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**OPERATION AND MAINTENANCE EVALUATION
FOR NWSA ACTIVITIES
YEMEN ARAB REPUBLIC**

**Prepared for the U S. AID Mission
to the Yemen Arab Republic
Under Contract Number NEB-0028-S-00-2015-00**

**by
Ronald F. Layton, Ph.D., R.S.**

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LAYTON AND ASSOCIATES INTERNATIONAL, INC.

Report No. 1

Yemen Arab Republic
Operation and Maintenance Evaluation for
NWSA Activities

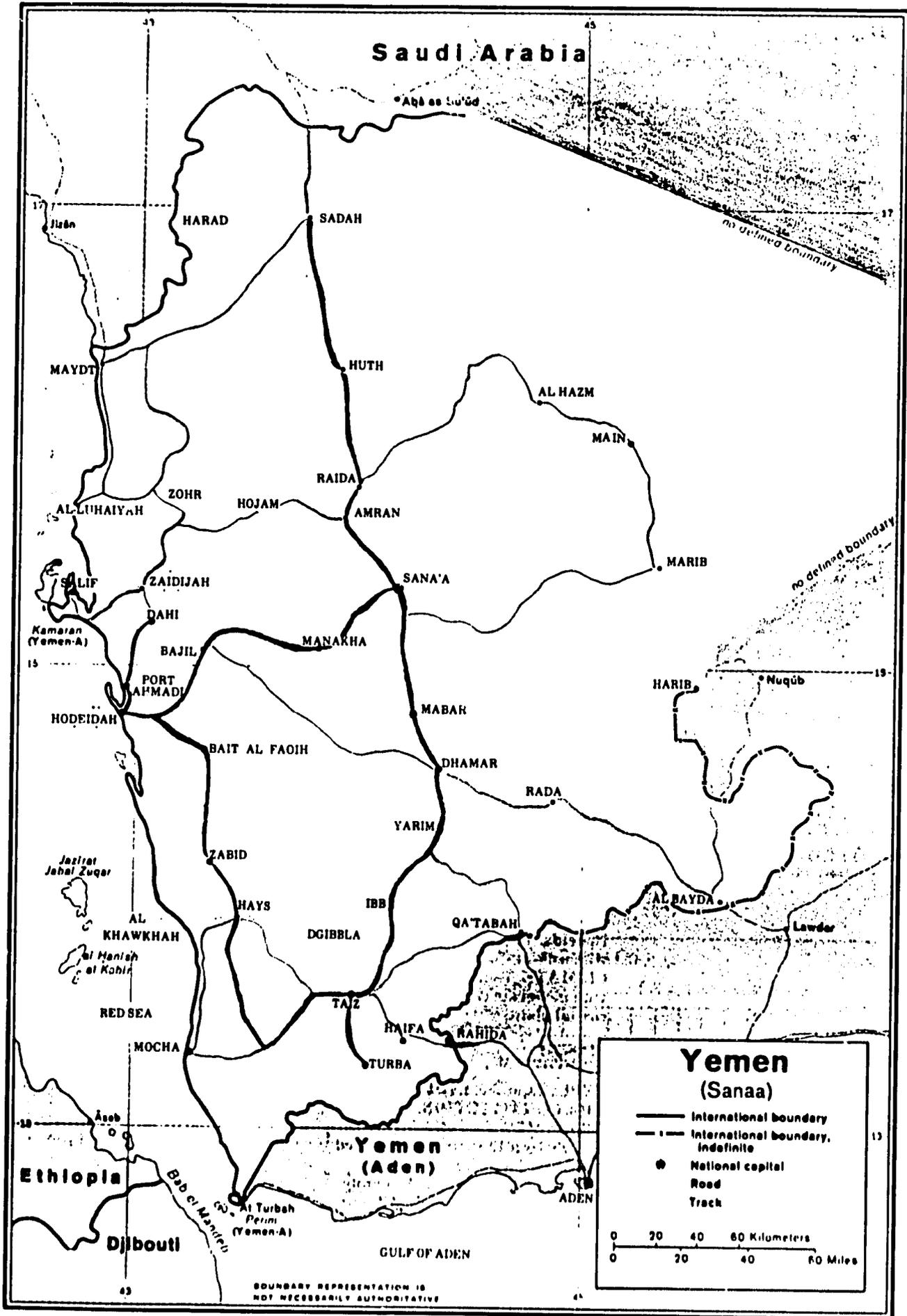
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FIGURE 1
MAP OF YEMEN ARAB REPUBLIC



EXECUTIVE SUMMARY

This project has as its goal the finding of solutions to a very complex issue: that of producing an immediate and long-term plan for the operation and maintenance needs of the National Water and Sewerage Authority (NWSA) of Yemen.

After long years of design and construction, NWSA now has the wonderful news that five new projects costing over \$250 million (total) will be completed in the immediate future. The bad news is that all five systems will arrive within the 3-month period of June-September 1982. Adding to this concern over simultaneous project completion is the realization that training in the O & M areas has been quite limited in producing both the types and quality of persons needed to operate and maintain these new plants. Complicated power generating equipment, pumps, meters, valves, storage tanks, telemetry systems, laboratories, and other equipment are now being installed without the preparation of Operational Manuals or Personnel Staffing Charts for their operation. The anticipated stoppages and other operational problems of two new sewage plants, at Taiz and Hodeidah, would present a challenge even to experienced plant operators, but Taiz and Hodeidah have not a single wastewater collection or treatment operator on their staff, which is a staggering thought! Also, no provisions have been made for the necessary tools to clean, service or maintain these systems!

The following aspects of the three complicated new water systems at Taiz, Hodeidah and Sana'a are also of great concern to NWSA:

- >intricate pumping schedules involving various elevations and "floating systems";
- >telemetry systems;
- >the installation of massive numbers of house connections and corporation stops;
- >the required laboratory monitoring; and
- >maintenance of unfamiliar electrical generating equipment as well as a new type of pump.

Evaluation of how the present situation was allowed to occur is not within the scope of this assignment; but rather, the priority of this assignment is to prepare a short-term and long-term solution to the O & M needs previously described.

This Executive Summary presents a synopsis of the overall plan which has, it seems, met the objectives of preparing a National O & M Training Plan for Yemen. A review by NWSA, the World Bank, and the U.S.AID Mission in Sana'a has found enthusiastic support of the plan and principle. The plan suggests an integrated approach to utilizing local Yemen training facilities including: the Sana'a Vocational Technical School (also known as the "German School"), the Electrical Training Center at Dhban and the Sana'a University Civil Engineering College. Immediate execution of a revised funding schedule from various donors to allow use of existing funds for this O & M training is also proposed. The establishment of NWSA's firm commitment to make this plan work by forming and strengthening the NWSA Training Branch is essential to the plan's success. Such a Branch is strongly proposed as well as the development of a program for "training of trainers." A variety of cooperative programs is outlined which would utilize (1) the "German School" to recruit and train potential water and sewage plant operators, (2) the Electrical Training Center to train persons in electrical generation and transmission, and (3) Sana'a University's new Civil Engineering College as a source for undergraduate engineers. The preparation of technical managers and administrators to handle upcoming O & M issues is addressed in a short-term series of "O & M Management Training Courses" over the next 18 months. The preparation of Operation and Maintenance manuals to be used as training documents is also considered a top priority. The preparation of detailed manpower staffing guides and preventive maintenance schedules are to be included in the O & M manuals. The listing of suitable O & M maintenance equipment for cleaning and maintaining the sewage collection system and plant will also be needed and prepared.

After the formation of a strong and viable Training Branch with four assistants for the branches of Taiz, Hodeidah, Sana'a and Ibb/Dhamar, the "Train the Trainer" program will prepare these individuals to be specialists in "hands-on" instruction of water and sewage system O & M. The revisions of the Operation and Maintenance Training Manual, in cooperation with the Yemen counterparts, will produce documents to assist in making NWSA self-sufficient in training by July 1, 1983. Perhaps most important as a major and energetic proposal is to help NWSA develop its own water and wastewater O & M School at Taiz at the soon-to-be-abandoned facilities used by the contractors during the construction of the Taiz Water and Sewerage Projects. An integrated series of events that will allow this project to be successful is proposed. Short-term "experts" who can provide instruction by working with their hands will be provided as part of the project. The recruitment of these individuals, who will have expertise in the areas of identified needs of NWSA as listed below, will be provided. Six areas of specialization include:

- Water utility O & M and Distribution Networks with Meter Installations;

- Wastewater Collection, Transport and Ultimate Disposal, with Sewer Cleaning;

- Laboratory Monitoring for Efficient Performance and Public Health;

- Electrical/Mechanical-Power Generation with Instrumentation Knowledge;

- Pumps and Lift Station Operator;

- Automobile Maintenance and Heavy Equipment O & M Specialist;

and are recognized as top priority O & M needs for NWSA. Again, the intent of the training activity is to make NWSA self-sufficient regarding its O & M needs within two (2) years. Continued use of the O & M Training Manuals, equipment and facilities at Taiz

(for O & M) and at the Sana'a Branch for laboratory control training will assist with such self-sufficiency. The Graphic Display of the O & M activity and the Chronological Listing of activities (including Costs and Funding Sources) are illustrated in numbers 4.51 and 4.52, respectively, of the following Report.

The long-term goal of NWSA is to become self-sufficient in the areas of design, construction management, statistical forecasting, training, and administrative control. Accordingly, after careful consideration, the following seven goals are suggested.

Long-Term Goals

1. Make NWSA self-sufficient in the areas of design, construction management, operations/maintenance, training, and statistical forecasting--goal 5 years.

2. And accordingly, provide Master's degree work for NWSA engineers in:

- | | |
|----------------------------------|----------------------------|
| -- structural (3) | In a 5-year period; |
| -- mechanical (3) | In a 5-year period; |
| -- electrical (3) | In a 5-year period; |
| -- environmental civil works (5) | One each year for 5 years; |
| -- construction management (5) | One each year for 5 years; |
| -- statistics (2) | In a 5-year period. |

Thus, a separate department staffed by B.S. engineers with some "apprenticeship" training with consulting firms in the branches is suggested. The M.S. degree holders above will be department heads functioning at NWSA headquarters or in some instances in the branches.

3. The restructuring of World Bank and other donor support for undergraduate support should be carefully reviewed. NWSA could offer minimum support for Yemen undergraduate engineering students

who are enrolled and in good standing as students. Students in Yemen and in other countries could enter into "contracts" with NWSA after appropriate interviews by NWSA personnel. The continued funding by World Bank, U.S. AID and other donors should not be discouraged, for it is greatly needed by NWSA. A top priority, however,--that of O & M training--suggests a greater cost/benefit ratio for these funds.

4. Encourage the support of M.S. and Ph.D. teachers in civil engineering at Sana'a University--NWSA should recruit its engineers from Sana'a University in the future, when possible.

5. In 1983, provide a Master's degree for the chief of the training department in the areas of training, manpower development and recruitment, to allow self-sufficiency in the execution of manpower growth and evaluation.

6. A long-term, six-month to one-year training program is suggested in financial management and project implementation. At least one individual from each of the branches and two NWSA head-quarter persons are suggested for this training.

7. Continue the participation in all the following activities:

| The Sana'a Vocational Technical School ("German School");

| The Electrical Training School at Dhban ("French School");

| The University of Sana'a, College of Engineering;

| The Well Drillers Institute in the Sudan;

| Various scholarships provided by donors for both O & M technical training and advanced M.S. and Ph.D. students;

| The New Taiz O & M Mechanical Training Center; and

| The New Sana'a Laboratory Training Center.

Final Remark

The immediate need for proper O & M of the Taiz, Hodeidah and Sana'a systems necessitates the implementation of training at the earliest possible time.

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1. INTRODUCTION AND BACKGROUND

The Yemen Arab Republic is involved in a massive planning and construction activity that has currently developed a water and sewerage portfolio in excess of \$650 MM. Future projections made in the 1981-86 Five-Year Plan of NSWA indicate an additional construction cost of \$211 MM for seven new towns with water and sewerage projects. Table 1 lists the current and proposed activity regarding water and sewerage. Estimates within NWSA indicate the addition of nine new Branch Headquarters to the existing Sana'a, Hodeidah and Taiz groups. NWSA, which was formed in 1973 and is responsible for towns with populations over 20,000, is a viable and growing organization that should be extremely proud of its last five years' performance. Evaluations of NWSA's efforts for the five-year period of 1976-1981 were rated overall at 87%--excellent in every regard except in the training and manpower development areas. One could ask why such a viable and energetic effort did not give more attention to its future manpower needs and the answers appear quite interesting.

First, NWSA has only 550 employees who are involved in the huge construction-grant projects listed in Table 1. It is often too easy to forget training and manpower planning for the future while struggling to manage and direct projects that involve a variety of lenders, consultants, contractors and agencies. Numerous disputes, claims and poor performance by consultants and contractors have simply pressed an already understaffed organization to the breaking point. The fact that NWSA has a very limited number of graduates (67 degree holders) in the technical, financial and administrative fields, representing only 13% of its staff, indicates the shortage of engineers, chemists and managers available for the growing list of projects.

TABLE 1.--Water and Sewerage Projects - Yemen (Layton, Jan. 82)

Name of Town	Cost of Water/Sewerage	Estimated Completion Date	Population 1975	Estimated Population 1981	Estimated Population 1986
SANA'A	\$ 60 MM Water only	June 1982	135,000	277,000	543,000
HODEIDAH	\$ 80 MM Water & Wastewater	July 1982	80,000	126,000	210,000
TAIZ	\$104 MM Water & Wastewater	Sept. 1982	78,000	119,000	193,000
IBB	\$ 9 MM Water	1985	19,000	34,000	54,000
DHAMAR	\$ 5 MM Water	1985	19,000	39,000	62,000
IBB	-- Wastewater	1985	--	--	--
DHAMAR	-- Wastewater	1985	--	--	--
AL BAIDA	\$ 57 MM Water & Wastewater	1987	--	--	--
ZABID	\$ 32 MM Water & Wastewater	1987	--	--	--
RADDA	\$ 32 MM Water & Wastewater	1987	--	--	--
HAJJA	\$ 26 MM Water & Wastewater	1985	--	2,000	41,000
SADA	\$ 21 MM Water & Wastewater	1987	--	--	--
AL MOCHA	\$ 18 MM Water & Wastewater	1987	--	--	--
SANA'A	-- Wastewater - New Project under consideration.				

NWSA also has 26% of its staff (144) or twice the number of degree-holding graduates who can not read or write! The absence of a training officer on NWSA's staff, despite continued pressure from various lending agencies, indicates the acute manpower shortage which relegated training and manpower development to a low priority which has proven to be a mistake.

