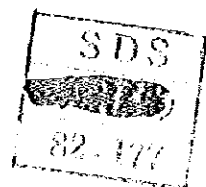




ROYAL IRRIGATION DEPARTMENT  
MINISTRY OF AGRICULTURE AND COOPERATIVE  
GOVERNMENT OF THE KINGDOM OF THAILAND

DOK KRAI—MAB TA PUD WATER PIPELINE PROJECT  
IN  
THE EAST COAST AREA  
PARTICULAR SPECIFICATIONS

AUGUST 1982





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AUGUST 1982

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## PARTICULAR SPECIFICATIONS

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## DIVISION 1. GENERAL REQUIREMENTS

### SECTION 1000. SUMMARY OF WORKS

#### 1001. GENERAL

- (1) The Particular Specifications shall be read in conjunction with the Agreement, Conditions of Contract, General Specifications, Drawings and Bill of Quantities, and the Contractor shall comply with all the provisions contained within these documents and the Engineer's instructions.
- (2) The Contractor shall fulfill all the requirements and obligations of all clauses and items of the Conditions of Contract, General Specifications and Particular Specifications. Where there is not specific item in the Bill of Quantities and where no statement is made in the Specifications to the contrary, the cost of requirement or obligation such as mobilization of construction equipment, overhead, profit, etc. shall be included in each appropriate pay item in the Bill of Quantities.

#### 1002. PROJECT DESCRIPTION

- (1) Dok Krai-Mab Ta Pud Water Pipeline is to be located at the existing Dok Krai Reservoir, Mab Ta Pud and the area between Dok Krai and Mab Ta Pud along the highways Route-3191 and Route-3 in Changwat Rayong in the east coast area of Thailand.
- (2) The projected works under the Contract consist of:
  - a) General Requirements
  - b) Intake Facilities at Dok Krai Reservoir
  - c) Pipeline between Dok Krai and Mab Ta Pud
  - d) Head Tank at Ban Ni Khom
  - e) Receiving Facilities at Mab Ta Pud
  - f) Control System
  - g) Buildings
  - h) Test Operation & Commissioning

#### 1003. DELIVERY POINTS TO OTHER PROJECTS

- (1) The following works at the respective delivery point to other contracts shall be within the Works under this Contract:
  - a) at delivery point to the Sattahip Pipeline System: An outlet pipe (ø900 mm) of the Receiving Reservoir with valve and flange.
  - b) at delivery point to Mab Ta Pud Industrial Area: An outlet pipe (ø700 mm x 4) of Receiving Well with valve and flange.
  - c) at delivery point to P.T.T. Gas Separation Plant: A branch pipe (ø500 mm) of Main Pipeline immediately after crossing highway Route-3, with valve and flange.
  - d) at delivery point to the area around highway Route-36: Two branch pipes (ø250 mm both sides) of Main Pipeline at about 40 m before crossing highway Route-36, with valve and flange for each.
  - e) at delivery point to the area around highway Route-3371: Branch pipes (ø150 mm both sides) of Main Pipeline at about 40 m before crossing highway Route-3371, with valve and flange for each.

#### 1004. CONSTRUCTION MATERIALS

- (1) Principal materials to be supplied for the works shall be subject to the Engineer's approval.

The Contractor shall submit samples of materials and list of their supply sources and/or manufacturers to the Engineer for his approval within two months after signing of the Contract. Principal materials being subject to the Engineer's approval include cement, aggregate, sand, water for concrete mixing, materials for rip-rap, reinforcing bar, steel, etc.

- (2) All reinforcing bars for reinforced concrete shall be the deformed bars conforming to JIS G3112 or ASTM A615, except reinforcing bars for the concrete of building works which shall be the round bars.
- (3) Cement shall be supplied from the following listed manufacturers or approved equal:
  - a) Jalaprathan Cement Co. Ltd.
  - b) Siam Cement Trading Co. Ltd.
  - c) Siam City Cement Co. Ltd.



1005. PLANTS & MATERIALS

- (1) Manufacturers of principal plants and materials to be supplied in this Contract shall be nominated by the Contractor and accepted by the Employer at the time of Contract.
- (2) Principal plants and materials to be supplied in this Contract shall include pumping plants, electrical plants and materials, steel pipes, valves and couplings, EPT rubber sheets, concrete P.C. girders, etc.

1006. SUB-CONTRACTORS

- (1) When and in case the Contractor intends to employ sub-contractor(s) for the major part of civil works, such sub-contractor(s) shall be nominated by the Contractor and accepted by the Employer at the time of Contract.
- (2) Construction works of Intake Tower, Intake Bridge, Head Tank, Receiving Reservoir and installation works of pipeline, etc. shall be deemed as the major part of civil works.

1007. WORK SCHEDULE

- (1) The Contractor shall submit the Detailed Work Schedule in accordance with the Work Schedule attached to the Contract to the Engineer for his approval, within twenty-eight (28) days after the signing of Contract. The Detailed Work Schedule shall include detailed schedules of labour requirements, material supply, plant and equipment requirements, etc.

The critical path method shall be applied for the Detailed Work Schedule.

- (2) The Contractor's construction planning network shall maintain or improve on the key dates listed below. Should the Contractor's activities be delayed to the point where the maintenance of key dates for the Works are jeopardized, the Contractor shall submit to the Engineer a detail report showing all corrective actions he proposes to adopt to retrieve the intended schedule status.

Completion of provisions of Employer's and Engineer's Facilities	Within 3 months after signing of Contract.
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Completion of water and electricity systems and swerage and drainage system for office & residential buildings	12 months after signing of Contract
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Delivery of water to the P.T.T.  
Gas Separation Plant

16 months after signing  
of Contract

Completion of Commissioning Works

6 months after the date  
of Provisional Take-over

1008. MEASUREMENT AND PAYMENT

Payment for the Works of this Section shall be deemed to be included in the Contract Price.

SECTION 1100. GENERAL

1101. SETTING OUT

- (1) The bench mark P.T.T. A-8 shall be the control bench mark for elevation control of setting out on this Contract and the elevation of the bench is El. 54,776 m.

The bench mark R.I.D. 22393-OK-(136-48-32) shall be the control bench mark for location control of setting out on this Contract and the coordination of the bench is N-120,000 and E-120,000.

Two control bench marks and other references for setting out are shown on the Contract Drawing No. 1002.

- (2) The Contractor shall install concrete-made bench marks and survey stations at the minimum intervals of 500 m along the alignment of the Pipeline.

The concrete-made bench marks and survey stations in the vicinities of the Intake Facilities, Head Tank, and Receiving Facilities shall be also installed by the Contractor.

The number and location of these bench marks will be instructed by the Engineer.

- (3) Prior to commencing the Works, the Contractor shall undertake the check survey of the control bench marks and bench marks for references and satisfy himself as to their accuracy.
- (4) The Contractor shall install new control bench marks for setting out of feature works at the areas of Head Tank and the delivery points stated Clause 1003 of the Particular Specifications. Setting out of elevations and coordinates of such new control bench marks shall be performed by the Contractor under instruction of the Engineer.

1102. SHOP DRAWINGS AND OTHER DATA

- (1) The Contractor shall prepare Shop Drawings for all Works to be carried out under the Contract.

(2) The Contractor shall submit five (5) copies each of the detailed design reports, detailed specifications and detailed construction plan for the following listed works in addition to the Shop Drawings to the Engineer for his approval at least two (2) months ahead of commencement of the respective works:

- a) Preparatory arrangement for caisson works
- b) Temporary works for caisson structure
- c) Preparatory arrangement for Intake Bridge
- d) PC Girder for Intake Bridge
- e) Intake Gate and Screen
- f) Pumping Facilities at Intake
- g) Electrical Facilities at Intake
- h) Air Chamber at Intake Yard
- i) Valves
- j) P.C. Head Tank
- k) Measuring Equipments, Telecommunication System and Control System

Should the detailed design reports and/or detailed specifications for all kinds of works under the Contract including the works listed above be submitted and approved by the Engineer at the time of Contract and/or during the period of Contract, the approved design report and specifications shall be deemed a part of the Particular Specifications.

#### 1103. PHOTOGRAPHIC RECORD

- (1) The Contractor shall submit to the Engineer five (5) sets of the Photographic Record containing first quality colour photographs of all significant aspects of construction works at the end of each calendar month during the Construction Period.
- (2) This monthly Photographic Record shall contain approximately thirty (30) colour photographs of 11 cm by 16 cm in size with brief explanation of aspects, sites, and date.

#### 1104. MEASUREMENT AND PAYMENT

No separate payment will be made for complying with the provisions of this Section and all costs shall be deemed to be included in the rates for the various items of the Works in the Bill of Quantities.

## SECTION 1200. COMMON TEMPORARY WORKS

### 1201. SITE PREPARATION

- (1) The area of works nominated in the Contract and handed over to the Contractor as the Site is shown in the Contract Drawing No. 1003. The Contractor shall keep the Site free from any damage after the Handover of the Site.
- (2) The lands for quarries, borrow areas, spoil areas, the Contractor's camping facilities, the Contractor's work shops, stores, Contractor's other temporary works and facilities, etc. are not nominated in the Contract. The Contractor shall prepare such lands by his own effort and expenses, after obtaining the approval of the Engineer.
- (3) Usable trees recovered during clearances at the land prepared by the Employer shall be stored at the place indicated by the Engineer.
- (4) When it is necessary to compensate for existing houses, walls, fences, trees, crops, other artificial obstacles, etc. in the land area not handed over by the Employer, such compensation shall be made at the Contractor's own expense after obtaining the approval of the Engineer.

### 1202. POWER SUPPLY FOR CONSTRUCTION

- (1) Should the Contractor intend to use electric power from public transmission lines for constructional works, the Contractor shall get the approval of the Provincial Electric Authority of Thailand through the Engineer. The installation and maintenance of transformers, distribution lines and switches shall be carried out under the regulations of the Provincial Electric Authority as well as the Specifications.
- (2) The Contractor shall secure and supply sufficient electrical power to meet all the requirements relating to the Works under the Contract including the demands of laboratories, requirements for testings and test operations, etc. on a twenty-four (24)-hour per day basis throughout the Construction Period from the commencement of the Works up to the time of issuance of the certificate of Provisional Take-over.

The sufficient electrical power shall be also supplied to the Employer's and Engineer's Offices and Residences on a twenty-four (24)-hour per day basis up to the end of Commissioning Period.

#### 1203. WATER SUPPLY

- (1) Should the Contractor intend to use the water of Dok Krai Reservoir for construction purpose, the Contractor shall submit the plan, method and facilities for utilization of the water of the Reservoir to the Engineer for his approval. The Contractor may use the water of Dok Krai Reservoir free of charge after obtaining the approval.
- (2) The Contractor shall supply sufficient amount of water of provable quality to meet all the requirements relating to the Works under the Contract including the demands of Employer's and Engineer's offices and residences, laboratories, etc. as well as the requirements for testings and test operations on a twenty-four (24)-hour per day basis throughout the Construction Period.
- (3) The Contractor shall supply sufficient amount of domestic and potable water to all office and residential buildings during the period between the Stage 1 Provisional Take-over of such building works and the Stage 2 Provisional Take-over of whole contracted works.

#### 1204. TELECOMMUNICATIONS

The Contractor shall provide and maintain telephone lines connected to public telephone system for uses of the Employer and the Engineer during the Construction Period other than the telephone system to be provided under the Contract, in addition to his own requirements.

#### 1205. MAINTENANCE OF TRAFFIC

- (1) The Contractor shall have full responsibility for the safety at the Site along the highways Route-3191, Route-3 and any other roads related.
- (2) The Contractor shall submit his weekly activities schedule and the locations of the works along the highways to the Department of Highways through the Engineer, and obtain all necessary approvals from the Department of Highways, prior to commencement of the respective works.
- (3) Should the Contractor intend to occupy the land of the Department of Highways and/or disturb the traffic of the highways for his construction purpose, the Contractor shall take necessary procedure and carry out the Works under the instructions of the Department of Highways and other authorities concerned.

- (4) The Contractor shall provide substitute passes and bridges to give access to the existing villages, houses, etc. to the satisfaction of the Engineer and authorities concerned whenever and in whatever manner the Contractor disturbs such existing way during the execution of the Works.

1206. FIRST AID

- (1) The Contractor shall provide, maintain and service a properly equipped and staffed ambulance with driver which shall be in readiness on the site for use at all times.

1207. MEASUREMENT AND PAYMENT

- (1) Payment for all kinds of common temporary works shall cover the supply, installation, operation, maintenance and removal of all kinds of common temporary facilities and temporary works except otherwise particularly itemized works in the Bill of Quantities.
- (2) Payment for all kinds of common temporary works will be made in lump-sum under Items 1001 to 1009 inclusive of the Bill of Quantities. Thirty (30) percent of the lump-sum will become payable when the Engineer deems the common site preparation and the Contractor's temporary facilities to be completed. The remaining seventy (70) percent of the lump-sum will be paid in equal monthly payments so that the total sum shall be fully disbursed upon the Stage 2 Provisional Take-over of the Works.

SECTION 1300. EMPLOYER'S & ENGINEER'S FACILITIES

1301. EMPLOYER'S & ENGINEER'S OFFICES

- (1) The Contractor shall provide and maintain the Employer's & Engineer's Offices throughout the Construction Period.

This Clause shall consist of construction and/or the rent, maintenance and cleaning of the Employer's & Engineer's Offices as well as the furnishing and maintenance of the office furnitures including the air-conditioners for the sole use of the Employer and the Engineer and their staffs together with the provision, installation, maintenance and services. The buildings, furniture and equipment shall remain the property of the Contractor. The buildings shall be approved in advance by the Engineer.

The buildings and services shall be available in full working order within three (3) months after signing of the Contract and shall continue to be so available during progress of the Works until the Certificate of the Stage 2 Provisional Take-over of the Works has been issued.

The Contractor shall provide substitute facilities and/or space for the Employer's & Engineer's Offices during the period until the Offices become available, for approximately 10 persons of the Employer and the Engineer.

The Contractor shall be responsible for the security of the buildings and its contents at all times and shall employ watchmen for this purpose.

- (2) Location of the Employer's & Engineer's Offices will be at Mab Ta Pud or in the vicinity of the Site which shall be proposed by the Contractor and approved by the Engineer.

The Buildings for the Employer's and Engineer's offices shall have the following rooms and total area of these buildings shall not be less than 500 sq.m.:

- a) Site Manager's Room (Employer)
- b) Site Engineers' Room for 6 persons (Employer)
- c) Resident Engineer's Room (Engineer)
- d) Supervisors' Room for 16 persons (Engineer)
- e) Drafting Room
- f) Administration Room
- g) Conference Room for 20 persons
- h) Conference Room for 8 persons
- i) Storage
- j) Kitchen
- k) Toilet



- (3) The buildings shall be furnished with new furniture and equipment. The following are lists of the minimum basic furniture and equipment to be provided by the Contractor for the Employer's & Engineer's Office.

<u>a) Site Manager's Room</u>	<u>Quantities</u>
- Wooden Desk, 1.90 m x 0.90 m top, 6 side Drawers and 1 center drawer	1
- Revolving Executive Chair, on rollers, with armrests	1
- Straight Chair	2
- Bookcase, 0.30 m x 0.90 m x 0.80 m high, wood or metal	2
- Overstuffed Office Lounge Suite, Coffee Table, wooden, Formica top, 0.50 m x 1.20 m x 0.40 m high	1
- Wastebasket, large, solid sides, no wire	2
- File cabinet, four drawers, lock type, legal size with metal clip hanging files (30 per drawer)	1
- Wall Board, 250 cm x 150 cm	2
- 1 H.P. (12500 BTU) air conditioner	1
<u>b) Site Engineers' Room</u>	
- Wooden Desk, 1.50 m x 0.75 m top, 6 side drawers and 1 center drawer	6
- Executive Chair with armrests	6
- Drafting Table	2
- Stool	2
- Bookcase, 0.30 m x 0.90 m x 0.80 m high, wood or metal	3
- Straight Chair	6
- Wastebasket, large, solid sides, no wire	6
- Wall Board, 250 cm x 150 cm	2

	<u>Quantities</u>
- Coffee table	1
- 1 H.P. (12500 BTU) air conditioner	2
c) <u>Resident Engineer's Room</u>	
- same as those for Site Manager's Room	
d) <u>Supervisors' Room</u>	
- Wooden Desk, 1.70 m x 0.75 m top, 6 side drawers and 1 center drawer	6
- Executive Chair with armrests	6
- Wooden Desk, 1.5 m x 0.75 m top, 6 side drawers and 1 center drawer	10
- Executive Chair	10
- File Cabinet, four drawers, lock type, legal size with metal clip hanging files (30 per drawer)	8
- Drawing Cabinet, twelve drawers, lock type, 0.9 m x 1.3 m x 1.5 m high	2
- Drawing Hanger, 0.9 m x 1.2 m high	4
- Coffee Table	2
- Bookcase, 0.30 m x 0.90 m x 0.80 m high, wood or metal	4
- Straight Chairs	8
- Wastebasket, large, metal, solid sides, no wire	16
- Wall Board, 250 cm x 150 cm	4
- 1 H.P (12500 BTU) air conditioner	4

<u>e) Drafting Room</u>	<u>Quantities</u>
- Drafting Table	2
- Complete Set of Drafting Machine	2
- Stool	2
- Wastebasket, large, metal solid sides, no wire	2
- Drawing instruments	2
- Drawing Cabinet, twelve drawers, lock type, 0.9 m x 1.3 m x 1.5 m high	2
- Drawing Hanger, 0.9 m x 1.2 m high	4
- Cupboard with shelves & locks	2
- Wall Board, 250 cm x 150 cm	2
- Blue Printing Machine, Electric to handle up to 90 cm x 120 cm paper, to be approved by the Engineer	1
- 1 H.P (12500 BTU) air conditioner	1
<u>f) Administration</u>	
- Wooden Desk, 1.50 m x 0.75 m top, 6 side drawers and 1 center drawer	2
- Executive Chair	2
- File Cabinet, four drawers, lock type, legal size with metal clip hanging files (30 per drawer)	2
- Coffee Table	1
- Bookcase, 0.30 m x 0.90 m x 0.80 m high, wood or metal	1
- Wastebasket, large, metal, solid sides, no wire	2
- Cupboard with shelves and locks	1
- Wall Board, 250 cm x 150 cm	1
- Typewriter Table, metal no rollers	2

	<u>Quantities</u>
- Electric typewriters, IBM, Dualelectric, Thai & English or approved equal	2
- Dry Photo-Copier, Electric, XEROX Model "4800" or approved equal	1
- Wooden Desk, 1.25 m x 0.75 m top, 3 side drawers and 1 center drawer	2
- Straight chair	2
- 1 H.P (12500 BTU) air conditioner	2
<u>g) Conference Room for 20 persons</u>	
- Table, 250 cm x 125 cm	4
- Straight Chair	20
- Wall Board, 250 cm x 150 cm	2
- Blackboard with eraser	2
- Wastebasket, large, solid sides, no wire	2
- 1 H.P (12500 BTU) air conditioner	4
<u>h) Conference Room for 8 persons</u>	
- Table, 250 cm x 125 cm	1
- Straight Chair	8
- Wastebasket	1
- 1 H.P (12500 BTU) air conditioner	1
<u>i) Kitchen</u>	
- Kitchen necessities	1 set
- Tea and coffee sets	2 doz.
- Electric refrigerator (14 cu. feet)	1

- (4) The Contractor shall be required to employ and be responsible for the welfare and housing of the following staff to be available during the hours agreed by the Engineer.
- Two cleaners
  - Two office boys
- (5) Following services shall be provided, installed and maintained in the Employer's & Engineer's office by the Contractor:
- a) An adequate piped supply of clean, fresh water connected to the toilet and suitable sewage disposal facilities.
  - b) Potable water.
  - c) Electricity supply, with sufficient and suitable light fittings and socket outlets.
  - d) Fire extinguishers.
  - e) Two outside telecommunication lines.
  - f) Office supplies.
- (6) The Contractor shall provide a total of fifty (50) sets of safety helmets, boots, raincoats in the Employer's and Engineer's Offices for use of the Employer and the Engineer. Color of these shall be white or other color differing from those of the Contractor, and the qualities of these shall be subject to approval of the Engineer.

