PD-AAR-406
40465

INTERNATIONAL DEVELOPMENT

PROJECT COMPLETION REPORT

TAIZ WATER AND SEWERAGE
CONSTRUCTION PROJECT

Grant 279-0039
Ln 279-U-002
Ln/Grant 279-U-001

PD/MENA, Justin Williams, Jr.
Washington, D.C.
September 28, 1984

TABLE OF CONTENTS

	Page
List of Figures	iv
Abbreviations Used	v
I. Project Background	1
II. Project Design	2
A. The 1973 James M. Montgomery Feasibility Study	2
B. The 1973 A.I.D. Design Project	3
C. The 1977 Hazen and Sawyer Feasibility Study	4
D. Assessment of Design	6
E. Other Tala Studies, 1973-1979	6
III. Project Financing	8
A. A.I.D.'s 1977 $10 Million Grant	8
B. The 1977 Financing Plan	9
C. The 1979 Financing Plan	10
D. Project Financing upon Completion of Construction	12
IV. Project Contracting	13
A. The First Supervision Contract	13
B. Construction Contracting	13
V. Project Construction	19
A. Construction by Stevin	19
B. Description of the Completed Project	20
VI. Engineering Supervision of Construction	21
A. Hazen and Sawyer Engineers' Supervision	21
B. The Change of Supervisory Engineers	22

	Page
C. Stanley Consultants Inc. Supervision	22
D. Claims	23
E. Technical Management Systems, Inc.	23
VII. Opinions and Recommendations	24
A. Project Cost	24
B. Opinions Concerning Project Cost	25
C. Recommendations	29

LIST OF FIGURES

		Page
1.	James N. Montgomery's 1973 First Phase Cost Estimate	3
2.	The 1973 A.I.D. Design Project	4
3.	Hazen and Sawyer's 1977 Cost Estimate	5
4.	Other Tala Studies, 1973-1979	7
5.	Project Cost Estimate, 1977, A.I.D. PP	8
6.	Donor Financing Terms	10
7.	Project Financing Plan, 1979	11
8.	Ultimate Project Financing	12
9.	Contract B and C Bid Prices	16
10.	Contract Award Prices	17
11.	Original 1979 Contract Prices	18
12.	Ultimate Project Cost	24

ABBREVIATIONS USED

A.I.D.	Agency for International Development
ADFAED	Abu Dhabi Fund for Arab Economic Development
GNP	Gross National Product
H&S	Hazen and Sawyer Engineers
IBRD	International Bank for Reconstruction and Development
JMM	James M. Montgomery Consulting Engineers, Inc.
NE/CD	Office of Capital Development, Near East Bureau
NE/DP	Office of Development Planning, Near East Bureau
NE/PD	Office of Project Development, Near East Bureau
NWSA	National Water and Sewerage Authority
OPEC	Organization of the Petroleum Exporting Countries
PIO/T	Project Implementation Order/Technical Services
PP	Project Paper
SFD	Saudi Fund for Development
TMSI	Technical Management Services, Inc.
USAID/Sanaa	A.I.D.'s Mission in Yemen
YARG	Yemen Arab Republic Government

PROJECT COMPLETION REPORT
TAIZ WATER AND SEWERAGE CONSTRUCTION PROJECT

1. PROJECT BACKGROUND

1.01 United States aid to the Taiz municipal water system began in 1960 when the Imam requested A.I.D.'s predecessor, the International Cooperation Agency, to establish a municipal water system at Taiz, then the capital of Yemen. A small project was completed in 1961. A 1962 agreement resulted in the completion of the Kennedy Memorial Water System at Taiz in September 1963 at a cost of about $4.3 million.

1.02 During the 1963-1972 civil war in Yemen Taiz water system capacity declined due to inadequate maintenance. The U.S. severed diplomatic relations with Yemen in 1967, following an attack on its embassy. Diplomatic relations were resumed in 1973. In November 1973 Yemen's National Water and Sewerage Authority (NWSA) was established. One of the first projects the new Yemen Arab Republic Government (YARG) asked A.I.D. to undertake was the rehabilitation of the 1963 Taiz water system. A.I.D. provided a technician and equipment in response to that request. By early 1974 the Taiz water system had been restored to its original design capacity, service for a 20,000 population.

1.03 The Organization of the Petroleum Exporting Countries (OPEC) was formed in 1960. During the 1970's, acting as a cartel, it took control of four-fifths of the non-communist world's oil supply from the seven giant oil companies that had formerly controlled it. There were two sharp increases in the price of oil that in turn dampened the rates of GNP growth and industrial employment in Western Europe and the United States during the late 1970's. During that decade, and especially after the end of the 1974-75 recession, the annual rate of price inflation accelerated into the double-digit range. Commercial interest rates likewise soared.

1.04 The oil exporting countries of the Persian Gulf area, including Saudi Arabia and Abu Dhabi, experienced unprecedented increases in income. Surplus revenues became available for investment abroad and for domestic construction projects that created new demands for expatriate labor. Many skilled Yemeni construction workers went to Saudi Arabia, and their remittances became Yemen's principal source of foreign exchange earnings. At Taiz, remittances from Saudi Arabia contributed to accelerated population growth and construction of new residential areas. The 1973 population of Taiz was estimated to be about 80,000 persons. By 1980, however, over 100,000 was a commonly accepted estimate.

II. PROJECT DESIGN

The 1973 James M. Montgomery Feasibility Study

1.01 When, in 1973 the YAWC requested an A.I.D. loan to finance design and construction of a new water and sewerage system for Yaiz' expanding population, then assumed to cost $10 or $13 million maximum, no one could have foreseen that the project would not be completed until 1983, or that it would cost over $104 million. In response to a Commerce Business Daily advertisement of August 1, 1973, A.I.D. Washington's Contract Management Office received proposals from 12 U.S. engineering firms. An A.I.D. panel ranked James M. Montgomery first on September 21, 1973. Seven months later, on April 17, 1974, A.I.D. directly contracted the services of James M. Montgomery, Consulting Engineers, Inc. of Pasadena, California (JMM) to study the feasibility of such a new system for Yaiz. The scope of work was exceptionally thorough. It included provision for cost estimates, economic and financial analysis, water and sewerage rate schedules keyed to socio-economic needs, environmental assessment, and assessment of "soils or rock to be encountered during construction". JMM study began in June 1974. Twelve experts were utilized for periods at Yaiz that ranged from two weeks to six months. A well-drilling and testing program was conducted. Sufficient data were obtained regarding water resources to permit design of a master plan and the completion of feasibility studies. JMM presented its feasibility study report to A.I.D. in May 1975 in three volumes: I. Master Plan and Feasibility Study, II Water Resources Evaluation, III. Institutional Development and Training Programs.

1.02 JMM found that Yaiz water quality was rapidly deteriorating due to percolation of untreated sewage directly into the aquifer that supplied the city's wells. New organization structures and training programs were recommended and developed. A water rate structure was developed. Four full paragraphs were devoted to a description of the igneous, metamorphic, and sedimentary rocks underlying the entire region. JMM presented master plans and feasibility studies for completion of new water supply and sewerage systems in two phases: (1) to 1983; (2) to 1991. JMM's recommended first phase, designed to serve the population of Yaiz until 1983, became the outlook of the project for which A.I.D. subsequently provided some financing. Cost estimates were based on January 1975 prices. No provision was made for price inflation. JMM's May 1975 first phase cost estimate is shown in Figure 1 below.

