VI. IMPLEMENTATION PLAN

VI. IMPLEMENTATION PLAN

6.1 Organization for Implementation

The Rural Water Supply Department (RWSD) of the Ministry of Public Works (MPW)* is the organization to implement this project. The Bilateral Project Office of this Department is directly responsible for this project, while the Drilling and Hydrogeology Section and the Projects Section will support the project on technical matters.

The Japanese counter-organization to the RWSD consists of the consultant who will directly make a contract with the government of the Yemen Arab Republic for detailed designing and supervision of construction works, and the Japanese contractor who will carry out the construction works. Since the project sites are scattered in all directions from the capital city of Sana'a and the contractor must make negotiations with RWSD and comprehensive management of the works, a main office is required to be located in Sana'a. For the main office, a project manager must be assigned to manage the entire construction works. Furthermore, considering the construction scale of each site, effective allocation of site engineers is necessary for smooth progress of the works. An outline of the implementing organization is presented in Fig. 16.

Note: During the site survey (November, 1986), a cabinet decision was made to transfer the authority of the entire Rural Water Supply Department to the Ministry of Electricity and Water Supply (MEWS). The actual schedule for this transfer is unknown, but at the earliest, in 1987 the new organization of RWSD under MEWS (or the Rural Water Supply Agency) will start. However, it was confirmed that the basic organization of RWSD will not change and the implementing organization for this project will not change. Nevertheless, during the detailed design stage, this matter must be sufficiently examined and a final confirmation on the implementing organization must be made.

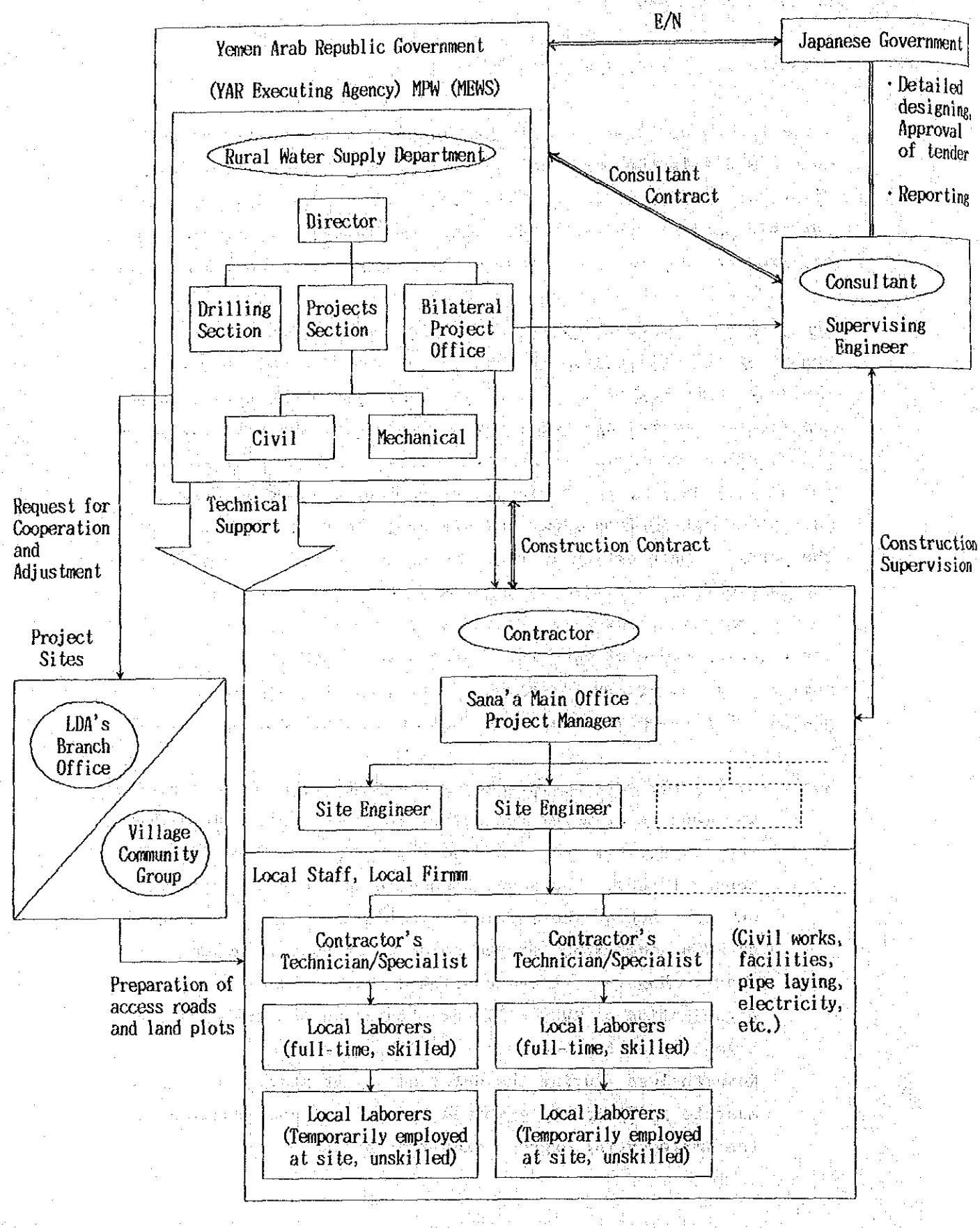

Fig. 16 Implementation System

6.2 Construction Plan

6.2.1 Construction Situation

The capacities for construction of rural water supply facilities in the Yemen Arab Republic are described below.

1) Conditions of Construction Works in General

The general conditions in the country of the construction works related to this project are outlined below. Based upon them, possible practical plans to implement the project is also described.

a. Well Drilling

About 30 well drilling companies can be found around the county, but of these, only 3 or 4 companies are eligible to participate in tender activities of RWSD in Sana'a, with each of these companies possessing about 3 drilling rigs. However, their organizations are generally weak, with their technical level remaining still to be improved.

b. Facilities Construction

As the need for improved water supply systems increases all over the country, local contractors for pipe laying, pumping unit installation and others are emerging. However, these firms are still small and not yet well organized.

