No.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NATIONAL WATER SUPPLY AND DRAINAGE BOARD
MINISTRY OF HOUSING AND PLANTATION INFRASTRUCTURE
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

THE DETAILED DESIGN STUDY ON GREATER KANDY WATER SUPPLY AUGMENTATION PROJECT IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

FINAL REPORT

(DRAFT) TENDER DOCUMENTS

VOLUME 2A
(PARTICULAR SPECIFICATIONS)

MAY 2002

NJS CONSULTANTS CO., LTD.
NIHON SUIDO CONSULTANTS CO., LTD.

S S S
CR (4)
02 - 93

Contract GK/JBIC/04
Tender Documents

The Tender Documents comprise the following volumes:

Volume 1

- Invitation to Tender
- Check List of Submissions
- Instructions to Tenderers
  - Annex ITT 1- Outline of the Project
  - Annex ITT 2- Form of Tender Guarantee
  - Annex ITT 3- Form of Line of Credit Guarantee
- Form of Tender
  - Appendix to Tender
- Form of Agreement
- Conditions of Contract
  - Part 1 (as published by FIDIC 4th Edition)
  - Part 2 Conditions of Particular Application
    - Annex 1 – Form of Performance Guarantee
    - Annex 2 – Form of Advance Repayment Guarantee
    - Annex 3 – Form of Retention Guarantee
    - Annex 4 – Beneficiary Statement
    - Annex 5 – Commitment Procedure

Volume 2A

- Particular Specifications
- Technical Schedules
- Functional Design Specification

Volume 2B

- Standard Specifications
  - Division 1 - General Requirements
  - Division 2 - Site Work
  - Division 3 - Concrete
  - Division 4 - Masonry
  - Division 5 - Metals
  - Division 6 - Wood and Plastic
  - Division 7 - Thermal and Moisture Protection
  - Division 8 - Doors and Windows
  - Division 9 - Finishes
  - Division 10 - Specialities

Volume 2C

- Division 11 - Equipment
- Division 12 - Furnishings
- Division 13 - Special Construction
- Division 14 - Conveying Systems
- Division 15 - Mechanical
- Division 16 - Electrical

Volume 3

- Preamble to Bills of Quantities
- Bills of Quantities
- Summary of Bills of Quantities
- Day work Schedules

Volume 4A

- Drawings for Intake and Water Treatment Plant

Volume 4B

- Drawings for Mechanical and Electrical Facility

Volume 4C

- Drawings for Transmission and Distribution

Volume 4D

- Service Reservoirs

Contract GK/JBIC/04

Tender Documents
Particular Specifications, Technical Schedules and Functional Design Specification

Table of Contents

Particular Specifications

Particular Specifications (Addition)

Technical Schedules

Functional Design Specification

End of Table of Contents

Contract GK/JBIC/04

Particular Specifications

Section 01010

PS 1.01 Description of the Works

A The Government of Sri Lanka has appointed the National Water Supply and Drainage Board as the Implementing Agency for the Greater Kandy Water Supply Augmentation Project. The Project is funded by the Japan Bank for International Development. The work comprises a water intake on the Mahaweli Ganga, a water treatment plant at Katugastota, transmission mains, service reservoirs, water towers, pumping stations and distribution pipelines.

B This contract, Contract GK/JBIC/04, includes the construction of the raw water intake at the Mahaweli Ganga, the raw water pipeline to the treatment plant, the water treatment plant, the DI transmission mains, service reservoirs and distribution systems. The work includes the furnishing of all labour, materials, plant and equipment necessary and as shown and specified comprising:

- intake pump station structure, screens, pumps, inlet gates, piping, cranes, electrical equipment and instrumentation;
- Katugastota water treatment plant including:
  - distribution chamber
  - flocculation and sedimentation basins
  - filtration units
  - clear water reservoir
  - clear water pump station
  - sludge lagoons
  - chemical building
  - electrical substation and generator building
  - miscellaneous structures
  - pipework
  - access road and on-site roads
  - ancillary facilities
- service reservoirs, water towers and pump stations;
- treated water transmission main including Mahaweli Ganga crossing;
- distribution systems;
- all ancillary facilities.

C The contract also includes:

- testing and commissioning of the works;
- training of NWSDB personnel in the operation and maintenance of the works.

PS 1.02 Contractor's Use of Site

A All construction operations and facilities on the treatment plant site shall be confined to within the property boundary unless otherwise approved by the Engineer and the relevant authorities.

B All construction operations and facilities over the entire lengths of the contract shall be confined to within the highway or road rights-of-way boundaries and facility sites unless otherwise approved by the Engineer and the relevant authorities.

C All such areas shall also be designated and treated as included within the definition of the word "Site". Unless identified in the Contract as to be demolished, the Contractor shall be responsible for safeguarding all utilities and structures (including but not limited to drainage dikes, head walls, culverts, bridges, abutments, distance marker posts, signs and fences) and the like in the vicinity of the Site and shall ascertain from the private and public utility authorities positions of all existing underground services and shall maintain and protect or divert them as required. At least one lane of traffic shall be maintained over the entire length of the road.

PS 1.03 Drawings

A The Drawings forming a part of the Contract Documents are listed in Volume 4

B. Compliance with Drawings
1. All work, during its progress and upon completion shall conform to the lines, elevations and grades as shown on the Drawings.
2. Contractor shall complete the proposed work in every detail as shown or specified.
3. Should any detail or details be omitted from the Drawings and Specifications which are essential to its intended completeness, then it shall be the responsibility of the Contractor to design such detail and then furnish and install Works so that upon completion, the Work will be acceptable, operational and ready for use.

C Further drawings may be issued to the Contractor by the Engineer as work progresses.

D Interpretive Drawings
1 Any additional drawings which the Contractor requires to interpret the drawings for the use of his employees shall be prepared by the Contractor.
2 Four copies of each shall be supplied to the Engineer, if required by him.

E The Employer accepts no responsibility for any omissions or the correctness of the representation of existing features on the Drawings.

PS 1.04 Local Conditions

A These data are provided as an indication of the type of conditions in which the Contractor's plant will have to operate and particular attention should be paid to concrete curing and corrosion conditions. In the event of the Tender being awarded to the Contractor, he shall satisfy himself as to the accuracy of the information provided.

B The site conditions shall be taken as follows:

Max Monthly Average Temperature	26.5 ^{0}C
Min. Monthly Average Temperature	23.6 ^{0}C
Ambient Humidity Range	70 - 85 %
Design Wind Velocity	33.5 m/s
Yearly Rainfall	1,500 to 2,200 mm
Altitude Range (above M.S.L.)	440 to 720 m
Traffic Loading	HA

C Sri Lanka is an island in the Indian Ocean having an area of 65,610 square kilometres with a central mountain region rising to some 2,100 metres surrounded by coastal plains on all sides. It is located 880 km north of the equator, off the southern tip of India. The latest population (based on 1994 census excluding Northern and Eastern Provinces) is estimated at 15.02 million with 80 percent in rural areas and 20 percent urban inhabitants. Population growth is estimated around 1.8 percent with a total 2000 figure around 16.7

million. These totals are projected to reach about 20.0 million by 2010 with some 16.0 million in rural areas.

Languages:	Sinhala, Tamil and English English is widely spoken throughout Sri Lanka, except in remote villages.	
Ethnic Groups:	Sinhalese	75%
	Tamil	18%
	Muslims	6%
	Burghers and Others	1%
Religion:	Buddhism	69%
	Hinduism	15%
	Christianity	7%
	Islam	7%

Section 01041

PS 1.05 Project Co-ordination

The Contractor shall co-operate with the NWSDB, other contractors, private and public utility organizations and with the RDA with regard to the execution of work, connections to the work, delivery of materials and co-ordinate with them subject to approval of the Engineer.

PS 1.06 Notification to Residents, Business and Public

The Contractor shall hand deliver to each residence and business in close proximity to the site, a written notice three days in advance of commencing any construction work, including delivery of pipe, which will involve temporary inaccessibility or water shutdown to their properties. Said notice shall state when operations will start and approximately when they will end. The notices shall be printed on A4 paper with wording similar to that shown as follows in Sinhalese, Tamil and English. In addition, the Contractor shall post, no further than 1 kilometre apart along the pipeline route, signs on posts placed (a minimum of 600 mm below ground and surrounded with 150 mm of concrete) 1.4 m above ground with the same wording in all three languages as directed by the Engineer. The notice shall be laminated to protect it from rain, securely fastened to a signboard and securely fastened to the post.

NOTICE

To The People along This Road

Within the next few days, work will be started on the installation of a water transmission main in this road as part of the Greater Kandy Water Supply Augmentation Project. We should complete the work by ……..
This work may cause some inconvenience but will be of permanent benefit.
We will appreciate your co-operation in the following:

- *please be alert when driving or walking in the construction area;*
- *tools, materials, pipe and equipment are attractive to children. For their safety, please keep them away from the construction site;*
- *please report all inconvenience to the job superintendent or call the office at the number given below.*

This work is being performed for the National Water Supply and Drainage Board on behalf of the Government of Sri Lanka, by:

(Insert name, address and telephone number of the Contractor in this space)

We will endeavor to complete this work as rapidly as possible and with a minimum of inconvenience to you .

Signed :

Title :

Section 01043

PS 1.07 Details of Contractor's Supervisory Staff and Subcontractors

The Contractor shall provide within 14 days of the Letter of Acceptance of the Works, the name, age, nationality, working language and degree of proficiency, official position in the firm and title, duration of assignment in Sri Lanka; qualifications, memberships in technical organizations; and professional experience for each employment held including employer; name and description of work, projects and location; and position held in the project for all key staff as follows. These shall include the Project Manager and Deputy, Site and Project Engineers, Land and Quantity Surveyors, Construction and Equipment Superintendents, Safety Officer, Quality Control Manager, Administrative Manager and Foremen/ Supervisors. The names shall be the same names submitted for key personnel at the site for each position with the pre-qualification documents and with the Tender. No substitution of key personnel shall be permitted except in exceptional circumstances, and only with the permission of the Engineer.

PS 1.08 Plant Record

The Contractor shall provide the plant proposed in the pre-qualification document. If the plant to be supplied is different than that proposed, he shall obtain approval of the Engineer prior to shipment to Sri Lanka and provide the reasons for the substitution and details of ownership or lease. A detailed comparison shall be made by the Contractor between the original and substitute plant and equipment. The substitute shall be equal or better than that originally proposed. If the Contractor ships his equipment without approval, he may be required to remove it from the country, at his own expense, and provide the equipment originally proposed or an approved substitute, again at his own expense, to the site.

PS 1.09 Overtime Working

A Whenever working outside the normal hours is proposed, the Contractor shall request approval from the Engineer giving not less than two working days notice.

B The Engineer's inspection staff are to be compensated for the additional time at a negotiated rate, mutually agreed, for the overtime work which will be deducted from the next or following payment due the Contractor.

PS 1.10 Daily Programme

A The Contractor shall furnish a daily programme for the following working day before the close of each site where the Contractor is working on each working day. The programme shall include the following:

1 work to be executed during normal working hours only;
2 location of the area of the site where work will be carried out;
3 proposed labour and Contractor's equipment and supervision to be provided.

B The Contractor shall be responsible for safety on site and shall take all necessary precautions for the safety of workers, visitors and the public alike. He shall provide for all costs and charges incurred by complying with all safety, health and welfare regulations pertaining to all employees, visitors and the general public including those employed by, or on the site at the request of, sub-contractors. The Contractor shall attend to the protection and temporary covering and/or barricading of open excavations, trenches, pits and other hazards to safety.

C The Contractor shall file with the Engineer, the names, addresses, and contact numbers of representatives who can be contacted at any time in case of emergency. The representatives shall be fully authorized and equipped to correct unsafe or excessively inconvenient conditions at short notice.

D The Contractor shall programme and execute the works in such a manner to maintain access to existing residences and businesses at all times as far as is practicably possible.

Section 01050

PS 1.11 Field Datum

The following data have been used to produce the information shown on the Drawings from the Survey Department national datum based on the national grid values:

-	AA10-Kandy District Survey Office	Elevation 534.16 m	N232111.1220-E185699.0332
-	A138-Digana	Elevation 518.41 m	N230566.9784-E105077.2258
-	A143-Gannoruwa	Elevation 475.02 m	N230109.1279-E180921.0739

Section 01090

PS 1.12 Abbreviations

CEB	Ceylon Electricity Board
NWSDB	National Water Supply and Drainage Board
RDA	Road Development Authority
SLS	Sri Lanka Standard

Section 01200

PS 1.13 Pre-Construction Conference

The pre-construction conference shall be held at the office of the NWSDB.

Section 01300

PS 1.14 List of Submittals

The Contractor shall submit a list of all submittals showing the forecast date for submission of each item at the commencement of the Contract. Extension of time will not be granted because of the Contractor's failure to make timely and correctly prepared and presented submittals with allowance for checking and review periods as specified in Section 01300. Unless otherwise specified, initial submittals shall be made within 56 days from the Latter of Acceptance of the Works.

PS 1.15 Foundation Drawings

The Contractor shall, within the times named in the Specifications or in accordance with the programme, provide Drawings showing the manner in which the equipment is to be fixed together with all information relating to the works, required for:

1 Preparing suitable foundations and anchoring facilities;
2 Providing suitable access for the equipment to the point on site where the equipment is to be erected;
3 Making all necessary connections to the equipment (whether such connections are to be made by the Contractor under the Contract or not).

PS 1.16 Record Documents

A The Contractor shall maintain one record copy of all Drawings, Specifications, Addenda, Variations, Approved Submittals, Correspondence and Transmittals at the Site in good order and readily available to the Employer the Engineer and the Engineer's representative.

B In addition to the requirements of the Technical Specifications, Record Documents shall be clearly and correctly marked and the Record Specifications annotated by the Contractor to show all changes made during the construction process at the time the changed Work is installed and the Works as executed complete with:

1 existing & finished levels
2 National Grid coordinates;
3 profiles of all pipelines larger than 100 mm diameter;
4 dimensions;
5 reinforcing steel details;
6 details of supports left in place;
7 locations of all services and underground utilities encountered;
8 locations of all structures including reservoirs, tanks, buildings, chambers & appurtenances including those existing features not to be demolished;
9 invert and cover levels of all chambers;
10 connection details and locations;
11 details of pipe materials and bedding;
12 sizes and types of manhole and access covers
13 any other information requested by the Engineer.

C For Mechanical & Electrical equipment the details shall include the whole plant as erected and described in the Specification. Drawings shall be supplemented as necessary by schedules and data sheets. O and M manuals shall be as described in Section 01730.

D Draft Record Documents shall be submitted to the Engineer for his approval, and then finalized in accordance with any amendments required by him. Record Document submission shall be as specified in the Specifications and shall include:

1 five bound sets of "As-Built " Record Drawings on paper to A1 size;
2 five bound sets of "As-Built " Record Drawings on paper to A3 size;
3 one set of first copy mylars (negatives) to A1 size;
4 two sets of compact disks containing the record drawings and all operation and maintenance manuals in MS Word and Autocad, or other approved format. The Engineer will make available to the Contractor an electronic copy of the tender drawings and specification;
5 two legal copies of the all the software used on the compact disks, registered in the name of NWSDB.

E Each drawing shall have the Contract Number & Drawing Number detailed to the approval of the Engineer. Computer files containing Auto CAD Drawings shall be maintained as seamless Drawings.

F No final payment shall be made except for work that has been completed in accordance with

the Specification and has been duly presented on the "As-Built" Record Documentation. The Contractor shall not be entitled to any extra payment or extension of time for the preparation or changes thereto of the As-Built Record Documentation.

Section 01310

PS 1.17 Progress Schedules

To enable the Engineer to interface with the scheduling system, the Contractor shall provide to the Engineer an original, licenced copy of the software used by the Contractor for scheduling purposes registered in the name of NWSDB. This software shall be handed over to NWSDB at the end of the project and will become the property of NWSDB thereafter.

Section 01380

PS 1.18 Photography Requirements

A Prior to beginning of construction, initial photographs shall be taken at every bend, junction, culvert, bridge and every building adjacent to the site and at no more than 0.5 km apart along road and pipeline routes. Sufficient numbers of photographs shall be taken of the treatment plant, service reservoir, water tower and pump station sites to record the existing conditions prior to construction.

B For the monthly progress photographs the Contractor shall furnish four colour presentation prints (200 x 250 mm) of each of the maximum of ten of the negatives selected by the Engineer.

Section 01400

PS 1.19 Quality Control

The measuring and test equipment provided by the Contractor shall be available for the use of the Engineer as required. The Contractor shall provide all necessary assistance and attendance to the Engineer for this use.

Section 01450

PS 1.20 Health and Safety

A The Contractor shall be responsible for the implementation of all safety related site procedures. These shall include working within, or about, cofferdams within rivers or other areas subject to flooding, including, but not limited to life saving buoys, life jackets, warning signs, barriers, diving apparatus and rescue craft.

B The Contractor shall erect the safety sign board adjacent to the main site office and also at the service reservoir, water tower and pumping station sites.

C The use of the words 'sewers' and/or 'sanitary structures' shall mean the same as 'enclosed spaces' and/or 'non-ventilated enclosures'.

D 'Workforce' shall mean in this case, only those personnel working within enclosed spaces or non-ventilated enclosures.

E The Contractor need not test for radio-activity.

F The Contractor need not provide a mobile mess room for each working area, but shall provide the emergency equipment nearby each working area.

Section 01500

PS 1.21 Site Offices

A The Contractor shall provide temporary site offices for his own requirements and for the Engineer as specified hereafter. The Engineer's offices shall be located near the site of the work and shall be located in an area acceptable to the Engineer and in proximately to those of the Contractor. The Contractor or his authorized representative shall be present in the office at all times while the work is in progress.

B Prior to providing workshop or dwellings near the job site, permission shall be obtained from the Engineer. Workshops shall not be an obstacle to the movements of the general public, shall not cause noise pollution and shall be aesthetically acceptable. The area shall be kept clean at all times. If the Contractor provides living accommodation for those employed by him, the dwellings shall be maintained in a clean and sanitary condition. Each dwelling unit shall be provided with lights, water supply and sanitary facilities and properly furnished.

C The Contractor shall provide for the use of the Engineer, one main site office at Katugastota Treatment plant, and three field offices comprising one at the Gohagoda intake and two others for north and south pipeline areas.

D Within thirty calendar days after signing of the contract agreement, the Contractor shall have completed the installation and furnishing of the Engineer's main site office, which may be a rented building, provided it conforms to the requirements specified.

E All office equipment and furnishings shall be for the exclusive use of the Engineer. At completion, the equipment and furnishings of the main site office shall be handed over to NWSDB and will become the property of NWSDB thereafter. Immediately prior to handing over to NWSDB all defects in equipment and furnishings shall be made good and shall be in a serviceable condition to the satisfaction of the Engineer. The Contractor shall provide all required toner cartridges and consumables for the equipment provided.

F The Contractor shall provide the Engineer with field offices for the intake and inspection of the pipeline construction work, not later than the commencement of the work at each specific area. The offices shall be maintained by the Contractor until the completion of the specific area work. The offices, equipment and furnishings shall become the property of the Contractor thereafter.

G The main site office and field offices shall be insulated, and painted internally and externally. Floor to ceiling height in the main site office shall be at least 2.7 m. Each external wall of each room shall have at least one screened window. All windows shall have blinds. The office shall have at least two external lockable doors with screened storm doors.

H The Contractor shall provide janitorial services to maintain a good working environment and security service at each office. Water and electricity supply including receptacles on all walls shall be provided. The offices, including the field offices, shall be well lighted, equipped with ceiling fans and air-conditioners with temperature control capable of maintaining a constant temperature of about 23 to 25 ^{0}C. The Contractor shall provide all

wiring, receptacles and fixtures in accordance with relevant codes and regulations and shall provide sufficient electrical sockets for the all the equipment provided. Offices, in general, shall comply with local building ordinances and be provided with all necessary fire extinguishers and approved first-aid kits.

I The Engineer's Main Site Office shall be made up as follows:

Room	Approximate Area (m^2)
Chief Resident Engineer's Room	25
Resident Engineer's Rooms	4 rooms each 15
Reception area	15
Other Staff Rooms	4 rooms each 15
Conference Room	40
Minor Staff Room	25
Storage Room	15
Equipment Room (Photo Copy Machine etc.)	25
Kitchen	10
Wash Room	10
Toilet (Water Closet)	2 toilets each 5

J The kitchen shall contain a sink, 0.7 m^3 refrigerator, one burner gas cooker with 12 kg gas cylinder, lockable cupboard (approx. 1.9 x 0.7 x 0.9 m high) with Formica top. The washroom shall contain low level suite complete with fittings, 550 x 375 mm washbasin, 500 x 400 mm mirror, a shower, towel racks, soap holder etc. All plumbing fittings shall be porcelain and all plumbing including pipes shall comply with local laws and regulations.

K A covered parking area shall be constructed and maintained for at least six motor vehicles for the Engineer's use.

L At the Main Site Office, new furniture and equipment as shown below shall be provided to meet the approval of the Engineer.

Item	Quantity
Steel desk 1.6 m x 0.9 m with six lockable drawers	2
Steel desk 1.5 m x 0.75 m with six lockable drawers	15
Table 1.5 m x 0.75 m	6
Conference table 1.8 m x 3.6 m with 10 chairs	1
Swivel medium back executive chair	16
Arm chairs	30
Steel Cupboard 1.8 m 0.9 m x 0.45 m	4
4-drawer steel filing cabinet	12
Steel book shelf 1.8 m x 1.2 m	8
Magnetic white board 1.0 m x 1.5 m	2
3 telephone lines (with 6 extensions)	1 set
Computer/Monitor/Mouse/Printer/UPS	6 sets
Software (Windows 98, MS office 2000)	6 sets
Scientific calculators (12 digit display)	16
Heavy duty photocopy machine A3 size with 10 bin sorter	1
Dry-type photocopy machine, A1 size	1
Scanner IBM compatible A4 size high resolution colour	1
High quality digital camera	1
Plain paper fax machine	1
Steel cash box	1
Binding machine A4 size	1
File trays	20
Waste paper baskets	20
Water filter	2

M The Contractor shall provide, three field offices for the Engineer. Each of the field offices shall have a space of 15 m^2. Adequate ventilation and sanitation facilities shall be provided to the approval of the Engineer. Each field office shall be supplied with the following new furniture,

Item	No.
Steel desk 1.5 m x 0.75 m with six lockable drawers	2
Arm chairs	4
Drawing rack	1
Water filter	1
Steel file cabinet, 4 drawers	2

N The Contractor shall install in the Engineer's Main Site Office three telephone lines with 6 extensions in the name of Employer and provide an e-mail system for the Engineer's use and maintain it in good working order and pay for all monthly charges, excluding long distance charges. In addition, the Contractor shall supply the Engineer with four mobile telephones and maintain them and pay for all monthly charges, including long distance charges until they revert to the Contractor on completion of the project.

O The Contractor shall provide, as required by the Engineer, safety helmets, safety boots, rubber boots, gloves, torches and the like for the use of the Engineer and his staff and for visitors to the site.

Section 01570

PS 1.22 Traffic Control

A The Contractor shall obtain all necessary approvals from the appropriate authority having jurisdiction over the road, traffic police, and the Engineer for, and prior to implementation of, all traffic control operations.

B The Contractor shall take all necessary precautions and provide all necessary traffic diversions including watching, lighting, temporary barriers, temporary signals etc., all to the approval of the Engineer and the relevant authorities at no additional cost to NWSDB.

Section 01580

PS 1.23 Project Signs

A Fixed project sign boards shall be erected at the entrance to the treatment plant site, at the service reservoir, water tower and pump station sites and at two other locations to be determined by the Engineer. Movable project signboards shall be erected at each end of the pipeline construction area and shall move as the work proceeds.

B The safety signboard shall be erected adjacent to the main site office and also at the service reservoir, water tower and pumping station sites.

Section 01600

PS 1.24 Materials and Equipment

A No substitutions of materials, equipment, pipes and valves, listed in the tender by the Contractor, in the Technical Schedules in Volume 1 of these documents, will be permitted.

B All products shall be imported in the name of NWSDB and originals of all test certificates

including the guarantees and warranties with NWSDB named as the beneficiary shall be submitted to the Engineer at the time of delivery of all such products to site.

C The tests carried out by the Engineer are intended solely to check on the acceptability of materials and work completed. If the Contractor requires additional or more frequent testing to be undertaken to reduce the risk of his work being rejected by the Engineer, then this shall be carried out as the Contractor deems necessary.

Section 01661

PS 1.25 Testing of Pumps

A All tests shall be performed in accordance with the latest Hydraulics Institute Standards or JIS B 8301 and 8302 as specified in Section 11005.

B Pumps shall be shop tested as follows:
1 Factory test pumps with actual motors to demonstrate compliance with specifications.
2 Plot flow rate, discharge pressure, operating speed, and power on certified performance curve for Engineer's approval.
3 Test one of each size and type of pump provided.
4 Submit three copies of certified test reports to engineer for approval. Reports shall be approved prior to shipping the equipment.

C Pumps shall be field tested as follows:
1 Manufacturer's representative shall operate each pump after installation to monitor vibration and noise, bearing temperatures as well as specified performance parameters. All values shall be as specified; or if not specified, as recommended by the manufacturer.
2 The system shall be operated in both hand and automatic modes. Flow pacing signals, if used, shall be operating. The system shall operate as specified.

D The Contractor shall arrange to have the manufacturer or supplier of the equipment furnished under this Section, furnish the services of competent factory-trained personnel to supervise the installation, field testing and initial operation. Installation and erection of all assemblies and components shall be in accordance with the details indicated on the approved shop drawings and the printed instructions of the manufacturer.