A second factor directly responsible for NWSA's poor training and manpower development was the failure of Project No. 279-0028 (U.S. AID) to produce significant numbers of qualified O & M staff for NWSA. For those reasons which were thoroughly described in the September, 1981, report entitled, "Evaluation of Yemen Water Supply Systems Management Project--WASH Field Report No. 22," the proposed O & M training simply did not occur. NWSA now finds itself completing projects in Sana'a, Taiz and Hodeidah with inadequate O & M staff to operate and maintain the new facilities. Within six or seven months, and perhaps sooner, NWSA will be given direct responsibility for assuring the performance of some \$250 MM worth of new plants: <>without a single experienced wastewater plant operator to manage the Taiz or Hodeidah sewerage systems; <>without trained electrical/mechanical staff for water systems dependent upon complicated auxiliary power supplies; and <>most important, without a training and manpower development plan to correct this situation. A disaster is certain to follow without such a plan and its immediate implementation!

This report attempts to find feasible solutions to a variety of complex issues that do not have easy answers but require the expenditure of substantial capital. The old adage that "A stitch in time saves nine" truly applies to the critical and urgent training need for NWSA regarding O & M--spend the preventive costs now or spend huge amounts later as a result of poor O & M training and management.

Specifically, this report will evaluate the following items A through E, which were the terms of reference for this assignment and are as follows:

- "A. Assess source and availability of operation and maintenance instructors (from 4 to 6) to come to Yemen for approximately 12 months to run short-term (concentrated 6 weeks) training courses.
- B. Investigate possibility of coordinating short-term training program with programs of educational institutions already in existence to provide alternatives for training.
- C. Prepare proposal including manpower requirements for setting up on-the-job training programs at the plants in each of the three cities (Sana'a, Taiz, and Hodeidah) coming on line in the next few months.
- D. Review available documentation that has been prepared to date by or for NWSA regarding manpower requirements to operate and maintain its systems and review NWSA's short- and long-term training plans.
- E. Assess possibility of coordinating efforts of all donors, including AID, World Bank, Abu Dhabi and Saudi Funds, and others, in developing long-term training/institutional development plan."

The methodology for offering the following plan was to seek the advice and support of AID, NWSA, the Branch Managers of NWSA, the Consulting Engineers employed by NWSA, the Contractors at Sana'a, Taiz and Hodeidah, and particularly to seek the suggestions and support of Mr. Yasin Ismail, NWSA's new Chief Training Officer, who traveled to the various NWSA branches for on-site evaluations and interviews with this Consultant.

2. FIELD EVALUATIONS

2.1 U.S. AID Mission in Yemen

The initial thrust of this work was to obtain a clear definition of the terms of reference regarding the background data and upcoming projects, and to determine the most expeditious, yet cost-effective, way to achieve adequate O & M training for Yemen. Discussions with various U.S. AID personnel indicated the urgent need to provide technical assistance regarding O & M training and a firm commitment by the Yemen AID mission to support such an effort. A review of available training funds indicated approximately \$1,200,000 available for such O & M training (from Project 028) and perhaps additional funds that might be available from Project 043. It was this \$ estimate that was used to prepare the prioritized list for O & M training for NWSA's enormous need. Background data was also made available by the AID mission and is listed in Appendix A of this report. After discussion, the itinerary for the entire visit was prepared with concurrence of NWSA and is presented in Appendix B. A list of officials interviewed is also given in Appendix C.

The support and encouragement of Mr. Charles Ward, Mr. Zachary Hahn, Mr. Lee Young and particularly Mr. John Giusti of the U.S. AID mission in Yemen and of Mr. Justin Williams, Mr. Paul Holmes and Mr. Steve Dean of U.S. AID, Washington, is appreciated.

2.2 NWSA Headquarters Comments

A scoping session was held on the first day of the assignment with the Director-General of NWSA, Engineer M. Ali Al-Fusail, and various key individuals on NWSA's staff. The Director-General established his firm commitment to solving the O & M dilemma facing Yemen and directed his entire staff to provide an "open door"

policy in discussing the problems of NWSA which would serve the development of both a "short-term" or immediate training plan and a "long-term" plan regarding manpower development. Indeed, in all discussions with NWSA officials, his directive was followed and candid comments and suggestions were made by Headquarters and Branch personnel which comprise large portions of this report.

Although Figure 2, page ii is essentially the same information as reported previously in the WASH report of September 23, 1981, three changes have occurred in NWSA Headquarters which merit discussion since they have a potentially major influence on current and future O & M manpower development activity.

Mr. Yasin Ismail, a graduate of Public Administration from the American University of Beirut, has been appointed and has accepted the role of NWSA's Chief of Training. During the field evaluations and travel, lengthy discussions and interviews were of mutual benefit between the new Training Chief, various key individuals and the U.S. AID effort. A summary of NWSA's internal and external (out of country) training from 1979-1981 was prepared by Mr. Yasin and is included herein as Table 2. A number of persons are projected to receive training in 1982 and current commitments are found in Table 3.

Director General Al-Fusail and Chief of Training Yasin requested an evaluation of the 1979-1984 Draft Training Plan prepared by N.K. Hussein from the Sudan which was partially approved by the funding agencies. Table 4 lists this plan which was improved and updated based upon data generated during this assignment.

Agreement was reached with NWSA Headquarters that a new Training Division of NWSA be formed that will establish a Training Officer within each Branch (initially Sana'a, Taiz, Hodeidah and Ibb/Dhamar). These Training Officers will be trained as "O & M Trainers" and will serve as counterparts and ultimate replacements for contract training consultants who come to Yemen during 1982-83.

FIGURE 2
NATIONAL WATER & SEWERAGE AUTHORITY
(LAYTON, JAN. '82 - REVISED FROM WASH REPORT)

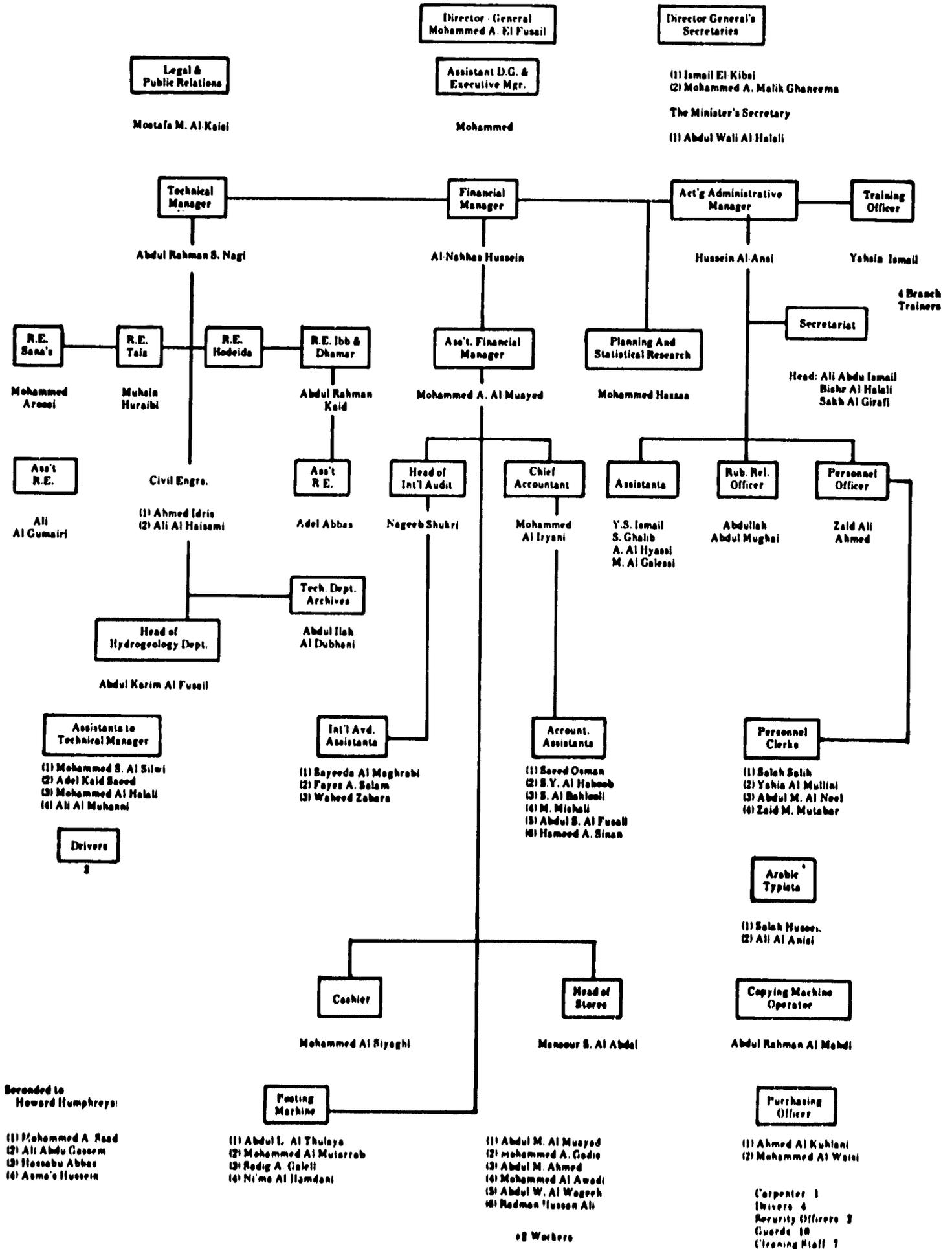


TABLE 2.--NWSA Existing Training [Internal and External Technical; Internal and External Financial]
(Source: Yasin, NWSA)

Name	Field of Training	Place	Duration		Financier
			From	To	
<u>INTERNAL, TECHNICAL</u>					
Mohamed H. Sharafi	Electricity	Sana'a Vocational Training Center	June 79	June 81	NWSA
Tawfeek Hadrami	"	"	"	"	"
Mahmood Yahay	"	"	"	"	"
Ali A. Mansour	Mechanic	"	"	"	"
Abdul Hakean Amer	Pipe Fitting, Welding & Water Networks	"	"	"	"
Abdulmalek Syagi	"	"	"	"	"
Jamal Saleh	"	"	"	"	"
Mohamed Al Matari	"	"	"	"	"
Ali Al Mamari	"	"	"	"	"
Mohamed Al Rayhi	"	"	"	"	"
Rasaam Al Zendani	"	"	"	"	"
Abdulaziz Aroosi	"	"	"	"	"
Ibrahim Al Mutweekel	"	"	"	"	"
Mohamed Atef	"	"	"	"	"
Ali Omar	"	"	"	"	"
Sharaf Amer	"	"	"	"	"
Abdulla Alama	"	"	"	"	"
Ahmed Mogbel	"	"	"	"	"
Khaled Hyder	"	"	"	"	"
Abdo Al Moeen	"	"	"	"	"
Saleh Al Raii	"	"	"	"	"
Abdo Al Salam Ali	"	"	"	"	"
Abdol Kareen Al Shami	"	"	"	"	"
Abdulla Al Matari	"	"	"	"	"
Mohamed Al Awag	"	"	"	"	"
Sharaf Ismail	"	"	Aug. 81	June 83	"
Ibrahim Sayagi	"	"	"	"	"
Ibrahim Al Dwla	"	"	"	"	"
Suliman Daood	"	"	"	"	"
Ali Omar	"	"	"	"	"
Ridwan Salem	"	"	"	"	"
Abduljabaf Saleh	General Electricity	"	"	"	"
Sadeck Alarecki	"	"	"	"	"
Nabeel Al Asri	Pipe Fitting	"	"	"	"
Naser Alasoodi	"	"	"	"	"

TABLE 2.--Continued

Name	Field of Training	Place	Duration		Financier
			From	To	
Rayd Mohamed	General Electricity	Sana'a Vocational Training Center	June 81	June 83	M/SA
Mohamed Al Haradi	"	"	"	"	"
Yahya Abdulla	"	"	"	"	"
Ameen Aledi	"	"	"	"	"
Naser Alanesi	Pipe Fitting	"	"	"	"
Ahmed Saeed	"	"	"	"	"
<u>EXTERNAL, TECHNICAL</u>					
Adel A. Saeed	Water Station Installation	Sudan, Al Magboul Institute for Ground Sciences	Feb. 81	Feb. 82	Arab Fund
Ali M. Alwagra	"	"	"	"	"
Hussain Al Marshahi	"	"	"	"	"
Noor Al Shari	"	"	"	"	"
Mohamed Al Moalimi	"	"	"	"	"
Abdulla Al Shami	Ground Water	"	"	"	"
Abdusalam Hakimi	"	"	Feb. 81	Feb. 84	"
Salah Al Ansi	Water Control	"	"	"	"
Abdulrahman Kaced	Sanitary Engineer	Britain	Jan. 81	June 82	The British Council
Ali Hamood	Civil Engineer	Holland	Oct. 80	Oct. 81	Holland
Abdulla Al Matwakel	"	Romania	May 80	1984	Ministry of Education
Mohamed Ahmed	"	Romania	May 80	1984	"
Ali Gobari	"	Syria	1979	1983	"
Adel Abaas	Evaluation of Tender Documents	Syria	1975	1981	"
Galal Hirwee	Civil Engineer	Germany - Dorsh Consult	Mar. 81	May 81	Dorsh Consult
Ali A. Aziz	Civil Engineer - Wastewater Systems	U.S.A.	Oct. 80	Sep. 85	U.S.AID
Mohamed Al Aroosi	"	U.S.A. - Layton and Associates	Sep. 81	Nov. 81	"
Mohamed A. Razzak	"	"	"	"	"
Bishr A. Al Halali	"	"	"	"	"
Adel Kaid	Hydrology	Britain	Sep. 81	Nov. 81	British Council
Mohamed Al Mahdi	Civil Engineer	Britain	June 81	June 83	"
Esam Maki	"	U.S.A.	Sep. 81	1984	World Bank
Mohamed Sakkaf	Mechanical Engineer	U.S.A.	Sep. 81	1984	Ministry of Education
Said Mutaher	Civil Engineer	U.S.A.	Aug. 81	Sep. 83	U.S.AID
Hussain Al Huoti	"	U.S.A.	Sep. 80	1985	World Bank
Ahmed Idris	Structural Engineer	Cairo	Sep. 78	Sep. 82	Ministry of Education
Ali Al Haisami	Sanitary Engineer	U.S.A.	Sep. 79	Dec. 81	U.S.AID
Yahya M. Zabara	Sanitary Engineer	U.S.A.	Sep. 79	Dec. 81	U.S.AID
Abdulmalek Dalal	Civil Engineer	U.S.A.	Dec. 79	"	World Bank
Hussain Al Wageeh	Civil Engineer	Syria	Sep. 80	1985	Ministry of Education
		Cairo	Sep. 79	1984	Ministry of Education

TABLE 2.--Continued

Name	Field of Training	Place	Duration		Financier
			From	To	
<u>INTERNAL, FINANCIAL</u>					
1. Mansour Shamiere	Programing	NWSA Headquarters Office - (TMSI)	4 months starting Nov. 30		U.S.AID
2. Samira Alwan	"	" "	"		"
3. Hameed Sinan	Use of Computer output and preparation of input	" "	"		"
4. Abdulkareem Makathi	Operation and Programing of 7500 Batching Procedures	" "	"		"
<u>EXTERNAL, FINANCIAL</u>					
1. Saeed Othman	Finance Analysis	U.S.A.	Apr. 80	1982	"
2. Mohamed Al Mooaid	Accounting	Cairo, Alexandria Water Authority			NWSA
3. Najeeb Shookri	Auditing	" "	Apr. 80	1982	"
4. Shadiya Mufareh	Computer Programing		1981	1983	Ministry of Education

Additional Note from Yasin's data:--NWSA sent 10 employees to the British Council to attend a course in the English language in order to meet job requirements.