Figure 1

JMM's 1973 First Phase Cost Estimate

		Total Cost ($ thousands)
1.	Ten water wells with pumps	$250
2.	Three water storage reservoirs	360
3.	One water chlorination unit	37
4.	One booster water pumping station	202
5.	A water transmission pipeline 27 km long	3,[illegible]
6.	24 km of water distribution pipes	1,118
7.	Water meters, 4730	183
8.	Sewage collection piping, 131 km	1,844
9.	Sewage treatment facilities	1,433
10.	Public toilets	68
11.	Three 200 kw electric generators, one 62.5 kv generator, power distribution transformers, etc.	138
12.	Vehicles and misc. equipment	273
13.	Engineering final design and construction supervision (12%)	1,126
14.	Contingencies (12%)	1,131
15.	Training program	804
16.	Total	$12,[illegible]

3. The 1973 A.I.D. Design Project

3.01 Early drafts of JMM's feasibility study report served as the starting point for an A.I.D. Washington appraisal team's visit to Tais during April 1973. The A.I.D. Washington appraisal team concluded that information on some aspects of the project was incomplete. The team recommended additional study. Authorization of an A.I.D. loan to finance construction of the project was contemplated during August or September 1974. A June 10, 1973 PP was prepared in AID/Washington by NE/CD. It called for a $1,330,000 loan and a $100,000 grant to be utilized as shown in Figure 1 below. Although the PP concluded that, "the technical and environmental analyses leave no doubt that the project is feasible", and that, "the economic feasibility of the Project has also been established", it said, "considerable work needs to be done before financial feasibility can be assessed. We anticipate that the NWSA can become financially viable if a substantial part of the construction costs of the Project are assumed by the government." Other paragraphs of the PP, however, expressed an intention on the part of A.I.D. to finance all of the project construction cost as it had been defined by JMM, escalated by price inflation factors to a $14.1 million total cost. The PP's recommended $1.43 million A.I.D.

loan/grant (279-U-001) for the Design Project was obligated on July 17, 1973.

Figure 2

The 1973 A.I.D. Design Project

	A.I.D. - financed foreign exchange costs only ($ thousands)
1. Final design of JWW's recommended first phase project, including preparation of construction bidding documents	$830 (L)
2. Drilling of ten production wells in the Al Haina basin to increase the reliability of JWW's cost estimate	130 (L)
3. Another socio-economic study to be carried out by sole-source procurement of the services of Sha'ir and Company of Beirut, Lebanon, joint ventured with Deloitte, Robson, Morrow and Company of London, England	100 (G)
4. Water and sewerage facilities operation and maintenance training programs	370 (L)
5. Total	$1,430

C. The 1977 Hazen and Sawyer Feasibility Study

2.04 A host country contracting process for final design engineering services ensued. In October 1976, over 14 months after loan/grant obligation, Yemen's National Water and Sewerage Authority (NWSA) contracted the services of Hazen and Sawyer, Engineers, New York City (H&S) to: (1) review and revise, as necessary, the 1973 JWW proposals; (2) prepare detailed specifications and final designs for the proposed facilities, utilizing a design standard to meet projected municipal requirements to 1990. Final designs were to be completed by November 21, 1977. Hazen and Sawyer submitted its single-volume Project Design Report to NWSA on September 12, 1977. Hazen and Sawyer's preliminary draft of final designs were submitted December 21, 1977. Final design work was completed in mid-1978, during the process of contracting for construction. Figure 3 below

shows Hazen and Sawyer's project cost estimate in its September 1977 report. Comparison of Figure 3 with Figure 1, JRM's 1975 cost estimate, shows that project scope was considerably expanded by the redesign effort.

Figure 3

Hazen and Sawyer's 1977 Cost Estimate

		Total Cost ($ thousands)
1.	21 water wells with pumps, etc.	$1,702
2.	Five water storage reservoirs	1,363
3.	One water chlorination unit	249
4.	Four booster water pumping stations	363
5.	A water transmission pipeline 18 km long	3,888
6.	139.4 km of water distribution pipes	4,220
7.	Water meters, 4,000	120
8.	Sewage collection piping, 149.3 km	10,163
9.	Sewage treatment facilities	3,163
10.	Public toilets, 13	240
11.	Power lines and electric work with no power generators	424
12.	Vehicles and maintenance equipment	700
13.	Supervision of construction (12%)	3,800
14.	Contingencies (10%)	3,148
15.	Training program	-0-
16.	Water blow-off and air release station	18
17.	Water pressure break structures, 10	182
18.	Public faucets and fire hydrants	283
19.	Sewage pipe manholes	2,850
20.	Contractor's mobilization	3,000
21.	Price inflation (FX costs were escalated for one year at 10%; local costs were escalated 25% per year for two years)	14,376
22.	Land and right-of-way	[illegible]
23.	Total	$77,[illegible]

2.03 Hazen and Sawyer's September 1977 report noted that, "the cost of construction in Yemen is affected by factors difficult to quantify and to project. The YARG is developing so rapidly that the volume of public works programs places extreme demands on limited manpower, equipment, and material resources...there are no large Yemeni contractors experienced in water and sewerage construction. The net result is a construction-contracting market that is not truly competitive, and an escalation of construction prices of 25 percent or more annually...the cost of pipeline construction in Tais

will be expensive because of the presence of rock, steep terrain and restricted passages through streets and along right-of-ways."

D. Assessment of Design

2.06 In 1984, after project completion, NWSA concluded that Nasen and Sawyer's design concepts and structural designs were adequate. On the positive side, there were indications that the selection of the well-field sites had been technically sound and that the wells would provide high quality water to Taiz for many years. The design of the system to transmit the water from the well-fields to the city and to store it there for distribution was likewise considered technically sound. The water distribution system was considered to be of adequate design. The sewerage system stressed simplicity of operation and maintenance. All sewage is transported by gravity. Sewage treatment ponds are technically appropriate and present low operation and maintenance requirements. The low permeability of the soil at the ponds minimize seepage of untreated waste into the ground.

2.07 On the negative side of project design, NWSA considered that submersible well pumps would have been preferable to the kind provided due to problems encountered with well casing alignments. The absence of a remote control system for the well-fields was noted. Failure to incorporate house water and sewer service installations in the construction contract was considered a deficiency because the Taiz Branch of NWSA lacked adequate skilled personnel timely to accomplish these tasks. The sewage treatment process should have included chlorination facilities to protect people down stream.

E. Other Taiz Studies, 1973 - 1979

2.08 In addition to the 1973 James M. Montgomery and 1977 Nasen and Sawyer, feasibility and preliminary design studies, NE/TD's bulk files contain 12 other studies of this project. They are listed in Figure 4 below. Most were a product of A.I.D.'s 1973 Taiz Design Project. Item 12 provided the rationale for the amount of compensation to well-field farmers.

Figure 4

Other Taiz Studies, 1973-1979

Submission Date	Author	Subject
1. March 1973	Sha'ir and Company Beirut, Lebanon	YWSA's Accounting Systems
2. April 1976	Talal Abu-Ghazaleh and Company, Kuwait	YWSA Consolidated Balance Sheets and Income Statements, 1973-75
3. March 1977	Deloitte Haskins and and Sells Management Consultants (Haskins and Sells, founded in New York in 1893, began in 1923 to operate offices with London-based Deloitte, Robson and Morrow. In 1977, the Deloitte name was added to the Haskins and Sells title in the U.S.)	Household Survey in Taiz, July/August 1976
4. April 1977	Deloitte Haskins and and Sells Management Consultants	Socio-economic Survey of Taiz, July/August 1976
5. August 1977	NE/DP, AID/Washington	Taiz Social Beneficiaries Analysis
6. August 1977	USAID/Sanaa	Environmental Assessment, Taiz Project
7. November 1977	Haskins and Sells	Tariff Study for Taiz Water and Sewerage Authority, two volumes
8. December 1977	Haskins and Sells	Executive Summary of Tariff Study

Figure 4 (continued)

9.	October 1978	Crane Associates, Inc.	Power System Analysis and Cost Comparison
10.	Feburary 1979	Deloitte, Haskins and Sells	Financial Plan for NWSA
11.	July 1979	Deloitte, Haskins and Sells	Tais Tariff Study and Financial Plan
12.	September 1979	Hazen and Sawyer and Tipton and Kalmbach, Inc.	Irrigation and Compensation Study

III. PROJECT FINANCING

A. A.I.D.'s 1977 $10 Million Grant

3.01 After submission of a June draft of Hazen and Sawyer's September 1977 Project Design Report, and Haskins and Sells' April 1977 Socio-Economic Survey of Tais, GC/CD, A.I.D. Washington, prepared a PP recommending authorization of a $10 million A.I.D. grant to Yemen for partial financing of a projected $63.4 million construction project, as itemized in Figure 3 below. A.I.D.'s $10 million grant was then expected to be utilized to finance: construction supervision ($3.8 million); training ($0.2 million); well field development ($1 million); U.S.-source equipment ($5 million). The PP anticipated that prequalification of construction contractors would begin during October 1977, that a contracted construction firm would begin mobilization during August 1978, and that construction would be completed during May 1981.