With respect to the small to medium sizes, the construction works for this project are designed so as to enable local companies to handle them. However, the works on the large scale sites such as Al Rajam and Shihara require direct involvement of a Japanese firm to assure satisfactory accomplishment within the project schedule. Moreover, since the design of drilling works at Shihara and Wadi Asfan is a

special one, aimed at developing groundwater in shallow parts as well as in deeper ones, and needs upgraded drilling technology, the dispatching of engineers and specialists from Japan is recommended to be scheduled.

The large-scale construction works (public buildings, roads, etc.) in this country are handled mainly by foreign-based companies (China, Korea, EC countries, etc.). In addition, specialists/technicians such as drilling masters, etc. are mostly expatriate ones.

Taking into account the above mentioned conditions as well as the locations of the project sites scattered all over the country, the most appropriate implementation method is to make a turn-key contract with a firm for the whole project. For construction works, the contractor should employ local subcontractors or local skilled labor under his direct and full responsibility. In order to achieve satisfactory accomplishment of works within contract period, the contractor's project team will have to be divided into classified crew assigned to specific jobs, such as drilling, civil work, plumbing, etc., each one with a Japanese specialist/technician as its chief. The distribution of such classified crew to each of scattered project sites where all works simultaneously proceed should appropriately be determined to meet a performance period to be settled under the contract. Skilled labor can be employed in the capital or larger cities without much difficulty. On the other hand, ordinary labor engaging in unskilled works is recommended to be employed at each project site through local authorities, in order to save cost for accommodation and at the same time to assure good collaboration of inhabitants during the progress of works there.

Recently, the Yemeni government announced a policy that requires foreign contractors implementing loan projects to share at least 30% of the contract price with local companies. For this project, a Japanese firm will make a direct contract

with the executing agency in compliance with the provisions of the Exchange of Notes. The fund for this project is a grant, not a loan, but Yemeni companies, technicians and workers should be employed as much as possible in line with the said government's policy.

2) Local Labor Conditions

In order to prepare a pertinent plan of a time schedule to accomplish construction works within the period designated by Japan's grant aid system, the degree of work progress possibly affected by efficiency of local labor must be taken into account. The present working day is from 8:00 a.m. to 10:00 p.m. and from 3:00 p.m. to 6:00 p.m., but working efficiency after lunch tends to considerably decrease. Substantial working day is much less than the regular 8 hours.

In this country there is no reliable labor cost index classifying various jobs to be referred to for the estimate of work progress. Highly skilled labor cannot easily be found. Therefore, the preparation of work schedule with labor composition for this project needs to adopt appropriate adjustment of local labor efficiency, based upon Japan's standard labor cost index.

3) Climatic Conditions

Climatic conditions of the country is not considered to much affect the normal progress of works, since the intensity of rainfall ranging from April to September is less than 500mm in a year. Nevertheless, Tihama coastal plain is a special area in the country governed by high temperature and high humidity throughout the year with average daily maximum temperature mostly at more than 30°C and humidity at over 70%.

Accordingly adjustment in the progress of works due to climatic conditions is not necessary for six project sites in

mountainous areas, while two in Tihama plain, Ad Dahi and Harad, need to have adjustment of labor efficiency in the work progress in comparison with that in the former. The appropriate estimate of efficiency decrease is around 7/8 of that in the former, provided that a working day in the coastal area includes one hour of rest during regular 8 hours.

6.2.2 Description of Construction Works

The construction works included in this project will be classified as follows.

1) Deep Well Construction (Second Phase)

Four deep wells will be constructed at 3 sites. The structure of each well will differ, but depths down to 200m are planned.

2) Installation of Machinery (First Phase to Third Phase)

- Deep well : Installation of deep well pumps/power units
- Supply line: Installation of supply pumps/power units

3) Machinery House Construction (First Phase to Third Phase)

A machinery house to accommodate the pump and power unit will be constructed. The house will be of reinforced concrete block structure.

4) Distribution Tank Construction (First Phase to Third Phase)

Tanks having capacities of $20m^3$ to $150m^3$ will be constructed. The tanks will have foundations of reinforced concrete and will be of the prefabricated panel type. For topographically flat sites, steel framed elevated tanks of 15m in height will be erected.

5) Pipe Installation (First Phase to Third Phase)

Water transportation and distribution pipes will be installed. For the 6 sites located in mountainous areas, exposed pipes will be installed along the mountain sides. The 2 flat area sites will have underground pipeline networks.

6) Public Fountain Construction (First Phase to Third Phase)

Public fountains of reinforced concrete structure having multiple taps will be constructed.

For the construction works consisting of the above components, this basic design study recommends a packaged contract with the contractor.

6.3 Procurement of Equipment and Materials

Construction materials available in this country are mostly imported except cement, aggregates and some other materials. In addition, due to the shortage of foreign currency in recent years, the Yemeni government is striving for restriction on imports. Unstable high prices, poor stock of imported goods are the limiting factors in the present market situation. Therefore, for procurement of construction materials, the following policy is recommended.

1) Materials to be Procured Locally

The main materials to be procured locally are as follows.

a. Cement : Procurement is possible since two plants having annual production capacities of 500,000t and 350,000t are in operation.

b. Aggregates and water: Relatively good quality aggregates are available only in limited areas, and since the Sana'a area is the most reliable location, procurement from this area will be considered. Water is available in or near the construction sites.

c. Concrete block : Availability is good due to high production of blocks used for building wall construction.

d. Fuel (for vehicles and machineries) : Recently, domestic oil refining has started, but most fuel is imported from Saudi Arabia. Prices are relatively low and supply has been stable.

2) Materials to be Procured from Japan

Given the present local market conditions mentioned before, the industrial products such as pumps, pipes, etc. is recommended to be procured from Japan due to their proven qualities and stable prices. The main materials to be procured from Japan are listed below.

a. Deep well construction material : Casing pipes and screens

b. Pumps : Deep well pumps and multi-stage turbine pumps for water supply

c. Power units : Engines and generators

d. Piping materials : Water supply steel pipes, joints and valves

e. Distribution tank

materials : Steel panel tank and steel frame tower

3) Machineries and Vehicles

Since the 8 project sites are scattered all around the country, for transportation of materials to progress the works in parallel at several sites, coordination of the schedule through the main office in Sana'a and quality control, a great number of vehicles such as large-sized trucks and 4 wheel drive automobiles is required. In addition, for handling heavy materials, heavy machineries such as crane trucks are needed. Since procurement of these vehicles and machineries is now difficult in the country, basically these will be procured from Japan.