TABLE 3.--1982 Yemen Training Commitments - as of Jan. 15, 1982 (Layton, Jan.82)¹

Item	No. of Trainees	Subject Area	Location	Funding By
1	7	Water Station Attendants	The Sudan - Al Magboul Institute	Arab Fund
2	3	Wastewater Management	U.S.A.	U.S.AID
3	2	Post Graduate - Accounting	Great Britain	British Council
4	1	Post Graduate - Hydrology	Great Britain	British Council
5	2	Civil Engineering	Romania	Ministry of Education
6	2	Civil Engineering	Syria	Ministry of Education
7	1	Civil Engineering	U.S.A.	World Bank
8	1	Civil Engineering	U.S.A.	Ministry of Education
9	1	Mechanical Engineering	U.S.A.	U.S.AID
10	1	Civil Engineering	U.S.A.	World Bank
11	1	Civil Engineering	Egypt	Ministry of Education
12	1	Civil Engineering	Syria	Ministry of Education
13	1	Civil Engineering	Egypt	Ministry of Education
14	4	Computer Programing	NWSA - HQ	U.S.AID
15	1	Finance Analysis	U.S.A.	U.S.AID
16	1	Accounting	Egypt	NWSA
17	1	Auditing	Egypt	NWSA
18	1	Computer Programing	NWSA - Branch	Ministry of Education
TOTAL	32			
Long Term (>2 years) = 22				
Short Term (<2 years) = 10				

¹For additional reference, see Table 2.

TABLE 4.--Draft Form of Proposed (non-Approved) NWSA Training Plan - 1979-84
(Source: NWSA)

Name and Title of Post	Nature of Study/Training	Replacement	Recruitment		Remarks
			79/80	80/1/1 83/4	
			<u>79/80</u>		
Sanitary Engineer	Sanitary Engineering	Not required			Nominee is not occupying a tech. position at time being.
Structural Engineer	Structural Engineering	Available			
Personnel Officers	Non-Academic	"			
Admin. Assistants	"	"	2		Secondary School graduates.
Accountants	"	"			
Cost Accountants	"	"			
Accountants	B.Sc.		3		Commercial Sec. School graduates to replace the three accountants who are earmarked to go for undergraduate study course on F. R. of Germany Scholarship.
Purchasing + Whse Manager	Non-Academic		1		Secondary school graduate minimum 5 years experience in warehousing + domestic and international purchasing.
Store Keepers	"	"			
Kardex File Clerks	"	"	2		Secondary school graduates.
Hydrogeologist	Academic	"			
Civil Engineer	B.Sc. (Civil Eng.)		7		Secondary school graduates to replace the seven candidates who are earmarked to go for undergraduate study course on F.R. of Germany scholarship.
Distribution Supt. (W)	Non-Academic		1		Secondary Technical School.
Foreman (W)	"		1		"
Plant Operation Supt. (W)	"	Available			
Pumping Station Operators (W)	"	"			
Apprentices	"		30		Preparatory School graduates who will join Sama's Vocational Training Centre in September 1979.
			<u>80/81</u>		
Branch Manager	Public Utility Managem't	Available			
Branch Manager	"	"			
Public Relations Officer	Non-Academic	"			
Translator	"	"	1		Secondary School graduate.
Personnel Manager	Academic	Available			
Personnel Officers	Non-Academic	"			
Admin. Assistants	"	"			Secondary School graduates.
Education and Training Officer	Academic	Available			
Financial Manager	"	"			
Chief Accountants	Non-Academic	"			
Accountants	"	"			

TABLE 4.--Continued

Name and Title of Post	Nature of Study/Training	Replacement	Recruitment		Remarks
			79/80	80/1/3 83/4	
<u>82/83</u>			<u>82/83</u>		
Branch Manager	Public Utility Managem't	Available			
A/Branch Manager	" "	"			
Insurance + Compensation Officer	Non-Academic		1		Secondary School graduate.
Safety Security Officer	"		1		" "
Accountants	"	Available			
Purchasing Officers	"		2		" "
Store Keepers	"		2		" "
Kardex File Clerks	"		2		" "
Sanitary Engineers	Academic	Available			
Hydrogeologist	"	"			
Treatment Plant Operators (Sewage)	Non-Academic		6		Secondary Technical School graduates.
Meter Inspectors	"		5		" "
Lab Assistants	"		12		Preparatory School graduates.
<u>83/84</u>			<u>83/84</u>		
Personnel Officers	Non-Academic	Available			
Admin. Assistants	"		2		Secondary School graduates.
Chief Accountants	"		2		Commercial Secondary School graduates.
Accountants	"		3		" "
Sanitary Engineers	Academic	Available			
Senior Supt. (Sewage)	Non-Academic		2		Technical Secondary School graduates.
Foremen (Sewage)	"		2		" "
Treatment Plant Operators (Sewage)	"		16		" "
Distribution Supt. (W)	"		2		" "
Foremen	"		2		" "
Pumping Station Operators (W)	"		6		" "
Plant Operation Supt. (W)	"		2		" "
Repairs + Maint. Foremen	"		2		" "
Pipe Fitters	"		16		Vocational Training Centre graduates.

NOTE: Information in this table is presented as received by the author of this report from MWSA.

A special program of three months for training of the Chief Trainer plus the four Branch O & M Trainers is included as a critical part of this proposal. There is currently no one in the NWSA organization who appears capable of performing manpower forecasts, preparing "hands-on" instructional aids, performing on-the-job O & M instruction, evaluating training effectiveness and developing cost estimates regarding training. The coordination of this training will follow the Lenders' Conference in March, 1982, and will allow (1) participation in both the preparation of the Operation and Maintenance Training Manuals (proposed to begin March 1, 1982) and (2) participation in the formal long-term classroom and on-the-job training scheduled (proposed to begin June 15, 1982). A self-sufficient, Arabic course of instruction should be available by December, 1983, allowing withdrawal of the contract training consultants from the on-going training activity at that time. A discussion of the sequential training plan will be given later, but the establishment of the NWSA Training Branch is an important milestone in solving the O & M problems of Yemen!

The second important change (Figure 2) of the NWSA Headquarters is the information regarding the "draft" 5-year Plan for NWSA which was compiled by the newly formed Planning and Statistical Research Department under Mohammed Hazzaa. Information from that plan is included throughout this report and information regarding NWSA's manpower needs were forecast from information gathered from the Branches and Headquarters of NWSA.

As mentioned earlier, NWSA is expected to expand from three Branches of Sana'a, Taiz and Hodeidah to the total of twelve, as listed in Table 1. During that growth period, personnel will increase from the current 550 employees to an estimated 1446 persons, as shown in Table 5. An interesting observation was made with the aid of Mr. Hazzaa concerning the qualifications of NWSA personnel as is illustrated in Table 6--the planned continued use and actual

TABLE 5.--Projected NWSA Growth 1981-86

Location: Branch or HQ	Number of Personnel	
	1981	1986
Headquarters	128	180
Sana'a Branch	144	} 650 Total
Taiz Branch	168	
Hodeidah Branch	110	
Ibb/Dhamar/Hajaa	--	
7 New Towns/Branches	--	380
Totals	550	1446

TABLE 6.--Current and Projected Qualifications of NWSA Staff

Type of Qualifications	1981		1986	
	Number	%	Number	%
University Graduates	67	13	195	13
Secondary School Graduates	80	14	245	17
Preparatory School Graduates	43	8	160	11
Primary School Graduates	42	8	120	8
Can Read/Write only	174	31	345	24
Cannot Read/Write	144	26	355	25
Estimated additional people in 1986			26	2
Totals	550	100%	1446	100%

increased use of persons who cannot read or write. This would not be a good management practice and should be reconsidered. The establishment of "career ladder development" where laborers and other beginning workers at NWSA can achieve promotions and increased responsibility through hard work and self-improvement will benefit the entire organization, including the new workers. The lack of reading and writing skills prevents such development and damages the overall effectiveness of NWSA. An unsuccessful attempt was made to gather data which would estimate the future manpower needs of NWSA by job classification and should be prepared as part of future O & M Manual preparation. From compiled data and subsequent discussions in the three major Branches, a National O & M Training Plan was developed and is presented in section 4 of this report.

The specific training needs of NWSA Headquarters are felt to involve training personnel in various disciplinary skills to make NWSA Headquarters and its branches self-sufficient within five years. Careful selection of recipients of grants and scholarships should involve mechanical, electrical, structural, environmental and civil engineering students who agree to study for an advanced (Master's) degree in an area of need to fill NWSA's quota. The donor funding of undergraduate degrees should be discouraged because of the long-term and costly aspects of such funding when compared with other incentive programs used by NWSA to "contract" with undergraduate level engineers in the open market. The Training Plan, as discussed later, incorporates these ideas. The training of the top management of NWSA in financial matters and construction grant management is also advised. Personnel administration and statistical expertise to strengthen the newly formed Planning and Statistics Branch is encouraged.

2.3 Taiz Branch Comments

The Taiz Branch was visited and interviews held, facilities toured, plans reviewed and the conclusion reached that Taiz is an

ideal location for a National NWSA Training activity! Discussions with Branch Manager Ali M. Abdul-Aziz indicated additions to the existing "Kennedy Water Yard" will provide drinking water for a 1998 design horizon of 180,000 persons. A total of 21 wells, capable of delivering 10 to 25 liters/second, will utilize vertical turbine Worthington pumps with motors that range from 15 to 60 horsepower. Some 34 kilometers of primary mains from 150 to 600 mm in diameter and 50 kilometers of 100 mm secondary lines will be completed by September, 1982. Complicated pumping schedules from the Al Haima valley, located some 18 kilometers north of Taiz, as well as adjustment of flows from the five concrete storage tanks cause concern for the proper O & M of the new system. The electrical generating equipment at the Al Haima Generator Station (Detroit Diesel/Southern Cross) and the five power generators at the sewage pumping stations will require training of the Taiz Branch personnel in electrical operations. The forty fire hydrants, chlorination equipment and water meters will require training in water plant operations and maintenance via a special course of instruction.

The existing wastewater system of Taiz has never been operated by the Taiz Branch and, accordingly, reorganization and new departments may be required. Small diameter sewers and anticipated stoppages caused by sand and general misuse by the public will require extensive sewer maintenance and cleaning, an activity that has not been performed in the past. The absence of: <>staffing guides; <>various pieces of sewer maintenance equipment; <>operational guides; and <>individuals with a general knowledge of sewage collection or treatment indicates the severity of the O & M issue at Taiz. The management of this Branch appear to be diligent and hard working. Their efforts since the 60's to maintain equipment files, perform some maintenance and keep a steady supply of water to Taiz residents is commendable. Laboratory equipment and training, sewer cleaning equipment and training, upgrading of the

FIGURE 3
TAIZ BRANCH ORGANIZATION
 (LAYTON, JAN. '82 - AFTER WASH REPORT)

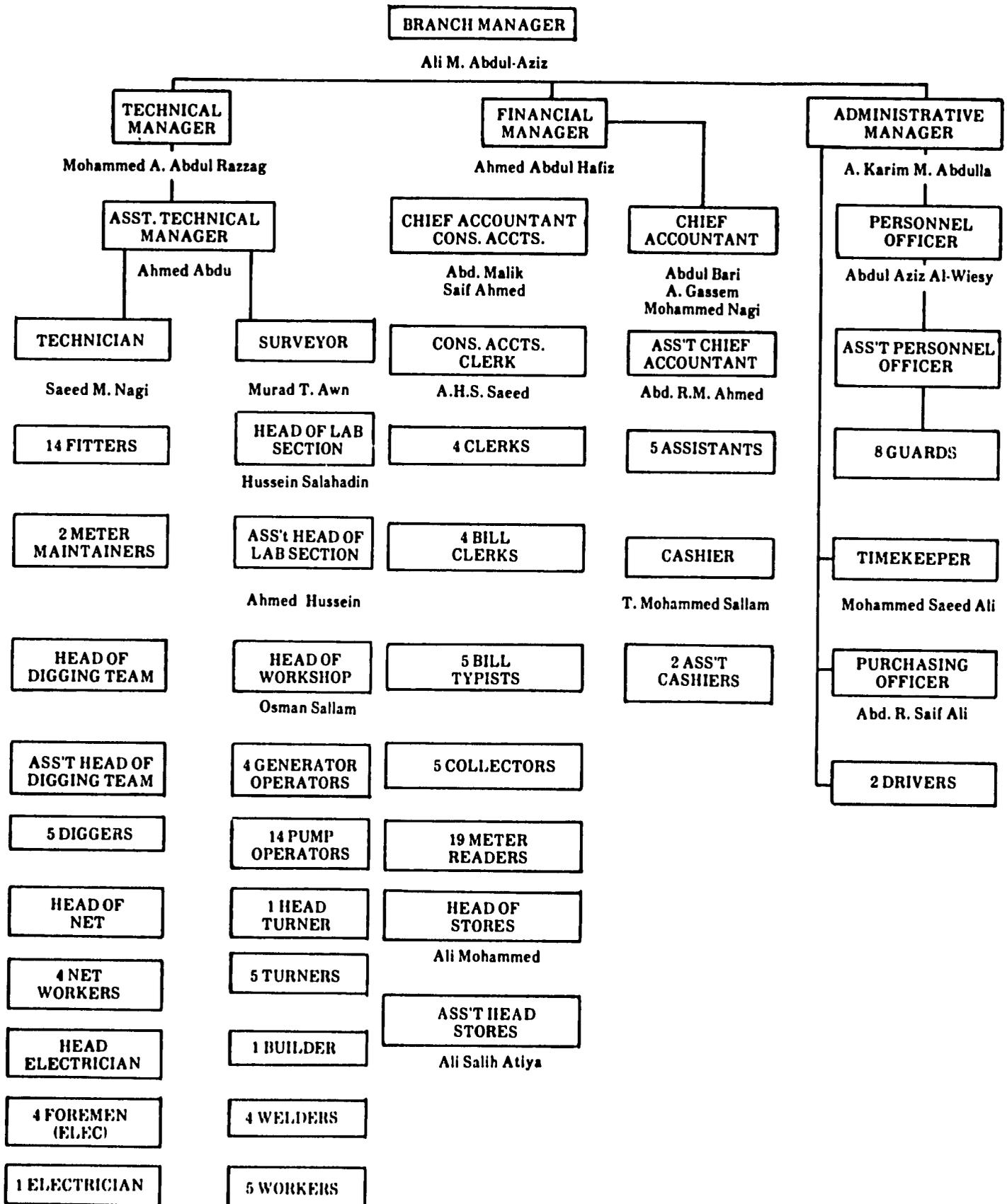
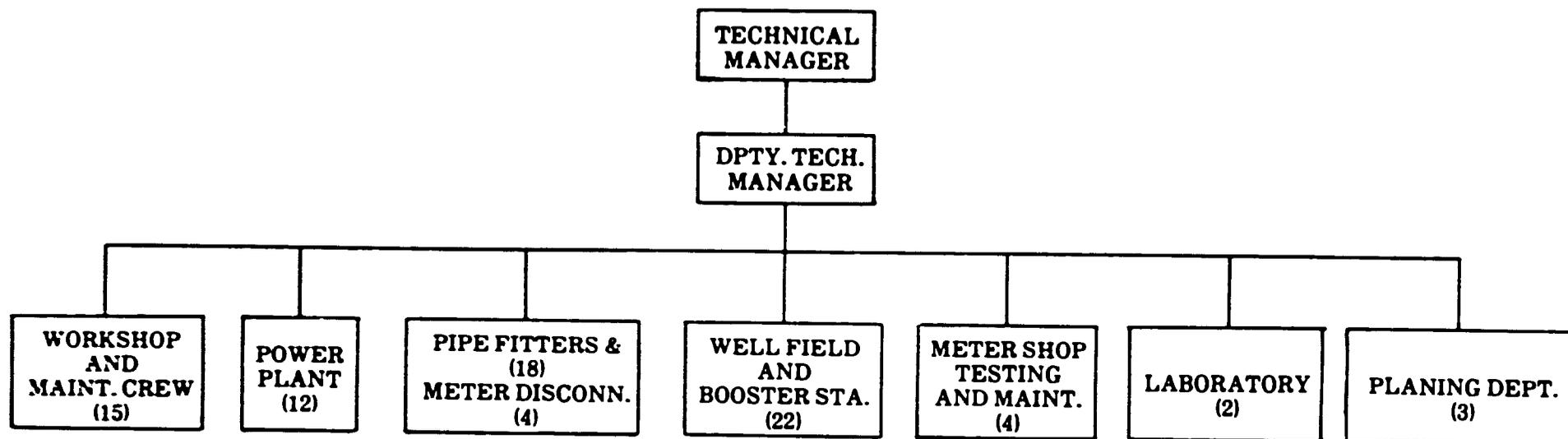