PS 1.26 Start-up, Performance Testing, Tests on Completion and Commissioning

A The issuance of the Taking Over Certificate requires that all operational, field and performance tests have been satisfactorily completed and all final test reports, after successful completion of the tests, have been delivered to, and accepted by, the Employer.

B Prior to the issuance of the Taking Over Certificate the Contractor shall clean and disinfect the entire system including the water treatment plant, the transmission main from the treatment plant to the high level reservoir, the high level reservoir and the transmission main from the high level reservoir to Panadura, and all associated works. The entire system shall be handed over in an acceptable condition such that potable water can be delivered to end users by NWSDB.

C Prior to the issuance of the Taking Over Certificate the Contractor shall have satisfactorily operated the complete treatment plant to produce potable water at the design flow of 38,500 m^3/d, without interruption for a continuous period of 72 hours. The Contractor shall provide all necessary temporary facilities for this test operation to ensure the safe functioning of the entire system, all to the approval of the Engineer. Any disruptions in

this 72-hour period shall result in the entire, 72-hour period being repeated. The issuance of the Taking Over Certificate is dependent upon this uninterrupted operation and potable water being delivered through the transmission mains.

D Until the issuance of the Taking Over Certificate the Contractor shall be responsible for the supply and costs of all chemicals, power, fuels and operating fluids and all other items necessary for the testing and operation of the facilities.

PS 1.27 Assistance with Operation

A After the operational, field and performance tests have been satisfactorily completed and upon issuance of the Taking Over Certificate, the Contractor shall assist with the operation of the Plant for a period of three months of continuous operation without any interruptions. This three month period will commence from the date of the Taking Over Certificate.

B During this period, the Employer will provide all necessary labour, attendance, chemicals, power, fuels and operating fluids and all other items to operate the Plant but the Contractor shall provide competent and responsible supervisory staff on a full time basis, including, but not limited to, a Treatment Plant Operation Manager and a Maintenance Engineer both of whom shall be experienced in the running of large treatment works. These supervisory staff shall give full and practical instruction to the operating personnel appointed by the Employer during this period, as described in Section PS 1.28.

C A provisional item is included in the Bill of Quantities for the extended stay of the Treatment Plant Operation Manager and Maintenance Engineer for the balance of the maintenance period.

Section 01670

PS 1.28 Training

A The training courses shall be conducted in the English, Sinhala and Tamil languages and all presentation materials prepared in the same languages. Prior to the issuance of the Taking Over Certificate, the Contractor shall provide a minimum of one day training for each course for the following systems:

- screens, raw water pumps and clear water pumps;
- flocculation, sedimentation and chemical systems;
- filtration systems;
- chlorination system;
- power generation;
- other equipment.

B During the assistance with operation, commencing at the issuance of the of the Taking Over Certificate, the Contractor shall give full and practical instruction to the operating personnel appointed by the Employer concerning the function, operation, maintenance and adjustment of each and every item of the Plant. Instruction shall be provided on proper operation of all the equipment including chemical mixing and dosing equipment, chlorination equipment etc. and measures to be adopted in case of emergency. Advice should also be given regarding the action to be taken under possible emergency situations (e.g. power failures) and for the control and monitoring of the water quality.

Section 01730

PS 1.29 Operation and Maintenance Manuals

Manuals shall be provided in both the Sinhala and English languages.

Section 02060

PS 2.01 Demolition

The Contractor shall demolish all structures as and when directed by the Engineer and as detailed on the drawings.

Section 02200

PS 2.02 Earthworks and Site Preparation

A In addition to the requirements of Clause 1.14 of Section 02200, the Contractor shall undertake a survey of all the underground existing utilities/obstructions/culvert foundations along all pipeline routes and shall determine the exact locations and depths of all such underground utilities and obstructions. The results of the survey shall be incorporated in the "As-Built" drawings.

B For each trial hole, the Contractor shall furnish a written report and a neat sketch of the data uncovered including:
1 soil characteristics;
2 utilities uncovered, materials, sizes and dimensions and depths;
3 any other interesting observations.

C On the water treatment plant site the Contractor shall remove all trees and shrubs within the area delineated on the drawings. The remaining areas shall be left in their natural state.

D After the site clearance, the ground shall be excavated to form the finished compound level as shown on the drawings. All cut and fill slopes not likely to be disturbed by the construction of structures/buildings shall be trimmed to final profiles as indicated or as directed by the Engineer and close turfed immediately after trimming to prevent surface erosion. All turfing that has become defective within the construction period and the defects liability period shall be replaced at the Contractor's expense.

E For the erection of the outer fence on the water treatment plant site the Contractor shall clear all trees and bushes in a 10 m wide, security strip on the inside of the fence. This strip shall be close turfed immediately after clearing to prevent surface erosion. All turfing that has become defective within the construction period and the defects liability period shall be replaced at the Contractor's expense.

Section 02221

PS 2.03 Trench Excavation

A The Contractor shall take all precaution's necessary to avoid damage to existing trees. Tree roots encountered larger than 75 mm in diameter shall not be cut and hand excavation may be required to avoid root damage.

B The Contractor is advised that the trench excavation will be adjacent to existing properties in numerous areas. Therefore all trenches shall be shored and braced, or otherwise stabilized, to prevent damage to such properties, to prevent sloughing and to protect workman in the trench and to safely accommodate surface surcharge loads from excavated materials, pipe, equipment and vehicles. Design calculations and details by a certified

soils engineer shall be submitted for approval prior to any trench excavation.

C The trench width may be increased at joints to allow proper installation of the joint. This increased working width should be kept to a minimum and shall be approved by the Engineer.

D For permanent reinstatement, see Clause 60.17 in Part II – Conditions of Particular Application. The RDA requirements for pipe laying along road reserves are given in the Appendix to these Particular Specifications. The requirements of the Technical Specifications and the Particular Specifications will prevail, except where the requirements of RDA are more stringent. The Contractor is required to carry out all temporary and permanent reinstatement in the A9 road. Permanent reinstatement is not required within other roads and will be undertaken by the road authority concerned, however temporary reinstatement is to be carried out by the Contractor in all roads.

E. Where the Contractor is required to carry out permanent reinstatement, the work shall be carried out in full compliance with the requirements of the relevant authority.

F. All temporary and permanent reinstatements, except permanent reinstatement of roads other than the A9 road, are deemed to be entirely covered by the Contractor's rates for pipeline installation.

G All temporary and permanent reinstatement of surface water drains, culverts and other facilities are deemed to be entirely covered by the Contractor's rates for pipeline installation.

PS 2.04 Pipe Bedding

All pipes shall be laid in granular bedding, except where otherwise stated or where concrete surround is to be provided. The granular bedding shall be provided with a geotextile surround when directed by the Engineer.

PS 2.05 Watercourse Crossings

A The Contractor shall furnish all labour, equipment and materials and perform all incidental work required to install watercourse crossings as shown, specified or directed by the Engineer.

B The Contractor shall submit for approval his proposed method and details of the construction. Approval of such methods and details shall not relieve the Contractor of his obligations.

C The Contractor shall take extreme care to protect the existing structures from damage. Vehicular and pedestrian traffic shall be maintained at all times. Costs or charges resulting from damage thereto shall be borne by the Contractor.

D Where crossings are outside of culverts but under the invert level, the necessary trench cut off walls and riprap shall be provided as shown on the Drawings.

E Steel used for pipe supports and incidental works of crossings shall be of structural steel as specified in Section 05120.

PS 2.06 Existing Services

The Engineer will assist the Contractor to collect drawings and data of existing utilities as supplied by the relevant authorities. The Engineer shall not be responsible for any

inaccuracies, or incomplete information, on these drawings, and it shall be the Contractor's responsibility to check the accuracy of the same.

Section 02222

PS 2.07 Structure Excavation and Backfill

Where the formation of any excavation, being other than rock, is to support the foundations or floor of a structure, the bottom 150 mm of which shall be carefully excavated and trimmed immediately before placing the permanent work upon it.

Section 02520

PS 2.08 Roads

A The roads include the access road to the water treatment plant, roads on the treatment plant site, and at the service reservoirs, water towers and pumping station sites.

B Road construction shall be generally as detailed in the Technical Specifications but to the specific details as shown on the drawings. If any conflict occurs, then the details on the drawings shall take precedence.

C The asphaltic concrete wearing course shall be laid at the end of construction period of the Contract and immediately prior to the issuance of the taking Over Certificate, as agreed by the Engineer.

Section 02700

PS 2.09 Pipes

A The minimum cover to the top of the pipelines comprising the transmission and distribution systems shall be 1.0 m. In the treatment plant and service reservoir, water tower and pump station sites, the depth of pipework shall be as shown on the Drawings.

B All buried pipes and fittings shall be mortar lined ductile iron installed in polyethylene sleeving, unless otherwise shown or specified. The mortar lining shall be made with OPC. The fittings must be manufactured by the same manufacturer as the pipes, and the manufacturer must have an accredited local agent with technical support services. Self anchoring (restrained) joints shall be provided as indicated. If the joint anchor system cannot be incorporated into fittings, then the Contractor shall provide flanged fittings with the necessary restrained flanged adapters. The actual configuration of the fittings and joints shall be as recommended by the pipe manufacturer to resist the thrusts. Any welding of ductile iron pipe and fittings outside of the pipe manufacturer’s manufacturing facility will only be approved in exceptional circumstances, under strict quality control requirements and with the agreement of the pipe manufacturer. Where detailed, thrust blocks will be constructed on the pipelines to resist horizontal or vertical forces. The Contractor shall submit, for the Engineer’s approval, details of his proposed location and types of required thrust blocks.

C The Contractor shall note that many of the routes of the pipelines are in narrow and winding roads. Therefore, the Contractor shall purchase a majority of the pipes in lengths not exceeding 6 m to assist in the laying of the pipes. Longer lengths of pipes will cause difficulties in transportation and laying.

D Flanges for all pipes, valves and fittings shall be PN 10, 16, and 25 as shown in the

Drawings.

E The working pressure shall be taken as 140 m head for the pipeline from the water treatment plant to the high level reservoir. The test pressure will be one and half times the working pressure.

F After testing the pipelines shall be flushed out with clean water and disinfection of the pipeline will be carried out.

G Test Certificates

Each consignment of pipes, pipe specials, fittings and valves delivered to site shall be accompanied with a witness testing and inspection certificate from a third party inspection and testing agency approved by the Engineer. The Engineer or his representative reserves the right to inspect the pipes, specials, fittings and valves to be supplied for the Works at the place of manufacture and to witness the manufacture and works tests.

H Transportation of Pipes & Fittings

Any vehicle on which pipes, are transported shall have a bed of such length that the pipes do not overhang. Large pipes shall be placed on cradles and the loads adequately secured during transit. The pipes shall be handled in accordance with the manufacturer's recommendations.

I Inspection of Pipeline Materials

Transportation of pipes, specials, fittings and valves to site over rough terrain may give rise to a high proportion arriving damaged. Before incorporation into the pipeline each item of pipeline material shall be brushed out and carefully examined for soundness. Damaged items which in the opinion of the Engineer cannot be satisfactorily repaired at site shall be rejected and removed from site. If under line test, the Engineer considers that an unacceptable proportion of the pipes within a test length has failed, the Contractor shall be required to test hydraulically to the works test pressure each pipe and joint before pipe laying. In this event, test results shall be submitted to and approved by the Engineer before any further pipes are laid.

J Resistivity Survey

The Contractor shall undertake a resistively survey along the route of the transmission main in accordance with the requirements of BS. 1377 Part 9, Section 5.1 to determine highly aggressive soil conditions and the type of special external coating system required. The results of the resistivity survey shall be presented in a tabular report format to be approved by the Engineer and the resistivity survey report for each section of pipeline shall be presented to the Engineer prior to placing the orders for pipes & fittings. As a minimum, the report shall list the following information for each measurement:

1. Date & time
2. National grid coordinates
3. Brief description of location
4. Resistivity values at depths of 1.5, 2, 3, 4 & 5m.

K Pipeline Marker Tape

All pipelines shall be marked with an acid and alkali resistant polyethylene detectable warning tape with a minimum width of 300 mm and shall consist of all accessories necessary for installation at the chambers, splicing, junctions etc. The tape shall be blue in colour and clearly marked in black lettering with "CAUTION – WATER MAINS BELOW" in both English & Sinhala/Tamil with a maximum repeat distance of not more than 1 m. The tape shall be placed during backfilling of the pipeline trench at a depth below finished ground level indicated on the drawings. The tape shall have a minimum strength of 125 kg/sq. cm in the longitudinal direction and 105 kg/sq. cm transversely. The minimum thickness of the tape shall be not less than 0.575 mm comprising of polyethylene sealing

layer of 0.1 mm, aluminium foil of 0.075 mm and base layer of polyethylene 0.4 mm. The metallic conductor(s) shall be either aluminium foil having a width of not less than 50 mm and a thickness of not less than 0.075 mm or stainless steel wires. The aluminium foil shall be not less than 99.5% pure. The foil/wires shall be totally enclosed within the polyethylene laminate such that the edges of the foil are totally protected against corrosive attack. The aluminium foil/wires shall be detectable from the ground surface using a buried cable locator. The manufacturer of the tape shall provide methods for joining and terminating the tape to enable a low resistance connection to be made to the foil/wires. Electrical connection points shall be made at each chamber along the pipeline route. Tape is not required in the water treatment plant site or the high level reservoir site.

L Casting Pipes into Concrete Sections

1 The Contractor shall provide and fix all ductile iron pipework both inside and immediately outside the structures as shown on the drawings. The pipework includes items required for building-in or under the structures. It is imperative therefore that the Contractor should place orders for these pipework items immediately after the Contract is awarded and makes every effort possible to ensure early delivery to site.

2 The supply and delivery of the built-in pipework should be clearly shown on the construction schedule to be submitted by the Contractor in accordance with Section 01310 Para 1.02 of the Specification

3 Where specified all pipes passing through concrete in structures where a thrust load has to be transmitted to the structure shall be provided with a puddle/thrust flange and shall be fixed in position before and rigidly held in position during concreting. The supports shall not be removed until the concrete has set sufficiently to support the item. Boxing out of the opening in the above circumstances shall not be permitted.

M Flotation of Pipework

The Contractor shall be solely responsible for ensuring that flotation of pipework does not occur during construction.

N Pipeline Swabbing

Upon completion of water pipeline installation but before hydraulic testing, the Contractor shall demonstrate and prove that the line is clear of debris and obstructions. This will require a video camera survey of the pipeline.

O RDA Requirements

The RDA requirements for pipe laying along road reserves are given in the Appendix to these Particular Specifications. The requirements of the Technical Specifications and the Particular Specifications will prevail, except where the requirements of RDA are more stringent.

P Steel Pipes and Fittings

1 General

Where specified in the drawings, pipes and fittings to be used in the pump house/room shall be of mid steel conforming to the requirements specified in this section.

2 Standard Specification References

The following standards are referred to:

BS 4504	Circular Flanges for Pipes, Valves, and Fittings
AWWA CI04	Cement Mortar Lining for Cast-Iron and Ductile-Iron Pipe and Fittings
AWWA C200	Steel Water Pipe 6 Inches and Larger
AWWA C203	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines-Enamel and Tape-Hot Applied
AWWA C205	Cement-Mortar Lining for Steel Water Pipeline
AWWA C208	Dimensions for Steel Water Pipe Fittings
AWWA C210	Coal-Tar Epoxy Coating System for the Interior and

	Exterior of Steel Water Pipe
AWWA C602	Cement Mortar Lining of Water Pipelines 4 inch (100 mm) and larger-In Place
AWWA Manual	Steel Pipe Design and Installation M11
ASTM A185	Welded Steel Wire Fabric for Concrete Reinforcement
ASTM A283	Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality
ASTM 307	Carbon Steel Externally Threaded Standard Fasteners
ASTM A570	Hot-rolled Carbon Steel Sheet and Strip, Structural Quality
BS 534	Flanges and Bolting for Pipes, Valves and Fittings
JIS G3101	Rolled Steel for General Structures
JIS G3443	Coated Steel Pipes for Water Service
JIS G3451	Fittings of Coating Steel Pipe for Water Service
JIS G3452	Carbon Steel Pipes for Ordinary Piping
JIS G3457	Arc Welded Carbon Steel Pipes
JWWA A109	Mortar-Lining of Steel Pipes for Water Works

3 Materials

(a) Pipes and Fittings

Steel pipe and fittings shall conform to AWWA C200 or equivalent standards, subject to the exceptions and supplemental requirements contained in the following sections.

(b) Steel Cylinder

For pipe and fittings, cylinder shall be fabricated from hot-rolled carbon steel sheets or plates conforming to either ASTM A283 Grade D, or ASTM A570 Grade 33, or JIS G3101 Class 2 SS 400. The minimum yield point of steel used for fabrication of steel pipe and fittings shall not be less than 2,300 kg/sq.cm. Steel conforming to JIS G3457 is also acceptable.

Fabrication of steel pipe and fittings shall be in accordance with AWWA C200 or BS534. The weld shall be of reasonably uniform width and height for the entire length of the pipe and shall be made by automatic means.

All longitudinal seams or spiral seams and shop girth seams of pipe shall be butt welded. The maximum allowable number of shop seams shall be one longitudinal seam and five girth seams per length of pipe. The longitudinal shall be staggered on opposite sides for adjacent section. No reinforcing ring, plate or saddle shall be provided on the exterior or interior of pipe.

All steel fittings except bends having a deflection angle less than 5 degrees shall be shop fabricated. Bends having a deflection angle less than 5 degrees may be field fabricated from shop fabricated steel pipe by means of field cutting and welding.

The pipe diameters shown on the drawings shall be of the nominal diameters.

(c) Fitting Dimensions

All fittings shall be of the same strength, outside diameter and wall thickness as that of pipes, and shall be provided with reinforcing rings and saddles when required in accordance with AWWA Manual M11 to meet the specially high pressure.

The dimensions of fittings shall conform to either JIS G3451 or AWWA C208 or equivalent.

(d) Joints and Pipe Ends

Pipes and fittings to be jointed by flexible coupling shall have the plain end.

Where shown on the drawings, flanged joints shall be provided. Flanges shall be made as seamless forgings or cut and fabricated from steel plates and shall conform to BS4504. Class of flange shall be PN10 unless otherwise specified on the drawings.

Material for flanges, bolts and nuts shall be the same steel used for fabrication of steel pipes and fittings. Flanges shall be steel welding neck flanges, and shall be attached to pipes or fittings by means of single butt-weld. All flanges shall be flat

faced with bolt holes straddling the vertical axis of the pipes or fittings, and all gaskets shall be of at least 3.0 mm thick asbestos or neoprene, full face with bolt holes correctly sized and spaced. Flanges shall be supplied complete with the required size, quantity and quality bolts, nuts and gaskets.

(e) Lining

Steel pipes and fittings shall be lined internally at the pipe manufacturer's works with two coats of bituminous epoxy enamel conforming to AWWA C210 or JWWA K135-1989 with the total uniform dry film thickness of at least 300 microns (0.3 mm).

Fittings larger than 600 mm in diameter shall be wire-fabric reinforced. The wire-fabric shall be 2 x 4 steel wire mesh, 13 gauge each way, and shall conform to the requirements of ASTM A185.

(f) Coating

The exterior of pipes and fittings shall be coated with non-breeding type coal tar epoxy at the total uniform dry film thickness of at least 200 microns.

(g) Lining and Coating at Pipe Ends

At all pipe and fitting ends, coating and lining shall be extended to the pipe ends.

(h) Manufacturer's Mark

Each pipe and fitting shall bear the mark of the manufacturer; the nominal diameter; wall thickness; year of manufacturer; the wordings "Steel Pipe" or "SP", and the owner's name "NWSDB". The marking shall be conspicuously painted in non-toxic paint on the outside of each pipe and each fitting.

4 Shop Testing

(a) Pipe

Shop testing and inspection of the pipe shall be conducted in accordance with AWWA C200 in the presence of the representative of the Engineer. The minimum hydrostatic test pressure for straight pipe shall be determined in accordance with Section 3.4 of AWWA C200 using the design stress equal to 75 percent of the minimum yield point of the steel used. When approved by the Engineer, the hydrostatic test may be replaced by other appropriate non-destructive testing methods such as ultrasonic and/or radiographic testing methods. During pressure test, all welds shall be thoroughly inspected and all parts showing leakage shall be marked. Pipes that show any leakage under test shall be rewelded at the points of leakage and subjected to further hydrostatic tests until satisfactory results are obtained.

(b) Fittings

Upon completion of welding, but before lining and coating, each fitting shall be bulk headed and tested under the same hydrostatic pressure as for the pipe. Provided, however, that if fittings are fabricated from previously tested straight pipe, only those welding seams that were not previously tested in the straight pipe may be tested by means of ultrasonic or radiography method or other methods as approved by the Engineer, with no further hydrostatic test.

Any leakage and porous welds which may be revealed by the test shall be chipped out and rewelded and the fitting be retested until satisfactory results are obtained.

5 Mechanical Couplings and Flange Adapters

Couplings for jointing plain-ended pieces shall be of the Dresser Viking Johnson or similar type approved by the Engineer and may be steel or ductile iron at the option of the Contractor.

The middle ring (sleeve) and the follower rings (flanges) shall be of such materials and dimensions and that they are not stressed beyond half the yield stress of the material when the pipes connected by them are subjected to the stated hydraulic test pressure.

Except where otherwise stated, the middle ring (sleeve) of the coupling shall be provided with a suitable pipe stop (centre register).

The joint rings used shall be of Class 'A' natural rubber and the physical properties of the mix shall meet the requirements of BS 2494.

Flange adapters for jointing flanged specials to plain-ended pipes shall conform to the foregoing contents of this clause.
Prior to the commencement of the manufacture the Contractor shall submit to the Engineer for approval detailed drawings of all mechanical couplings and flange adapters.
All couplings shall be supplied with a shop coat of quick drying primer approved by the Engineer which is compatible with the materials to be subsequently used for moulding or painting.
When harness is specified with coupling or flange adapter, the harnessing shall be provided as recommended by the manufacturer of couplings or flange adapters. Harness joint shall be designed to withstand for the pull-out force caused by the internal pressure of 10 bar at the joint.

Section 02830

PS 2.10 Fencing

A Fencing shall be constructed around the entire outer boundary of the water treatment plant site.

B At the service reservoirs, water towers and pump stations fencing shall be constructed as detailed on the drawings.

Section 02850

PS 2.11 Gabions

Box gabions shall be constructed for embankment protection on the inlet channel to the intake.

Section 02900

PS 2.12 Landscaping

Provisional sums or specific items are included in the document for landscaping.

Section 03300

PS 3.01 Cast-in-place Concrete

A All cast-in-place concrete for water retaining and water excluding structures shall be grade 35. All chambers and structures on the pipelines shall be considered as water retaining structures. All concrete for buildings shall be grade 25.

B Concrete Mix

Concrete Grade	Max. Size Agg. mm	Min. Cement Content kg/m^3	Max. Free Water/Cement Ratio	Cube Crushing at 28 days Trial Mix N/mm^2	Works Test N/mm^2
25	20	315	0.5	35	25

C Concreting Records
A written record of the concrete works shall be made each day by the Contractor and kept available for inspection by the Engineer. The record shall contain the following:
1 the names of the Contractor's engineers who are responsible for the different phases of

the concrete work, and also the names of their assistants;
2 the temperatures of air, water, cement, aggregates and concrete, together with the air humidity and type of weather;
3 deliveries to Site of concrete materials (quantity, type & brand of cement etc.,);
4 inspections carried out, tests performed, etc., and their results;
5 times of commencement and completion of different parts of the concrete works, and times of erection and striking formwork;
6 quantity of cement, fine and coarse aggregate, water and admixture used for each section of work and the number and kind of test samples taken on these ingredients.

D Blinding Concrete
Immediately upon completion of excavation, all excavated surfaces shall be covered with blinding concrete to prevent deterioration of the formation and to form a clean working surface for the structure as specified in Clause 3.06 C. The layer of blinding concrete shall be placed on the underside of all footings, ground beams and ground slabs. The underside of the blinding concrete shall be provided with a vapour barrier separation layer as specified in Clauses 2.12 A and 3.06 D.

E Immediately upon completion of excavation, all excavated surfaces upon which a structure is to be placed, shall be covered with blinding concrete to prevent deterioration of the formation and to form a clean working surface for the structure as specified in Clause 3.06 C. The layer of blinding concrete shall be placed on the underside of all footings, ground beams and ground slabs. The underside of the blinding concrete shall be provided with a vapour barrier separation layer as specified in Clauses 2.12 A and 3.06 D.

F The Contractor shall demonstrate the temperature/time relationship of setting concrete by means of casting a test panel 1m thick, 3m long and 3m high that his proposed concreting method, including shuttering will ensure that the maximum internal temperature of the concrete shall not exceed 70^0C.

G The concrete surface finish and tolerances of the sedimentation tank floors shall be either as specified in Section 03300 or to the requirements of the scraper manufacturer, whichever are the more stringent.

Section 03900

PS 3.02 Testing of Water Retaining Structures

All structures, excluding building superstructures, but including isolation valve chambers, washout boxes, air/vacuum chambers, access and sewer manholes, etc. are to be considered as watertight structures and are to be tested as specified.

Section 04220

PS 4.01 Masonry (Concrete Blockwork)

A Cement blocks for walls shall comply with BS 6073, Part 1 and shall have an average compressive strength of not less than 2.8 N/sq. mm. Nominal block sizes shall be 390 long, 190 high and 100, 150, or 200, solid or hollow as indicated on the drawings.

B Blocks shall be manufactured on pallets and after removal from the moulds, shall be carefully stored for at least 24 hours and kept wet by fine spraying before the pallets are removed. The blocks shall thereafter be stored under cover for a further six days protected from the sun. Drying of the blocks may commence on the ninth day after manufacture. No blocks may be used within 28 days of their production.

