hole method. In addition, the open hole method does not require a heavy tool, like drive pipes, which be advantageous from the aspect of safety.

The above findings are well recognized by CGWB, and the original request for drilling equipment of the cased hole method is revised for that of the open hole method before the site survey.

In conclusion, it is proposed to provide the open hole method drilling machines and their tools in the Project.

iv) Selection of Drilling Machine.

Considering general geological conditions and the drilling method, the cable percussion type drilling machine is proposed. As the drilling sites are distributed over a wide area it is also proposed that the drills truck mounted types. The drilling machine must be capable of drilling 300 m deep wells having 20 inch diameters.

As discussed in Chapter 3, 3, units of drilling equipment will be necessary.

(2) Open Hole Tools Previously Provided Percussion Rigs (for 3 rigs)

In the previous Project, four drilling units were provided. Of these, three units are equipped by cased hole tolls. In the analysis made on the drilling methods it is clarified that the open hole method is more advantageous in all aspects than the cased hole method. To complete the project by the set target in 2005, it is inevitable that the open hole method be selected.

For this reason, provision of the open hole tools for the remaining 3 drilling units is urgently required to attain the set target of the project.

The tools necessary for the remaining 3 units are as follows:

1) Drilling tools
2) Fishing tools
3) Auxiliary tools

To minimize the number of tools, it is proposed to supply necessary tools in a rational way. Drilling tools are required for each drilling units. The fishing tools and some auxiliary tools would be used by multiple drilling unit. Therefore, the necessary tools for open hole drilling shall be carefully determined by reviewing the quantity and present condition of the tools already provided and the overall requirement of the drilling plan.

Of the four rigs provided in phase 1, three were equipped cased hole drilling tools. These tools are effective for drilling loosely deposited formations, such as the loose parts of the boulder formation and soft sediments. The tools can be diverted to other percussion type rigs.

Auxiliary tools should be designed avoiding repetition with tools provided in phase 1 project.

(3) Crane Trucks

For drilling work and transportation of equipment and materials, heavy duty crane trucks are necessary. The weight of the heaviest tool is 4.5 tons. For loading and unloading of tools and equipment, 5 ton cranes are necessary. Usually, loading and unloading in India is accomplished manually whenever a heavy duty crane is unavailable. This requires many laborers and is Time consuming. In addition, when loading and unloading are done manually, the laborers and equipment/machines, continually risk injury or damage. In phase 1, drive pipes were unloaded manually; some of them were damaged when they shipped from the trucks.

The drilling time during the construction period of water wells by the open hole method in the phase 1 was 81 days. Mobilization and preparatory work took 27 days and 94 days were spent handling casings/screens and demobilization since there was no heavy duty crane truck available.

By Providing a crane truck, the construction period could be greatly reduced by minimizing the time required for handling equipment, tools and materials. Safety aspects to use a crane is not negligible.

The provision of one crane truck is preferable. However, 1 unit for 2 drilling units would by sufficient in the project since a crane truck is required mainly for loading and unloading of equipment, tools and materials. The project has 7 drilling units: 4 units from phase 1 and 3 units to be provided by phase 2. Considering efficiency of the CGWB's drilling plan implementation and minimized costs, a minimum of three crane truck units would be required.

(4) Pumping Test Equipment

For confirmation of the available quantity of ground water, pump tests are necessary. A well tapping water from aquifers developed in the boulder formation prevailing in the project area easily yields more than 2 tons/min. However, pumps available from the local manufacturer are insufficient both in their flow and head capacities. The inside wall of the well that has just been drilled is protected by the circulated mud. To evaluate the given capacity of ground water yield of the well, it is necessary to remove the circulation mud from the aquifer to maintain an efficient flow of ground water by the well development. For this purpose, a pump having sufficient capacity in flow rate and hydraulic head is required for well development and pump tests. Necessary equipment and materials are illustrated in Fig. 4.3-2.

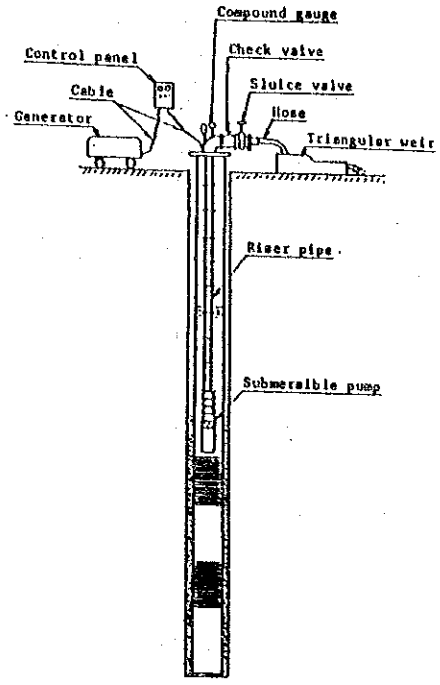


Fig. 4.3-2 Pumping Test Equipment

The required capacity of the pump is 2 ton/min with a lifting head of 150 m. Three pump test teams will be required for the 7 drilling team units called for in CGWB's drilling plan.

(5) Geophysical Survey Equipment

To confirm the results of the geological analysis for determination of the drilling site, geophysical prospecting is necessary.

After the completion of drilling, well logging is necessary for the well design to determine the exact screen locations.

The Geophysical Department is undertaking the geophysical survey for CGWB. This department is under the control of the Superintending Geophysicist at the headquarters in the Southern Regional Office (Hyderabad). The department consists of 45 scientist as shown below:

| | |
|---|---|
| Scientist D | 1 |
| Scientist C | 7 |
| Scientist B | 12 |
| Scientist A | 25 |
| Total number | 45 |

Scientists C, B and A will be team leaders of the field geophysical survey.

A field survey team consists of the following personnel:

a) Resistivity, Magnetic and Low Frequency Survey

| | | |
|---|---|---|
| Scientist | 1 | person |
| Technician | 1 | person |
| Laborers | 4 ~ 6 | persons |
| Driver | 1 | person |
| Total | 7 ~ 9 | persons |

b) Seismic Survey

| | | |
|---|---|---|
| Scientists | 2 | persons |
| Surveyor | 1 | person |
| Technician | 1 | person |
| Laborers | 6 ~ 8 | persons |
| Drivers | 2 ~ 3 | persons |
| Total | 12 ~ 15 | persons |

For this purpose the following equipment is available at CGWB:

< Geophysical survey >

| | |
|---|---|
| Seismic survey equipment | 3 units |
| Low frequency survey equipment | 4 units |
| Electro-magnetic survey equipment | 2 units |
| Resistivity survey equipment | 19 units |

< Well logging >

| | |
|---|---|
| Well logger | 9 units |

Considering the volume of work required for the Geophysical Survey Department, the amount of equipment is insufficient. Fortunately, there are enough scientists to handle the department's required work volume by increasing the amount of equipment.