FIGURE 4

TAIZ—TECHINICAL BRANCH (SOURCE: NWSA)
(LAYTON, JAN. '82)



existing water meter shop and new knowledge of electrical generators and pumps must be accomplished if the system is to function as designed. A list of equipment suppliers with the authorized time for "start-up" of the particular equipment is given in Table 7. It is suggested that the suppliers visiting Yemen be asked to provide instruction while starting up their equipment! This should be done in close coordination with the Branch Training Officer. Taiz water and wastewater systems, now estimated to be 80% completed, come on-line about September, 1982--in just seven or so months--at a projected cost of \$104 MM. THE SYSTEM MUST HAVE O & M GUIDANCE TO FUNCTION.

2.4 Sana'a Branch Comments

Various visits within the Sana'a Branch (organization chart presented in Figure 5), including the Technical Department (detailed in Figure 6), various wells, storage tanks, meter shops, laboratories, etc. resulted in this consultant's judgment that this Branch is also unprepared to assume responsibility for O & M of the new water supply system nearing completion. Portable power generation equipment, new chlorination equipment, the installation of some estimated 25,000 to 30,000 new house connections with water meters are all areas of concern. The 12 to 15 new wells, the new pumps, the ductile iron and PVC distribution system, the new reservoirs and the new laboratory are all areas of manpower needs. Discussions with the Contractor, the Consulting Engineers, the "Technical Advisor" (TMSI), and the NWSA Project Officer confirm this concern about the Sana'a Branch's ability to handle the new system. The complexity of the pumping schedules for the new system, the lack of an O & M Manual, and the shortage of skilled operators will necessitate excellent O & M training! The drawdown of the well field water level and the lack of water quality monitoring data are also important considerations. The highlight of the

TABLE 7.--Taiz Water Supply and Sewerage Project - Suppliers

Equipment & Supplier	Authorized Time for Start-Up
WATER DISTRIBUTION PUMPS Worthington Pump Corp. 65 Springfield Ave. Springfield, N.J. 07801	Field Engineers for 60 days.
CHLORINATORS Wallace and Tiernan 25 Main St. Belleville, N.J. 07109	Field Engineer for 10 days.
WATER METERS Sparling Envirotech Corp. California	Field Engineer - no time specified.
WELL PUMPS Worthington Pump Corp. 65 Springfield Ave. Springfield, N.J. 07801	Field Engineer for 20 days.
POWER GENERATION EQUIPMENT Southern Cross 71 Vanderbilt Ave. New York, N.Y. 10017	Field Engineer for 60 days. (Engines are Detroit Diesel, Lima Alternators)
SWITCHGEARS Southern Cross 71 Vanderbilt Ave. New York, N.Y. 10017	Field Service Engineer for 10 days. (Switchgears manufactured by Euclid)
TRANSFORMERS Niagara P. O. Box 233 Buffalo, N.Y. 14225	Field Service Engineer for 15 days.
AL HAIMA SUB STATION Tatman-McGraw Edison N.E. Power Agencies 60 Seventh Ave. New York, N.Y. 10001	Field Engineer for 10 days.

TABLE 7.--Continued

Equipment & Supplier	Authorized Time for Start-Up
PRESSURE REDUCING AND ALTITUDE VALVES Ross Valve Manufacturing 10 Oakwood Ave. Troy, N.Y. 12181	Certain altitude valves have been relocated and will require re-calibration by Field Engineers.
COMMUNICATION EQUIPMENT Motorola, Inc. Communication Division 85 Morriston Road Glen Rock, N.J. 07452	Field Engineer for 10 days, if required.
OVERHEAD LINES H. Foy	Field Engineer may be required for maintenance period.

Comments

Water Distribution Pumps and Well Pumping Equipment - (Supplier Worthington): No contractual obligation, but service engineer (or infi-drive system at main yard) would be of assistance to NWSA for maintenance purposes.

Chlorinators - (Supplier Wallace and Tiernan): No contractual obligation, maintenance of system could require instruction and is recommended.

Water Meters - (Supplier Sparling): Definite contractual obligation to provide a service engineer to supervise the installation and calibration when operational.

Power Generation - (Supplier Southern Cross): A service engineer is required to perform the pre-checks commissioning and basic operational instruction.

FIGURE 5

SANA'S BRANCH ORGANIZATION
(AFTER WASH REPORT, SEPT. '81)

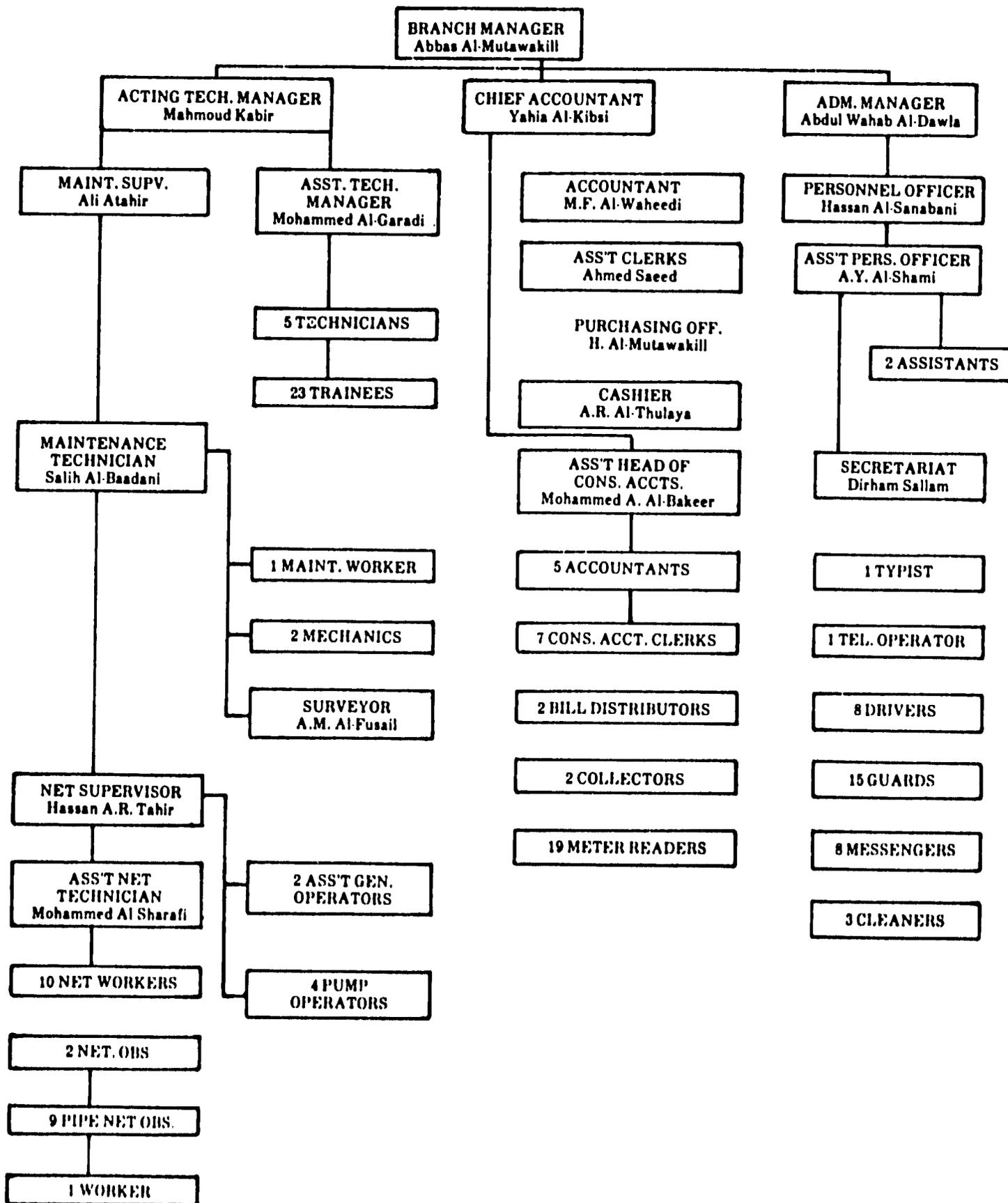
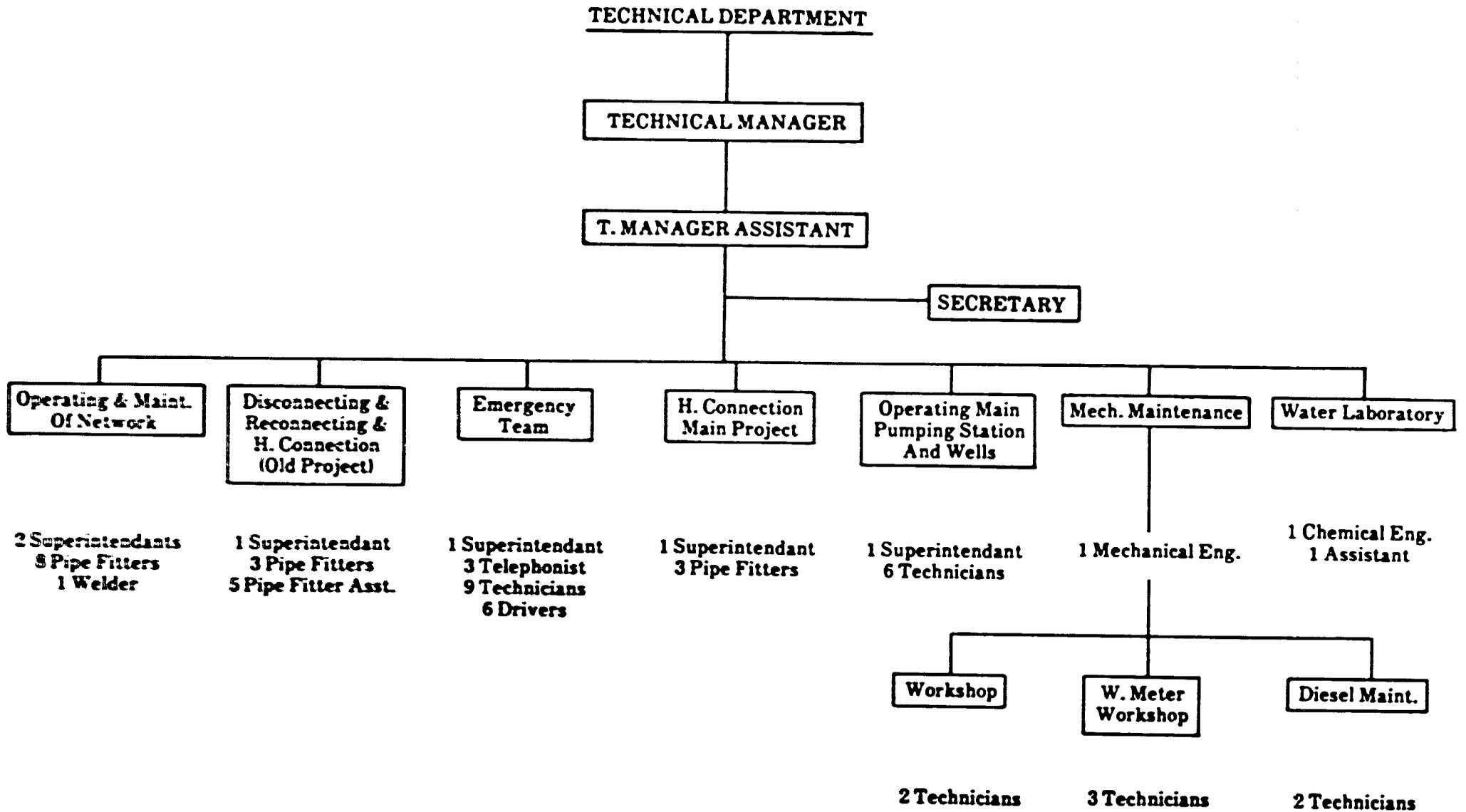


FIGURE 6
SANA'S BRANCH - TECHNICAL DEPARTMENT
(LAYTON, JAN. '82)



Sana'a Branch visits was the excellent Analytical Laboratory (with approximately \$100,000 worth of equipment)--this facility will be an excellent future Laboratory Training site.