C The contractor shall deliver loads of not less than 500 blocks at a time to the site, from which the Engineer shall pick samples for testing and reference.

D Bonding of blockwork shall be stretcher bond half lap for single leaf work or in cavity walls and double flemish bond alternate headers and stretchers in each course of each face of two course work. Bonding shall be arranged as far as possible to allow the use of full length blocks below lintel bearings. When blocks cannot be satisfactorily cut, fractional length blocks shall be pre-cast to the correct dimensions or formed in-situ between shuttering. Half blocks shall be positioned as necessary to give a neat finish.

E Joints between dissimilar materials such as block work or brick work with concrete shall be covered with a continuous strip of galvanized expanded metal lathing where the surface is to be rendered or plastered.

F Internal walls shall be built up of alternating five layers of blocks with one interim layer of brickwork, laid flat. External walls or external faces of composite walls shall consist of blockwork only.

G Bricks may be used for filling up the last layer of blockwork against the structure above (wedges and pinned) or contra-moulding to beams etc. with a flexible joint as shown on the drawings. The application of brickwork is limited to this, unless specifically mentioned otherwise in drawings or directed by the Engineer.

H Blockwork, abutting reinforced concrete or mild steel structures shall be anchored to the structure.

I Parapet block walls shall be anchored to the slabs/structures on which they are erected.

J The tops of block walls shall be pinned and wedged to all soffits.

K Blockwork shall be formed flush with the faces of the reinforced concrete columns and beams and reinforced with vertical 10 mm diameter high yield reinforcing bars to BS 4449: 1997 at 2000 mm centres and lapped with starter bars/anchors, tied into the concrete structure and anchored to the columns and beams.

L If block walls are longer than 6000, then, regardless of height, expansion joints shall be introduced composed of 10 mm thick polystyrene packing and approved sealant.

M Metal anchors for fixing blockwork or brickwork to concrete shall be galvanized mild steel to BS 1449, minimum tensile strength 460 N/mm^2, 4.5 mm thick x 35 mm minimum width, length to suit cavity with ends turned through 90 degrees to form lugs 60 mm long.

N Shot fired nails for fixing metal anchors to concrete shall be high tensile steel nails with a minimum pull out load of 6 kN in concrete with a characteristic strength of 30 N/sq.mm.

O Where a blockwork wall is built up against a column, a post or an in situ concrete wall the end void of blocks shall be filled with Grade 20 concrete. Metal anchors shall be fixed to the concrete and built into the blockwork at every second bed joint.

P Where an internal blockwork wall is separated from a column by a cavity, one void in the blockwork alongside the column shall be filled with Grade 20 concrete. Metal anchors shall be fixed to the concrete and built into the blockwork at every second bed joint.

Q Where an external blockwork wall is separated from a column by a cavity, one void in the blockwork shall be filled with Grade 20 concrete and reinforced with one 10 mm diameter mild steel reinforcing bar to within 250 mm of the top of the wall. Metal anchors shall be

fixed to the concrete and built into the blockwork at every alternate bed joint.

R Damp proof courses are required on all external walls on the ground floor, and where otherwise specifically shown on the drawings.

PS 4.02 Masonry (Brickwork)

A Bricks shall be solid common clay bricks, basically complying with SLS 39, and shall have an average compressive strength of not less than 2.8 N/sq.mm. Nominal brick sizes shall be 220 long, 105 wide and 65 thick.

B The Contractor shall deliver loads of not less than 500 bricks at a time to the site, from which the consultant shall pick samples for testing and for reference-keeping.

C Bricks shall not be handled in baskets, thrown from a height or in other manner that would destroy the sharpness of the edges. In no case shall bricks of different dimensions be used in the same work except when specially permitted by the officer in charge. In exposed brick work, selected bricks of the specified class shall be used for the face work.

D The bricks shall be wetted as necessary prior to laying and kept wet for three days after construction. The tops of walls left off shall be wetted before the work is recommenced.

E All surfaces on which brick work is to be built shall be clean. All brick work shall be built uniform, true and level, with all perpends, vertical and in line. The starting courses, tops, ends and jambs of all walls and all reveals are to be built solid and the contractor's rates are to include for this. Where shown on the drawings or as directed by the Engineer, reveals shall be built and air bricks, fixing bricks for joiners or other work and other relevant items shall be built in as the work progresses. Mortar joints in faces to be plastered shall be raked 10 deep to provide key.

F Bricks shall be laid in stretcher bond unless otherwise specified. Half or cut bricks shall not be used except where necessary to complete the bond; closers in such cases shall be cut to the required size and used near the ends of walls. In all load bearing walls the bricks shall be laid with frogs upwards and the frogs shall be filled with mortar.

G A layer of mortar shall be spread on full width over a suitable length of the lower course. Each brick shall be properly bedded and set home (in position)by gentle tapping with the handle of a trowel or wooden mallet. Inside faces of the set bricks shall be buttered with mortar and the next brick to be laid shall be pressed against it. All bricks in every course shall be grouted full with mortar using the trowel for chasing in for this purpose. The thickness of mortar joint shall not exceed 10 mm.

H The quoins shall be set out and built up in advance of the main body of the brick walling.

I The walls shall be carried up uniformly in all cases where the nature of the work admits it. No part shall be left more than 1 m below the rest of the work. The work shall not be built higher than 1.5 m in one day. The courses shall be kept perfectly horizontal and every fourth course shall be checked for level and plumb. Courses shall have break joints. At the end of the day's work and where it is not possible to raise the adjoining portion uniformly and in gable walls, the work shall be raked back according to the bond, at an angle not steeper than 45^0. All perpends, Quoins etc. shall be kept strictly true and square and properly bonded together and brought to final levels at each floor. Over hand laying shall not be used without approval. Panel walls or Non load bearing walls shall not butt against the concrete beams or slabs. The lateral stability of walls which are free standing during construction, shall be ensured by adequate shoring and scaffolding until the roof or floor providing the necessary stability is constructed.

J Brickwork shall be protected from rain by suitable covering when the mortar is green. Brickwork in cement/composite/lime mortar (except fat lime mortar) shall be kept constantly moist on all faces for a minimum period of seven days. In the case of masonry with fat lime mortar, curing shall commence two days after laying and shall continue at least for seven days thereafter.

K All iron fixtures like hold fasts, pipes, etc., which are required to be built into the wall shall be embedded in their correct positions in cement mortar or cement concrete as specified. Fixing in brick work/block work shall, wherever practicable, be built in as the brick/block work is built. Holes required for fixings after walls have been constructed and rendered, shall be made with a suitable drill to minimize damage to the surrounding surfaces. Any damage caused shall be made good by the contractor at his own expenses. Fixing of masonry work shall be of stainless steel or bronze and of an appropriate and approved size suitable for concealed fixing of masonry works to internal and external brick work and or concrete walls and columns.

L When the face work is to be plastered or joints alone pointed upon, the joints shall be raked to a minimum depth of 12 mm by a raking tool during the progress of work or when the mortar is still green. When plastering or pointing is not required to be done, the joints shall be struck flush and finished at the time of laying. The face and top of courses of courses of the brick work shall be cleaned thoroughly of all mortar droppings on the same day.

M Corbelling shall be effected by a one fourth brick projection (in every course) for ordinary work and a one eighth brick projection where greater strength is required.

N Damp proof courses are required on all external walls on the ground floor, and where otherwise specifically shown on the drawings.

PS 4.03 Masonry (Random Rubble)

A Stone shall be hard, sound, free from decay, weathering and defects like cavities, cracks, flaws, sand holes, veins, patches of soft or loose materials etc. It shall be obtained from an approved quarry and stone with a rounded surface shall not be used. Normally stones used shall be small enough to be lifted and placed by hand. The lengths of the stone shall not exceed three times the height and the breadth on base shall not be greater than three-fourth of the thickness of wall (except for through stones) nor be less than 150 mm. The height of a stone may be 300 mm maximum.

B The contractor shall submit samples of stones representing the range of variations to be used in the work and obtain the approval (of appearance) from the Engineer.

C Stone shall be hammer dressed on the face, the side and the beds, to enable it to come into close proximity with the neighbouring stone. The 'bushing' in the face shall not project more than 40 mm on an exposed face, and 10 mm on a face, to be plastered.

D All stones shall be clean and free of dust and shall be wetted before use. Chips, spalls etc. shall be washed clean with water to ensure a clean surface for the mortar to adhere to. The stone shall be laid on their natural bed on a full even bed of mortar. Every stone shall be carefully fitted to the adjacent stones, so as to form neat and close joints. Stones may be brought to level courses at plinth, window sills and roof level .Leveling up at plinth level, window sills and roof level shall be done with concrete comprising one part of the mortar as used for the masonry and two parts of graded stone aggregate of 20 mm nominal size. The bond shall be obtained by fitting in the adjacent stones closely, and by using bond-stones. Face stones shall extend and bond well into the backing. These shall be arranged to break joints as much as possible, and to avoid long vertical lines of joints. The hearting or

interior filling of the wall shall consist of rubble stones which may be of any shape but shall not pass through a circular ring of 150 mm inner diameter. The thickness of these stones in any direction shall not be less than 100 mm. These shall be carefully laid, hammered down with a wooden mallet into position and solidly bedded in mortar, chips and spalls of stone being used wherever necessary to avoid thick mortar beds or joints and at the same time ensuring that no hollow spaces are left anywhere in the masonry. The hearing will be laid nearly level with facing and backing, except that at about one metre intervals, vertical 'Plums' projecting about 150 mm to 200 mm shall be firmly embedded to form a bond between successive courses. The chips shall not be used below the hearting stone to bring these upto the level of-face-stones. The use of chips shall be restricted to the filling of interstices between the adjacent stones in hearing, and these shall not exceed 20 percent of the quality of stone masonry. The wall shall be carried up truly plumb or to the specified batter. The masonry in a structure shall be raised uniformly. Where the masonry of one part has to be delayed, the work shall be racked back at an angle not steeper than 45^0. Toothing in stonework shall not be allowed.

E A sufficient number of bond stones or through stones shall be used in building the wall. At least one through stone shall be build into the wall at intervals of 1.8 m horizontally and 0.6 m vertically. Such stones shall be at least 150 mm square at the face and shall run through the full thickness of the walls up to 600 mm in thickness. In case of walls exceeding 600 mm in thickness more than one stone may be used to run through the full thickness of the wall with overlaps of not less than 150 mm. In case of highly absorbent types of stones (porous lime stone and sand stone etc.) the bond stone shall extend about two-third into the wall. Through stones in such cases may give rise to damp penetration. Therefore, for all thicknesses of such walls, a set of two or more bond stones overlapping each other by at least 150 mm shall be provided. Where bond stones of suitable lengths are not available blocks of Grade 20 concrete conforming to the sizes mentioned above shall be used. All bond stones in stone masonry shall be marked suitably for identification as directed by the Engineer.

F Quoins shall be of selected stones neatly dressed with the hammer or chisel to form the required angle, and laid header and stretcher alternately. The quoins shall be set out and built up in advance of the main body of the rubble walling.

G Stones shall be so laid that all joints are fully packed with mortar and chips. Face joints shall not be more than 20 mm thick. When plastering or pointing is not required to be done, the joints shall be struck flush and finished at the time of laying. Otherwise, the joints shall be raked to a minimum depth of 20 mm by a raking tool during the progress of work, when the mortar is still green.

H Masonry work in cement or composite mortar shall be kept constantly moist on all faces for a minimum period of seven days. In the case of masonry with fat lime mortar curing shall commence two days after the laying of masonry and shall continue for at least seven days thereafter.

I Green work shall be protected from rain by suitable covering. The work shall also be suitably protected from damage, mortar dropping and rain during construction.

Section 04400

PS 4.04 Tile Work (Stone)

A Granite shall be locally available or imported plutonic igneous rock, based on assemblages of silicates with 65-75 per cent of silica ($Si0_2$), hewn from the living solid rock in Sri Lanka, and machined to sizes shapes and finishes as indicated. Slabs showing major

plutonic intrusions (so called joints) shall be rejected. Slabs/tiles shall be free from any defects on the faces visible in the completed work that could mark the appearance of the stonework. The Contractor shall provide samples of the required granites to the Engineer and the granites supplied by the Contractor shall match the approved samples in consistency, grain, colour and density.

B Joints of flooring shall match with the joints of wall cladding and care shall be taken that all wall and floor surfaces to be tiled, both internally and externally, are set out in such a way that no cut tiles or slabs of less than half the standard width are used.

C Skirtings shall be fixed to plastered walls or fairface concrete walls by means of approved epoxy or polyester resin mortar. Fixing materials such as cramps, dowels of wire ties shall be austenitic stainless shell sheet, strip or wire to BS 1449 or BS 970: Part 1, 1996 or non-ferrous materials such as aluminium bronze or phosphor bronze to CP 297 and 298. Fixings shall be concealed. Cramps, dowels, etc., shall be fixed into carefully drilled dowel mortices and holes on the substructure materials by means of detail slots and mortar of 1 cement: 3 sand or an approved epoxy or polyesters resin mortar. Granite slabs and tiles shall be to thickness and finishes on the visible face and edges as specified in the finishing schedules and comprise hone, polished and flamed (touched) finish. External flamed-finished slabs shall be treated with an approved type of polyester coating.

D Thickness and sizes of granite slabs/tiles shall be as shown on the Drawings. After thorough cleaning and wetting of the sub-screed, slabs/tiles shall be laid, well and fully bedded, on a screed as specified clause in accordance with CP 202. Tolerance in laying individual slabs shall be 1.5 mm in 3000 at the perimeters + 1 in 2000. Dimensions of slabs shall be accurate to within + 1 mm thickness to within 1.5 mm. Joints between polished slabs shall be approx. 2 mm wide and be straight and true. Grouting of joints to be carried out with an approved grouting compound matching colour and shade of the slabs. Joints between honed slabs shall be tight butt joints. Flamed finished slabs shall be treated with a polyester coating. Tolerance in fixing of cladding slabs shall be: perpendicular to floor slabs to within 0.25 mm. Individual slabs being level or perpendicular within + 1 in 3000. Dimensions of slabs shall be accurate to within + 1 mm, thickness to within 1.5 mm. Joints shall be compatible with joints specified for flooring. Flamed finished slabs shall be treated with polyester coating.

E Treads shall be min. 8, 25, and 40 mm thick, or as shown on the Drawings, and be provided with a grove 8mm deep, 40mm wide in the front-top, to be filled with a dark gray or black carborundum insert, protruding slightly from the finished top surface. Treads shall be of one piece including any upstands at the outer sides, unless particular circumstances require more pieces to the discretion of the Engineer. Visible faces of treads shall be polished, edges adequately beveled. Treads to be bedded in a cement-sand mortar as specified and fixed with 2 no. 6mm dowels per tread. Risers shall be minimum 17 thick, properly related at the joints with treads. Risers shall be of one piece, unless circumstances arise and approved by the Consultants. Visible faces or risers shall be polished, edges beveled or rebated as required to suit the particular situation. Risers to be fixed generally and with at least 2 no. stainless steel or non-ferrous cramps 3 mm diameter per riser. Tolerance in laying of treads shall be within + 1 mm of the riser height as per drawing and be level to within + 0.5 mm. Joints between treads and risers, if any, shall be as described in drawings. Skirting strips to stairs shall be min. 17 mm thick and be machined to follow the shape of treads / risers, or as generally shown on drawings. Visible faces of skirting strips shall be polished and edges slightly beveled. Skirting strips shall be fixed as described in drawings.

F Thresholds and plinth blocks shall be of sizes and thickness as shown on the Drawings. Generally, thresholds shall have the width of the door frame and follow the rebated shape of the frame. Plinth blocks shall follow the machined section of the frame-jambs or

mullions. If thresholds are applied only as a division between rooms without door or as a division between different floor finished, then threshold shall have the width of the finished wall in the opening of which it is to be laid.

G Thresholds shall be of one piece, unless particular circumstances require more pieces to the discretion of the Engineer. Visible faces of thresholds, generally protruding min, 25mm above finished floor level shall be polished, unless otherwise directed (e.g. in showers or the like), edges beveled. Thresholds to be fixed as specified. Tolerance in laying of thresholds shall be ; level to within + 0.5 mm; dimensions shall be accurate as specified.

H Skirting shall be minimum 17 thick, 100 high and correspond in length with the abutting (patterned) layout of the floor/wall, column, or as shown in detail drawings. Visible faces of skirtings shall be polished, unless otherwise specified; longitudinal edges slightly beveled; corner piece as shown in drawings.

I Vanity counters shall consist of polished granite slabs and fronts. 25 mm thick, laid on a mortar bedding or fixed with dowels to precast concrete substructure. The counters shall generally be shown on drawings. The layout of slabs shall be determined by the Engineer, joints of slabs and fronts shall correspond. Laying, fixing and finishing of the granite shall generally be as specified.

J Floor finishes in plant buildings shall be carried out after the installation of all M & E equipment.

Section 05500

PS 5.01 Miscellaneous Metals

All manhole and chamber covers shall be marked with the letters, or words, in English, to indicate the function of the piping/fitting within i.e.: FH, WO, AV, SV, METER, SEWER, DRAINAGE and also NWSDB in suitable size, cast in raised letters.

PS 5.02 Metalwork in Reservoirs

All metalwork inside reservoirs (ladders, grills etc,) shall be fabricated from 304 stainless steel.

PS 5.03 Equipment Supports

A The Contractor shall supply all necessary equipment supports including those for steady bearings for pumps , pipe supports, restraints and hangers.

B In the intake pump station the Contractor shall provide the necessary supporting steelwork for the pump motors to span across the access openings. The supports shall be adequate to resist all forces imposed by the pump motor system and shall be removable to enable direct access to the basement pumps. The steelwork shall be covered with checker plate flooring.

PS 5.04 Metal Roofing

A Roofing system should comply with the manufacture's specifications and it should be certified for use in the local climatic conditions and for the type of building. Fixing to be carried out according to the manufactures detailed fixing methods and by their certified installers.

B The roof system is to be guaranteed for a minimum of 20 years for both product and installation. Guarantees should cover; colour stability, corrosion, leakage, cracking, flaking or pealing of paint, fixing devises, stability to UV, accessories, etc.

C The minimum material specification requirements are:
aluminium zinc- minimum total coated thickness of 47mm zinc/aluminium alloy coated 55 percent aluminium, 43.5 percent zinc and 1.5 percent silicon. Hot-dipped to Australian Standard 1397-AZ 150 having a minimum alloy coating mass of 150/sq.m;
acrylic resin – under side of the sheet: minimum of 2 micron clear acrylic resin to act as moisture barrier to give corrosion resistance;
acrylic resin – top-side of the sheet: two coats of minimum of 2 micron clear acrylic resin to act as moisture barrier to give corrosion resistance;
acrylic colour coat: minimum of 32-micron acrylic paint top coat for an extra heavy-duty finish and colour to be selected by the Engineer on the submission of samples;
purlins shall be cold-formed from hot dipped zinc coated high strength steel strip which has minimum yield stress of 450 MPa, supplied cut to length and pre-punched;
The standard galvanize coating is 275 g/m2 (Z275, 9 micronm) to B.S. 2989 on both sides.
roof insulation shall be 50mm thick, glass wool, double-sided aluminum foil for reduction of heat flow through the roof;
profile to be approved by the Engineer.

D A roof mock up shall be prepared at site for approval before start of construction.

E Sheeting shall be delivered to the building site in strapped bundles. If not required for immediate use, sheets or bundles should be neatly stacked clear of the ground and if left in the open should be protected from rain and moisture with waterproof covers. On no account should sheeting in any surface finish be allowed to get wet while still in bundled or nested in stacks. For long length sheets the use of a spreader bar and fabrics slings shall be mandatory. To preserve the surface finish, and for personal safety, sheets should be handled wearing clean dry gloves. Do not slide sheets over rough surfaces or over each other and do not drag tool sets over sheets.

F The roofing installation shall be as follows:

1 The sheeting shall be fixed commencing from the leeward end with self drilling screws made of hot - dipped galvanized zinc coating applied minimum coating thickness having full compatibility with the coated sheets. Where sheeting rest on steel purlins the sheets should be painted with two coats of a zinc chromatic or barium chromate based paint. Alternatively, the painting may be done with two coats of bitumen paint or with two coats of zinc rich paint.

2 End laps of not less than 150mm and side laps of one corrugation shall be provided where the pitch of the roof is not less than 15^0 degrees. In case the pitch is less than 15^0 degrees the end laps shall not be less than 225mm. The side laps shall be turned away from the direction of heavy rains. The overhang at the eaves for corrugated profile shall not exceed 200mm in the case of un-stiffened, and 350mm in the case of stiffended. The sheets shall be so fixed as to close on the ridges and hips.

3 For roofing applications, fasteners shall be positioned in the centre of the corrugation or rib and shall be driven perpendicular to the support.

4 Side roofing fasteners shall be recommended to hold the side laps of roofs and wall cladding firmly together and maintain completely weatherproof joints. The side laps fastening shall be recommended to roof sheets to roof sheeting which may be subject to occasional roof traffic. Maximum spacing of side laps fasteners should be 900mm for roof cladding. Side lap fasteners shall be located in the centre of the crown of the overlapping corrugation or rib of Trimclad or Corrodek.

5 Fasteners shall have similar life expectancy to the roof or wall cladding materials. For screws other than the self - drilling type, holes through the sheeting should be drilled. The fasteners with EPDM sealing washers shall be tightened only until the washers are gripped firmly enough to provide a weatherproof seal. The fasteners shall be not over - tightened as this may split the sealing washer or deform the sheet, either of which could lead to water penetration.

6 To reduce the transmission of heat from solar radiation into a building, insulation shall be provided in the roof system during installation of the metal roof sheets. Provide a insulation over the purlins before laying the roof sheeting. In order to get better heat insulation, the membrane shall be allowed to drape down 50mm to 75mm between supports. The reflective foil or heat insulation can serve as a dual function as a vapour barrier by sealing the overlaps with moisture impervious adhesive tape. The laps shall be minimum 100mm and kept in close contact when positioning the laminate so the tape can be readily applied.

7 Adequate safety precautions shall be taken to distribute loads over the roof during installation. Operatives shall wear soft - soled shoes.

8 Care should be taken to sweep the roof after each day of installation to remove debris deposited on the roof which may result in unsightly staining of the surface.

PS 5.05 Rainwater Goods and Accessories

A Eaves gutters shall be of rectangular or square gutter type fabricated to the pattern shown in the drawings and shall be formed of 0.47mm total coated thickness, G550, sheeting, as specified above, laid to regular and even falls, preferably with a minimum fall of 1:500. They shall be foxed with custom made brackets. The gutter straps shall be designed and spaced to withstand the full load when the gutter is running full of water. The brackets shall be positioned and spaced as shown in the drawings. Preferably positioned at stop ends or down pipes shall not exceed more than 120mm.

B Internal box gutters unless otherwise specified box gutters shall be constructed of 0.47mm total coated thickness, G550, sheeting with the sections well reveted together to ensure water tight joints and laid to a fall of least 1 in 200. In gutters where the width of the sole exceeds 500mm, the fall shall be increased or the sole formed in a 'V' shape. Internal outlets shall be provided with sumps extending across the gutter width, and external outlets shall be provided with sumps and overflow weirs at lower levels than the gutter. Where ever possible the gutters shall be large enough and adequately supported to allow roof and maintenance workers to walk along the sole. Where required, the expansion joints shall be provided at the high point's midway between down pipes.

C Valley gutters shall be firmed with 0.47mm total coated thickness, sheeting, 470mm wide, dressed in to valley and fully supported and shall be by nailing or screwing at the top end to prevent creeping down wards. The end laps of valley gutters shall not be less than 150mm and shall be in the direction of flow. Installation shall include allowance for thermal expansion. The roof shall overlap each side of the valley guttering by 150mm. The upper end of valley gutter shall be turned up against the underside of the ridge, and the lower end shall be turned down in to guttering.

D Where thermal expansion of metal rainwater goods would otherwise have a deleterious effect, adequate provision shall be made to accommodate such expansion. Expansion joints shall be incorporated in gutter runs as follows:

1 gutter runs with fixed ends shall incorporate an expansion joint if the length of the run exceed that which would cause a free expansion of gutter than 20mm (12 m run).

2 gutter runs with a free end shall incorporate an expansion joint if the length of the run exceed that which would cause a free expansion of gutter than 40mm (25 m run).

Where expansion joints are required, the adjacent gutter lengths may be fitted with stop ends and separated by a gap of 25mm. The gap is bridged by a suitable saddle flashing.

E The rain water system shall be designed and constructed so as to achieve complete drainage or drying. Shielded areas capable of holding small volumes of stagnant water shall be avoided so as to prevent the possibility of intense localized corrosion and the breeding of mosquitoes.

F Ridge capping shall be formed with 0.47mm total coated thickness, G550 sheeting. The joints of the capping shall be lapped against the weather for not less then 100mm and ends of capping shall be stopped. The capping shall be securely fastened at intervals to resist thermal and wind forces. They shall be watertight at all inter sections and penetrations. The ridge capping shall overlap the roof sheeting on each side by not less than 100mm and low pitched roof a higher overlapping shall be recommended.

G Rainwater down pipes shall be formed of 0.47mm total coated thickness, G550, sheeting. Down pipes shall be fixed using down pipes straps with equal thickness as the down pipe materials at and shall be not less than 50 percent of the effective cross - sectional area of the gutter which it drains.

H Flashing and capping should conform to AS2179 and be made from steel of minimum base metal thickness of 42mm for G550 and similar finishes to roof. Flashing dimensions should be generous with ample cover width over roof sheeting and ample turn up. Longitudinal flashing and capping shall have a turned down edge located in a tray or valley of the roof sheets and depth to suit the sheet profile. Transverse flashing and capping for ribbed sheets shall be notched out and turned down along their lower edge to match the sheet profile. Where possible, transverse flashing and capping over crest fastened sheeting should be fastened in common with the sheeting by the normal sheet fasteners into top purlin or support.