#### 1302. EMPLOYER'S & ENGINEER'S RESIDENCES

- (1) The Contractor shall provide and maintain the Employer's and Engineer's Residences throughout the Contract Period.

This Clause shall consist of construction and/or the rent, maintenance and cleaning of the Employer's and Engineer's Residences as well as the furnishing and maintenance of the furniture including the air-conditioners for the sole use of the Employer and the Engineer and their staff together with the provision, installation and maintenance of services. The buildings, furniture and equipment shall remain the property of the Contractor. The buildings shall be approved in advance by the Engineer. The buildings, furniture, equipment and services shall be available in full working order within three (3) months after signing of the Contract, and shall continue to be so available during progress of the Works until the commissioning works have been completed.

The Contractor shall provide substitute facilities and/or spaces for the Employer and Engineer's Residences during the period until the Residences become available, for approximately 10 persons of the Employer and the Engineer.

A few bedrooms and related facilities and services shall be available during commissioning period after the date of Provisional Take-over.

The Contractor shall be responsible for the security of the buildings and its contents at all times and shall employ watchmen for this purpose.

- (2) Location of the Employer's and Engineer's Residences will be at Mab Ta Pud or in the vicinity of the Site which shall be proposed by the Contractor and approved by the Engineer.
- (3) The building(s) for the Employer's and Engineer's Residences shall have at least the following rooms and facilities and total area of the building(s) shall not be less than 900 sq.m.
  - a) Ten (10) single-bed Bedrooms with bath and toilet for the Employer use.
  - b) Five (5) twin-bed Bedrooms with bath and toilet for the Employer use.
  - c) Fifteen (15) single-bed Bedrooms with bath and toilet for the Engineer's use.
  - d) Five (5) twin-bed Bedrooms with bath and toilet for the Engineer's use.
  - e) Sitting and Recreation Room(s).
  - f) Canteen Facilities.
- (4) Each building of the Employer's and Engineer's Residences shall be furnished with new furniture and equipment. The following furniture and equipment shall be at least provided with each of the Residences by the Contractor as the minimum basic requirement:

<u>Description</u>	<u>Quantities</u>
<u>Sitting Room</u>	
- Wooden book case	1
- Wooden armchair	6
- Wooden tea table	1
- Curtain for window with insect net	
- 1 H.P (12500 BTU) air conditioner	1
<u>Recreation Room</u>	
- Wooden dining tables for 4 persons	2
- Wooden chairs for above table	8
- Wooden cup-board	1
- Curtain for window with insect net	
- 1 H.P (12500 BTU) air conditioner	1
<u>Twin-bed Bedroom</u>	
- Single bed with Dunlop-pillow mattress	2
- Wooden bed table	2
- Bed lamp	2
- Wooden table with chair	2
- Pillow with two pillow covers	2
- Sheet for single bed with mattress	4
- One person blanket	4
- Wardrobe	4
- Curtain for window with insect net	

Quantities

Single-bed Bedroom

-	Single bed with Dunlop-pillow mattress	1
-	Wooden bed table	1
-	Bed lamp	1
-	Wooden table with chair	1
-	Pillow with two pillow covers	1
-	Sheet for single bed with mattress	2
-	Blanket	2
-	Wardrobe	1
-	Cabinet, lock type	1
-	Curtain for window with insect net	

- (5) Canteen facilities shall have the capacity to provide mess for at least 40 persons of the Employer and the Engineer.
- (6) The Contractor shall provide the sufficient number of personnel, such as cleaners, housemaids, boys, etc., for the welfare and maintenance of the Employer's and Engineer's Residences.
- (7) Following services shall be provided, installed and maintained in the Employer's and Engineer's Residences by the Contractor:
- a) Adequate piped supply of clean water connected to toilets and bathrooms in the buildings and suitable sewage disposal facilities.
  - b) Potable water.
  - c) Electric immersion water heaters in the bathrooms connected to the piped water supply.
  - d) Electricity supply with sufficient and suitable light fittings and socket outlets.
  - e) Two internal telecommunication lines for each building.



1303. EMPLOYER'S & ENGINEER'S TRANSPORTATION

- (1) The Contractor shall provide and maintain until the end of the commissioning period vehicles for the Employer and the Engineer for both on-site and off-site transport. The vehicles shall be for the exclusive use of the Employer and the Engineer. The vehicles shall be new when provided. The property of vehicles shall remain with the Contractor during and after the Contract Period. Mileage of monthly off-site transport shall not be more than 5,000 km.
- (2) The Contractor shall be required to provide:
- a) Four (4) four-door saloon cars, air-conditioned, nominal engine capacity 2 litres, or similar.
    - One car for the Employer use.
    - Three cars for the Engineer use.
  - b) Four (4) micro buses, for not less than 10 passenger seats, air-conditioned, nominal engine capacity 2 litres, or similar.
    - Two micro buses for the Employer use.
    - Two micro buses for the Engineer use.
  - c) Two (2) pick up of 1 ton, nominal engine capacity 1.6 litres, or approved equal. Vehicles shall be right hand drive and shall be fitted with the following:
    - 1) Seat belts
    - 2) Fire extinguishers
    - 3) First aid kit
- (3) Vehicles shall be regularly serviced and repairs shall be made as soon as required. Vehicles which have to be kept out of service for more than 24 hours due to extensive repairs or maintenance work shall be substituted by similar serviceable vehicles within 24 hours from the time the original vehicles become out of service.

Any vehicle which has become permanently defective, unreliable or otherwise unfit for its intended use shall be replaced with a similar new vehicle within 60 days from the time the supply of such new vehicle has been ordered by the Engineer. Until the new vehicle is available for use at Site, a temporary substitute, serviceable vehicle shall be provided.

Vehicle maintenance shall include, but not necessarily be limited to, all fuels, lubricants, tires and other supplies; all maintenance repairs; insurance; licenses and other operating requirements.

- (4) The Contractor shall provide vehicles in accordance with the following delivery schedule:
- a) Four saloon cars : within one month after signing of Contract
  - b) Two pick-ups : within two months after signing of Contract
  - c) Four micro-buses : within three months after signing of Contract

Prior to ordering vehicles, the Contractor shall submit to the Engineer for approval detailed specifications, for each vehicle proposed. A pertinent service handbook and related manuals shall be supplied with each vehicle.

- (5) A licensed competent and experienced driver shall be provided on each vehicle at all times.

#### 1304. SUPPLY OF TRANSPORT

- (1) The Contractor shall supply the following transports which will be for uses of the operation and maintenance people of the Project.
- a) Five (5) pick-ups
  - b) Three (3) motorcycles
- (2) The pick-ups to be supplied shall be new and the specifications of the pick-ups are as follows:
- a) Type: Pick-up truck body, 4 x 2
  - b) Weight ratings: Gross vehicle weight not less than 1,950 kilograms. Payload approximately 1,000 kilograms.
  - c) Wheelbase: Minimum 2,400 mm.
  - d) Suspension: Springs and shock absorbers, front and rear
  - e) Steering: Right hand drive

- f) Engine: Make and model  
Gasoline, water cooled, multicylinder engine. Piston displacement approximately 1,600 C.C. Minimum output 55 KW (75PS) at not more than 100 rps. (6,000 rpm)
  - g) Clutch: Manufacturer's standard
  - h) Transmission: Floor mounted shift lever, synchromesh gear type
  - i) Brakes: 4-wheel hydraulic brake with vacuum booster. Hand parking brake shall be equipped.
  - j) Electrical Equipment: Manufacturer's standard
  - k) Gauges or warning lights: Direct reading or warning lights for fuel, lubricating oil pressure, temperature and battery charging indicator. Metric speedometer and recording odometer shall be equipped.
  - l) Accessories: Accessories and attachment furnished shall be the manufacturer's standard and shall include but not limited to dual electric windshield wipers, rear view mirrors, sun visors, insulated cab, safety glasses in cab, tools originally supplied in the manufacturer's tool kit.
  - m) Wheels and tires: Disc type wheel, tube type tires, manufacturer's standard tire size and ply rating. One spare wheel and tire.
  - n) Body: Steel-pick up type. Dimensions consistent with manufacturer's standard model. Non-skid steel floor type and equipped with synthetic fabric top with rear side seats.
  - o) Paint finish: Omaha orange
- (3) The motorcycles to be supplied shall be new and the specifications of the motorcycles are as follows:
- a) Suspension: Front and rear shock absorbers.
  - b) Engine: Approx. 100 cc piston displacement, gasoline, air cooled engine. Min. brake horsepower 9 HP or PS at approximately 7,500 revolutions per minute.
  - c) Electrical system: Kick starter type, front and rear turn signal lights, brake lights, speedometer light, head light, tail light and other necessary warning lights.
  - d) Clutch: Manufacturer's standard

- e) Brakes: Front and rear wheels.
  - f) Transmission: Multiforward speeds. Gear shift by foot operation.
  - g) Tire: Tube type tire. Manufacturer's standard size and ply rating.
  - h) Accessories: Accessories and attachments furnished shall be the manufacturer's standard and shall include but not be limited to rear view mirrors, electric horn, speedometer, tool equipment originally supplied in the manufacturer's standard tool kit. One copy of operator's Handbook.
  - i) Body: Rigid sturdy man riding type metal frame. Front and rear mudguards.
  - j) Paint: Dual seat - black  
Body - Manufacturer's standard paint.
- (4) The Contractor shall supply the pick-ups and motorcycles at 13th month after signing of the Contract or in accordance with the instructions by the Engineer.

Prior to ordering vehicles and motorcycles, the Contractor shall submit to the Engineer for approval detailed specifications for each vehicle proposed.

A pertinent service handbook and related manuals shall be supplied with the pick-ups and motorcycles.

#### 1305. FIELD LABORATORY

- (1) The Contractor shall construct the Field Laboratory and maintain it during the Construction Period to the satisfaction of the Engineer. The Field Laboratory is for the use of the Engineer.

The Field Laboratory shall be located at Mab Ta Pud or at other place in the vicinity of the Site which shall be proposed by the Contractor and approved by the Engineer.

Building of the Field Laboratory shall be spaced not less than forty (40) sq.m and shall be designed, proposed and constructed by the Contractor after getting the approval of the Engineer.

The Contractor shall supply and furnish the Field Laboratory with the following listed new furniture and equipment:

<u>Description</u>	<u>Quantity</u>
- Metal Desk, 1.50m x 0.75 m top, 6 side drawers and 1 center drawer	2
- Straight chair	4
- Table	2
- Wastebasket large, solid sides, no wire	2
- Wall Board, 250 cm x 150 cm	2
- Cupboard with shelves and locks	2
- File cabinet four drawers, lock type, legal size with metal clip hanging files (20 per drawer)	1
- 1 H.P (12500 BTU) air conditioner	2
- Set of shelves for the concrete wet room	1

The Contractor shall furnish the enough equipment and apparatus for the purpose of carrying out the required concrete and soil tests.

The laboratory equipment and apparatus shall be of approved types and shall be adequate in the opinion of the Engineer to carry out all the tests as listed in the Specifications.

The following listed equipment and apparatus shall be at least furnished to the laboratory by the Contractor.

#### Laboratory Equipment

<u>Designation</u>	<u>Specifications</u>	<u>Quantity</u>
A. Quality Control Test for Backfill		
1. Compaction Test	JIS A 1210 Method I-1-C	
◦ Mould	10 cm dia. 12.7 cm high	3
◦ Removable mould collar	10 cm dia. 5 cm high	3
◦ Base plate		3
◦ Hammer	2.5 kg weight 30 cm drop	2
◦ Sample ejector		1

<u>Designation</u>	<u>Specifications</u>	<u>Quantity</u>
2. Field Density Test	JIS A 1214, Method by using calibrated sand	
◦ Plastic cylindrical jar	4 lit. volume, 20 cm high	2
◦ Pyconometer-top		2
◦ Funnel	162 mm dia, 134 mm high	2
◦ Valve guide		3
◦ Base plate	300 mm dia.	2
◦ Glass plate	5 mm thickness 200mmx200mm	2
◦ Cylindric can for calibration of sand	2.5 lit. volume	1
3. Moisture Test	JIS A 1203	
◦ Drying oven	100 x 75 x 60 cm Internal size thermostatically controlled capable of maintaining a temperature of 110- 5°C	1
4. Balance and/or Scale		
◦ Table platform scale	Capacity 10 kg Sensitivity 1 gram	1
◦ Beam scale	Capacity 10 kg Sensitivity 5 gram	1
◦ Balance	Capacity 1 kg Sensitivity 0.1 gram	1
B. Concrete Test		
1. Slump Test	JIS A 1101	
◦ Slump cone	10 cm dia, 20 cm dia 30 cm high	1
◦ Iron plate		1
◦ Tamping Rod	16 mm dia, 50 cm length	1
◦ Scale		1
2. Making of specimen	JIS A 1132	
◦ Cylindrical mould	15 cm dia 30 cm high	15
◦ Capping set		2
◦ Concrete curing bath		1
3. Compressive strength	JIS A 1108	
◦ Compression Testing Machine	JIS B 7733, Capacity 100 tons	1

<u>Designation</u>	<u>Specifications</u>	<u>Quantity</u>
C. Miscellaneous		
◦ Straight edge	30 cm length	3
◦ Beaker	500 cc volume	30
◦ Small hand scoop		4
◦ Large hand scoop		4
◦ Vernier calipers	Measuring length 30 cm	1
◦ Steel scale	3.0 m	2
◦ Tray	40 x 30 cm	10
◦ Wire brush		5
◦ Sampling spoon		3

At the end of the Contract, all equipment, apparatus and furniture of the Field Laboratory shall become the property of the Contractor, and shall be removed from the Site.

The Contractor shall maintain the Field Laboratory and assist the Engineer for operation of the Laboratory.

The power, water, and gas shall be supplied to the Field Laboratory by the Contractor. The daily laboratory supplies shall also be supplied by the Contractor.

The Contractor shall supply one laboratory technician, who speak English well, and two labourers for operation of the Laboratory under the Engineer.

#### 1306. MEASUREMENT AND PAYMENT

- (1) Measurement for payment for the Employer's and Engineer's Offices shall cover the provision, maintenance and other requirements stated in the Specifications.
- (2) Payment for provision and maintenance of Employer's and Engineer's Office will be made by lump sum under Pay Item 1101 of the Bill of Quantities.

Thirty (30%) percent of the lump sum under Pay Item 1101 will become payable when the Engineer deems the provision and furnishing of the Employer's and Engineer's Office to be substantially completed.

The remaining seventy (70%) percent of the lump sum will be paid in equal monthly payments so that the total sum shall be fully disbursed upon the Stage 2 Provisional Take-over of the Works.

- (3) Measurement for payment for the Employer's and Engineer's Residences shall cover the provision, maintenance and other requirements stated in the Specifications:
- (4) Payment for provision and maintenance of the Employer's and Engineer's Residences will be made by lump sum under Pay Item 1102 of the Bill of Quantities.

Thirty (30%) percent of the lump sum under Pay Item 1102 will become payable when the Engineer deems the provision and furnishing of the Employer's and Engineer's Residences to be substantially completed.

The remaining seventy (70%) percent of the lump sum will be paid in equal monthly payments so that the total sum shall be fully disbursed upon the Stage 2 Provisional Take-over of the Works.

- (5) Measurement for payment for the Field Laboratory shall cover construction, furnishing, and maintenance of the laboratory and other requirements of the Specifications.
- (6) Payment for provision, operation and maintenance of Field Laboratory will be made by lump sum under Pay Item 1103 of the Bill of Quantities.

Thirty (30%) percent of the lump sum under Pay Item 1103 will become payable when the Laboratory is substantially completed and equipped.