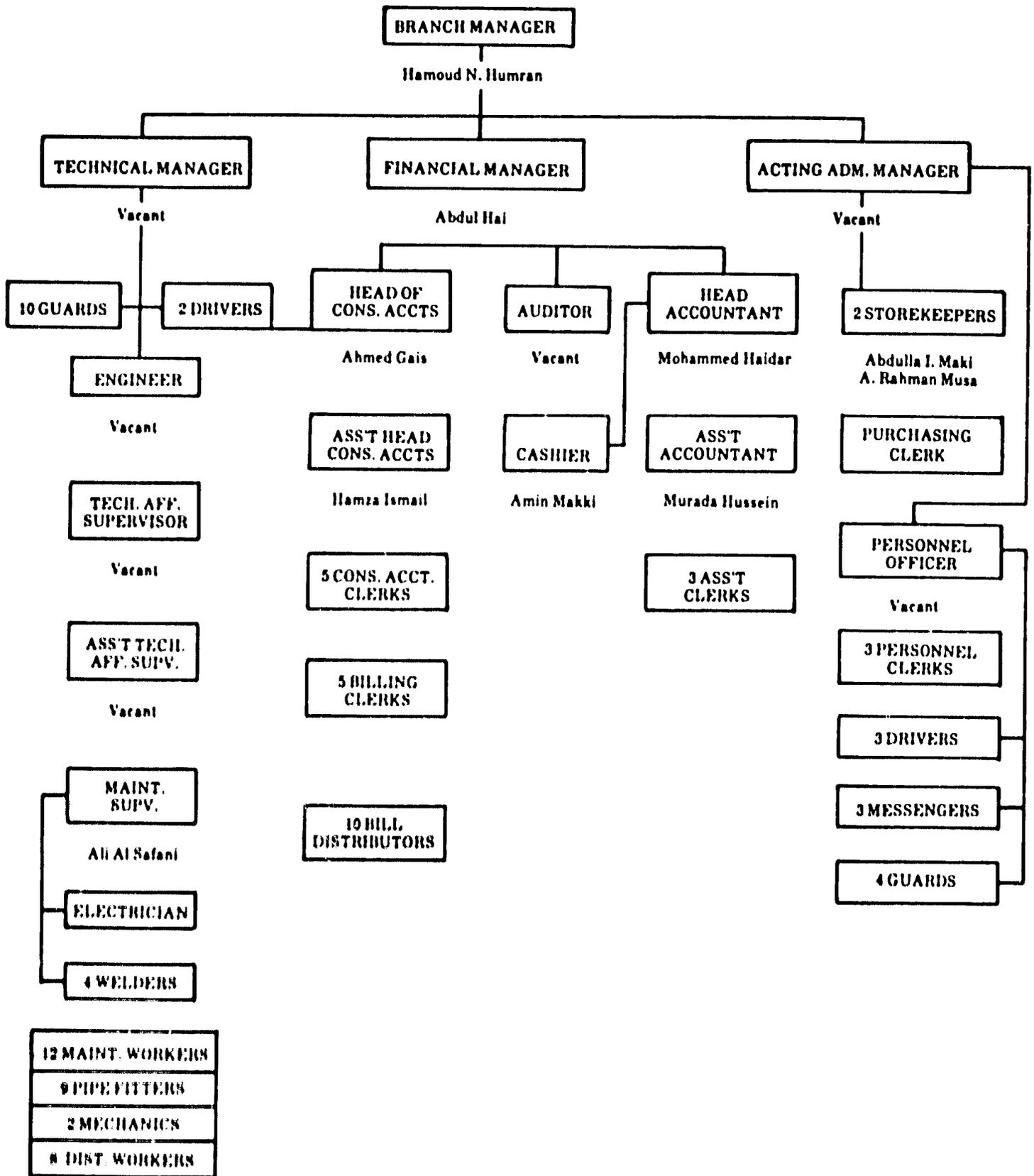
The Sana'a water project, costing approximately \$32 MM, will come on-line in July, 1982--again indicating the urgency of the need for a National O & M program.

2.5 Hodeidah Branch Comments

The Hodeidah Branch was the last visited and is the branch that is in an almost desperate O & M situation. Figure 7 is an organizational chart for the Hodeidah Branch which indicates the total lack of a Technical Department. The Technical Manager, Chief Engineer, Technical Affairs Supervisor, Acting Administration Officer, Auditor and the Personnel Officer positions were ALL vacant at the time of the January 1982 visits. There appears to be an almost total lack of qualified staff below the Branch Manager, Engineer Humran, who incidentally appears energetic, hard working and proud that Hodeidah has essentially built a new city with water, sewerage, electricity and roads coming on-line simultaneously.

No water quality testing was being done in Hodeidah, a city with extremely high salinity levels (too salty to drink!). The lack of O & M was obvious at the old well fields. The water system well field now being completed should involve some 14 production wells and will pump to a remote elevated storage tank (5,500 m³) that will gravity feed the town supply approximately 16 kilometers away. Electrical power for the wells will originate from a portable generator near the elevated storage tank since overhead power lines to the site have no definite installation timetable. There will be no standby power in case of failure of the single generator, which is a potential disaster for the operability of the system! Simply stated: **THE SINGLE GENERATOR MUST**

FIGURE 7
 HODEIDA BRANCH ORGANIZATION
 (LAYTON, JAN. '82 - REVISED FROM WASH REPORT)



FUNCTION! It can do so only with excellent and continuous O & M. The variety of Danish, German and Italian equipment in the system is also a concern--particularly since the Contractor is a Korean firm whose members speak little Arabic and there appears to be no arrangement for start-up by the equipment suppliers. The potential infiltration of salt-water into both the water and sewage lines could be anticipated at a later time and will require monitoring. There is at this time no monitoring capability in Hodeidah, a situation which should be corrected.

The water project is estimated for completion in late May or June, 1982, again indicating the urgency of the training issue. Large numbers of water meters and water and sewage house connections will be required after plant start-up. It was observed that a five-person crew could complete 10 to 12 sewage house connections each day and a twelve-person crew could complete approximately 25 water house connections each day. Approximately 13,000 water and sewage connections may need to be made immediately after plant start-up.

The sewage collection system utilized three pumping stations that pump a distance of some 20 to 25 kilometers from the town to seven lagoons, followed by chlorination and land disposal. Misuse of the sewers and the manhole covers (each with approximately 12, one-inch diameter holes) will allow sand and grit into the system, causing anticipated stoppages. With approximately 5,220 manholes in the system and the discharge pipe from houses averaging 300 mm flowing into a 150 mm sewer, blockages are sure to occur. The current situation with unavailable sewer maintenance and cleaning equipment must be remedied and should be included as part of the O & M Manual preparation. The laboratory monitoring of the sewage plant performance should be conducted which will necessitate new laboratory equipment to be identified as part of the O & M Manual.

The Hodeidah Branch will assume responsibility for a new water and sewage system in June, 1982 (now 78% completed) for which it has neither the personnel or the equipment. The cost of the systems is anticipated to be approximately \$75 MM--O & M TRAINING MUST START NOW!

2.6 Ibb-Dhamar and Other New Branch Comments

Both Ibb and Dhamar were visited on trips to Taiz and Hodeidah. These towns have water and sewerage projects that will soon begin construction and be completed in 1985. Many of the problems mentioned for these two and the other seven new branches as listed in Table 1 will reoccur unless adequate planning is begun now regarding staffing and O & M requirements. Specific comments are given in the Summary and Conclusions section in that regard.

3. ON-GOING EDUCATIONAL AND TRAINING ACTIVITY

3.1 General Observations and Comment

With Yemen's population of six million inhabitants who are predominantly scattered in many distant and remote locations, it is not surprising that an acute shortage of technical skills prevails. Since Yemen depends almost entirely on wells and ground water supplies, it is also not surprising that NWSA experiences O & M difficulties regarding wells, pumps, and power equipment to operate pumps.

NWSA has an excellent history of recruiting engineers for water pumping, treatment and distribution. Whether the stigma associated with wastewater treatment observed in other Islamic countries will occur in Yemen is uncertain. With the new wastewater plants at Taiz and Hodeidah will come the initial exposure to this potential problem for Yemen. The past success of NWSA to "contract," on the local market, engineers is a consideration that led to the comment in the Conclusions section regarding elimination of scholarships for undergraduates.

Initial Technician training for pipefitters and mechanical-electrical specialists at the Sana'a Vocational School (German School) and at the newly formed Electrical Training Center at Dhaban (Sana'a) appears very promising and will be reviewed in this section of the report. Initial efforts at on-the-job training (OJT) with Contractors and Consultants, as well as the attempts of "theoretical," non-practical oriented "advisors," have been less than acceptable. Other, more promising programs, both past and future, will be detailed.

The Initial Impressions gained in this study are that the Yemen people, as a whole, are hard-working, alert, cooperative, friendly and extremely capable of working with their hands--a combination that should lend itself to excellent O & M training success!

3.2 Comment on Past Training Efforts

A recent Contract for Training through U.S. AID (Project 028) which was initiated in May of 1979 was to provide the basis for NWSA's long- and short-term training in the O & M of water and wastewater systems. Unfortunately, for reasons that are adequately addressed in the WASH Report No. 22 of September, 1981, the much desired and needed O & M Training simply has, to date, not occurred. The establishment of Yemen counterparts to whatever "technical advice" was given under this contract likewise did not occur. Discussions with NWSA and its Branches indicated that the persons who actually traveled to Yemen had, perhaps, excellent theoretical knowledge but lacked the practical skills to do training that was "hands-on," or that involved demonstrations followed by participation of the trainees to duplicate the task. The Sana'a Branch Manager spoke of a power failure that was allowed to stop the entire City water supply for 24 hours, while both the electrical O & M "advisor" and the Branch Engineer struggled with the proper sequence of restarting the equipment. Upon return of an experienced long-term NWSA electrical-mechanical specialist of the Branch, the system was returned to normal operation within minutes. This event does not speak well of either the advisor or the Branch and indicates that PRACTICAL, EXPERIENCED, OPERATIONALLY ORIENTED trainers must be secured for O & M Training in Yemen, rather than Engineers or theoreticians! Comments by the Taiz Branch personnel indicated a similar lack of ability by the "advisor" to perform day-to-day maintenance tasks on water and sewage equipment. The Hodeidah Branch indicated that the total time spent by the technical advisors under the contract was negligible, as was the "training" performed. For whatever reasons, Yemen is now faced with start-up of three water systems and two wastewater systems without adequately trained O & M specialists. There is, however, still time, but immediate action must follow to meet the rapidly approaching deadlines of early summer.

3.3 Comments on Current Training Efforts

3.31 The Sana'a Vocational School (German School).--

The Sana'a Vocational School is often called the "German School" because it is a cooperative effort between the Ministry of Education, NWSA, the World Bank and the German Government. The School, which was founded in September, 1979, graduated its first students in June of 1981. Approximately \$6 MM has been spent to establish what appears to be an excellent training institution that in a two-year period trains technicians in six areas of study, which are: (1) Electricity, (2) Plumbing and Welding, (3) General Mechanics, (4) Building Trades, (5) Carpentry and (6) Auto Mechanics. There are 24 students in each of the six areas of study, or 144 students in the first year and the same number in the second year for a total of 288 men (no women) in training. There is an attrition rate of approximately 30% during the course of study. The students attend classes from 8:00 A.M. to 2:00 P.M. in the winter and from 7:30 A.M. to 1:30 P.M. in the summer. The students are also paid a stipend of 150 YR and are provided a hot meal. There are seven instructors and a director. A combination of expatriate instructors (Egyptian, etc.) and Yemen instructors (who were trained in Germany) are paid \$1,500 and \$1,000, respectively, per month. Twenty-four persons have been trained for NWSA as pipefitters (16), electricians (4), vehicle maintenance man (1), and surface explorers (3). Unfortunately, the first graduates were placed with contractors on the Sana'a, Taiz and Hodeidah projects to receive additional on-the-job training. Since none of the contractors' construction contracts provided for training, these men who can become the nucleus of NWSA's technician and operations staff are currently disgruntled because they spent two years in a difficult training program to now only be allowed to stand by and watch and not to actually perform. Several conclusions can be reached about this school's success.--

First, a viable long-term permanent school can be established for technical skills similar to the academic levels required for water supply and wastewater treatment personnel. This can be done by first establishing a center, then training the counterpart "Trainer" and eventually preparing the Yemen counterpart instructors to assume responsibility for the center. A similar proposal is suggested for NWSA at Taiz and can be even more successful than the "German" school for the urgency of the need is far greater.

Second, the retraining or additional training of the first (June 1981) 24 graduates of the German School is important because their success and performance can stimulate or destroy the incentive of others who may choose to follow in their footsteps. Accordingly, a short-term, three-month "hands-on" (or OJT) course in Jordan is recommended on how to operate pumps, meters, valves, etc. for water and sewerage systems.

The continued cycling of 24 persons through this school is an important part of the recruitment strategy for establishing a long-term school at Taiz for NWSA. The excellent curriculum which, incidentally, was reviewed in detail during the visit (although not sufficient for handing over complicated pieces of equipment to the graduates), is very acceptable for producing trainees who can then specialize in electricity at the Electrical Training Center at Dhban (Sana'a) (the French School) or in water systems O & M/ Sewage Systems O & M at NWSA's new school at Taiz. Details will follow in the Training Section. The Training Aids, Materials, Staff and Curricula for both the German and French Schools are considered to be excellent from the viewpoint of one who has served on numerous accreditation team visits for technical training schools throughout the United States and who served as President of an internationally known water and wastewater technical school for some eight years.

