 1.75 (W.F.) = 21.0 Sub Total IV

Categories - Sub-Elements	0	1	2	3	4
V. Available In-House Resources					
a. Equipment and facilities				X	
b. Reference materials				X	
c. Standard forms and reports		N/A	X	N/A	
d. Test equipment and facilities		N/A		N/A	X

Category Points 12 X 1.25 (W.F.) = 15.0 Sub Total V

Categories - Sub-Elements	0	1	2	3	4
VI. Financial Indicators					
a. Ratio of current assets to current liabilities		N/A		N/A	X
b. Adjusted ave. annual growth		N/A		N/A	X
c. Professional liability insurance	X	N/A		N/A	

Category Points 8 X 1.5 (W.F.) 12.0 Sub Total VI

CONSTRUCTION SUPERVISION DEVELOPMENT INDEX 105.2

Evaluated By: John D. Knoll, Jr.

David B. Bird

Date: March 1985

PRELIMINARY

FIGURE 7-4

CONSTRUCTION SUPERVISION DEVELOPMENT INDEX

Company Jouzy & Partners CSDI as of March 1985

Categories - Sub-Elements	Ratings 0	1	2	3	4
I. Staffing and Personnel					
a. Construction personnel, full time employees					X
b. Ave. years of experience, full time C.S. personnel			X		
c. Project managers with comparable experience				X	
d. Available in-house disciplines		X			

Category Points 10 X 3.0 (W.F.) = 30.0 Sub Total I

Categories - Sub-Elements	0	1	2	3	4
II. Management Tools and Techniques					
a. Project activity scheduling		N/A	X	N/A	
b. Project documentation systems		N/A	X	N/A	
c. Construction supervision manual - policies and procedures		N/A	X	N/A	

Category Points 6 X 3.5 (W.F.) = 21.0 Sub Total II

Categories - Sub-Elements	0	1	2	3	4
III. Experience					
a. Total construction superv. projects - last 3 years					
b. Comparable construction supervision projects					X
c. Construction superv. fees as % of total fees		N/A		N/A	X
d. Geograhpic location of projects for construction superv.				X	
e. Construction superv. on projects designed by others		X			

Category Points 16 X 1.8 (W.F.) = 28.8 Sub Total III

PRELIMINARY

FIGURE 7-4

CONSTRUCTION SUPERVISION DEVELOPMENT INDEX (CONTINUED)

Company Jouzy and Partners CSDI as of March 1985

Categories - Sub-Elements	Ratings 0	1	2	3	4
IV. Past Performance					
a. Timely initiation of preconstruction activities				X	
b. Complete projects within budget				X	
c. Professional reputation				X	
d. Relationships with clients, contractors and designers				X	

Category Points 12 X 1.75 (W.F.) = 21.0 Sub Total IV

Categories - Sub-Elements	0	1	2	3	4
V. Available In-House Resources					
a. Equipment and facilities		X			
b. Reference materials					X
c. Standard forms and reports		N/A	X	N/A	
d. Test equipment and facilities		N/A	X	N/A	

Category Points 9 X 1.25 (W.F.) = 11.25 Sub Total V

Categories - Sub-Elements	0	1	2	3	4
VI. Financial Indicators					
a. Ratio of current assets to current liabilities		N/A		N/A	X
b. Adjusted ave. annual growth		N/A		N/A	X
c. Professional liability insurance	X	N/A		N/A	

Category Points 8 X 1.5 (W.F.) = 12.0 Sub Total VI

CONSTRUCTION SUPERVISION DEVELOPMENT INDEX 124.05

Evaluated By: John D. Knoll, Jr.

David B. Bird

Date: March 1985

consistent with their reputation. Projects are started and completed on time generally and within the client's budget. The quality of the design work has been consistently acceptable to good.

Experience - The majority of Arabtech's experience has been in highways, bridges and buildings; and not on sanitary construction projects. They have performed well on comparable sized non-sanitary projects.

Arabtech has had a separate Construction Services group within their firm, specifically for providing construction services since 1966. They have done a large number of projects including major housing and human settlement projects in the Sudan Valley.

Arabtech has some field testing equipment and is familiar with reporting procedures.

Staffing, Project Understanding - Arabtech has a separate staff for construction services. As they tend to retain a high percentage of permanent staff, there have been periods when capacity exceeded workloads. They have been able to hire qualified staff (either part time or full time) when workload exceeded capacity. They draw from their in-house staff of design engineers and technicians whenever necessary and possible to staff projects.

Financial Strength - Arabtech appears to have the financial strength to undertake this project.

7.3.2 Consulting Engineering Center

The following is the summary assessment for Consulting Engineering Center.

Reputation, Performance - CEC has a good reputation and their past performance has been consistent with their reputation. Projects are started and completed on time and generally within the client's budget. The quality of their work has been consistently acceptable to good.

CEC has provided construction services on a number of sanitary and other civil type projects.

Experience - Their strength is in the soils foundation, and concrete areas, where they have a fully equipped laboratory to conduct most tests.

Staffing, Project Understanding - CEC has a limited range of in-house personnel capable of doing a major construction services projects.

Because of their experience and areas of expertise, CEC's personnel have a fair knowledge of this type of services. They will need help in specific areas and reporting procedures.

Financial Strength - CEC appears to have the financial strength to undertake this project.

7.3.3 Jouzy and Partners

The following is the summary assessment for Jouzy and Partners.

Reputation, Performance - Jouzy and Partners has a good reputation and their past performance has been consistent with their reputation. Projects are started and completed on time and generally within the client's budget. The quality of the design work has been consistently acceptable to good.

Experience - Jouzy and Partners has broad experience in the civil engineering field relating to highways, structures, planning and urban development and sanitary projects. They have work experience, and presently maintain offices, in the Region outside Jordan. They have performed well on comparable sized projects.

Jouzy and Partners have done a number of construction services projects, mainly for highways, bridges and major buildings.

Staffing, Project Understanding - Jouzy and Partners has civil, architectural, and planning disciplines in-house, in addition to construction services personnel.

Financial Strength - Jouzy and Partners appears to have the financial strength to undertake this project.

APPENDIX A

PERSONS CONTACTED

APPENDIX A

PERSONS CONTACTED

1. GOVERNMENT OF JORDAN

Ministry of Planning

Boulos Kefeya
Muna Al-Jawhari

Water Authority

Mohammad S. Kilani
Tawfik Batarseh
Nadir Abu Arkub
Anahit R. Taminian
Ibrahim Abu Shums

2. USAID/AMMAN

Bernard E. Donnelly
Chief Engineer
William A. Libby
Deputy Chief Engineer
Abdallah A. Ahmad
Civil Engineering Advisor
James F. Hanks
Project Development
Nancy Carmichael Hardy
Mission Evaluation Officer
Ray Romano
Committee Member

3. CONSULTING ENGINEERS

Arabtech Consulting Engineers
Ibrahim Abu Ayyash
Partner
Ali Adib Hattar
Project Manager
Ziad Nobani
Chief Engineer Construction Supervision Department

CH2M Hill International
Kenneth D. Bielman
Project Manager
Grover Jones
Sanitary Engineer
Randy Hoffman
Civil Engineer

Consulting Engineering Center
Aziz Abdo Sajdi
President
Izzat Aziz Sajdi
Project Manager
Fuad Sweis
Sanitary Engineer
Nabel Darwish
Structural Engineer

Black & Veatch International
Ray J. Selk
Project Manager
Thomas A. Lyon
Project Engineer
Robert Owens
Designs

Jouzy and Partners Consulting Engineering Bureau
Dr. Neddy Jouzy
Partner
Najeab F. Tleel
Project Manager

Engineering Science Inc.

Mr. Jerome Esmay
Project Manager

APPENDIX B

REFERENCES

APPENDIX B

REFERENCES

1. Agency for International Development - Jordan: Water Systems and Services Management. A Project Paper, Project Number 278-0259, Jordan, May 1983.

2. Agency for International Development - Design and Evaluation of AID-Assisted Projects, Washington, D.C. November 1980.

3. Agency for International Development - Handbook 3-Project Assistance, (TM 3:43). Washington, D.C., 30 September 1982.

4. Arabtech Consulting Engineers and CH2M Hill International - Technical Proposal for Water Distribution, Sewerage and Stormwater Drainage in the Southern Cities. June 1983.

5. Consulting Engineering Center and Black & Veatch International - Technical Proposal for Water Distribution, Sewerage and Storm Water Drainage Systems in Tafila, Ma'an, Karak and Madaba, June 1983.

6. Jouzy and Partners C.E.B. and Engineering Science Inc. - Technical Proposal for Municipal Water Distribution, Sewerge and Storm Wate Drainage Systems in Ramtha, Mafraq, Anjara, Ajloun, Ein Janneth and Kufranjeh, Volumes I and II, July 1983.

7. WASH - A Proposed Action Plan for a National Training Program in the Water Sector of the Hashemite Kingdom of Jordan. (Field Report No. 34). Arlington, Virginia, February 1982.

8. Arabtech Consulting Engineers - General; Brochure, Undated.

9. Jouzy and Partners, C.E.B. - General Brochure, Undated.

10. The Hashemite Kingdom of Jordan - Standard Specifications for the Construction of Roads and Bridges 1974.

11. Agency for International Development - Near East Bureau, Evaluation Guidelines, (NE/DP/Evaluation) August, 1984.

12. Agency for International Development - Technology Transfer Evaluation Baseline Survey of Three Jordanian Firms Capabilities March 1984

APPENDIX C

QUESTIONNAIRES UTILIZED IN THE BASE LINE SURVEY

QUESTIONNAIRES - FIRST INTERIM STUDY

QUESTIONNAIRES - JORDANIAN ENGINEERING FIRM

FIRST INTERIM EVALUATION

Questionnaire - Jordanian Consulting Firms

1. Name of firm.

2. How many projects of any type and size were completed in the last three years?

3. How many of the above projects were sanitary engineering projects?

4. Has the firm done any projects outside Jordan, and if so, where?

5. Who are your top three competitors?

6. Does your firm carry professional liability insurance?

7. What are your firm's strengths and weaknesses?

8. What do you feel is the reputation of your firm's reputation?

9. How do you rate your firm?

Prestige -	Will only do a quality job regardless of cost.
Leader -	Does quality work out control budgets carefully.
Me Too -	Follows along on advancements of other consultant firms. Watch budgets closely.
Price Competitive -	Prices low to get volume of work, and controls budgets rigorously.

10. Number of employees by engineering discipline and average number of years of experience?

11. Number of engineers, drafters, secretaries and clerical employees plus any other types of employees?

12. How many full time employees were hired for this project?

13. How many of these were kept as employees after completion of the project?

14. Average annual percent increase or decrease in fees for each of the last three years?

15. Annual percentage of fees (approximate) relating to Sanitary Engineering for each of the last three years?

16. Ratio of total current assets to total current liabilities?

17. Describe technical services and transfer of technology the U.S. subconsultant provided in project management, technical and others.

18. Are the management, engineering and drafting techniques taught by the U.S. subcontractor being used on any current projects?

19. How do you feel that your firm is better qualified now to manage projects than you were before this project?

20. Do you think the U.S. Subcontractor provided enough technology transfer, or could more have been provided?

21. Were equipment, reference materials, and course lectures notes provided by the U.S. subcontractor as part of this project. If so, please list major items.

22. Suggest any changes or additions you think would improve the technology transfer process.

23. Any pertinent comments and/or observations you would like to make on this project and its implementation?

24. Are you utilizing drafting standards?

25. Are you utilizing standard detail drawings?

26. Are you utilizing progress reports, scheduling, and cost reports on a regular basis?

27. How would you compare this work experience to previous work experiences with foreign firms?

QUESTIONNAIRE - U.S. CONSULTING FIRMS

FIRST INTERIM EVALUATION

1. Name of firm.

2. Identify and describe both tangible and intangible evidence of technology transfer obtained by the local firm as a result of this project.