The remaining seventy(70%) percent of the lump sum will be paid in equal monthly payments so that the total sum shall be fully disbursed upon the Stage 2 Provisional Take-over of the Works.

- (7) Measurement for payment for provision, operation and maintenance of vehicles shall cover the purchase, delivery of the vehicles to the Site, provision of and operation by a licensed competent driver on a full time basis, depreciation, taxes, the cost of comprehensive insurance and licenses, petrol, oil and lubricants, repairs and replacement of parts and vehicles and all other costs and charges incurred in the running and upkeeping of the vehicles, and any other requirements stated in the Specifications.
- (8) Payment for provision, operation and maintenance of vehicles will be made under Pay Items 1104, 1105, and 1106 of the Bill of Quantities and shall be made on the vehicle-month basis as computed from the date of delivery of each vehicle to be ready for operation to the date of return back of each vehicle to the Contractor.



- (9) Measurement for payment for supply of pick-up cars shall be the number of pick-up cars supplied, and shall cover the purchase and delivery to Site of pick-up cars and any other requirements stated in the Specifications.
- (10) Payment for supply of pick-up cars will be made under Pay Item 1107 of the Bill of Quantities. The payment will be made at the time of delivery of the pick-ups and against the certificate of acceptance of the Engineer.
- (11) Measurement for payment for supply of motorcycles shall be the number of motorcycles supplied, and shall cover the purchase and delivery to Site of motorcycles and any other requirements stated in the Specifications.
- (12) Payment for supply of motorcycles will be made under Pay Item 1108 of the Bill of Quantities. The payment will be made at the time of delivery of the motorcycle and against the certificate of acceptance of the Engineer.

DIVISION 2. INTAKE FACILITIES

SECTION 2000. GENERAL

2001. SCOPE OF WORKS

The scope of works of the Intake Facilities consists of:

- a. Intake Tower
- b. Intake Bridge
- c. Intake Yard
- d. Pumping Plants
- e. Electric Facilities

2002. TEMPORARY WORKS

- (1) The Contractor shall submit to the Engineer for his approval full details of the Contractor's temporary arrangements for construction of the Intake Facilities including following details, prior to commencement of the works.
  - a. Construction Method of the Intake Tower
  - b. Construction Method of the Intake Bridge
  - c. Shop Drawings for the caisson yard if the Contractor intends to construct, including details for temporary supportings of the caisson walls at every critical construction stage, installation details of the caisson, temporary requirements of reinforcing bars in addition to the permanent requirements if any, and formworks arrangements including the arrangement of waterproof formworks and their supporting and scaffolding details, etc.
  - d. Structural calculations for these temporary facilities.
- (2) All kinds of temporary works relating to the construction of the Intake Tower and Intake Bridge shall not be commenced without getting the Engineer's approval for the whole construction method of the facilities. Nevertheless, the approval of the Shop Drawings, Contractor's proposals, or other data and method by the Engineer shall not exonerate the Contractor from any of his responsibilities under the Contract.

### 2003. EXPLORATORY DRILLINGS

- (1) The Contractor shall execute, prior to the excavation works and piling works, the exploratory drillings at the foundations of the Intake Tower, the Intake Bridge and other necessary places in accordance with the instructions of the Engineer.
- (2) Exploratory drill holes shall be NX size with a 75 mm hole diameter and a minimum core diameter of 55 mm. Penetration tests shall be performed in every one meter of drill holes and the Contractor shall take all care and precaution to maximize core recovery.

### 2004. ENGINEER'S INSPECTION & SAFETY CONTROL

- (1) The Contractor shall provide transport or access possibility to the Intake Tower and to the Intake Bridge on a twenty-four-hour basis for the Engineer's inspection of the Works at Contractor's own expense.
- (2) The Contractor shall submit to the Engineer for his approval full details of safety precautions relating to the Works in and around the reservoir including the details of the manner and method of diving works.

### 2005. MEASUREMENT AND PAYMENT

- (1) All kinds of temporary works necessary for construction of the Intake Facilities including preparation, construction, maintenance and removal works shall be paid by lump-sum under Pay Item 2001 of the Bill of Quantities.

Thirty (30%) percent of the lump sum under Item 2001 will become payable when the Engineer deems the temporary works necessary for construction of the Intake Facilities are substantially completed. Twenty (20%) of the lump sum will be payable when the removal works are substantially completed. And the remaining fifty (50%) percent of the lump sum will be paid in equal monthly payments so that the total sum shall be fully disbursed upon the Provisional Take-over of the Works.

- (2) Measurement for payment for the exploratory drillings shall be the length, measured in meter, of drilled holes executed. Measurement shall include drillings, all testings required, sampling and reporting, etc.

Payment for the exploratory drillings will be made under Pay Item 2002 of the Bill of Quantities.

## SECTION 2100. INTAKE TOWER

### 2101. EARTHWORKS

- (1) Excavation works of the Intake Tower shall be made in accordance with the Drawings and Division 2 of the General Specifications. The manner and method of the excavation works under water shall be subject to the approval of the Engineer.
- (2) The elevation to be excavated to at the foundation of the Intake Tower, which is provisionally shown in the Contract Drawing, will be instructed by the Engineer after examination of the results of exploratory drillings and depending upon the materials excavated during the Works.

All soft and/or weathered rock materials shall be completely removed. Method of excavation which may damage the dam body shall not be used.

- (3) When drilling and blasting is to be conducted for rock excavation, the Contractor should pay maximum attention not to damage the dam body and the dam structures.

The Contractor shall submit to the Engineer for his approval a detailed plan for rock excavation under water prior to the preparation of materials, including the kind of explosives and detonators, amount of explosives to be used at one time, etc.

The Contractor shall abide strictly by the statutory laws and regulations concerning the procurement, handling, transportation, storage and use of explosives.

- (4) The Pay-lines shown in the Contract Drawings related to the Works of Intake Tower are the lines indicating the minimum required area to be excavated and the lines to be measured for the payment.
- (5) The spoil area for excavated materials from the foundation of the Intake Tower may be a shore area of the Reservoir and both location and method of spoiling shall be proposed by the Contractor for approval by the Engineer.

### 2102. FOUNDATION WORKS

- (1) The under-water concrete at the foundation of the Intake Tower shall be the Class B concrete and be cast under water after getting approval of the Engineer for the foundation excavation. Section 3000 of the General Specifications shall be applied to these Works, and the method of placing concrete as well as the method of levelling control of concrete surface shall be subject to the Engineer's approval.
- (2) Base plates at the foundation for the shoe of Intake Tower shall be solidly fixed to exact locations and elevation as indicated

on the Drawings before placing the underwater concrete at the foundation.

Method of fixing the plate shall be subject to the Engineer's approval.

- (3) Secondary underwater concrete at the foundation of Intake Tower shall be cast after the Intake Tower is installed and the location of the Tower is confirmed. Intrusion of the concrete to the space below the caisson will be acceptable.
- (4) Mortar grouting shall be made to the space below the caisson in accordance with the Shop Drawings. The cement content of grouting mortar shall be instructed by the Engineer and will be approximately 700 kg/m<sup>3</sup>.

The pipes for grouting shall be installed to the concrete of the caisson body prior to execution of the installation of caisson body. The number of outlets for the grouting to be allocated at the bottom of caisson shall be not less than eight (8) and the blow-off pipes and valves shall also be installed. The timing of the grouting works shall be decided taking the balance between the weight of caisson and uplift into consideration. The pressure of grouting shall be controlled in accordance with the instruction of the Engineer.

Detailed schedule and method of the grouting shall be proposed by the Contractor for the Engineer's approval prior to commencement of concrete works of the caisson.

- (5) Boring logs and geological profiles shown in the Contract Drawings are only for reference. The Contractor has no right to claim for the differences between the geological profiles shown on the Drawings and the actual geological conditions at the site.

### 2103. CONCRETE CAISSON WORKS

- (1) Reinforcing bars of the caisson tower shown in the Contract Drawings are the minimum requirements only for the stress at and after the time of completion of the Works, and may not be enough for the stress occurring during the construction and installation. The Contractor shall design and submit to the Engineer for his approval the reinforcing bars requirements at the time of construction and installation in addition to the reinforcing bars shown in the Contract Drawing with detailed structural calculations, in accordance with the approved construction method.
- (2) The classes of the concrete of caisson tower are as follows:

Structural Concrete of Caisson	C - concrete
Filling Concrete	E - concrete
Cinder Concrete	G - concrete
Base Concrete	D - concrete

- (3) The dimensions of base concrete shown in the Contract Drawings are subject to alteration depending upon the sizes and forms of the approved pumping plants and their appurtenant facilities. The Contractor shall propose the dimensions of base concretes including its reinforcing bar arrangements on the Shop Drawing for the Engineer's approval.
- (4) No contraction joint shall be accepted for the concrete walls of the caisson body which face the water.
- (5) The waterstop shall be placed in every horizontal construction joints of the walls of caisson body which face the water. The waterstop shall be W-1015-P and R-1006 of Span Seal which are made of nonvulcanized butyl reclaimed rubber, or other material which ensure an equal or higher quality. Span Seal shall be also bound round on pipes, separators and any other materials intalled in the concrete of caisson body.
- (6) Suction pipes with valves for pumping plants and  $\phi 80$  mm pipes with valves for water level meter shall be installed prior to concreting.
- (7) The waterproof membrane shall be coated on the wall of caisson as shown in the Drawings. The material of the waterproof membrane shall be Vandex or approved equal.
- (8) Filling concrete shall be vibrated and compacted enough so that the concrete is filled at every corner of pre-cast concrete structure. The method of concreting shall be subject to the Engineer's approval.
- (9) Tolerances to be permitted for the installation of the caisson shall be as follows:

Elevation	$\pm 2$ cm
Location	$\pm 5$ cm
- (10) Any kind of concrete walls and/or concrete beams and/or concrete columns of caisson body shall be free from water pressure for at least four weeks period after casting of concrete, during the installation of the caisson.

#### 2104. MISCELLANEOUS WORKS

- (1) The Contractor shall supply and install the Dust Floaters including guide pipes to be fixed to the Caisson body, synthetic fiber ropes of 40 mm diameters to be fixed to the anchor Concrete and the Catwalk of Caisson with turnbuckle for tensioning, and Floating Fences. The material of guide pipe shall be stainless steel and the material of rope shall be synthetic fiber. The Floating Fence shall be polymeric resin or

higher quality. Excavation and concreting for anchor concrete shall be within the scope of these Works. Anchor concrete shall be Class B-concrete. The minimum requirements of spare parts of the Dust Floaters shall be supplied by the Contractor.

- (2) Hand rails, stairways, screens, ladders, expanded metals, manhole covers, and other miscellaneous metal works shall be executed in accordance with the Drawings and Division 6 of the General Specifications.
- (3) Ladders to be installed in the caisson tower shall be made by stainless steel as shown in the Drawings.
- (4) Hooks for holding 3 tons load shall be set up at the roof of each floor of the caisson tower, prior to concreting. Hooks for crane installation shall be installed at the roof of 4th floor, and hooks for Dust Floaters shall be also installed at the Catwalk of the caisson tower.

#### 2105. MEASUREMENT AND PAYMENT

- (1) Measurement for payment for common excavation at Intake Tower foundation shall be the volume of materials excavated as computed in place from the original ground surface to the required line and grades and surrounded by the vertical Pay-lines shown in the Drawings, measured in cubic meters.

Volume of voids formed as above shall be computed by the average-end-area method with cross sections taken at every 5 meters or at such intervals as directed by the Engineer.

The Contractor should note that the term "common excavation" means excavation of all other materials than rock as specified in Section 2000 "Excavation" of the General Specifications. The excavation of soft or weathered rock shall be therefore part of common excavation.

- (2) Payment for common excavation at Intake Tower foundation will be made under Pay Item 2101 of the Bill of Quantities, and shall cover excavation, disposal of excavated material, preparation of foundation and other requirements stated in the Specifications and the Drawings.
- (3) Measurement for payment for rock excavation at Intake Tower foundation shall be the volume of rock material excavated as computed in place from the original rock excavation surface to the required neat lines of excavation and surrounded by the Pay-line shown in the Drawings, measured in cubic meters.
- (4) Payment for rock excavation at Intake Tower foundation will be made under Item 2102 of the Bill of Quantities, and shall cover excavation, disposal of excavated material, preparation of foundation and other requirements stated in the Specifications and the Drawings.

- (5) Measurement for payment for underwater concrete at Intake Tower foundation shall be the volume of concrete in cubic meters placed as computed between the lines, limits, configuration of the concrete and the vertical Pay-lines.

The volume of secondary underwater concrete which flow out into the space under the caisson will not be computed.

Measurement for payment for underwater concrete at Intake Tower foundation shall include the supply of all necessary materials, all measures necessary for the batching of materials, the mixing, transporting, preparation prior to placing, formwork if any, placing, compacting, protecting, curing, temperature control, supply and transport of test cylinders and finishing of this concrete.

- (6) Payment for the underwater concrete at Intake Tower foundation will be made under Pay Item 2103 of the Bill of Quantities.
- (7) Measurement for payment for base and shoe plates at Intake Tower foundation shall be the number of set of base and shoe plates installed.
- (8) Payment for base and shoe plate at Intake Tower foundation will be made under Pay Item 2104 of the Bill of Quantities.
- (9) Measurement for payment for concrete of the caisson, including reinforced concrete of caisson body, filling concrete, base concrete and cinder concrete shall be the volume of concrete in cubic meters placed in the caisson.
- (10) Payment for reinforced concrete of caisson body will be made under Pay Item 2105 of the Bill of Quantities. Payment shall cover concrete works, formworks, special waterproof formwork if any, water stop, scaffolding and supporting, reinforcing bar, structural steel if any, shoe plates and anchor bar, embedded steel and supply and transport of test cylinders, and any other works related.
- (11) Payment for filling concrete in caisson will be made under Pay Item 2106 of the Bill of Quantities.
- (12) Payment for base concrete in caisson will be made under Pay Item 2107 of the Bill of Quantities, and shall cover concrete works, formworks, reinforcing bar, embedded steel, and any other works related.
- (13) Payment for cinder concrete in caisson will be made under Pay Item 2108 of the Bill of Quantities, and shall cover concrete works, formworks, and any other works related.
- (14) All kinds of works necessary for installation of the caisson will be paid by lump sum under Pay Item 2109 of the Bill of Quantities. Thirty (30%) percent of the lump sum under Pay Item 2109 will be payable when the Engineer deems all kinds of preparatory works necessary for installation of the caisson are substantially completed. Fifty (50%) percent of the lump sum



will be payable when the caisson is set out exactly on the base plate. And the remaining twenty (20%) percent of the lump sum will be paid when all concrete works of the caisson are completed and approved.

- (15) Measurement for payment for mortar grouting at caisson foundation shall be the volume of mortar in cubic meters injected in the space below the caisson.
- (16) Payment for mortar grouting at caisson foundation will be made under Pay Item 2110 of the Bill of Quantities, and shall cover supply and installation of grouting pipes and valves as well as blow-off pipes and valves, grouting works, mortar materials grouted and other requirements stated in the Specifications and Drawings.
- (17) Measurement for payment for waterproof membrane shall be the area, measured in square meters, of concrete surfaces on which such waterproof membrane is coated.
- (18) Payment for waterproof membrane will be made under Pay Item 2111 of the Bill of Quantities.
- (19) Measurement for payment for stairway shall be the weight in kilogram of steel and metal of stairway installed, and shall include the provision of anchor bolts and bars, connectors and any other materials and measures necessary to complete the supply, erection and painting of the stairway.
- (20) Payment for stairway will be made under Pay Item 2112 of the Bill of Quantities.
- (21) Measurement for payment for ladder shall be the weight in kilogram of ladder installed, and shall include the provision of anchors, connectors and any other materials.
- (22) Payment for ladder will be made under Pay Item 2113 of the Bill of Quantities.
- (23) Measurement for payment for handrail shall be the weight in kilogram of handrail installed.
- (24) Payment for handrail will be made under Pay Item 2114 of the Bill of Quantities.
- (25) Measurement for payment for miscellaneous metal shall be the weight in kilogram of miscellaneous metal installed, and shall include the provision of anchor bolts, connectors and any other materials and measures necessary to complete the supply, erection, painting or galvanizing of the miscellaneous metal items. Checker plate coverings, expanded metal coverings, rung, hooks, etc. shall be measured as miscellaneous metal. No measurement shall be made for any embedded metal which are required for installation of pumping plants, gates, waterpipes and electrical facilities.

(26) Payment for miscellaneous metal will be made under Pay Item 2115 of the Bill of Quantities.

(27) Measurement for payment for supply of Dust Floater shall be the No. of sets of such dust floaters including floating fences, synthetic ropes with turnbuckles and hook anchors, guide pipes, necessary spare parts and any other materials supplied.

(28) Payment for supply of Dust Floater will be made under Pay Item 2116 of the Bill of Quantities.

Fifty (50%) percent of the amount of the supply item will become payable at the time of delivery of the Dust Floater to the Site.

The remaining fifty (50%) percent of the payment will be made at the time of completion of installation works.

(29) Measurement for payment for installation of Dust Floater shall be the set of such Dust Floater installed, and shall include the excavation and concreting for sea-anchor concrete, fixing guide pipes and hook anchor to the caisson body, installation of synthetic fiber ropes and floating fences and any other works required.

(30) Payment for installation of the Dust Floater will be made under Pay Item 2117 of the Bill of Quantities.

Payment will be made at the time of completion of the installation works.

SECTION 2200. INTAKE BRIDGE

2201. PILING WORKS

- (1) Piling works of the Intake Bridge shall comply with requirements of the Drawings and Division 4 of the General Specifications. The manner and method of installing the piles together with kind of the equipment to be used shall be subject to the approval of the Engineer.
- (2) Steel pipe piles for the bridge pier shall be 508 mm in diameter and 9 mm of wall thickness. Field welding for jointing the piles shall not be accepted.