4) Temporary Works

Most of constructions for rural water supply in this country are rather small sized, and temporary facilities for contractors are not enough. Such difficulty in local procurement of materials for temporary works suggests that these be procured from Japan also, as are basically required for other construction materials and equipment.

6.4 Scope of Construction Works

6.4.1 Responsibilities of the Yemen Arab Republic

Under the management of the RWSD, the Japanese consultant will conduct the detailed designing and construction supervision, and the Japanese contractor will carry out the construction works on a turn-key basis. The scope of responsibilities of the Yemeni side is described below.

1) To provide data and information necessary for the project works.

2) To provide, secure, clear and level land at each construction site prior to the commencement of construction of water supply facilities.

3) To provide and secure land to serve as a base for storage of materials, equipment and other construction items both in Sana'a and at the project sites. This land should be cleared and levelled before the start of construction.

4) To prepare access roads to the sites before the start of construction.

5) To bear commissions to the Japanese foreign exchange bank for the banking arrangement.

6) To ensure prompt unloading, tax exemption, customs clearance of imported materials at the port of disembarkation and prompt internal transportation therein of the products and related equipment under the grant.

7) To exempt Japanese nationals from custom duties, internal taxes and other fiscal levies which may be imposed in the Yemen Arab Republic with respect to the supply of the products and the services under the verified contracts.

8) To accord Japanese nationals whose services may be required in connection with the construction of water supply facilities under the verified contracts such formalities as may be necessary for their entry into the Yemen Arab Republic and stay therein for the performance of their works.

9) To bear all expenses, other than those to be borne by the grant aid, necessary for execution of the project.

10) To organize necessary counterpart staff in the Ministry of Public Works for the execution (siting, drilling, installation of water supply systems and wells, etc.) prior to the commencement of the project.

11) To take necessary measures to secure acquisition of essential local items necessary for the execution of the project.

12) To maintain and use properly and effectively the facilities constructed as well as the equipment provided under the grant.

6.4.2 Responsibilities of the Japanese Government

The responsibilities of the Japanese Government are listed below.

1) To bear the costs for construction of water supply facilities included in this basic design study.

2) To bear the costs necessary for freight and insurance of equipment.

6.5 Implementation Schedule

The schedule for this project starts from the Exchange of Notes in the first stage, detailed designing by a consultant in the second stage, followed by the selection of a contractor by tender and then construction of the facilities. In consideration of the whole scope of construction and the conditions of Japan's grant aid system, this project should be implemented in three phases. Each of these phases is summarized below.

1) First Phase

Though the period of the E/N can change the schedule, considering the detailed design and tendering period, the construction will last 8 to 9 months. Of this, procurement and manufacturing of equipment and materials will take about 4

months, and with the 1 to 2 months period for ocean transportation and customs clearance, the actual construction period at the site will be only 2 to 3 months. The sites possible for construction completion within this period will be the smaller scales sites of Al Khasna, Al Zakira and Al Kheisen. Therefore, these 3 sites will be the candidate sites for the First Phase.

2) Second Phase

To complete the remaining 5 sites in one phase will require a large amount of labor and the simultaneous supply of equipment and materials, and this will result in an uneconomical plan. Therefore, for the larger sites of Al Rajam and Shihara, only a point source supply system will be constructed in the Second Phase and the rest will be carried over to the Third Phase. Project period of ten months is required for local construction.

3) Third Phase

Major works for Al Rajam and Shihara will be completed in this phase. The construction period of this phase is estimated as ten months.

6.6 Detailed Design and Construction Supervision

The services from detailed designing through tendering procedures and supervision of construction works to operation training will be conducted by a Japanese consultant following the process listed below.

Preconstruction Stage

(1) Detailed designing
(2) Preparation of tender documents
(3) Assistance in tendering
(4) Tender evaluation
(5) Assistance in contracting

	(6)	Supervision of construction works
Construction Stage	(7)	Inspection, training on operation, report preparation and others

In the preconstruction phase, first, the detailed designing including field surveys is conducted for each project site, and facilities plan and specifications for equipment and materials are determined. Then, the tender documents for these plans are prepared, and based on this, a tendering program, upon discussions with the concerned authorities, is prepared. Assistance in tendering will be given to the executing agency, and the tender results will be evaluated in accordance with the tender documents. Assistance in carrying out the contracting between the executing agency and the successful contractor will be provided.

The construction phase starts with the site transfer for each project site by the assigned engineer, and then the quality control and progress supervision of construction works, in addition to discussions with concerned authorities on problems that may arise. Near the completion of the works, the machineries to be supplied will be inspected and the completed facilities will be tested. Then, training on operation and maintenance to the operators will be carried out and a final completion report will be prepared.

VII. OPERATION AND MAINTENANCE

VII. OPERATION AND MAINTENANCE

7.1 Present Operation and Maintenance System of YAR

7.1.1 Outline of Present Operation and Maintenance System

The present operation and maintenance system of the water supply facilities completed by the Rural Water Supply Department (RWSD) is outlined by the following procedure now in practice.

Step 1: When the facilities completed by the contract between RWSD and the contractor are inspected in the attendance of RWSD engineers, then delivery from the contractor to RWSD is completed.

Step 2: RWSD will prepare a delivery certificate describing the facilities for the local community. This will be signed by the representatives of both RWSD and local community organizations (LDA's branch office, etc.), and the completed facilities will be received by LDA. At this time, keys to the main facility will be presented. Thereafter, the facilities become the common property of the community, and operation and maintenance responsibilities are handed over to LDA. LDA will also bear the operation and maintenance costs.

Step 3: Routine operation and maintenance will be carried out by the operator (usually 1 or 2 persons, depending on the facilities scale) designated by LDA.

Step 4: The operator of LDA is obliged to participate in the training program of RWSD.

Step 5: After start of operations, if a defect in construction is discovered or a problem untreatable by the operator develops, a request from LDA is submitted to RWSD and water supply/mechanical engineers from the office will make field inspections to solve the problem.

7.1.2 Routine Operation and Maintenance

Of the communities which received facilities, for small villages having about 500 inhabitants, daily operation and maintenance is carried out by a person selected to be in charge, but do not measure up to charged water service systems.

However, for villages with over 1,000 inhabitants, one or two villagers with some technical knowledge are chosen as full-time operators of the facilities. Their salaries range from YR 2,000 to YR2,500/person/month.