I Fasteners shall be durable, corrosion resistant in accordance with AS3566 and compatible with which they may be in contact in the roof if not compatible shall be electrically insulated from such materials. The fasteners shall be suitability plated or coated to achieve the necessary corrosion resistance and compatibility.

Section 06610

Section 07100

PS 7.01 Waterproofing and Damp-proofing

A Notwithstanding maintenance requirements for the Works, the Contractor shall warrant the Employer with the assurance of a reputable local insurance company that roofs and tanks shall remain waterproof and damp-proof in respect of workmanship and materials for a period of 10 years calculated from the time that the works are certified as substantially complete. The form of guarantee offered by the specialist applicator shall be submitted for the Engineer's approval prior to commencement of waterproofing. This guarantee shall in no way indemnify the Contractor against the improper performance of the waterproofing system.

B It shall be the Contractor's responsibility to ensure that the specialist applicator takes note of the structure, including any movement joints, on which the waterproofing or damp proofing is to be applied. The laying of a water proofing system on a concrete or steel surface will be taken as signifying the acceptance of that surface, both in terms of surface quality, spacing and arrangement of movement joints, by the Contractor and his specialist applicator.

C Waterproofing systems shall dress up all pipes and other penetrations to a minimum height of 250 mm outside of the structure being waterproofed. The Contractor shall ensure that all penetrations of the structure shall be water proofed in a workmanlike manner and in accordance with the manufacturer's instructions and to the approval of the Engineer.

D Sharp corners shall be filled with screed or other fillets and waterproofing shall be laid with generous overlaps in accordance with the manufacturer's instructions. When water proofing is to be applied on exposed areas, its colour shall be approved by the Engineer.

E Where finishes such as concrete paving or tiles etc., are laid over waterproofing membranes laid on concrete floors, the floor shall be tested for water-tightness prior to laying of these tiles etc.

F Joints with abutting structures shall be carried out with appropriate materials as required.

G Damp-proof courses between block or brick walls and concrete ground beams or slabs shall be hessian based bitumen strip to BS 743, Type 5A as specified in BS 6398 to the same width as the block walls. The damp-proof course shall be bedded in cement mortar (1:4) with 150 mm end laps and full width at passings and angles.

H The external faces of all underground structures in direct contact with the ground shall be damp-proofed as specified in Clauses 2.03 and 3.03 with bituminous damp-proofing.

PS 7.02 Waterproofing to Reservoir Roofs

The roofs to the clearwater and service reservoirs shall be waterproofed with two layers of waterproof sheet membrane in accordance with Section 7100. The installed membrane shall be protected with a geotextile layer, in accordance with Section 02520, on top of which shall be placed 150 mm layer of 25 mm single sized shingle aggregate for the high level reservoir and earth fill for the clearwater reservoir. Edges and inserts shall be sealed with 316 stainless steel flashing and approved sealants.

PS 7.03 Waterproofing to Building Concrete Roofs

A The Contractor shall prepare all surfaces which are to receive waterproofing and damp-proofing materials and the surface shall be dry, clean, free from loose materials and to the entire satisfaction of the Engineer. Concrete, which is contaminated by oil or grease, shall be removed and repaired.

B Lightweight aggregate shall be exfoliated, vermiculated, pulverized fuel ash, expanded clay or other approved material to BS 3797; nominal pellet size: 6mm.

C Roof screeds shall be applied in two layers after grouting the concrete slabs with a cement/water slurry. The first layer shall consist of a mortar of 1 part cement and 5 parts vermiculite. This layer shall be finished with a top layer, approx. 10 mm thick, of a mortar of 1 part cement, 3 parts sand and 1 part vermiculite.

D Screeding shall be mechanically batch-mixed and shall be laid in alternating bays of max. 10 m^2. The maximum screed thickness shall be 25 mm and the falls to be achieved are not less than 1:200 or as shown on the drawings; finishing with a wooden float. Screeds shall be laid with even slopes and internal and external corners shall have coved fillets with a radius of at least 70 mm. After laying, the screed shall be covered with wet sand or equal and approved method and kept damp for 72 hours, or as ordered by the Engineer.

E The specification comprises waterproofing systems of non-metallic roofing compound of laminar, bituminised construction.

F Insulation sheets shall be covered with a layer of perforated bituminous glass fibre felt (weighing 34 kg/20 m^2) by hot bitumen 110/30 with the swing method. An interim coat of hot bitumen 110/30 shall be applied at a rate of 1.5 kg/m^2.

G A finishing layer shall be applied comprising an UV resistant mineralized atactic polypropylene (APP) modified bituminous polyester sheet with double glass fibre felt; weight approx. 4.5 kg/ m^2, 4.5 mm thick, one side mineralized with white granules, the other side provided with a burn foil. The sheet shall be applied to the underlay by means of a burner. At the interruption of work the edges of the sheets shall be finished in such a manner that rain, dust etc., cannot penetrate underneath. Particular areas, to be subjected to heavy duty use, such as gutters, trims, unprotected walkways, and areas near access doors, ladders, and the like shall receive two layers.

H Upstands, trims and other exposed parts shall have a reflecting/protecting finish, to the approval of the Engineer.

PS 7.04 Waterproofing to Building Concrete Surfaces before Finishes

A This Section includes interior and exterior concrete slabs to be waterproofed before receiving the final finish such as screed, screed with tiling, screed with masonry slabs, asphaltic concrete etc. This specification is based on a bituminous system reinforced with hessian or glass fibre sheeting.

B Concrete or brickwork, whether plastered or not, shall be well cleaned and free from damp, laitance, dust and dirt. If contaminated by oil or grease of whatever nature, the patches shall be removed and repaired. Uneven areas, rough areas and patches shall be treated with an epoxy-resin based non-pigmented primer, and shall be leveled with a homogeneously mixed two component epoxy-mortar, applied while the primer is not fully hardened (wet-in-wet-method). Both the primer and the epoxy mortar shall be of an approved quality. The smoothness and evenness of the surfaces of concrete or brickwork to which the water proofing system is to be applied shall be to the entire satisfaction of the Engineer.

C The primer shall be a cement paste (cement/water/resin dispersion) applied as a grout for key of the mortar. The mortar shall consist of cement, sand and resin dispersion. The compressive strength of the fully hardened mortar shall not be less than 20 N/mm^2. Both primer and mortar shall be of an approved make and be mixed and applied in strict accordance with the manufacturer's instructions. The mortar shall be finished smooth and straight using steel floats in a rotating movement and under even pressure, with rounded or covered fillets/edges as the positions or purposes dictate.

D Waterproofing of concrete slabs before receiving the ultimate finish shall be divided into two categories:
- WP 2 waterproofing to receive screed, asphalt or screed with tilling/slabs in heavy duty areas, subject to vehicle traffic;
- WP 3 waterproofing to receive screed or screed with tilling in light duty areas such as, but not limited to, shower rooms, terraces, kitchen.

E In heavy duty areas, the prepared concrete floor and abutting upstands/fillets shall be waterproofed by means of a PVC film/self-adhesive modified bitumen laminate, supplied in roll form or other approved system. The laminate, or other approved system, shall have a sanded surface finish to form a key for the screed. The laminate shall be applied in strict accordance with the manufacturers' instructions, including the necessary prime coats, tack coats etc.

F In light duty areas, the prepared concrete floor and abutting upstands/fillets shall be water proofed by means of chemical crystalline systems or other approved method. The chemical crystalline waterproofing system shall be applied in strict accordance with the manufacturer's instructions, including primers etc. The system shall be suitable to receive the screed.

Ps 7.05 Waterproofing to Finished Concrete in Buildings

A This Section includes waterproofing as a final finish of floor areas, consisting of either precast or cast in-situ concrete slabs without further finish, and precast or cast in-situ slabs/elements with a screeded finish. This specification is based on brush or spray applied liquid plastic membranes, primarily intended for waterproofing purposes, but also for fungal, insect and corrosion control.

B Preparation of the substructure shall be as specified with the further requirements that smoothness and evenness shall receive particular attention so as not to disturb the visible appearance of the finished work.

C Waterproofing of floor areas as a final finish shall be divided into two categories:
WP 4 waterproofing in heavy duty areas, subject to vehicle traffic and fully exposed to open air;
WP 5 waterproofing in light duty areas, subject to vehicle traffic but not directly exposed to open air, or subject to little traffic but fully exposed to open air.

D In heavy duty areas, the prepared concrete floor and abutting upstands/fillets, shall be waterproofed by means of a solvent based, high build, elastomeric barrier coating of a colour to be decided by the Engineer. In light duty areas, the prepared concrete floor and abutting upstands/fillets shall be water proofed by means of a liquid plastic membrane coating of a colour to be decided by the Engineer. The coatings shall be applied in strict accordance with the manufacturers' instructions, including the necessary primers, fabrics or matting etc.

Section 08520

PS 8.01 Aluminium Doors, Windows and Screens

A All aluminium work shall have a fluorocarbon finish. The term "Fluorocarbon" as used in this document is the generic term used to refer to polyvinylidene difluoride containing at least 70 percent Kynar 500 or Hylar 5000. Fluorocarbon coating shall be selected from the following or approved equal and shall conform to the requirements of AAMA 605.2.90.
a) Durannar based on Kynar 500 manufactured by PPG Industries, Pittsburgh, Pennsylvania, USA.
b) Duraset 2 from ICI, UK.
c) Fluorpon from De Soto, USA.

B The Contractor shall prepare three samples each, 200mm x 150mm of aluminum sheet painted with the colours selected by the Engineer. All samples shall be securely identified. In order to reduce problems of matching and maintenance, non-metallic satin finishes may be preferable but the Engineer's views will be given due consideration.

C The coating system, including materials and application, shall conform to the requirements and recommendations of the coating manufacturer and the following.
1) cleaning and pre-treatment system which shall remove organic and inorganic surface soils, grease, oils, residual oxides etc.
2) chemical conversion consisting of the following:

a alkali clean with mild etching.
b thorough water rinse.
c acid de-oxidation.
d thorough water rinse.
e amorphous chrome phosphate conversion coating.
f acidulated final rinse.

3) The conversion coating shall correspond to a density of 600 to 900mg/sq.m.
4) The above process shall be followed immediately by the application of the finishing coats without permitting any handling or intermediate storage of the pre-treated metal.
5) The finishing coats shall consist of a shop-applied, recommended inhibitive primer, colour coat and abrasion-resistant clear top coat, oven-baked separately according to the paint manufacturer's instructions. Application shall be by conventional air of electrostatic spray. The clear top coat shall be Fluroclear Hardcoat manufactured by The Valspar Corporation Ltd, or an approved equivalent. The minimum thickness of the coats shall be:
   a primer - 15 micron
   b colour coat - 30 micron
   c clear top coat - 20 micron

D The Contractor shall obtain from the paint manufacturer test reports in respect of the following for the specified thickness of the fluorocarbon paint offered, and submit same with his Tender.
a) dry film thickness
b) dry film hardness
c) dry film adhesion
d) wet film adhesion
e) gloss measurement
f) salt-spray resistance
g) humidity resistance
h) abrasion resistance
i) resistance to 10 percent hydrochloric acid solution
j) resistance to mortar
k) detergent resistance
l) colour retention
m) chalk resistance

E The clear top coat shall have a minimum manufacturer's recommended hardness when tested by Eagle Turquoise Pencil.

F In-process testing shall be performed on test specimens of 3mm thickness, pretreated and finished along with the production metal, specimens shall be at least 300mm x 75mm to permit instrument readings. All test samples shall be properly identified with the date, and batch and shift numbers. The following tests shall be conducted at least one per production shift and the results submitted to the Consultant routinely.
1 dry film thickness
2 film hardness
3 dry cross-hatch adhesion
4 boiling water adhesion
5 gloss measurement
6 colour examination against the specified standard cure
7 general appearance – smoothness, freedom from blisters, sags, pinholes and other surface imperfections.

G All fluorocarbon-coated surfaces shall have a good quality protective film applied as soon as possible after painting. This film shall not be removed until the installation of the Claddings is completed in its entirety. No fluorocarbon-coated element shall be cut,

trimmed, drilled or otherwise modified without the prior approval of the Engineer. In the event of any such cutting trimming, drilling or other modification being permitted, the contractor shall protect the cut edges with a high-grade protective application to the approval of the Engineer.

Section 09200

PS 9.01 Plaster and Rendering

A Internal plastering shall comply with BS 5492: 1990. External rendering shall comply with BS 5262: 1991.

B Expanded metal lathing shall be laid over all joints between blockwork / brickwork and concrete and all chases made in the blockwork / brickwork.

C Angle beads, corner beads, stop beads and strip laths shall be fixed to all corners, edges and across differing backgrounds and over chases.

D Lime shall be non-hydraulic lime to comply with BS 890 obtained from an approved source and run into putty 16 hours before use.

E All platforms, tools and utensils shall be washed before each fresh mix. Mixes shall be mechanically mixed, using clean fresh water. Mixes containing cement must be used within two hours. Reactivating a mix with water will not be allowed at any time, any unusual material shall be discarded and cleared away.

F Proportions for internal coats shall be as follows:

a) 1:5 cement sand plaster finished with 2-3 mm skim coar plaster and 1 coat primer and 2 coats of emulsion paint
b) 1:5 cement sand plaster finished with neat cement float and 2 coats epoxy paint

G Proportions for external coats shall be as follows:

a) semi-rough 1:1:5 cement lime sand plastered surface painted with one coat primer and 2 coats weather shield
b) semi-rough 1:3 grey cement sand plaster

H The Contractor shall prepare and apply trial mixes as directed by the Engineer to determine the appropriate proportions of mixes under the prevailing conditions.

I All plaster and rendering work shall be two coat work. Screeds shall be formed to serve as, guides to bring the work to an even surface. The maximum thickness of each coat shall not exceed 10 mm nor the finished thickness of two coat work 20 mm. The rendering coat shall be allowed to stand firm before scratching for key. The surface shall be combed. Time shall be allowed for thoroughly drying out to allow complete shrinkage before application of the setting coat but rapid drying out shall be avoided by periodic wetting or by handling moist hessian on the surface. The surface of the rendering coat shall be tested for suction with a wet brush, and damped down if necessary before application of the setting coat. The plaster shall be applied with a wood skimming float and traversed with a floating rule to a true and even surface. The surface shall be scoured with a wooden or steel hand float as specified in the Finishing Schedules, but overworking of the surface shall be avoided. The setting coat shall be kept damp for at least seven days after its application. The Contractor shall allow for all cornices, quirks, splays, arises, mitres, stops, returns, etc. Deviations in place of more than 3 mm from an 1800 mm straight edge will not be permitted.

J Internal plaster shall be wood trowel finished to give a smooth, sand-grain appearance. Only where shown or as directed by the Engineer shall external plaster be of wood trowel finish.

K The second coat of external plaster, when so indicated in the Finishing Schedules, shall be sprayed plaster, i.e. mortar evenly applied by a Tyrolean hand-spray machine or by gun. For application by gun, the Contractor may adapt the mix, as directed and/ or approved by the Engineer.

L Wherever smooth plaster is indicated the finish shall be obtained by scouring with a steel trowel, without crazing.

M Wherever sponge finish plaster is required, such finish shall be obtained by wiping and plugging the finished plaster when still green with a wet sponge to obtain a texture approved by the Consultant.

N The blockwork sides of pits, gulleys, etc., of the waste, sewerage, supply and other piping and cabling systems shall be rendered smooth with rounded edges etc. The bottom of pits, gulleys etc., in which fluids are flowing in the open, shall be provided with proper smooth, curved benching.

O All external walls of brick and blockwork shall be rendered and finished externally with waterproof plasterwork. Water proofing of mortar shall be achieved by means of an approved additive or a reputable manufacture, applied strictly in accordance with the manufacturer's instructions.

Section 09510

PS 9.02 Suspended Ceilings

A Suspended acoustic frame and tile ceilings consisting of mineral fibre tiles shall be of the following specifications:

Pattern	:	To be selected from samples provided
Colour	:	White
Tile-dimensions	:	600 x 600 x 15 mm
Absorption value	:	N.R.C.: 0.56 according to Mounting 7
Surface spread of flame (BS 476 Part 7)	:	Class 1

B Fibrous plasterboard shall be of approved manufacture, 12 mm thick comprising gypsum plaster reinforced with strands of fiberglass mainly distributed throughout at the ratio of 365 grams per m^2. Support systems shall be of timber framing and shall be designed by the Contractor in conjunction with the ceiling lining manufacturer. All ferrous metals shall be rust-proofed. Hangers shall be substantial and sufficient to prevent excessive deflection in the ceiling. Suspension by means of wires will not be permitted. Additional hangers and support work shall be provided at recessed light fittings, diffusers and access panels pelmets etc. Fix the support system and ceiling lining in accordance with manufacturer's recommendations ensuring compliance with design and performance requirements. Set out accurately to give level soffits free from undulations and lipping, with all lines and joints straight and parallel to walls. Cut and fit sheets around recessed light fittings, air-conditioning diffusers, sprinkler heads and the like. Form openings for access panels together with additional trimming and framing, etc. Samples of access panels must be submitted to the Engineer for approval. Flush up all joints with superfine gypsum plaster and leave homogeneous surface ready for painting. The grid system is to be installed in 600 x 1200 or 600 x 600 modules. The main carriers shall be hung by direct suspension

from floor slab or structure by means of 6 diameter galvanized wire with butterfly suspension keys. Hangers and main carriers shall be spaced and leveled in accordance with manufacturer's specifications and expected maximum load.

Section 09870

PS 9.03 Coating Systems for Ferrous Metals

All exposed piping, fittings, appurtenances and valves within valve chambers, vaults, boxes, etc. shall be coated with System B.

Section 10270

PS 10.01 Access Flooring

A Access flooring shall be provided in the monitoring room of the administration building. The flooring shall be 300 mm high with two equal height steps formed at the room entrance door as shown on the drawings. Access holes shall be provided in the flooring to suit the monitoring and computing equipment.

B The carpet tile finish shall be to an approved colour.

Section 11005

PS 11.01 Safety Guards

A The installation layout and plant design shall not allow any item of plant to be so positioned that danger to operating personnel could arise during normal operation and maintenance.

B All flywheels, rotating shafts, couplings, gears, belt drives or other moving parts shall be fully guarded. Guards shall be designed to provide ready access to bearings, grease points, thermometer pockets and other check points and to allow safe routine observation and servicing to be executed without the need to dismantle any part of their structure.

PS 11.02 Special Tools, Diagnostic Equipment and Test Equipment

A The Contractor shall supply a complete set of special tools and test equipment including diagnostic equipment necessary for routine maintenance, calibration, trouble shooting of the systems and testing of any part of the Plant to be carried out during the life of the Plant, whether of an electrical, mechanical, instrumentation or any other nature.

B The tools, diagnostic equipment and test equipment shall not be used for the erection of the Plant and shall be handed over in a new and unused condition excepting that the Engineer may call upon the Contractor to prove their effectiveness.

C The tools, diagnostic equipment and test equipment shall be boxed separately in suitable containers marked or labeled with their contents.

D All cases, containers or other packages shall be designed to facilitate opening and subsequent repacking.

E Tools, diagnostic equipment and test equipment for internally sited plant shall be mounted in suitable cabinets with lockable doors. Racks or clips shall be provided for individual items with outline markings and labels showing which tools or equipment are missing.

The cabinets shall be wall mounted with best quality finish and appearances.

F Detailed list of special tools, diagnostic equipment and test equipment shall be provided with the tender as recommended by the manufacturer of the respective systems.

G Training shall be provided by the Contractor on using the special tools and the test equipment.

PS 11.03 Electric Motors

Motors shall be sized to be 10 percent over and above the power required by the pump at duty point and shall be capable of starting and running the pump throughout the operational range of the pump. The service factor shall not be used for sizing the motor.

PS 11.04 Switchboards

All high tension / low voltage switchboards and motor control centre rooms shall be provided with suitable rubber insulation mats 600mm wide to BS 921 on each accessible side of panel. The mats shall meet local and international safety regulations.

PS 11.05 Vibration Measuring Equipment

Portable vibration measuring system shall be provided for measurement of pump and motor vibrations for each pumping station installation.

Section 11070

PS 11.06 Raw Water Pumps

A The pumps shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	01 RP 11 and 01 RP 21
Purpose	to pump raw river water to the distribution chamber through balancing tank
Pump type	split casing, vertical centrifugal pumps (variable speed control)
Number	2 (1 duty, 1 standby)
Rated capacity	26.74 m^3/min
Rated head	44 m TDH
Speed	888 rpm to 1480 rpm
Efficiency	not less than 87 percent at duty point not less than 87 percent at water level of + 440.270 m amsl
NPSHA	approx. +10 m
Max. noise level	85 dB(A) at 1.0 m
Driving method	through shafting from motor at ground level
Installation	indoor
Motor encl. protection	IP 55
Wet well water levels	HWL +440.740 m amsl Median WL + 440.270 m amsl LWL +436.930 m amsl
Pump room floor level	+433.160 m amsl
TWL at discharge	+477.000 m amsl
Motor room floor level	+443.000 m amsl

Transmission main	800 mm diameter, approx. 400 m long (this main and an additional 900 mm main will also accommodate the Stage II flow of 80.21 m^3/min)

B The variable speed control is to provide a stable flow to the treatment plant with the fluctuating river levels. The system curve for the raw water pump station is given in the Technical Schedules.

C Space is left in the station for third and fourth pumps which will be provided in Stages 2 and 3. The connection pipework and valving for the third and fourth pumps will be provided in this stage and blanked off.

D The intermediate bearing unit shall be supplied by the pump manufacturer and the pump manufacturer shall have the experience of furnishing unit of the same configuration. At the time of shop test, pump may be operated directly coupled with motor without the above intermediate power transmission facilities.

E The pump manufacturer shall substantiate quoted efficiency with at least one owner's certificate and corresponding test record of specific speed similar to the large impeller with suction diameter of not less than 350 mm.

F The Contractor shall provide the supporting steelwork for the pump motors. The steelwork shall be removable for direct access to the lower levels. The entire access hole in the ground floor slab shall be provided with sectionalised, removable covers of checker plate steelwork and necessary supports designed for the equipment supplied.

G The manufacturer shall conduct physical or computerized hydraulic modelling for Raw Water Pumps to be supplied in the Intake Station. The model shall encompass the inlet channels and wetwells and, as a start, match the inlet channels, wet well shown on the Drawings.

1 Wetwell modelling shall be required to assure that the wet well configuration shall not adversely impact pump performance.
2 The manufacture shall submit the procedure for the modelling prior to the test and obtain the engineer's approval.
3 Tests shall also be made using suitable materials to simulate the pattern of flow, accumulation of these materials in the pump with and without the modifications.
4 On completion of the test, the Contractor shall submit six (6) copies of a comprehensive report and recommendation, including drawings, photographs and related to the test to the Engineer for acceptance. Upon acceptance, the Contractor shall also submit reinforced concrete or other structural design based on the recommendation of the report.

H The pump manufacturer shall substantiate manufacturing and supplying of pumps and motors with the following conditions satisfactorily completed outside of home country during last 10 years.

1 Vertical centrifugal pump of similar capacity and head with floating shaft and intermediate bearing unit.
2 Vertical centrifugal pump with quoted pump efficiency at lower speed and capacity than specified.

PS 11.07 Clear Water Pumps for Upland and Asgiriya (A-1)

A The pumps shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	09 CP 11 and 09 CP 12
Purpose	to pump treated water to Upland and Asgiriya service reservoirs and Bahirawakanda service reservoir through

	Asgiriya booster pump station
Pump type	split casing horizontal centrifugal pumps
Number	2 (1 duty, 1 standby)
Rated capacity	Stage 1 12.22 m^3/min
	Stage 3 11.83 m^3/min
Rated head	Stage 1 134 m TDH
	Stage 3 137 m TDH
Speed	less than 1500 rpm
Efficiency	not less than 80 percent for Stage 1 duty point
	not less than 80 percent for Stage 3 duty point
Fly wheel	not less than 100 kg.m^2
NPSHA	approx +9.5 m
Max. noise level	85 dB(A) at 1.0 m
Driving method	direct
Installation	indoor
Motor encl. protection	IP 55
Wet well water levels	HWL +445.820 m amsl
	LWL +442.820 m amsl
Pump room floor level	+ 439.780 m amsl
HWL at discharge	Uplands - 566.000 m amsl
	Asgiriya - 567.000 m amsl
	Bahirawakanda - 629.000 m amsl
Transmission main	refer to transmission pipeline drawings

B Space is left in the station for third and fourth pumps which will be provided in Stages 2 and 3. The connection pipework and valving for these future pumps will be provided in this stage and blanked off as per drawings.

C The pumps shall be furnished with the small impellers for the Stage 1 duty above and a larger impeller for the Stage 3 duty shall be provided as spare parts.

D The pumps shall be installed on a steel fabricated common baseplate with driving motor and flywheel unit. The pump and each piece of equipment shall be connected by flexible gear coupling. The flywheel unit shall comprise with flywheel shaft, support at the both side of shaft with grease lubricated air cooled plummer blocks. The bearing cover shall be tapped for replenishing the grease. The flywheel with plummer blocks should be supplied by the pump manufacturer and the pump manufacturer shall have the experience of furnishing unit of the same configuration and similar magnitude.

E The pump manufacturer shall carry out surge analysis on the force main on the basis of data of rotating element, characteristic of reflux valve and force main to ensure if moment of inertia of the rotating elements has to be increased or not. If the moment of inertia has to be increased, a flywheel shall be added between pump and motor, and additional shaft and plummer blocks shall be provided if necessary. The magnitude of flywheel and detailed construction of the plummer block shall be proposed by the pump manufacturer for the engineer's approval along with report of surge analysis. The pump manufacturer shall have experience of surge analysis of similar magnitude and supply of flywheel together with horizontal shaft pump.