3. Describe what training programs were provided to the local firm, both formal and informal.

4. What in your opinion are the training programs that worked and why; also what didn't work and why?

5. Identify any external influences that may have affected the technology transfer (either positively or negatively) on this project.

6. Suggest any improvements you would recommend to enhance the technology transfer process.

7. Provide any comments and/or observations you feel are pertinent to this evaluation.

QUESTIONNAIRE - GOVERNMENT AGENCIES

FIRST INTERIM EVALUATION

1. Name of government agency.

2. Do you feel that the technology transfer programs benefited the Jordanian consulting engineering firms? If so, in what ways, or how, were they benefited?

3. Describe how each of the consulting firms improved their managerial and technical capabilities during the project. (If they did improve in your opinion.)

4. What were the favorable and unfavorable aspects of the technology transfer programs employed by each of the U.S. subconsultants?

5. Do you feel these three Jordanian consulting firms are fully qualified to do similar design projects without foreign technical and managerial assistance?

6. Considering the changes from the WSC to the WAJ, were the projects completed on schedule and within budget?

7. Were the projects completed in a satisfactory manner?

8. How do you feel the country of Jordan, WAJ, the consulting firms and the individuals that participated on these projects will benefit from this technology transfer?

9. Do you feel each, or any, of the Jordanian consulting firms will utilize the managerial and technical skills learned during these projects?

10. What do you feel was (were) the most important skill(s) acquired as a result of these projects and the emphasis placed on technology transfer by USAID?

11. Do you know of any external factors that may have affected the technology transfer?

12. Indicate what you feel are the current strengths and weaknesses of each firm?

13. Suggest any changes or additions you think would improve the technology transfer process.

14. Any pertinent comments and/or observations you would like to make regarding this project and its implementation.

APPENDIX D

QUESTIONNAIRES UTILIZED IN THE CONSTRUCTION

SUPERVISION BASELINE EVALUATION

CONSULTANTS DATA SHEET

QUESTIONNAIRE - JORDANIAN FIRMS

CONSTRUCTION SUPERVISION BASELINE EVALUATION

1. Name of firm?

2. How many construction supervision projects of any size and type were completed in the last 3 years?

3. How many of these were comparable in size and complexity to this project?

4. How many of these were sanitary projects?

5. Were these projects all designed by you, or designed by others?

6. Has the firm undetaken any construction supervision projects outside of Jordan? If so, where?

7. Who are your top 3 competitors for construction services?

8. What are the strengths and weaknesses of your firm relative to construction supervision?

9. What do you feel is the reputation of your firm? How would you rate your firm:

   Prestige - Will only do a quality job regardless of cost.
   Leader - Does quality work but controls budget carefully.
   Me Too - Follows along on advancements of other consultants. Close control on budget.
   Price Competitive - Low prices to get volume of work and rigorous control of budgets.

10. Number of personnel with construction supervision experience and average number of years of experience?

11. Total number of employees by classification/discipline?

12. How many employees were (will be) hired for this project?

13. Does your firm carry professional liability insurance?

14. Ratio of current assets to current liabilities?

15. Average percentage of fees for last 3 years for construction supervision?

16. Average annual percentage of increase (decrease) in fees for last 3 years?

17. How were your past relationships with; clients, contractors, and designers (if done by others)?

18. What test equipment is available in-house?

19. Will you do materials/soils testing in-house, or will you utilize an outside service?

20. What testing standards and material standards do you have in your library?

21. Do you have a company construction manual and/or a company standard procedures manual?

22. Do you have an established:
    - Policy to handle correspondence?
    - Documentation system?
    - Policy for handling submission?
    - Policy for handling change orders?
    - Procedure for preparing and reviewing progress payments?
    - Testing plan and manual?

23. Do you normally perform minor materials and soils testing in the field (ie: concrete slump, entrained air, compaction and moisture content)?

24. Do you conduct pre-construction meetings and regular construction meetings? Are written minutes made of all meetings?

25. Do you normally initiate projects in a timely fashion and complete within budget?

26. Have you selected your construction manager for this project? If so, please provide bio-data information.

27. What do you hope to gain through the transfer of technology from the US subcontractor?

QUESTIONNAIRE - GOVERNMENT AGENCIES

CONSTRUCTION SUPERVISION BASELINE EVALUATION

1. Reputation of each of the three firms with respect to: the firm in general, the management of the firm, the quality of their construction managers, and the quality of their construction supervision?

2. How many construction supervision projects has each firm completed for your agency in the last 5 years?

3. To the best of your knowledge were all of the above projects completed in a satisfactory manner?

4. Were they initiated in a timely fashion?

5. Were they completed within budget?

6. Were you supplied with complete documentation? If so, was the documentation submitted promptly following the completion of construction?

7. How would you rate the quality of the following for each firm:

   Construction managers
   Resident engineers and inspectors
   Construction supervision record keeping and documentation

8. Indicate what you feel are the strengths and weaknesses of each firm relative to construction supervision.

9. Indicate what, in your opinion, each firm should try to acquire (or improve) through the transfer of technology from the US subcontractor.

CONSULTANTS DATA SHEET

Firm Name ______________________________

1. Percent of fees from sanitary engineering designs.
   Last year: Previous year: Year before previous:

2. Percent of fees from construction supervision.
   Last year: Previous year: Year before previous:

3. Percent of increase (decrease) in total fees.
   Last Year: Previous year: Year before previous:

4. Employees/classification, discipline/experience.

Class/Discipline	No. of Employees	Avg. Yrs of Experienc
Sanitary		
Civil		
Mechanical		
Electrical		
Structural		
Architects		
Soils Others	Not Applicable	
Construction:		
Const. Mgrs:		
Resident Engrs.		
Inspectors		
Surveyors		N.A.
Designers		N.A.
Drafters		N.A.
Other Technical		N.A.
Administrative		N.A.
Clerical		N.A.
Others		N.A.
Total		N.A.

5. Percent of total fees paid to outside consultants.
   Last Year: Previous Year Year before Previous

APPENDIX E

GENERAL CONTRACT REQUIREMENTS FOR CONSTRUCTION SUPERVISION

GENERAL CONTRACT REQUIREMENTS FOR CONSTRUCTION SUPERVISION

1. The Consultant shall provide services during the construction of the Works so as to ensure, within the limits of this Agreement, and as defined in the construction contract(s), that the Works are executed in accordance with the contracts between the Employer and the construction contractors.

2. The Consultant shall provide the site staff necessary for administering the construction of works for such periods as may be required; additionally, the Consultant shall arrange for visits by senior members of the firm and other specialists at regular intervals, to ensure that the duties required of the resident staff are being properly performed, the construction of works properly supervised or for any other necessary reason.

3. The Consultant is expected to examine the proposals put forward by each contractor for the performance of his contract as to their adequacy, shall comment thereon to the contractor and make recommendations to the Employer.

4. The Consultant is expected to give all necessary instructions to contractors, providing that the Consultant shall not, without prior approval of the Employer, give any instructions which, in the opinion of the Consultant, are likely to increase the contract amounts. If it is not practical for the Consultant to obtain such approval where, in his opinion, lives, property or the Works are in danger, or further delay would result in additional cost, he shall inform the Employer of his action as soon as is possible. The Employer's instructions to the contractors shall be through the Consultant.

5. The Consultant shall make final check and supervision of the location of junctions for house connections to the plot boundaries.

6. The Consultant shall perform any services which he may be required to carry out under any of the contracts for the execution of the Works, including, where appropriate, the witnessing of normal tests and the commissioning of the Works.

7. The Consultant shall advise the Employer as to the need for inspection during manufacture and prior to shipment of the various materials to be supplied in accordance with the contract and shall, if so required by the Employer, obtain tenders for such inspection from qualified agents and make such recommendations as may be appropriate.

8. The Consultant shall from time to time and on completion of the Project, with the assistance of his site staff, arrange for the proper measuring and determining of the quantity of work completed and compute its value. He shall certify that the work has been carried out in accordance with the requirements of the contracts or indicate any work that has not been so carried out.

9. The Consultant shall from time to time and on completion of each contract, certify to the Employer the value of the Works completed and the amount due to each contractor in accordance with his contract.

10. The Consultant shall submit monthly site reports not later than the 10th of the month following, indicating the progress made since the submission of the previous report and to comment on the progress to date in relation to the agreed programme. The reports shall indicate the approximate value of the Works completed and any problems which may require the attention of the Employer.

11. Additionally, the Consultant shall submit a quarterly report dealing more fully with the progress and commenting on the contractors' performance and whether completion of the Works is likely to be advanced or delayed, and whether circumstances have arisen such that the cost is likely to be materially affected.

12. On completion of the Works the Consultant shall deliver to the Employer certified final record drawings (based on contractor's 'as-built' drawings) and such records, operation and maintenance manuals and instructions regarding the Works as are reasonably necessary.

13. The Consultant shall promptly examine and prepare recommendations on claims from the contractor for extensions of time, payment for extra work and other similar matters, and to negotiate with contractor on the rates for any unscheduled items or work which arise and submit recommendations on these to the Employer.

14. The Consultant shall prepare a training plan, including training of future operations and maintenance personnel during the construction phase and on-the-job training as may be required during the start-up and early phase of operation of the wastewater treatment facilities.

15. The Consultant shall assist the Employer on a periodic basis, as may be required, in reviewing and assessing the operation of the wastewater treatment facilities during the maintenance period. The Consultant shall conduct the final maintenance inspection and prepare a final report for presentation to the Employer.