For this purpose it is proposed to provide following equipment:

i) Well Logging Equipment

Four units of well logging equipment units with sufficient cables for 1,000 m deep wells. The equipment units should be capable for the survey items of resistivity, spontaneous potential, natural gamma, fluid resistivity, temperature and caliper.

ii) Micro flow meter

4 micro flow meters with sufficient cable for taking measurements of 300 m.

iii) 1 unit of Seismic Survey Equipment

iv) 1 unit of Resistivity Survey Equipment

v) 1 unit of Signal Averaging Resistivity Survey Equipment

vi) 1 unit of Low Frequency Resistivity Survey Equipment

2) Specifications of the Major Equipment

Based on the above evaluations, the specifications of the major equipment were established as follows:

(1) Percussion Type Drilling Rigs and Tools 3 Units

i) Cable percussion type truck-mounted drilling rigs. 3 units

- Capacity:
Capable of handling tool weights of not less than 2,700 kgf using 26 mm diameter drilling line at the depth of 300 meters.

- General specifications:
  Powered by a deck-mounted water-cooled diesel engine, the rig is equipped with bull reel, sand reel, casing reel, crank mechanism, lighting for night operation, etc. The mast is power-raised and lowered, and is equipped with wire line sheaves, shock absorber, etc.

- Deck engine:
  Water-cooled diesel engine, not less than 90PS.

- Truck:
  GVW : Not less than 26,000 kgf
  Engine : Water-cooled diesel, not less than 260PS.
  Drive system : 6 x 4
  Steering : Right hand
  Accessories : Spare tire, hydraulic jack and standard hand tool kit.

  Note : Applicable up to the altitude of 2,500 meters

ii) Standard operational accessories. 3 set
(For 300 meters drilling)

| | | |
|---|---|---|
| (i) | Drilling wire ropes, 26mm diameter. | 3 sets |
| (ii) | Sand line wire ropes, 14mm diameter. | 3 sets |
| (iii) | Casing line wire ropes, 18mm diameter. | 3 sets |
| (iv) | Travelling block for casing line, 30 tons. | 3 pcs. |
| (v) | Mast-reinforcing legs/A-frame legs. | 3 sets |
| (vi) | Working platform | 3 sets |
| (vii) | Other necessary equipment. | 3 sets |

iii) Drilling tools for open hole drilling. 3 sets

| | | |
|---|---|---|
| (i) | Drill bit for 25", 20" and 16" hole. | 6 each |
| (ii) | Spare edge for above bits. | 3 sets |
| (iii) | Bit gauges for above bits. | 3 sets |
| (iv) | Flat and dart valve bailers.<br>(For 25", 20" & 16" hole and 14", 12-3/4", 10-3/4" & 8-5/8" casing, 1 each/set) | 3 sets |
| (v) | Rod type sand pumps | 3 sets |

| | | | |
|---|---|---|---|
| | | (For 25", 20" & 16" hole, 1 each/set) | |
| | (vi) | Sleeve pipe, 36" x 1.5m | 12 pcs. |
| | (vii) | Conductor pipe, 24" & 18" x 6m | 30 each |
| | (viii) | Clamp for above conductor pipes. | 3 sets |
| | (ix) | Motor driven mud mixer with hoses. | 3 sets |
| | (x) | Other necessary equipment. | 3 sets |
| iv) | Casing tools. | | 3 sets |
| | (i) | Casing clamps for 14", 12-3/4", 10-3/4", 8-5/8" and 6-5/8" casing, 1 each/set | 3 sets |
| | (ii) | Spanners and sling wire rope for above. | 3 sets |
| v) | Fishing tools (1 set for three rigs) | | 1 set |
| | (i) | Fishing tools, hydraulic jack operated. | 1 set |
| | (ii) | Two prong wire line grab with latch jack. | 1 set |
| | (iii) | Fishing magnet. | 1 set |
| vi) | Miscellaneous ancillary equipment and maintenance hand tool kit. | | 3 sets |
| | (i) | Diesel engine driven welder with accessories and welding electrodes for hard surfacing and general use, 20 to 280A, 10kVA | 3 sets |
| | (ii) | Diesel engine driven generator, 17kVA, AC440V/3-phase & AC220V/single phase, 50Hz. | 3 sets |
| | (iii) | Electrical tools (Sander, drill, bayonet type water-proof hand lamp, cord reel, etc.) | 3 sets |
| | (iv) | Diesel engine driven self priming pump with hoses, 200 liter/min. x 20m. | 3 sets |
| | (v) | Submersible dewatering pump with hoses, 400 liter/min. x 10m. | 3 sets |
| | (vi) | Collapsible water tank, 1,500 liter. | 6 sets |
| | (vii) | Water level indicator, portable type, 200m. | 3 sets |
| | (viii) | Chain pipe tongs, 2" to 12" pipes. | 6 each |
| | (ix) | Pipe wrenches, 450mm to 900mm. | 6 each |

| | | |
|---|---|---|
| (x) | Sling wire ropes, shackles, clips, etc. | 3 sets |
| (xi) | Rig maintenance hand tool kits. | 3 sets |
| (xii) | Cat line sheaves. | 3 pcs |
| (xiii) | Cat line ropes, 20mm & 12mm x 30m. | 3 each |
| (xiv) | Chain block, 2 ton. | 3 sets |
| (xv) | Oxygen/acetylene cutting and welding equipment. | 3 sets |
| (xvi) | Wheelbarrow, deep type. | 6 pcs. |
| (xvii) | Others (Saw, shovel, fuel drum pump, steel wires, etc.) | 3 sets |
| (xviii) | Engine driven wire rope winding machine. | 3 sets |