Following paint shall be applied to the outside of steel tube piles:

At the Shop	-	75 $\mu$ m of zinc rich primer after blasting
	-	10 $\mu$ m of mist coat of tar epoxy
At the Site	-	1st 200 $\mu$ m of tar epoxy
	-	2nd 200 $\mu$ m of tar epoxy
	-	3rd 200 $\mu$ m of tar epoxy

A reinforcing band shall be welded at the tip of each pile and the cross stiffener plate with cover plate shall be welded at the head of each pile in accordance with the instructions shown in the Drawings. A reinforcing bar basket shall be welded tightly at the head of pile prior to placing concrete of footing.

- (3) The manufacturing and installation of reinforced concrete pile shall comply with the requirements of the Drawings and Division 4 of the General Specifications.

The head of the pile shall be covered by a steel plate which is fixed to the pile so as to be square to the longitudinal axis. Steel pile shoe shall be welded to the reinforcing bar of the pile as shown in the Drawings.

Class D concrete shall be applied for the concrete pile and the pile shall not be driven until at least 28 days after casting of concrete.

2202. FOOTING OF BRIDGE, RETAINING WALL AND ANCHOR BLOCK

- (1) The concrete works including formworks and reinforcing bar arrangement of the Intake Bridge shall comply with requirements of the Drawings and Division 3 of the General Specifications.

Class D concrete shall be applied to the concrete of footings of the Bridge, retaining walls and anchor blocks. The levelling concrete shall be Class H concrete. The Contractor shall submit the construction plan of concreting for footings of the Bridge including the method for formwork supporting, one month prior to commencing of the works for the Engineer's approval.

- (2) Joint fillers shall be placed between A2-Footing of the Bridge and retaining walls. The material of the joint filler shall be Elastite or approved equal.

2203. PRESTRESSED CONCRETE GIRDER

- (1) Following materials shall be applied for manufacturing of the prestressed concrete girders.

- Concrete : \* Class A concrete
- Reinforcing bar : \* corresponding to SD 24  $f_{sa} = 1,400 \text{ kg/cm}^2$

a. Design Load

Live Load TL-14 loadings

Coefficient of Impact  $i = 10/(25 + L)$   
(L: Span Length in metric)

Wind Pressure  $q = 100 \text{ kg/m}^2$

Unit Weight  
Prestressed concrete =  $2.4 \text{ t/m}^3$   
Reinforced concrete =  $2.4 \text{ t/m}^3$

Range of Open Air Temperature  $10^\circ\text{C} - 50^\circ\text{C}$

- b. Loading combinations and rate for increase of allowable stress

* Loading combinations	Rate of Increase
* P	1.00
* P + T	1.15
* P + W	1.25
* P + T + W	1.35
* D + (PS + PCR + PSH) + EQ	1.50
* D + (PS + PCR + PSH) + EQ + T	1.70
* ER	1.25

Where, P : Principal loads  
 $P + D + L + I + PS + PCR + PSH$   
 D : Dead load  
 L : Live load (TL-14 loadings)  
 I : Impact  
 PS: Prestress  
 PCR: Effect of creep in prestressed concrete members  
 PSH: Effect of shrinkage in prestressed concrete members  
 T : Thermal forces  
 W : Wind loads  
 EQ : Earthquake forces  
 ER : Temporary loads and forces during erection

c. Alignment

Plan Alignment	R = 0
Longitudinal Alignment	0.2187%
Angle of Skew	90°00'00"

d. Prestressed Concrete

\* Allowable stress for concrete

Compressive strength after 28 days	$f_c = 350 \text{ kg/cm}^2$
Modulus of elasticity	$E = 325,000 \text{ kg/cm}^2$
Allowable bending compressive stress	
Temporary stress before loss by creep and shrinkage	$f_{ct} = 160 \text{ kg/cm}^2$
Stress at design load after loss	$f_{ca} = 125 \text{ kg/cm}^2$
Allowable bending tensile stress	
Temporary stress before loss by creep and shrinkage	$f_{tt} = 13.5 \text{ kg/cm}^2$
Stress at design load after loss	$f_{ta} = 13.5 \text{ kg/cm}^2$
Stress at dead load after loss	$f'_{ta} = 0 \text{ kg/cm}^2$

Allowable shear stress	$f' = 5 \text{ kg/cm}^2$
Stress at design load	$f_{sa} = 46.5 \text{ kg/cm}^2$
Stress at ultimate load	$f_{su}$
Allowable diagonal tensile stress	$f_{ia} = 9 \text{ kg/cm}^2$
Creep coefficient	$= 3.0$
Shrinkage coefficient	$= 20 \times 10^{-5}$
Prestressing steel	
T 9.3 strands are employed.	
Ultimate strength	$f'_s = 175 \text{ kg/mm}^2$
Yield point	$f_y = 150 \text{ kg/mm}^2$
Allowable stress	
At a time of initial prestress	$f_{sia} = 135 \text{ kg/mm}^2$
Temporary stress before loss by creep and shrinkage	$f_{sta} = 122.5 \text{ kg/mm}^2$
Stress at design load after loss	$f_{sa} = 105 \text{ kg/mm}^2$

- (2) The Contractor shall supply and install three different types of bridge girder as shown in the Drawings, two kinds of Type-A girders for road bridge and one kind of Type-B girders for pipe supporting bridge. The stirrup reinforcing bar shall be fixed to the girder for the curb concrete in accordance with the Drawings. The shop inspections on manufacturing of the girder will be carried out prior to concreting and during concreting. The Contractor shall notify the Engineer one week before the commencement of concreting of girders. The Contractor shall submit the result of material tests for approval of the Engineer.
- (3) Way and method of installation as well as transportation of the bridge girder shall be subject to the Engineer's approval. The Contractor shall submit his proposal of method of installation and transportation for the bridge girder one month before such works being commenced.

#### 2204. NEOPRENE BEARING, LATERAL TIE BAR AND EXPANSION JOINT

- (1) Neoprene bearing pad for the bearings of the Intake Bridge shall be ST Pad RbS.D 150 mm x 23 mm, or approved equal. Bearing works shall include supply and installation of Neoprene bearings, anchor bars, non-shrinking mortar and any other works related.

(2) Lateral tie bar shall be the steel bar for prestressed concrete with bearing plates, washers and lock-nuts. The following shall be applied for the tie bar:

- Diameter 32 mm of PC-steel bar SBPR 80/95 corresponding to JIS G3109
- Section area: 804.2 sq.mm
- Ultimate tensile stress:  $f_{pu} = 95 \text{ kg/sq.mm}$
- Yield stress:  $f_{py} = 80 \text{ kg/sq.mm}$

The cement grouting shall be carried out to the holes for lateral tie bar after completion of fixing of tie bars. The grouting materials shall be as follows:

- Compressive strength:  $f_7 = 150 \text{ kg/sq.cm}$   
 $f_{28} = 200 \text{ kg/sq.cm}$
- Ratio of swelling: 0-10%
- Consistency of "J" Flow Line: 6-10 Sec.

(3) Expansion joint of the Intake Bridge shall be Sho-Bond Cut Off Joints M-2, or approved equal. The Cut Off Joints shall include supply and installation of joint seal rubber M-2 type, corner metal with anchor, SB mortar as for surface course, F.R.P., and epoxy mortar.

(4) Non-shrink mortar to be placed for fixing bearing anchor bars of the Intake Bridge and for fixing anchor bolts of saddle supports as well as ring supports shall be the Masterflow 870 Grout of Nisso Master Buildings Co, or approved equal.

The block-out holes at the concrete of footings of bridge piers and of the caisson for bearing anchor bar shall be 100 mm in diameter and 300 mm in depth.

The holes on the bridge girders for anchor bolts of saddle and ring supports shall be 50 mm in diameter and 300 mm in depth.

The holes for anchors and the concrete surface around shall be adequately absorbed with water before placing the non-shrink mortar.

#### 2205. HANDRAIL OF BRIDGE

(1) Each span of handrail between the posts shall be fixed by bolts and nuts so as to make it removable for the maintenance services for cable box and water pipeline.

(2) The painting of the handrail shall be as follows:

- At the Shop: \* Etching primer 15  $\mu\text{m}$   
\* 2 times of red lead 35  $\mu\text{m}$  x 2
- At the Site: \* gum chloride paint of light blue color 45  $\mu\text{m}$   
\* final coating of gum chloride paint of light blue color 35  $\mu\text{m}$

2206. STEEL PIPE 1350 mm DIAMETER

- (1) The specifications to be applied for the steel pipe works in this item shall be in general same as the specifications described in Clauses 3101 and 3102 of the Particular Specifications, except otherwise specially described below.
- (2) Standard length of unit steel pipe to be supplied should be eight (8) meters. The Contractor shall submit to the Engineer for his approval the schedule of pipes to be supplied including the standard pipes and non-standard pipes one month before commencement of manufacturing.
- (3) External coating of the pipes exposed to the air shall be as follows:
  - At the Shop : \* 15  $\mu\text{m}$  of zinc rich primer after blasting  
\* Two (2) times of 75  $\mu\text{m}$  of Non-bread type tar epoxy  
\* Two (2) times of 30  $\mu\text{m}$  of epoxy-MIO paint
  - At the Site : \* 30  $\mu\text{m}$  of gum chloride paint  
\* 25  $\mu\text{m}$  of gum chloride paint

The manner of coating shall be in accordance with JWSP 009-79.

- (4) (3) to (6) of Clause 3201 of the Particular Specifications shall apply to installation works of steel pipe in this Clause.

2207. SADDLE SUPPORT

- (1) The steel materials to be used shall correspond to SS-41.
- (2) Coating of steel material shall be the same standard and manner as that of the steel pipe.



- (3) (4) of the Particular Specifications Clause 2204 shall be applied for the works of non-shrinking mortar.
- (4) Neoprene pad shall be 250 mm in width and 5 mm in thickness.
- (5) The movable bearing shall be the steel-made, corresponding to SS-41, and be zinc-galvanized in accordance with JIS H8641. The bearing shall be bearable against maximum 5 tons of reaction force and maximum 50 mm of movement.
- (6) The Contractor shall submit the Shop Drawing showing the manufacturing details to the Engineer for his approval at least one month before commencement of manufacturing.

#### 2208. RING SUPPORT

- (1) The steel materials to be used shall correspond to SS-41.
- (2) Coating of steel material shall be the same standard and manner as that of the steel pipe.
- (3) The fixed bearing shall be the steel-made corresponding to SS-41, and be zinc-galvanized in accordance with JIS H8641. Each side of a pair bearings shall be bearable against maximum 5 tons of reaction force and also maximum 5 tons of horizontal force.
- (4) The ring support shall be manufactured and welded to the main water pipe at the shop.
- (5) (4) of the Particular Specifications Item 2204 shall be applied for the works of Non-shrinking mortar.
- (6) The Contractor shall submit the Shop Drawing showing the manufacturing details for Engineer's approval at least one month before commencement of manufacturing.

#### 2209. TEE PIPE WITH MANHOLE

- (1) The specification to be applied for the tee pipe with manhole in this Clause shall be in general same as the specifications described in Clauses 3101 and 3102 of the Particular Specifications, except otherwise specially described hereinunder.
- (2) Four (4) and eight (8) meters should be the unit length of 1,350 mm steel pipe with manhole, as differing from that of the tee pipe under Clause 3000 of the Particular Specifications.
- (3) Same coatings as specified in (3) of Clause 2206 of the Particular Specifications shall be applied for the works of external coating for the tee pipe with manhole.

2210. HIGH SPEED AIR VALVE

The Specifications to be applied for the high speed air valve in this Section shall be the same as the Specifications described in (3) of Clause 3105 of the Particular Specifications.

2211. COUPLING FOR WATER PIPE

The Specifications to be applied for the coupling in this Section shall be same as the Specifications described in (1) Clause 3104 of the Particular Specifications.

2212. CABLE BOX

- (1) Division 6 of the General Specifications shall be applied for supply and installation works of the cable box.
- (2) All parts of metal for the cable box shall be galvanized.
- (3) The cable box shall be fixed tightly both to the curb of road bridge and to the girder of pipe support bridge by bolts and nuts, or by other methods approved.
- (4) Covering plate at the side of road bridge shall be installed so as to be able to be removed at the time of necessity.

2213. MEASUREMENT AND PAYMENT

- (1) Measurement for payment for supply of steel pipe pile shall be the number of each length of steel pipe pile supplied.
- (2) Payment for supply of steel pipe pile of bridge pier will be made under Pay Item 2201, Pay Item 2203 and Pay Item 2205 of the Bill of Quantities, and shall cover the supply of steel pipe with shop paintings, reinforcing band, cover plate, cross stiffing plate, reinforcing bar basket to be welded at the top of pile and any other materials specified and intended.

Fifty (50%) percent of the amount of the supply item will become payable at the time of delivery of steel pipe pile to the site.

The remaining fifty (50%) percent of the payment will be made at the time of completion of installation works.

- (3) Measurement for payment for installation of steel pipe pile shall be the number of each length of steel pipe pile installed.
- (4) Payment for installation of steel pipe pile will be made under Pay Item 2202, Pay Item 2204 and Pay Item 2206 of the Bill of Quantities, and shall the storage, handling, installation of steel pipe pile, all kinds of treatment and arrangement including field painting, welding accessories, cutting of pile

if necessary, field testings including X-ray test and field water pressure test and any other works related.

Payment will be made at the time of completion of installation works.

- (5) Measurement for payment for supply and installation of reinforced concrete pile shall be the number of each length of reinforced concrete pile supplied and installed.

No measurement for payment shall be made for the pile which is damaged and/or not accepted for use, for any reasons, by the Engineer during manufacturing, storage and/or installation.

- (6) Payment for supply and installation of reinforced concrete pile will be made under Pay Item 2207 and Pay Item 2208 of the Bill of Quantities, and shall cover manufacturing, transportation, storing, handling, driving, treatment of pile top and any other works related. Payment will be made after completion of installation works of each pile.

- (7) Measurement for payment for concrete of the Intake Bridge including reinforced concrete of footings of the Bridge, reinforced concrete of retaining walls, reinforced concrete of anchor blocks, slab concrete of the Bridge and levelling concrete shall be the volume in cubic meters of concrete placed, and shall include the supply of all necessary materials including cement, aggregates and sand, and for all measures necessary for batching of materials, mixing, transporting, preparation prior to placing, compacting, protecting, curing, temperature control, supply and transport of test cylinders and any other works related.

- (8) Payment for concrete of footing of the Bridge, retaining wall and anchor blocks will be made under Pay Item 2209 of the Bill of Quantities. The expenses for joint filler between footing and retaining wall shall be included in the rate of this Pay Item.

- (9) Payment for levelling concrete will be made under Pay Item 2212 of the Bill of Quantities.

- (10) Payment for slab concrete including shear key concrete of the Bridge will be made under Pay Item 2219 of the Bill of Quantities.

- (11) Measurement for payment for formwork shall be the area shown in the Drawings, measured in square meters, of concrete surfaces formed, and shall include the supply of all materials and for all measures necessary for preparation, transportation, placing, supporting scaffolding, removing and any other works related.

No measurement for payment shall be made for formwork for levelling concrete.

- (12) Payment for formworks in this Section will be made under the following Items of the Bill of Quantities:
- Pay Item 2210 will cover formworks to concrete Pay Item 2209.
  - Pay Item 2220 will cover formworks to concrete Pay Item 2219.
- (13) Measurement for payment of reinforcing bar shall be the weight of reinforcing bars placed in the concrete in metric ton as computed from the approved detailed bar bending schedule, using theoretical unit weights, and shall include supply and placing of reinforcing bars, tie wire, metal and concrete supports spacers and other fixing devices, splice coupling or welding, and other works related.
- (14) Payment for reinforcing bars in this Section will be made under the following Items of the Bill of Quantities:
- Pay Item 2211 will cover reinforcing bars for footings of the Bridge, Retaining Walls and Anchor Blocks.
  - Pay Item 2221 will cover reinforcing bars for slab of the Bridge.
- (15) Measurement for payment for supply of prestressed concrete girder for the Intake Bridge shall be the number of each type of the bridge girder supplied.
- (16) Payment for supply of prestressed concrete girder for the Intake Bridge will be made under Pay Items 2213 and 2214 of the Bill of Quantities, and shall cover design, manufacturing, testing, transportation and any other works related.
- Fifty (50%) percent of the amount of the supply item will become payable at the time of delivery of prestressed concrete girder to the Site.
- The remaining fifty (50%) percent of the payment will be made at the time of completion of installation works.
- (17) Measurement for payment for installation of prestressed concrete girder for the Intake Bridge shall be the number of the bridge girder installed.
- (18) Payment for installation of prestressed concrete girder for the Intake Bridge will be made under Pay Item 2215 of the Bill of Quantities, and shall cover all kinds of necessary works to complete the installation works of the bridge girder, unless otherwise the works are separately itemized.
- (19) Measurement for payment for supply and installation of neoprene bearing pad with bearing anchors shall be the area, measured in square meters of the bearing pad supplied and installed.

(20) Payment for supply and installation of neoprene bearing pad with bearing anchors will be made under Pay Item 2216 of the Bill of Quantities, and shall cover the supply of the bearing pad, bearing anchor bars, material of non-shrinking mortar and any other materials related and also cover the installation works of the bearing pad and bearing anchors including drilling block-out for anchors and non-shrinking mortar grouting for fixing of the anchors and any other works related.

Payment will be made after completion of installation works of each bridge bearing.

(21) Measurement for payment for supply and installation of lateral tie bar shall be the number of place where each length of the tie bar is supplied and installed.

(22) Payment for supply and installation of lateral tie bar will be made under Pay Items 2217 and 2218 of the Bill of Quantities, and shall cover the supply of the bars, bearing plates, washers, locknuts and any other materials related, and also cover the installation of the tie bar with bearing plates, washers and locknuts and cement grouting works for the holes of the tie bar, and any other works related.

(23) Measurement for payment for supply and installation of expansion joint of the bridge shall be the number of the place where the expansion joint is supplied and installed.