APPENDIX F

PROJECT ORGANIZATIONAL CHART

AND

PROPOSED TECHNOLOGY TRANSFER METHODS

AND

SUBCONTRACT SCOPES OF WORK

PROJECT ORGANIZATIONAL CHART

AND

PROPOSED TECHNOLOGY TRANSFER METHOD

AND

SUBCONTRACT SCOPE OF WORK

FOR

ARABTECH CONSULTING ENGINEERS

AND

CH2M HILL INTERNATIONAL

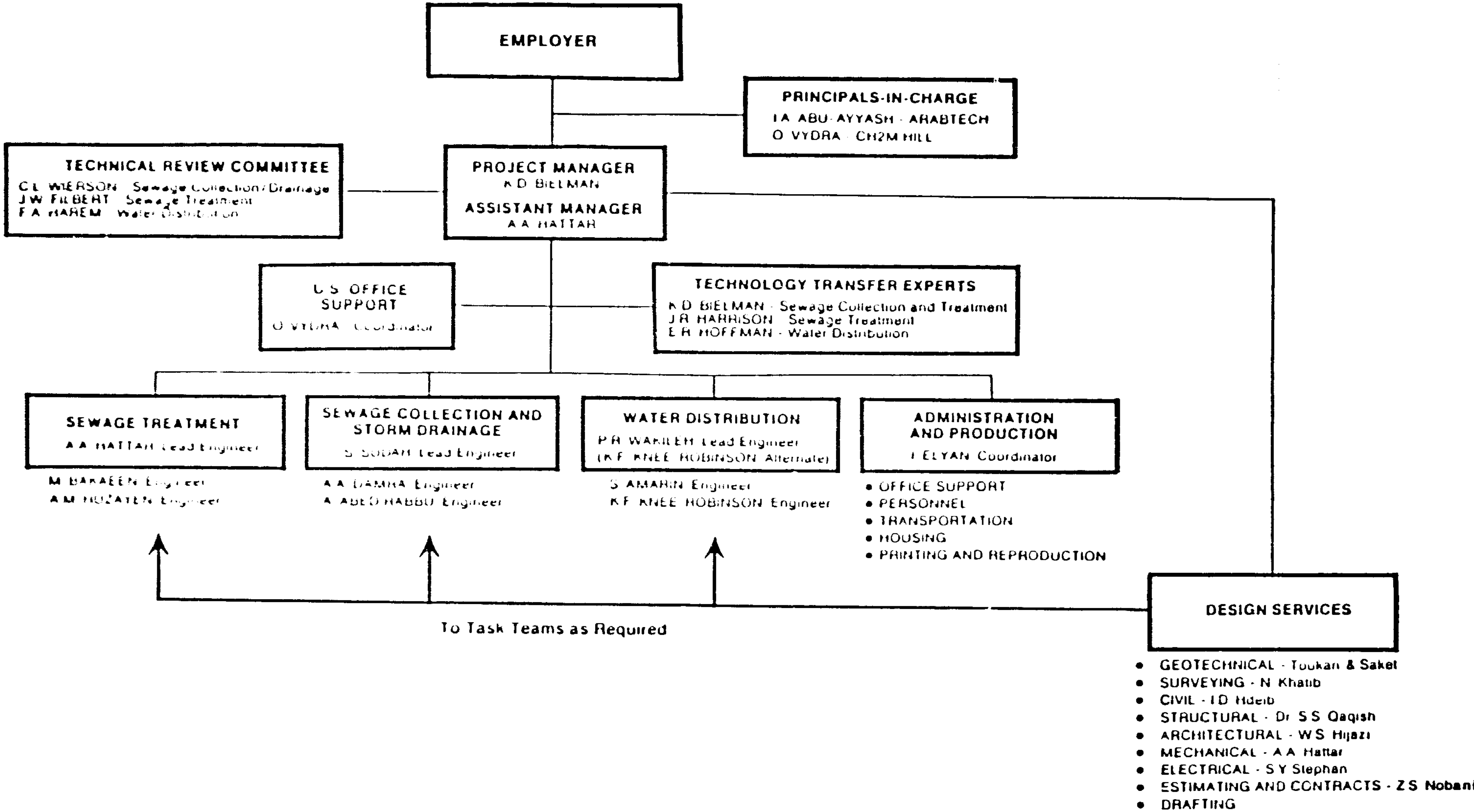

FIGURE C-1
ORGANIZATION CHART
SOUTHERN CITIES

Section D
TECHNOLOGY TRANSFER

An excellent way to exchange technical information is for those who need experience to not simply observe but to actually bring a design or study to a successful conclusion. The cooperative effort between CH2M HILL and ARABTECH provides an opportunity for Jordan to import learning experiences from the United States in the areas of water, sewage, and storm drainage design and project development. The CH2M HILL staff assigned to this project can provide study, design, and supervision experience. Complementing this, ARABTECH engineers have strong backgrounds in local Jordanian practices, geology, storm water, construction needs, and basic civil engineering disciplines that must have a major input in the final engineering product. The joint effort between ARABTECH and CH2M HILL will complement both firms' expertise, bringing the projects to successful, timely completion and benefit all involved.

For the technology transfer to be successful, one of the most critical items will be the assignment of the staff members actively working on the project, especially those from CH2M HILL who will be located in Jordan and working directly with ARABTECH in Amman. Other important aspects will be on-the-job training, management and project reviews, and operator training and assistance. These areas essential to successful technology transfer are discussed below.

STAFF SELECTION

The specific CH2M HILL staff members selected for assignment in Jordan have been carefully chosen. Section F of this proposal contains the complete resumes of these individuals and alternate and backup personnel. Kenneth Bielman, the proposed project manager, is a manager with international experience in water supply and distribution, and sewage collection and treatment. Sewage treatment is the engineering specialty most impacted by the need for technology transfer. Mr. Bielman's project guidance in both technical and managerial fields will be of great benefit to the professional staff of both the Employer and our partner, ARABTECH. Lessons best learned are those acquired in the day-to-day development of engineering works to meet specific needs. Mr. Bielman will involve senior and junior ARABTECH staff on the project team and include them in the philosophic and practical application of engineering principles to municipal utility system design. Specialists in the areas of water distribution and sewage treatment will also be assigned to assist the ARABTECH staff. All three CH2M HILL staff members will be in Jordan through most of the 20 percent design efforts. In final design, technology transfer efforts will change course and the ARABTECH staff will gain engineering experience related to the specialty areas by doing most of the final design. Mr. Bielman will remain in Jordan throughout the project's duration to assist in project design and review.

Additional opportunity for technology transfer will occur during final design review of the two projects. The first designs completed, either Tafila or Karak, will be reviewed at CH2M HILL's home office. Two ARABTECH team members will travel there to participate in the review process. The second designs completed, for either Ma'an or Madaba, will be reviewed in Amman. CH2M HILL water and sewer experts will contribute their review comments at ARABTECH's office there. The task and manpower summaries given in Figures E-1 and E-2 illustrate the scheduling of these staff members.

The selection of ARABTECH as the Jordanian firm to receive additional training and experience in water distribution, wastewater treatment, and stormwater drainage will greatly enhance the technical capabilities now available in Jordan. Since ARABTECH provides services almost exclusively within Jordan, its newly-gained knowledge is likely to be available for additional projects in Jordan rather than exported to other countries.

ON-THE-JOB TRAINING

CH2M HILL staff members will be located in Amman to work closely with ARABTECH engineers in preparing the 20 percent design materials. Since preliminary engineering work on the Tafila or Karak project will precede similar efforts for Ma'an or Madaba, the ARABTECH staff will be able to execute the latter project with less assistance from CH2M HILL. The close succession of the engineering efforts associated with Tafila and Ma'an will be ideal for technology transfer. Engineering tasks that required greater CH2M HILL involvement on the Tafila project will be repeated more quickly in the Ma'an project, with the ARABTECH engineers now able to apply the information previously learned. A similar succession of observation and team engineering on the first project, followed by ARABTECH taking a lead on the second project, could occur at Karak and Madaba.

In addition to their personal reference materials, the CH2M HILL specialists in Jordan will use design-oriented literature and reference material developed throughout the years by CH2M HILL engineers. These study and design guides will remain with the ARABTECH staff for use on future Jordanian projects.

Another technology transfer tool will be the use of weekly project meetings. Planned are meetings lasting from 2 to

111

3 hours in duration. Project status and near future planning will be the first topics to be discussed. During the meetings, the ARABTECH team leaders, with assistance of CH2M HILL experts, will review major design decisions, problems, and solutions. CH2M HILL staff members will also be available to assist in the review and explanation of design theory and principles as needed. The CH2M HILL staff members will prepare a tentative schedule of topics to be covered and review this with the Employer. Also, slides and other visual aid material will be supplied by CH2M HILL for use at the discretion of the ARABTECH staff. The ARABTECH engineer who actually develops and presents these materials (with the assistance and guidance from CH2M HILL) will prepare either brief notes or a memorandum. These written materials will be collected in a DESIGN GUIDE notebook. A limited number of the design guide notebooks will be made and supplied to the Employer at the time of project completion.

MANAGEMENT AND PROJECT REVIEW

Formal reviews are planned at 20 percent completion and at the final stages of design work. These reviews are an excellent opportunity for the work of individual engineers to be reviewed and analyzed by senior consultants not closely associated with the day-to-day project design. This enables the management team to examine the engineering work from an independent perspective and to remain objective as they look for areas of possible improvement. By having interim design reviews, technology transfer will be enhanced and a better final engineering product will be obtained.

CH2M HILL has assigned three of their leading specialists to the Technical Review Committee (TRC). The TRC members will be in charge of the formal review process; however, the individual members will be familiar with the principal design aspects of the project from its beginning and will be available to consult with the design team at any time during the project progression.

OPERATOR TRAINING AND ASSISTANCE

Part of the 20 percent design document will be a description of the plant operation. This will help in the final detailed design, and ensure that when the facility starts operation, the necessary flexibility, equipment, and processes will be available for complete operation. The best way to transfer the engineering technology to successful operation is to have the design engineer complete brief operating instructions while the design proceeds. These instructions can be compiled and refined at the conclusion of the design project.

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PROJECT ORGANIZATIONAL CHART

AND

PROPOSED TECHNOLOGY TRANSFER METHOD

AND

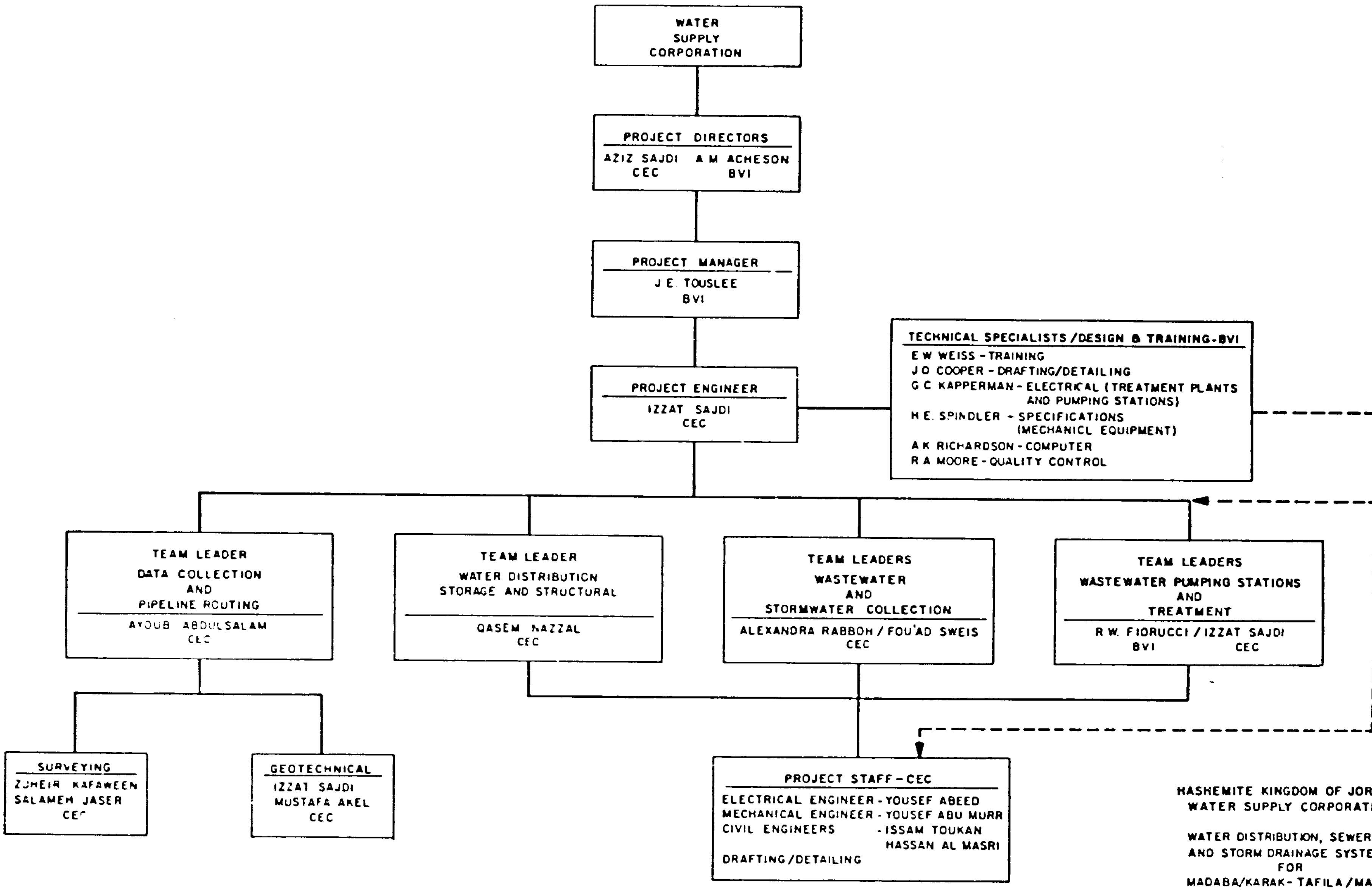
SUBCONTRACT SCOPE OF WORK

FOR

CONSULTING ENGINEERING CENTER

AND

BLACK & VEATCH INTERNATIONAL



HASHEMITE KINGDOM OF JORDAN
WATER SUPPLY CORPORATION

WATER DISTRIBUTION, SEWERAGE AND STORM DRAINAGE SYSTEMS FOR MADABA/KARAK-TAFILA/MA'AN

EXHIBIT 4-1

ORANIZATION CHART FOR DESIGN

CEC/BVI

SECTION 2 - TECHNOLOGY TRANSFER AND TRAINING

One of the significant objectives of the project is to strengthen the managerial and technical capability of Jordanian engineering firms. This section discusses the approach proposed by CEC/BVI for reaching this objective.