(2) Open Hole Tools for Previously Rigs (for 3 rigs). — 1 Lot

i) Drilling tools — 1 Lot

| | | |
|---|---|---|
| (i) | Drill bit for 25", 20" and 16" hole. | 6 each |
| (ii) | Spare edge for above bits. | 3 sets |
| (iii) | Bit gauges for above bits. | 3 sets |
| (iv) | Dart valve bailer, 8-1/2" and 4-1/2". | 4 each |
| (v) | Rod type sand pump, 14" and 12-1/2". | 4 each |
| (vi) | Wire line drilling clamp. | 3 sets |
| (vii) | Solid type jar bumper. | 4 pcs. |
| (viii) | Babbitt metal. | 200 kgf |
| (ix) | Sleeve pipe, 36" x 1.5m | 12 pcs |
| (x) | Motor driven mud mixer with hose. | 3 sets |
| (xi) | Other necessary equipment. | 3 sets |

ii) Fishing tools — 1 set

| | | |
|---|---|---|
| (i) | Fishing tools, hydraulic jacks operated | 1 set |
| (ii) | Two prong wire line grab with latch jack. | 1 set |
| (iii) | Fishing magnet. | 1 set |

iii) Miscellaneous ancillary equipment and maintenance hand tool kits. — 3 sets

| | | |
|---|---|---|
| (i) | Diesel engine driven welder with accessories and welding electrodes for hard surfacing and | 3 sets |

| | | |
|---|---|---|
| | general use, 20 to 280A, 10 kVA | |
| (ii) | Diesel engine driven generator, 17kVA, AC440V/3-phase & AC220V/single phase, 50Hz. | 3 sets |
| (iii) | Electrical tools (Sander, drill, bayonet type water-proof hand lamp, cord reel, etc.) | 4 sets |
| (iv) | Diesel engine driven self priming pump with hoses, 200 liter/min. x 20m | 3 sets |
| (v) | Submersible dewatering pump with hoses, 400 liter/min. x 10m | 3 sets |
| (vi) | Collapsible water tank, 1,500 liter. | 8 sets |
| (vii) | Cat line ropes, 20mm & 12mm x 30m | 4 each |
| (viii) | Oxygen/acetylene cutting and welding equipment. | 3 sets |
| (ix) | Wheelbarrow, deep type. | 6 pcs. |
| (x) | Others (Saw, shovel, fuel drum pump, steel wires, etc.) | 3 sets |
| (xi) | Chain block, 2 tons. | 4 sets |
| (xii) | Working platform. | 4 sets |

(3) Crane Trucks — 3 Units

- Truck:
  GVW: Not less than 26,000 kgf
  Engine: Water-cooled diesel, not less than 260PS.
  Drive system: 6 x 4
  Steering: Right hand
  Cargo space: Approx. L=6m, W=2.3m, H=0.45m
  Payload capacity: Not less than 11 tons
  Accessories: spare tire, hydraulic jack and standard hand tool kit.

- Crane: 5 ton, 2-section boom,
  360° continuous slewing angle.

(4) Pumping Test Equipment. 3 Units

i) Submersible pump, 3 sets
Capacity: 2,000 liter/min. x 150m head.
Power: AC440V/50Hz
Min. setting well diameter: 10"
Accessories: Riser pipes, submersible cable/170m control panel, water level control cable with electrodes, frame, valves, pressure gauges, etc.

ii) Diesel engine generator for above pump. 3 sets
(Applicable at the altitude of 2,500 m)

iii) Triangular weir (Max. 2.9 cu. m/min) 3 pcs.

(5) Well Logging Equipment 4 sets

i) Recording system : automatic recording system on a floppy diskette

ii) Logging items : - normal resistivity, SP, natural gamma
- fluid resistivity, temperature
- caliper

iii) Maximum logging depth: 1,000 m

iv) Detailed specifications

(i) Normal resistivity
- electrode spacing : 16" and 64"
- range : 200, 2K, 20K ohm and automatic

(ii) SP
- range : -2000mV to +2000mV

(iii) Natural gamma
- range : 200, 2K, 20K cps and automatic

(iv) Fluid resistivity / temperature
- range : o °C to 100 °C

(v) Caliper
- type : 3 arm motorized
- range : max. 300mm dia.

(vi) Recorder : thermal plotter
(vii) Digital recording : floppy diskette, 2DD
(viii) Winch : electric powered with line speed control max. 2000m.

(6) Micro Flow Meters 4 sets

i) Measurement method : 4 wing impellar for the detection of water flow rate in vertical direction along the borehole
ii) Recording system : automatic recording system on a floppy diskette and on thermal paper
iii) Capable of measurement : max. 300 m
iv) Detailed specification
(i) Detector : Optical switch
(ii) Range : 2 cm/sec to 200 cm/sec
(iii) Cable : 300m, 4 conductor 300m polyurethane jacket
(iv) Probe diameter : 70 mm dia.

(7) Seismic Survey Equipment 1 set

i) Seismic source : weight dropping and shot firing
ii) recording system : automatic recording system on thermal paper and on a floppy diskette
iii) Analysing system : seismic reflaction data processing programme for automatic analysis
iv) Detailed specification
(i) No. of channels : 24 channel
(ii) Equivalent input noise : less than 5 micro volts
(iii) Dynamic resolution : 20 bit or equivalent IFP
(iv) Sample rate : 50 micro seconds or higher
(v) Filters : Hi-cut, Low cut and Notch
(vi) Recorder : thermal type,
(vii) Digital data storage : floppy diskette, 720KB, 1.22MB, 1.44MB
(viii) Waveform display : 5.5" CRT
(ix) Built-in software : digital filter, AGC, normalization
(x) Power requirement : DC 12 volt battery

(8) Deep Resistivity Survey Equipment 1 set

i) Power supply : car battery or motor generator
ii) Measuring system : signal averaging function for higher accuracy
iii) Recording system : automatic recording on a floppy diskette
iv) Data transmitting : to external computer for automatic analysis
v) Detailed specification

(i) Potential measurement
- Input impedance : 1 mega-ohm or more
- Input resolution : 10 micro volts or more
- SP compensation : full automatic
- Chargeability : 1% or better in resolution
- Signal processing : automatic stacking
- Filters : notch filter 50Hz/60Hz

(ii) Transmitter
- Max. power : 700 watts or more
- Max. voltage : 700 volts or more
- Max. current : 1000 mA or more

(iii) Other
- Digital data storage : more than 200 records

(9) Signal Averaging Resistivity Meter 1 set

i) Measuring item : electric resistivity and induced polarization on the ground

ii) Detailed specification

(i) Potential measurement
- Input impedance : 10 mega-ohm or more
- Input resolution : 1 micro volt or more
- SP compensation : full automatic
- Signal processing : automatic stacking

(ii) Transmitter

- Max. power : +/- 200 V or more
- Max. current : 200 mA or more

(iii) Other

- Digital data storage : 2,000 records or more

(10) VLF EMR Equipment — 1 set

i) Measuring item : tilt angle of electric / magnetic field and apparent resistivity

ii) Detailed Specification

(i) Measurement ranges

- Tilt angle mode : 3 magnetic sensors, 2 inclinometers
- Resistivity mode : 1 magnetic sensors, 1 electric line

(ii) Frequency range : 10 K to 30 KHz, in 100 Hz step two frequencies can be measured at the same time.