Figure 3

Project Cost Estimate, 1977 A.I.D. PP

		Total Cost ($ millions)
1.	11 water wells (addition to the ten water wells financed under the A.I.D. Design Project	$1.0
2.	Remedial work to existing water system	1.0

Figure 3 (continued)

3.	New water systems, other components	13.1
4.	Water system total	(15.1)
5.	Sewerage system	17.5
6.	Vehicles and maintenance equipment	0.7
7.	Land	1.8
8.	Supervision of construction	3.8
9.	Contingencies (10%)	5.0
10.	Training program	0.2
11.	Contractor's mobilization	3.0
12.	Price inflation (25% per year for 2 years)	12.1
13.	Total	$63.4

3.02 The relevant documentation does not provide an explicit rationale for A.I.D.'s decision to finance only a minor (13.5 percent) proportion of the project. A.I.D.'s $10 million Development Assistance grant was intended to provide a catalyst to stimulate a matching $10 million equivalent contribution from the Abu Dhabi Fund for Arab Economic Development (ADFAED), and the equivalent of $44.4 million, the balance of the total estimated cost of construction, was to come from the TARC or other, unspecified, donors. The A.I.D. $10 million grant agreement signed August 28, 1977 (279-0039) included a condition precedent to disbursement, for anything other than well field drilling and non-supervisory engineering services, that called for written evidence that the TARC and other donors had committed funds adequate to finance the difference between the A.I.D. grant and the total cost of construction.

B. The 1977 Financing Plan

3.03 The TARC was ultimately successful in attracting two other donors to the project, based in part on the presumed soundness of the project's design concept and on the assurance that a U.S. engineering firm, financed by A.I.D., would supervise construction. In March 1978 the Saudi Fund for Development, Riyadh, Saudi Arabia (SFD) pledged the equivalent of about $30 million. The Abu Dhabi Fund for Arab Economic Development, (ADFAED) pledged the equivalent of about $10 million. The TARC committed itself to finance the balance not provided by foreign donors. Figure 4 below shows the terms of the donor financing package, as the contributions

were provided to the YARG, and as the YARG passed on the various loan and grant proceeds to NWSA. The most significant aspects of this financing package, in addition to the relatively low A.I.D. share, was the softness of the terms to the YARG and NWSA in comparison with the peaks that commercial interest rates were to reach as the project progressed.

Figure 4

Donor Financing Terms
($ millions)

Donor	Donor Terms to YARG	YARG Terms to NWSA	
		Loan Pass-on Component (16%)	Grant Pass-on Component (4%)
1. SFD	$30 loan; repayment in 20 years; 3 years grace on repayment of principal; 2% annual interest.	$16.8 loan; repayment in 20 years; 3 years grace on repayment of principal; 4% annual interest.	$13.2
2. ADFAED	$10 loan; repayment in 20 years; 3 years grace on repayment of principal; 3.3% annual interest.	$3.6 loan; repayment in 20 years; 3 years grace on repayment of principal; 6% annual interest.	$4.4
3. A.I.D.	$10 grant	$3.6 loan; repayment in 20 years; 3 years grace on repayment of principal; 2% annual interest.	$4.4
	Loan total to NWSA:	$28 at an average 4% annual rate of interest, repayable over 20 years.	
	Grant total to NWSA:		$22

C. The 1979 Financing Plan

3.04 The ADFAED's willingness to participate in project financing was nearly eroded by the sharp increase in cost estimates and by A.I.D.'s

unwillingness, in spite of urgent and repeated ADFAED requests in 1977 to increase its share in proportion to the increase in the total cost. The ADFAED had initially agreed to consider participation with A.I.D. in financing a project estimated in 1973 to cost $24.6 million (roughly the sum of JNN's Phases I and II estimates). The ADFAED was distinctly displeased at the 1977 prospect of increasing its $10 million pledge to finance a $63.4 million project for which A.I.D. would be contributing no more than its originally planned $10 million.

3.03 In March 1978 the scope of the project was increased to include additional water and sewer service areas and restoration to the project of independent power generation facilities, part of JNN's design not incorporated by R&S. At the time of contract awards in early 1979, total estimated project cost had increased to about $73.6 million. As the three foreign donors had obligated or pledged a total of about $40 million, the YARG committed itself to provide the additional $33.6 million then projected to be required to complete the project.

3.04 During the period before and after contract awards in early 1979, the three foreign donors began the process of making discrete financial commitments. They reviewed the various subcontracts under the three main contracts, and each selected those considered most appropriate for its financing. The YARG contribution was allocated to residual subcontracts not selected by one of the donors, and to local cost project components not included in the three construction contracts; e.g., land, rights-of-way, and compensation to farmers in the well-field area. This resulted in the financial undertakings shown in Figure 7 below. A.I.D.'s $10 million grant was then allocated: engineering supervision of construction, $4.6 million; U.S.-source, contract "B", electro-mechanical equipment, $3.4 million; additional well-drilling, $0.7 million; training, $0.2 million; contingency, $1.3 million.

Figure 7

Project Financing Plan 1979

		% Share	Amount ($ millions)
1.	YARG	44%	$33.6
2.	EEC	28	20.8
3.	A.I.D.	14	10.0
4.	ADFAED	14	9.2
5.	Totals	100%	$73.6

3.07 In 1979 the YARG had made urgent requests for A.I.D. to increase the amount of its financing for the project. This was based partly on its perception that more money would be required, and on the view that the KFD and the ADFAED would not increase their participation unless A.I.D. led the way. The Near East Bureau then declined to provide additional financing for the project based upon the YARG's undertaking in the 1977 grant agreement to provide any additional funds that might be required. By mid-1980 accumulated evidence strengthened the conclusion that the project faced significant cost overruns. A donor's conference was convened by the YARG at Sanaa during late January 1981. A.I.D. offered to increase its $10 million grant by $3 million. The KFD tentatively committed itself to the rial equivalent of an additional $8.75 million. The ADFAED tentatively offered an additional $6.2 million. A.I.D. obligated the resulting $3 million Loan 279-U-002 on June 4, 1981. Its terms were repayment in 40 years with ten years grace on repayment of principal; two percent annual interest during the grace period; three percent annual interest thereafter. As the YARG initially declined to utilize these loan proceeds to finance supervisory engineering services, A.I.D. provided a supplementary $1.2 million grant that was obligated June 8, 1982. Total A.I.D. obligations for this project thus ultimately amounted to $16.2 million: $11.2 million grant; $3 million soft loan.

D. Project Financing Upon Completion of Construction

3.08 On April 30, 1984, the supervisory engineer presented its final payment certificate. Thanks in part to informal understandings reached at the donors conference in 1981, the YARG and the donors shared ultimate project costs as shown in Figure 8 below. The significant aspects of this final array were: (1) project cost was 67.7 percent, or $41 million higher than anticipated in A.I.D.'s 1977, $63.4 million, PP estimate; (2) the YARG's ultimate share of the financing package rose from a planned 22 percent share in 1977 to an actual 42 percent share in 1984.