The aim of CEC/BVI is to insure that technology transfer and training are integrated into the basic processes of the project. The criteria for success in achieving this aim are: 1) that CEC will, at a later date, be able to carry out, without substanial external assistance, the activities essential to the effective completion of other projects of this type, and, 2) that CEC staff will have developed the capacity to apply a systematic planning and management approach that can be applied to a wide variety of project-related problems.

2.1 TECHNOLOGY TRANSFER

While there are many definitions of technology, for practical purposes in project development and implementation, it is advisable to interpret the idea of technology broadly. As one practitioner of many years' experience has said, "... the proper perception of technology by recipients really should be related to the <u>how</u>, <u>where</u>, <u>why</u>, <u>why-not</u>, <u>where-not</u>, <u>who</u>, and <u>when</u> of interactive services related to facilities and processes, not just the facilities and processes themselves."*

Seen in this manner, technology includes the systems, procedures, working methods, and "know-how" accumulated and developed by societies

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*John E. Robb, "What Is Technology Transfer?"

and organizations, in addition to the more narrowly defined hardware and products those societies and organizations develop. To insure the best possible transfer of technology, broadly defined, requires a collegial working relationship and full participation by all parties. This is the relationship proposed by CEC/BVI, and it is to be reflected in the working procedures established.

2.1.1 Proposed Method of Technology Transfer

Specifically, BVI staff will, from the inception and throughout each phase of the project, work closely with CEC to insure that CEC staff assigned to the project are fully involved in discussions, planning, and actions necessary to carry out the project. BVI specialists will work out a series of specific work assignments that will be carried out by CEC counterpart staff members. Progress in completion of these assignments will be closely monitored by the BVI Project Manager, as appropriate to the nature of each assignment. At least once weekly, and on other occasions if required, a staff meeting will be held to review problems encountered the previous week and the action plan of each person for the following week. This will help to insure that lessons of success are shared and that all staff are aware of conditions and actions of others that might affect their work. During the initial management training course, some tasks will have been focused on the development of the process and methods of "How to Run Successful Meetings," "Development of Individual and Group Work Plans," and "Monitoring Work Performance." This will be a further aid to bridging the gap from the training to the work environment, and insure that the CEC staff have management working tools to make the on-the-job technology transfer operate more smoothly and effectively.

Specific assignments in which the staff will be engaged will follow the sequence given in Parts 3.2 through 3.4 of the "Scope of Work of the Consultant" provided in the TOR and discussed in the Methodology Section of this Proposal. Designated BVI staff members, as appropriate, will have primary responsibility for monitoring the work assignments and providing assistance to one or more of the CEC staff.

2.2 TRAINING

Training and technology transfer will be woven into the project in several ways. It is emphasized that the training will be provided only to permanent, full-time CEC staff. It is not intended for part-time staff or occasional consultants, but to institutionalize a continuing capability with permanent CEC staff. First, CEC staff would participate in an intensive, in-country course with the BVI trainer to improve their management skills and to give them practice in team building/team management methods and processes. This initial training will provide CEC staff with the basic management tools that they will begin to apply to job-related problems during the training. Trainees will work out, with assistance from the trainer, procedures for setting and clarifying aims, establishing criteria by which to measure progress, devising work plans, working effectively as a group to accomplish assigned tasks, and, upon completion of each task, systematically reviewing what has been accomplished and problems encountered, in order to improve subsequent performance. One specific product of the training will be a monitoring method which CEC staff will subsequently use on the job to track work progress.

This initial course will set the stage for the effective transfer of technology that will take place throughout the project. Working in close cooperation with the CEC staff, the BVI Project Manager and technical specialists will insure that CEC staff are involved in each step in the planning and implementation of the project, as explained later in this section. This hands-on, intensive on-the-job training will continue on an individual and small group basis throughout the project. Midway through the project, the BVI trainer will return to Jordan to conduct a workshop in which management progress and problems to date will be reviewed and further tasks in skill development carried out. Project work plans will be reviewed, and CEC staff will draw up individual work plans that will serve as guidelines for their work for the remainder of the project. During the workshop, procedures will also be established for the CEC staff, under the guidance of the resident BVI project manager, to process and systematize their lessons of experience, and to compile them into a Manual of Procedures and Guidelines for the conduct of further work on similar projects.

2.2.1 Problems Commonly Associated with Training

Experience indicates that certain recurring problems have often thwarted the good intent of trainers and negated the effects of training. There follow some of the most insistent problems, and an indication of how CEC/BVI plan to deal with them.

* Lack of support from senior management

  Thorough discussions will take place, in advance of the actual training, between the top CEC/BVI management and the trainer regarding the training procedures. BVI project staff will know what to expect from the trainees, and how they can most effectively support them. Senior CEC/BVI project staff will also take part at specific points during the training, to work with trainees in developing systems and procedures that will be applied in implementing the project.

* <u>Training is too theoretical and not related to actual jobs</u>

The proposed training would be based, for the most part, on training tasks and exercises. Each task or exercise deals with a management problem of the kind that will be faced in implementing the project. In the training, however, the problems are somewhat simplified to encourage participants to apply a range of possible practices at lower risk than is found on the job, so they can determine which management practices work best for them. Trainees build up a "tool kit" of approaches used during training which they can then be helped to apply on the job. Tasks and exercises are given in a sequence, beginning with simpler ones and working into those that are more complex. Throughout, a "systematic approach to planning and implementing work" is used. This approach consists of setting and clarifying objectives, gathering information, establishing a work plan with specific measurable criteria for success, implementing the plan so that all group members are effectively used, and reviewing to learn how to improve performance on future jobs.

* <u>No transfer from training to job situation</u>

The Project Manager and technical staff are aware of the training approach and work with the trainer in insuring that the training meshes with the on-the-job training/technology transfer that will take place throughout the project. Further, each participant develops a specific plan for applying training to problems on the job.

* <u>No follow-up evaluation to make sure training works</u>

The mid-project evaluation and review is specifically designed to deal with this problem. Individual and group review will assure that participants are using the methods effectively, and that a continuing system of reviewing to improve is taking place. Individual work plans are reviewed and revised in light of experience.

* <u>Training not suited to conditions in developing countries</u>

This training approach has been tested extensively in Liberia, Egypt and Nepal, and refined in training courses with managers from other countries of Asia, Africa and Latin America. It is continously reviewed in light of experience and modified to fit local conditions. After basic management principles are learned, through a learning-by-doing approach, tasks are more and more oriented to the kind of problems encountered on the job, and not from "canned" materials developed elsewhere.

In summary, then, the initial management training course and mid-project workshop will enable the CEC staff to:

* Utilize a common, practical method and terminology applicable to problems encountered on the job;

* establish aims, criteria for success, and a means of monitoring progress for all types of work activity;

* coordinate, supervise, and review the work of others whose specialized inputs are necessary for a project or program; and,

* work together effectively as a management team.

PROJECT ORGANIZATIONAL CHART

AND

PROPOSED TECHNOLOGY TRANSFER METHOD

AND

SUBCONTRACT SCOPE OF WORK

FOR

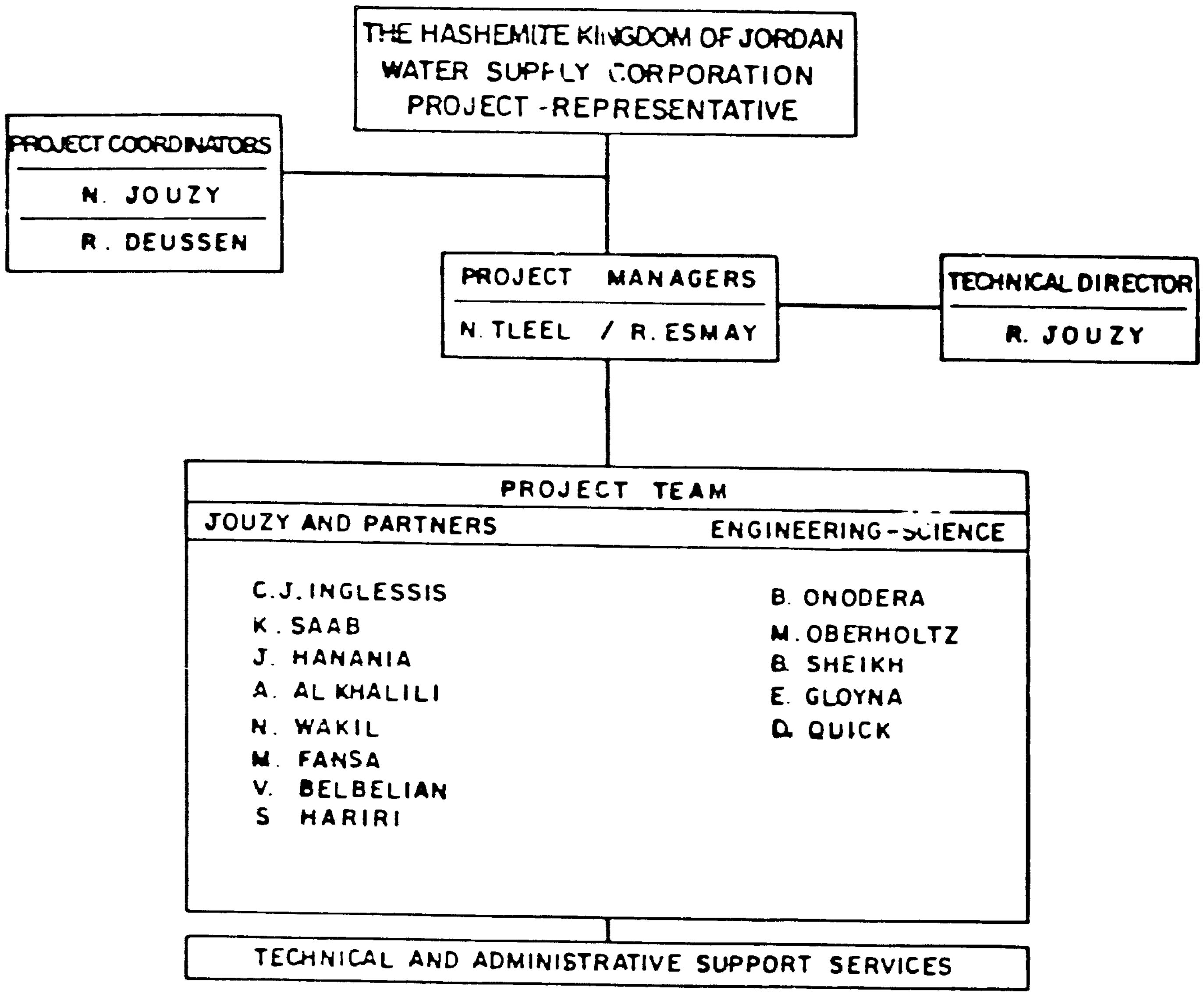
JOUZY AND PARTNERS CONSULTING ENGINEERING BUREAU

AND

ENGINEERING SCIENCE INC.