(iii) Other

- Fraser derivative : automatic calculation and plotting

(11) Spare Parts — 1 Lot

i) For drilling rigs. — 1 lot
(Clutches, brakes, bushings, bearings, belt, etc.)

ii) For deck engine. — 1 lot
(Elements, clutch, bearings, bushings, gaskets, oil seals, etc.)

iii) For rig's truck. — 1 lot
(Elements, clutch, brake, bearings, bushings, axle parts, electrical parts, etc.)

| | | |
|---|---|---|
| iv) | Spare wire ropes.<br>(Drilling, sand and casing lines) | 1 lot |
| v) | For Miscellaneous ancillary equipments.<br>(Engine welder, generator, electrical tools, wire rope winding machines, etc.) | 1 lot |
| vi) | For crane truck.<br>(Truck elements, clutches, brake, etc. and crane hydraulic parts, wire rope, etc.) | 1 lot |
| vii) | For pumping test equipment.<br>(Pump parts, control panel parts and generator parts, etc.) | 1 lot |
| viii) | For survey equipment.<br>(Well Logger, Micro Flow Meter, 24 Channel Seismic Unit, Deep Resistivity Unit, Signal Averaging Resistivity Meter and VLF EMR Equipment.) | 1 lot |

## 4.4 Implementation Plan

### 1) Project Implementation Structure

(1) Ministry of Water Resources:

The implementation agency of the Project is the Ministry of Water Resources(MWR) of the Government of India. The actual Project construction will be undertaken directly by the Central Ground Water Board (CGWB) of MWR.

After the Government of India and the Government of Japan sign the Exchange of Notes, MWR will secure the personnel necessary for Project, procure the equipment and materials necessary for the Project (equipment and materials other than those provided by the Japanese side) at its own expense, and will conduct the construction of tubewells by using the equipment and materials provided under the phase 1 project and the Project.

With the cooperation of other Indian agencies concerned, MWR will sign the Exchange of Notes together with the Government of Japan, and will smoothly carry out various procedures, such as banking arrangements, tax exemption and customs clearance for imported equipment and materials for the Project, site procurement, tax exemption and customs clearance for Japanese engineers required for Project implementation, etc.

(2) Consultant

Immediately after the Exchange of Notes for the Project is signed by the Japanese and Indian governments, the consultant will make a contract with CGWB to proceed with the following consulting services:

(i) Assisting with the equipment and material procurement, in the preparation of the detailed design and tender documents.

(ii) Assisting with the tendering and evaluation of tender documents.

(iii) Witnessing the contract agreement and assisting the Indian Government and the contractor in its preparation.

(iv) Supervision of procuring and transporting equipment and materials, and of the Japanese engineers dispatched for Project implementation and technique transfer.

(v) Other related services

(3) Contractor

The contractor shall procure the equipment and materials specified in the contract and transport them to the Division II office located at Ambala. The contractor shall dispatch engineers to India for the set period of the contract. The contract will effect the transfer of techniques related to the installation of drilling rig and the open hole drilling method.

2) Boundary of Responsibility for the Project

Project work is to provide necessary equipment including 3 percussion type drilling rigs.
The Project that is so necessary for India will be possible to implement within the limitations of the Japanese grant aid programme. The responsibilities of the Indian and Japanese government in relation to the Project are as follows:

(1) Items to be Covered by Grant Aid from the Japanese Government:

i) Procurement, transportation, and delivery of the major equipment and materials described in 2) of Section 4.3 "Specifications of Equipment and Materials."

ii) Dispatch drilling and geophysical survey engineers and transfer techniques to the Indian team.

iii) Design management services related to the above Project items including the dispatch of design management engineers.

(2) Items to be Borne by the Government of India

i) Payment of bank commissions.

ii) Ensuring that customs clearance and tax exemption for equipment and materials related to the Project is taken care of at the port of entry.

iii) Securing land and passage necessary for commissioning of equipment.

iv) Securing the smooth entry and reentry, ensuring customs clearance and tax exemptions, and providing for the security of Japanese engineers working on the Project.

v) At its own expense, secure a sufficient number of counterparts for implementing the Project.

vi) Management and maintenance of granted equipment.

vii) Bearing costs that will not be provided by grant aid from the Government of Japan.

3) Engineers' Dispatch Plan

Japanese engineers shall be dispatched to assist the Indian personnel in the implementation of the Project within the limits of the Japanese grant aid cooperation system.

The dispatched Japanese engineers will provide technical advice to the Indian personnel. After arriving in India, they will immediately conduct the transfer of techniques, particularly in the following fields:

i) Installation of equipment.
ii) Making a trial run of equipment.
iii) Operation of equipment
iv) Repair, maintenance, and management of drilling machines and supporting equipment.

The Japanese side shall dispatch the following engineers to accomplish the above objective:

| | | |
|---|---|---|
| i) | Drilling engineer | 1 person x 3 month |
| ii) | Geophysical survey engineer | 1 person x 2 month |

4) Project Implementation Schedule

Commencement of the Project will be at a time when the Government of Japan and the Government of India sign the Exchange of Notes of the Project's grant aid cooperation agreement. After the signing of the Exchange of Notes, CGWB of the Ministry of Water Resources and a Japanese consultant company will make a contract concerned with the Project's design management services. After approval of the contract agreement by the Japanese Government, the Consultant will prepare the detailed design and tender documents. After the approval of the detailed design and tender documents by the Japanese and Indian governments, the Consultant will conduct the tendering of the Project of Japanese contractors for the Government of India, and will evaluate the tender documents.

The consultant will witness the contract agreement between the prospective Japanese contractor and the Government of India. This contract will also come into effect after approval by the Japanese Government.

It will take approximately four months to reach contract agreement after the signing of the Exchange of Notes.

After the contract agreement, the Japanese contractor will procure equipment and materials necessary for the Project. It may take about six (6) months to

manufacture, procure, and pack the new drilling machine and survey equipment. Further, it will take approximately two (2) months for the land and sea transportation of the equipment and materials.

Thus, it will take around twelve (12) months before commencement of Project construction and technical guidance will be possible.

Installation and technical transfer may also take three (3) months.

The implementation schedule is shown in Table 4.4-1.