F The pump manufacturer shall substantiate manufacturing and supplying of pumps and motors with the following conditions satisfactorily completed outside of home country during last 10 years.

1 Horizontal centrifugal pump of similar capacity and head with flywheel unit more than 100 kg-m^2 (GD^2).

2 Horizontal centrifugal pump with quoted pump efficiency at lower speed and

capacity than specified.

PS 11.08 Clear Water Pumps for Akurana, Kahawatta, Kahalla, Balanagala, Pihilladeniya and Bangalawatta (A-3)

A The pumps shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	09 CP 31 and 09 CP 32	
Purpose	to pump treated water to Akurana, Kahalla, Balanagala, Pihilladeniya, and Bangalawatta service reservoirs	
Pump type	split casing horizontal centrifugal pumps	
Number	2 (1 duty, 1 standby)	
Rated capacity	Stage 1	9.99 m^3/min
	Stage 3	10.24 m^3/min
Rated head	Stage 1	93 m TDH
	Stage 3	102 m TDH
Speed	less than 1500 rpm	
Efficiency	not less than 79 percent for Stage 1 duty point	
	not less than 79 percent for Stage 3 duty point	
Fly wheel	not less than 50 kg.m^2	
NPSHA	approx +9.5 m	
Driving method	direct	
Installation	indoor	
Wet well water levels	HWL +445.820 m amsl	
	LWL +442.820 m amsl	
Pump room floor level	+ 439.780 m amsl	
HWL at discharge	Akurana	+512.000 m amsl
	Kahawatta	+522.250 m amsl
	Kahalla	+491.250 m amsl
	Balanagala	+515.000 m amsl
	Pihilladeniya	+524.140 m amsl
	Bangalawatta	+521.280 m amsl
Transmission main	refer to transmission pipeline drawings	

B The pumps shall be furnished with the small impellers for the Stage 1 duty above and the larger impellers for the Stage 3 duty shall be provided as spare parts.

C The pumps shall be installed on a steel fabricated common baseplate with driving motor and flywheel unit. The pump and each piece of equipment shall be connected by flexible gear coupling. The flywheel unit shall comprise with flywheel shaft, support at the both side of shaft with grease lubricated air cooled plummer blocks. The bearing cover shall be tapped for replenishing the grease. The flywheel with plummer blocks should be supplied by the pump manufacturer and the pump manufacturer shall have the experience of furnishing unit of the same configuration and similar magnitude.

D The pump manufacturer shall carry out surge analysis on the force main on the basis of data of rotating element, characteristic of reflux valve and force main to ensure if moment of inertia of the rotating elements has to be increased or not. If the moment of inertia has to be increased, a flywheel shall be added between pump and motor, and additional shaft and plummer blocks shall be provided if necessary. The magnitude of flywheel and detailed construction of the plummer block shall be proposed by the pump manufacturer for the engineer's approval along with report of surge analysis. The pump manufacturer shall have experience of surge analysis of similar magnitude and supply of flywheel together with horizontal shaft pump.

E The pump manufacturer shall substantiate quoted efficiency with at least one owner's certificate and corresponding test record of specific speed similar to the large impeller with suction diameter less than 300 mm.

F The pump manufacturer shall substantiate manufacturing and supplying of pumps and motors with the following conditions satisfactorily completed outside of home country during last 10 years.

1 Horizontal centrifugal pump of similar capacity and head with flywheel unit more than 50 kg-m^2 (GD^2).

2 Horizontal centrifugal pump with quoted pump efficiency at lower speed and capacity than specified.

Section 11071

PS 11.09 Sample Pumps

The pumps shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	06 SP 01
Purpose	to pump water for sampling to the administration building
Pump type	horizontal shaft self priming volute pumps
Number	1 + 1 spare
Rated capacity	60 l/min
Rated head	12 m TDH
NPSHA	approx +6.5 m
Motor encl. protection	IP 55

PS 11.10 Backwash Water Pumps

The pumps shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	07 BP 11, 07 BP 21 and 07 BP 31
Purpose	to pump filtered water for back washing
Pump type	horizontal centrifugal pumps
Number	3 (2 duty, 1 standby)
Rated capacity	7.72 m^3/min each pump
Rated head	8 m TDH
Speed	1450 rpm
Efficiency	not less than 75 percent
NPSHA	approx +11 m
Max. noise level	85 dB(A) at 1.0 m
Driving method	direct
Installation	indoor
Motor encl. protection	IP 55
Wet well water levels	HWL +446.500 m amsl
	LWL +446.000 m amsl
Pump room floor level	+444.410 m amsl
TWL at discharge	+447.310 m amsl
Backwash water main	350 mm diameter

PS 11.11 Chlorination Booster Pumps

The pumps shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	09 PP 11and 09 PP 21
Purpose	to pump treated water to the chlorinators
Pump type	horizontal centrifugal pumps

Number	2 (1 duty, 1 standby)
Rated capacity	260 l/min each pump
Rated head	45 m TDH
Speed	less than 1500 rpm
Efficiency	not less than 55 %
NPSHA	approx +9.5 m
Max. noise level	85 dB(A) at 1.0 m
Driving method	direct
Installation	indoor
Motor encl. protection	IP 55
Wet well water levels	HWL +445.820 m amsl
	LWL +442.820 m amsl
Pump room floor level	+ 439.780 m amsl
Chlorinator floor level	+ 447.700 m amsl
Transmission main	100 mm diameter, approx 100 m long

PS 11.12 Plant Water Supply Unit

The unit shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	09 PU 11
Purpose	to pump treated water for distribution system in the plant
Pump type	horizontal centrifugal pumps with pressure tank
Number	1 set (two pumps, one pressure tank and accessories)
Rated capacity	1.6 m^3/min
Rated head	28 to 39 m TDH
Speed	less than 1450 rpm
Efficiency	not less than 70%
NPSHA	approx +9.5 m
Max. noise level	85 dB(A) at 1.0 m
Driving method	direct
Installation	indoor
Motor encl. protection	IP 55
Pressure tank	4.0 m3
Wet well water levels	HWL +445.820 m amsl
	LWL +442.820 m amsl
Pump room floor level	+ 439.780 m amsl
Transmission main	200 mm diameter

PS 11.13 Backwash Recovery Pumps

The pumps shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	11 WP 11 and 11 WP 21
Purpose	to pump spent backwash water to the distribution chamber
Pump type	horizontal slurry pumps
Number	2 (1 duty, 1 standby)
Rated capacity	4.45 m^3/min each pump
Rated head	15 m TDH
Speed	not more than 1500 rpm
Efficiency	not less than 60 percent
Driving method	direct
Installation	indoor
Motor encl. protection	IP 55
Wet well water levels	HWL +444.010 m amsl

	LWL +441.010 m amsl
Pump room floor level	+439.210 m amsl
Recovered b/wash main	250 mm diameter, approx. 200 m long

PS 11.14 Booster Pumps at Kahawatta for Kurugada, and Thelambugahawatta (E)

The pumps shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	304 BP 11 and 304 BP 21	
Purpose	to pump treated water to Kurugada, and Thelambugahawatta	
Pump type	horizontal End-suction centrifugal pumps	
Number	2 (1 duty, 1 standby)	
Rated capacity	2.94 m^3/min each pump	
Rated head	64 m TDH	
Speed	not more than 3000 rpm	
Efficiency	not less than 65 percent	
Driving method	direct	
Installation	indoor	
Motor encl. protection	IP 55	
Wet well water levels	HWL +516.000 m amsl	
	LWL +522.250 m amsl	
Pump room floor level	+499.500 m amsl	
HWL at discharge	Kurugada	+573.000 m amsl
	Thelambugahawatta	+566.750 m amsl
Transmission main	refer to transmission pipeline drawings	

PS 11.15 Booster Pumps at Kondadeniya for Kulugammana (H)

The pumps shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	310 BP 11 and 310 BP 21	
Purpose	to pump treated water to Kurugammana	
Pump type	horizontal End-suction centrifugal pumps	
Number	2 (1 duty, 1 standby)	
Rated capacity	1.11 m^3/min each pump	
Rated head	64 m TDH	
Speed	not more than 3000 rpm	
Efficiency	not less than 55 percent	
Driving method	direct	
Installation	indoor	
Motor encl. protection	IP 55	
Wet well water levels	HWL +535.250 m amsl	
	LWL +531.250 m amsl	
Pump room floor level	+531.470 m amsl	
HWL at discharge	Kurugammana	+583.259 m amsl
Transmission main	refer to transmission pipeline drawings	

PS 11.16 Booster Pumps at Asgiriya for Bahirawakanda (G)

The pumps shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	315 BP 11 and 315 BP 21
Purpose	to pump treated water to Bahirawakanda
Pump type	horizontal End-suction centrifugal pumps
Number	2 (1 duty, 1 standby)
Rated capacity	1.58 m^3/min each pump
Rated head	68 m TDH

Speed	not more than 3000 rpm
Efficiency	not less than 65 percent
Driving method	direct
Installation	indoor
Motor encl. protection	IP 55
Pump room floor level	+536.200 m amsl
HWL at discharge	Bahirawakanda +629.000 m amsl
Transmission main	refer to transmission pipeline drawings

PS 11.17 Booster Pumps at R2 for Hantana Place (F)

The pumps shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	318 BP 11 and 318 BP 21
Purpose	to pump treated water to Hantana Place
Pump type	horizontal End-suction centrifugal pumps
Number	2 (1 duty, 1 standby)
Rated capacity	1.36 m^3/min each pump
Rated head	102 m TDH
Speed	not more than 3000 rpm
Efficiency	not less than 55 percent
Driving method	direct
Installation	indoor
Motor encl. protection	IP 55
Wet well water levels	HWL +555.000 m amsl
	LWL +549.490 m amsl
Pump room floor level	+548.000 m amsl
HWL at discharge	Hantana Place +641.000 m amsl
Transmission main	refer to transmission pipeline drawings

PS 11.18 Booster Pumps at Heerassagala Low for Heerassagala Middle (B)

The pumps shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	320 BP 11 and 320 BP 21
Purpose	to pump treated water to Heerassagala Middle
Pump type	horizontal end-suction centrifugal pumps
Number	2 (1 duty, 1 standby)
Rated capacity	1.90 m^3/min each pump
Rated head	68 m TDH
Speed	not more than 3000 rpm
Efficiency	not less than 65 percent
Driving method	direct
Installation	indoor
Motor encl. protection	IP 55
Wet well water levels	HWL +570.000 m amsl
	LWL +566.000 m amsl
Pump room floor level	+565.100 m amsl
HWL at discharge	Heerassagala Middle +617.000 m amsl
Transmission main	refer to transmission pipeline drawings

PS 11.19 Booster Pumps at Heerassagala Middle for Heerassagala Upper (C)

The pumps shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	321 BP 11 and 321 BP 21

Purpose	to pump treated water to Heerassagala Upper
Pump type	horizontal end-suction centrifugal pumps
Number	2 (1 duty, 1 standby)
Rated capacity	0.49 m^3/min each pump
Rated head	77 m TDH
Speed	not more than 3000 rpm
Efficiency	not less than 55 percent
Driving method	direct
Installation	indoor
Motor encl. protection	IP 55
Wet well water levels	HWL +617.000 m amsl
	LWL +613.000 m amsl
Pump room floor level	+610.200 m amsl
HWL at discharge	Heerassagala Upper +678.000 m amsl
Transmission main	refer to transmission pipeline drawings

PS 11.20 Booster Pumps at Ampitiya for Elhena (D-1)

The pumps shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	324 BP 11 and 324 BP 21
Purpose	to pump treated water to Elhena
Pump type	horizontal end-suction centrifugal pumps
Number	2 (1 duty, 1 standby)
Rated capacity	0.83 m^3/min each pump
Rated head	45 m TDH
Speed	not more than 3000 rpm
Efficiency	not less than 60 percent
Driving method	direct
Installation	indoor
Motor encl. protection	IP 55
Wet well water levels	HWL +586.000 m amsl
	LWL +582.500 m amsl
Pump room floor level	+583.500 m amsl
HWL at discharge	Elhena +615.000 m amsl
Transmission main	refer to transmission pipeline drawings

PS 11.21 Booster Pumps at Ampitiya for Meekanuwa (D-3)

The pumps shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	324 BP 31 and 324 BP 41
Purpose	to pump treated water to Meekanuwa
Pump type	horizontal end-suction centrifugal pumps
Number	2 (1 duty, 1 standby)
Rated capacity	1.49 m^3/min each pump
Rated head	73 m TDH
Speed	not more than 3000 rpm
Efficiency	not less than 65 percent
Driving method	direct
Installation	indoor
Motor encl. protection	IP 55
Wet well water levels	HWL +586.000 m amsl
	LWL +582.500 m amsl
Pump room floor level	+583.500 m amsl

HWL at discharge	Meekanuwa	+635.000 m amsl
Transmission main	refer to transmission pipeline drawings	

Section 11072

PS 11.22 Multi-Stage Centrifugal Pumps

A The Contractor shall furnish and install the specified horizontal or vertical multi-stage centrifugal pumps complete with motors and appurtenances as shown on the drawings and as specified herein.

B Submittals

1 The Contractor shall submit complete information including fabrication, assembly, foundation, and installation data together with detailed specifications and performance information covering materials of construction, power drive assembly, parts, devices, wiring diagrams, and all other accessories of the equipment furnished. The submittals shall include, but not be limited to the following:

a Manufacturer's product data.

b Shop Drawings.

c Motor data, including:

i Manufacturer.

ii Minimum guaranteed efficiency.

iii Power factor at full load, 3/4 load, and 1/2 load.

iv Locked rotor current.

v Motor speed.

vi Mounting details.

d Pump characteristic curves.

i Plot flow, total dynamic head, brake power, shutoff head, efficiency, and net positive suction head required for full operating range of pump.

ii Plot minimum of four curves for variable speed pumps covering required speed range (for variable speed pumps).

iii Show recommended limits of continuous operation.

iv Reflect operation with the specified fluid (e.g. include the effects of fluid viscosity).

e Certificates of compliance.

f Certified test reports.

g Operation and maintenance manuals.

h Training program.

C Quality

The equipment to be furnished shall be new and shall be a standard product of a manufacturer experienced in the design, fabrication and construction of pumping equipment. The pumps shall be the product of an experienced manufacturer and:

1. must demonstrate equal or larger capacity installations using similar equipment and equipment installed and successfully operating for at least 5 years;
2. provide names and phone numbers of contacts at referenced installations to verify performance;
3. demonstrate to satisfaction of Engineer that equipment to be provided is equal to that specified;
4. the pump manufacturer's machining and assembly shops must be ISO 9001 certified in order to assure conformance to the highest quality standards.

D General

Pumps and drives shall be rated for continuous duty and shall be capable of pumping the specified flow range without surging, cavitation, or vibration. The pumps shall not overload

the motors for any point on the maximum speed pump performance characteristic curve within the limits of stable pump operation as recommended by the manufacturer to prevent surging, cavitation, and vibration, as well as throughout the entire pump operating range. The service factors for the motors shall not be applied when sizing the motors. To ensure vibration-free operation, all rotating components of each pumping unit shall be statically and dynamically balanced. The mass of the unit and its distribution shall be such that resonance at normal operating speeds is avoided. In any case, the amplitude of vibration as measured at any point on the pumping unit shall not exceed the limits set forth in the latest edition of the Hydraulic Institute Standards or Japan Industrial Standards. Excessive vibration shall be sufficient cause for rejection of the equipment. All parts of each pump shall be designed to withstand the stresses that will be imposed upon them during their handling, shipping, erection, and operation. The completed units, when assembled and operating, shall be free of cavitation, vibration, noise, and water leaks over the range of operation. All units shall be so constructed that dismantling and repairing can be accomplished without difficulty.

E Materials of Construction:

1. Casing: Grey iron casting (BS1452, JIS G5501 FC200, or ASTM A48 Grade 35, or better)
2. Impeller: Bronze Casting (BS 1400, JIS H5120 CAC 402, ASTM B584 C90300, or better)
3. Wearplate: Bronze Casting (BS 1400, JIS H5120 CAC 402, ASTM B584 C90300, or better)
4. Shaft: Carbon Steel (BS970/I, JIS G4051 S45C stainless steel ASTM A582. JIS G4303 SUS420 J2 or better)
5. Shaft sleeve: Bronze Casting (BS1400, ASTM BS84 C83600, JIS H5120 CAC 406 or better)
6. Packing/Gland Housing: Gray Iron, ASTM A48, Grade 30 – 35 or better

F Pump Construction

The following requirements shall apply:

1 Casing.
Grey iron castings (BS1452, JIS G5501 FC200, or ASTM A48 Grade 35, or better). The casing shall be multi-stage turbine type and flanged and bolted together or machined and screwed into each other. The faces of each casing shall be accurately machined for tight and accurate fit. The suction and discharge flanges shall conform to BS4504 PN16 or more to meet the delivery pressure. Pipe taps for pressure gauges, vent, drain, etc. shall be provided

2 Impeller
Bronze casting (BS 1400, JIS H5120 CAC 402, ASTM B584 C90300, or better). The impeller shall be of multi-stage and finished smooth. The impeller shall be dynamically balanced, tightly mounted on the pump shaft with a key/cotter to that it shall not become loose due to rotation either in the forward or in the reverse direction.

3 Casing Wearing Rings
Bronze casting (BS 1400, JIS H5120 CAC 402, ASTM B584 C90300, or better) removable wearing rings shall be provided on pump casing.

4 Shaft and Sleeves
Carbon Steel (BS970/I, JIS G4051 S45C, stainless steel ASTM A582, JIS G4303 SUS420 J2 or better). Carbon steel shaft shall be protected from wear and corrosion by removable sleeves. Sleeves shall be of bronze casting conforming to BS1400, ASTM BS84 C83600, JIS H5120 CAC 406 or better. The sleeves shall extend from the impeller to the outside of the stuffing boxes.

5 The bearings shall be of heavy-duty anti-friction ball, or spherical roller type or sleeve type. The bearings shall be installed in bearing case to prevent the ingress of water to each bearing.

6 Stuffing boxes shall be large and deep and shall be provided with at least four rings of square packing and a lantern ring. Packing glands shall be of bronze casting, split

horizontally to facilitate for installing packings. Piping with orifice and globe valve shall be provided for sealing water to each stuffing box from discharge volute casing. Drain pipes from the pumps shall be properly led to drain trenches in pump houses.

7 Bed Plates shall be of fabricated steel with web reinforcing or grey iron casting so designed that they can be grouted after alignment and leveling.

8 Coupling between pump and motor shall be the gear flexible type, shall have sufficient capacity to develop the full strength of the shafting which they connect. The coupling shall be enclosed and sealed to retain the lubricant and exclude dust and moisture from the gear surface. Coupling shall be provided with guard.

9 Pressure gauges not less than 100 mm diameter shall be provided at both the suction and discharge sides of each pump. The gauge ranges shall be approximately double the maximum operating pressure. The gauge on the suction side shall be compound gauge. The gauge shall have brass case and ring, 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.

G Motor

Motors shall be sized to drive the pumps throughout the pump operating curve on 400V, 3 phase, 50 Hz power. Motors shall be connected to the pump using a coupling with guards. Motors shall be squirrel cage induction type with TEFC enclosure, 1.15 service factor as specified in Section 11510.

H Accessories

Each pump shall be furnished with, but not limited to the following accessories:

Couplings with guard	: One (1) set
Bed plate (common)	: One (1) set
Compound and pressure gauge	: Complete set
Flange adapter with tie rods for discharge pipe	: Complete set
Foundation bolts and nuts	: One (1) set
Air vent and others piping	: One (1) set
Suction and delivery reducer with flange	: Complete set
Special tools for maintenance as recommended by the Manufacturer or as instructed by the Engineer	: One (1) set (for each pump station)

I Spare Parts

1 The Contractor shall provide the following spare parts for each unit of pump, and supply other items as recommended by the Manufacturer as spares for 5 years operation.

Complete set of bearings for pump	: One (1) set
Complete set of bearings for motor	: One (1) set
Complete set of pressure gauges	: Two (2) sets
Complete set of wearing rings	: Two (2) sets
Complete set of all gaskets	: Two (2) sets
Complete set of all packing	: Two (2) sets
Shaft sleeves	: One (1) set
Lantern rings	: Two (2) sets
Complete sets of all special bolts, screws and nuts	: Two (2) sets
Complete pump rotor assembly	: One (1) set

2 All spare parts shall be properly preserved and packed for a long period of storage, and in a hot and humid climate and shall be properly marked in the English language on the outside to permit easy identification of the contents without opening and exposing the contents.

J Installation

Conform to the requirements of Section 11005.

K Equipment Shop Testing

1 Each major component of the pumping equipment shall be subjected to a complete shop test as specified herein, witnessed by the Engineer if so desired. All costs for the shop tests shall be borne by the Contractor.

2 Each assembled pump shall be shop tested by the manufacturer to determine the following characteristics for the minimum and maximum speed and two intermediate speeds at which the pumps will be operated. All tests shall be performed in accordance with the latest Hydraulic Institute Standards or JIS B 8301 and 8302.

i head-capacity curve,

ii power curve,

iii efficiency curve.

3 Each motor shall be shop tested by the manufacturer in accordance with the requirements of Division 16.

L Start-Up

1 The Contractor shall provide the services of the pump manufacturer's representative for two days to operate the pumps of each type.

2 The pump performance shall be documented by obtaining concurrent readings showing motor voltage and amperage, pump suction head, pump discharge head, and pump speed (rpm). Readings shall be documented for at least three pumping conditions to ascertain the actual pumping curve. One test shall be at shutoff head. Each power lead to the motor shall be checked for proper current balance.

3 Bearing temperatures shall be determined by a contact type thermometer. Alternatively, lubricant temperature may be measured. A running time or at least twenty minutes shall be maintained for this test.

4 The pump shall be visually and manually checked for excessive vibration. If the pump vibration is excessive, it shall be checked and recorded. The vibration of the pump measured at any point on the pump and motor when operating at full speed shall not exceed the following:

Speed, rpm	Vibration Amplitude
minimum speed	as H.I. Standards
full speed	as H.I. Standards

5 If pumps fail to meet specified requirements, adjustments shall be made and the test re-run until performance meets the requirements. Test results shall be recorded for each pump for each test and full reports shall be submitted to the Engineer. The costs of re-testing and reporting shall be borne by the Contractor.

M Instruction

The Contractor shall conform to the requirements of Section 11005 and provide a minimum of one day of instruction for each pump class.

PS 11.23 Clear Water Pumps for Kondadeniya and Gohagoda (A-2)

A The pumps shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	09 CP 21 and 09 CP 22	
Purpose	to pump treated water to Kondadeniya, Gohagoda (Wegiriya) and Gohagoda (Pallemulla) service reservoirs	
Pump type	horizontal multi-stage centrifugal pumps	
Number	2 (1 duty, 1 standby)	
Rated capacity	Stage 1	3.27 m^3/min
	Stage 3	4.08 m^3/min
Rated head	Stage 1	93 m TDH
	Stage 3	102 m TDH
Speed	less than 1500 rpm	
Efficiency	not less than 72 percent for Stage 1 duty point	

	not less than 74 percent for Stage 3 duty point	
Fly wheel	not less than 20 kg.m^2	
NPSHA	approx +9.5 m	
Driving method	direct	
Installation	indoor	
Wet well water levels	HWL +445.820 m amsl	
	LWL +442.820 m amsl	
Pump room floor level	+ 439.780 m amsl	
HWL at discharge	Kondadeniya	535.250 m amsl
	Gohagoda (Wegiriya)	528.410 m amsl
	Gohagoda (Pallemulla)	524.100 m amsl
Transmission main	refer to transmission pipeline drawings	

B The pump manufacturer shall carry out surge analysis on the force main on the basis of data of rotating element, characteristic of reflux valve and force main to ensure if moment of inertia of the rotating elements has to be increased or not. If the moment of inertia has to be increased, a flywheel shall be added between pump and motor with shaft and plummer block. The magnitude of flywheel and detailed construction of the plummer block shall be proposed by the pump manufacturer for the engineer's approval along with report of surge analysis. The pump manufacturer shall have experience of surge analysis of similar magnitude and supply of flywheel together with horizontal shaft pump.

C The pump manufacturer shall substantiate quoted efficiency with at least one owner's certificate and corresponding test record of specific speed similar to the large impeller with suction diameter less than 300 mm.

D Pump manufacturer shall substantiate quoted efficiency with at least one owner's certificate and corresponding test record of specific speed similar to the large impeller with suction diameter less than 150 mm.