Figure 8

Ultimate Project Financing

Donor	% Share	Amount ($ millions)
1. YARG	42%	$44.1
2. KFD	21	22.4
3. A.I.D.	13	13.9
4. ADFAED	12	12.0
5. Totals	100%	$106.4

IV. PROJECT CONTRACTING

A. The First Supervision Contract

4.01 During January 1978 discussions among the NWSA, the ADFAID, USAID/Sanaa and NE/CD, A.I.D. Washington, it was agreed to exercise the option in the NWSA - Hazen and Sawyer final design services contract that permitted NWSA to amend the contract to provide for H&S services to supervise construction. In response to A.I.D.'s explicit recommendation, NWSA agreed to waive FARC regulations requiring competitive proposals. H&S had already submitted a proposal for such amendment to its contract. USAID/Sanaa had then reported that "the working relationship and quality of H&S work vis-a-vis NWSA is quite good". The resulting contract between NWSA and H&S for "Additional Engineering Services and Construction Supervision" was signed on April 14, 1978, by H&S and on July 11, 1978, by NWSA. The contract total price was $1,939,330, including dollar and Yemeni rial costs. Hazen and Sawyer had earlier estimated the cost of supervision of construction based on five expatriate engineers and 15 Yemeni engineers and technicians engaged for 39 months.

B. Construction Contracting

4.02 Hazen and Sawyer began the construction contracting process on behalf of NWSA under its October 3, 1976 design services contract. On December 31, 1977, H&S submitted draft project designs to NWSA, organized into six contracts: (1) international bulk supply; (2) U.S. bulk supply; (3) pipelines; (4) civil works; (5) electrical and instrumentation work; (6) mechanical work. This reflected NWSA's preference, and JNM's recommendation, to implement the project via a number of small local contracts. NE/CD, A.I.D. Washington immediately (January 4, 1978) objected to this fragmented contracting plan: "A.I.D. strong preference is to use, if feasible, only one single-responsibility contractor who would employ subcontractors, foreign or Yemeni, as necessary. We believe that a proliferation of contracts would create substantial problems of coordination, even though a supervising engineer would be available to assist." This position was reiterated on March 7, 1978.

4.03 In response to January 1978 advertisements in Europe, the U.S., and Yemen, 31 construction firms submitted prequalification data. On March 23, 1978, H&S found 13 firms qualified to do the work. Five firms were added that had been separately prequalified for a similar project at Hodeida. The 18 prequalified bidders, in rank order, were: (1) Mitsui and Nigata, J.V. Japan; (2) Samwhan, Korea; (3) Hyundai, Korea; (4) Wimpey, UK; (5) Babcock-Bau, Germany; (6) Berlin Consult, Germany; (7) J.A. Jones, U.S.; (8) Italconsult,

Italy; (9) SOCEA, France; (10) N.A. Karafi, Kuwait; (11) Jebsen et al., Germany and Korea; (12) Stevin, Netherlands; (13) Manama et al. consortium, U.S. and Saudi Arabia; (14) Costain International, UK; (15) Frevere et al., J.V., Italy; (16) Howard International, U.S.; (17) F.C. Lilley, UK; (18) Engineering Projects, India. Samwhan, the second-ranked firm, had a point score of 91. Stevin, the twelfth ranked firm that would ultimately construct the project, had a point score of 78.

4.04 On April 2, 1978, NWSA directed H&S to issue construction bidding documents to the prequalified firms. Bids were to be on the basis of two contracts: (1) construction, including supply and erection of U.S.-source electro-mechanical equipment; (2) international bulk supply. H&S issued the bidding documents on that basis in April 1978 with a July 13, 1978, bid closing date. NWSA had been unwilling to accept the single-construction-contract pattern that A.I.D. had urged because it feared a single contractor would overcharge for pipe; i.e., it wanted directly to receive quotations from pipe suppliers rather than subsuming pipe supply in a construction contract. The project was tendered on a "pre-final design" basis, based upon the concept that only minor design changes would be required during construction.

4.05 In mid-April 1978 USAID/Sanaa asked A.I.D. Washington to urge Hazen and Sawyer to improve its backstopping of the project. "From this side, quality of backstopping appears poor. One reason may be that responsibility for this project apparently split between Hazen and Sawyer's New York and Miami offices... Hazen and Sawyer/New York appears to be assigning personnel to project for short periods... and then switching them to something else before they can really become familiar with project." In 1984, after project completion, NWSA noted four major deficiencies in Hazen and Sawyer's contracting work, particularly as it had been reflected in the bidding documents. An apparent lack of field verification of quantities, such as rock excavation, tended to allow unbalanced tendering by the construction contractor. Incompleteness of the bidding documents when they were issued resulted in an "overwhelming" number of variations that significantly increased the amount of supervisory engineering work required to administer the project. The bidding documents generally reflected a lack of organization and coordination between the conditions of contract, technical specifications, and plans. Lack of well-defined terms for measurement and payment of unit items created ambiguities that caused construction contractor claims and increased supervisory engineering workload.

4.06 A.I.D. Washington's review of the tender documents was cabled to Sanaa on June 20, 1978, approximately two months after their issuance to the prospective bidders. It called for detailed revisions. Although NWSA advised A.I.D. Washington "because of high

daily escalation cost here in Yemen Arab Republic, we strongly desire to avoid any further delays in the bid closing date. AID/Washington requested extension of the bid closing date for an additional 30 days to provide tenderers with sufficient time to modify bids after receipt of an addendum. The bid closing date would ultimately be extended to October 21, 1978, pursuant to four addenda.

4.07 The Saudi Fund for Development, the major donor to the project, completed its review of the bidding documents during July 1978. At a July 23, 1978, meeting at Riyadh, NWSA acceded to an SFD request to reconstitute Contract B as a separate contract for U.S.-source electro-mechanical equipment; i.e., to segregate that portion of the procurement from Contract C, the construction contract. The SFD was concerned that the Contract C construction tender, as issued, would be attractive only to U.S. bidders. Lack of clarity in the tender documents had given the SFD the erroneous impression that A.I.D. was attempting to impose its procedures, rules, and regulations on the works being financed by the other donors. Although USAID/Sanaa accepted the NWSA-SFD plan to revise the scheme of contracting, A.I.D./Washington requested that the U.S.-source electro-mechanical equipment remain a subcontract to the prime construction contract on the grounds that: (1) the prequalified construction firms had already structured their bids on that basis--change would result in delay and increased project cost; (2) were the electro-mechanical equipment to become an independent contract, separate new advertisement would be required. Notwithstanding A.I.D.'s objection to the three-contract structure, NWSA instructed H&S to issue revised bidding documents, reflecting that scheme, on September 13, 1978. NWSA was not being arbitrary - the SFD had made this change a condition of its financing for the construction contract.

4.08 In mid-August 1978, in the midst of the bidding controversy described above, NWSA questioned the wisdom of continuing Hazen and Sawyer's services for construction supervision "unless H&S was able to provide resident and home office staff necessary to do work of acceptable level of professional competence/accuracy and complete it on time". The first and second addenda to the original tender documents were nearly as voluminous as the original, and this contributed to NWSA's view that the original tender documents had been incomplete and inaccurate. USAID/Sanaa concurred in NWSA's views and asked A.I.D./Washington to convey them to H&S' New York headquarters. That was done, and a new H&S engineer was thereafter dispatched to Sanaa to replace temporarily the H&S field chief-of-party who had contracted hepatitis. In October 1978 NWSA expressed its displeasure with the quality of the revised tender documents prepared by Hazen and Sawyer, New York, and requested the H&S New York City project director to go to Sanaa to discuss the problems. Hazen and Sawyer presented a long letter (October 30,

1978) to the Director General of MWSA that recapitulated various delays during design work. M&J noted the three changes to the project contracting scheme, and three changes in the project's technical scope of construction, that occurred after the draft final designs became available to the donors in January 1978. "We regret that the project has suffered delays. While everyone participating in the project must bear some responsibility, we are confident that any fair-minded person reviewing the record will identify the principal causes as a lack of agreement among the donors on the contracting pattern and a changing scope during the tendering period."