STAGE I – PRELIMINARY ENGINEERING DESIGN AND DETAILED DESIGN AND TENDER DOCUMENTS AND PREQUALIFICATION AND PRE-CONTRACT SERVICES

PROPOSED ORGANIZATION



TECHNICAL AND MANAGERIAL TRAINING AND UPGRADING OF THE JORDANIAN ENGINEERING FIRM TO BE PROVIDED BY ENGINEERING-SCIENCE, INC.

Engineering-Science (ES) will accomplish technology transfer to the Jordanian engineering firm of Jouzy and Partners in the fields of sewerage treatment, pumping, instrumentation technology and environmental assessment, financial and economic analysis through: on-the-job training; management improvement; optional training in the U.S.A.; and training of operation and maintenance personnel. The general approach to accomplishing technology transfer is described in the following paragraphs.

On-the-Job Training

During the engineering, design and supervision of construction phases of the project Engineering-Science will provide support staff for on-the-job training of Jordanian personnel as follows:

(1) ES will evaluate with the Jordanian associate the ES support staff needed in the fields of sewage treatment, pumping, instrumentation technology and environmental assessment.

(2) Following this analysis, and in the fields mentioned above, Jouzy and Partners (J & P) staff will work under the guidance and supervision of FS staff.

(3) Where the analysis indicates a need for skills which are not available within the J & P organization, recommendations will be made to train certain personnel in these skills.

(4) Emphasis during on-the-job training will be placed on the methodology for applying state-of-the-art technology to the resolution of engineering design for specific elements of the project consistent with local construction practice and availability of materials and equipment. ES staff personnel will work closely with Jordanian personnel to accomplish state-of-the-art technology input into the project.

(5) Jordanian individuals assigned to the engineering and design phase of the project will be monitored to determine ability for project management, staff administration and production supervision. The scheduling of work, reporting of work accomplished and the use and preparation of, where appropriate, subcontracts. Schedule and budgetary controls will be mutually developed and monitored by the ES staff member, and his Jordanian counterpart to ensure that their assigned work is completed in a timely manner, coordinated with the related engineering disciplines, and prepared to professional standards consistent with the terms of the contract and within budget.

(6) Project planning procedures will be defined for the Jordanian personnel to indicate its importance to the technical and fiscal control of the work, preparation, review and checking of plans and specifications, construction contract documents and cost estimates. The preparation, need for and use of basis of design information will be stressed as the forerunner to successful project planning.

(7) A records program will be initiated in the early phases of the project. Jordanian personnel will be integrated into the program from its inception.

(8) Those Jordanian individuals who have demonstrated advancement during the engineering and design phase will be encouraged to progress on other projects within the J & P organization and new individuals will be phased into the project to maximize personnel training.

(9) As construction is completed on specific elements of the project the Jordanian personnel will be integrated into operational check-out and acceptance testing. ES personnel will work with assigned Jordanian personnel to transfer the methodology for accomplishing these activities to the mutual benefit of the client and consultant as well as the contractor.

Management Improvement

During the progress of the work, ES staff personnel will interface with their Jordanian counterparts as well as the management of J & P organization. This will provide the ES staff with the opportunity to observe and evaluate the Jordanian engineering organization with respect to organizational structures, management administration and fiscal control of work and compare these features with those of the U.S.A. engineering firm. The approach for management improvement is as follows:

(1) Review organizational structure and evaluate personnel assignments with respect to academic training, professional proficiency and proficiency development in assignment. Meet with the management of the J & P organization and discuss the results of the review and discuss management observation for consideration by the J & P engineering

organization.

(2) Observe company approach to personnel administration as evidenced by Jordanian personnel assigned to the project. Evaluate what impact company policy has on personnel attitudes and productivity. ES will concentrate on the effects and impact of company policy on the professional attitude and development of individuals.

(3) As work proceeds on the project the ES staff will be cognizant of the schedule and budget controls of the J & P engineering organization. This will enable the ES staff to compare these controls with those of their parent U.S.A. company. Where applicable recommendations will be made to improve schedule and budget controls so as to provide management of the J & P organization with better visibility of the status of a project.

Optional Training in the U.S.A.

ES has conducted numerous training programs in the United States for engineers, administrators, and managers from other countries. Many of training programs have included both ES' local associate staff members as well as personnel from client organizations. ES is prepared and would be pleased to arrange such programs for selected personnel of J & P engineering organization and WSC in order to ensure appropriate technology transfer so that future projects to be designed, and subsequently constructed, will be properly implemented and operated. Such programs could at the discretion of the J & P engineering organization and/or WSC be structured to include academic work correlated with office work related to the production of plans, specifications, contract documents and cost estimates.

Training of Operation and Maintenance Personnel

ES staff personnel will assist the J & P engineering personnel and WSC in the development of a program for the training of operation and maintenance personnel. The general approach to providing this assistance will be as follows:

(1) Prior to the preparation of a training program by Jordanian personnel, an ES training specialist will

review the requirements of the training program with the Jordanian personnel. This review will focus on classroom work, hands-on experience, preparation of text materials, use of manuals and personnel assignments. The ES training specialist will monitor the initiation of work by the Jordanian engineering personnel.

(2) Training curricula and text material prepared by the Jordanian personnel will be reviewed by the ES staff and recommendations for changes where appropriate, will be discussed with the Jordanian personnel.

(3) Initially classroom and hands-on training sessions will be conducted by ES staff personnel. Jordanian personnel will be phased into the program so that by the mid-point of the program Jordanian personnel are conducting the sessions and ES personnel are in a monitoring status.

(4) ES staff personnel will provide their Jordanian counterparts an outline of documentation required for facilities operation and maintenance. When the Jordanian personnel have completed drafts of operation and maintenance check lists, report forms, maintenance, records and operating logs, ES staff will review the material and discuss with the Jordanian personnel where changes are appropriate or required.

(5) When the training program is about two-thirds complete the ES training specialist will review the work accomplished to date by the Jordanian engineering firm, and WSC monitor classroom and hands-on instruction and assess proficiency acquired by the trainees. The ES training specialist will discuss his findings with the Jordanian engineering personnel and mutually develop remedial measures where appropriate and if necessary.

PROFESSIONAL SERVICES SUBCONTRACT AGREEMENT BETWEEN CONSULTING ENGINEERING CENTER AND BLACK & VEATCH INTERNATIONAL FOR FINAL DESIGN AND CONSTRUCTION SUPERVISION OF WATER DISTRIBUTION IMPROVEMENTS AND SEWERAGE AND STORM DRAINAGE SYSTEMS IN THE CITIES OF KARAK & MADABA

This Subcontract Agreement is made and entered into between **CONSULTING ENGINEERING CENTER**, hereinafter called CEC, as the prime contracting party, having its principal offices in Amman, Jordan, and **BLACK & VEATCH INTERNATIONAL**, hereinafter called BVI, as the subcontractor, having its home offices in Kansas City, State of Missouri, USA.

1. BACKGROUND

The **WATER SUPPLY CORPORATION** of the Government of the Hashemite Kingdom of Jordan, hereinafter called the WSC, based on an Agreement dated 6 December, 1983, hereinafter called the Prime Agreement, has retained CEC as its prime consultant for the furnishing of the professional services, defined in the Prime Agreement, which are required in connection with final design and construction supervision for water distribution improvements, wastewater treatment plant, sewerage collection and storm drainage systems in the cities of Karak and Madaba, hereinafter referred to as the Project. A copy of the duly executed and approved Prime Agreement is attached hereto for reference. BVI was named as the designated foreign consulting engineering associate for the Project in the proposal submitted to the WSC by CEC, and BVI's participation on the Project in that role under subcontract to CEC, has been approved by the WSC and is properly acknowledged and covered in the Prime Agreement.

2. PURPOSE

The purpose of this subcontract agreement is to establish the proper contractual basis for BVI's participation in the Project as the designated foreign consulting engineering subcontractor to CEC.

3. SCOPE OF WORK

The scope of work to be carried out by CEC, with the participation of BVI as defined herein, is detailed in the Prime Agreement. The terms and the conditions of the Prime Agreement are incorporated by inference in this subcontract.

APPENDIX A

SCOPE OF SERVICES

The following items outline the scope of engineering services to be provided by SUBCONTRACTOR to CONTRACTOR for project management and design services for the water and wastewater systems in the towns of Tafila and Ma'an. This scope of services is based upon the requirements outlined in the Request for Proposals, the work scope defined in the proposal for engineering services dated June 28,1983, and subsequent amendments to the proposal regarding staffing, order of design sequence, etc.

It is the mutual understanding of CONTRACTOR and SUBCONTRACTOR that CONTRACTOR has complete and total responsibility for the management and final production of the design documents and the SUBCONTRACTOR shall be responsible for quality control and technology transfer through the provision of his experts and services as outlined hereunder . All work not outlined below, such as, but not limited to, surveying services, geotechnical exploration, drafting, reproduction, general office services , etc. shall be provided by CONTRACTOR .

TASK 1-- Project Management Services

A. SUBCONTRACTOR will provide the services of a senior project engineer for the preliminary and final design phases of the project to serve as the Management Advisor for the entire project and also as the lead design engineer for preliminary and final design of the sewage treatment plants. The Management Advisor will advise the Project Manager in developing a work plan, system of project accounts, design assignments, identification of specific design deadlines, and communications with CONTRACTOR and USAID .

B. The period of project services for the Management Advisor is estimated to be 7.8 Man-Months .

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J.A.A.

TASK 2 -- Preliminary Design Services

A. SUBCONTRACTOR will provide two senior design engineers to assist CONTRACTOR's designers in the areas of water storage and distribution and sanitary sewer collection treatment and transport systems . These positions will be filled by engineers working in CONTRACTOR's office through the period of preliminary design.

B. The senior design engineers will provide technical advice and project guidance to CONTRACTOR's lead engineers in the discipline areas hereinbefore identified as may be requested or required.

C. The senior design engineers and the Management Advisor will facilitate and make provisions for an in-depth process of technology transfer in the design areas of water systems and wastewater systems. They will also be responsible for the formal and informal process of technology transfer between SUBCONTRACTOR and CONTRACTOR in the area of Project Management.

D. The period of project service for the combined services of the two senior design engineers is estimated to be 5.5 man-months. It is estimated that the time will be evenly distributed between the water and wastewater systems' design.

TASK 3 -- Final Design Services

A. The Management Advisor provided by SUBCONTRACTOR per 1.A above will also serve as a lead engineer to direct design of the sewage treatment facilities. He will plan and direct the acitivites of the design team and provide technical and engineering management for

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J.A.W.

preparation of detailed plans and specifications, develop the design records' system, and coordinate quality assurance activities for the sewage treatment plants' design.

TASK 4 -- Project Review Services

The following items outline the services to be provided by SUBCONTRACTOR to assist in the review and finalization of the design packages for the towns of Tafila and Ma'an:

A. DESIGN PACKAGE FOR MA'AN: SUBCONTRACTOR will provide a technical review team to review the plans and the legal and technical specifications for the Ma'an design package. This design review committee will be responsible for technical excellence review and markup of the design plans and specifications. This review will be performed in SUBCONTRACTOR's home offices in the United States.

CONTRACTOR will provide two senior design engineers to work with SUBCONTRACTOR's technical review team in SUBCONTRACTOR's home offices to review the work done by the design teams in Jordan. CONTRACTOR will be responsible for final corrections and back-checking of the documents prior to their submittal to the owner.

B. DESIGN PACKAGE FOR TAFILA: SUBCONTRACTOR will provide two technical experts to assist with the final review of the legal and technical specifications and the plans for the Tafila design package. These individuals will assist the CONTRACTOR's lead engineers and other designers in a technical review of the plans and specifications, and assist in the markup and evaluation of the design. This review will occur in CONTRACTOR's Jordan offices.