Table 4.4-1 Project Implementation Schedule

| Items \ Months | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Submit the Basic Design Study Report (Phase II) | ◆ | | | | | | | | | | | | | | | | | | | | | | | |
| 2. Conclusion of E/N | | | ◆ | | | | | | | | | | | | | | | | | | | | | |
| 3. Contract with Consultants | | | ◆ | | | | | | | | | | | | | | | | | | | | | |
| 4. Tender Formalities | | | | ▬ | ▬ | ▬ | ▬ | | | | | | | | | | | | | | | | | |
| 5. Contract with Supplier | | | | | | | ◆ | | | | | | | | | | | | | | | | | |
| 6. Manufacture and Procurement of Equipments and Materials | | | | | | | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | | | | | | | | | | | |
| 7. Transport by Sea and Land | | | | | | | | | | | | | ▬ | ▬ | | | | | | | | | | |
| 8. Installation and Technical Transfer | | | | | | | | | | | | | | | ▬ | ▬ | ▬ | ▬ | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | | | | | | | | |

5) Equipment Procurement

The equipment and material procurement, within the rules of the Japanese grant aid system, is limited to either Japanese or Indian products. The equipment and materials that are unobtainable in India must therefore be procured in Japan and exported to India.

Upon the expiration of the Exchange of Note, additional materials required to complete the Project are to be procured by the Indian side at its own expense.

## 4.5 Maintenance and Management Plan

1) Maintenance and Management Plan

The subjects concerned with the maintenance and management of the Project are drilling rigs and survey equipment. Maintenance and management for the above will be CGWB's responsibility and will be undertaken in the same manner as at present.

Equipment, tools, and spare parts that will be provided under the Project for repair shop use shall be maintained either at the repair shop or at the warehouse of CGWB. These items must be properly managed. Also, spare parts are limited and any replacement spare parts required by the Project, or any other project, must be made with costs borne by CGWB after two years.

2) Maintenance and Management of Drilling Rigs and Supporting Equipment

Three drilling rigs, crane trucks and pumping test units to be provided as Japanese grant aid will be arranged at the CGWB's Division II Office at Ambala city, Haryana State.

In the phase 1 project, two drilling rigs were assigned to the Divisional Office. Those rigs are well maintained and managed because the office has well trained experts. Equipment to be provided by the Project will be maintained and managed in the same manner.

Fig. 4.5-1 shows an organization chart of CGWB's division Office consists of drilling unit, store unit and workshop unit.

The Division II Office is equipped with nine drilling rigs and supporting equipment including two rigs that are provided in the phase 1 project. Table 4.4-2 show a list of rigs assigned to the office.

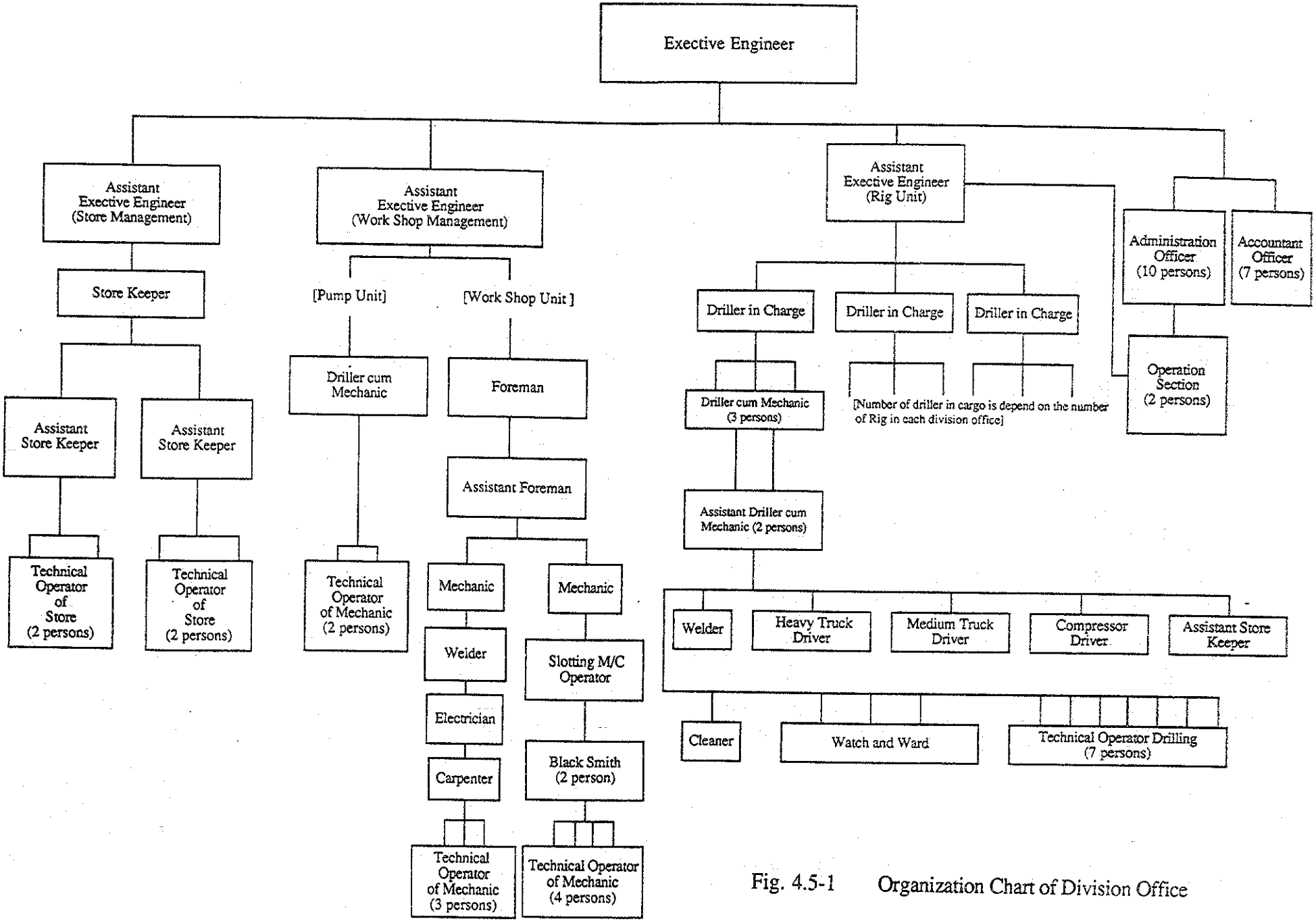


Fig. 4.5-1 Organization Chart of Division Office

Table 4.5-1 List of Rigs (Division II Office)

| No. | Rig No. | Year Procured | Note |
|---|---|---|---|
| 1 | DR/FR-55/2 | 1955 | American |
| 2 | DR/FR-55/8 | 1955 | " |
| 3 | DR/FR-55/9 | 1955 | " |
| 4 | DR/Wab-69/28 | 1969 | " |
| 5 | P/DM-77/56 | 1977 | Indian |
| 6 | C/WR-86/70 | 1986 | American |
| 7 | DTH/Recp-88/93 | 1988 | Indian |
| 8 | P/Sankyo-92/107 | 1991 | Japanese |
| 9 | P/Sankyo-92/108 | 1991 | " |

As shown in the Table 4.4-2, three American rigs produced in 1955 are still in working condition. This fact shows that CGWB has high maintenance and management ability.