4.09 MWSA opened construction bids on October 21, 1978. After rejecting two bids for lack of tender guarantees (bid bonds), ten firms had submitted bids on one or more schedules of Contract A, international bulk supply. Only two firms submitted bids on Contract B, U.S. -source electro-mechanical equipment, and Contract C, construction. The mid-September addendum which required the bidders to restructure their bids to segregate the electro-mechanical equipment from construction, only one month from the revised October bid-closing date, had apparently dissuaded the other bidders from trying to bid on Contracts B and C. An analysis of the bids on these contracts from Samsung, South Korea, and Stavia, Netherlands, is shown in Figure 9 below.

Figure 9

Contract B and C Bid Prices

Bidder	Electro-mechanical equipment Contract B ($ millions)	Construction Contract C ($ millions)	Total ($ millions)
1. Samsung (no discount offered)	$9.5	$44.9	$54.8
2. Stavia (offered to discount total to $47.3 million if awarded both contracts)	13.1	39.0	54.0
3. Engineer's estimate	8.6	47.9	56.5

4.10 The significant aspects of the October 21, 1978 bid opening were: (1) the receipt of only two bids for the construction contract from the 13 prequalified construction firms that requested bidding documents; (2) the disparity of Stavia's two bids from the

engineers estimate and Samwhan's bid. Stevin had, apparently, overbid the U.S.-source electro-mechanical equipment (Contract B) and underbid the construction work at Taiz (Contract C). On October 11, 1978, Twombly, Inc., New Jersey, had sent its $8.8 million supply and erection proposal for Contract B to Stevin's Netherlands office. It seems likely that it had not been received in time to influence Stevin's $23.1 million bid for the same items. Inspection of the bid prices in Figure 10 above leads to a conclusion that Samwhan furnished the only responsible bids for Contracts B and C because they were the only bids that reasonably corresponded to the engineer's estimate.

4.11 On December 31, 1978 R&S concluded its bid review and evaluation at New York City. It recommended: (1) award Contract A, international bulk supply, to various bidders; (2) award Contract B, U.S.-source electro-mechanical equipment, to Samwhan; (3) award Contract C, construction, to Stevin. A.I.D. Washington affirmed its willingness to finance a portion of Contract B, provided it could be shown that Samwhan's U.S. subcontractor, M.J. Keller, had secured competitive offers for the equipment. On January 31, 1979, NWSA requested all bidders to extend their bid validity dates to March 31, 1979. All bidders other than Samwhan extended. Samwhan extended for Contracts A and C only, because its U.S. equipment suppliers for Contract B could not hold their prices beyond February 18, 1979, the original expiration of the 120-day bid validity period. Stevin was thereafter the only bidder for Contract B.

4.12 On March 29, 1979, NWSA, after consultations with USAID/Sanaa, the SFD, the ADFAED, the NWSA Board of Directors, and the TARG High Committee for Tendering, and after negotiations with Stevin, awarded Contracts B and C to Hanab Stevin Pipelines Middle East Ltd., as shown in Figure 10 below. The Government of the Netherlands is thought to have exerted some degree of influence upon this TARG decision.

Figure 10

Contract Award Prices

Contract	Award Amounts ($ millions)
A. International bulk supply (various)	$10.8
B. U.S. electro-mechanical equip. (Stevin)	13.0
C. Construction (Stevin)	27.4
Total	$51.2

4.13 In March 1979, USAID/Sanaa deferred processing several of Razen and Sawyer's monthly payment vouchers in an effort to induce the firm to provide timely monthly reports and to conform them to the agreed format. R&S' monthly reports for May-November 1978 were submitted in February 1979. Monthly and quarterly reports for December 1977 were submitted in January 1979. In April 1979 USAID/Sanaa noted that R&S' invoices for January and February 1977 had not yet been submitted. In May 1979 the Director General of NWSA addressed a letter to the R&S field project manager that protested the quality of one of R&S' invoices: "This invoice, in addition to being unusually thick, was unusually sloppy, disorganized and very difficult to review. The number of cost items included which should not have been included was unjustifiably large. Frankly, NWSA was surprised that Razen and Sawyer would submit an invoice in such unsatisfactory condition".

4.14 The NWSA construction contract (Contract C) with Ranab-Stevin Pipelines Middle East Ltd. was signed on April 16, 1979 at a price of $30,643,424. It required completion of construction in 39 months; i.e., by July 16, 1982. Contract B, U.S.-source electro-mechanical equipment, was signed on April 16, 1979, by NWSA and Stevin at a total price of $12,990,940. The total price of Contract A contracts as signed, was $11,163,794. Some of these contracts went to Stevin; others went to various European and Asian suppliers. The project's nominal contracted cost in mid-1979 was $38.9 million as recapitulated in Figure 11 below. On March 26, 1979, however, NWSA and Stevin had signed a memorandum that modified Contracts B and C to provide for 13 percent price escalation for all work items certified after April 13, 1980. The escalation was subsequently increased to 20 percent for works accomplished after July 13, 1982.

Figure 11

Original 1979 Contract Prices

Contract	Contract Price ($ millions)
Contract A, various suppliers	$11.2
Contract B, Stevin	12.9
Contract C, Stevin	30.6
Supervision, Razen and Sawyer	4.2
Total	$38.9

4.13 After adding the equivalent of about $14.6 million in ancillary costs such as land, compensation, rights-of-way, etc., and about $10 million for contract currency fluctuations, price

escalation, and contingencies, to the contracted costs shown in figure 11 above, a realistic total project cost estimate after contracting was then about $82 million. The disturbing features of the project at contract signature remained the significant discrepancy between the contracted $70.8 million construction contract price and the $47.9 million engineer's estimate and the $44.9 million Samahan bid price for that same contract. Samahan is presumed to have had special knowledge about Yemen construction costs because it was the higher-ranked bidder already engaged in similar construction work in Yemen. The Contract C price for construction was 36 percent lower than the engineer's estimate, i.e., about $13 million below the best estimates of the cost of doing the specified work in Yemen. Stevin had underbid the job and had been contracted at a very low price.

V. PROJECT CONSTRUCTION

A. Construction by Stevin

3.01 Hanab-Stevin Pipelines Middle East Ltd. is a Cyprus-based company that is a wholly-owned subsidiary of the Netherlands corporation, Koral Volker Stevin. The contract called for completion of mobilization by September 1979, but the certifiable level was not completed until December 1979. As the name of the firm implies, about 70 percent of Stevin's staff were directly or indirectly related to pipeline work. There were between 43 to 60 European administrative and supervisory personnel assigned to the project for most of its duration. Most of the Yemenis employed by Stevin on the project worked on pipeline installation, although some Yemenis carried out supervisory and administrative functions. About 23 Filipinos worked on mechanical and electrical installations from November 1981 to September 1982. Over 200 Indians worked on civil construction and performed administrative functions. Administrative personnel declined from about 17 percent of the workforce in 1979 to about 11 percent in 1982-83. Stevin's personnel were housed in a camp that Stevin built at Taiz, complete with office buildings, warehouses, club, and swimming pool.

3.02 In May 1980, Stevin proposed to substitute a 29-month construction schedule for the contracted 30-month schedule. The latter called for project completion by July 16, 1982. The 29-month schedule proved to be unrealistic because it did not allow adequate time for land acquisition, material delivery, mechanical installations, or pipeline construction. After the 29-month schedule was abandoned there was no effective schedule against which project progress could be monitored. Stevin then submitted a provisional schedule that called for completion of most of the work by September 1982. Work on water tanks and electrical transmission lines proceeded ahead of schedule. Most other work took two to five times the originally planned completion time.