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D. CONTRACTOR will provide the final fixup and plan revisions for preparation of the final contract documents to be submitted to the owner.

TASK 5-- Post Design Services

A. The Management Advisor will assist CONTRACTOR with final project details pertaining to preparation of final documents, prequalifications of tenderers, and analysis and evaluation of the tenders received for the construction projects .

Services and compensation related to stage II of client AGREEMENT " Supervision of Construction " shall be negotiated between CONTRACTOR and SUBCONTRACTOR in good faith pursuant to client request for the implementation of that stage .

TASK 6-- Home Office Services

A. SUBCONTRACTOR will provide home office technical and management support for the project as may be required by the project teams to insure timely project completion . These services and costs may include, but are not limited to, office supplies, phone , mail and telex services, administrative support and project work plan management .

APPENDIX A
SCOPE OF WORK

In the following Scope of Work, it is understood that ES will only provide for completion of matters relating to the sewage treatment plants and one pump station and only the process, mechanical and instrumentation design of water supply and sewerage systems and in preparation and presentation as required by WB and U.S.A.I.D. ES will also provide for the technical and managerial training and upgrading of J&P and its personnel through on-the-job and general training.

In addition, ES will assist J&P in the preparation of the preliminary design submittal.

Design and specifications will be prepared in accordance with World Bank Standards.

The Agreement signed 6 December 1983 between J&P and the WSC defines the Scope of Services for Final Design and Supervision and Stormwater Drainage Systems in Ramtha, Mafraq, Anjara, Ajloun, Ein Janneh and Kufrinja. Within Section 3 of the referred Agreement, ES will perform the process, mechanical and instrumentation design and specifications for the work contained in the following sections:

SECTION	TITLE
3.1 (i)	Sewage Treatment Facilities for Ramtha.
3.1 (i)	Sewage Treatment Facilities for Mafraq.
3.1 (ii)	Pumping Stations with Standby Pumps and generators for Mafraq and Ramtha if required.
3.1 (i)	Regional Sewage Treatment Facility Serving Anjara, Ajloun, Ein Janneh and Kufrinja
3.2 (vi)	Review Wastewater Treatment Processes, Sizes, and designs for the Sewage Treatment Plants.
3.2 (vii)	Detailed Treatment Plant Design Computations.
3.2 (ix)	Prepare Update Cost Estimate for Treatment Plants.
3.3 (i)	Prepare Detailed Designs for the Treatment Plant and the Mafriq Pumping Stations and Ramtha P.S. if required.
3.3 (iii)	Design Appropriate Facilities for Reuse of Treated Wastewaters.
3.3 (iv)	Prepare Detailed Working Notes and revised cost estimates for the treatment plants, Ramtha and Mafriq Pumping Stations and Reuse Facilities.

SECTION	TITLE
3.3 (vi)	Prepare bid packages for the construction of the Treatment Plants, Mafraq Pumping Station and Reuse Facilities.
3.3 (viii)	Submit Draft Detailed Drawings, Specifications, Tender Documents, and detailed working notes for the process, mechanical and instrumentation within 180 days from the effective date of the letter of intent for the treatment plant and reuse facilities serving Anjara, Ajloun, Ein Janneh and Kufrinja; 240 days for Treatment Plant and reuse facilities in Ramtha; and 300 days for Treatment Plant reuse facilities and pumping station in Mafraq.
3.3 (ix)	Revise all documents listed in 3.3 (viii) above within 30 days of receiving WSC Comments.
ANNEX I	Technical and Managerial Training and Upgrading Program.

In addition to the above, ES will assist J&P in completing other tasks, noted in the referred contract agreement, as requested by J&P, to the extent staff is available in Jordan or can be accomplished by telex.

AGREEMENT BETWEEN

JOUZY AND PARTNERS

AND

ENGINEERING-SCIENCE

FOR CONSULTING SERVICES RELATED TO

RAMTHA, MAFRAQ, ANJARA, AJLOUN,

EIN JANNEH AND KUFRINJA

APPENDIX A
SCOPE OF WORK

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3.3 (ix)	Revise all documents listed in 3.3 (viii) above within 30 days of receiving WSC Comments.
ANNEX I	Technical and Managerial Training and Upgrading Program.

In addition to the above, ES will assist J&P in completing other tasks, noted in the referred contract agreement, as requested by J&P, to the extent staff is available in Jordan or can be accomplished by telex.

APPENDIX G

INVITATION TO BIDDERS

THE HASHEMITE KINGDOM
OF JORDAN
WATER SUPPLY CORPORATION
AMMAN
Tel. 44215 -- 44216
Telex : 1698 Water Jo
P. O. Box 5012
Cable Add. (WATER - JORDAN)

بسم الله الرحمن الرحيم

المملكة الاردنية الهاشمية
مؤسسة مياه الشرب
عمان
تلفون ٤٤٢١٥ - ٤٤٢١٦
تلكس ١٦٩٨
ص.ب ٥٠١٢
العنوان البرقي : (ووتر - الاردن)

Ref. No. .... الرقم ....

Date /4/1983 التاريخ ....

Dear Sirs,

The Government of Jordan is seeking the services of two suitably qualified, local consulting engineering firms for final design and supervision of construction of water distribution, sewerage and stormwater drainage systems as follows:

Package No.1 - Tafila and Ma'an, Jordan
Package No.2 - Karak and Madaba, Jordan

The local firm is expected to associate with a U.S. consulting engineering firm to enhance its technical capability in certain areas of specialty as explained in Enclosure III hereto.

Your firm is one of a selected short list which is being invited to submit proposals on the basis of Enclosures I and II, Terms of Reference and Sample Contract Agreement for Packages No.1 and No.2. Your proposals shall be submitted in three copies in a single envelope marked "SOUTHERN CITIES WATER DISTRIBUTION, SEWERAGE AND STORMWATER DRAINAGE SYSTEMS" in the lower left-hand corner. The envelope shall contain two sealed envelopes, marked "TECHNICAL PROPOSAL" and "FINANCIAL PROPOSAL" respectively, which shall contain but not necessarily be limited to the following information:

<u>Envelope I - Technical Proposal</u> (Single Proposal covering both Packages).

1. A detailed statement of the experience and qualification of your firm, providing information on: specific experience in preparing final design and supervision of construction of water distribution, sewerage and stormwater drainage systems; length of experience; location of prior related jobs, their size and estimated cost; information on size of professional staff; present work load; financial status of your firm; and any other pertinent information which will demonstrate the degree of qualification of your firm for the projects under consideration.

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2. Ditto, but for the U.S. consulting engineering associate.

3. A detailed description of the planned method of technology transfer and institution upgrading from your association with the U.S. firm as outlined in Enclosure III hereto.

4. A detailed description of the proposed method of carrying out the work for Package No.1 and Package No.2, with clear definitions of the professional effort and tasks to be performed by your firm and the U.S. associate for each Package. (Note: It is expected that all design work shall be accomplished in Jordan with the possible exception of some design review which may be accomplished in the home office of the U.S. associate).

5. A detailed listing of nominated staff of the association and their alternates, related to professional categories included in 3 and 4 above and their curriculum vitae. Separate listings shall be made for Package No.1 and Package No.2. (Note: Since no firm will be awarded more than one Package, some of the names on the separate listings may be common).

Envelope II - Financial Proposal

1. As the Employer expects to enter into contract agreements with the two selected consultants, proposers shall submit their proposals in detail in accordance with Annex I to Enclosures I and II, Terms of Reference and Sample Contract Agreement. Separate financial proposals shall be submitted for Packages No.1 and No.2.

2. The amount of professional effort required for Stage II, Supervision of Construction, will be negotiated if mutually agreed between the Employer and the consultant prior to issuance of an authorization to proceed with that stage.

Those firms receiving Requests for Proposals are expected to make their own investigations and inquiries before submitting their proposals. A copy of the Project Feasibility Study will be available at the Water Supply Corporation for background information.

Technical proposals will be evaluated against relevant criteria, including the methodology and approach to achieve the objectives expressed in Enclosure III hereto. The most responsive proposals will be selected for further consideration. The financial proposals of the firms submitting the most responsive technical proposals will then be opened. The technical and price proposals will be analyzed and evaluated together and the proposals will be ranked based on both technical and cost factors; however, the greater emphasis will be placed on the technical factor. The two top ranked firms will be invited by the Water Supply Corporation for negotiations expected to lead to a contract for one each of the two Packages. Should such negotiations be unsuccessful, discussions will be held with the next ranked firm.

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The proposals as outlined above shall be delivered to the Water Supply Corporation before 12.00 a.m. (noon) on 28 May 1983. Late proposals, whether delayed in the mail or for other reasons, will not be considered.

All correspondence regarding this invitation and the proposals shall be addressed to:

H.E. Director General
Water Supply Corporation
P.O.Box 2012
Amman, Jordan.

Yours faithfully,

Yasin El-Kayed
Director General

Enclosure III (Revised)

WATER SUPPLY CORPORATION

HASHEMITE KINGDOM OF JORDAN

WATER SYSTEMS AND SERVICES MANAGEMENT

The Water Supply Corporation is seeking proposals for professional services for a Water Systems and Services Management Project in Jordan. Proposals will be accepted only from a list of preselected Jordanian engineering firms. Each of the Jordanian firms will be required to establish a relationship with a United States engineering firm, with the latter serving as sub-consultant. The services will include the design and supervision of construction of municipal water and wastewater facilities for certain Jordanian cities. The design and supervision elements of the project will serve as the primary training vehicle for institutional input from the United States engineering firms for improving the technical and managerial capability of the Jordanian engineering firms. Firms submitting proposals should bear in mind that the Water Supply Corporation attaches importance to both project components - the design and related services and the institutional enhancement. In this regard, it is a project objective not only to complete the design and related services but also to develop the capability of the contracting firms to the point where they can effectively compete for future sanitary engineering contracts.

Initially, two contracts will be awarded by the Water Supply Corporation for final designs of municipal water and wastewater systems for the following four Jordanian cities: (1) Karak and Madaba and (2) Tafila and Ma'an. It is expected that the design contracts will be amended to provide for construction supervision services at the appropriate time. The Water Supply Corporation will construct the systems in all four cities but first priority has been assigned to the construction of the systems for the cities of Karak and Tafila, under two or more separate construction contracts.

The Water Supply Corporation may request proposals for similar design and supervision services in other cities in Jordan; however, no assurances are offered in this regard.

During the course of design and supervision of construction, the U.S. engineering firm will be expected to provide technical and managerial training and upgrading of the Jordanian engineering firm and its personnel. Two categories of such training and upgrading are contemplated: (1) on-the-job training; (2) general training and management improvement not necessarily specifically or directly related to the design and supervision tasks.

Jordanian and United States engineering firms that wish to propose for these services will be required to form a relationship of the type specified above and to indicate in their technical proposal how the relationship that is formed will address the services requested herein. Both parties submitting a proposal must be established, working, consulting engineering firms with in-house capability in their own offices to carry out technical studies, engineering, and design. Each must have an adequate number of full-time, permanent staff of engineers, architects, draftsmen, surveyors, etc. Further, the Jordanian firm must have been prequalified by the Government of Jordan to participate in this project.

All of the design work will be done in Jordan with the possible exception of some design review which may be accomplished in the home office of the U.S. firm. Thus, a major share of the work will be performed by the Jordanian firm.

The contracts for this work are expected to be partially financed by the United States Agency for International Development (A.I.D.) under an agreement with the Government of Jordan. The terms and conditions of the contracts will substantially conform to the principles set forth in the sample contract format in the request for proposals. In addition standard A.I.D. requirements are expected to be included; these are contained in A.I.D. Handbook 11, Chapter 1, a copy of which may be inspected at WSC's Amman office.

Firms submitting proposals are advised that, in evaluation of their technical proposals, the WSC intends to assign approximately equal weight to the five categories of information listed in the transmittal letter requesting proposals.