(24) Payment for supply and installation of expansion joint of the bridge will be made under Pay Item 2222 of the Bill of Quantities, and shall cover the supply of joint seal material and any other materials required and also cover the installation works of joint seal material including cutting of concrete, tippings, mortar filling and any other works related.

(25) Measurement for payment for supply and installation of handrail for bridge shall be the weight in kilogram of handrail installed.

(26) Payment for handrail will be made under Pay Item 2223 of the Bill of Quantities.

(27) Measurement for payment for supply and installation of drainage installation shall be the number of drainage installation supplied and installed.

(28) Payment for supply and installation of drainage installation will be made under Pay Item 2224 of the Bill of Quantities.

- (29) Measurement for payment for supply of steel pipe, 1,350 mm in diameter and 11.9 mm in thickness of wall, shall be the length measured in meters of the steel pipe supplied as computed from the length of centerline of the alignment of pipeline including the lengths of straight pipes, deformed pipes, bend pipes, and joints, etc., but excluding the length of tee pipe for manhole.
- (30) Payment for supply of steel pipe, 1,350 mm in diameter and 11.9 mm in thickness of wall will be made under Pay Item 2225 of the Bill of Quantities, and shall cover the manufacturing of pipe, blasting and shop coatings, all kinds of required shop testings, transportation and any other works related.
- Fifty (50%) percent of the amount of the supply item will become payable at the time of delivery of steel pipe to the Site.
- The remaining fifty (50%) percent of the payment will be made at the time of completion of installation works.
- (31) Measurement for payment for supply of tee pipe with manhole shall be the number of tee pipe with manhole supplied.
- (32) Payment for supply of tee pipe with manhole will be made under Pay Items 2226 and 2227 of the Bill of Quantities, and shall cover the manufacturing, blasting and coating, testing transportation and any other works related.
- Fifty (50%) percent of the amount of the supply item will become payable at the time of delivery of tee pipe to the Site.
- The remaining fifty (50%) percent of the payment will be made at the time of completion of installation works.
- (33) Measurement for payment for installation of steel pipe, 1,350 mm in diameter and 11.9 mm in thickness of wall, shall be the length in meters of steel pipeline installed, as computed from the length of centerline of the alignment of pipeline including the lengths for straight pipes, deformed pipes, bend pipes and the tee pipes with manhole, joints, etc. No separate measurement for payment for installation of the steel pipe with manhole shall be made.
- (34) Payment for installation of steel pipe, 1,350 mm in diameter and 11.9 mm in thickness of wall, will be made under Pay Item 2228 of the Bill of Quantities, and shall cover the storage, handling, installation, field welding and coatings, and any other works related.
- (35) Measurement for payment for supply and installation of saddle support shall be the number of saddle support installed.

- (36) Payment for supply and installation of saddle support will be made under Pay Item 2229 of the Bill of Quantities. The payment shall cover the supply of steel made support, neoprene pad, movable bearing, bolts and nuts, non-shrinking mortar, and any other materials related, and also cover all kinds of installation works including the shop and field coatings.
- (37) Measurement for payment for supply and installation of ring support shall be the number of ring support installed.
- (38) Payment for supply and installation of ring support will be made under Pay Item 2230 of the Bill of Quantities. The payment shall cover the supply of steel-made support, fixed bearing, bolts and nuts, non-shrinking mortar and any other material related, and also cover all kinds of installation works including the shop and field coatings.
- (39) Measurement for payment for supply of high speed air valve  $\phi$  150 mm shall be the number of air valve supplied.
- (40) Payment for supply of high speed air valve  $\phi$ 150 mm will be made under Pay Item 2231 of the Bill of Quantities.
- Fifty (50%) percent of the amount of the supply item will become payable at the time of delivery of the air valve to the Site.
- The remaining fifty (50%) percent of the payment will be made at the time of completion of installation works.
- (41) Measurement for payment for installation of high speed air valve  $\phi$ 150 mm shall be the number of air valve installed.
- (42) Payment for installation of high speed air valve  $\phi$ 150 mm will be made under Pay Item 2232 of the Bill of Quantities.
- (43) Measurement for payment for supply of Dresser type coupling of steel pipe  $\phi$ 1,350 mm shall be the number of coupling supplied.
- (44) Payment for supply of Dresser type coupling of steel pipe  $\phi$ 1,350 mm will be made under Pay Item 2233 of the Bill of Quantities.
- Fifty (50%) percent of the amount of the supply item will become payable at the time of delivery of the coupling to the Site.
- The remaining fifty (50%) percent of the payment will be made at the time of completion of installation works.
- (45) Measurement for payment for installation of Dresser type coupling shall be the number of coupling installed.
- (46) Payment for installation of Dresser type coupling will be made under Pay Item 2234 of the Bill of Quantities.

- (47) Measurement for payment for supply and installation of the cable box shall be the weight in kilogram of metal of cable box installed, and shall include the provision of anchor bolts connectors and any other materials and measures necessary to complete the supply and installation of the cable box.
- (48) Payment for supply and installation of the cable box will be made under Pay Item 2235 of the Bill of Quantities.
- (49) Measurement for payment for supply and installation of lighting post shall be the number of lighting post supplied and installed.
- (50) Payment for supply and installation of lighting post will be made under Pay Item 2236 of the Bill of Quantities. The payment shall cover the supply of steel post, fixing anchors and metals, lamp, electric wires & pipe duct and any other materials related, and also cover fixing and installation of post, painting, wiring and any other kinds of installation works.



## SECTION 2300. INTAKE YARD

### 2301. EARTHWORKS

- (1) Excavation works of the Intake Yard shall be made in accordance with the Drawings and Division 2 of the General Specifications. The manner and method of the excavation works under water shall be subject to the approval of the Engineer.
- (2) Stripping works shall be executed for the area on which embankment and rip-rap mound works for the Intake Yard will be executed. The limitation of the area to be stripped under water level of the reservoir shall be instructed by the Engineer. All rubbish, vegetation together with its roots and soil with organic matters shall be thoroughly removed. Stripped material shall not be used for embankment, and shall not be spoiled into the reservoir. Soil area shall be proposed by the Contractor for the Engineer's approval.
- (3) Common excavation shall be executed at the foundation of pipeline and other places in accordance with the instruction of the Engineer. Backfill shall be made by selected ganular material which is subject to the Engineer's approval.
- (4) The Contractor will be allowed to carry out excavation works for foundation of the air chamber and/or pipe installations after completion of embankment of the Intake Yard. Such excavation as well as backfilling shall not be subject for the payment.
- (5) Earth material for embankment of the Intake Yard shall be the selected granular material free of organic matter. The Contractor shall propose the borrow area and borrow material to the Engineer for his approval.
- (6) Embankment works for the Intake Yard shall be mostly completed within nine (9) months after commencement of the Works.
- (7) Hand tamping compactions shall be required at foundation and surroundings of the anchor concrete of pipeline as well as the structures of air chamber and pipes. Each layer shall not exceed 200 mm in thickness for such hand tamping compaction.

### 2302. RIPRAP

The works of riprap mound and riprap revetment shall be made in accordance with Section 2200, especially (1), (3) & (4) of Clause 2202 of the General Specifications except for the thickness and configuration requirements, which are indicated on the Contract Drawing No. MD2301. The Contractor shall propose to the Engineer for approval the manner and method of riprap works in the reservoir as well as the quarry of the rocks.

2303. SODDING

Bermuda grass or approved equal shall be used for sodding. Watering to grass during two months after sodding shall be the obligation of the Contractor.

2304. BITUMEN SEAL COAT PAVEMENT

Section 2300 of the General Specifications shall apply to the works of bitumen seal coat pavement at the Intake Yard. 40cm of compacted subbase shall be prepared prior to prime coating. And the bitumen seal coating of the road shall be as follows:

Crushed rock sub-base	:	15 cm of crushed rock
Prime coating	:	1.5 liter/sq.m
First layer coating	:	0.5 liter/sq.m of coating with 20 kg/sq.m of crushed rock.
Second layer coating	:	0.5 liter/sq.m of coating with 10 kg/sq.m of crushed rock.
Wearing coating	:	0.5 liter/sq.m of coating with 5 kg/sq.m of coarse sand.

2305. GUARDRAIL

Guardrail to be installed at the Intake Yard shall comply with the standard of the Department of Highways, Thailand.

2306. REINFORCED CONCRETE PILE FOR AIR CHAMBER

- (1) Boring logs and geological profiles shown in Contract Drawings are only for reference.

The Contractor has no right to claim whatsoever for the differences between the geological profiles shown on the Drawings and the actual geological conditions at the site.

- (2) Specifications described in (3) of Clause 2201 of the Particular Specifications shall be applied for supply and installation of reinforced concrete pile for foundation of Air Chamber.
- (3) The Contractor shall submit to the Engineer for his approval the check calculations for the number, length and allocation of the piles or the Contractor's new proposal on these in accordance with the number, weight, and configuration of his proposed air chamber.

2307. CONCRETE WORKS FOR AIR CHAMBER

- (1) The Contractor shall submit to the Engineer for his approval the check calculations for size, thickness and amount of required reinforcing bars, etc. of reinforced concrete or the Contractor's new proposal on these including the Shop Drawings and calculations in accordance with the number, weight, and configuration of his proposed air chamber.
- (2) The concrete works including formworks and reinforcing bar arrangement for the Air Chamber shall comply with requirements of the Drawings and Division 3 of the General Specifications. The class of concrete shall be as follows:

Leveling Concrete	:	H-concrete
Reinforced Concrete	:	D-concrete
Base Concrete	:	D-concrete
Cinder Concrete	:	G-concrete

2308. HANDRAIL & MISCELLANEOUS METAL WORKS

- (1) Handrails and other miscellaneous metal works shall be executed in accordance with the Drawings and Division 6 of the General Specifications.
- (2) Metal works specified and related to the air chamber including cat-walks and drain pipes shall be the scope of supply and installation works of the air chambers.

2309. MEASUREMENT AND PAYMENT

- (1) Measurement for payment for stripping of the Intake Yard foundation shall be the area of material stripped, calculated in square meters. The area stripped shall be calculated by the projection of the boundaries of the stripped surfaces onto the plane parallel to the average slope of these surfaces.
- (2) Payment for stripping of the Intake Yard foundation will be made under Pay Item 2301 of the Bill of Quantities.
- (3) Measurement for payment for common excavation shall be made in the same manner as specified in (1) of Clause 2105 of the Particular Specifications.
- (4) Payment for common excavation shall be made under Pay Item 2302 of the Bill of Quantities, and shall cover excavation, disposal of excavated material, and any other works related.

- (5) Measurement for payment for fill and backfill shall be the volume of compacted fill and backfill placed and measured in cubic meters. Measurement shall be made between the original ground surface as determined by surveys in the field or in case of backfill in excavation the foundation lines upon completion of excavation and the lines upon completion of fill and backfill. Allowance for the volume arising from the stripping works shall not be considered nor included in the calculation of fill and backfill measurement. Volumes shall be computed by the average-end-area method with cross sections taken every 5 meters or at such intervals as directed by the Engineer.

No allowance shall be made in measurement for payment for fill and backfill for any settlement of the structure foundations, for internal settlement of the fill or backfill during the construction, or any fill and backfill which is eroded, removed or wasted during construction. All these losses shall be refilled at the Contractor's own expense and it shall not be measured for payment.

- (6) Payment for fill and backfill will be made under Pay Item 2303 of the Bill of Quantities.
- (7) Measurement for payment for embankment of the yard shall be the volume of compacted embankment placed and measured in cubic meters. Measurement shall be made between the original ground surface as determined by surveys in the field or in case of embankment in excavation the foundation lines upon completion of excavation and the lines upon completion of the embankment. Volumes shall be computed by the average-end-area method with cross-sections taken every 5 meters or at such intervals as directed by the Engineer.

No allowance shall be made in measurement for payment for embankment for any settlement of the structure foundations, for internal settlement of the embankment during the construction, or any embankment which is eroded, removed or wasted during construction. All these losses shall be refilled at the Contractor's own expense and it shall not be measured for payment.

- (8) Payment for embankment of the yard will be made under Pay Item 2304 of the Bill of Quantities, and shall cover all kinds of necessary expenses for development of borrow area including the compensation for land and crops, excavation of borrow material, hauling, transportation, spreading, compaction, watering, obtaining and transporting test samples, and any other works related.

- (9) Measurement for payment for riprap mound and riprap revetment shall be the volume of riprap placed, measured in cubic meters. Measurement shall be made between the lines upon completion of riprap and either the original ground surface as determined by surveys in the field or the foundation lines upon completion of excavation or stripping or embankment as the case may be. Volume shall be computed by the average-end-area method with cross-sections taken at every 10 meters or at such intervals as directed by the Engineer.

No allowance shall be made in measurement for payment for the subsided riprap into the ground or into the embankment due to settlement.

- (10) Payment for riprap mound will be made under Pay Item 2305 of the Bill of Quantities, and payment for riprap revetment will be made under Pay Item 2306 of the Bill of Quantities. Payment for riprap shall cover all kinds of necessary expenses for development of quarry, transportation, dumping, finishing, and any other works related.
- (11) Measurement for payment for sodding shall be the area, measured in square meters, of sodding placed.
- (12) Payment for sodding will be made under Pay Item 2307 of the Bill of Quantities.
- (13) Measurement for payment for bitumen seal coat pavement shall be the area in square meters of bitumen seal coat pavement placed, and compacted to the neat lines, and shall include excavation for sub-base foundation, if necessary, compacted sand or laterite filling for sub-base, crushed rock sub-base, layers of base course and bitumen seal coatings, wearing coatings and any other works related.
- (14) Payment for bitumen seal coat pavement will be made under Pay Item 2308 of the Bill of Quantities.
- (15) Measurement for payment for guardrail shall be the length of guardrail installed, measured in meters, and shall include supply and installation of guardrail and its accessories.
- (16) Payment for guardrail will be made under Pay Item 2309 of the Bill of Quantities.
- (17) Measurement for payment for supply and installation of reinforced concrete pile for air chamber foundation shall be made in the same manner as specified in (5) of Item 2213 of the Particular Specifications.

- (18) Payment for supply and installation of reinforced concrete pile for foundation of the air chamber will be made under Pay Item 2310 of the Bill of Quantities, and shall cover manufacturing, transportation, storing, handling, driving, treatment of pile top and any other works related.

Payment will be made after completion of installation works of each pile.

- (19) Specifications described in (7) of Clause 2213 of the Particular Specifications shall apply to the measurement for payment for concrete of the Intake Yard including reinforced concrete, base concrete, cinder concrete and levelling concrete for the air chamber.
- (20) Payment for levelling concrete of air chamber will be made under Pay Item 2311 of the Bill of Quantities.
- (21) Payment for reinforced concrete of air chamber will be made under Pay Item 2312 of the Bill of Quantities.
- (22) Payment for base concrete of air chamber will be made under Pay Item 2313 of the Bill of Quantities, and shall cover concrete works, formwork, reinforcing bar arrangement, embedded steel and any other works related.
- (23) Payment of cinder concrete of air chamber will be made under Pay Item 2314 of the Bill of Quantities.
- (24) Specifications described in (11) of Clause 2213 of the Particular Specifications shall apply to measurement for payment for formwork to concrete at the air chamber.
- (25) Payment for formwork to concrete at the air chamber will be made under Pay Item 2315 of the Bill of Quantities.
- (26) Specifications described in (13) of Clause 2213 of the Particular Specifications shall apply to measurement for payment for reinforcing bar at the air chamber.
- (27) Payment for reinforcing bar at the air chamber will be made under Pay Item 2316 of the Bill of Quantities.
- (28) Measurement for payment for handrail shall be the weight in kilograms of handrail installed.
- (29) Payment for supply and installation of handrail will be made under Pay Item 2317 of the Bill of Quantities.

- (30) Specifications described in (25) of Clause 2105 of the Particular Specifications shall apply to measurement for payment for miscellaneous metal works at the air chamber.

No measurement for payment shall be made either for any embedded metals which are required for installation of chambers and appurtenant facilities, nor for metal works being specified in the scope of supply and installation of the chambers.

- (31) Payment for miscellaneous metal at the air chamber will be made under Pay Item 2318 of the Bill of Quantities.

## SECTION 2400. PUMPING PLANTS

### 2401. SCOPE OF WORKS

- (1) The Contract includes the design, manufacture, supply, shop testing, packing and protection for shipment, insurance, delivery to Site, complete erection, Site testing, commissioning and putting into reliable and efficient commercial service, painting and finishing off in full working order of the plant described and defined herein.
- (2) The equipment involved in this Section shall comprise the following:
  - a. Main pump: 6 units including one unit of standby
  - b. Main motor: 6 units including one unit of standby
  - c. Butterfly valve: 12 units of manual operating and 6 units of electric motor operating
  - d. Check valve: 6 units of non-slam type swing check
  - e. Crane: 1 unit of overhead travelling type
  - f. Drainage pump: 2 units including one unit of standby
  - g. Air chamber facilities: 1 unit comprising 3 chambers and necessary accessories
  - h. Intake gate: 10 units of sluice steel gate with screen
  - i. Pipe: Suction and delivery pipes
  - j. Catwalk: For inspection passage

### 2402. GENERAL ARRANGEMENT

#### (i) General

The Contractor shall be responsible for the design of the complete electric motor driven pumping units, and shall guarantee the complete units to be free from harmful torsional or other vibration stresses throughout the entire operating range of speed and loads. The torsional mass elastic system of each complete pumping unit including the pump, the electric motor, all shafting and couplings, and appurtenances shall be analyzed by the Contractor to determine if blade frequency excited torsional resonances occur within the operating speed range, and that all shafting is free from critical



vibrations. A report covering the results of this analysis shall be submitted to and approved by the Engineer prior to manufacture of the unit.

(2) Nameplates

There shall be a metal nameplate on each pump with the serial number, size, type or model, design head, capacity and speed stamped into the plate. There shall also be an arrow indicating the direction of forward rotation.

(3) Shop Painting

The pumps, couplings and bed plates shall have a shop coat of primer in accordance with the General Specification titled "Painting" of Division 9.