The main operation and maintenance costs are operators' salaries and fuel costs for engines/generators. These are generally paid by the beneficiaries at YR 50-100/household/month.

In communities comprised of multiple-villages with some 3,000 inhabitants, LDA is very active and water fees are charged based on water meters. The water fees are calculated with allowance for repair costs of pumps and other equipment. At the sites completed through the Japanese loan project, the water rates were YR 10 to YR20/m^3 (1985 survey).

7.1.3 Treatment of Problems

Whenever the operating situation of the deep well or equipment such as pumps, engines and generators become abnormal, LDA sends a request to RWSD for treatment of the problem. The problems in the deep wells are handled by the Drilling Section and the other problems are treated by the Mechanical Section. However, the staff number and experience need to be increased and technology needs to be improved, especially with respect to mechanical/electrical problems.

On the other hand, as for procurement of parts required for repairs, spare parts equivalent to 10% of the equipment cost in the Japanese loan project were supplied and are stored in the Hasabba

stockyard of MPW. Furthermore, equipment and machineries of Japanese make have become conspicuously popular in this country and share a large portion of the market. Such a situation has facilitated procurement of spare parts. However, the degrading foreign currency situation since the previous year has caused the high price rise in the market and even made procurement difficult. Since this situation is not likely to improve in the near future, procurement of spare parts for this project within a feasible limit needs to be planned.

7.1.4 Training System of RWSD

As was explained previously, the operators are selected from the community and are not always sufficiently skilled. To improve the technical level of these unskilled operators, which will in turn improve the operation and maintenance of the facilities, RWSD occasionally holds training classes. The present training system is outlined below.

1) The training of village operators started in 1980, when USAID carried out operator training sporadically at RWSD only for their own project.

2) In July, 1984, USAID implemented a new grant project for RWSD, and at that time, training on a full scale was consented. Consequently, training was expanded to operators of other projects under RWSD as well as USAID's own projects. This has become the present training system and is financed 100% by USAID. The classes are held at classrooms and workshops of MPW's Hasabba office.

3) Whenever a project is completed, LDA submits to RWSD a request in writing for training of 2 candidate operators. Then the training program commences when about 30 to 50 applications have been received, which is about once every 2 or 3 months.

4) The program is divided into 2 grades, where grade 1 centers around theoretical study and grade 2, practical training. Both of the 2 candidates sent by LDA are obliged to go through grade 1, but only one is required for grade 2. In the grade 2 phase, the trainee will acquire knowledge in engine assembly, pipe threading, welding and other skills. The training periods are one month for grade 1 and 25 days for grade 2.

5) The number of graduates now total 179 persons for grade 1 and 20 persons for grade 2. The goal for the next 2 years is to raise the number to 200 persons for grade 1 and 80 persons for grade 2. The principal lecturers are USAID engineers, Peace Corps trainers and RWSD engineers, and the practical training is handled by Yemeni skilled workers. The contents of the course have gradually improved by trial and error attempts, but recently this has become fixed. The number of trained personnel remains yet to be increased, but this training system by the cooperation between RWSD and USAID is worthy of attention and successful results are anticipated.

7.1.5 Present Water Fee System

Though water fees differ between local communities, these are based upon operation and maintenance costs (including operators' salaries). The salary of a full-time operator is YR 2,000-2,500/month, but most of the operators are non-professionals selected out of the villagers.

Water fees are levied either by a consumed-rate method which is based upon the amount consumed, or a fixed-rate method where a fixed monthly charge is collected from each household. Concerning the consumed-rate method, metered rates of YR 9/m^3, 10/m^3 and 12/m^3 are common (presently, the rate in Sana'a is YR 2/m^3). For the fixed-rate method, rates are determined according to factors such as the house size and number in family and this ranges from YR 50/month to YR 100/month. The collected water fees are alloted

mainly to salaries, generator fuel costs, oil costs and purchase of spare parts, but some communities reserve a portion of the fees for future replacement of equipment and pipe extensions. The ratio of the water fee to family income is about 1-4 % which is not a big burden on the inhabitants. This is also reasonable from the viewpoint that IBRD/IDA recommends to rural water supply departments of developing countries the establishment of a water fee system which will allow the lower income inhabitants to receive an necessary amount of water charged within 5% of their incomes.

7.2 Operation and Maintenance System

The basic flow of the existing operation and maintenance system consists of three parts: the technical training of operators and then the technical maintenance during break-downs by engineers of the executing agency; and daily operation and maintenance by the operator of the community; and ordinary fee payment by the village beneficiaries.

The operation and maintenance system for this project must provide normal functioning of the completed water supply facilities on a long term basis with a stable supply of safe drinking water. The existing system sufficiently holds these conditions, and therefore, for this project, the existing system will be basically followed and referred to. The basic system is indicated in Fig. 17. The personnel plan for the project sites is summarized thereafter.