APPENDIX H

CURRICULUM VITAE OF PROJECT MANAGERS

CURRICULUM VITAE

OF

PROJECT MANAGERS

ARABTECH CONSULTING ENGINEERS

AND

CH2M HILL INTERNATIONAL

ALI ADIB HATTAR

PROJECT ASSIGNMENT	Lead Engineer -- Sewage Treatment Assistant Project Manager
POSITION	Chief Mechanical Engineer
EDUCATION	B.Sc. Mechanical Engineer, 1971
SOCIETIES AND HONORS	Jordan Engineers Association ASHRAE

PROFESSIONAL EXPERIENCE

1980 - Present

Arabtech Consulting Engineers. Chief Mechanical Engineer. Responsible for design and supervision of mechanical HVAC and sanitary systems. Some of the most important projects he was in charge of are:

- Jordan Electricity Authority, Central Office Building
- National Archaeological Museum
- Jordan Valley Development Project, Phase II
- Amman Development Corporation, Prince Mohamad Street Car Park Project
- J.F.I. Facilities at Aqaba
- HVAC for Health Centers at Jordan Valley
- Social and Sport Centers at Jordan Valley
- Several Villas at Amman
- RIVCO, Housing Project at Sweifiya
- Ministry of Justice Housing Project

ALI ADIB HATTAR

1977 - 1980	M. A. Jardaneh Office. Chief of Mechanical Department. Responsible for design and supervision of mechanical and sanitary systems for buildings and industry; urban and water supply pipelines and pump stations, including:

- Sahab Industrial Estate
- Suwaga Water Supply Project
- Sumayya Water Supply Project
- Ein El Tannoun Water Supply Project
- South Amman Water Supply Project (Preliminary Study)

1972 - 1977 SNMETAL "Unite" Engineering, Algiers, Algeria. Mechanical Engineer, then Chief of Fluid and Thermodynamic Department and Chief of Project for 5 years.

DNC-ANP Unite' Bereg, Algiers, Algeria. Chief of Hydraulics and Thermodynamic Department for 1 year. Responsible for design, execution and supervision of fluid and thermodynamic systems for factories and annexes, i.e., water supply, drainage, rain water drain, compressed air and different gases, thermal insultion, vacuum system, water treatment. HVAC, for prevention and fighting, coordination between different services and establishment of contracts and specification for 11 factories, two polytechnique and several office buildings.

1981 - 1982 Preparing standards for RSS in Jordan for sanitary works of the Jordan Construction Code.

Member of committee to review Standards of Mechanical Works for the Jordan Construction Code.

■ KENNETH D. BIELMAN
Senior Project Director
Project Assignment: Project Manager

Education

B.S., Civil Engineering, Oregon State University

Experience

Mr. Bielman is currently completing a 2-year assignment as Deputy Project Director and Director of Engineering Services on the Alexandria (ARE) Sewerage Project. His work has encompassed the direction of engineering planning and design for a sewerage system to meet the needs of an estimated 5.3 million population including two major treatment plants of in excess of 500 Ml-per-day and a double 8-km sea outfall into the Mediterranean Sea. Included in the project are more than 20 pumping stations and some 200 km of sewers and force mains ranging in size from 200 mm to 3,000 mm. Estimated project cost is L.E. 1.6 billion.

Mr. Bielman has been resident in Egypt since March 1982, and is fully familiar with engineering practices in the Middle East. His work has entailed close contact with various international funding agencies and Egyptian ministries.

Prior to his assignment to Egypt, Mr. Bielman served as manager of the CH2M HILL Atlanta regional office from 1978 to 1982, where he was responsible for water and wastewater activities in the states of Georgia, Tennessee, and Kentucky. Water and Wastewater projects for which he served as principal in charge included:

West County Wastewater Treatment Plant for Louisville-Jefferson County Metropolitan Sewer District, Louisville, Kentucky, USA. This project involves the design of a 188,700 m^3/day secondary wastewater treatment plant serving industrial and residential land uses within the southwesterly sector of the Louisville metropolitan area.

North Wastewater Treatment Plant, City of Memphis, Tennessee, USA. This project consisted of design and operations of an analysis for a 377,000 m^3/day secondary treatment plant treating the wastes from a heavily industrialized portion of Memphis, Tennessee. Structural and operations modification brought the plant well within EPA discharge permit limitations.

U.S. Virgin Islands wastewater program for the Department of Natural Resources, Government of U.S. Virgin Islands, Saint Thomas, U.S.V.I. The Project consisted of conceptual planning, design, and services during construction for sewage service for the Cruz Bay region on the Island of Saint John. The project was complex because of the decision to renovate, relocate, and reuse abandoned treatment system components rather than following conventional procedures.

Harriman Wastewater Treatment Facility, City of Harriman, Tennessee. This project included design and construction services for a 38,000 m^3/day secondary treatment plant capable of treating high-strength, high-color industrial wastes mixed with domestic sewage. Sludge handling facilities, including land treatment alternatives, were included in the project.

Drainage improvements for the City of Atlanta, Georgia. The project involves conceptual design and ultimate construction of drainage improvements in a 64,000-feddan drainage basin. Ultimate improvements include over 160-km of open channel improvements and over 250-km of storm sewers up to 3.66 m in diameter.

Prior to 1978, Mr. Bielman served as Regional Manager of the CH2M HILL Denver regional office.

As Regional Manager, Mr. Bielman was responsible for the technical output for the newly established regional operation which grew to a staff of 55 people. Representative projects performed under his direction or as special technical consultant included:

Foothills Water Treatment Complex, Board of Water Commissioners, Denver, Colorado, USA. This project includes a 61-m, thin arch, double curvature dam, approximately 1,220 m of 3-m-diameter tunnel, a 472,000-m^3/day water treatment plant expandable to 1,887,000-m^3/day and 6 km of 108-inch transmission pipeline.

Denver Successive Use Program for the Board of Water Commissioners, Denver, Colorado, USA. This project consists of an initial 3,800-m^3/day pilot wastewater treatment plant to convert secondary sewage effluent into potable drinking water for direct reuse. Initial construction cost is US $15.2 million. The pilot plant consists of lime treatment and recarbonation, multimedia filtration, selective ion exchange for ammonia removal, activated carbon filtration, ozonation, reverse osmosis, and chlorine dioxide disinfection. The pilot plant precedes a 380,000-m^3/day full-scale plant.

KENNETH D. BIELMAN

Technical consultant for the Caroni-Arena Water Supply, Water and Sewerage Authority, Valsayn, St. Joseph, Trinidad, West Indies. The project consists of design and construction supervision of a US $150-million water supply system, including a pump-storage reservoir complex with a 100,000-m^3/day pump station, a 21-m-high earth fill dam with a capacity of 36 million m^3 storage volume and related appurtenances; a 275 000-m^3/day water treatment plant with a high head pumping station; 93 km of ductile iron pipeline ranging in size from 600 mm to 1,400 mm; three concrete and two steel reservoirs--one concrete reservoir is 45,400 m^3, the other four have capacities of 22,700 m^3 each; three pumping station, including one new 68,000-m^3/day pumping station, and modification and expansion of two existing pumping stations to increase the capacity by 40,000 and 50,000 m^3/day, respectively.

Technical Consultant for the North Oropuche and Northern Range Water Systems, Ministry of Finance, Port of Spain, Trinidad, W.I. This project consists of design and services during construction on water system improvements including: a diversion works on the North Oropuche River consisting of a concrete dam, 92,000-m^3/day raw water intake, 760-mm welded steel raw water pipeline which is 0.9-km long, and an electrical substation to power the pumps; a 92,000-m^3/day filtration plant on the North Oropuche River consisting of a concrete diversion dam, 92,000-m^3/day raw water intake pumping station, raw water transmission line, sedimentation-filtration plant, two 22,000-m^3 steel clear well reservoirs, control station, access roads, electrical substations, and transmission lines and appurtenances; a 1,900-m^3/day filter plant processing water from the Acono River source; a 3,800-m^3/day filtration plant for the Loango/Naranjo River water; two 11,450-m^3/day filtration plants for the Caura and Aripo River supplies; and diversions, intake pumping stations, pipelines, high service pumping facilities, and clear well storage reservoirs as required and 26 km of 1,065-mm transmission line and 24 km of distribution lines 150 mm to 900 mm diameter.

Professional Registration

Registered Professional Engineer: Oregon, Colorado, Wyoming, Georgia

Membership in Professional Organizations

American Consulting Engineers Council
Consulting Engineers Council of Georgia
National Society of Professional Engineers

KENNETH D. BIELMAN

Georgia Society of Professional Engineers
American Water Resources Association
American Water Works Association
Water Pollution Control Federation
Georgia Water and Pollution Control Association

Publications

"Point-Counterpoint; Water Utility Construction," Journal of the American Water Works Association, 1978.

"Management Information Systems for the Consulting Engineering Firm," Consulting Engineers Council of Colorado, 1975.

"Utility System Design for Developing Suburban Areas," County Commissioners Association of Oregon, 1960.

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CURRICULUM VITAE

OF

PROJECT MANAGERS

CONSULTING ENGINEERING CENTER
AND

BLACK & VEATCH INTERNATIONAL

Name : Izzat Aziz Sajdi

Degree : B.Sc Civil Engineering
: University of Salford - England, July 1980

Member : Jordan Engineering Association No. 2649

Training : August - October 1980 in Foundation Engineering Co. London - U.K. Soils Laboratory.

: October 1980 - February 1981

Title : Assistant Engineer
Employer : The Arab Community College
Work : 1. Supervising the works executed by the Contractor of the Arab Community College (total area 9000m2)

2. Quality Control

3. Design of simple structures such as retaining walls, roof slabs etc.

: February 1981 - Nov. 1981

Title : Soils Engineer at the Consulting Engineering Center C.E.E. soils lab.

Work : Carrying out site investigation to determine the safe bearing capacity of the soil and the ground conditions - Analysing lab. tests results to determine the relevant engineering properties of the site. Analysing field and lab. results to establish foundation design criteria.

: December 1981 - Present

Title : Civil Engineer
Work : Overall supervision on the design of wasterwater collection systems for Suweileh, Wadi Sir and Jarash (phase II).

RAY J. SELK

CIVIL ENGINEER

Mr Selk has served as resident engineer on the construction of sewers, lift stations, and oxidation ponds for Louisburg, Kansas. He assisted in field surveys and the preparation of plans and specifications for sewers and pumping stations in Grandview, Missouri, Billings, Montana, Johnson County, Kansas, Holland, Michigan, and Paragould, Arkansas. He also served as design engineer on new sewage treatment plants for Boulder, Colorado, Russellville, Arkansas, and Springfield, Ohio. As project engineer, he developed a 108-inch-diameter concrete-lined rock tunnel for Springfield, Ohio, and a 300 mgd pumping station for Dade County, Florida. Mr Selk model tested the Potomac Sewage Pump Station for the District of Columbia.

Water supply projects on which Mr Selk has served as design engineer or project engineer include those involving reservoir studies, field surveys, distribution studies, and preparation of plans and specifications for well fields, pipelines, pumping stations, storage reservoirs, and elevated tanks. Clients served include Cincinnati, Middletown, Springfield, and Troy, Ohio, Bay City and Zeeland, Michigan, North Little Rock, Arkansas, Evansville, Indiana, and the Indianapolis Water Company. Water treatment plant projects include the design and preparation of plans and specifications for Cincinnati, Troy, and Middletown, Ohio, Evansville, Indiana, the Indianapolis Water Company, the Mid-America Industrial District, [illegible] Wyoming, and Bogota, Colombia. He has also served as project engineer on a 60 mgd river intake and raw water pump station for Evansville, Indiana.