Division II Office has enough space for a store, workshop and stockyard even if three rigs and supporting equipment will be provided in addition to the above mentioned equipment. It is , however, necessary to increase the store and workshop staffs. Staff increases are shown as follows:

i) Store Unit
   a) Assistant storekeeper 1 person
   b) Technical operator 2 persons

(ii) Workshop Unit
   a) Mechanic 1 person
   b) Electrician 1 person
   c) Technical operator 3 persons

3) Maintenance and Management Cost

(1) Basis of Cost Estimate

Maintenance and management costs are expenditures necessary to cover the periodic inspection and repair work for three rigs and supporting

equipment. The costs were estimated for a thirteen (13) - year period. The cost estimate was made as follows:

i) Scope of work
   (i) conservation and management of parts and tools
   (ii) periodic inspection of equipment
   (iii) repairing equipment in the store and drilling sites

ii) Formation of staff and equipment
   (i) Store unit
      - Assistant storekeeper 1 person
      - Technical operator 2 persons

   (ii) Workshop unit
      - Mechanic 1 person
      - Electrician 1 person
      - Technical operator 3 persons

   (iii) Jeep for workshop unit 2 vehicles

iii) Cost of parts and repair equipment

Actual cost per one rig in 1990 (the cost for a two-year period is included in equipment to be provided by the Project).

iv) Fuel (per one car)

(i) repair work : 500 km/time x 3 times/month = 1,500 km/month
(ii) daily use : 50 km/time x 30 days/month = 1,500 km/month
Total 3,000 km/month

v) Lubricant oil for repairing equipment
Actual cost for equipment provided by phase 1.

(2) Management and Operation Cost Estimate

i) Personnel costs:

(i) Assistant storekeeper (1):
1,500 Rp/month x 12 months = 18,200 Rp
(ii) Technical operator of store (1):
940 Rp/month x 2 x 12 months = 22,560 Rp
(iii) Mechanics (1):
1,800 Rp/month x 12 months = 21,600 Rp
(iv) Electrician (1):
1,500 Rp/month x 12 months = 18,000 Rp
(v) Technical operator of work shop (3):
940 Rp/month x 3 x 12 months =
33,840 Rp

Subtotal (7 persons) 114,000 Rp
114,000 Rp/year x 13 years = 1,482,000 Rp/13 years

ii) Cost of parts and repair equipment
443,000 Rp/L.S. x 3 = 1,329,000 Rp/year
1,329,000 Rp/year x 11 = 14,619,000 Rp/13 years

iii) Fuel

- Fuel
3,000 km/month x 2 vehicles x 12 month = 72,000 km/year
72,000 km/year ÷ 10 l/km x 5.22 Rp/l = 37,584 Rp/year
37,584 Rp/year x 13 years = 488,592 Rp/13 yeas

- Oil
72,000 km/year x 3,000 km x 10 l x 45 Rp = 10,800 Rp/year
10,800 Rp/year x 13 years = 140,400 Rp/yeas

iv) Lubricant fuel (including oil)
1,517 Rp/L.S/month x 12 months x 3 L.S = 54,000 Rp/year
54,600 Rp/month x 13 years =709,800 Rp/13 years

Total i) + ii) + iii) + iv) = 17,439,792 Rp/13 years = 1,341,522 Rp/year

Total maintenance and management costs: 17,439,792 Rp/13 years.
Therefore, the average annual maintenance and management costs will be 1,341,522 Rp.

4) Problem and Recommendations Relating to Management and Maintenance

Equipment granted in the phase 1 project are well managed and maintained by CGWB. CGWB has enough facilities, organization and staff for the equipment that will be provided under the Project.

The borehole drilling equipment to be provided under the Project will last about thirteen years if it is properly maintained and repaired, and if there is an adequate supply of consumable parts. It should be possible, during that span of time, to utilize the equipment for borehole drilling even after Project completion. Thus, it will be necessary for CGWB to establish an equipment and material maintenance and management system that will be solely operated by CGWB.

For the above reasons, the Study Team presents below their recommendations concerning the equipment and material maintenance and management system:

(1) To make effective use of the equipment and vehicles, it must be inspected and maintained periodically, and it needs to establish the good coordinating system with the users (well construction team) for quick response.

(2) The materials and spare parts are properly classified, marked and stored in the warehouse. Their use conditions and consumption rates must be recorded to provide the basic data that will be required two years later for reordering purposes.

# CHAPTER 5 PROJECT EVALUATION AND CONCLUSION

# Chapter 5 Project Evaluation and Conclusion

## 5.1 Project Evaluation

The Project is for the exploitation of ground water in the developing area located in the northern part of India. The Project was established based on the Government's agricultural and rural development policies. The objectives of the Project are to increase agricultural products, to improve social conditions and to stabilize the livelihoods of rural people by supplying reliable, safe drinking and irrigation water that will not be depleted throughout the year.

The phase 1 project was implemented twice, and 4 Drilling Rigs and Geophysical Survey Equipment has been provided in 1989 and 1990 with grant aid from the Government of Japan. Project (Phase 2) is a continuation of the phase 1 project. Under the Project, 3 Drilling Rigs and Geophysical Equipment are to be newly provided.

Through implementation of the Project, the following direct benefits will be achieved:

(1) Drinking water will be newly supplied to 583,000 persons every year. Thus, this unsanitary and unstable drinking water will be reduced by providing safe, reliable drinking water sources that will not become exhausted at any time during the year. Compared to shallow wells that can not be used in the dry season, deep wells planned by the project will contribute greatly to the provision of stable water throughout year. The available water supply will have a rate of 45 litter/cap./day.

(2) The Project area has often experienced droughts. Through Project implementation, 1,916 ha of farmland will receive irrigation water every year and drought damage will be minimized.

(3) Other than during rainy seasons, irrigation is difficult in the Project area. This situation has restricted the increase of agricultural products. However, as a result of Project implementation, all season irrigation will be possible.

(4) Agricultural products will be increased by the irrigation water provided. In the Punjab states, for example, the rice harvest will be 3.5 times higher and the wheat harvest will be 3.7 times higher than at present.

(5) The livelihood of the people will be stabilized, and social conditions will be improved in the rural area by the above mentioned benefits.

If the equipment provided under the Project is properly maintained and managed, and if the consumable tools, spare parts, and materials will continue to be supplied after completion of the drilling plan, CGWB will be able to go forward with the ground water development in the Project area.