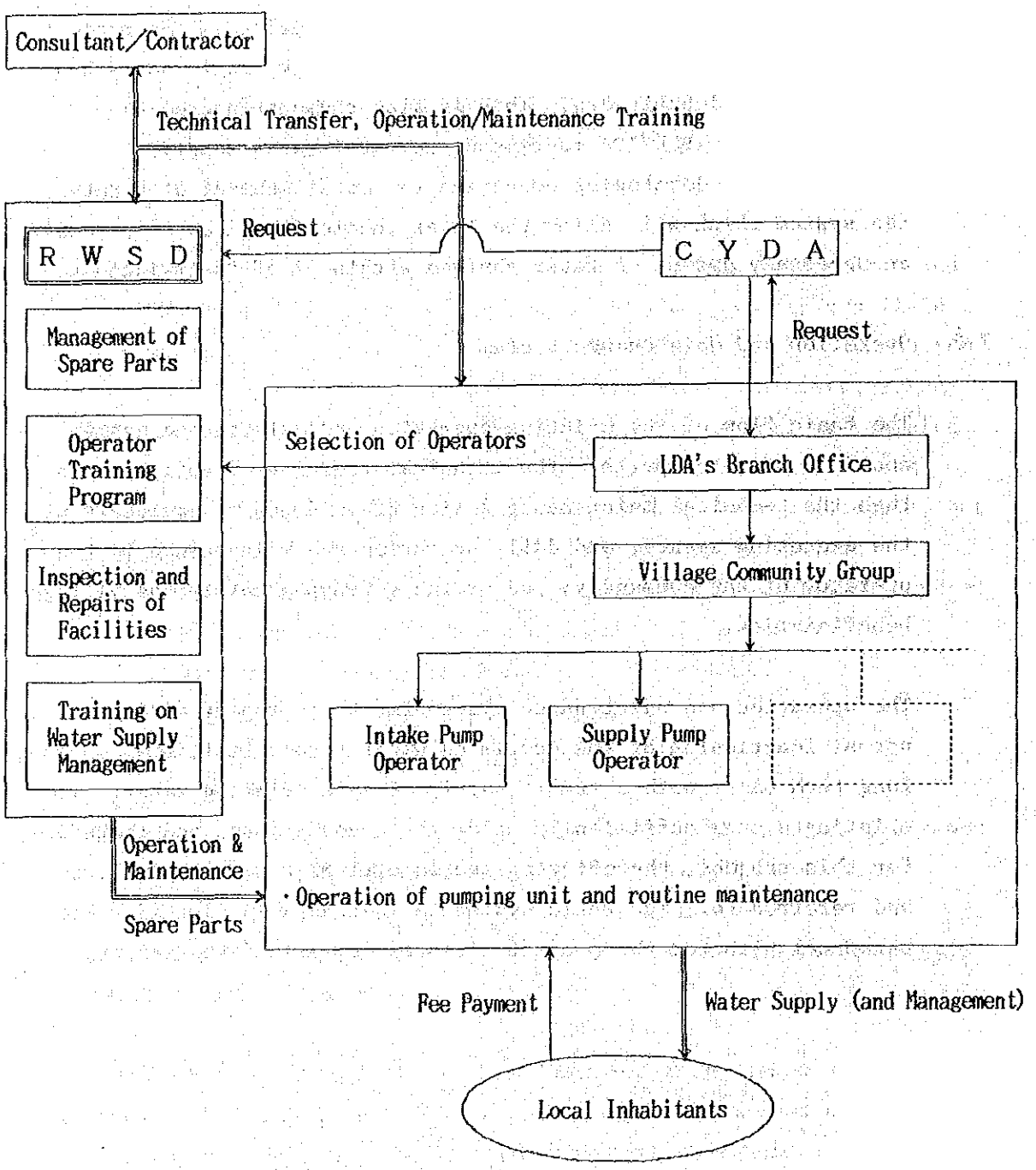

Fig. 17 Operation and Maintenance System

7.3 Operation and Maintenance Plan

7.3.1 Personal Plan for Operation and Maintenance

The personnel plan differs with the scale of the facilities and the village conditions in the respective project sites. The plan for each site recommendable at the present time is shown below.

	Site Name	Required No. of Personnel	Description
1.	Wadi Asfan	1 (1)	Five villages composing this site will carry out the maintenance collectively. Of the 2 persons, one should work full-time.
2.	Al Khashna	1 (1)	This site consists of one small village with a short operating time, but one regular operator and one substitute is recommended.
3.	Al Zakira	1 (1)	A full-time operator is already assigned to the facilities completed at this site by the second grant project. However, the present project will construct facilities at a separate area on the far mountains and an operator must be selected from the benefitting village for this purpose. The conditions are same as that for Al Khasna.
4.	Al Kheisen	2 (2)	The operation at this site is divided into 2 sections, one for the intake pump and another for the supply pump for the village located about 3km away. The 2 sections are collectively referred to as Al Kheisen, but are geopolitically separated. Each section requires 2 operators including a substitute.

	Site Name	Required No. of Personnel	Description
5.	Al Rajam (Block D)	3 (2)	At this site, a control station to operate 2 deep wells and a booster pump will be constructed in the wadi, and a second booster pumping station, at the top of Al Hajar located midway on the mountain side. Two operators at the central control room and one at the booster station are needed.
6.	Shihara	5 (2)	For this site, from the deep well located in the wadi to the mountain top 1,300m above, water will be transported through 7 supply/distribution stations. Of these, 5 stations will be manned, since the 1st station accommodates the deep well pump and the 1st booster pump and the 6th station is automatically controlled at the 5th station. Therefore, one operator for each station is advisable, but when the operation is in full force, the 3rd and 4th stations can be served concurrently so that 4 operators is possible.
7.	Ad Dahi	3 (2)	This site is planned to have 2 well pumping stations and a distribution pipeline network will be installed. Therefore, an operator for each of the stations and a pipeline service man are needed full-time.
8.	Harad	3 (2)	This site is similar to Ad Dahi with 2 pumping stations and a pipeline network, and so the same number of persons are required.

Note: ( ) denotes substitute personnel number.

7.3.2 Equipment and Materials

Due to the import restriction caused by the recent slump in the foreign currency situation in the YAR, even automobile parts are difficult to procure locally. Therefore, spare parts for the main machineries and special materials will also be procured by this project to carry out the stable and continuous operation of the completed systems. The appropriate materials and equipment plan is listed below.

1) Submersible Motor Pumps

One each of standby motor for each specified pump
(This is due to the fact that the motor of a submersible pump is unrepairable and needs to be replaced, when it is damaged.)

2) Borehole Pumps

Spare parts equivalent to 20% of equipment proper cost
(Since borehole pumps are operated by diesel engines installed on the ground, unlike submersible motor pumps, repairs on damaged pumps are easily coped with. With these spare parts, operation and maintenance for about 2 to 3 years is possible.)

3) Multi-phase Turbine Pumps Directly Coupled to Motor

One each of standby pump for each specified pump
One each of standby motor for each specified output rating
(Especially, since high lift pumps are not available in YAR, standby equipment is necessary.)

4) Diesel Engine/Generators

Spare parts equivalent to 20% of equipment proper cost
(With these spare parts, operation and maintenance for about 2 to 3 years is possible. During this period, procurement by local LDAs is possible.)

5) Control Panels

Spare parts equivalent to 20% of equipment proper cost
(The selection is due to the same reason as for the above item.)

6) High Pressure Cast Steel Valves

One each of standby valve for each specified valve size
(This is due to the fact that heavy duty high pressure valves are not available in YAR.)