PS 11.24 Booster Pumps at Ampitiya for Mullepihilla (D-2)

The pumps shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	324 BP 31 and 324 BP 41	
Purpose	to pump treated water to Mullepihilla	
Pump type	horizontal multi-stage centrifugal pumps	
Number	2 (1 duty, 1 standby)	
Rated capacity	0.68 m^3/min each pump	
Rated head	146 m TDH	
Speed	not more than 3000 rpm	
Efficiency	not less than 60 percent	
Fly wheel	not less than 2 kg.m^2	
Driving method	direct	
Installation	indoor	
Motor encl. protection	IP 55	
Wet well water levels	HWL +586.000 m amsl	
	LWL +582.500 m amsl	
Pump room floor level	+583.500 m amsl	
HWL at discharge	Mullepihilla	+713.000 m amsl
Transmission main	refer to transmission pipeline drawings	

Section 11079

PS 11.25 Screen Wash Pumps

The pumps shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	01 SW 01 and 01 SW 02
Purpose	to pump raw water to screens for washing
Pump type	submersible pumps
Number	2
Rated capacity	0.6 m^3 /min each pump
Rated head	42 m TDH
Speed	not more than 1500 rpm
Efficiency	not less than 60 percent
Driving method	direct
Chlorinator floor level	+447.700 m amsl
Transmission main	100 mm diameter, approx. 100 m long

Section 11190

PS 11.26 Progressive Cavity Pumps (Alum Pumps)

The pumps shall meet the operational and dimensional requirements as follows:

Type	progressing cavity pump
Number	2 (1 duty, 1 standby)
Pump Tag Nos.	10 AP 11 and 10 AP 21
Purpose	to dose alum solution to dosing point
Rated capacity	1.3 to 12 l/min
Rated head	10 m TDH
Materials	
Pump body	stainless steel casting
stator	nitrile rubber
rotor	stainless steel JIS G 4313 SUS 304
pump shaft	stainless steel JIS G 4313 SUS 304
Driving method	direct driving with variable speed motor
Motor	totally enclose, fan cooled, indoor type, insulation class F 0.4 kW x 4-pole
Motor encl. protection	IP 55
Power Supply	400 V x 50 Hz x 3-phase.

PS 11.27 Progressive Cavity Pumps (Lime Feed Pump at Filtration Units)

The pumps shall meet the operational and dimensional requirements as follows:

Type	progressing cavity pump
Number	2 (1 duty, 1 standby)
Pump Tag Nos.	07 LP 11 and 07 LP 21
Purpose	to dose alum solution to dosing point (part lime)
Rated capacity	1.3 to 8 l/min
Rated head	5 m TDH
Materials	
Pump body	cast iron JISG 5501 FC 2500
stator	nitrile rubber
rotor	alloy tool steels, JIS G 4404 SKS
pump shaft	carbon steel JIS G 4051 S445C
Driving method	direct driving with variable speed motor
Motor	totally enclose, fan cooled, indoor type, insulation class F 0.4 kW x 4-pole

Motor encl. protection	IP 55
Power Supply	400 V x 50 Hz x 3-phase.

PS 11.28 Progressive Cavity Pumps (Lime Feed Pump at Chemical Building)

The pumps shall meet the operational and dimensional requirements as follows:

Type	progressing cavity pump
Number	four
Pump Tag Nos.	10 LP 31 and 10 LP 41
Purpose	to dose alum solution to dosing point (pre-lime)
Rated capacity	1.3 to 12 l/min
Rated head	10 m TDH
Materials	
Pump body	cast iron JIS G 5501 FC 250
stator	nitrile rubber
rotor	alloy tool steels, JIS G 4404 SKS
pump shaft	carbon steel, JIS G 4051 S45C
Driving method	direct driving with variable speed motor
Motor	totally enclose, fan cooled, indoor type, insulation class F 0.4 kW x 4-pole
Motor encl. protection	IP 55
Power Supply	400 V x 50 Hz x 3-phase.

Section 11196

PS 11.29 Sump Pumps

The pumps shall meet the operational and dimensional requirements as follows:

Pump Tag Nos.	01 DP 01; 01 DP 02; 07 DP 01; 07 DP 02; 09 DP 01; 09 DP 02
Purpose	to pump drainage water from low level structures
Pump type	submersible sump pumps
Number	6 + 2 spare
Rated capacity	0.1 m^3/min
Rated head	15 m TDH
Speed	2900 rpm
Driving method	close coupled
Installation	submersible
Motor encl. protection	IP 68

Section 11199

PS 11.30 Surge Control

Surge control for the clear water pumps and the booster pumps will be as follows:

Clear Water Pumps (A-1) (09 CP 11 and 09 CP 12)	Flywheel 100 kg-m^2 each
Clear Water Pumps (A-2) (09 CP 21 and 09 CP 22)	Flywheel 20 kg-m^2 each
Clear Water Pumps (A-3) (09 CP 31 and 09 CP 32)	Flywheel 50 kg-m^2 each
Booster Pumps (D-3) (324 BP 51 and 318 BP 61)	Flywheel 15 kg-m^2 each
Booster Pumps (F) (318 BP 11 and 318 BP 12)	Pressure tank 100 l

Section 11210

PS 11.31 Gates

Details of gates are as given in the Technical Data Schedules

Section 11261

PS 11.32 Chlorination Equipment

A The chlorination system shall be able to feed chlorine solution at variable rates as needed by the quantity and quality of the water to be treated at the distribution chamber; at the settled water outlet from the sedimentation basins and the filtered water channel from the sand filters. The general requirements of the chlorination system are;

Design flow rate Stage 1	36.700 m^3/d
Design flow rate Stage 2	110.000 m^3/d
Dosage rate (pre-chlorination)	5 mg/l
Dosage rate (post-chlorination)	2 mg/l

B The equipment required shall be:
chlorinators
injectors (10 IJ 11 and 10 IJ 21)
manual system control
residual chlorine analyser
vacuum regulator
automatic chlorine switch over system
weigh scales
cylinders and accessories
instrumentation
piping, valves, regulators and all ancillary equipment
the capacity of the chlorine motive water pumps to be provided in the high lift pump station shall be coordinated with the chlorination equipment
safety equipment including atmospheric chlorine gas detectors, protective clothing, breathing apparatus with air cylinders and regulators, gas masks, cabinets, wall charts and posters and automatic shower and eye wash arrangements.

C The chlorinators shall be described as follows (no evaporators are required):

Type	manual control, solution feed vacuum type, floor mounted
Number	four - total
Tag numbers	10 CL 11, 10 CL 12 (pre-chlorinators) 10 CL 21, 10 CL 22 (post-chlorinators)
Capacity	max 12 kg/hr (pre-chlorinators) max 5 kg/hr (post-chlorinators)
Feed range	1.5 to 15 kg/hour
Accuracy	within +/- 2 percent of full scale

D The weigh scales shall be as follows:

Type	hydraulic load cell type with one dial at the scale for two, 1 tonne chlorine cylinders
Number	one set
Tag numbers	10 WD 01

E Chlorine cylinders shall be provided with minimum two sets of rollers for on-line drum rotation alignment of take off valves. Each set shall comprise of 4 rollers of a heavy-duty construction resistive to chlorine

F The Contractor shall supply fourteen sets of full, one tonne chlorine cylinders to the chlorination section of the chemical building. The cylinders shall be designed, manufactured,

inspected and tested by the manufacturer of the cylinder. The Contractor shall submit hydraulic and radiographic test records to the Engineer. The cylinders shall be as follows:

Number	fourteen sets
Gas capacity	1000 kg
Volumetric capacity	840 l
Overall length	approx. 2.2 m
Inside diameter	approx. 770 mm
Max. working pressure	19.9 kg/cm^2
Hydraulic test pressure	37.6 kg/cm^2
Number of fusible plug	three in each cylinder
Melting point of fusible plug	74 ºC +/- 3 ºC

G One-tonne chlorine cylinders shall be designed to contain the specified quantity of liquefied chlorine. The cylinder shall have a cylindrical shell with convex or concave heads and two identical valves on either side of the centre of one head. The cylinder shall be fabricated from mild steel having a minimum tensile strength of 41 kg/mm^2 and a minimum yield point of 25 kg/ mm^2. The wall thickness of cylinder shall be minimum 12 mm. Screw threads for fitting valves and fusible plugs shall conform to JIS B8246 or equivalent. Each cylinder shall have steel valve protection cap.

H After manufacture, each cylinder shall be subject to radiographic examination by X-ray or gamma-ray of longitudinal and circumferential seam welds, junctions of welds, and repair welds.

I The following items shall be marked on one end of each cylinder in a plain and permanent manner.

Name or mark of manufacturer
Name of gas (Cl_2)
Identification mark and serial number
Water capacity (Symbol V, unit in litre)
Weight without valves, fusible plugs and protection cap (Symbol W, unit in Kg)
Date of hydraulic test
Hydraulic test pressure (Symbol TP, Unit in kg/ cm^2)
Thickness of cylindrical shell of cylinder (Symbol t, unit in mm)

J The following safety equipment shall be provided:

Gas masks and cabinets	two sets
Cylinder emergency kit	two sets
Wall charts	two sets
Emergency shower and eye wash	two sets

Section 11262

PS 11.33 Alum Dosing Systems

A The alum dosing system shall be able to feed alum solution at variable rates to the distribution chamber. The general requirements of the alum dosing system are;

Design flow rate Stage 1	33,700 m^3/d
Design flow rate Stage 3	110,000 m^3/d.

B Alum solution with a chemical strength of approximately ten percent as solid alum ($A12(SO_4)_3$ l8H_2O) by weight will be prepared in the alum dissolving tank and pumped to the alum distribution tank (05 AT 11) at the distribution chamber by alum pumps. The alum feed system shall be able to feed alum solution at variable rates as needed by the

quantity and quality of water to be treated. The control and adjustments of feed rates of alum feed pumps shall be manually set at the location of the alum feed pumps.

C The alum dissolving tank mixers shall be vertical type propeller mixer, two stage -three impellers as follows:

Number	two units
Tag numbers	10 MM 11; 10 MM 21
Alum tank volume	approx. 10 m^3 each
Diameter of impeller	approx. 800 mm
Length of shaft	approx. 2500 mm
Materials	
Impeller	316 stainless steel
Shaft	316 stainless steel
Speed	approx. 50 rpm
	Motor totally enclosed, fan-cooled, indoor type, insulation class F, 2.2 kW x 4-pole
Motor encl. protection	IP 55
Power Supply	400 V x 50 Hz x 3-phase

D Alum level tank shall be as follows:

Type	cylindrical tank
Number	1
Tag numbers	10 AT 01
Purpose	to monitor water level of alum dissolving tanks
Dimensions	300 min dia. x 3.5 mH
Material	PVC

PS 11.34 Lime Dosing Systems

A The lime dosing system shall be able to feed lime solution at variable rates to the distribution chamber and the clear water reservoir. The general requirements of the lime dosing system are;

Design flow rate Stage 1	33,700 m^3/d
Design flow rate Stage 2	110,000 m^3/d.

B Lime solution, with a chemical strength of approximately 10 percent by weight as calcium hydroxide, will be prepared in the lime dissolving tank and pumped to the lime mixing tanks to be fed to the distribution chamber and the backwash water tank. The lime feed system shall be able to feed lime solution at variable rates as needed by the quantity and quality of water to be treated. The control and adjustments of feed rates shall be manually set at the location of the lime dosing.

C The lime dissolving tank mixers shall be as follows:

Vertical type propeller mixer, two stage -three impellers

Number	two units
Tag number	10 MM 21; 10 MM 22
Lime tank volume	approx. 10 m^3 each
Diameter of impeller	approx. 800 mm
Length of shaft	approx. 2500 mm
Materials	
impeller	304 stainless steel
shaft	304 stainless steel
Speed	approx. 40 rpm
Motor	totally enclosed, fan-cooled, indoor type, insulation class F, 2.2 kW x 4-pole
Motor encl. protection	IP 55

Power Supply	400 V x 50 Hz x 3-phase.

D The lime dissolving tank mixers shall be as follows:

Type	Cylindrical tank
Number	one
Tag number	10 LT 01
Purpose	to monitor water level of lime dissolving tanks
Diameter	300 mm dia. x 3.5 m/l
Materials	PVC

E The lime pumps shall be as follows:

Type	vertical split type rubber-lined centrifugal pump
Number	two
Pump Tag Nos.	10 LP 11 and 10 LP 21
Purpose	To pump lime solution to lime mixing tank at the sand filters
Rated capacity	200 l/min
Rated head	10 m TDH
Speed	1450 rpm
Driving method	V-belt driven
Materials	
casing	cast iron JIS G 5501
casing liner	natural rubber
impeller	natural rubber
shaft	carbon steel
Motor	totally enclose, fan cooled, indoor type, insulation class F 5.5 kW x 4-pole
Motor encl. protection	IP 55
Power Supply	400 V x 50 Hz x 3-phase.

F The lime mixing tank shall be as follows:

Type	cylindrical tank
Number	one
Tag number	07 LT 11;
Material	fiber reinforced plastic
Effective capacity	1.5m^3
Dimensions	1.2 m dia. x 1.6 m
Accessories	lime mixer (07 LM 11)

G The lime dust extraction system shall consist of a lime dust extraction tank and an exhaust fan as follows:

Lime dust extraction tank	
Type	rectangular washing tank
Number	one
Tag Nos.	10 GW 11
Purpose	to remove lime dust
Rated capacity	10 m^3/min
Materials - tank body	PVC
Exhaust fan	
Type	turbo fan
Number	one
Tag Nos.	10 EF 11
Purpose	to exhaust air from lime dissolving tanks
Rated capacity	10 m^3/min
Rated head	50 mmAq

Materials - body	PVC
Motor	totally enclosed, fan cooled, indoor type, insulation class F 0.75 kW x 4-pole
Motor encl. protection	IP 55
Power Supply	400 V x 50 Hz x 3-phase.

H The portable belt conveyor shall be as follows:

Type	portable belt conveyor
Number	one
Purpose	to carry chemicals
Width of belt	350 mm
Length of conveyor	approx. 5.0 m
Materials	
frame	mild steel, JIS SS 400
belt	nitrile rubber
roller	PVC or rubber lined steel pipe
Speed	approx. 0.6 m/s
Motor	motorized pulley, 1.0 kW
Motor encl. protection	IP 55
Power Supply	400 V x 50 Hz x 3-phase.

PS 11.35 Chlorination Unit

A The chlorination unit shall be able to feed hypo-chlorite solution at variable rates to the service reservoir at Kahawatta. The general requirements of the chlorination unit are;

Design flow rate Stage 1	4,240 m^3/d
Design flow rate Stage 3	7,310 m^3/d.

B Hypo-chlorite solution with a chemical strength of approximately five percent as calcium hypo chlorite (Ca (O cl)$_2$ 4H_2O) by weight will be prepared in the hypo-chlorite tank (304 HT 01) and pumped to the reservoir by hypo-chlorite pump (304 HT 01). The chlorination unit shall be able to feed hypo-chlorite solution at variable rates as needed by the quantity and quality of water to be distributed. The control and adjustments of feed rates of hypo-chlorite pump shall be manually set at the location of the hypo-chlorite pump.

C The hypo-chlorite tank mixer shall be vertical type propeller mixer -three impellers as follows:

Number	one unit
Tag numbers	304 MM 01
Alum tank volume	approx. 0.5 m^3 each
Materials	
Impeller	316 stainless steel
Shaft	316 stainless steel
Motor	totally enclosed, fan-cooled, indoor type, insulation class F, 0.4 kW x 4-pole
Motor encl. protection	IP 55
Power Supply	400 V x 50 Hz x 3-phase

D Hypo-chlorite tank shall be as follows:

Type	rectangular tank
Number	one unit
Tag numbers	304 HT 01
Purpose	to dissolve and store hypo-chlorite solution
Dimensions	0.9 mm. x 0.9 mm x 0.9 mH
Material	PVC

E The hypo-chlorite shall be as follows:

Type	diaphragm pump
Number	one
Pump Tag Nos.	304 HP 01
Purpose	To pump hypo-chlorite solution to reservoir
Rated capacity	350 ml/min
Rated head	30 m TDH
Motor	totally enclose, fan cooled, indoor type, insulation class F 0.4 kW x 4-pole
Motor encl. protection	IP 55
Power Supply	400 V x 50 Hz x 3-phase.

Section 11326

PS 11.36 Manual Screen

A The bar screens (01 CS 11, 01 CS 12) shall consist of steel bars arranged to provide 50 mm spaces. The screen shall be easily removable and shall be curved over at the top where they shall be fix onto a strong steel member which shall be supported to the concrete cleaning platform. The bar screen shall be strong enough to withstand the water level difference of 2.0m caused by clogging of the screening. The whole assembly shall be fabricated from 304 stainless steel.

B Two suitable hand rakes of aluminium alloy shall be provided with each screen.

PS 11.37 Fine Screen

The fine screens shall meet the operational and dimensional requirements as follows:

Tag Nos.	01 FS 11 and 01 FS 21	
Number	two	
Dimensions	Approx. 2.0 m wide and 7.0 m from invert to operating level	
Screen velocity	from 15 to 50 mm/s	
Screen opening	approx. 10 mm	
Screen wire	1.0 mm diameter	
Materials		
main frame	mild steel, JIS G 3101 SS400	
guide rail	stainless steel, JIS 4303-5 SUS304	
chain	stainless steel, JIS 4303-5 SUS403	
screen	stainless steel, JIS 4303-5 SUS304	
screen frame	stainless steel, JIS 4303-5 SUS304	
Accessories		
trough	mild steel, SS400	1 set
cage	stainless steel, SUS304	2 sets
Motor	totally enclose, fan cooled, outdoor type, insulation class F 2.2 kW x 4-pole	
Motor encl. protection	IP 55	
Power Supply	400 V x 50 Hz x 3-phase.	

Section 11356

PS 11.38 Sludge Collector (Reciprocating Scraper Type)

A The Contractor shall furnish and install the specified sludge collector (reciprocating scraper type) complete with motors and appurtenances as shown on the drawings and as

specified herein.

B The Contractor shall submit complete information including fabrication, assembly, foundation, installation and maintenance data together with detailed specifications and performance information covering materials of construction, power drive assembly, parts, devices, wiring diagrams, and all other accessories of the equipment furnished in accordance with Section 01300 and all the requirements specified therein.

C The complete system shall be provided by a single supplier, having unit responsibility for the equipment and shall be the product of an experienced manufacturer and:
1 must demonstrate equal or larger capacity installations using similar equipment and equipment installed and successfully operating for at least 5 years;
2 provide names and phone numbers of contacts at referenced installations to verify performance;
3 demonstrate to satisfaction of Engineer that equipment to be provided is equal to that specified.

D The sludge collector shall be used to collect and remove the sludge that settles and accumulates at the bottom of the sedimentation basins. The scraper consists of a series of wedge shaped sections fixed together to form a continuous unit so that they function as a moving floor over the bottom of the tank.

E The direction of movement of the collector is such that when the scraper sections move forwards, towards the sludge hopper, they transport the sludge with them. During the return movement the wedge shape of the scraper slides under the blanket of sludge, so that the top layer flows over them.

F The forward motion is approximately 700 mm and the speed of the return movement is approximately three times that of the forward movement.

G The scrapers movement is induced by a system of levers attached to the drive mechanism located at one end of the tank above water level.

H The scraper blades travel over low-friction strips laid on the tank floor.

I The frames and scrapers shall be welded construction using shaped steel and plate made of stainless steel JIS G 4313 SUS 304 or equivalent.

J The low-friction pads laid on the floor of the tank shall be fabricated from high density polythene.

K Fabrications shall conform to ASTM Designation A36 for fabricated steel or equivalent.

L The scraper sections shall be wedge shaped with a concave face for movement of the sludge to the sludge hopper. The shape of the inclined slope, on the return movement side, shall be such as to cause minimum disturbance to the sludge.

M Sufficient lengths of low-friction strips shall be fixed longitudinally to the floor of the tank to provide minimum frictional resistance to the motion of the scraper blades and to reduce the wear on the steel sections. The strips shall be firmly fixed to the floor of the tanks with stainless steel bolts. The strips shall be supplied in the longest lengths possible to minimise the number of joints in the strips perpendicular to the scraper movement.

N The reciprocating movement for the scrapers is achieved by a system of levers transferring the motive power from the electric motor located at one end of the tank on the slab of the sedimentation basin above water level, down the end wall and then horizontally to the

scrapers.

O When the power is turned on, the mechanism starts scraping. As the lever arm from the motor rotates and the scraper reaches the limit of forward travel, the motor control changes the speed of the motor to achieve the faster return motion of the scraper. On return to the start position the speed control again adjusts the speed of the motor to provide the slower forward motion.

P `The motor shall be directly coupled to the lever arm and with variable speed control. The equipment shall be fixed onto a common floor panel. The drive unit shall perform cyclic operation through the various control selection switches once it is turned on.

Q For safety, the driving gear shall be provided with torque limiter device to protect the machine and motor from overload, etc.

R This equipment shall delivered after completion of manufacturing and after it has passed all the tests and inspections carried out. For the delivery, the equipment shall be packaged carefully so that the equipment is not deformed or damaged during normal transportation. Stainless steel material shall be used for all the bolts and nuts for fixing the equipment and anchors. Painting shall be carried out on all surfaces other than stainless steel.

S All special tools required for normal operation and maintenance shall be furnished with the equipment. In addition, spare parts shall be furnished with the equipment as follows:

scraper blades	:	four for each unit
lever arm system	:	one set
end wall support framework	:	one set
drive unit	:	one
(motor, reduction gears etc.)		
lubricating oil	:	2 cans

T Conform to the requirements of Section 11005.

U Each motor shall be shop tested by the manufacturer in accordance with the requirements of Division 16.

V The Contractor shall conform to the requirements of Section 11005 and provide a minimum of one day of instruction for each pump class.

PS 11.39 Sludge Collector

A The purpose of the sludge collector is to remove accumulated sludge, as a result of the pre-treatment of raw river water, from the floor of the sedimentation basins to the sludge hoppers.

B The sludge collectors shall meet the operational and dimensional requirements as follows:

Tag Nos.	06 SC 11, 06 SC 12, 06 SC 21 and 06 SC 22
Number	four
Tank dimensions	approx. 5.5 m wide, 40 m long, 4.4 to 5.3 m depth
Scraping velocity	from 2.5 to 10 mm/s
Materials	
scraper frame	stainless steel, JIS 4303-5 SUS304
scraper	stainless steel, JIS 4303-5 SUS304
lever arm system	stainless steel, JIS 4303-5 SUS304
end wall support frame	stainless steel, JIS 4303-5 SUS304
Motor	totally enclose, fan cooled, outer type, insulation class F variable speed motor with brake, 0.75 kW x 4-pole

Motor encl. protection	IP 55
Power Supply	400 V x 50 Hz x 3-phase.

Section 11369

PS 11.40 Sand Filters

A The purpose of the sand filters is to remove fine solids from the water being treated after flocculation and sedimentation of the raw river water.

B The sand filters shall meet the operational and dimensional requirements as follows:

Type	gravity type rapid sand filter, single media.
Number	4 units
Unit flow	9,170 cu m/day
Dimension per unit	W 8.8 m x L 8.6 m & area 61.9 sq m/unit.
Filtration Rate	normal operation = 148 m/day with one unit out service = 197 m/day.
Flow control	constant rate filter with varying water level
Filter media	single media: effective diameter 1.0 to 1.2 mm, depth 1.2 m
Underdrain system	suspended floor of monolithic construction with adjustable nozzles
Washing method	backwashing and air scour
Washing rate	backwashing 0.25 $m^3/m^2/min$ air scour 1.0 $m^3/m^2/min$
Washing time	backwashing 10 min air scour 5 min.
Backwash water pump	7.72 m^3/min each (2 duty, 1 standby)
Air scour blower	6.2 m^3/min each (1 duty, 1 standby)
Pipe and valves	complete set

C The Contractor shall provide 10 percent spare material to be handed to the Employer.

Section 11373

PS 11.41 Blowers

The blowers shall meet the operational and dimensional requirements as follows:

Tag Nos.	07 AB 11 and 07 AB 21
Purpose	to provide air for filter backwashing and cleaning
Type	horizontal, rotary, positive displacement blowers
Number	2 (1 duty, 1 standby)
Rated capacity	62 m^3 /min
Rated head	3500 mm Hg
Speed	approx. 1000 rpm
Efficiency	not less than 60%
Noise (at 1 m)	not more than 85 dB(A)
Driving method	belt
Installation	indoor
Motor encl. protection	IP 55
Motor room floor level	+447,460 m amsl

Section 12100

PS 12.01 Laboratory Equipment - Physical/chemical Laboratory

The equipment shall meet the operational and dimensional requirements as given in the Technical Schedules (TS2).

PS 12.02 Glassware - Physical/chemical Laboratory

The glassware shall meet the operational and dimensional requirements as given in the Technical Schedules (TS3).

PS 12.03 Glassware - Microbiological Laboratory

The glassware shall meet the operational and dimensional requirements as given in the Technical Schedules (TS4).

PS 12.04 Microbiological Equipment

The microbiological equipment chemicals shall meet the operational and dimensional requirements as given in the Technical Schedules (TS5).

PS 12.05 Consumables

The consumables shall meet the operational and dimensional requirements as given in the Technical Schedules (TS6).

PS 12.06 Laboratory Furniture

The laboratory furniture shall meet the operational and dimensional requirements as given in the Technical Schedules (TS7).

PS 12.07 Laboratory Chemicals/Reagents

The grade of chemical shall be the specified grade in JIS K-series "Chemical Engineering" or equivalent unless otherwise specified. The chemicals and reagents to be provided shall be as listed in the Technical Schedules (TS8).

Section 12300

PS 12.08 Maintenance Equipment

A The Contractor shall provide for the Employer's use the equipment, parts, tools and other materials as specified in this section. The equipment, materials and tools to be procured shall be new and of first quality as approved by the Engineer. The Contractor shall submit to the Engineer for approval shop drawings, catalogues and other information as required regarding the items to be provided. The procured items shall be tested for performance before acceptance by the Engineer. The Contractor shall also be fully responsible for storage of such items until the completion of the Contract.

B The Contractor shall purchase and deliver a complete backhoe loader with bucket capacity of 0.2 m^3 shall be supplied with necessary accessories and spare parts for use of the Employer. Each set of tools shall be provided with a steel case of suitable design. A complete set of the operation and instruction manuals shall be supplied for the equipment and tools.