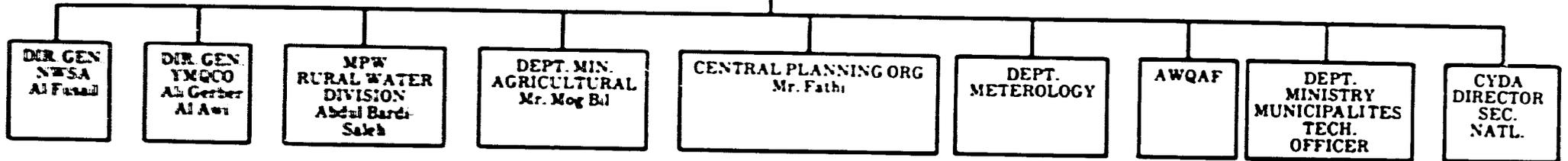
3.32 Electrical Training Center at Dhaban (Sana'a)

(French School).--An evaluation visit was made to the newly completed Electrical Training Center at Dhaban in the outskirts of Sana'a. The intent of this visit was to evaluate the applicability of NWSA personnel attending this school which is a cooperative effort between the Ministry of Education, the Ministry of Electricity, Water & Sewerage and the French Government. Since NWSA is an important part of the High Commission for Water, which is chaired by the Ministry of Electricity, Water & Sewerage (Figure 8), it is entirely possible that NWSA can help the French School by providing students and their fees on a cyclic schedule while the French School provides NWSA with much needed electrical O & M specialists. This school, which was started in September 1980, consists of 80 buildings costing approximately \$1.2 MM plus equipment. The school has a capacity of 110 students and now has approximately 60 trainees or "participants," some of whom are instructors. A six-month course of instruction begins in February 1982 and the school has agreed to provide four NWSA trainees with instruction in Generator Maintenance, Basics of Electricity, Cables, Switches, Relays, etc. at a cost of approximately 1800 YR/month (\$400) which includes tuition, books, clothes, three meals a day and incidentals. NWSA must write a letter requesting the participant positions and if, for some reason, additional training slots are available, NWSA should consider training as many as 10 participants in the program. If the Chief of Training evaluates the program as a success, then cyclic training of electrical specialists should occur in September and February of each year for the foreseeable future. Graduates of this school, like the mechanical and pipefitter graduates of the German School, should then obtain "top-off" or polishing at the Taiz Water and Sewage School of NWSA. Recruitment of the four trainees for the February 1982

FIGURE 8
A GENERAL ORGANIZATION CHART
FOR THE
HIGH COMMISSION FOR WATER
(LAYTON, JAN. '82)

CHAIRMAN AL GUNAID -
(Also Minister Elec. Water, Sewerage)
SEC. GENERAL AL KIBSI

MEMBERS OF HIGH COMMISSION



course should be trainees showing aptitude and interest in electrical training and who are also graduates of the German School who have been detailed to the Contractors.

3.33 The University of Sana'a Engineering School.--

The integration of existing Yemen educational institutions into the proposed long- and short-term O & M activity of NWSA was a stated objective of this assignment. Likewise, an identified manpower training need for meeting NWSA's self-sufficiency goal lies in the area of undergraduate Engineers. The unsatisfactory results of the efforts of U.S. AID, World Bank and others to fund undergraduate Yemen engineering students is well documented. Accordingly, the NWSA Chief of Training participated with Sana'a University officials in a meeting arranged and moderated by this Mission's effort. A cooperative agreement seemed to be reached that encourages NWSA support of Sana'a University's undergraduate Engineering school. In 1979, UNESCO performed a feasibility study concerning the establishment of a Faculty of Engineering at Sana'a University. After concurrence of such a need, a team of Yemen officials consisting of six (6) persons commissioned by the Prime Minister and functioning under the Ministry of Public Works visited various Engineering Universities in the Arabic Nations and recommended four departments: [Civil Engineering, [Mechanical Engineering, [Electrical Engineering and [Structural Engineering, with a top priority being Civil Engineering. The English language was also selected as the educational delivery mode. A curriculum was prepared by an Egyptian University (Asyut) and was completed in April, 1981. Various donors were contacted and the World Bank prepared an "Executive Summary" for the project which included a work plan integrating the classroom, laboratory and field training for this project. Land was located at the University for the buildings and several \$ MM (6) were allocated by the World Bank

for the Civil Engineering Project. After solicitation of prequalifications and the establishment of a short list, the firm of Heinle Wischel (German) is now completing the design of the facility. The building should start in January 1983 with an anticipated completion date of June, 1984, according to school officials. Students will formally enroll, however, in September, 1982, in basic sciences related to Civil Engineering and will be third and fourth year Engineering students when the new building is occupied in 1984. The initial enrollment is expected to be 120 to 150 students, according to school officials (listed in Appendix C). It is at this point that NWSA should carefully screen and recruit future employees. The total cost for development of the five-year Engineering program of the University is estimated at \$38 MM.

The World Bank is also providing scholarships for the Engineering faculty members who have been enrolled in Ph.D. programs in the U.S., Great Britain and France since 1979. The first graduate is expected in Sana'a later this year (1982) with specialization in Civil Engineering. Before 1984, two others currently studying Electrical Engineering and Electronics should return as faculty members with Ph.D. degrees. A total of ten scholarships has been funded for faculty members with seven additional participants scheduled to begin study in September 1982. The first Yemen Engineers should graduate in June 1986 in what appears to be a carefully planned and coordinated effort. NWSA is now aware of this planned activity and has pledged its assistance to a mutually beneficial cooperation with the new Faculty of Engineering. U.S. AID, the World Bank and other "donors" are, accordingly, encouraged to carefully review their funding of costly undergraduate support and to redirect funds correspondingly to O & M needs.

3.34 On-the-Job Training of Technicians.--Of the twenty-four graduates of the Sana'a Vocational School in June of 1981, eighteen were detailed to the construction firms in Taiz, Hodeidah and Sana'a. The idea was to provide technical education on-site for these recent graduates, in their home locations and with equipment and plants that they had helped build. It was a fine idea; however, it did not work as planned for several reasons. First, the contractors had no provision in their contracts for training and their obligation was and is to finish their jobs on schedule. The training that was to occur, accordingly, did not and the recent graduates in Sana'a, Taiz and Hodeidah were relegated to watching. Some benefit occurred, no doubt, by this period of observation, but a fine opportunity has been missed to provide excellent, meaningful training. In interviews conducted by the Training Chief of NWSA with 12 or so trainees at Sana'a, Taiz and Hodeidah (and observed by this Consultant), vocal dissatisfaction was expressed about the lack of actual training.

Future contractors should be required to accommodate trainees and training, but the responsibility of assuring training effectiveness must rest with the NWSA Training Chief and the Branch Training Officers. Important lessons can be learned by the initial contractor-trainee interface for future training success.

The selection of nine of the recent graduates for further training on-the-job in Jordan and the selection of four of them for entrance into the Electrical School (French School) at Sana'a is encouraged.

3.35 On-the-Job Training of Engineers.--Engineers from NWSA have been detailed to the three engineering firms involved in the Taiz, Sana'a and Hodeidah Projects. In some cases the Engineer was relegated to "watching" while in other cases Engineers appeared to be utilized, predominantly as draftsmen.

The WASH Report indicated and the visits confirmed that engineering expertise in the Engineering staff detailed to the firms had not developed to the desired proficiencies. Again, the Engineering contracts do not specifically require training and there has been little follow-up on the part of the NWSA training effort to correct this situation.

If Yemen Engineers are not trained and assisted in becoming self-sufficient in all areas of Design and Construction, the continuous use of expensive expatriate firms will continue. It is highly recommended that as part of future Engineering Contracts, a strictly enforced requirement be that Yemen Engineers do engineering work and really be trained as counterparts.

3.36 Recent O & M Management Course - Six-Week U.S. Program. --Discussions with U.S. AID Washington (both the Near East Bureau and the Office of International Training), U.S. AID Mission personnel in Yemen, NWSA Headquarters, and the three NWSA Branches indicated that a recent six-week training course in Wastewater Operations, Maintenance and Management conducted in the United States was one of the best O & M activities ever experienced by NWSA personnel. Participation by NWSA's Director General and Technical Manager, the Taiz Branch Chief, the Taiz Branch Technical Manager and the Sana'a Project Officer was excellent. Actual O & M activity, in-plant study and attendance at the International Water Pollution Control Federation's Annual Conference highlighted the work (the participants also became members of the WPCF). One participant was quoted as saying, "This program was to me the equivalent of getting a Master's degree." The development of NWSA personnel with future International activities of this type is highly recommended. Three NWSA personnel are attending a similar Wastewater Operations, Maintenance and Management course in

February/March, 1982 and it is recommended that five participants enroll in the Water Utility Operations, Maintenance and Management course in May/June, 1982 (in conjunction with the international American Water Works Association Annual Meeting). It is further recommended that five participants attend the Wastewater Operations, Maintenance and Management course in September/October, 1982 (in conjunction with the international Water Pollution Control Federation's Annual Conference. The future organization of a water supply and a wastewater treatment professional society is also encouraged.

4. A NATIONAL O & M TRAINING PLAN FOR YEMEN

4.1 General Comment On A National Goal and Recruitment

A National Training Plan for Yemen, if correctly prepared, should initiate actions that will solve both the immediate and long-range manpower development needs for the water and sewerage sectors. To prepare such a document implies that certain manpower baseline data is available and that forecasts of future needs are accurate. Unfortunately, detailed manpower data, both current and projected, are sketchy. The new "Five Year Plan" now in draft status, visits and surveys of Branch and Headquarters NWSA data, and personal interviews are the basis for the following plan. The assistance of the Director General, the Chief of Training, the Technical Manager, the Chief of the Statistics Department and each of the three Branch Chiefs was instrumental in proposing this plan.

First to be evaluated was the immediate need for qualified O & M specialists to operate and maintain the three water and two sewage systems coming on-line this summer. There is clearly a need for operators and technicians knowledgeable in:

- >>Water Treatment, Production, Transport, Storage and Sales;
 - >>Wastewater Collection, Transport, Treatment and Ultimate Disposal;
 - >>Laboratory Monitoring, including Process Control, Effluent Quality and Public Health;
 - >>Electrical Power Generation, Transmission and Use;
 - >>Pumps, Mechanical Equipment and Pumping Stations;
- and
- >>Maintenance of Automobiles and Heavy Equipment.

Although the exact number of such people is not entirely known, one thing is certain--development of this operations staff ranks the top priority and should be considered accordingly.

After agreement upon this top priority need, several ideas seemed worthwhile in the plan's development and are as follows:

- (1) NWSA should be self-sufficient regarding O & M personnel as quickly as is feasible;
- (2) The use of existing institutions in Yemen for this training should occur cooperatively when possible;
- (3) The "institutionalizing" of manpower development and training should evolve by formation and strengthening of NWSA's training components, both at NWSA Headquarters and in each Branch. In as short a time period as is feasible, the Yemen manpower development group will function in an independent fashion;
- (4) To seek a long-term solution to the O & M issue by assisting NWSA's development of permanent training activities and facilities;
- (5) The training objective should be a realistic and workable training plan that produces skilled O & M operators and technicians and not just paper goals; and
- (6) To do so at the lowest possible cost to NWSA and the donors to various projects!

Accordingly, the established plan appears to accomplish these goals.

If the ultimate quality and quantity of both drinking water and wastewater are considered to be the prime objective of designing, constructing and maintaining systems, then the long-term training plan should make NWSA first and foremost a self-sufficient organization capable of projecting its future needs. In order to achieve this objective, the strengthening of the Statistical Planning Department is encouraged. The details of this effort toward self-sufficiency are provided in the prioritized list of action.

The recruitment of technicians and operators has been carefully considered in the Training Plan and should not represent an undue hardship for the Training Department. Recruitment from those Yemen employees who provided support to the Contractors could be a first option. Also, the highly successful recruitment of Engineers and Managers should be an area of pride in NWSA's review of its last five-year plan. This trend and new considerations, as presented, should ease the minds of those who view recruitment as a difficult task. A last item concerning NWSA recruitment is that of using only persons who can read and write, for obvious reasons.

4.2 O & M Training for the Existing Branches

The desperate need for all three branches to obtain technical manpower is very clear. The subject areas previously listed are also relatively clear. The exact number of persons by specific job classification is, however, not so clear. The specific O & M equipment to be used by those persons has not been identified, nor the chemical testing, lubrication schedules, spare parts inventory or numerous other cleaning and maintenance equipment and activities--all important considerations in the preparation of a Preventive Maintenance and Management Program for a water or sewage system!

The first need, therefore, for each Branch is to help prepare a detailed "Operations and Maintenance Training Manual" that details these and other factors in operating each facility. These documents must not be merely a cut and paste project of manufacturers' literature as is so often done by contractors and consultants, but rather, should reflect a realistic operational guide for each plant.

The detailed, prioritized list as presented will clarify the types of trainees, their recruitment, potential funding sources and numbers of persons to be trained. Sana'a, Taiz and

Hodeidah will require water systems operators and laboratory, electrical, mechanical and automotive technicians while only Taiz and Hodeidah will need immediate wastewater operators with Sana'a, Ibb, Dhamar and Hajja soon to follow.

The proposed NWSA Operations and Maintenance Training Center at Taiz can and will contribute to the long-term success of all 12 proposed Branches. With a wonderful existing facility that is fully equipped with a water system (including reverse osmosis), a wastewater system, various workshops including electrical and many of the same technical skill areas previously discussed, dining facilities, recreational facilities, housing for approximately 550 persons, offices, training shops, and a ready-made arrangement for a National NWSA Operations and Maintenance School. To let this facility slip from its current level of excellence would be a mistake. A huge expenditure of funds has been made to establish this camp and its equipment and it should become NWSA's O & M Training show place. Figure 9 is a drawing of the Hanab Stevin Pipeline Camp and Table 8 provides a partial list of available training equipment. The Project Director, Mr. W. Sutton, has agreed to prepare a list of equipment that will be returned to NWSA. Obtaining this list and a close supervision of the camp site equipment are encouraged.

NWSA will need training in O & M for many years into the future, perhaps forever. Now is the time to establish such a school, when potential funding seems likely!