7.3.3 Management

1) Operation

The daily operation of the facilities basically depends upon the situation of the water level in each tank. The pump is stopped when the level rises to the upper limit and is started again when the level lowers below the middle or to the lower limit. In order to confirm the hourly fluctuation in the supply rate, the appropriate supply rate, the consumption pattern and others, operation records should be kept.

2) Maintenance

For normal operation of the systems, the facilities must be periodically inspected and maintained. Especially, machineries such as pumps require proper maintenance by personnel with sufficient knowledge and experience. Moreover, to prevent leaks in the pipeline, routine checks must be considered.

3) Role of RWSD

RWSD does not directly participate in the actual operation and maintenance of the water supply systems. However, for complete management, the following points need to be taken into account.

a. Training

Since operators must be trained until they master the secondary phase of the RWSD training program, RWSD needs to organize the training program in accordance with the progress of the construction works at each site.

b. Routine Inspection

For sites where large-scale facilities are included, the site management situation should be inspected periodically (at least once every 2 months) by engineers dispatched by this office. Furthermore, for operation and maintenance of the sites with central control systems, possibility of dispatching Japanese specialists may be taken into account.

c. Maintenance of Equipment and Materials

Spare parts and other materials are stocked in the RWSD-managed warehouse in Sana'a, and materials are brought out of stock whenever a request is received from the village. However, due to complicated procedures to bring materials out of stock, delivery of these materials is usually delayed. Therefore, in particular for sites located far away from Sana'a such as Shihara, Ad Dahi, Harad and Al Zakira, delivery of spare parts at the same time as the site delivery to local LDAs is highly recommended.

7.4 Operation and Maintenance Cost

The cost for operation and maintenance of the completed facilities is composed of the following expenses.

1) Operation Salaries: YR 2,000-2,500/person/month
(For small to medium sized villages, operators may be unpaid.)

2) Fuel Cost : Engine oil for operating engines/generators

3) Oil Cost : 10% of fuel cost

4) Operation and Maintenance Cost : Reserve fund for repairs, parts purchase, etc. (This is necessary for sites with large-sized facilities and large number of households.)

Estimates for 4 representative project sites are listed below. The details of the calculations are indicated in Appendix.

Table 34 Operation and Maintenance Cost

Site Name	Operation & Maintenance Cost		Ratio to Income
	YR/Household/Month	YR/Month	%
Wadi Asfan	45.9	9,091	1.1
Al Khashna	59	5,825	1.5
Al Zakira	27	4,431	0.7
Al Kheisen	51	11,922	1.3
Al Rajam	70	85,257	1.8
Shihara	120	202,386	3.0
Ad Dahi	15.2	24,489	0.4
Harad	23	31,566	0.6

VIII. PROJECT EVALUATION

VIII. PROJECT EVALUATION

In the recent economic growth of the Yemen Arab Republic much effort has been made for improvement of social infrastructure including rural water supply. By the end of the second five year development plan in 1986, however, almost 75% of rural population may still suffer from insufficient and unsafe domestic water supply.

In these areas only the surface water, stored rain water in systerns, is the available source of domestic use which tends to be contaminated by inflow of polluted surface run-off. Provision of safe and sufficient domestic water for such areas is an urgent task from view point of public hygiene.

Most of the sites of this project distribute over a wide area in the Republic and are suffering from lack of safe and sufficient domestic water. Accordingly, drinking water is purchased from water vendors.

Considering such present condition of water shortage in the project sites, the project implementation definitely contributes to improvement of safe and sufficient water supply to the rural people which may result in decrease of water born epidemic occurrence as well as improvement of public hygiene in the project sites. In addition, provision of service systems may reduce the existing distance between water point and the service area which, in turn, may produce labor to be used for productive purposes, otherwise to be wasted, to carry water.

Through implementation of this project, a total of 1,130m^3 of clean water will be supplied every day for 21,470 people which will be increased to 1,835m^3/day for 33,390 people after 20 years.

From the technical point of view, a wide range of technology transfer will be made through the project implementation, since water supply facilities in the most of the project sites require high standard water supply engineering technique. Together with equipment and means of transport to be provided by the project much improvement will be expected in capacity of local engineers for construction of water supply facilities and operation maintenance in the Republic.

Considering present operation and maintenance system and technical standards of the Republic no difficulty will be expected in operation and maintenance of the water supply facilities to be constructed under the project although further improvement may be required in the institutional aspects.

Local portion of the project is estimated YR 12 million and Annual Operation & Maintenance Cost is estimated YR 4.5 million:

Assuming 3% of interest rate and 30 years of payback period the annual capital costs of local portion is estimated YR 0.6 million:

Accordingly unit annual cost (YR/m^3) of the water is estimated YR 7.7/m^3

This unit annual cost of the clean water of the project is equivalent to 1/4-1/20 of the present price of drinking water obtained from water vendors which means a significant savings in the household economy.

Comparison of domestic water supply between with the project and without the project is summarized in Table 35.

Table 35 Comparison of Domestic Water Supply between with & without Project

	Without Project	With Project
Water Source	Unsteady & Unsafe Water	Steady & Safe Water
Water Consumption		
Mountainous Area	15-25 ℓ /day/cap	40 ℓ /day/cap
Plain Area	20-40 ℓ /day/cap	70 ℓ /day/cap
Price of Water	40-500 YR/m3	3-25 YR/m3
Distance to the Water	0.5-10 km	less than 0.5 km

IX. CONCLUSION AND RECOMMENDATION

IX. CONCLUSION AND RECOMMENDATIONS

9.1 Conclusion

Provision of safe and sufficient water for all people is one of the substantial development policies in the Yemen Arab Republic. The responsible government institution for rural water supply of 90% of the national population is the Rural Water Supply Department of the Ministry of Public Works. Under the circumstances, implementation of the project will significantly contribute to the above development policy. Through the project safe and sufficient domestic water supply will be maintained at 8 project sites which may result in much improvement of social infrastructure at the project sites. It is obvious that the project implies deeply the contribution to the government development policy to increase household income and upgrade living standards in rural areas through rural development. It is therefore recommended to implement the project under the grant aid cooperation between the two governments.

9.2 Recommendations

It is concluded that the project will significantly contribute to improvement of social infrastructure of the project sites. However, in order to maintain these facilities to be provided by the project satisfactorily it is recommended as summarized below:

1) Improvement of organization and institutional mechanism for efficient operation and maintenance of the rural water supply facilities.