(4) Anchor Bolts

The Contractor shall furnish all anchor bolts and other necessary bolts and nuts for the complete pump installation.

2403. MATERIALS AND WORKMANSHIP

(1) General

All materials shall be of the highest grade, free from defects and imperfections, of recent manufacture and unused, and of the classification and grades designated. Material not specifically described shall conform to the manufacturer's standard for the applicable part in the service intended. If the Contractor desires for any reason to deviate from the prescribed standards, the Contractor shall submit a statement of the exact nature of the deviation, and shall submit for the approval of the Engineer complete specifications for the materials which the Contractor proposes to use. All materials, supplies, and articles, not manufactured by the Contractor, shall be the products of recognized reputable manufacturers. The product of firms other than those specified herein will be accepted when it is proved to the satisfaction of the Engineer that they are equal in strength, durability, usefulness, and convenience for the purpose intended.

The Contractor shall furnish to the Engineer for his approval the names of the manufacturers of all machinery and other equipment which the Contractor contemplates incorporating in the work, together with performance capacities and other relevant information pertaining to the equipment. Samples of materials shall be submitted for approval when so directed. Equipment, materials, and articles installed or used without such approval shall be at the risk of subsequent rejection.

Workmanship shall be of the highest grade and in accordance with the best modern standard practice.

(2) Working Stresses

Liberal factors of safety shall be used throughout the design, and especially in the design of all parts subject to alternating stresses or shock. For pumps, the maximum unit stress due to maximum operating conditions shall not exceed the values given in the following table, with the exception of the pump shaft in which the combined torsional and axial stress shall not exceed seven (7) percent of the ultimate tensile strength of the material.

TABLE OF UNIT STRESSES

Maximum Units Stress in Kilograms per Square Centimeter

	<u>Stress in Tension</u>	<u>Stress in Compression</u>
Cast Iron .....	150	750
Plate Steel ....	900	900

(3) Tests of Materials

All materials, supplies, and parts and assemblies thereof entering into the works to be done under these Specifications shall be tested unless otherwise directed in conformity with the referenced Specifications and according to the best modern approved method for the particular type and class of work. In case the Contractor desires to use stock material not manufactured specially for the work covered by these Specifications, he shall submit evidence satisfactory to the Engineer that such material conforms to the requirements of these Specifications, in which case detailed tests on these materials may be waived.

Unless waived in writing by the Engineer, all tests or trials shall be made in the presence of a duly authorized representative of the Engineer. When the presence of such a representative is so waived, certified copies in triplicate of the tests made, and of the results thereof, shall be furnished to the Engineer by the Contractor as soon as possible after the tests are made. The results of these tests shall be in such form as to provide means of determining compliance with the applicable specifications for the material tested.

Test specimens and samples for analysis shall be plainly marked to indicate the materials they represent and, if required, they shall be properly boxed and prepared for shipment.

All costs of all tests and trials, except the pay and expense of the authorized representative, shall be borne by the Contractor

and shall be included in the Contract price.

For other materials used in the construction of the pump, the maximum stresses in tension or compression due to the most severe operating conditions shall not exceed one-third of the yield point or one-fifth of the ultimate strength of the material, whichever is lesser. The maximum unit working stresses in shear shall not exceed 150 kg per square centimeter in cast iron, nor more than 60 percent of the allowable stresses in tension for other materials.

(4) Iron Castings

Iron castings shall conform to the requirements of JIS G 5501 or ASTM A48. "Gray Iron Castings". Class shall be as specified under the paragraph applicable to the part. Where no class is specified the castings shall be not less than class FC 15 or 25A.

(5) Steel Forgings

Steel forgings shall have physical properties at least equal to those required by ASTM A668, "Steel Forgings, Carbon and Alloy, for General Industrial Use", Class E.

(6) Steel Plates and Bolts

Steel plates shall conform to ASTM A285 "Pressure Vessel Plates, Carbon Steel, Low and Intermediate Tensile Strength", Grade B, or ASTM A283 "Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes, and Bars", Grade B or C.

Steel bolts shall conform to ASTM A307 "Carbon Steel Externally and Internally Threaded Standard Fasteners".

(7) Bronze Bolts and Nuts

Bronze for bolts and nuts shall conform to the requirements of JIS H 3250 or ASTM B21 "Naval Brass Rod, Bar, and Shapes".

(8) Bolts, Nuts, Studs, and Fittings

The sizes and threads of all valves, pipe and fittings, conduit and fittings, and connecting equipment, shall be in accordance with Division 7, "Mechanical Work", and 8, "Electric Facilities" of the General Specifications. All bolt heads and all nuts shall be hexagonal.

#### 2404. SHOP TESTS

Prior to shipment all pumps shall be tested at the manufacturer's plant to demonstrate complete compliance with these Specifications. The tests shall be in full compliance with the applicable provisions of the JIS B 8301 and B 8302 and as herein noted.

All tests shall be conducted or witnessed by and the test results certified by an internationally accepted testing organization. The results so certified shall be submitted in triplicate to the Engineer for approval. No shipment shall be made until such approval has been obtained.

#### 2405. INSTALLATION

The Contractor shall install all equipment furnished under this Contract, including for the forming and placing of the concrete foundations. All handling and placing of the equipment including leveling and alignment shall be performed by the Contractor.

The Contractor shall provide the Shop Drawings for base concrete and its reinforcing bar details for the Engineer's approval. The anchor bolts in suitable pipe sleeves will be installed at the time the concrete bases are poured. The Contractor shall furnish drawings, instructions, rigid templates, and supervision for installing the anchor bolts and sleeves.

After the Contractor has properly leveled and aligned the equipment, the equipment shall be grouted. After the grout has adequately set, the shims shall be removed and the shim pockets will be grouted by the Contractor.

#### 2406. SITE TESTS

As soon as convenient after the equipment is installed, it shall be field tested to determine that the units have been properly installed, to verify shop tests (as mentioned in Clause 2404 above), and to demonstrate that the complete units will operate continuously without over-heating and that the drives are not overloaded. The flowmeter installed and calibrated will be used to measure the flow.

Readings of all essential data shall be taken and recorded at 15 minute intervals. All instruments required for the readings shall be furnished by the Contractor at no additional cost. Readings required include, but are not limited to, voltage, amperage, RPM, suction and discharge pressure, flow and vibration. Full details of tests will be determined by conditions existing in the field at time of test.

## 2407. DESIGN REQUIREMENT OF PUMPING

### (1) General and Hydraulic Conditions

- a. The pumping facilities to be installed in the intake tower shall be of six (6) units of vertical shaft double suction, centrifugal type pump and induction type, squirrel cage motor including one unit of standby.
- b. The Contractor shall design appropriate pumping facilities taking into consideration all water conveyance systems in this Contract, operation manner, hydraulic conditions, water demand, stability of the facilities and operation and maintenance.
- c. Hydraulic conditions of the system are summarized as follows:
  - i. Specified water level at suction pool of intake tower
    - High water level: MSL 54.100 m
    - Low water level: MSL 42.000 m
  - ii. Specified water level at head tank (delivery pool)
    - Control high water level: MSL 102.850 m
    - Control mean water level: MSL 101.200 m
    - Control low water level: MSL 99.550 m
  - iii. Maximum dynamic water head at the beginning point of aqueduct pipeline: MSL App. 116.900 m
  - iv. Design discharge at full development: 2.62 cu.m/sec
  - v. Coefficient of William-Hazen formula: 120 (c)
  - vi. Delivery steel pipeline from the beginning of aqueduct to head tank: Length of 7,450 m, diameter of 1,350 mm, thickness of 11.9 mm as shown on Drawing

### (2) Operation Manner and Design for Main Pump

- a. The operation manner and intensity of the pumps will be made based on water demand of respective consumer with ranging from one unit at initial stage to five units at full development year in 2000.

- b. The pumps shall be automatically operated in accordance with delivery water level set forth at the head tank in which setting water levels of ON and OFF for the pumps are MSL 100.300 m to MSL 99.550 m and MSL 102.850 m to MSL 102,100 m respectively, and shall be operated in order to meet water demand of consumer.
- c. Discharge control shall be made by varying number of pump units without valves and speed control system.
- d. The main pumps shall satisfy the following duty requirements:
  - Suction bore: Not less than 500 mm
  - Pump speed: 1,000 to 1,500 rpm. 50 Hz
  - Motor service factor: 10 percent at maximum pump power output
  - Duty point: Discharge: 31.5 cu.m/min.  
Total head: 79 m  
Min. efficiency at the point: 80%
  - Design point: Discharge: 40 cu.m/min.  
Total head: 70 m  
Min. efficiency at the point: 85%
  - Run-out point: Discharge: 54 cu.m/min.  
Total head: 48 m  
Min. efficiency at the point: 75%

In addition, pumps shall have a continuously rising head-capacity performance curve between run-out point and shut-off.

- e. The Contractor shall propose pumping facility's specifications, such as total lifting head, motor output, number of poles and so forth, in accordance with above mentioned conditions without any cavitations and overload for motor.
- f. The Contractor shall make detailed water hammer analysis and shall submit the results with flow chart of computation, output of computation case and necessary data, because the water pipeline (delivery pipe of the pumps) from Dok Krai Intake Tower to Head Tank (delivery pool) has about 7.5 km length with vertical fluctuation in its profiles.

- g. Special attention shall be paid to air chamber design as follows:
- The hydraulic gradient of down surge case on the water pipeline shall be kept higher than center line of the pipe at any point.
  - The Contractor shall consider the conditions of up and down surge pressure of the water pipeline for the air chamber designing.
  - Number of air chamber shall be 3 units with equal volume allocation based on the required capacity of air chamber.
  - Water to air chamber shall be inflowed through orifice plate.
  - Control method of water level in air chamber shall be made using air compressor system automatically.

#### 2408. MAIN PUMP

##### (1) General

- a. Six (6) units of main pumps and main motors shall be installed in the first floor and the fourth floor of the intake tower respectively. The pumps and motors shall be connected with intermediate shafts.
- b. Intermediate bearings shall be installed in the second and third floor.
- c. Normal operation shall be by five (5) pumps in paralleling. However, in the initial period after completion of works, one or two units of pumps shall be able to operate without cavitation.
- d. The type of main pump shall be of vertical shaft, double suction centrifugal pump.

##### (2) Structures

###### a. Casing

The pump casing shall be of highest quality spheroidal graphite cast iron with adequate strength, rigidity and thickness to meet all test requirements and operating conditions for the service life of the pumps.

The casing shall be vertically split on the centerline of the shaft with suction and discharge connections cast integrally in the side half to permit removal of the complete rotating element by removal of the side half casting, the bearing caps, and coupling bolts.

The faces shall be accurately machined and doweled for tight and accurate fit. The bearing brackets shall be cast separately and bolted to the side half of the casing. The suction and discharge flanges shall conform to Flange JIS B 2212. Bolt holes shall match the flanges specified under General Specifications.

Fitted bolts and parting screws with counter-board mating faces shall be provided at the joint in the casing and the cover half shall be provided with lifting lugs or eyebolts. A davit shall be provided to lift and swing the cover half out of the way so that the rotating element can be inspected or removed.

The water passages shall be designed to give the highest possible hydraulic efficiency.

The drain shall be fitted with a gate valve and the vent with a gate valve followed by a priming sight glass. Both the exterior and the interior surfaces shall be finished smooth. No plugging, welding, or on the repairs to casting will be permitted. The casings shall be of spheroidal graphite iron casting in accordance with JIS G 5502 FCD45 or equivalent.

b. Impeller

The impeller shall be of the enclosed double suction type, of one-piece construction, finished smooth. The impeller shall be tightly mounted on the pump shaft with a key so that it will not become loose due to rotation either in the forward or in the reverse direction. The key shall extend beyond both ends of the impeller to lock the shaft sleeves in place.

The pump impeller materials shall be of stainless steel castings conforming to JIS G 5121 or equivalent. The impeller shall be of enclosed type and statically and dynamically balanced prior to assembly.

c. Wearing Rings

Removable wearing rings shall be provided on both the pump casing and the impeller. All wearing rings shall be locked in place against rotation in either direction. Impeller wearing rings shall conform to stainless steel JIS G 4304, 4305, SUS304 or equivalent, casing wearing rings shall



conform to bronze casting JIS H 5111 BC 6 or equivalent.

d. Shaft and Sleeves

The pump shafts shall be of carbon steel JIS G 4051 S 35C or equivalent, ground and polished over the entire length. Shafts shall be of ample size and rigidity to insure low working stresses under all conditions of operation.

The shaft shall be protected from wear and corrosion by removable sleeves. The sleeves shall extend from the impeller to the outside of the stuffing boxes, shall be keyed to the shaft and held in place with external shaft nuts. Sleeves shall be of stainless steel JIS G 4304, 4305, SUS 304 or equivalent. Sleeves shall fit tight against the impeller hubs, or a positive means of preventing leakage between the sleeves and impeller shall be provided.

The complete rotating assembly of each pump shall be statically and dynamically balanced in the manufacturer's works and shall operate free from vibration after installation at site, under all operating conditions.

e. Bearings and Housings

The pump bearings shall be of heavy-duty ball or plane type.

Lubrication shall be by oil or grease and shall be manufactured withstanding thrust loads.

Temperature detectors shall be provided by the pump manufacturer. Bearing temperature detectors shall be provided on each bearing and designed for remote indication. Bearing detectors, type and resistance, shall be coordinated with the electrical Specifications hereof. The inboard and outboard bearings shall be preferably the same size and type. The radial bearing shall be free to move longitudinally. Removable bearing housings with suitable seals shall be bolted to the bearing brackets. Bearing housing and brackets shall have a tapped drain. Bearing shall have a "rating life" of at least 40,000 hours.

f. Intermediate shaft and coupling

The shaft connecting pump and motor shall be three pieces connected by universal joints and/or form flex coupling and supported by an intermediate bearing. The shaft material shall be of carbon steel.

g. Stuffing boxes

Stuffing boxes shall be large and deep and shall be provided with at least six rings of square packing and a lantern ring. Packing glands shall be bronze conforming to bronze casting JIS H 5111, BC 6 or equivalent, split vertically to provide for installing packing. Bolts shall be swing-type with brass nuts. Piping with globe valve shall be provided for sealing water to each stuffing box from a tapping on each side of the discharge volute casing through the strainer.

i. Bed plates

Bed plates shall be fabricated steel box type with web reinforcing so designed that the bed plates can be grouted after alignment and levelling. After final alignment and testing, pumps shall be dowelled to the bed plates with taper dowel pins with jack nuts.

j. Pressure Gauges and Connections

There shall be provided not less than 10 cm glycerin-filled gauges for both the suction and discharge side of each pump. The gauge ranges shall be selected such that they will be roughly double the maximum operating pressure.

The gauges shall have brass case and ring, finish black and phosphor bronze Bourdon tube. The ranges selected shall be submitted to the Engineer for approval.

The gauges shall have bottom connection with shut-off valves mounted on the front of the gauge panel.

(3) Accessories and spare parts

a. Accessories

The Contractor shall provide the following necessary accessories for each pump unit.

- Pump base plate: 1 set
- Motor base plate: 1 set
- Motor support bracket: 1 set
- Intermediate shaft: 3 sets
- Intermediate bearings and support bracket: 2 sets
- Universal joints and/or form flex coupling: 3 sets

- Pressure gauge: 1 set
- Bolts and nuts: 1 lot
- Other necessary appurtenances

b. Spare parts and tools

The Contractor shall provide the following necessary spare parts and tools for all pumps.

- Pump shaft: 1 set
- Shaft sleeve: 1 set
- Impeller: 1 set
- Liner ring: 1 set
- Pump bearing: 1 set
- Motor bearing: 1 set
- Shaft coupling: 1 set
- Gland packing: 3 sets
- Gland: 3 sets
- Intermediate bearing: 1 set
- Pressure gauge: 3 sets
- Universal joint and/or  
form flex coupling: 2 sets
- Necessary tools: 1 lot

2409. MAIN MOTOR

(4) Type and Starting

- a. The motors shall be of the induction type, with squirrel-cage motors.
- b. The motors shall be designed for reduced voltage starting with starting reactor.

(2) Structure and Enclosure

The motor shall be of open type, dripproof protected and screen-protected at the openings of air inlet and outlet for cooling. the motors shall be vertical shaft type.

(3) Stator Windings

Vacuum-pressure impregnation system shall be used for insulating of stator windings. Insulation class shall be of class F with tropical protection.

(4) Noise Level

The sound pressure levels on no-load and rated voltage and frequency shall not exceed 88 dB (A) at one meter from the surface of the machines. Method of measurement shall conform to JIS Z 8731.

(5) Efficiency and Power Factor

The motor efficiency on full-load shall be not less than 93%. The power factor shall be not less than 90% with power factor correcting capacitors to be installed in the motor starter panel.

(6) Motor Space Heater

All motors shall be equipped with anti-condensation heaters. The heaters shall be sized to warm the air inside of the motors a few degrees above the ambient air.

(7) Accessories and Spare Parts

- Dial thermometer with alarm contact stator winding 1 set
- One set of motor bearing

2410. BUTTERFLY VALVE

(1) Manual Operating Butterfly Valves

a. General requirements of the valves shall be as follows:

- Type of valve: Horizontal shaft manual operating
- Size of valve bore: 500 mm
- Application flange: JIS B2212, 10 kg/sq.cm
- Max. service pressure: 10 kg/sq.cm
- Application liquid: Raw water

b. Structures and material of the valve shall be conformed and manufactured in accordance with "7008 Butterfly Valves for Water" in Division 7 of the General Specifications.

c. Accessories

As necessary accessories of the valves shall be provided one unit of operating hand wheel, foundation bolts and nuts, packing and other necessary parts for each valve set.