3.03 The Contract B mechanical and electrical works were to have been performed by Stevin's U.S. subcontractor, Twomly. Because Stevin would not accede to A.I.D.'s standard payment and warranty provisions, A.I.D. agreed directly to reimburse Stevin for stipulated shipments of electro-mechanical equipment. Relations between Stevin and Twomly, however, soured. Stevin therefore directly performed the Contract B mechanical and electrical installation work. This may have contributed to delay in starting that work. A.I.D. ultimately reimbursed Stevin for $3.4 million of U.S.-source electro-mechanical equipment.

3.04 On July 6, 1981, Stevin terminated work based upon charges that MWSA was in default due to late payments. Although the crisis was resolved, this termination eliminated the maintence period included in the contracts. When on February 3, 1983, Stevin again formally notified MWSA that it had terminated work, all but one of the variation orders under the five "A" contracts awarded to Stevin had been completed, all of the Contract B supply and installation work had been completed, and the construction contract was nearly 100 percent complete. Stevin continued work on certain items for several more months, and MWSA's Taiz Branch completed construction of certain items. The completion of construction of the project thus occurred nearly a year after the contracted completion date of July 18, 1981.

B. Description of the Completed Project

3.05 The completed project comprised facilities to upgrade municipal water supply, water storage and distribution and sewage collection and treatment, to serve a population of 180,000, the projected 1990 level. Water is supplied by 21 wells in the Al-Maina Valley northeast of Taiz. After pumping to a 20-meter control tank, the water is carried by gravity through an 18-kilometer transmission pipe to the Kennedy Water Yard at Taiz. Chlorination occurs along the transmission main. Improvements to the water distribution system include 84 kilometers of water mains, 40 hydrants, five concrete storage tanks, and five booster pumping stations. There is independent electric power for all pumping facilities, including three 500 kw generators at a central power station, and a transmission line to the well-field pumps. Sewer improvements include nine kilometers of interceptor sewers, 40 kilometers of collector sewers, house connections, and public toilets throughout the city. A seven-kilometer low pressure siphon line carries sewage to the Brayhi treatment facility southwest of Taiz. Secondary treatment is provided by anaerobic lagoons and oxidation ponds.

VI. ENGINEERING SUPERVISION OF CONSTRUCTION

A. Hazen and Sawyer Engineers Supervision

6.01 Supervision of construction was performed by Hazen and Sawyer Engineers from Stevin's mid-1979 mobilization through July 1981. In January 1980 an NE/PD engineer visited the project and reported that H&S did not have enough inspectors at the project site to verify quantities or to certify that Stevin was meeting construction specifications. A.I.D. Washington made urgent requests to H&S New York, in meetings and by letter, for the firm to upgrade its field staff. Measures taken did not stem the rising chorus of criticism from NWSA, the other donors, the U.S. Embassy, and USAID/Sanaa. A.I.D. sponsored two studies that were simultaneously conducted during October 1980. A team of A.I.D. direct-hire personnel, two sanitary engineers and a lawyer, comprised the first study team. The second, simultaneous study of the project was performed by Stanley Consultants Inc. (SCI) of Muscatine, Iowa, under an indefinite quantity contract with A.I.D. It fielded a team consisting of a sanitary engineer and a value analysis engineer.

6.02 The reports of the two study teams, independently prepared, were mutually confirming and reinforcing. Hazen and Sawyer had underestimated quantities of rock excavation, cement, reinforcing steel, and mass concrete. Stevin had taken advantage of this by setting unrealistically high prices for underestimated items. A total of 81 variation orders with 974 individual items had been issued as of September, 1980, but had not been priced by Stevin, negotiated by H&S, or approved by NWSA. The H&S field staff was required to refer almost all judgments to H&S' New York office for decision. H&S had not procured vehicles for its field staff as authorized a year earlier by an A.I.D. source waiver. H&S did not have a procedures manual to coordinate administration of the project. None of H&S' management at Taiz had been employed by H&S before the project supervision phase began. Stevin letters concerning delays and costs were either not answered or were being verbally answered.

6.03 Both reports recommended that H&S place an experienced construction contract management engineer at Taiz qualified by experience to conduct cost negotiations, and that H&S' staff of field technical inspectors be increased. The A.I.D. Study Team Report further recommended that a partner of H&S be stationed full-time in Yemen to provide the strong supervision and control demanded by the complex nature of the activity and the forceful and independent stance of the project construction contractor, Stevin, and to end H&S' administrative weakness generated by referral of most matters to New York City. The A.I.D. Study Team Report discussed at length the possibilities involved in termination and replacement of H&S and concluded that NWSA would have to weigh the

considerable additional costs and problems associated with the installation and establishment of a new engineer against the likelihood that Hazen and Sawyer would be unable to upgrade its performance in a fashion acceptable to NWSA.

B. The Change of Supervisory Engineers

4.04 During January 1981 the two study reports were reviewed by NWSA, A.I.D., SFD, and ADPAED at the donors conference. It was then determined that NWSA and A.I.D. should negotiate with H&S to secure improvements to field staffing and management. During early 1981 H&S was, however, unsuccessful in its efforts to recruit and place a stronger staff at Taiz. The NWSA-H&S contract expired December 31, 1980, and the firm was continued on short-term contract amendments. Between January and August, 1981, H&S submitted six contract amendments for such short-term continuation that increased its supervision contract price by $2,103,863.

4.05 In April 1981 USAID/Sanaa, directly confronting the day-to-day burden of major construction supervision and management problems, concluded, in consultation with NWSA, that a final ultimatum must be delivered to H&S. A.I.D. Washington was requested to demand that H&S upgrade its field staff and delegate full authority to it as a condition of further extension of its contract. On April 19, 1981, A.I.D.'s Near East Bureau staff met with two H&S senior partners and requested: (1) the Yemen field staff be upgraded, specifically to include a strong Hazen and Sawyer principal in the field; (2) the New York City level of effort be reduced; (3) substantial delegation of authority to the field staff such that it could handle every aspect of project supervision, negotiation, and management. When, in early May, H&S replied that it was unable to upgrade its staff in Yemen, A.I.D. Washington advised USAID/Sanaa that H&S' response was not strong enough to warrant further contract extension.

4.06 Following May 1981 NWSA and USAID/Sanaa consultations at Riyadh with the SFD and ADPAED, the Director General of NWSA on June 3, 1981, signed a PIO/T authorizing A.I.D. to procure SCI's services to supervise the project. A.I.D. waived competitive procurement requirements to permit sole source procurement. On July 4, 1981, a terminal contract amendment was negotiated with H&S. SCI mobilized to Yemen under its new, direct A.I.D. contract during July and assumed responsibility for project supervision on August 1, 1981.

C. Stanley Consultants Inc. Supervision

4.07 When SCI assumed construction supervision responsibility, it faced a challenging situation. Construction was about 90 percent complete. SCI had to integrate some of H&S' former employees with its own newly arrived expatriate staff, acquire project records and

data from N&S, establish day-to-day supervisory control of the ongoing construction project, and address the backlog of contractor claims and unsettled variation orders. By mid-1982 a strong field team had established supervisory control of construction. Contractor payment invoices were expeditiously approved at Taiz. Variation orders were timely issued and appropriately costed. A manual of procedures had been developed to guide all participating parties. Home office support for problem-solving and trouble-shooting missions to Yemen was exceptional.

4.08 During SCI's nearly two years of project supervision NWSA accepted and implemented many of the value analysis, technical, and construction management recommendations offered in SCI's original November 1980 report. On April 13, 1982, the Director, USAID/Sanaa, directed a personal letter to the President of Stanley Consultants Inc. thanking him on behalf of A.I.D. for the role his firm played in mediating a payments dispute between NWSA and Stevin. During 1982 A.I.D. Washington likewise commended SCI for its superior performance on this project. SCI's fine performance earned the full confidence of NWSA and A.I.D. This restoration of confidence alleviated a serious political embarrassment for the USG and favorably influenced SFD and ADFAED willingness to supplement their financial contributions to the project. On June 30, 1983, SCI demobilized from Taiz.