Considering the number of beneficiaries from one tube well in the Project area, the planned equipment to be provided will contribute greatly to improvement in the rural area.

For humanitarian, social and economic reasons, the implementation of the Project by grant aid cooperation from the Government of Japan will be most worthwhile. Project implementation will contribute significantly to the international community, and will serve in strengthening Japanese and Indian relationships.

In view of the points outlined above, it is deemed to be appropriate and extremely worthwhile to carry out the Project with grant aid cooperation from the Government of Japan.

## 5.2 Recommendation

It is recommended that persons concerned with this Project should execute the following items as well as the items agreed upon in the Memorandum of Discussions prepared during the Basic Design Study.

(1) Scope of the Project

The Project will be completed when the equipment arrives in India. Thus, the Indian Government must come forth with a budget and personnel that will be sufficient to complete CGWB's drilling plan.
The equipment and materials to be provided under the Project shall be used exclusively in Project construction.

(2) Equipment

It was determined that a two-year supply of spare parts would be sufficient for project use. During that two-year period, the Indian side must take the necessary steps to establish the method for obtaining the additional spare parts that will be needed for the further construction.

By properly using the equipment and the transferred techniques, CGWB's drilling plan can be carried out efficiently.

(3) The technical transfer of the following items should be made to the Indian side:

i) For drilling rigs and geophysical survey equipment

Considering India's short experience with the open hole method, being supplied with drilling rigs and various kinds of survey equipment, CGWB may find it necessary to transfer the techniques for displacing and installing machines and for the operation and drilling methods for upgrading the technical level of Indian engineers by dispatch of Japanese engineers as follows:

| | | |
|---|---|---|
| Drilling engineer | : | 1 person x 3 months |
| Geophysicist | : | 1 person x 2 months |

ii) For maintenance & repair of geophysical survey equipment

In India it is quite difficult to have the sophisticated, computerized survey equipment supplied under the phase 1 project. Therefore, the transfer of maintenance and repair techniques to the Indian engineers is required to keep the equipment on the line. It is desired that the technical transfer be conducted at the manufacturer's factory in Japan. If such is to be the case, the required number of Indian geophysical engineers and the transfer period is calculated as follows:

2 persons x 3 months = 6 man/month

# APPENDIX

# MEMBER LIST OF THE STUDY TEAM

| | |
|---|---|
| Yuji, MARUO | Leader<br>Environmental Geology Development Specialist,<br>Institute for International Cooperation<br>Japan International Cooperation Agency |
| Yasumasa, YAMASAKI | Ground Water Development<br>Registered Consulting Engineer,<br>Chief Hydrogeologist of Water Resources<br>and Environment Department<br>Pacific Consultants International |
| Yuichi, HATA | Equipment Planning<br>Senior Hydrogeologist of Water Resources<br>and Environment Department<br>Pacific Consultants International |
| Yukio, HOSHINO | Cost Estimation<br>Registered Consulting Engineer,<br>Technical Advisor of Agricultural and Rural<br>Development Department<br>Pacific Consultants International |

# Schedule of the Field Survey

| | Date | Travel / Movement | Activities |
|---|---|---|---|
| 1 | 7/12/Sun | Tokyo (JL739) → → Delhi<br>09:35 18:25 | |
| 2 | 7/13/Mon | Delhi | Courtesy Call to JICA office, Embassy of Japan, Ministry of Finance, MWR and CGWB.<br>Confirmation of the Schedule. |
| 3 | 7/14/Tue | Delhi | Meeting with MWR and CGWB. |
| 4 | 7/15/Wed | Delhi | Meeting with CGWB. |
| 5 | 7/16/Thu | Delhi → → Ambala | Meeting with Div II office in Ambala. |
| 6 | 7/17/Fri | Ambala | Site Survey (Paonta Sahib). |
| 7 | 7/18/Sat | Ambala | Site Survey (Ambala City). |
| 8 | 7/19/Sun | Ambala → → Delhi | Arrangement of Data. |
| 9 | 7/20/Mon | Delhi | Meeting with CGWB.<br>Collecting Data. |
| 10 | 7/21/Tue | Delhi → → Varanasi | |
| 11 | 7/22/Wed | Varanasi | Meeting with Div. III office in Varanasi. |
| 12 | 7/23/Thu | Varanasi → → Lucknow | Site Survey (Jaunpur). |
| 13 | 7/24/Fri | Varanasi → → Delhi | Meeting with Northern Regional office in Lucknow. |
| 14 | 7/25/Sat | | Collecting Data. (Team Leader arrived in Delhi.) |
| 15 | 7/26/Sun | Delhi | Inner Meeting |
| 16 | 7/27/Mon | Delhi | Meeting with JICA office and Embassy of Japan. |
| 17 | 7/28/Tue | Delhi | Meeting with CGWB(Reporting the field survey results. Collecting Questionnaire.) |
| 18 | 7/29/Wed | Delhi | Meeting with CGWB and MWR. |
| 19 | 7/30/Thu | Delhi → → Hyderabad | Meeting with Southern Regional office in Hyderabad. |
| 20 | 7/31/Fri | Delhi | Meeting with Southern Regional office in Hyderabad. |
| 21 | 8/ 1/Sat | Hyderabad → → Delhi | |
| 22 | 8/ 2/Sun | Delhi | Inner Meeting. |
| 23 | 8/ 3/Mon | Delhi | Courtesy Call to Ministry of Finance and MWR.<br>Meeting with CGWB. |
| 24 | 8/ 4/Tue | Delhi | Signing of Memorandum of Discussions.<br>Reporting to JICA office and Embassy of Japan. |
| 25 | 8/ 5/Wed | Delhi (AZ788) → → Tokyo<br>00:10 11:55 | |

# List of Organizations and Persons Contacted

Government of India

1) Ministry of Finance

| | |
|---|---|
| Mr. Navin Kumar | Director/Department of Economic Affairs |

2) Ministry of Water Resources (MWR)

| | |
|---|---|
| Mr. R.L. Pardeep | Additional Secretary |
| Mr. Abhay Prakash | Joint Secretary |
| Mr. N. Suryanarayanan | Commissioner |
| Mrs. Promila Bhardwai | Deputy Secretary |
| Mr. V. Rajakopalan | Deputy Secretary |
| Mr. M. S. Chadha | Desk Officer |

3) Central Ground Water Board (CGWB)

| | |
|---|---|
| Dr. R.K. Prasad | Chairman |
| Mr. S. C. Sharma | Director & Secretary |
| Mr. M. L. Chaurasia | Chief Engineer & Member |
| Dr. A. N. Bhowmick | Superintending Geophsist |
| Mr. S. S. Chauhan | Superintending Engineer |