2) Establishment of filing systems of all drawings, documents, records of construction works and operation for day to day operation and maintenance and also for future extension schemes.

3) Social education to recognize importance for safe and sufficient water supply for public hygiene.

4) Much effort has been made to provide facilities with durable and easy operation and maintenance, however the rationalized standardization of facilities and equipment will be required in future.

5) In order to maintain appropriate precious water source management a nation wide water resources assessment of both surface and underground water and their development plan will be required.

APPENDIX

A - 1 FIELD SURVEY

a. Study Team

Assignment	Name	
Team Leader	Junzo Sago	Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs
Sub-Leader	Masao Tsujioka	Japan International Corporation Agency
Chief Enginer/ Water Supply	Eigiro Ueno	Pacific Consultants International
Facilities Design/ Hydrogelogy	Masami Mochizuki	- do -
Hydrogeology A	Sakae Takada	- do -
Hydrogeology B	Hisashi Kobayashi	- do -
Cost Estimation	Kiyoshi Nakahara	- do -

b. Schedule of the Site Survey

Site Survey Schedule

	Date	Weather	Stay	Brief of Works	Remarks
1.	Oct.24.Fri.			Departure NRT-BHL	JL481
2.	25.Sat.	Fine	BHL	BHL-SANA'A Arrival at SANA'A	IY752
3.	26.Sun.	- do -	SANA'A	Courtesy Call Japanese Embassy The first meeting with MPW	
4.	27.Mon.	- do -	- do -	The second meeting with MPW Courtesy call COP	
5.	25.Tse.	- do -	- do -	Courtesy Call the Minister of MPW Sign on Records of Discussion	
6.	29.Wed.	- do -	- do -	Preparation of Survey Equipment Date Collection	
7.	30.Thr.	- do -	- do -	Brief survey at WADI and ASFAN	
8.	31.Fri.	- do -	- do -	WADI ASFAN Water Resources Survey, Rute Surveying	
9.	Nov. 1.Sat.	- do -	- do -	- do -	
10.	2.Sun.	- do -	DIMUNA	Brief Survey at DIMUNA	

	Date	Weather	Stay	Brief of Works	Remarks
11.	3.Mon.	Fine	SANA'A	Facilities and Water Resources Survey to SANA'A	
12.	4.Tse.	- do -	AC KHASHNA	Data Collection Brief Survey	
13.	Nov. 5 Wed.	- do -	SANA'A	Water Resources and Rute Surveying Movement from SANA'A to AL KHASHNA	
14.	6.Thr.	- do -	- do -	Data Collectionn Internal Meeting	
15.	7.Fri.	- do -	- do -	Data Arrangement	
16.	8.Sat.	- do -	SAKIRA	Movement from SANAA to AL ZAKIRA	
17.	9.Sun.	- do -	- do -	Facility survey rute surveying	
18.	10.Mon.	- do -	- do -	Winter Resources, rute surveying	
19.	11.Tse.	- do -	SANA'A	Movement from ZAKIRA to SANA'A	
20.	12.Wed.	- do -	AL KHEISEN	Movement to AL KHEISEN Brief Survey at AL KHEISEN	
21.	13.Thr.	- do -	SANA'A	Water Resources and Facilities survey Movement to SANA'A	
22.	14.Fri.	- do -	- do -	Holiday	
23.	15.Sat.	- do -	- do -	Data Collection and Arrangement	
24.	16.Sun.	- do -	- do -	Meeting with MPW for Work Schedule and Progress. Data Arrangement	
25.	17.Mon.	- do -	- do -	Brief Survey at AL HUSUN	
26.	18.Tse.	- do -	- do -	Meeting with MPW about AL HUSUN Survey	
27.	19.Wed.	Fine/ Shower	- do -	Electric Prospective Suvey at WADI ASFAN	
28.	20.Thr.	Fine	SANA'A	Hydrogeologist Mr. Takad arrived at SANA'A courtesy call the Japanese Embassy Meeting with MPW	
29.	21.Fri.	- do -	- do -	Data Arrangement	
30.	22.Sat.	- do -	- do -	Inferium Meeting with MPW. Data Collection. Check of Electric prospective survey equipment.	
31.	23.Sun.	- do -	AL RAJAM	Movement from SANA'A to AL RAJAM	

	Date	Weather	Stay	Brief of Works	Remarks
32.	Nov.24.Mon.	Fine/ Cloudy	- do -	Investigation of existing wells, survey Preparation Electric prospective survey	
33.	25.Tse.	- do -	- do -	Survey of Pipe-line and Electric prospective survey	
34.	26.Wed.	- do -	- do -	- do -	
35.	27.Thr.	- do -	SANA'A	- do - Movement from AL RAJAM to SANA'A	
36.	28.Fri.	Fine	- do -	Data Arrangement survey, Check of Electric prospective survey Data	
37.	29.Sat.	- do -	- do -	Data Arrangement of Rute Surveying Analysis of Electric prospective survey Data.	
38.	30.Sun.	- do -	SHIHARA	Movement from SANAA to SHIHARAH	
39.	Dec. 1.Mon.	- do -	- do -	Site investigation at SHIHARA, Rute surveying	
40.	2.Tse.	- do -	- do -	Rute surveying and Electric prospective survey	
41.	3.Wed.	- do -	- do -	Rute surveying and Electric prospective survey at Wadi Woar	
42.	4.Thr.	Fine/ Cloudy	- do -	- do -	
43.	5.Fri.	Rain	SANA'A	- do - Movement from SHIHARAH to SANA'A	
44.	6.Sat.	Shower	- do -	Data Arrangement of Rute surveying and Electric prospective survey	
45.	7.Sun.	Fine	- do -	Data Analysis of Rute surveying and Electric prospective survey	
46.	8.Mon.	- do -	- do -	Meeting with MPW	
47.	9.Tse.	- do -	HUDAYDAH	Movement from SANA'A to HUDAYODAH	
48.	10.Wed.	- do -	- do -	Field Investigation at AL DAHI	
49.	11.Thr.	- do -	- do -	Field Investigation at HARADA	
50.	12.Fri.	Fine/ Cloudy	- do -	- do -	