C Backhoe Loader

Type : backhoe loader with multi purpose bucket

Engine	: 4 cylinder, direct injection water cooled engine
Engine power	: not less than 75 hp
Net peak torque	: not less than 285 Nm
Fuel tank capacity	: not less than 125 l
Power train	: 4 wheel drive
Max. travel speed	: not less than 30 km/h
Hydraulics	: load sensing, closed centre system
Hydraulic pump capacity	: not less than 135 l/min at 2200 rpm
System pressure	: not more than 3000 psi
Operator's station	: ROPS canopy
Steering	: hydrostatic steering on front wheel
Loader attachment	: hydraulically operated front loader
Multi-purpose backet	: not less than 2250 mm
Backhoe attachment	: hydraulically operated backhoe attachment
Max. digging depth	: not less than 4375 mm
Max. reach	: not more than 6725 mm (from rear axle centreline)
Backhoe bucket	: two (12" and 18")
Accessories	
Necessary tools	: one set
Necessary operator's manuals	: one set
Spare parts manual	: one set

Section 13415

PS 13.01 Functional Design Specification

The Functional Design Specification is given in a separate section of this document.

Section 13420

PS 13.02 Monitoring Devices

A The equipment shall meet the operational and dimensional requirements as follows.

B All monitoring equipment for the filtered water tank in the sand filters, the clear water reservoir and the high level reservoir shall be provided with the necessary cover to seal the opening in the structure to prevent the access of rain water and rodents.

PS 13.03 Electromagnetic Flow Meter

Name of Loop	Alum Dosing Flow	Pre Lime Dosing Flow	Post Lime Dosing Flow
Tag no.	10IFM11	10IFM21	07IFM03
Quantity	1	1	1
Size meter/pipe line	80mm/100mm dia.	50mm/50mm dia.	50mm/50mm dia.
Measurement fluid	Alum Solution	Lime Solution	Lime Solution
Measurement range	0~50 l/min	0~50 l/min	0~50 l/min
Mounted device on panel	Indicator x1 Indicating Controller x1 Isolator x1	Indicator x1 Indicating Controller x1 Isolator x1	Indicator x1 Indicating Controller x1 Isolator x1
Remarks	Install the meter in the longitudinal pipe.	Install the meter in the longitudinal pipe.	Install the meter in the longitudinal pipe.

PS 13.04 Ultrasonic Flow Meter

Name of Loop	Raw Water Intake Flow	Backwash Water Flow	Transmission Flow (A-1)
Tag no.	01IFM01	07IFM01	09IFM01
Quantity	1	1	1
Pipe line size	700mm dia.	350mm dia.	800mm dia.
Measurement fluid	Raw Water	Filtered Water	Clear Water
Measurement Range	0~5000m3/Hr	0~1000m3/Hr	0~2500m3/Hr
Mounted device on panel	Indicator x1 Integrator x1 Isolator x1 Setting Device x1 Indicating Controller x1	Indicator x2 Isolator x1 Setting Device x1	Indicator x1 Isolator x1 Setting Device x1

Name of Loop	Transmission Flow (A-2)	Transmission Flow (A-3)	Backwash Water Return Flow
Tag no.	09IFM02	09IFM03	11IFM01
Quantity	1	1	1
Pipe line size	350mm dia.	450mm dia.	300mm dia.
Measurement fluid	Clear Water	Clear Water	Raw water
Measurement Range	0~150m3/Hr	0~2000m3/Hr	0~300m3/Hr
Mounted device on panel	Indicator x1 Isolator x1 Setting Device x1	Indicator x1 Isolator x1 Setting Device x1	Indicator x1 Isolator x1

PS 13.05 Orifice Type Flow Meter

Name of Loop	Air Scouring Flow
Tag no.	07IMF02
Quantity	1
Pipe line size	250mm dia.
Measurement fluid	Air
Measurement range	0~1000m3/Hr
Transmitter	General Type with Indicator
Mounted device on panel	Indicator x2 Temperature & Pressure Compensator x1 Distributor x1

PS 13.06 Submersible Hydrostatic Type Level Meter

Name of Loop	Raw Water Wet Well Level	Clear Water Reservoir Level	Backwash Recovery Tank Level
Tag no.	01ILM01	08ILM01, 02	11ILM01, 02
Quantity	1	2	2
Measurement liquid	Raw Water	Clear Water	Raw Water
Measurement range	0~5m	0~4m	0~4m
Mounted device on panel	Indicator x2 Distributor x1 Setting Device x1	Indicator x2 Distributor x1 Setting Device x1	Indicator x4 Distributor x1 Setting Device x1

PS 13.07 Ultrasonic Type Level Meter

Name of Loop	Filter Level
Tag no.	07ILM11 to 14
Quantity	4
Measurement liquid	Raw Water
Measurement range	0~2.5m
Mounted device on panel	Indicator x1 Distributor x1 Setting Device x1

PS 13.08 Electrode Type Level Switch

Name of Loop	Screen Pit Level Switch	Sump Drainage Level Switch	Distribution Chamber Level Switch
Tag no.	01ILS01, 02	01ILS03, 07ILS02, 09ILS01, 11ILS01	05ILS01
Quantity	2	3	1
Measurement liquid	Raw Water	Drainage	Raw Water
Numbers of rods	2 pieces	4 pieces	2pieces
Length of rod	3.0m MAX	1.5m MAX	6.0mm MAX
Material of rods	SUS 304	SUS 304	SUS 304
Mounted device on panel	Relay Unit	Relay Unit	Relay Unit

Name of Loop	Sampling Pump Level Switch	Backwash Water Tank Level Switch	Alum Mixing Tank Level Switch
Tag no.	06ILS01	07ILS01	10ILS11, 12
Quantity	1	1	2
Measurement liquid	Raw Water	Clear Water	Alum Solution
Numbers of rods	2 pieces	3 pieces	1 pieces x4
Length of rod	5.0m MAX	5.0m MAX	3.0m MAX
Material of rods	SUS 304	SUS 304	SUS 304
Mounted device on panel	Relay Unit	Relay Unit	Relay Unit

Name of Loop	Alum Level Tank Level Switch	Lime Mixing Tank Level Switch	Lime Level Tank Level Switch
Tag no.	10ILS13	10ILS21, 22	10ILS23
Quantity	1	2	1
Measurement liquid	Alum Solution	Lime Solution	Lime Solution
Numbers of rods	1 pieces x4	1 pieces x4	1 pieces x4
Length of rod	3.0m MAX	3.0m MAX	3.0m MAX
Material of rods	SUS 304	SUS 304	SUS 304
Mounted device on panel	Relay Unit	Relay Unit	Relay Unit

Name of Loop	Post Lime Head Tank Level Switch
Tag no.	07ILS03
Quantity	1
Measurement liquid	Lime Solution
Numbers of rods	1 pieces x4
Length of rod	3.0m MAX
Material of rods	SUS 304
Mounted device on panel	Relay Unit

Name of Loop	KAHAWATTA S.R. Level Switch	KONDADENIYA S.R. Level Switch	R2 S.R. Level Switch
Tag no.	304ILS01	310ILS01	318ILS01
Quantity	1	1	1
Measurement liquid	Clear Water	Clear Water	Clear Water
Numbers of rods	3 pieces	3 pieces	3 pieces
Length of rod	4.0m MAX	4.0m MAX	4.0m MAX
Material of rods	SUS 304	SUS 304	SUS 304
Mounted device on panel	Relay Unit	Relay Unit	Relay Unit

Name of Loop	HEERASAGALA LOW S.R. Level Switch	HEERASAGALA MIDDLE S.R. Level Switch	AMPITIYA S.R. Level Switch
Tag no.	320ILS01	321ILS01	324ILS01
Quantity	1	1	1
Measurement liquid	Clear Water	Clear Water	Clear Water
Numbers of rods	3 pieces	3 pieces	3 pieces
Length of rod	4.0m MAX	4.0m MAX	4.0m MAX
Material of rods	SUS 304	SUS 304	SUS 304
Mounted device on panel	Relay Unit	Relay Unit	Relay Unit

PS 13.09 Diaphragm Type Pressure Meter

Name of Loop	Transmission Pressure
Tag no.	09IPM01to03
Quantity	3
Measurement fluid	Clear Water
Measurement range	0~1.20kPa
Sensor type	Electric Type Pressure Transmitter
Mounted device on panel	Indicator x1 Distributor x1 Setting Device x1
Others	Stop Valve

PS 13.10 Load Cell Type Weighing Meter

Name of Loop	Chlorine Cylinder Weight
Tag no.	10IWM31
Quantity	1
Measurement fluid	Liquid Chlorine
Measurement range	0 to 4 tonns
Sensor type	Mechanical Standard Equipment
Mounted Device on Panel	Indicator x1

Section 13430

PS 13.11 Instrumentation Panel

A. General

Structure

Structure Parts	Steel plate thickness
Side plate	2.3 mm
Bottom plate	1.6 mm
Roof	2.3 mm
Back door	2.3 mm
Front panel	3.2 mm
Separator	1.6 mm

Standard Accessories

Name Plate — Plastic plate, with engraved black letter on white back-ground

Inboard Lighting — with lighting door switch

B. Instrumentation Panel for INTAKE

Tag No. 01INP01
Name Instrumentation Panel
Quantity 1 panel
Type Indoor, Self-supporting, Metal enclosed, Vermin-proof Type
Mounted equipment in the panel
Auxiliary of 01ILM01, 01IFM01
Other necessary equipment 1 lot
Mounted equipment on the panel
Auxiliary of 01ILM01, 01IFM01, Fuel tank level indicator
Assembled indicating lamp 1 set
Other necessary equipment 1 lot

C. Instrumentation Panel for FILTER UNIT

Tag No. 07INP01
Name Instrumentation Panel
Quantity 1 panel
Type Indoor, Self-supporting, Metal enclosed, Vermin-proof Type
Mounted equipment in the panel
Auxiliary of 07ILM11to14, 07IFM01, 02, 03
11IFM 01, 11ILM01, 02
Other necessary equipment 1 lot
Mounted equipment on the panel
Auxiliary of 07ILM11to14, 07IFM01, 02, 03
11IFM 01, 11ILM01, 02
Assembled indicating lamp 1 set
Other necessary equipment 1 lot

D. Instrumentation Panel for CLEAR WATER PUMP STATION

Tag No. 09INP01
Name Instrumentation Panel
Quantity 1 panel
Type Indoor, Self-supporting, Metal enclosed, Vermin-proof Type
Mounted equipment in the panel
Auxiliary of 08ILM01, 02, 09IPM01to03, 09IFM01to03
Necessary space for future 1 lot
Other necessary equipment 1 lot
Mounted equipment on the panel
Auxiliary of 08ILM01, 02, 09IPM01to03, 09IFM01to03

Necessary space for future	1 lot
Other necessary equipment	1 lot

E. Instrumentation Panel for CHEMICAL DOSING

Tag No.	10INP01
Name	Instrumentation Panel
Quantity	1 panel
Type	Indoor, Self-supporting, Metal enclosed, Vermin-proof Type

Mounted equipment in the panel

Auxiliary of 10IFM11, 10IFM21, 10IWM31	
Necessary space for future	1 lot
Other necessary equipment	1 lot

Mounted equipment on the panel

Auxiliary of 10IFM11, 10IFM21, 10IWM31	
Assembled indicating lamp	1 set
Necessary space for future	1 lot
Other necessary equipment	1 lot

PS 13.12 PLC Panel

A. General

Structure

Structure Parts	Steel plate thickness
Side plate	2.3 mm
Bottom plate	1.6 mm
Ceiling	1.6 mm
Door	2.3 mm
Separator	1.6 mm

Standard Accessories

Name Plate	Plastic plate, with engraved black letter on white back-ground
Inboard Lighting	with lighting door switch
Door Key	

B. PLC Panel for INTAKE

Tag No.	01PLC01
Name	Intake PLC
Quantity	1 panel
Type	Indoor, Self-supporting, Metal enclosed, Vermin-proof Type
Processing Function	Sequential control, Instrumentation loop control
Data transmission line	Telecom dedicated line

Input/Output Capacities

	Digital I/O	Analog I/O	Pulse I
Phase 1	60	2	4
Total	100	2	6

C. PLC Panel for Power Receiving Facility

Tag No.	04PLC01
Name	Power Receiving PLC
Quantity	1 panel
Type	Indoor, Self-supporting, Metal enclosed, Vermin-proof Type
Processing Function	Sequential control, Instrumentation loop control
Data transmission line	Optical Fibre line

Input/Output Capacities

	Digital I/O	Analog I/O	Pulse I
Phase 1	20	0	6
Total	40	0	10

D. PLC Panel for Water Treatment Facility

Tag No. 07PLC01
Name Water Treatment PLC
Quantity 1 panel
Type Indoor, Self-supporting, Metal enclosed, Vermin-proof Type
Processing Function Sequential control, Instrumentation loop control
Data transmission line Optical Fibre line
Input/Output Capacities

	Digital I/O	Analog I/O	Pulse I
Phase 1	250	4	0
Total	250	4	0

E. PLC Panel for Clear Water Pump Station

Tag No. 09PLC01
Name Clear Water Pump PLC
Quantity 1 panel
Type Indoor, Self-supporting, Metal enclosed, Vermin-proof Type
Processing Function Sequential control, Instrumentation loop control
Data transmission line Optical Fibre line
Input/Output Capacities

	Digital I/O	Analog I/O	Pulse I
Phase 1	100	8	0
Total	160	12	0

F. PLC Panel for Chemical Dosing Facility

Tag No. 10PLC01
Name Chemical Dosing PLC
Quantity 1 panel
Type Indoor, Self-supporting, Metal enclosed, Vermin-proof Type
Processing Function Sequential control, Instrumentation loop control
Data transmission line Optical Fibre line
Input/Output Capacities

	Digital I/O	Analog I/O	Pulse I
Phase 1	70	2	0
Total	100	2	0

Section 13440, 13450

PS 13.13 Central Monitoring System

A. General

1 Central Monitoring System is composed of following items.
   a. Monitoring System PLC 2 sets
   b. Computer 2 sets
   c. Server 1 set
   d. Printer 2 set

2 Two PLCs (00PLC01, 02) shall be the interface between the computers and the local PLCs (PS 13.11) to collect the data. One PLC (00PLC01) shall be duty, while the other (00PLC02) shall be hot standby. Tow PLCs have same function.

3 Two computers shall be the man-machine interface to monitor the plant loads status, failure and process values through a graphical interface. It is possible to monitor independently with these computers respectively.

4 The server shall play a data processing role so that it can generate the required reports such as hourly, daily, monthly, and yearly reports, historical trend graphs, historical process running and historical alarms.

B. PLC Panel for Central Monitoring System-1

Tag No.	00PLC01
Name	Monitoring System PLC-1
Quantity	1 panel
Type	Indoor, Self-supporting, Metal enclosed, Vermin-proof Type
Data transmission line	Optical Fibre line

Input/Output Capacities

	Digital I/O	Analog I/O	Pulse I
Phase 1	550	16	10
Total	1100	20	16

Control power distribution unit

C. PLC Panel for Central Monitoring System-2

Tag No.	00PLC02
Name	Monitoring System PLC-2
Quantity	1 panel
Type	Indoor, Self-supporting, Metal enclosed, Vermin-proof Type
Data transmission line	Optical Fibre line

Input/Output Capacities

	Digital I/O	Analog I/O	Pulse I
Phase 1	550	16	10
Total	1100	20	16

D. Central Monitoring System

Tag No.	00MON01
Name	Monitoring System
Quantity	1 lot
Data transmission line	Ethernet
Computer	2 sets
personal computer	
OS	Windows 2000
display	more than 500 mm
Server	1 set
	main internal storage with backup unit
	large capacity auxiliary storage
Printer	2 sets (for logging and announcement)
	black-and-white laser printer
Others	exclusive monitoring desks and chairs

Section 14650

PS 14.01 Lifting Equipment

A All lifting equipment shall have the minimum specified rated capacity or be capable of lifting 25 percent more than the weight of the largest piece of equipment/pipework within its reach, whichever is the larger.

B The cranes and hoists shall meet the operational and dimensional requirements as follows:

Tag Nos.	01 MH 01
Location	raw water intake facility
Purpose	to lift screenings up and travelling
Type	electrically operated hoist with geared trolley for travelling
Number	1 set
Rated capacity	0.5 tonne
Travelling distance	approx. 8 m

Lifting speed	approx. 100 mm/s
Travelling speed	approx. 200 mm/s
Lowest floor level	- 441,000 m amsl
Main floor level	+ 443,000m amsl
Rail corbel level	approx +445,500m amsl

Tag Nos.	01 HC 01
Location	raw water intake facility
Purpose	to lift equipment up and travelling
Type	manually operated chain hoist with geared trolley for travelling
Number	1 set
Rated capacity	3.0 tonne
Travelling distance	approx. 17 m
Lowest floor level	- 433,000 m amsl
Main floor level	+ 443,000 m amsl
Underside of hoist beams	approx. +448,000 m amsl

Tag Nos.	09 HC 01
Location	clear pump station
Purpose	to lift equipment - up, down, traversing and travelling
Type	manually operated overhead travelling bridge crane, double girder, chain hoist with geared trolleys for traversing and travelling.
Number	1 set
Rated capacity	7.5 tonne
Travelling distance	approx 40 m
Span	approx 9.2 m
Lowest floor level	+ 439,780m amsl
Main floor level	+ 447,000 m amsl
Rail corbel level	+ 450,500 m amsl
Underside of roof beams	+ 451,600 m amsl

Tag Nos.	10 MC 01
Location	Chemical building
Purpose	to lift chemicals - up, down, traversing and travelling
Type	Electrically operated overhead travelling bridge crane, double girder, chain hoist with geared trolleys for traversing and travelling.
Number	1 set
Rated capacity	2 tonne
Travelling distance	approx. 25 m
Span	approx. 9 m
Lifting speed	approx. 50 mm/s
Traversing speed	approx. 200 mm/s
Travelling speed	approx. 200 mm/s
Lowest floor level	+ 446,800 m amsl
Main floor level	+ 448,000 m amsl
Rail corbel level	+ 452,000 m amsl
Underside of roof beams	+ 453,300 m amsl

Tag Nos.	10 MC 02
Location	Chemical building
Purpose	to lift chlorine containers up and down and travelling
Type	Electrically operated overhead travelling bridge crane, double girder, chain hoist with geared trolleys for

	traversing and travelling.
Number	1 set
Rated capacity	2 tonne
Travelling distance	approx. 20 m
Span	approx. 8.3 m
Lifting speed	approx. 50 mm/s
Traversing speed	approx. 200 mm/s
Travelling speed	approx. 200 mm/s
Lowest floor level	+ 446,800 m amsl
Main floor level	+ 447,400 m amsl
Rail corbel level	+ 451,500m amsl
Underside of roof beams	+ 452,700 m amsl

Section 15060

PS 15.01 Process Pipework

A All internal pipework (not plumbing) in raw water and clear water pump stations shall be considered as process piping and shall, unless otherwise described below, be steel. The term pipework shall include all necessary supports, saddles, slings, fixing bolts and foundation bolts required to support the pipes and associated equipment, valves and fittings.

B All internal pipework (not plumbing) in booster pump stations, buildings, pipe galleries, valve chambers and flow meter chambers shall be considered as process piping and shall, unless otherwise described below, be ductile iron. The term pipework shall include all necessary supports, saddles, slings, fixing bolts and foundation bolts required to support the pipes and associated equipment, valves and fittings.

C All pipes and fittings for the alum dosing systems shall be polyvinyl chloride with flanged or solvent welded joints or polyethylene tube as indicated on the drawings.

D All pipes and fittings for the lime dosing systems shall be galvanised steel pipe with flanged or screwed joints for ordinary conditions and polyvinyl chloride with flanged and/or solvent welded joints or polyethylene tube as otherwise indicated on the drawings.

E All pipes and fittings for the chlorine solution dosing system shall be polyvinyl chloride with flanged and/or solvent welded joints or polyethylene tube as indicated on the drawings. Chlorine gas piping shall be black steel or copper tube from the container discharge to the chlorinators.

F Pipework Design

1 The pipework shall be laid out and designed so as to facilitate the erection, painting in situ and dismantling of any section for maintenance to give a constant and uniform flow of working fluid with a minimum of head loss. The number of flanges are to be kept to a minimum and the size of each unit of pipework determined by the ease of handling, installation and general appearance of the completed pipe system. Positions of flanges shall take into account any necessary concrete pipe supports or thrust blocks required. For the design, the pressure in the pipework from pumps shall be taken as the maximum and minimum pressures caused by surge.

2 Flexible joints or unions shall be provided where necessary to facilitate removal of plant and/or to allow for differential movement of the building structure. Wherever practical, flexible joints shall be provided with tie bolts or other means to transfer longitudinal thrust along the pipework as a whole.

3 Wherever possible, standard fittings shall be used in preference to fabricated or

special fittings.

4 Facilities shall be provided for draining the pipe system and releasing air. The drainage fluid shall be piped into the building drainage system and the period of time for drainage shall not exceed 30 minutes.

5 The pipework layout within pump stations shall have the approval of the pump manufacturer.

6 Valves, strainers and other devices mounted in the pipework shall be supported independently of the pipes to which they connect.

7 Energy dissipation orifice plates shall be provided as shown on the following list and drawings. The plate shall be designed and manufactured to fit between two pipe flanges. Number of orifice holes and spacing shall be determined to meet the requirements. Orifice plates shall be made of stainless steel (JIS 4303 SUS 304 or equivalent) with minimum thickness of 10 mm.

Tag No	02 OR 01	05 OR 01	305 OR 01
Location	raw water transmission	water treatment plant	Kahalla service reservoir
Facility	transmission pipeline	distribution chamber	inlet pipeline
Pipe Diameter	600 mm	600 mm	200 mm
Hole	240 mm	246 mm	45 mm
Quantity	1	1	1

Section 15101

PS 15.02 Valves

A Flanges for all valves shall be PN 16 unless otherwise specified.

B All valves of one type shall be from one manufacturer, unless approved otherwise, in exceptional circumstances, by the Engineer. The valve manufacturer must have an accredited local agent with technical support services.

C The details of the valves are as given in the Technical Data Schedules

PS 15.03 Butterfly Float Valve

A General
Butterfly float valve to be used shall be designed to mechanically and automatically open and close according to the water level in the reservoir and water tower.

B Design and Materials
Butterfly float valve shall be the all stainless butterfly float valve type LD-B-1/2 of Daiwa Tekkosho of Japan or approved equal. The valve shall consist of a rubber sheeted butterfly valve, gear unit, float and a connection rod to support the float. The gear unit shall be so designed to operate the butterfly valve between full opening and full closing positions in the range of 45 degree vertical move of the connection rod which shall be operated with float. Gear unit shall be provided with a stopper to prevent the connection rod from moving exceeding 45 degree. The float shall have the enough volume and weight for operating the valve gear unit. The operating level of the float shall be adjustable. The float shall be suspended with stainless steel (JIS G4303 SUS316) wire from the ceiling of the reservoir/tower so as to prevent the float from falling down during low level water storage. The valve shall have flanged ends conforming to the working pressure of 10 kgf/sq.cm for reservoirs. Mating dimension of flange and number of bolt hole shall be according to the manufacturer's recommendation. The material to be used for the construction shall be stainless steel, stainless steel castings or rubber. Materials of major parts are as follows;

Valve body	:	Stainless Steel, JIS G5121 SCS 13
Valve disc	:	Stainless Steel, JIS G5121 SCS13, Rubber Sheeted
Valve shaft	:	Stainless Steel, JIS G4303 SUS304
Short pipes	:	Stainless Steel, JIS G4303 SUS304
Connection Rod	:	Stainless Steel, JIS G5121 SCS 14
Float	:	Stainless Steel, JIS G4303 SUS 316

C The Contractor shall submit for approval by the Engineer the design data and other engineering information of the butterfly float valve.

Section 15102

PS 15.04 Actuators

The valves and gates to be electrically operated are as listed in the valve and gate schedules and with the designation MV or MG.

Section 15410

PS 15.05 Plumbing

The cold water systems in each building will be fed directly from the pressure ring main fed from the high lift pump station. Cold water storage systems will not be provided in each building.

Section 15780

PS 15.06 Split System Air-conditioning Units

A The split unit air conditioners are as listed below and the following rooms in the administration building shall be air-conditioned:
manager's room;
conference room;
chemist's room;
monitoring room..
biological room

B Shop drawings shall include details and routing of all refrigerant and condensate piping. Condensate drainage shall be discharged to the nearest drainage system. All piping shall be neatly arranged and shall be concealed by suitable, removable GRP or painted timber covers.