(2) Motor Operating Butterfly Valves

a. General requirements of the valves shall be as follows:

- Type of valve: Horizontal shaft motor operating
- Size of valve bore: 500 mm
- Application flange: JIS B2212, 10 kg/sq.cm
- Max. Service pressure: 10 kg/sq.cm
- Application liquid: Raw water
- Motor output: App. 0.75 KW/380 V

b. Structures and materials of the valve shall be conformed and manufactured in accordance with 7008 "Butterfly Valves for Water" in Division 7 of the General Specifications.

c. Special requirements of the valves shall be specified as follows:

- The valve operation shall be made at fourth floor on the control house
- The floor stand shall be equipped with worm gear, bearing, motorised driving unit
- The floor stand and valve shaft shall be connected with stems and intermediate bearings shall be installed in the second and third floor
- Opening and closing time of the valve shall be approximately 120 seconds and shall be selected as the nearest as possible and practicable in accordance with manufacturer's standards

d. Necessary accessories for each unit shall be provided as follows:

- Limit switch: 1 set
- Torque switch: 1 set
- Manual operating hand wheel: 1 set
- Manual and auto-changeover handle: 1 set
- Opening indicator: 1 set
- Floor stand: 1 set
- Intermediate bearings: 1 set
- Foundation bolts and nuts: 1 lot
- Gland packing: 1 set
- Other necessary parts

2411. CHECK VALVE

a. General requirements of the valves shall be as follows:

- Type of valve: Horizontal non-slam type swing check
- Size of valve: 500 mm
- Application flange: JIS B2212, 10 kg/sq.cm
- Max. service pressure: 10 kg/sq.cm
- Application liquid: Raw water

b. Structure and materials of the valve shall be conformed and manufactured in accordance with 7005 "Swing Check Valves 75 mm to 900 mm" in Division 7 of the General Specifications.

c. Accessories

As necessary accessories of the valves shall be provided one unit of supporting legs, foundation bolts and nuts and other necessary parts for each unit.

#### 2412. CRANE

- a. The crane shall be installed for carrying equipment and materials in the intake tower. The crane shall be manufactured to fulfil the safety regulations and construction standard specifications set forth in JIS B 8801 Electric Overhead Travelling Cranes or approved equal.
- b. General requirements of the crane shall be as follows:
  - Type of crane: Electrically operated overhead travelling crane
  - Capacity: 5,000 kg
  - Crane span: Approx. 15.4 m
  - Height from the first floor to top of girder: Approx. 23 m
  - Length of track: App. 16 m
  - Travelling speed and motor output: 20 m/min. 2.5 KW
  - Hoisting speed and motor output: 3.2 m/min. 6.3 KW
  - Traversing speed and motor output: 10 m/min. 0.75 KW
  - Power receiving system: Current collector trolley system
  - Operation system: Push-button switch suspended from crane
- c. As necessary accessories of the system shall be provided one unit of crane girder with stoppers, current collector trolley with duct and wiring and other necessary appurtenances.

#### 2413. DRAINAGE PUMP

- a. The pumps shall be manufactured conforming to the construction standard specifications set forth in JIS B 8325 Submersible Motor Pump for Sump or approval equal.
- b. General requirements of the system shall be as follows:
  - Type of system: Submersible motor pump
  - Number of system: 2 units including one unit of standby
  - Capacity: 100 liters per min.

- Total head: Approx. 20 m
- Pump speed: 1500 to 3000 rpm, 50 Hz
- Motor: The motor shall be capable of continuous operation under the water and shall be rated at 3 phase, 50 Hz, 380 V.

- c. As necessary accessories of the system shall be provided one unit of cable with length of about 10 m, liquid level sensor, gate valve, check valve, delivery pipe up to specified on the drawing, and other necessary appurtenances.

#### 2414. AIR CHAMBER FACILITIES

##### (1) General

- a. The air chamber facilities shall be provided with appropriate capacity of pressure tank and accessories based on the water hammer computations. The conditions are described in the relevant clauses of the pumping facilities and delivery water pipeline up to the head tank.
- b. The Contractor shall propose suitable capacity of air chamber system taking into consideration technical stability and regulations JIS B 8243 "Construction of Pressure Vessels".
- c. The systems shall basically comprise air chamber, air compressor unit, valves, gauge, pipe, control panel, and other necessary instruments.
- d. All civil works of the air chamber system including foundation treatments will be specified in another items of these Specifications.

##### (2) Air Chamber

- a. General requirements of the air chamber shall be as follows:
  - Type: Cylindrical shell fabricated from mild steel plate with head convex outwards.
  - Number of units: 3 units
  - Capacity: Recommendable volume by the Contractor, based on the water hammer computations and approved by the Engineer.



- Application flange: JIS B2212, 10 kg/sq.cm
  - Max. service pressure: 10 kg/sq.cm
  - Hydrostatic test pressure: 15 kg/sq.cm
- b. The three (3) air chambers shall be connected directly to the discharge pipe of the pumps. Each tank shall be connected independently, through a pipe provided with a guard valve, normally open, so that it can discharge and receive water freely.

The air for pressurizing the tanks shall be produced by two (2) compressors which shall be alternated in service, so that there is always a stand-by compressor. Starting and stopping the compressors shall be controlled by a control panel.

- c. After manufacture, each chamber shall be subject to radiographic examination by X-ray of longitudinal and circumferential seam welds, junction of welds, and repair welds. This shall be followed by stress relieving by heat treatment and testing by hydraulic pressure.
- d. As necessary accessories of the air chamber for respective unit shall be provided one unit of supporting-leg, manhole, level gauge, level switch, pressure gauge with cock and pipe, flanged ends solenoid valves, flanged ends pressure relief valves, junction box and other necessary appurtenances.

### (3) Air Compressor System

- a. The air compressor system shall be provided to keep specified water level in the air chamber. General requirements of the system shall be as follows:
- Type: Oil free compressor
  - Number of unit: 2 units including one standby
  - Capacity: Recommendable volume
  - Max. service pressure: 10 kg/sq.cm
- b. As necessary accessories of the system for respective unit shall be provided one unit of air tank, pressure switch with cock and pipe, drain separator, compressor protection cover, pipes and valves, and other necessary appurtenances.

(4) Control Panel

- a. The control panel for operation of compressor and solenoid operated valves shall be installed in the compressor room. The compressor and valve operation shall be made both manually and automatically at the site.
- b. General requirements and components of the control panel shall be the followings:
  - Type of panel: Self standing and indoor use type
  - Number of unit: One unit
  - 3 pole molded case circuit breaker: 1 set
  - 3 pole molded magnet switch with thermal relays: 1 set
  - Control circuit, control relays and auxiliary relays: 1 set
  - Control switch: 1 set
  - Push-button switch: 1 set
  - Indicator and alarming lamp: 1 set
  - Voltmeter and ammeter: 1 lot
  - Changeover switch: 1 set
  - Other necessary articles: 1 lot
  - All necessary wiring shall be made from the panel to compressors and air chamber facilities

(5) Pipings and Valves

All pipes and piping of the air chamber facilities which will be branched out from the main water pipeline shall be included together with appropriate valves in the scope of this Clause.

2415. INTAKE GATES WITH SCREEN

(1) General Requirement

The general requirements of the gates which shall be installed on the intake tower as shown on the Drawings shall be as follows:

- Type of gate: Manual operating sluice gate
- Number of unit: 10 units
- Stem length: Schedule No.1. Approx. 5.5 m, 2 units  
                   Schedule No.2. Approx. 8.0 m, 2 units  
                   Schedule No.3. Approx.10.5 m, 2 units  
                   Schedule No.4. Approx.13.0 m, 2 units  
                   Schedule No.5. Approx.15.5 m, 2 units
- Size of gate: Width of 1.30 m, height of 1.30 m
- Max. service pressure: 1.5 kg/sq.cm

(2) Structure and Materials

- a. Sluice gates shall be supplied complete with frames, guides, wedges, operating stems, stems guides, anchor bolts and other necessary appurtenances and fasteners.
- b. Gates and floorstands shall be provided with protective coating in accordance with manufacturer's standards.
- c. Stem length shall be considered as the distance between the center of the gate opening and the surface of concrete slab on which operating floorstand is to be installed.
- d. The materials to be used in the construction of gates and appurtenances shall conform to the following standards.
  - Disc, frames, guides and wedges: Gray Iron Castings
  - Stem: Stainless Steel Bars
  - Other materials shall be in accordance with manufacturer's standards
- e. The manual lift mechanism shall be of the bevel gear type.
- f. Each floorstand shall be provided with a position indicator to show the position of the gate.
- g. The screen shall be equipped with carbon steel screen guide, guide bracket and screen rack.

- (3) As necessary accessories of the gates for respective unit shall be provided one set of foundation bolts and nuts, wheel handle and other necessary appurtenances.

#### 2416. PIPE WORKS

- (1) Supply and installation of suction and delivery pipes at the intake tower shall be within the scope of works in this Section. The scope of works shall cover all kinds of piping works at the intake tower including suction pipes, delivery pipes, reducer pipes, drainage pipe from the drainage pump to delivery points, and other auxiliary pipes in the intake tower facilities.
- (2) The Contractor shall submit the Shop Drawings on these piping works with a design report containing the statistical and hydraulic analysis and computations, for the Engineer's approval.
- (3) The specifications to be applied for the steel pipe works in this Clause shall be in general the same as the Specifications described in Clause 2206 of the Particular Specifications.

#### 2417. CATWALK

- (1) The catwalk for inspection passages shall be manufactured and installed in the first floor of the intake tower as shown on the Drawings.
- (2) The catwalk dimension shall be 1.0 m in width and 1.5 m in height from floor. The Contractor shall propose appropriate structure of the catwalk facilities taking into consideration the installation works of pipes and valves as well as operation and maintenance of the facilities, for the Engineer's approval.
- (3) The catwalk shall include handrails, stairs and supports, and shall be fabricated of structural steels, steel pipe, checker plates, etc.

#### 2418. MEASUREMENT AND PAYMENT

- (1) Measurement for payment for supply of main pumps, main motors, manual operating butterfly valves, motor operating butterfly valves, check valves, drainage pumps with motor in the pump room, overhead travelling crane, intake gates with screen shall be the number of each unit for respective equipment supplied. Necessary instruments and accessories for the above mentioned equipments shall be included into respective items of the equipments except the items mentioned below in (3), (5), (7) and (9) of this Clause.

- (2) Payment for supply of the pumping plants will be made under Pay Items 2401 to 2407 and Pay Item 2409 of the Bill of Quantities, and shall cover the supply of respective equipment with shop painting and necessary accessories specified in Clauses 2408 to 2413 and Clause 2415 of the Particular Specifications, and shall include the cost of the preparation of Shop Drawing with detailed design, manufacturing, shop tests, and any other works related.
- (3) Measurement for payment for supply of suction and delivery pipes shall be on the lump-sum basis.
- (4) Payment for supply of the suction and delivery pipes will be made under Pay Item 2408 of the Bill of Quantities, and shall cover the supply of the pipes with shop painting and coating and necessary accessories.
- (5) Measurement for payment for supply of catwalk in the pump room shall be on the lump-sum basis.
- (6) Payment for supply of the catwalk will be made under Pay Item 2410 of the Bill of Quantities, and shall cover the supply of cat-walk facilities with shop painting and necessary accessories including preparation of Shop Drawings.
- (7) Measurement for payment for supply of air chamber facilities, which consists of three (3) units of air chamber, two (2) units of air compressor systems, one unit of local control panel with cabling and wiring required, pipes and valves, and necessary accessories shall be on the lump-sum basis.
- (8) Payment for supply of the air chamber facilities will be made under Pay Item 2411 of the Bill of Quantities, and shall cover the supply of air chamber facilities with shop painting and necessary accessories specified Clause 2414 of the Particular Specifications, and shall include the costs of the preparation of Shop Drawing with detailed design, manufacturing, shop tests and any other works related.
- (9) Measurement for payment for supply of spare parts and tools described in the Clauses 2408 and 2409 of the Particular Specifications shall be on the lump-sum basis.
- (10) Payment for supply of the spare parts and tools will be made under Pay Item 2412 of the Bill of Quantities, and shall cover the supply of the spare parts with shop painting and coating, shop test and preparation of detailed designs.
- (11) Measurement for payment for transportation of all pumping plants and equipment, which are covered in Section 2400 "Pumping Plants" of the Particular Specifications, shall be on the lump-sum basis.

- (12) Payment for transportation of all pumping plants and equipment will be made under the Pay Item 2413 of the Bill of Quantities, and shall cover all costs, charges and expenses associated with the transportation of all pumping plants and equipment to the Site listed under Bill of Quantities No. 2400 which include but are not limited to ocean-freight charge, insurances, port charges, customs, taxes, demurrage, inland transportation and packing charges.
- (13) Measurement for payment for installation of all pumping plants and equipment, which are covered in Section 2400 "Pumping Plants" of the Particular Specifications, shall be on the lump-sum basis.
- (14) Payment for installation of pumping plants and equipment will be made under the Pay Item 2414 of the Bill of Quantities, and shall cover all kinds of necessary works to complete the installation works of the pumping plants and equipment and conducting the site tests.

Payment will be made when the relevant test results of all the pumping plants and equipment have shown complete compliance with the requirements of the Specifications.

- (15) The down payment of the supply items including Pay Items 2401 to 2412 inclusive of the Bill of Quantities will be, as a rule, made as follows:

Fifty (50%) percent of the amount of the supply items will become payable at the time of delivery of the supply materials to the Site.

The remaining fifty (50%) percent of the payment will be made at the time of completion of installation works and the relevant site tests have shown complete compliance with the requirements of the Specifications.

## SECTION 2500. ELECTRIC FACILITIES

### 2501. SCOPE OF WORKS

The scope of works of electric facilities in the section shall consist of the followings.

- (1) Substation equipments, necessary accessories.
- (2) All control center equipment of main pumping plants and necessary accessories.
- (3) All wire, cable and duct works of the above mentioned equipments.
- (4) Installation of three single core cables from 22 KV power line to 22 KV receiving cubicle shall be out of the Contract.
- (5) Wire and cable works for the lighting of the control house shall not be included in this section.

### 2502. OPERATION AND CONTROL SYSTEM OF THE ELECTRIC FACILITIES

#### (1) 22 KV substation

- a. All the circuit breaker for 22 KV and 3 KV lines shall be operated on the both respective switchgear in the substation and the central supervising control panel in the intake tower. The remote-local change-over switch shall be provided on each switchgear in the substation.
- b. Voltage and ampere of both 22 KV and 3.3 KV line shall be supervised on the central supervising control panel and also audible and visible fault alarm shall be provided on the both central supervising control panel and substation switchgear.
- c. Two main transformers shall be installed to supply 3 KV power in parallel operation for full five pumps on duty and associated auxiliary equipment operation.
- d. Each main transformer shall have enough capacity for three (3) pumps operation and associated auxiliary equipment operation.

#### (2) Main Pumping Station (Intake Tower)

- a. Main pumps and their associated discharge valves shall be controlled by the pin-board sequencer installed in the

remove supervising control panel.

- b. The purpose of the pin-board sequencer is to judge how many numbers of main pumps should be on duty depending upon the head tank water level and to control each starter unit of main pump.
- c. Each main pump starter panel shall have two numbers of control switches of REMOTE-STARTER selection and SYNCHRO-INDIVIDUAL selection. Furthermore, the remote supervising control panel shall have two numbers of control switches of SYNCHRO-AUTO selection and ON-OFF selection for each main pump.
- d. The said switches shall have following functions respectively.

STARTER means that pumps and discharge valves are not controlled by the pin-board sequencer but can be operated by each starter panel.

REMOTE means that pumps and discharge valves shall be controlled by the remote supervising control panel.

SYNCHRO means the pumps and associated discharge valves shall be operated under the same functions and/or interlockings.

INDIVIDUAL means that all the interlock signals are released and the pumps and discharge valves can be operated separately.

AUTO means that pumps and discharge valves shall be controlled by the pin-board sequencer.

ON means that pumps and discharge valves are controlled under AUTO.

OFF means that pumps and discharge valves are off-duty.

- e. After establishing the emergency power, all the discharge valves shall be automatically turned to full close position. The main pumps shall be automatically restarted after full recovery of public power supply and release from all the shut-down troubles.

### (3) Drainage Pump Operation

- a. Drainage pump shall be controlled by the associated float type level switch or the electrode type level switch.



- b. One pump shall be always on duty and another shall be on standby. In case the pump on duty becomes out of order, the standby pump shall be automatically switched on.
- c. The local control panel shall be installed close to these drainage pumps. Each pump can be operated by the said panel and also can be operated by the motor control center in the Intake Tower.

(4) Station Service Power Supply System

- a. The 3-phase 380/220 V power will be supplied from the station service transformer and/or from the standby diesel engine driven generator which shall be automatically started at power failure.
- b. The Generator control panel shall have mode selection switch (LOCAL-REMOTE) and bus transfer control switch (MAIN-GENERATOR).
- c. The remote supervising control panel shall have mode selection switch (MANU-AUTO) and bus transfer control switch (MAIN-GENERATOR).
- d. Change-back operation to the station service transformer line shall be done by cascade operation of the mode selection switch "MANU" and the line selection switch "MAIN" on the remote supervising control panel after recovering public power supply.

(5) Emergency Diesel Generator Operation

The diesel engine driven generator shall be automatically started immediately after failure of public power supply. After recovering the public power supply, the generator will be stopped by the executive manual switch. The diesel generator can be operated from both generation control panel and remote supervising control panel.

(6) Fuel Oil Transfer Pump Operation

The fuel oil transfer pump shall be controlled by the level of fuel oil at service tank and/or by the control switch on the generator control panel.

### 2503. EQUIPMENT OF SUBSTATION

Equipment of substation facilities and respective major components of the equipment shall conform to the following specifications.