4.3 O & M Training for NWSA Headquarters

Although it is envisioned that most of the O & M responsibility for the water and sewage systems will rest with the Branches, certain comments seem appropriate for the management aspects of the NWSA Headquarters. If NWSA is to become self-sufficient in the next five years in Engineering, Design, Construction Management, and O & M, then a concerted effort should be made to provide

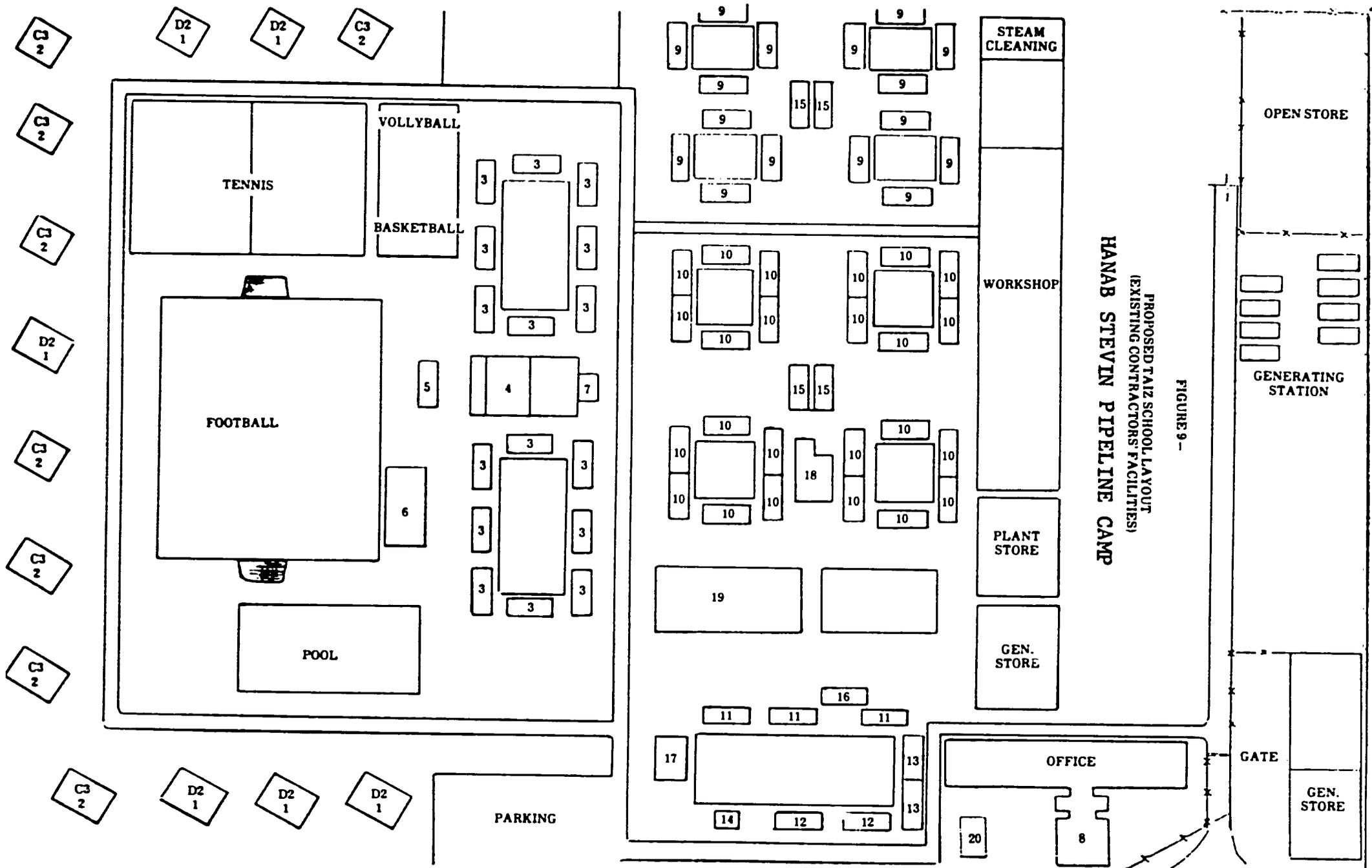


FIGURE 9 -
 PROPOSED TAIZ SCHOOL LAYOUT
 (EXISTING CONTRACTORS' FACILITIES)
 HANAB STEVIN PIPELINE CAMP

TABLE 8.--Partial List of Hanab-Stevin Pipeline Camp Equipment

Equipment	Number
a) Trucks and tippers	37
b) Lowloader	1
c) 375 Kva generator (for camp)	3
d) Pick-ups, landrovers and cars	64
e) Excavators and trenchers	17
f) Bulldozers (D8)	3
g) Mobile cranes	2
h) Stone crushing plant	1
j) Welding plants	8
k) Wheeled shovels	3
l) Concrete batching plant	1
m) Tractor	2
n) Grader	1
o) Road Roller	1
p) Air compressor	11
q) Generator 30 - 162	4
r) Generator small	13
s) Dumpers 1m ³	10
t) Pump 2 - 6"	11
u) Fork lift truck	2
v) Transport mixer	3
w) Tracked shovels	2
x) Tracked crane	1
y) Compactors	14
z) Sheepfoot roller	2
aa) Lighting set	2

NOTE: i) was not included in the list, as presented to the author of this report.

advanced (M.S.) degrees in Structural, Mechanical, Electrical, Environmental-Civil Works and Construction Management Engineering. Such programs should require no more than 18 months to two years and could be supported by the World Bank, the Abu Dhabi Fund, Saudi Funds, the Kuwait Funds and U.S. AID Funds. The continued support of undergraduate students by both the World Bank and U.S. AID does not appear cost-effective.

The support of Financial Management for construction grant activities is recommended under the short-term activity (six month); and the Headquarters Technical Manager, the Director General, and the Branch Financial Managers are suggested participants. Investigations will need to be made to find a suitable place for such an activity. In the interim, participation is suggested by key Headquarters and Branch Management officials in the "Water Utility Management for O & M" (May/June, 1982) and the "Wastewater Management, Operations and Maintenance" (September/October, 1982) courses.

The Billing (computer) Program, Accountant Training, Cost Accounting, Purchasing and Filing Personnel, although not directly related to O & M, will require training which might be best accomplished through specialty seminars of a regional nature, sponsored by WHO or The World Bank and held at NWSA Headquarters or at the proposed Taiz school.

4.4 A Prioritized List for Implementation of the NWSA National Training Plan

Of primary importance in implementing a National Training Plan is concurrence by appropriate agencies and donors involved that such a training plan is needed. The Plan was prepared with input from NWSA, U.S. AID and the World Bank after a consensus was reached regarding priorities. The following points reiterate these conclusions:

- (1) Two types of actions are needed--short-term and long-term;

(2) NWSA desperately needs Operation and Maintenance personnel at Taiz, Hodeidah, Sana'a and Ibb/Dhamar for the plants to run;

(3) There are no existing solutions on the horizon to solve the problem; and

(4) Immediate (January/February) action must be initiated to meet the start-up deadlines!

A Proposed Short-Term Course of Action:

1. Initiate a contract for using all available funds for immediate O & M Training, internal and external, with advisors in-country--suggest Layton and Associates International, Inc., as the Yemen Manpower Specialists.

2. Establish NWSA policy at National level for developing O & M Training and Yemen Trainers. Accordingly, form a Training and Manpower Development Branch with one Chief and four Assistant Trainers, one each for Taiz, Hodeidah, Sana'a and Ibb/Dhamar. These people will supervise O & M through training, operate the Projects when needed, write job descriptions. EMPHASIS: Make NWSA self-sufficient in training in two years.

3. Prepare three people (one each from Taiz, Sana'a and Hodeidah) for six-week "Wastewater Operations, Maintenance and Management" course in the U.S. February 8 - March 19, 1982. EMPHASIS: O & M for Taiz, Sana'a and Hodeidah.

4. Initiate O & M Manuals to be used for training for Taiz, Sana'a and Hodeidah in March, 1982. Suggest March/April/May/June for first drafts; final drafts (after plant start-up/running); and finished form December, 1982, to be used as an O & M guide for the Training document. Include staffing guides, job descriptions, job tasks, O & M schedules, and equipment lists for proper O & M--standardize when possible.

5. Send nine trainees to Jordan for O & M training in pumps and mechanical equipment maintenance in March/April/May, 1982--

three each from Sana'a, Taiz, and Hodeidah, after initial evaluation visit by the Training Branch Chief.

6. Provide "Train the Trainer" program for Training Branch Chief and four Branch Assistants March 15 - June 15, 1982 (three months) in: [How to plan O & M Training; [How to execute O & M Training; [How to select appropriate O & M Trainees; [How to evaluate O & M Training; and [How to prepare select O & M Training Materials for Yemen.

7. Initiate training at the Sana'a Electrical Training Center (French School) at Dhban for electrical specialists in power generation and transmission. The detailed schedules are planned to begin in February, 1982.

8. Send five Engineers/Managers to a program for "Water Utility Management for O & M" in May/June/July, 1982. Attend AWWA meeting in May; select a six-week program for three Branch and two Headquarters persons to review management and financial aspects of Water Utility Management. The three-month program should conclude prior to September, 1982.

9. Initiate a one-year Training Course at Taiz at the current facilities used by the Hanab-Stevin Pipeline Construction site. Begin instruction June 15 for basic course in water and sewage O & M (two months), extend 18 months to make NWSA self-sufficient in training; use "Trainers" as counterparts with complete transfer in 18 months; World Bank support \$500,000 for equipment, etc. Subject areas:

- (1) Water plant O & M and Distribution/Meters;
House connections, breaks, cross connections.
- (2) Wastewater Plant O & M and Collection System;
House connections, stoppages.
- (3) Electrical/Mechanical-Power Generation with
Instrumentation.
- (4) Pumps and Lift Stations.

- (5) Laboratory Procedures and Analyses--Sana'a, Taiz, Hodeidah;
Water quality monitoring, drinking water, sewage, plant performance, O & M performance, public health.

- (6) NWSA Automobile and Heavy Equipment O & M.

CONCEPT: Rotate classroom (formal) with field training at each branch; stress practical hands-on learning-by-doing concept, not theory.

Suggest that one Sana'a Branch official of NWSA begin inventory and accountability of all camp equipment, etc.

10. September 15 through November 1, 1982, five persons participate in six-week "Wastewater Utility O & M, Management" course--emphasis management and financial accountability.

11. Long-term, six-month Financial Management training for NWSA Headquarters and Branch Administrators, Managers (approximately five people).

12. Continue technical courses at the Sudan Wad El Maghoul Institute (Arab Fund), eight persons/year--well drilling and surveying.

13. Appoint a Public Relations Officer for NWSA; suitable training should be given a top priority enabling this Officer to handle complaints and free top management from such problem situations.

Long-Term Goals:

1. Make NWSA self-sufficient in the areas of Design, Construction Management, Operations and Maintenance Training, and Statistical Forecasting. Goal: 5 years.

2. Provide Master's Degree work for NWSA Engineers:

- Structural (5) - one each year for five years;
- Mechanical (5) - one each year for five years;
- Electrical (5) - one each year for five years;
- Environmental-
Civil () - one each year for five years;
- Construction
Management(3)-one each year for three years.

and form separate departments for each area of Engineering, both in NWSA Headquarters and in each Branch.

3. Restructure World Bank and other donor support for scholarships for undergraduates (five years). NWSA should: (1) offer support for undergraduates (minimum) and insist that funds formerly spent for undergraduates be used to strengthen other areas, particularly O & M; (2) recruit B.S. candidates from the local market; and (3) support "hands-on" O & M training.

4. Encourage the Kuwait support of M.S. and Ph.D. teachers in Civil Engineering at Sana'a University and then NWSA recruit its Engineers from Sana'a University in the future, when possible.

5. In 1983, provide a Master's Degree for the Chief of the Training department in the areas of training, manpower development and recruitment to allow self-sufficiency in the execution of manpower growth and evaluation.

6. Continue the participation of all activities at:

|The Sana'a Vocational Technical School (German School);

|The Electrical Training School at Dhban (French School);

|The University of Sana'a, College of Engineering;

|The Well Drillers Institute in the Sudan;

|Various scholarships provided by donors for both O & M Technical training and advanced M.S. and Ph.D. students;

|The new Taiz O & M Mechanical Training Center; and

|The new Sana'a Laboratory Training Center.

FINAL REMARK:

The immediate need for proper O & M of the Taiz, Hodeidah and Sana'a systems necessitates the implementation of training at the earliest possible time.

4.51 A National Short-Term O & M Training Plan for NWSA - Yemen
(Jan. 82-Layton)

ACTIVITY	1982												1983			
	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April-May June
TRAINING PLAN	X															
PREPARE CONTRACT	X															
NWSA TRAINING DEPT.	X															
Sudan Training		X	X	X	X	X	X	X	X	X	X	X	X	X		
Jordan Training		X	X													
Wastewater O & M		X	X													
Electricians - Sana'a		X	X	X	X	X	X	X								
DONORS' CONFERENCE			X													
O & M Manuals			X	X	X	X	X									
Trainers Trained			X	X	X	X	X				X	X				
Water Utility O & M					X	X										
ORDER O & M EQUIPMENT					X											
INITIATE TAIZ SCHOOL						X										
Specialists						X	X	X	X	X	X	X	X	X	X	X
New Equipment						X	X	X								
O & M Funds						X	X	X	X	X	X	X	X	X	X	X
M.S. Structural Eng.							X	X	X	X	X	X	X	X	X	X
Electricians - Sana'a								X	X	X	X	X	X	X	X	X
Wastewater O & M									X	X	X	X	X	X	X	X
PLANTS ON LINE						SANA 'A			TAIZ							
						HODEIDAH										

4.5 Scheduling Activity February 1982 - July 1983 (18 mo.)

4.52 The Yemen National O & M Plan (Chronological Listing)

Date	Activity Description	Est. Cost US \$	Funding Source
JAN 82	Complete NWSA Training Plan		USAID
	Initiate Funding Contract for Plan		USAID
	Formulate NWSA Long-Term Plan		USAID
FEB 82	Recruit and Send Nine Technicians to Jordan		NWSA
	Three NWSA Participants to "Wastewater O & M," U.S.	36,000 ⁺	USAID
	Enroll Four Electrical Specialists in French School	10,000	USAID
	Sudan Well Drillers School - Seven Trainees	140,000	ARAB FUND
MAR 82	(NWSA and CPO Participant Conference - Adopt Yemen Training Plan; Invite Donors and WHO)		
	<u>Prepare O & M Training Manuals for:</u>		
	Taiz Water <u>and</u> Sewage	100,000	USAID
	Hodeidah Water <u>and</u> Sewage	70,000	USAID
	Sana'a Water	40,000	USAID
APR 82	Train the Trainer Course - Five People	65,000	USAID
MAY 82	Water Utility Management Course U.S. - Five People	44,000	USAID
	Order O & M Equipment for Three Locations:		
	Taiz	200,000	
	Hodeidah	100,000	
Sana'a	100,000		
JUN 82	Initiate Taiz School - Two Specialists for training at Taiz	400,000	USAID
	- Training Specialist & Equipment Sana'a	250,000	USAID
	- Training Specialist & Equipment Hodeidah	200,000	USAID
	- Specialists & Misc. Equipment, Taiz School	100,000	USAID

Continued --

4.52 CONTINUED

Date	Activity Description	Est. Cost US \$	Funding Source
JUL 82	Master's Degree - Struc. Eng. Al-Aroosi	43,000 ⁺	USAID
	Master's Degree - Const. Mgt. M. Razzak	43,000 ⁺	USAID
	Order Taiz School New Equip., Curricula, Goods, etc.	500,000	
	Provide Student Support, Utilities, Food, etc., Taiz School	300,000	
AUG 82	Enroll Four Electrical Specialists - French School	10,000	USAID
SEPT- OCT 82	"Wastewater O & M, Management Course" US - Five People	50,000	USAID
MAY 83	"Water Utility & Public Health Monitoring Course" - five People, US	50,000	USAID
OCT 83	"Wastewater O & M, Management Course" US - Five People	50,000	USAID
TOTAL USAID -		<u>\$1,389,000</u>	

⁺Previously funded

5. CONCLUSIONS AND SUMMARY

The following conclusions will summarize the overview of this assignment, which was to assist NWSA in the development of a short-term and long-term Training Plan. The thrust of this plan was to have an energetic, yet achievable approach to solving the URGENT vocational training needs of NWSA, Yemen. The prepared plan has been tentatively reviewed by a World Bank official who was in Yemen during the Report review and his remarks were highly complimentary. NWSA officials were also pleased with this approach and they hope to submit this document for review by all appropriate donors in attendance at the scheduled Donors' Conference in March 1982. The Deputy Minister of the Central Planning Office requested that the author attend that Conference, indicating his faith in the plan and NWSA's intent to proceed immediately with its implementation.