(1) CGWB Division II (Ambala)

| | |
|---|---|
| Mr. K. B. Biswas | Executive Engineer |

(2) CGWB north Western Regional Office (Chandigarh)

| | |
|---|---|
| Mr. V. M. Sikha | Senior Hydrogeologist |

(3) CGWB Division III (Varanasi)

| | |
|---|---|
| Mr. C. P. Gawri | Executive Engineer |
| Mr. G. Sengupta | Assistant Engineer |

(4) CGWB Northern Regional Office (Lucknow)

| | |
|---|---|
| Mr. S. K. Sinha | Director |
| Dr. S. B. Singh | Scientist |
| Dr. B. C. Joshi | Scientist |
| Dr. K. S. Pandy | Scientist |

(5) CGWB Southern Regional Office (Hyderabad)

| | |
|---|---|
| Mr. S. Ranganathan | Director |
| Mr. G. Dhoolappa | Scientist |
| Mr. M. B. Raju | Scientist |
| Mr. K. Ramam | Scientist |
| Mr. K. V. Kumar | Scientist |

2) Embassy of Japan

| | |
|---|---|
| Katsutoshi Hama | First Secretary |

3) JICA India office

| | |
|---|---|
| Tohio Higuchi | Resident Representative |
| Toshifumi Sakai | Deputy Resident Representative |

NEW DELHI

INDIA

, the 4th August, 1992

# MEMORANDUM OF DISCUSSIONS ON

# BASIC DESIGN STUDY

# FOR

# THE PROJECT

# FOR

# THE EXPLOITATION OF GROUND WATER IN INDIA

In response to a request from the Government of India, th. Government of Japan decided to conduct a Basic Design Study on the subject of Exploitation of Ground Water in India (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent a study team to India, which is headed by Dr. Yuji Maruo, Senior Development Specialist, JICA, and is scheduled to stay in the country from July 12 to August 5, 1992.

The team held a series of discussions with the concerned officials in the Central Ground Water Board (herein after referred to as "Indian side") and conducted a field surveys of the proposed project areas.

During the course of discussions and field survey, both parties confirmed the main items of equipments and services described in the attached sheets as Annex I & II.

Dr. Yuji Maruo
Leader
Basic Design Study Team
JICA.

Dr.R.K.Prasad
Chairman
Central Ground Water Board
Ministry of Water Resources

ANNEXURE I

TO THE MEMORANDUM ON DISCUSSIONS DATED THE AUGUST 4, 1992

CONCERNING THE PROJECT 'EXPLOITATION OF GROUNDWATER IN INDIA'

1. **Objective**

The objective of the Project is to provide adequate and sustained supplies of water for meeting the requirements of drinking and domestic use and for increasing food production in the otherwise water-short areas.

2. **Project sites**

The Project sites are located in the following eight states in so far as drilling rigs are concerned:

1) Himachal Pradesh
2) Punjab
3) Haryana
4) Uttar Pradesh
5) West Bengal
6) Assam
7) Arunachal Pradesh
8) Gujarat.

The survey equipment will however, be deployed in all the states of the country on need-based basis.

3. **Executing agency**

Central Ground Water Board under the Ministry of Water Resources is responsible for the administration and execution of the Project.

4. **Items requested by the Government of India**

After discussions with the Basic Design Study Team, the following items were finally requested by the Indian side. Individual items are referred in Annex II.

1) Well Construction Equipment

2) Hydrogeological Survey Equipment.

However, the final components to the Project will be decided after further studies.

5. **Japan's Grant Aid System**

1) The Central Ground Water Board has understood the system of Japanese Grant Aid explained by the team.

2) The Central Ground Water Board will take all necessary measures, as per Annex II, for smooth implementation of the Project after the Grant Aid Assistance by the Govenment of Japan is extended to the Project.

..2.

## 6. Schedule of the Study

Based on the Memorandum of Discussions and technical examination of the study results, JICA will complete the final report by the end of September, 1992 and send it to the Central Ground Water Board, Government of India through JICA India office.

ANNEXURE II

## LIST OF EQUIPMENTS

The following Items of equipment have been requested by the Central Ground Water Board:

1. Drilling Rigs (Percussion type)
2. Open-hole Drilling Tools
3. 5 ton Truck Crane.
4. Submersible Pump with necessary Accessories and Generator
5. Well Logging Equipment with the necessary accessaries
6. Micro Flow Meter
7. 24 channel Seismic Survey Equipment with the required accessaries
8. Deep Resistivity Survey Equipment with necessary accessories
9. Signal Averaging Resistivity Meter with necessary accessories.
10. VLF EMR Equipment with necessary accessaries
11. Spare parts (for Drilling Rigs and Survey Equipment) - lumpsum

Training of personnel in the application of Open-hole drilling method and operation, maintenance and repairs of survey equipment is also requested by the Indian side.

..4.

ANNEXURE -III

OBLIGATIONS OF THE CENTAL GROUND WATER BOARD

The following measures are requested to be taken by the Government of India in case Japan's Grant Aid is executed.

1. To secure the site for the Project.

2. To bear commissions to the foreign exchange bank in Japan for the banking services based upon the Banking Arrangement.

3. To obtain exemptions or pay taxes and to take necessary measures for customs clearance of the materials and equipment brought for the project at the port of disembarkation.

4. To exempt from all taxes and duties of all the goods, equipment and personal effects of the Japanese consultants and suppliers brought under the Project.

5. To accord Japanese Nationals whose services may be required in connection with the supply of products and the services under the verified contract such facilities as may be necessary for their entry into India and stay therein for the performance of their work.

6. To provide all the counterpart personnel and bear all their expenses under the Project.

7. To bear all the expenses other than those to be borne by the Japanese Grant Aid and during the period of stay of the Japanese experts in India, if and when necessary.

..5..

ANNEXURE-IV

List of officers who participated in the discussions/ field visits from both sides:

INDIAN SIDE

**Central Ground Water Board**

1. Dr. R.K. Prasad, Chairman, CGWB
2. Mr. M.L. Chaurasia, Chief Engineer & Member, CGWB
3. Dr. A.N. Bhowmick, Superintending Geophysicist, CGWB.
4. Mr. S.S. Chauhan, Superintending Engineer, CGWB.
5. Mr. S.C.Sharma, Secretary, CGWB.

JAPANESE SIDE

1. Mr. Toshifumi Sakai, Dy. Resident Representative, JICA India Office
2. Dr. Yuji Maruo, Team Leader, JICA
3. Mr. Yasumasa Yamasaki, Ground Water Development Planner, JICA Study Team.
4. Mr. Yuichi Hata, Equipment Planner, JICA Study Team.

..6.