	Date	Weather	Stay	Brief of Works	Remarks
51.	Dec.13.Sat.	Fine	SANA'A	Movement from HUDAYDAH to SANA'A	
52.	14.Sun.	- do -	- do -	Analysis of Rue surveying and Electric prospective survey	
53.	15.Mon.	- do -	- d -	- do - TSUJIOKA, KOBAYASHI moved to SHIHARA and HUDAYDAH	
54.	16.Tse.	- do -	- do -	Electric prospective survey at SADI ASFAN	
55.	17.Wed.	- do -	- do -	Analysis of Rute surveying and Electric prospective survey and collection	
56.	18.Thr.	- do -	- do -	Meeting with MPW	
57.	19.Fri.	- do -	- do -	Holiday	
58.	Dec.20.Sat.	- do -	- do -	Data Arrangement	
59.	21.Sun.	- do -	- do -	Sign the Minutes of a Meeting Movement from SANA'A to Tokyo	
60.	22.Mon.	- do			

c Minutes of Meetings

بسم الله الرحمن الرحيم

الجمهورية العربية اليمنية
وزارة الاشغال العامه
الاداره العامه لمشاريع مياه الريف
صنعاء

الرقم
التاريخ 30/10/1986
المرفقات

Minutes of Discussions On

The Basic Design Study for the Rural Water Supply Project In Yemen Arab Ripublic

In response to the request of the Government of the Yemen Arab Republic , the government of Japan decided to conduct a basic design study on the Rural Water Supply Project and entrusted the study to the Japan international cooperetion agency (JICA) . JICA sent to the Yemen Arab Republic the study team , headed by Mr. Masao Tsujioka , which is schedualed to lead their field study in the Yemen Arab Republic from October 26th to December 21st 1986 .

The team explained the inception report of the project to the officials concerned of the government of the Yemen Arab Republic .

The Yemeni side agreed to the report. Both parties expressed their wish that the study leads to success by friendly cooperation of both parties .

Oct. 28th , 1986 .

Mr. Masao Tsujioka
Leader, the Basic study team , Design JICA

Mr. Ibrahim Al-Shami ,
Deputy Director Of R.W.D
MPW.

MINUTES OF DISCUSSIONS

ON

THE RURAL WATER SUPPLY PROJECT

IN

THE YEMEN ARAB REPUBLIC

In response to the request of the Government of the Yemen Arab Republic, the Government of Japan decided to conduct a basic design study on the Rural Water Supply Project and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to the Yemen Arab Republic the study team headed by Mr. Junzo Sago, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs.

The team had a series of discussions on the Project with the officials concerned of the Government of the Yemen Arab Republic and conducted a field survey.

As a result of the study, both parties agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the Project.

Sana'a, 21 of December, 1986

佐合純造

Junzo Sago
Team Leader
JICA Study Team
Japan

Muhsien Al-Hamdani
Deputy Minister
Ministry of Public Works
The Yemen Arab Republic

ATTACHMENT

1. The objective of the project is to construct water supply facilities for the people of the rural areas where drinking water is urgently needed.

2. The scope of work for the project is to construct water supply facilities at the following sites; AL KHASHNA, AL ZAKIRA, AL KHEISEN, HARAD, AL DHAHI, AL RAJAM, SHIHARA, WADI ASFAN.

3. The Ministry of Public Works in the Yemen Arab Republic is responsible for the land acquisition, water rights, implementation and operation and maintenance of the project.
   With regards to the land acquisition and clearance of water rights at the project sites, the Ministry of Public Works is required to report to the Japanese side in written form as soon as possible.

4. Before the Japanese Grant Aid is extended to the Government of the Yemen Arab Republic, the Government will take the measures listed out in the Appendix.

5. Both parties confirmed that the study team explained the Japanese Grant Aid programme and the Yemen Arab Republic side has understood it.

6. The Yemeni side expressed their wish to make new request of water supply facilities' construction at the sites of AL DUMNA/DAWRAN and BAIN HUSHASH and explained that they would like to prepare necessary documents and materials for the projects.
   The Japanese side explained that the request needs to be informed to the Japanese side by formal procedure.

APPENDIX

The necessary measures to be undertaken by the Government of the Yemen Arab Republic for the Project are as follows:

1. To provide data and information necessary for the Project works.
2. To provide, secure, clear and level land at each construction site prior to the commencement of construction of water supply facilities.
3. To provide and secure land to serve as base for storage of materials, equipment and other construction items both in Sana'a and at the Project sites. This land should be cleared and levelled before the start of construction.
4. To prepare access roads to the site before the start of construction.
5. To bear commissions to the Japanese foreign exchange bank for the banking arrangement.
6. To ensure prompt unloading, tax exemption, customs clearance of imported materials at the port of disembarkation and prompt internal transportation therein of the products and related equipment under the grant.
7. To exempt Japanese nationals from custom duties, internal taxes and other fiscal levies which may be imposed in the Yemen Arab Republic with respect to the supply of the products and the services under the verified contracts.
8. To accord Japanese nationals whose services may be required in connection with the construction of water supply facilities under the verified contracts such formalities as may be necessary for their entry into the Yemen Arab Republic and stay therein for the performance of their works.

9. To bear all expenses, other than those to be borne by the grant aid, necessary for execution of the Project.

10. To organize necessary counterpart staff in the Ministry of Public Works for the execution (siting, drilling, installation of water supply systems and wells etc.) prior to the commencement of the Project.

11. To take necessary measures to secure acquisition of essential local items necessary for the execution of the project.

12. To maintain and use properly and effectively the facilities constructed as well as the equipment provided under the grant.

d. List of Person Contacted

-Ministry of Public Works(MPW)

Minister	Mr. Abdulah Fusein Al Kurshimi
Deputy Minister	Mr. Muhsien Al Hamudani
Director General of Rural Water Supply Department(RWDS)	Mr Abdul Basi Saleh
Deputy Director Gereral of RWSD	Mr Ibrahin A. Al-Shami
Assistant Manager of Account	Mr. Hassan Moshin
Engineer	Mr. Majide
-do-(counterpart)	Mr. Abdula Hamid Al Bashiri
Geologist(-do-)	Mr. Ahamed
-do-	Mr. Mohamed Al Hamdani

-Central Planning Organization(CPO)

Assistant Deputy Minister	Mr. Annuol Haragi

-Enbassy of Japan

Ambassador	Mr. Matsumoto
Prime Secretary	Mr. Shimazu
Prime Secretary	Mr. Saito