On natural gas projects, Mr Selk has served as resident engineer and assisted in preliminary field surveys and layouts for new gas distribution systems, pipelines, and regulating stations for the Illinois Power Company. He has made studies and reports on gas distribution systems and assisted in the preliminary studies for the design of a natural gas liquefaction plant for Memphis, Tennessee. Other experience includes assistance in financial appraisals of water, gas, and electric utility properties.

PERSONAL DATA

Nebraska University, B.S., Civil Engineering, 1955
University of Kansas, M.S., Environmental Health Engineering, 1967

Member ASCE, MSPE, NSPE, SAME, AWWA

Registered Professional Engineer: Indiana, Missouri, Ohio

Joined Black & Veatch 1955

RAY J. SELK
BLACK & VEATCH
ENGINEER/CIVIL-ENVIRONMENTAL DIVISION

SPECIALIZATION: Management of Design Engineering and Construction Coordination on Water Treatment Plants, Intakes, Pump Stations, Raw Water Supplies, and Storage Facilities

EDUCATION: University of Nebraska, Lincoln, Nebraska, B.S., Civil Engineering, 1955
University of Kansas, Lawrence, Kansas, M.S., Environmental Health Engineering, 1967

CITIZENSHIP: United States of America

PROFESSIONAL QUALIFICATIONS: Registered Professional Engineer: Missouri

YEAR JOINED BLACK & VEATCH INTERNATIONAL: 1955

PROFESSIONAL EXPERIENCE:

BLACK & VEATCH

Project	Location	Activity	Position	Year
Tunnels & Conduits	Cairo, Egypt	Review of plans and specifications	Engineer	1983
High Service Pump Station	Evansville, Indiana	Responsibility for management, design, plans, specifications, and resident inspection.	Project Manager	1982
Artesian wells, 37 km Pipeline, Storage Reservoirs, Chlorination & Instrumentation	Worland, Wyoming	Responsibility for management, design, plans, specifications, and resident inspection.	Project Manager	1981
Redesign 1.7 million m^3/d Wastewater Pump Station	District of Columbia	Responsibility for management, design, plans, and specifications including model testing.	Project Manager	1981
Water Supply Distribution & Treatment Study	Troy, Ohio	Responsibility for management.	Project Manager	1980
Water Treatment Plant Expansion	Cincinnati, Ohio	Responsibility for design, plans, and specifications for treatment plant expansion including a sludge disposal study, carbon study, new laboratory and office facilities.	Project Engineer	1975-1979
Raw Water Intake & Pump Station	Evansville, Indiana	Responsibility for design, plans, and specifications.	Project Engineer	1976-1979
1.36 million m^3/d Wastewater Pump Station	Dade County, Florida	Responsibility for design, plans, specifications, and resident inspection.	Project Engineer	1974-1978
Elevated Storage and Pumping Stations	Evansville, Indiana	Responsibility for design, plans, specifications, and resident inspection.	Project Engineer	1972-1976
Water Treatment Plant	Bogota, Columbia	Responsibility for design, plans, and specifications.	Project Engineer	1975-1976

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BLACK & VEATCH (Continued)

Project	Location	Activity	Position	Year
Water Distribution & Storage Facilities	Middletown, Ohio	Responsibility for design, plans, and specifications.	Project Engineer	1971-1974
Water Distribution & Storage Facilities	Troy, Ohio	Responsibility for design, plans, and specifications.	Project Engineer	1973-1974
Water Treatment Plant	Cincinnati, Ohio	Responsibility for design, plans, and specifications, and field construction.	Project Manager	1972-1973
Water Intake, Pump Station, and Treatment Plant	Indianapolis Water Company	Responsibility for design, plans, and specifications.	Design Engineer	1972
Pump Station	Greenville, South Carolina	Responsibility for design, plans, and specifications.	Design Engineer	1970-1971
Water Treatment Plant	Troy, Ohio	Responsibility for design, plans, and specifications	Design Engineer	1967-1969
Water Treatment Plant	Middletown, Ohio	Responsibility for design, plans, and specifications.	Design Engineer	1965-1967
Reservoir Study	Indianapolis, Indiana	Responsibility for design, plans, and specifications.	Design Engineer	1968
Sewage Treatment Plant	Boulder, CO & Russellville, Arkansas	Responsibility for design, plans, and specifications.	Design Engineer	1964-1965
Gas Distribution	Various locations in the USA and in Mexico	Responsibility for design, plans, and specifications.	Design Engineer	1963-1964
Gas Pipelines	Illinois	Construction	Resident Engineer	1961-1963
Various utilities	Various locations in the USA	Rate and appraisal studies	Engineer	1959-1961
Various Civil Engineering Assignments	Various locations in the USA	Responsibility for resident engineering for gas distribution projects, surveying for various projects, and rates appraisal for various utility projects.	Engineer	1955-1959

CURRICULUM VITAE

OF

PROJECT MANAGERS

JOUZY AND PARTNERS CONSULTING ENGINEERING BUREAU

AND

ENGINEERING SCIENCE INC.

NAJEEB F. TLEEL
Associate
Jouzy & Partners, C.E.B.

EXPERIENCE

1975 - Present

Jouzy and Partners
Consulting Engineering Bureau

Associate in Amman Office.

Associate worked on and responsible for the following projects:

The feasibility study, preliminary design of water supply, sewerage, stormwater and sewage treatment plants for five Cities North Jordan; Mafraq, Ramtha, Ajloun, Anjara and Ain Janneh.

The feasibility study, design and supervision of construction of water supply, sewerage, stormwater and sewage treatment plant and pumping stations for Zarqa - Ruseifa area which is about 500 sq.Kms.

The feasibility study, design and supervision of construction of the Mujib and Southern Ghors Irrigation Project. The collection and conveyance of the flood waters of Wadi Mujib and associated wadis, to irrigate and develop the agricultural region of the Southern end of the dead Sea, Jordan.

The feasibility study, and final design of infrastructure for three residential Areas in Aqaba which included about 60 km. of water mains and distribution system and about 60 km. of sewer collection system.

The design of water supply and sewage Collection System for three sites for Urban Development for low income groups at Qweismeh, Marka and N. Ruseifa., financed by world Bank.

The feasibility study, design and supervision of construction of Prince Ali Dam, 30 meters in Height, giving a potential storage of 6.8 million cubic meters that will serve to increase recharge of the upper acquifer and prevent potential flooding of downtown Amman, Jordan.

The design of wastewater disposal, stormwater drainage and sewage treatment plants for cities of Zarqa, Salt and Jarash, Jordan.

Design of Airfield at Jafr, incorporating runway, taxiways, apron, airbase, roads, water supply, sewage and sewage treatment works, Jordan.

The master plan and preliminary design of the Faculty of Engineering and Technology of the Jordan University covering an area of 5 hectares to include five departments of engineering: civil, mechanical, architectural, chemical and electrical.

1970 - 1975 Natural Resources Authority
Amman, Jordan

Director of Irrigation of Water Department. The work comprised the design, construction operation and maintenance of all irrigation projects in Jordan, including Jordan Valley Desert and Highlands projects.

Co-Manager of Development of Underground Water Project with UNDP, FAO. Also Director of Agriculture and Irrigation Department of Jordan Valley Commission 1973-1974, on secondment.

1965 - 1970

Natural Resources Authority
Amman, Jordan.

Director of Water Supply Department. The work comprised design, construction, operation and maintenance of all water supply projects in Jordan with the exception of Amman.

Major projects include:

Water Supply of Irbid and Northern District.

Water Supply, World Bank Finance; Zarqa Water Supply Project, World Bank Finance.

Salt Water Supply Project, Municipal Loan Fund.

Aqaba Water Supply Project, N.R.A.

South of Amman Water Supply, N.R.A.

Karak District Water Supply, N.R.A.

Central Jordan Valley Supply Project, N.R.A.

Sweilleh Water Supply Project, Municipal Loan Fund.

Ma'an Water Supply Project, N.R.A.

Azrak - Irbid Water Supply Project, N.R.A.

North Shuneh Water Supply Project, Municipal Loan Fund.

South Shuneh Water Supply Project, Municipal Loan Fund.

Several projects in West Bank of Jordan including Ramallah, Jerusalem Water Supply Project, Bethlehem, Hebron, Nablus and many others, some of which financed by World Bank.

1960 - 1964

Central Water Authority
Amman, Jordan

Head of Design Division. The work comprised the design of water supply and irrigation projects in Jordan including spring development projects.

1949 - 1960

Department of Irrigation
Amman, Jordan

Irrigation Engineer. The work comprised the design and construction of irrigation projects on side wadis of the Jordan Valley and the design of the East Ghor Canal Project.

1942 - 1948

Department of Land Settlement and Water Commissioner
Jerusalem, Palestine

Irrigation Engineer. The work comprised the design of irrigation projects and hydrological studies.

EDUCATION

B.Sc. in Civil Engineering
American University of Beirut, Lebanon, 1941.

International Program in Sanitary Engineering,
University of North Carolina, Chapel Hill, U.S.A., 1965.

SOCIETIES

Member, Order of Engineers of Jordan.

Member, American Society of Civil Engineers.

Member, American Water Works Association.

Member, British Institution of Water Engineers and Scientists.

Biographical Data

R. JEROME ESMAY

Environmental Engineer

Perosnal Information

Education

B.S. in Civil Engineering, 1969, University of Washington
M.S. in Environmental Engineering/Economic Planning, 1971, Stanford University

Professional Affiliations

Registered Professional Engineer (California No. 21731)
American Society of Civil Engineers
American Society for Testing and Materials (Honorary Member)
California Water Pollution Control Association
Santa Ana Region Water Pollution Control Association
Water Pollution Control Federation

Foreign Languages

Portuguese
Spanish

Experience Record

1971-1975 Wilsey and Ham, Foster City, California. Environmental Engineer. Responsible for the study, development, and design of wastewater collection and treatment systems and land treatment systems. Analyzed the infiltration/inflow and capacity of a major interceptor for Hillsborough, California. Also investigated economic and technical feasibility of wastewater reuse as part of a 208 Wastewater Management Plan for the County of San Mateo, California. Evaluated several municipal wastewater collection and treatment systems for the U.S. Forest Service including primary digestion and aeration ponds. Developed the wastewater collection and treatment system for residential developments in Fresno County, California. Planned and designed a land

R. Jerome Esmay (Continued)

treatment system along lake shores. Also conducted sewer and water rate studies as well as power load studies involving a cost/benefit analysis of the use of bagasse to generate electricity.

1975-1980 Metcalf & Eddy, Palo Alto, California. Environmental Engineer. Responsible for Environmental engineering aspects of wastewater treatment facility planning, land treatment systems, and rate and assessment studies. Served as lecturer at EPA-Sponsored workshops on planning and designing process systems for land treatment and wastewater treatment.

Wastewater porjects include preparation of facilities plans for the upper Santa Ana River watershed in California; management study for municipal Sao Paulo, Brazil in which atternative process designs were considered including primary treatment, secondary treatment and as an alternative for wastewater reuse aeration ponds; and preparation of the planning, design and small systems sections of the EPA process design manual.

Land treatment projects include development and conduct of a pilot testing program involving high strength, high nutrient brewery wastewater for An-heuser-Busch, Inc.; analysis of a 3.5 mgd system at Fort Meade, Maryland, for the Army Corps of Engineers; study involving tomato process wastewater; and investigations, feasibility reports, and preliminary designs for systems in Ismailia, Egypt.

1980-Date Engineering-Science. Environmental Engineer. Responsible for conducting studies and developing facilities plans for water resources and wastewater treatment systems for assigned projects in Central and South America. Served as assistant technical director on development of water and sewerage master plan for

R. Jerome Esmay (Continued)

metropolitan Lima, Peru, with responsibility for field evaluation and planning for wastewater collection, treatment, and disposal as well as reclamation/reuse of wastewaters from aeration ponds for irrigation and groundwater recharge.