- |   |        |
|---|--------|
| (1) 22 KV receiving cubicle (E-1)   | 1 unit |
| - High voltage pilot indicator:   | 1 set  |
| - Potential transformer with primary fuse, single phase, dry or oil immersed type:            | 2 sets |
| - 24 KV surge arrester:   | 1 set  |
| - Voltmeter and change-over switch:   | 1 set  |
| - Other necessary articles:   | 1 lot  |
| (2) 22 KV incoming circuit breaker cubicle (E-2)  | 1 unit |
| - Circuit breaker three pole, single throw drawout vacuum type (24 KV, 600 A, RC. 25 KV RMS): | 1 set  |
| - Current transformer, molded bushing type:   | 3 sets |
| - Status and fault indicator:   | 1 lot  |
| - Change-over switch and control switch:  | 1 lot  |
| - 22 KV main bus compartment to connect the 22 KV circuit breaker cubicles each other         | 1 lot  |
| - Ammeter and ammeter switch:   | 1 set  |
| - Over-current protection relay:  | 3 lot  |
| - Three phase watt and watthour meter:  | 1 lot  |
| - Three phase power factor meter:   | 1 lot  |
| - Over current grand relay:   | 1 set  |
| - Single phase protection relay:  | 1 set  |
| - Other necessary articles:   | 1 lot  |

- (3) 22 KV Circuit Breaker Cubicle (E-3) 2 units
- Circuit breaker, three pole, single throw drawout vacuum type (24 KV, 600 A, RC. 25 KA. RMS): 1 set
  - Current transformer, molded bus hinge type: 3 sets
  - Status and fault indicator: 1 set
  - Change-over switch and control switch: 1 set
  - 22 KV main bus compartment to connect the 22 KV circuit breaker cubicles: 1 lot
  - Ammeter and ammeter switch: 1 set
  - Overcurrent protection relay: 3 sets
  - Other necessary articles: 1 lot
- (4) 22 KV Bus Duct (E-4)
- Bus duct shall be outdoor, metal-enclosed type with supporting materials and shall be rated for 22 KV, three phase, three wire
  - Conductor shall be of copper
  - Bus duct shall withstand the prospective short circuit current of the main transformer primary circuit
- (5) Main Transformer (E-5) 2 units
- The type of the transformer shall be of three phase, oil immersed, self cooling type
  - Output shall be greater than the maximum demand of the plant (3000 KVA or more). The Contractor shall submit his calculation on the output of transformer based on the demand capacity of the plants for the Engineer's approval.
  - Primary and secondary voltage shall be designed as 22 KV and 3.15 KV respectively
  - No-voltage taps shall be provided on the primary winding to effect voltage variation of  $\pm 2.5\%$ ,  $\pm 5\%$  of normal voltage
  - Bushing type shall be solid bushing
  - Impedance shall be 5%

- Oil preservation system of the transformer shall be nitrogen gas sealed type or diaphragm seal type
  - Insulation oil shall be non-sludging and medium viscosity, characteristics of which shall be proposed by the Contractor for the Engineer's approval.
  - Necessary accessories shall be of name plate showing maker's name, serial number, year of manufacture, type, capacity and other main characteristics, and no-voltage tap changer, pressure relief vent, dial type thermometer with alarm contacts, oil drain valve, oil gauge, grounding terminal, hand hole, hanger ear, radiator, skid base, and other necessary articles.
- (6) Transformer Secondary Cubicle (E - 6) 2 units
- Two single phase potential transformer with fuse, drawout type: 1 set
  - Current transformers, molded type: 3 sets
  - Vacuum circuit breaker, three pole, single throw, drawout type, 3.6 KV 600A RC 12.5 KA 1 set
  - Ammeter and ammeter switch: 1 set
  - Voltmeter and voltmeter switch: 1 set
  - Power factor meter: 1 set
  - Three phase watthour meter: 1 set
  - Three phase watt meter: 1 set
  - Low voltage protection relay: 1 set
  - Change-over switch: 1 set
  - Control switch: 1 set
  - Status and fault indicator: 1 set
  - Overcurrent relay: 3 sets
  - Overcurrent ground relay: 1 set
  - Other necessary articles: 1 set
- (7) 3 KV Bus Connecting Cubicle (E-7)
- Vacuum circuit breaker, three pole single throw, drawout type, 3.6KV 600A RC 12.5KA 1 set
  - Status indicator: 1 set

- Change-over switch: 1 set
  - Control switch: 1 set
  - Other necessary articles: 1 lot
- (8) Feeder Cubicle (A) for pump driven service and spare (E-8) 2 units
- Vacuum circuit breaker, three pole, single throw, drawout type, 3.6KV RC 12.5 KA 2 sets
  - Current transformers, molded type: 6 sets
  - Ammeter and ammeter switch: 2 sets
  - Three phase watt hour meter: 2 sets
  - Status and fault indicator: 2 sets
  - Change-over switch: 2 sets
  - Control switch: 2 sets
  - Overcurrent relays 6 lots
  - Directional ground relay 2 lots
  - Other necessary articles 1 set
- (9) Feeder Cubicle (B) for auxiliary service and pump driven service (E-9)

Equipment to be mounted shall be completely the same as above E - 8 Feeder Cubicle (A)".

2504. EQUIPMENT OF CONTROL HOUSE IN THE INTAKE TOWER

Equipment of the control house and respective major components of the equipment shall conform to the following specifications.

- (1) Cable connection materials and cable laying facilities in and from the Substation. (E-10)
- a. All power wiring, all on rolling wiring and interconnecting wiring for substation equipment shall be furnished and installed completely from the substation to the following cubicles.
- High tension feeder cubicle in the control house
  - DC cubicle in the control house
  - Central supervising control cubicles in the control house

- Other necessary cubicles
- b. All necessary grounding works shall be included
- (2) 3.15 KV Receiving Cubicle (E-11) 2 units
- Disconnecting switch, three pole, single throw, manual operation 1 set
  - Potential transformer, single phase, molded, drawout type, with primary fuse 1 set
  - Voltmeter and voltmeter switch 1 set
  - Status indicator 1 set
  - Other necessary articles 1 set
- (3) 3.3 KV Bus Connecting Cubicle (E-12)
- Disconnecting switch, three pole, single throw, manual operation 1 set
  - Status indicator 1 set
  - Other necessary articles 1 lot
- (4) Feeder Cubicle for Pumping Station Supply Transformer (E-13) 1 unit
- Disconnecting switch, three pole, single throw, manual operation 1 set
  - Combined power fuses and vacuum contactor, three pole, single throw, drawout type 3.3 KV 200A 1 set
  - Current transformers, molded type 2 sets
  - Two single phase potential transformer, molded, drawout type 1 set
  - Ammeter and ammeter switch 1 set
  - Voltmeter and voltmeter switch 1 set
  - Three phase watthour meter 1 set
  - Status and fault indicator 1 set
  - Change-over switch 1 set

- Control switch	1 set
- Two elements relay (overcurrent and phase fault)	2 sets
- Low voltage relay	1 set
- Other necessary articles	1 lot
(5) Main Pump Motor Starter Cubicle (E-14)	6 units
- Vacuum type combination starter with power fuse drawout type 3.3KV 200A	2 sets
- Vacuum type contactor, drawout type 3.3KV 200A	1 set
- Starting reactor, three phase, dry type	1 set
- Static capacitor with discharge coil	1 set
- Surge absorber (if necessary)	1 set
- Current transformers, molded type	3 sets
- Running hour counter	1 set
- Three phase watthour meter	1 set
- Three phase watt meter	1 set
- Ammeter and ammeter switch	1 set
- Change-over switches	2 sets
- Control switches	2 sets
- Status and fault indicator	1 set
- Directional ground relay	1 set
- Two element relay	1 set
- Other necessary articles	1 set
(6) Station Supply Change-over Cubicle (E-15)	1 unit
- 3 phase, dry type, H class insulated station supply transformer, 200 KVA 3150/380-220V, 50Hz	1 set
- Molded potential transformer with protection fuse	2 sets

- 3 pole mold-case circuit breaker  
AC 600 V, 400 AF, 20 KA. RMS 1 set
  - Molded current transformer 2 sets
  - 3-pole change-over contactor 1 set
  - Ammeter and ammeter switch 1 set
  - Other necessary articles 1 lot
- (7) Motor Control Center and Sequence Relay  
Cubicle (E-16) 1 unit
- Bus connection unit 1 lot
  - Non-reversing motor control unit 6 sets
  - Reversing motor control unit 3 sets
  - Power distribution unit for crane,  
compressors, ventilation fan, 380/220 V  
feeders and UPS system 10 sets
  - Auxiliary sequence control relay 1 lot
  - Other necessary articles 1 lot
- (8) DC/AC Uninterruptable Power Source  
Cubicle (E-17) 1 unit

The uninterruptable power source systems shall be installed to back up the power source for instruments, alarming and indicating circuit, each switch board, control power source and emergency lamps, so as to avoid suspension of supervising functions. Time ratings are about 30 minutes. Type of the systems shall be indoor use self-standing, metal enclosed type and shall be dead front cubicle type with completely verminproof.

- 3 phase, 380 V power incoming unit,  
molded case circuit breaker, matching  
transformer, pilot lamp 1 set
- By-pass, single phase, 220 V power income  
unit 1 set
- 110 - 150 V DC floating thyristor charger  
unit 1 set
- 110 V DC, nickel cadmium alkaline  
battery with rack 1 set



- 110 V DC distribution feeder molded circuit breaker 1 lot
  - Silicon dropper and by-pass contactor 1 set
  - DC/AC inverter 1 set
  - AC uninterruptable power supply circuit unit, dry-type transformer, change-over contactor, five distribution molded circuit breakers 1 set
  - Protection relay, over and under voltage earth fault 1 set
  - Control and indication instrument 1 set
  - Metering instrument, DC/AC voltmeter and switch, DC/AC ammeter and switch, AC frequency meter 1 lot
  - Current transformer 1 set
  - Other necessary articles 1 lot
- (9) Central Supervising and Control Panel (E-18) 1 package
- a. Electricity supply unit (For 22 KV, 3.3 KV and 380 V generator) 1 unit
    - Electricity line, mimic diagram, acryl resin materials lusterless finished and status indicators 1 set
    - Grouped fault indicators 1 set
    - Annunciator relay, audible, and visible indicators 1 set
    - Status indicator of selection 1 set
    - Main metering instrument of 22 KV line, with voltmeter, ammeter, change-over switches and frequency meter 1 set
    - Main metering instrument of 3.15 KV line with voltmeter, ammeter & change-over switch 1 set
    - Main metering instrument of 380 V service line for both commercial & generator with voltmeter for commercial, voltmeter, wattmeter, frequency and power factor meter for generator 2 sets

- Selector switch, control switch	1 lot
- Other necessary article	1 lot
b. Pump Control Unit	1 unit
- Water flow line mimic diagram	1 set
- Grouped fault indicators	6 sets
- Annunciator relay and audible indication	1 lot
- Pin-board type, 6-pumps ON/OFF sequence controller	1 set
- Selection and control switch	6 sets
- Motor ammeter and run-hour counter	6 sets
- Auxiliary control relay	1 lot
- Selector and control switch for drainage pumps and compressor	4 sets
- Other necessary articles	1 lot
c. Metering	1 unit
- Suction water level indicator of main pump with alarm contact	2 sets
- Delivery water flow indicator of main pump including recorder and integrator	1 set
- Pressure and level alarm indicator of air chamber	1 lot
- Head tank water level indicator with alarm indicator	1 set
- Metering source unit, distribution, necessary signal amplifiers and signal fault detector system	1 lot
- Control source (110 V DC, 220 V DC) distribution switch and fuses	1 lot
- Internal lighting, terminal boards and complete wirings	1 lot

- |      |  |        |
|------|--|--------|
| (10) | Local Control Panel of Drainage Pump in Pump House (E-18A) | 1 unit |
|      | - Pump operation selector switch                           | 2 sets |
|      | - Pump ON/OFF control switch                               | 2 sets |
|      | - Status and fault indicator                               | 1 lot  |
|      | - Other necessary articles                                 | 1 lot  |
| (11) | Diesel Engine Generator for Station Power Supply (E-19)    | 1 unit |

This generator system will be used for lighting, ventilation, instruments, communication and drainage pump operation in the control house as for minimum power supply. The generator shall be automatically started immediately after failure of public power supply and shall be able to be stopped manually.

a. Diesel engine

- Type: 4 cycle vertical water cooling with direct injection
- Rating: 173 PS, not more than 1,800 rpm
- Time rating: Not less than 48 hours continuously
- Engine starter: DC motor driving
- Cooling: Radiator
- Fuel: Diesel gas oil
- No. of cylinder: 2 or more
- DC battery and necessary equipment

b. Generator

- Type: Self ventilated open drip-proof guarded type
- Rating: 3 phase 4 wire, 380/220 V, 50 Hz, 125 KVA
- Power factor: 80% lagging
- No. of pole: 4 or more
- Speed: 1,800 rpm or less
- Insulation rating class: F or E
- Generator control: Brushless type

- c. Fuel oil service tank and accessories
  - Fuel oil services tank capacity: 480 liters with oil transferring and pipes 1 set
  - Air inlet, outlet duct and necessary accessories 1 set
- d. Generator control cubicle 1 set
  - Static exciter and AVR controls 1 set
  - Mold case circuit breaker 1 set
  - Metering instruments, with voltmeter, ammeter, wattmeter and frequency meter 1 lot
  - Overcurrent relay 2 sets
  - Under voltage relay 1 set
  - Over voltage relay 1 set
  - Voltage relay 1 set
  - Other necessary articles 1 lot

(12) Cable Connection and Installation (E-20)

- a. All wiring, such as power, control and interconnecting, for Intake Facilities shall be furnished and installed completely through the cable pit and trench. Major cable routes are as follows:
  - Main pump motor starter panel to each main motor
  - 380 V motor control center to auxiliary facilities
  - 380 V generator to motor control panel through generator control panel
  - Motor control center to DC source panel
  - Supervising control panel to power controls and control source panels
  - Other necessary interconnecting cable
- b. All Necessary Grounding Works in this Category

**2505. SPARE PARTS AND SPECIAL TOOLS FOR MAINTENANCE**

The Contractor shall provide the following necessary spare parts, tools and recommendable spare parts by the Contractor for all electric facilities.

**(1) Substation**

	<u>Quantity</u>	<u>Unit</u>
<b>1.1. For 22 KV Switchgear</b>		
a. Signal lamp bulb	200	%
b. Signal lamp globe	30	%
c. Complete signal lamp	10	%
d. LT fuse element	100	%
e. Power fuse element for P.T.	2	No.
f. Vacuum tube assembly	3	No.
g. Primary contact finger assembly	3	No.
h. Secondary disconnect assembly	3	No.
i. Closing solenoid	1	No.
j. Trip solenoid	1	No.
k. Auxiliary switch assembly	1	No.
l. Auxiliary relay	10	%
m. Timer	10	%
n. Control switch	1	No.
o. Change-over switch	1	No.
p. Voltmeter switch	1	No.
q. Ammeter switch	1	No.
<b>1.2. For Main Transformer</b>		
a. N <sub>2</sub> Gas Vessel 6000 liter / 1 ATM	1	No.
b. Pressure reduced valve	1	No.

**(2) Control house**

<b>2.1. For 3 KV Switchgear</b>		
a. Signal lamp bulb	200	%
b. Signal lamp globe	30	%
c. Complete signal lamp	10	%
d. LT fuse element	100	%
e. Power fuse element for P.T.	4	No.
f. Vacuum tube assembly	3	No.
g. Primary contact finger assembly	3	No.
h. Secondary disconnect assembly	3	No.
i. Closing solenoid	1	No.
j. Trip solenoid	1	No.

	<u>Quantity</u>	<u>Unit</u>
k. Auxiliary relay	10	%
l. Control switch	1	No.
m. Change-over switch	1	No.
n. Voltmeter switch	1	No.
o. Ammeter switch	1	No.
<b>2.2. For 3 KV Combinations starter</b>		
a. Signal lamp bulb	200	%
b. Signal lamp globe	30	%
c. Complete signal lamp	10	%
d. LT fuse element	100	%
e. Power fuse element for P.T.	6	No.
f. Power fuse element for combination unit	6	No.
g. Combination starter unit	1	unit
h. Contactor unit	1	unit
i. Auxiliary relay	10	%
j. Timer	10	%
k. Change-over switch	2	No.
l. Control switch	1	No.
m. Voltmeter switch	1	No.
n. Ammeter switch	1	No.
<b>2.3. For Station Supply Transformer Cubicle</b>		
a. LT fuse element for P.T.	100	%
b. Change-over contactor	1	No.
<b>2.4. For Motor Control Center</b>		
a. Fuse element	100	%
b. Signal lamp bulb	200	%
c. Signal lamp globe	30	%
d. Complete signal lamp	10	%
e. Magnetic contactor (non reverse type)	1	No.
f. Magnetic contactor (reverse type)	1	No.
g. Thermal relay	4	No.
<b>2.5. For DC/AC Uninterruptable Power Source</b>		
a. Control card	1	No.
b. Signal lamp bulb	200	%
c. Fuse element	100	%

	<u>Quantity</u>	<u>Unit</u>
<b>2.6. For Remote Supervising and Control Panel</b>		
a. Signal lamp bulb	200	%
b. Annunciator relay	10	%
c. Change-over switch	3	No.
d. Control switch	3	No.
e. Auxiliary relay	10	%
<b>2.7. For Sump Pump Local Control Panel</b>		
a. Signal lamp bulb	200	%
b. Signal lamp globe	30	%
c. Complete signal lamp	10	%
<b>2.8. For Station Supply Engine Driven Generator Set</b>		
<b>Engine:</b>		
a. Piston ring	1	set
b. Oil ring	1	set
c. Nozzle tip	1	set
d. Fuel injection pipe	1	set
e. Intake valve	1	set
f. Exhaust valve	1	set
g. Fuel oil filter element	1	pcs.
h. Lubricating oil filter element (System oil)	1	pcs.
i. Lubricating oil filter element (Rocker arm)	1	pcs.
j. Various packing	1	set
k. Various spring	1	set
<b>Control:</b>		
a. Signal lamp bulb	200	%
b. Signal lamp globe	30	%
c. Complete signal lamp	10	%
d. Change-over switch	1	No.
e. Control switch	1	No.
f. Fuse element	100	%
g. Fuse element for thyristor	100	%
h. AVR unit	1	unit
i. Aux. relay	10	%