D. Claims

4.09 Most final variation orders issued by N&S were maintained by SCI. N&S variation orders that had been issued but not made final were reissued, cancelled, or combined with other variation orders by SCI. At the conclusion of Stevin's construction activities in March 1983, variations had all been costed and accounted for in final valuations of relevant contracts. On April 30, 1984, SCI issued its final payment certificate for Contracts A, B, and C. Prior to that issuance, Stevin submitted numerous claims for arbitration as provided for in contract General Conditions, Clause 32 (3). The total amount claimed by Stevin exceeded $38.9 million. NWSA retained a New York City law firm, Layton and Sherman*, to advise it concerning these claims. A.I.D. extended SCI's contract to May 31, 1983, to permit engineering advice relevant to the claims to continue. The disputed claims will, presumably, be settled by arbitration or negotiation at some future date.

E. Technical Management Services, Inc.

4.10 On May 24, 1979, NWSA contracted the services of Technical Management Services, Inc. of Los Angeles, California, (TMSI) to provide technical and advisory services. The contract was financed by A.I.D. Grant 279-0018, Water Supply Systems Management. The contract was extended by a series of amendments until September

*In September 1984 Layton and Sherman merged with Surrey and Morse, another New York law firm.

1984. During this period, TMSI provided continuous technical assistance to NWSA's central organization at Sanaa. It trained the staff of the NWSA Taiz Branch to operate and maintain the Taiz project then under construction. It procured operations and maintenance supplies and equipment for the Taiz project. Although its role was auxiliary to project construction supervision, TMSI's day-to-day administrative assistance to NWSA was indispensable to the ultimate successful completion and start-up of the project.

VII. OPINIONS AND RECOMMENDATIONS

7.01 The author of this report either supervised the assigned A.I.D. Washington project officer for this project, or directly performed the Washington project officer functions for it, for the seven-year period October 1977 to October 1984. Although the opinions that follow therefore reflect the point of view of a participant, no superior wisdom is claimed. Indeed, continuous confrontation with this project's intractable problems has tended to unsettle cherished problem-solving, and project management, verities. The opinions and recommendations that follow should be considered to be hypotheses that await testing and verification.

A. Project Cost

7.02 The ultimate total cost of the project not counting disputed claims is shown in Figure 12 below.

Figure 12

Ultimate Project Cost

Item	Amount $ million	Percent increases over 1977 PP estimate
1. Contract A	$13.0	
2. Contract B	16.0	
3. Contract C	36.8	
4. Construction contracts total	(67.8)	= 13.7%
5. Ancillary costs (land, compensation, etc.)	22.9	=663.3%
6. General items	3.9	=350.0%
7. Supervision (H&S and SCI only)	11.8	=220.5%
8. Project total Cost	$106.4	= 67.7%

D. Opinions Concerning Project Cost

7.03 Why did the project cost so much more than originally estimated? Six principal categories of inquiry have been identified: (1) questionable contracting decisions; (2) physical additions to the project; (3) design factors; (4) construction delays not associated with item (3); (5) supervision; (6) indirect, underlying influences. Although some categories are susceptible to precise dollar definition, others cannot be quantified.

7.04 Questionable contracting judgments. The following seven contracting decisions are believed to have influenced project total cost:

- the decision not to amend JRM's 1974 A.I.D.-direct feasibility study contract for follow-on final design and supervision services, but rather to launch more studies and a host country contracting process for a new engineering consultant;

- the decision to implement the project via several foreign equipment and construction contracts rather than follow JRM's 1973 recommendation to utilize a foreign contractor only for the installation of major equipment, construction of large hydraulic structures, and construction of the large water transmission main, and to utilize local Yemeni contractors for the installation of water distribution piping, collector sewers, and minor structures; the senior vice-president of BCI, however, strongly supports A.I.D. Washington's 1973 view that a single NWSA prime contract with a single foreign construction contractor would have been the best way to do it;

- the decision to launch the construction bidding process before final designs were completed and before the foreign donors had reviewed the bidding documents;

- the decision to alter the contracting structure to a three-contract pattern in the midst of construction contracting, and after bidders had prepared bids based upon a two-contract pattern, a probable cause of receipt of only two bids for the construction contract from the 12 prequalified bidders who requested the bidding documents;

- the decision to execute a construction contract with Stevin rather than Samhan, the only responsible bidder for Contracts B and C;

- the decision non-competitively to extend Hazen and Sawyer's design services contract for construction contracting and supervision of construction;

- the signature of a NWSA - Stevin memorandum that modified the construction contract to provide for escalation of payments for work items certified after certain dates, and thus gave the contractor a financial incentive to delay the work.

7.03 Physical additions to the project. During the advanced design and construction tendering process NWSA decided to make additions to the physical configuration of the project, including: (1) restoration of independent power generating facilities to the project; (2) substitution of concrete water storage tanks for steel tanks; (3) installation of a second water distribution system; (4) provision of water service to Zone VI with concomittant modifications to the Zone V pump station and water storage tank; (5) additional sewers, replacement of 20 percent of existing sewers, and installation of man-holes on existing sewers; (6) addition of a pressure reduction station and two pressure break structures; (7) a 10 percent increase to quantities of pipes and fittings; (8) addition of materials for utilization of oxidation pond effluent. There were also significant work variations during construction, including scope expansion, redesign, and resolution of construction problems, that contributed to cost increases.

7.04 Design factors. A.I.D.'s $10 million 1977 grant PP estimated that project ancillary costs would amount to $2 million. In the end, these costs increased 663 percent to $12.9 million. The principal element of this increase was $10 million equivalent for compensation payments to farmers in the Al Kalaa well-field area that was not included in the 1977 estimate. Quantities of rock excavation, embankments, select backfill, earthwork, and concrete were underestimated and generated high-cost increases to the construction contract, especially in Contract C-2, pipe installation, and Contract C-4, gravity sewers. The design engineer, HLS, did not provide designs for the power line, and this generated a controversy between BCI and Stevin with resulting construction delay. HLS occassionally did not timely provide drawings to the contractor, and that generated some construction delays. The contracts lacked well-defined, precise, terms for measurements and payments. This contributed to delays, misunderstandings, and higher costs.

7.05 Construction delays not related to design problems. Stevin the construction contractor, delayed its scheduled certifiable level of mobilization three months to December 1979. Because NWSA did not station a project director at Taiz, every minor change order required a drive to Sanaa, five to six hours distant from Taiz by road. Some materials, such as pipe and power line poles, were delivered late by suppliers. Work was halted at times by the direct obstruction of Tamani citizens, or by the failure of the Taiz provincial government to provide timely rights-of-way. Each delay

increased project cost by extending the total length of the construction period. The financial consequences of delays were magnified by NWSA's March 1979 agreement to escalate contract prices for work items certified after stipulated dates. Payments to the contractor were delayed by slow H&S certifications, lengthy NWSA and YARG reviews, and equally lengthy SFD reviews. A.I.D. and ADFAED generally made payments expeditiously. The contractor was paid interest on delayed payments.

7.08 Supervision. At the end of the project, construction supervision cost amounted to 14.8 percent of total project construction cost, not including the cost of ancillary and general items. Weak supervision by H&S, notwithstanding the many mitigating factors and extenuating circumstances that applied, contributed to increased project cost in five principal ways: (1) the botched construction contracting process, including confused bidding documents; (2) the failure of H&S to station a strong construction supervision team in Yemen and to delegate adequate authority to it resulted in loss of confidence by NWSA, NWSA withdrawal of authority from H&S, and Stevin's temporary ascendancy in the management of the project; (3) analysis and reporting by H&S/New York, as requested by NWSA, of the project's constant cost increases generated high-cost amendments to H&S' supervision contract for "additional work"; (4) the necessity to change engineers in the midst of construction resulted in six months of high cost, month-to-month, extensions of H&S' supervision contract, and procurement of SCI's services on a sole-source, emergency basis.