This National O & M Training Plan will not be easy to execute, but it is achievable provided that the very rigid time tables are followed. There is no time for a single month's delay in the implementation! If various organizations do not act with certainty in solving NWSA's O & M problems, the potential damage and destruction of new equipment and new facilities could be catastrophic!

It is unfortunate that NWSA finds itself in such a position but it is not too late to correct all of the errors of the past and have great successes in the future! The time-honored adage of "No action IS an action" will certainly be true if further delay of a National O & M Training Plan continues and "no action" could produce millions of \$ of wasted investment--ACT NOW!

APPENDIX A

DOCUMENTS REVIEWED

1. "Taiz Water Supply and Sewerage Project"; status of Design, Construction, Supply and Certification as of October 31, 1981 - Final Report, Hazen & Sawyer.
2. Project Assistance Paper: "Yemen--Taiz Water and Sewerage Construction Project" as amended. U.S. AID, March 18, 1981.
3. Contract between NWSA and TMSI for Public Utility Technical and Managerial Services - YAR, May 1979.
4. Project Assistance Paper: "Yemen: Water Supply Systems Management." U.S. AID, February 23, 1977.
5. NWSA Manpower Plan - 1976-1981. Dated April 7, 1977.
6. NWSA "Draft" Manpower Plan, 1981-84.
7. NWSA Training Program Evaluation Report (covers period 1979-81). June 17, 1981.
8. Evaluation of Yemen Water Supply Systems Management Project. WASH Field Report No. 22, September, 1981.
9. A Proposed Action Plan for a National Training Program in the Water Sector for the Hashemite Kingdom of Jordan. WASH Draft Report, November 17, 1981.
10. Executive Summary: Tariff Study for Taiz Water and Sewerage Authority, Yemen Arab Republic, for U.S. AID. Haskins & Sells, December, 1977.
11. Taiz Tariff Study and Financial Plan for NWSA. Deloitte, Haskins & Sells, July, 1979.
12. Taiz Water Supply and Sewerage Project, Revised Bill of Quantities for Contracts A, B and C. July, 1980 (Revised September, 1980).
13. Sana'a Sewerage and Sewage Treatment - Final Design. Howard Humphreys and Sons, July, 1976.
14. Sana'a Sewerage and Sewage Treatment Project Reports Stage 2, Appendices and Addendum, Stage 2. Howard Humphreys and Sons, April, 1981.

15. Sana'a Water Supply System, Construction Completion Report; Vol. 1, Main Report.
Dar Al Handasah Consultants, December, 1980.
16. Taiz Water Supply and Sewerage Project - Monthly Progress Reports, 1981.
17. Report, John F. Kennedy Water System, Taiz, Yemen.
Camp Dresser & McKee International, Inc., 1971.
18. Area Handbook for North Yemen.
U. S. Government Printing Office, 1977.
19. Report to U.S. Department of State AID: Feasibility Study of Water Supply and Sewerage Facilities for Taiz, YAR.
James M. Montgomery, Consulting Engineers, Inc., (undated).
20. Quarterly Reports - TMSI to Director-General, NWSA.
Period from July 1, 1979 through March 31, 1981.
21. Twenty-three Monthly Reports - TMSI to Director-General, NWSA,
period from July 1, 1979, through May 31, 1981.
22. Special Report No. 13/14 - SMSI to NWSA: Water System
Operation and Maintenance Guideline Manual, March, 1981.
23. Hodeidah Water Supply and Sewerage Projects; Final Design and
Supervision of Construction.
F. H. Kocks, KG Consulting Engineers, Germany.
24. Financial Plan for NWSA, prepared for U.S. AID.
Haskins & Sells, February, 1979.
25. NWSA "5 Year Plan for 1981-86" - Draft.
January 20, 1982.
26. Sana'a Water Supply Project Report.
Howard Humphreys and Sons, October, 1977.
27. Dhamar and Ibb Water and Sewerage Projects, Preliminary Design
Report. Dorsch Consult for NWSA, 1981.

APPENDIX B

YEMEN ITINERARY FOR DR. RONALD LAYTON
January 11-24 Inclusive

<u>DAY</u>	<u>DATE</u>	<u>ACTIVITY</u>	<u>LOCATION</u>
1 (M)	Jan. 11	Arrive USAID Mission - Review terms of reference. Meet NWSA Personnel - Scoping session	Sana'a
2 (Tu)	Jan. 12	8:00 Kasper Bom - Stanley Consultants, reference Taiz Project. 9:00 Meet NWSA Training Director - set Layton itinerary. 11:30 Tour part of Sana'a System - Engineer Al Aroosi.	Sana'a Sana'a Sana'a
3 (W)	Jan. 13	8:00 HHM Consultants - David Laird (Manpower estimates obtained). 9:30 Discussed 5-Year Plan with Central Planning Organization; met Deputy Minister. 11:00 Tour Sana'a Water Project.	Sana'a Sana'a Sana'a
4 (Th)	Jan. 14	9:00 Layton picked up by Yasin at Sheba. 10:00 Visit German School. 11:30 Visit Sana'a Branch (Obtain Manpower data).	Sana'a Sana'a Sana'a
5 (F)	Jan. 15	Review available data, Taiz; draft Sana'a Training Needs/Plan, including NWSA Headquarters. Travel with Eng. Al Aroosi and Chief of Meter Installations, Sana'a.	Sana'a
6 (S)	Jan. 16	7:30 Travel by car from Sana'a to Taiz with USAID/NWSA officials. 1:00 Meet with SCI Tour in-town water/wastewater facilities (collect Manpower estimates). Accommodations at Marib Hotel.	Taiz
7 (Su)	Jan. 17	7:00 Tour complete Taiz Project 11:00 Meet with Abdul-Aziz and Razzak, Taiz Branch (collect Manpower estimates). Accommodations at Marib Hotel.	Taiz

Dr. Layton's itinerary--continued.

<u>DAY</u>	<u>DATE</u>	<u>ACTIVITY</u>	<u>LOCATION</u>
8 (M)	Jan. 18	8:00 Complete discussion with Taiz Branch. 12:00 Leave Taiz for Hodeidah by car. Courtesy visit with GITEC, time permitting. Accommodations at Ambassador Hotel.	Taiz Hodeidah
9 (Tu)	Jan. 19	8:00 Meet with GITEC. Tour water and wastewater facilities, meet with Contractor, Sam Whan (collect Manpower data). Meet with six "trainees" detailed to Contractor.	Hodeidah
10 (W)	Jan. 20	8:00 Meet with Hamoud Hamran, Hodeidah Branch. 11:00 Leave Hodeidah for Sana'a by car.	Hodeidah
11 (Th)	Jan. 21	9:00 Meet with Mohammed N. Ghaleb, Abdul Nadji, Mohammed Nooman, U.S. AID and Steve Serdehaly, World Bank, on Findings. Tour Electrical Training Center, Dhaban. Luncheon with U.S. AID, NWSA, World Bank; expanded discussion on Findings.	Sana'a
12 (F)	Jan. 22	Revise data, complete preliminary "Executive Summary". Meet with Training Chief. Dinner with Director General and World Bank Representative.	Sana'a
13 (S)	Jan. 23	USAID/NWSA meeting regarding proposed training activity. Afternoon meeting with NWSA and World Bank. Visit Sana'a University, Ambassador Toyem.	Sana'a
14 (Su)	Jan. 24	Revised draft Executive Summary with USAID/NWSA concurrence; formally transmitted to NWSA and USAID. PM- attend going-away reception for Dr. Layton most NWSA officials, appropriate USAID officials, the Ambassador and his wife in attendance.	Sana'a

Dr. Layton's itinerary--continued.

<u>DAY</u>	<u>DATE</u>	<u>ACTIVITY</u>	<u>LOCATION</u>
		Late night - prepared a brief (8 or 9 page) proposed "work plan" for the O & M Training Plan for transmittal to USAID/ Yemen Mission before leaving Yemen.	Sana'a
15 (M)	Jan. 25	Left hotel 7:30 A.M., travel to Cairo on Yemen Air Flight 514, overnight.	
16		Cairo--London--New York--Washington, D.C.	
	Feb. 1	Delivered Mission mail to AID, Washington, D.C. Reviewed Draft Report and Executive Summary with USAID. Traveled Washington--Joplin--Neosho.	Wash.D.C.
	Feb. 19	Final Report transmitted to AID, Washington, in English, Arabic to follow.	

APPENDIX C

OFFICIALS INTERVIEWEDNational Water & Sewerage Authority, YAR

Mohammed Ali Al-Fusail
Director-General

Mohammed A. Abu-Taleb
Assistant Director-General and Executive Director

Hussein Al-Ansi
Acting Administrative Manager

Abdul Rahman S. Nadji
Technical Manager

Yasin Abdul Ismail
Head, Training Department

Abbas Al-Mutawakil
Sana'a Branch Manager

Yahia Al-Kibsi
Chief Accountant, Sana'a Branch

Mahmoud Kabir
Acting Technical Manager, Sana'a Branch

Sana'a Branch Staff: Meter Repair Man
Pumping Station Operators
Pumping Station Foreman

Ali M. Abdul-Aziz
Taiz Branch Manager

Mohammed A. Abdul Razzak
Taiz Technical Manager

Ahmed Abdul Hafiz
Taiz Financial Manager

Abdul Bari
Taiz Chief Accountant

Mohammed Al Aroosi
Sana'a Project Manager

Hamoud N. Humran
Hodeidah Branch Manager

Abdul Wahab Al-Muayud
Hodeidah Technical Manager

Ibrahim S. Farrah
Hodeidah Personnel Officer

Abdul Hai
Hodeidah Financial Manager and Acting Admin. Manager

Hodeidah Branch Staff: Chief Pipefitter Foreman, Mr. Babasaleh
Foreman, Wellfield #1

TMSI

Robert Wooster
Financial Advisor, Headquarters

William Mabry
Civil/Pipelines Advisor

Betty Bailey
Office Manager

USAID

Charles Ward
Mission Director

Zachary Hahn
Capital Resources Development Officer

John J. Giusti
General Development Officer

F. Le Young
Project Officer

Dr. Bashati Ali
Project Officer

Ahmed Alshabba
USAID 028 Project Manager

Burno Kosheleff
Planning Officer

Robert Burford
Comptroller

Tina Ferguson
Administrative Assistant

USAID
Washington, D.C.

Justin Williams, NE/PD/NENA

Paul Holmes, NE/PD/NENA

Steve Dean, Contract Officer

World Bank

Steve Serdehaly
Country Representative

University of Sana'a
P. O. Box 1247)

Mohamed Abdel Azziz
Director of Planning (Tel. #73444, Ext. 252)

Mohamed A. Mohsen
Head, Planning Department

Stanley Consultants

Joseph R. Raub, P.E.
Contracts Administrator

Ernest Gefert
Resident Engineer, Taiz Project

Richard Fahey
Design Manager, Taiz

Richard Lord
International Project Manager, Atlanta, Georgia

Contractors and Others

W. Sutton, Hanab-Steven Pipelines M.E. Ltd.
Project Director, Taiz Project

D.S. Kim, Sam Whan Corporation
Project Manager, Hodeidah Project

Klaus Jarck - Technical Director, Deutsche Gesellschaft Fur
Technische Zusammenarbeit (GTZ) GMBH (German School, Sana'a)

Sherif Ahmed El Horiebi - Manager, Electrical School at Dhban

John Dameme - Chief of Training School at Dhban (French School)

Project Manager of Sana'a Engineering Firm

Plus many, many others for whose assistance this Training
Consultant is most grateful.

APPENDIX D

Letter of Transmittal of Draft Executive Summary

Letter of Receipt and Concurrence

January 24, 1982

Mr. Charles D. Ward
Mission Director
USAID/Sanaa
P.O. Box 1088
Sanaa, Yemen Arab Republic

ATTN: Mr. Zachary M. Hahn

Dear Mr. Ward:

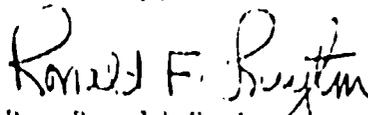
Please find enclosed a draft executive summary of the preliminary conclusions and recommendations concerning Contract NWSA-C028-5-00-2015-00 made during the period January 11-24, 1982, by our firm.

The content of this document was, as you know, presented orally to the USAID Mission and to NWSA on January 23 and 24, 1982, with a general consensus reached by all parties concerned.

We will await the receipt of comments from NWSA and USAID and shall submit appropriate copies of the final report within 30 days.

Please convey my thanks for the wonderful hospitality afforded me during this assignment by both the USAID Mission and NWSA personnel.

Sincerely,


Dr. Ronald F. Layton
President, Layton and
Associates International, Inc.
Crosby, Missouri 64830

Enclosure: a/b

cc: NWSA/Sanaa
AID/W



AGENCY for INTERNATIONAL DEVELOPMENT
UNITED STATES AID MISSION TO YEMEN ARAB REPUBLIC
 الولايات المتحدة الأمريكية بعثة وكالة التنمية الدولية الى الجمهورية العربية اليمنية

USA Address
 SANAA (I.D.)
 Department Of State
 Washington, D.C. 20520

International address:
 USAID
 P. O. Box 1088
 Sanaa, Y. A. R.

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January 24, 1982

Mr. Ronald F. Layton
 President, Layton and Associates
 International, Inc.
 Neosho, Missouri 64850

Dear Mr. Layton:

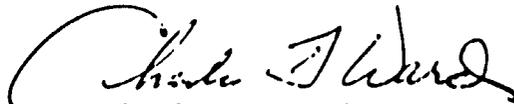
We are in receipt of your draft executive summary, submitted January 24, per terms of contract NEB-0028-5-00-2015-00.

In the several meetings prior to your departure, both NWSA and USAID provided substantive input to your summary and the report to be prepared in the near future.

Both NWSA and USAID have indicated concurrence with the substance of your executive summary and agree that you should proceed immediately with preparing the final report.

We appreciate the contribution that you have made toward developing an immediate and long-term training plan for NWSA.

Sincerely,


 Charles D. Ward
 Director

cc: Mohammed Al-Fusail, NWSA
 AID/W