7.09 Indirect, underlying influences. Five underlying factors contributed to the high cost of the project: (1) lost time in an inflationary price environment; (2) the nature of Yemen; (3) the relative weakness of coordination among, and within, the sponsoring organizations; (4) the relative complexity of A.I.D.'s host country contracting rules; (5) soft financing terms.

7.10 Time. Napoleon said: "Go sir, gallop, and don't forget that the world was made in six days. You can ask me for anything you like except time." When a capital infrastructure project is coming down the track, every minute counts. Additional studies, delayed decisions and approvals, bureaucratic controversies, etc. are directly translated into lost time and higher costs. A short delay of a minor project element that is on a project's critical path may cause much longer delays in subsequent major items and in the ultimate length and cost of a project. A compulsive, demanding approach to schedules is not a notable attribute of government organizations.

7.11 Yemen. Yemen is remote and backward. Its private and government institutions are weak. There is a shortage of trained Yemeni personnel at every level. Arabic is the only language spoken

or read by all but a small, foreign-trained, elite. Transportation and communications are weak. It is difficult to find well-qualified foreigners willing to serve in Yemen for prolonged periods.

7.12 Donor coordination. Five government organizations participated in the administration of this project: (1) Yemen's National Water and Sewerage Authority, the project owner; (2) the Saudi Fund for Development, the major donor; (3) the Abu Dhabi Fund for Arab Economic Development; (4) A.I.D. Washington; (5) USAID/Sanaa. During the critical early years of the project, project implementation and contracting authorities had not been delegated by A.I.D. Washington to USAID/Sanaa. All information had to flow by letters and cables to Washington, and Washington decisions flowed, in due course, back to Sanaa. This included major judgments and line-by-line reviews of contracting minutiae. The first effort to coordinate the views of all the donors did not occur until early 1981, over three years after the project was launched. Confusion and misjudgments concerning project implementation resulted from the absence of cordial relations and effective communications among donor officials and organizations prior to 1981.

7.13 A.I.D.'s rules. A.I.D.'s host country contracting rules are complex and difficult for a foreign official to understand and to merge with the contracting rules of his own country. A host country contracting process executed according to A.I.D.'s rules cannot be effectively and timely executed without the assistance of A.I.D. officers with specialized training and experience. A.I.D.'s rules permit opportunity for difference of opinion within A.I.D. concerning their interpretation and application.

7.14 Easy money. Grant financing of capital infrastructure activities, or financing via loan terms that are far below market interest rates, are thought by several noted economists to be directly responsible for malinvestment, i.e., misallocation of capital to projects that should not have been undertaken, and structural cost overruns during project construction. Government projects, or other kinds of projects equally subject to long regulatory delays, are considered especially vulnerable to cost overruns when project financing has been provided at interest rates below market value. Figure 5 above amply demonstrates that each of the three donors to this project, A.I.D., IFD, and ADFAED provided their funds to the TAWC either as a grant, or on loan terms virtually equivalent to a grant, during that era of double-digit market interest rates. Population growth and other dynamic forces at Taiz provided political stimuli to expand the project during contracting and during construction. If the "free" money provided by the donors did not actively generate continuous project expansion, it certainly did nothing to inhibit it.

C. Recommendations

7.15 The following recommendations directly stem from the Tais Water and Sewerage Construction Project experience described above and are considered applicable to possible future A.I.D. financing for a capital infrastructure project in the Yemen Arab Republic.

7.16 Project economic viability. A.I.D. should not provide financing for an infrastructure project in Yemen that has not been shown by economic analysis to be economically viable at interest rates equivalent to the U.S. Treasury's that current long-term borrowing rate.

7.17 Project financing source. A.I.D. should try to provide adequate development assistance funding within a single fiscal year to loan finance all the estimated foreign exchange costs of an infrastructure project in Yemen, with YAR financing for all of the estimated local costs.

7.18 Multi-donor financing. If A.I.D. cannot alone finance all foreign exchange costs and, for good and sufficient reasons, determines to participate in another multi-donor financing package for a Yemen infrastructure project, then it should condition its financing share on prior establishment by the YAR of a donor coordination mechanism that would meet at least semi-annually throughout the period of project implementation.

7.19 Financing terms. A.I.D. lending for construction should bear terms equivalent, or nearly equivalent, to the U.S. Treasury's long term borrowing rate. Current IBRD loan terms for such projects are instructive.

7.20 A.I.D. project implementation organization. Full authority should be delegated to the director, YAR/Yemen, including authority to approve contracts, make payments, authorize necessary procurement waivers, and extend project implementation control dates.

7.21 A.I.D. staffing. YAR/Yemen should not undertake to sponsor another infrastructure project in Yemen without an experienced, A.I.D. capital project officer and an experienced A.I.D. engineer assigned to the mission for the duration of implementation of the project; i.e., for a full four years. The services of an A.I.D. lawyer should be available to the mission at least once each month throughout the execution of the project. Every effort should be made to slow the rate of personnel turnover for key project personnel.

7.22 Project design. Every effort should be made during the course of engineering design of an infrastructure project in Yemen, for

which A.I.D. financing is contemplated, to insure that the project implementation schedule and cost estimate reflect the special difficulties of construction work and supervision in Yemen.

7.13 A.I.D. direct contracting. A.I.D. Washington should directly contract, via competitive procedures, for U.S. engineering services for feasibility study, final design, construction contracting and construction supervision. Host country contracting by the YAR for such engineering services should be discouraged. The construction contract itself should, of course, be a host country contract.

7.14 Engineering continuity. An A.I.D.-direct contract for feasibility study services should provide for options to award the contract for follow-on final design, construction contracting, and construction supervision services. The initial contract should be let to a U.S. engineering firm fully qualified for the full sequence of subsequent engineering services. Only one lengthy competitive procurement exercise should be required for the procurement of engineering services.

7.15 Fully qualified U.S. engineering firm. The absolute requirement for good engineering services from start to finish is the single point upon which all Yemen project specialists would agree. The request for proposals should be structured to evoke responses only from large, overseas-experienced, well-qualified, U.S. engineering firms. Small or minority contracting is not applicable. Three special areas of competence should be prerequisite to selection: (1) technical engineering design capability relevant to the project, with special emphasis upon experience in designing simple facilities suitable for such a less-developed country; (2) staff experienced in preparation of bidding documents and contracting for construction, including international competitive bidding if construction will be financed by a source other than A.I.D.; (3) depth of available engineering staff to field a strong, inhouse, supervision team in Yemen for the duration of construction.

7.16 A.I.D. distancing from construction. A.I.D. should not consider directly contracting for construction in Yemen (or in any other country). During construction, A.I.D. should avoid direct involvement as much as possible. Every effort should be made to place the entire burden of supervision upon the contracted supervisory engineer. That engineer's timely submission of quality monthly reports is the best vehicle for A.I.D. monitoring of project construction progress.

7.17 Additional technical assistance. Consideration should be given in Yemen to A.I.D.-financed technical assistance to the Yemen project other than would be additional to, and separate from, the supervisory engineering services contract. The auxiliary training

and administrative services that TNGI provided to NWSA during the execution of the Tala project provide a most instructive example.

7.18 Post-construction engineering services. Should A.I.D. again finance supervisory engineering services for a capital construction project in Yemen, the supervision contract should extend for a lengthy period after the completion of construction to provide time for the engineer's final certifications and claims administration.

Drafted: A.I.D., NE/TD/MENA, Justin Williams, Jr.
Washington, D.C.
September 18, 1984