C The units shall meet the operation and dimensional requirement as follows:

Equipment Tag Nos.	14 PAC 01 & 02
Location	administration building – monitoring room
Purpose	to condition the specified area
Type	Ceiling-mounted Cassette type
Number	2 duty, a stand-by unit is not installed in the facility
Rated Capacity	6000 kcal/h each unit
Rated power	2.4 kW consumption
Electrical system	230/1/50 voltage/phase/Hz
Driving method	by remote sensor
Installation	indoor & outdoor
Equipment Tag Nos.	14 PAC 03 and 04

Location	administration building – conference room
Purpose	to condition the specified area
Type	ceiling-mounted cassette type
Number	2 duty, a stand-by unit is not installed in the facility
Rated Capacity	9000 kcal/h each unit
Rated power	3.6 kW consumption
Electrical system	415/3/50 voltage/phase/Hz
Driving method	by remote sensor
Installation	indoor & outdoor

Equipment Tag Nos.	14 PAC 05
Location	administration building – manager (room)
Purpose	to condition the specified area
Type	ceiling-mounted cassette type
Number	1 duty, a stand-by unit is not installed in the facility
Rated Capacity	6000 kcal/h each unit
Rated power	2.4 kW consumption
Electrical system	230/1/50 voltage/phase/Hz
Driving method	by remote sensor
Installation	indoor & outdoor

Equipment Tag Nos.	14 PAC 06
Location	administration building – chemist's room
Purpose	to condition the specified area
Type	ceiling-mounted cassette type
Number	1 duty, a stand-by unit is not installed in the facility
Rated Capacity	3000 kcal/h each unit
Rated power	1.2 kW consumption
Electrical system	230/1/50 voltage/phase/Hz
Driving method	by remote sensor
Installation	indoor & outdoor

Equipment Tag Nos.	14 PAC 07
Location	administration building – biological room
Purpose	to condition the specified area
Type	ceiling-mounted cassette type
Number	1 duty, a stand-by unit is not installed in the facility
Rated Capacity	3000 kcal/h each unit
Rated power	1.2 kW consumption
Electrical system	230/1/50 voltage/phase/Hz
Driving method	by remote sensor
Installation	indoor & outdoor

Section 15870

PS 15.07 Floor–Mounted Fans

The fans shall meet the operation and dimensional requirement as follows:

Fan Tag Nos.	01 CF 01
Location	raw water intake facility
Purpose	to supply make-up outdoor air for ventilation
Fan type	centrifugal forward curve, floor-mounted
Number	1 duty
Rated Capacity	43 m^3/min
Rated Static pressure	30 mm Aq.(external)
Speed	not more than 1450 rpm

Driving method	belt & pulley
Max noise level	85 dB(A) at 1 m
Installation	indoor

Fan Tag Nos.	07 CF 01
Location	filter unit
Purpose	to supply make-up outdoor air for ventilation
Fan type	centrifugal forward curve, floor-mounted
Number	1 duty
Rated Capacity	39 m³/min
Rated Static pressure	30 mm.Aq.(external)
Speed	not more than 1450 rpm
Driving method	belt & pulley
Max noise level	85 dB(A) at 1 m
Installation	indoor

Fan Tag Nos.	09 CF 01
Location	clear water pump station – pump room
Purpose	to supply make-up outdoor air for ventilation
Fan type	centrifugal floor-mounted
Number	1 duty
Rated Capacity	1,000 m³/min
Rated Static pressure	30 mm.Aq.(external)
Speed	not more than 1450 rpm
Driving method	belt & pulley
Max noise level	85 dB(A) at 1 m
Installation	indoor

Fan Tag Nos.	09 CF 02 and 09 CF 03
Location	clear water pump station – generator room
Purpose	to supply make-up outdoor air for ventilation
Fan type	centrifugal floor-mounted
Number	2 duty
Rated Capacity	1,100 m³/min each fan
Rated Static pressure	30 mm.Aq.(external)
Speed	not more than 1450 rpm
Driving method	belt & pulley
Max noise level	85 dB(A) at 1 m
Installation	indoor

PS 15.08 Axial Fans

The fans shall meet the operation and dimensional requirement as follows:

Fan Tag Nos.	09 AF 01
Location	clear water pump station – control room
Purpose	to supply make-up outdoor air for ventilation
Fan type	axial type, duct-mounted
Number	1 duty
Rated Capacity	260 m³/min
Rated Static pressure	30 mm.Aq.(external)
Speed	not more than 1450 rpm
Driving method	direct
Max noise level	85 dB(A) at 1 m
Installation	indoor

Fan Tag Nos.	09 AF 02

Location	clear water pump station – sub-station
Purpose	to supply make-up outdoor air for ventilation
Fan type	axial type, duct-mounted
Number	1 duty
Rated Capacity	420 m³/min
Rated Static pressure	30 mm.Aq.(external)
Speed	not more than 1450 rpm
Driving method	direct
Max noise level	85 dB(A) at 1 m
Installation	indoor

PS 15.09 Wall–Mounted Air Inlet Fans

The fans shall meet the operation and dimensional requirement as follows:

Fan Tag Nos.	01 SF 01,01 SF 02, 01 SF 03 and 01 SF 04
Location	raw water intake facility
Purpose	to supply make-up outdoor air for ventilation
Fan type	propeller, wall-mounted
Number	4 duty
Rated Capacity	110 m³/min each fan
Rated Static pressure	5 mm Aq.(external)
Speed	not more than 1450 rpm
Driving method	direct
Max noise level	85 dB(A) at 1 m
Installation	indoor

Fan Tag Nos.	07 SF 01 and 07 SF 02
Location	filter unit – electrical room
Purpose	to supply make-up outdoor air for ventilation
Fan type	propeller, wall-mounted
Number	2 duty
Rated Capacity	41 m³/min each fan
Rated Static pressure	5 mm.Aq.(external)
Speed	not more than 1450 rpm
Driving method	direct
Max noise level	85 dB(A) at 1 m
Installation	indoor

PS 15.10 Wall–Mounted Exhaust Fans

The fans shall meet the operation and dimensional requirement as follows:

Fan Tag Nos.	01 EF 01, 01 EF 02, 01 EF 03 and 01 EF 04
Location	raw water intake facility
Purpose	to extract exhaust air for ventilation
Fan type	propeller, wall-mounted
Number	4 duty
Rated Capacity	121 m³/min each fan
Rated Static pressure	5 mm Aq.(external)
Speed	not more than 1450 rpm
Driving method	direct
Max noise level	85 dB(A) at 1 m
Installation	indoor

Fan Tag Nos.	07 EF 01
Location	filter unit – electrical room
Purpose	to extract exhaust air for ventilation

Fan type	propeller, wall-mounted
Number	1 duty
Rated Capacity	82 m³/min each fan
Rated Static pressure	5 mm Aq.(external)
Speed	not more than 1450 rpm
Driving method	direct
Max noise level	85 dB(A) at 1 m
Installation	indoor

Fan Tag Nos.	09 EF 01, 09 EF 02, 09 EF 03, 09 EF 04 and 09 EF 05
Location	clear water pump station – pump room
Purpose	to extract exhaust air for ventilation
Fan type	propeller, wall-mounted
Number	5 duty
Rated Capacity	200 m³/min each fan
Rated Static pressure	5 mm Aq.(external)
Speed	not more than 1450 rpm
Driving method	direct
Max noise level	85 dB(A) at 1 m
Installation	indoor

Fan Tag Nos.	09 EF 06, 09 EF 07, 09 EF 08, and 09 EF 09
Location	chemical building
Purpose	to extract exhaust air for ventilation
Fan type	propeller, wall-mounted
Number	2 duty
Rated Capacity	65 m³/min each fan
Rated Static pressure	5 mm.Aq.(external)
Speed	not more than 1450 rpm
Driving method	direct
Max noise level	85 dB(A) at 1 m
Installation	indoor

Fan Tag Nos.	09 EF 10 and 09 EF 11
Location	chemical building
Purpose	to extract exhaust air for ventilation
Fan type	propeller, wall-mounted
Number	2 duty
Rated Capacity	210 m³/min each fan
Rated Static pressure	5 mm.Aq.(external)
Speed	not more than 1450 rpm
Driving method	direct
Max noise level	85 dB(A) at 1 m
Installation	indoor

Fan Tag Nos.	10 EF 01
Location	chemical building – chlorinator room
Purpose	to extract exhaust air for ventilation
Fan type	propeller, wall-mounted
Number	1 duty
Rated Capacity	26 m³/min
Rated Static pressure	5 mm Aq.(external)
Speed	not more than 1450 rpm
Driving method	direct
Max noise level	85 dB(A) at 1 m
Installation	indoor

Fan Tag Nos.	10 EF 02 and 10 EF 03
Location	chemical building – chlorine cylinder room
Purpose	to extract exhaust air for ventilation
Fan type	propeller, wall-mounted
Number	2 duty
Rated Capacity	87 m³/min each fan
Rated Static pressure	5 mm Aq.(external)
Speed	not more than 1450 rpm
Driving method	direct
Max noise level	85 dB(A) at 1 m
Installation	indoor

Section 16111

PS 16.1 Cable Trays (Racks)

A The term cable tray, or rack, shall include all necessary supports, fixing bolts and foundation bolts required to support the tray work. The traywork shall be laid out and designed so as to facilitate the installation of cables and dismantling of any section for maintenance. Positions of joints shall take structure expansion joints into account to allow for differential movement of building structure. Wherever possible, standard fittings shall be used in preference to fabricated or special fittings.

B All cables laid across floors to equipment, and which is not shown or specified as being in ducting or conduit, shall be installed on cable tray which is raised above the finished floor level.

Section 16112

PS 16.2 Conduit

A Conduits shall be installed as follows:
1 Corrugated rigid polyethylene conduit (FEP) for underground cable installation.
2 Heavy-duty stainless steel grade 316 conduits for corrosive environments such as chlorinator room or chlorine container storage.
3 Galvanized steel conduit for normal environments.

B The term conduit shall include all necessary supports, fixing bolts and foundation bolts required to support the conduit. The conduit shall be laid out and designed so as to facilitate the installation of cables and dismantling of any section for maintenance. Positions of joints shall take structure expansion joints into account to allow for differential movement of building structure. Wherever possible, standard fittings shall be used in preference to fabricated or special fittings.

C Except for conduit passing through floor slabs or walls, when post drilling for the necessary hole may be undertaken, conduit to be concealed in the structural concrete shall installed before concrete is placed.

Section 16114

PS 16.3 Trunking or Ducts

The term trunking or ducts shall include all necessary supports, fixing bolts and foundation bolts required to support the trunking. The trunking shall be laid out and designed so as to facilitate the installation of cables and dismantling of any section for

maintenance. Positions of joints shall take structure expansion joints into account to allow for differential movement of building structure. Wherever possible, standard fittings shall be used in preference to fabricated or special fittings.

Section 16120

PS 16.4 Cables

A All cables laid across floors to equipment, and which is not shown or specified as being in ducting or conduit, shall be installed on cable tray which is raised above the finished floor level.

B All underground cables shall be laid in corrugated rigid polyethylene conduits (FEP). The number and sizes of ducts shall be as detailed on the drawings.

Section 16150

PS 16.5 Induction Motors

The induction motors are as listed in the Technical Schedules.

Section 16320

PS 16.6 Power Transformer

A. General
Structure

Structure Parts	Steel plate thickness
Side plate	2.3 mm
Bottom plate	1.6 mm
Roof	2.3 mm
Ceiling	1.6 mm
Door	3.2 mm
Separator	1.6 mm

Standard Accessories

Name Plate	Plastic plate, with engraved black letter on white back-ground
Inboard Lighting	with lighting door switch
Door key	
Isolation rubber mat	
Withdrawing lifter	
Spare parts	

B. Power Transformer Panel

Tag No.	04TRP01
Name	NO.1 HT Transformer Panel
Quantity	1-panel
Type	Molded 3phase-4wire, double wound, naturally cooled type to be built in metal enclosed switchgear
Rated capacity	2000kVA
Rated voltage	33kV/420-242V
System highest voltage	36kV
Withstand voltage	Lightning impulse 170kV

Power-frequency	70kV
Method of connection	HV winding Delta connection
LV winding	Star connection, neutral solidly earthed
Insulation type	Class B
Permissible winding temperature	75C
Over current grand relay	1-set
Zero-phase current transformer (ZCT)	1-set
Necessary accessories	1-lot

Section 16375

PS 16.7 High Voltage Metal-clad Switchgear

A General

Structure

Structure Parts	Steel plate thickness
Side plate	2.3 mm
Bottom plate	1.6 mm
Roof	2.3 mm
Ceiling	1.6 mm
Door	3.2 mm
Separator	1.6 mm

Standard Accessories

Name Plate	Plastic plate, with engraved black letter on white back-ground
Inboard Lighting	with lighting door switch
Door key	
Isolation rubber mat	
Withdrawing lifter	
Spare parts	

B HT Power Receiving Panel for WTP

Tag No.	04HTP01
Name	HT Power Receiving Panel
Quantity	1-panel
Type	Indoor, Self-supporting, Metal enclosed, Vermin-proof
Rated voltage	AC 33kV
System highest voltage	AC 36kV
Withstand voltage	Lightning impulse 170kV
Power-frequency	70kV
Control circuit voltage	DC 100V
Vacuum circuit breaker (VCB)	1-set
Type	Withdrawal, Three-pole
Rated voltage	36kV
Rated current	1200A
Rated breaking current	25kA
Rated breaking time	3cycles
Current transformer (CT)	2-set
Type	Molded
Rated current	100/5A
Voltage transformer (VT)	3-set
Type	Molded
Rated voltage	33*1.73k/100*1.73V
Lightning arrester	3-set
Type	Metal oxide arrester

Rated voltage	42kV
Nominal discharge current	10kA
Disconnecting switch	
Measuring instrument	
Ammeter with selector switch	1-set
Voltmeter with selector switch	1-set
Transducer	1-lot
Protective relay	
Voltage detector	1-set
Under voltage relay	1-set
Over current relay	1-set
Control switch	1-lot
Indication lamp	lot
Necessary accessories	1-lot

C HT Feeder Panel for WTP

Tag No.	04HTP02
Name	NO.1 HT Feeder Panel
Quantity	1-panel
Type	Indoor, Self-supporting, Metal enclosed, Vermin-proof
Type	
Rated voltage	AC 33kV
System highest voltage	AC 36kV
Withstand voltage	Lightning impulse 170kV
Power-frequency	70kV
Control circuit voltage	DC 100V
Vacuum circuit breaker (VCB)	1-set
Type	Withdrawal, Three-pole
Rated voltage	36kV
Rated current	1200A
Rated breaking current	25kA
Rated breaking time	3cycles
Control switch	1-lot
Indication lamp	1-lot
Necessary accessories	1-lot

Section 16410, 16425

PS 16.8 Low Voltage Metal-clad Switchgear

A. General

Structure

Structure Parts	Steel plate thickness
Side plate	2.3 mm
Bottom plate	1.6 mm
Roof	2.3 mm
Ceiling	1.6 mm
Door	3.2 mm
Separator	1.6 mm

Standard Accessories

Name Plate	Plastic plate, with engraved black letter on white background
Inboard Lighting	with lighting door switch
Door key	
Withdrawing lifter	
Spare parts	

B. LV Receiving Panel for INTAKE

Tag No.	01LRP01
Name	LV Receiving Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Rated current	2500A
Control circuit voltage	DC 100V
Air circuit breaker (ACB)	1-set
Type	Withdrawal, 4-pole, motor operated
Rated current	2500A
Rated breaking current	not less than 50kA (sym)
Current transformer (CT)	2-sets
Type	Molded
Rated current	2500/5A
Voltage transformer (VT)	2-sets
Type	Molded
Rated voltage	440/110V
Lightning arrester	1-lot
Measuring instrument	
Ammeter with selector switch	1-set
Voltmeter with selector switch	1-set
Power factor meter	1-set
Protective relay	
Under voltage relay	1-set
Over current relay	2-sets
Auto PF controller	1-set
Control switch	1-lot
Indication lamp	1-lot
Necessary accessories	1-lot

C. Generator Connection Panel for INTAKE

Tag No.	01GCP01
Name	Generator Connection Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Rated current	2500A
Control circuit voltage	DC 100V
Air circuit breaker (ACB)	1-set
Type	Withdrawal, 4-pole, motor operated
Rated current	2500A
Rated breaking current	not less than 50kA (sym)
Current transformer (CT)	2-sets
Type	Molded
Rated current	2500/5A
Voltage transformer (VT)	2-sets
Type	Molded
Rated voltage	440/110V
Measuring instrument	
Ammeter with selector switch	1-set
Voltmeter with selector switch	1-set
Power factor meter	1-set
Control switch	1-lot
Indication lamp	1-lot

Necessary accessories	1-lot

D. LV Feeder Panel for INTAKE

Tag No.	01LFP01
Name	No.1 LV Feeder Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Rated current	2500A
Control circuit voltage	DC 100V
Molded case circuit breaker (MCCB)	1-lot
3P 2500AF	1-set
3P 600AF	3-sets
3P 100AF	7-sets
Over current grand relay	9-sets
Zero-phase current transformer (ZCT)	9-sets
Indication lamp	1-lot
Necessary accessories	1-lot

E. Transformer Secondly Panel for WTP

Tag No.	04TSP01
Name	No.1 Transformer Secondly Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Rated current	3000A
Control circuit voltage	DC 100V
Air circuit breaker (ACB)	2-sets
Type	Withdrawal, 4-pole, motor operated
Rated current	3200A
Rated breaking current	not less than 50kA (sym)
Current transformer (CT)	4-sets
Type	Molded
Rated current	3000/5A
Voltage transformer (VT)	4-sets
Type	Molded
Rated voltage	440/110V
Measuring instrument	1-lot
Ammeter with selector switch	2-sets
Voltmeter with selector switch	2-sets
Power factor meter	2-sets
Protective relay	1-lot
Under voltage relay	1-set
Over current relay	2-sets
Auto PF controller	1-set
Control switch	1-lot
Indication lamp	1-lot
Inboard lighting	1-lot
Bus duct	1-set
Type	3phase air insulation
Rated voltage	600V
Rated current	3000A
Short-circuit intensity	100kA
Material	Aluminium
Length	About 10m
Necessary accessories	1-lot

F. LV Feeder Panel-1 for WTP

Tag No.	04LVP01
Name	No.1 LV Feeder Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Rated current	4000A
Control circuit voltage	DC 100V
Molded case circuit breaker (MCCB)	1-lot
3P 400AF	1-set
3P 225AF	2-set
3P 100AF	10-sets
Over current grand relay	13-sets
Zero-phase current transformer (ZCT)	13-sets
Indication lamp	1-lot
Inboard lighting	1-lot
Necessary accessories	1-lot

G. LV Feeder Panel-2 for WTP

Tag No.	04LVP02
Name	No.2 LV Feeder Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Rated current	4000A
Control circuit voltage	DC 100V
Molded case circuit breaker (MCCB)	1-lot
3P 1200AF	2-sets
3P 600AF	2-sets
3P 225AF	2-sets
Over current grand relay	6-sets
Zero-phase current transformer (ZCT)	6-sets
Indication lamp	1-lot
Inboard lighting	1-lot
Necessary accessories	1-lot

H. Static Capacitor Panel for WTP

Tag No.	04SCP01
Name	Static Capacitor Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated voltage	420V
Rated current	4000A
Static Capacitor	1-lot
Type	Gas filled type with series reactor (6%)
Effective capacity	50kVA x1, 25kVA x1, 15kVA x1
Molded case circuit breaker (MCCB)	1-lot
3P 100AF	1-set
3P 50AF	2-sets
Electromagnetic contactor	1-lot
Control switch	1-lot
Indication lamp	1-lot
Inboard lighting	1-lot
Necessary accessories	1-lot

I LV Receiving Panel for KAHAWATTA S.R. & P.S.

Tag No.	304PRP01
Name	Power Receiving Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Rated current	600A
Control circuit voltage	AC 240V
Molded case circuit breaker (MCCB)	1-lot
4P 400AF	2-sets
3P 50AF	1-set
2P 50AF	4-sets
Over current grand relay	4-sets
Zero-phase current transformer (ZCT)	5-sets
Lightning arrester	1-set
Voltmeter	1-set
Indication lamp	1-lot
Inboard lighting	1-set
Electric space heater	1-set
Generator connection terminal	1-lot
Necessary accessories	1-lot

J LV Receiving Panel for KONDADENIYA S.R. & P.S.

Tag No.	310PRP01
Name	Power Receiving Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Rated current	600A
Control circuit voltage	AC 240V
Molded case circuit breaker (MCCB)	1-lot
4P 100AF	2-set
2P 50AF	4-sets
Over current grand relay	4-sets
Zero-phase current transformer (ZCT)	4-sets
Lightning arrester	1-set
Voltmeter	1-set
Indication lamp	1-lot
Inboard lighting	1-set
Electric space heater	1-set
Generator connection terminal	1-lot
Necessary accessories	1-lot

K LV Receiving Panel for ASGIRIYA P.S.

Tag No.	315PRP01
Name	Power Receiving Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Rated current	600A
Control circuit voltage	AC 240V
Molded case circuit breaker (MCCB)	1-lot
4P 100AF	2-set
2P 50AF	4-sets
Over current grand relay	4-sets
Zero-phase current transformer (ZCT)	4-sets

Lightning arrester	1-set
Voltmeter	1-set
Indication lamp	1-lot
Inboard lighting	1-set
Electric space heater	1-set
Generator connection terminal	1-lot
Necessary accessories	1-lot

L LV Receiving Panel for R2 S.R. & P.S.

Tag No.	318PRP01
Name	Power Receiving Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Rated current	600A
Control circuit voltage	AC 240V
Molded case circuit breaker (MCCB)	1-lot
4P 225AF	2-set
2P 50AF	4-sets
Over current grand relay	4-sets
Zero-phase current transformer (ZCT)	4-sets
Lightning arrester	1-set
Voltmeter	1-set
Indication lamp	1-lot
Inboard lighting	1-set
Electric space heater	1-set
Generator connection terminal	1-lot
Necessary accessories	1-lot

M LV Receiving Panel for HEERASAGALA LOW S.R. & P.S.

Tag No.	320PRP01
Name	Power Receiving Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Rated current	600A
Control circuit voltage	AC 240V
Molded case circuit breaker (MCCB)	1-lot
4P 100AF	2-set
2P 50AF	4-sets
Over current grand relay	4-sets
Zero-phase current transformer (ZCT)	4-sets
Lightning arrester	1-set
Voltmeter	1-set
Indication lamp	1-lot
Inboard lighting	1-set
Electric space heater	1-set
Generator connection terminal	1-lot
Necessary accessories	1-lot

N LV Receiving Panel for HEERASAGALA MIDDLE S.R. & P.S.

Tag No.	321PRP01
Name	Power Receiving Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V

Rated current	100A
Control circuit voltage	AC 240V
Molded case circuit breaker (MCCB)	1-lot
4P 50AF	2-set
2P 50AF	4-sets
Over current grand relay	4-sets
Zero-phase current transformer (ZCT)	4-sets
Lightning arrester	1-set
Voltmeter	1-set
Indication lamp	1-lot
Inboard lighting	1-set
Electric space heater	1-set
Generator connection terminal	1-lot
Necessary accessories	1-lot

O LV Receiving Panel for AMPITIYA S.R. & P.S.

Tag No.	324PRP01
Name	Power Receiving Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Rated current	400A
Control circuit voltage	AC 240V
Molded case circuit breaker (MCCB)	1-lot
4P 225AF	2-set
2P 50AF	4-set
Over current grand relay	4-sets
Zero-phase current transformer (ZCT)	4-sets
Lightning arrester	1-set
Voltmeter	1-set
Indication lamp	1-lot
Inboard lighting	1-set
Electric space heater	1-set
Generator connection terminal	1-lot
Necessary accessories	1-lot

P Incoming Feeder Box for R2 S.R. & P.S.

Tag No.	318IFB01
Name	Incoming Feeder Box
Quantity	1-box
Type	Outdoor, wall-mounted, metal enclosed, water-proof
Rated insulation voltage	AC600V
Rated current	600A
Molded case circuit breaker (MCCB)	1-lot
4P 600AF	1-set
4P 400AF	1-set
4P 225AF	1-set
Over current grand relay	2-sets
Zero-phase current transformer (ZCT)	2-sets
Indication lamp	1-lot
Necessary accessories	1-lot

PS 16.9 Independent Motor Starter Panel

A. General

Structure

Structure Parts	Steel plate thickness
Side plate	2.3 mm
Bottom plate	1.6 mm
Roof	2.3 mm
Ceiling	1.6 mm
Door	3.2 mm
Separator	1.6 mm

Standard Accessories

Name Plate	Plastic plate, with engraved black letter on white back-ground
Inboard Lighting	with lighting door switch
Door key	
Withdrawing lifter	
Spare parts	

B. Raw Water Pump VVVF Panel

Tag No.	01VVF01
Name	Raw Water Pump VVVF Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Inverter unit	1-set
Adapted motor	280kW squirrel-cage motor
Converter	Sine wave PWM type
Mounted equipment in the panel	
MCCB 4P 600AF	1-set
Electromagnetic contactor	2-sets
Radio noise filter	1-set
AC reactor	1-set
Current transformer	2-sets
Zero-phase current transformer	1-set
Over current grand relay	1-set
Thermal relay	1-set
Running time meter	1-set
Control circuit	1-lot
Other necessary equipment	1-lot
Mounted equipment on the panel	
Ammeter with selector switch	1-set
Speed indicator	1-set
Flow indicating controller	1-set (01IFM01)
Assembled indicating lamp	1 set
Control switch	1-lot
Change over switch	1-lot
Indication lamp	1-lot
Inboard lighting	1-lot
Other necessary equipment	1 lot

C Raw Water Pump Panel

Tag No./Name	01RPP01 / No.1 Raw Water Pump Panel 01RPP02 / No.2 Raw Water Pump Panel

Quantity	2-panels
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
(The following quantities show the quantity of each one panel.)	
Motor starter-1	1-set
Adapted motor	280kW squirrel-cage motor
Electronic soft starter unit	1-set
MCCB 4P 600AF	1-set
Electromagnetic contactor	2-sets
Current transformer	2-sets
Zero-phase current transformer	1-sets
Over current grand relay	1-sets
Thermal relay	1-set
Static capacitor	1-set
Mold type 75kVA with 6% series reactor	
Control circuit	1-lot
Other necessary equipment	1-lot
Motor starter-2	1-set
Adapted motor	0.2kW valve motor
Starter	Reversible starter
MCCB 3P 50AF	1-set
Electromagnetic contactor	2-sets
Zero-phase current transformer	1-sets
Over current grand relay	1-sets
Thermal relay	1-set
Control circuit	1-lot
Other necessary equipment	1-lot
Mounted equipment on the panel	
Ammeter with selector switch	1-set
Running time meter	1-set
Assembled indicating lamp	1 set
Control switch	1-lot
Indication lamp	1-lot
Inboard lighting	1-lot
Other necessary equipment	1 lot

D Transmission Pump (A-1) Panel

Tag No./Name	09TPP11/No.1 Transmission Pump (A-1) Panel 09TPP12/No.2 Transmission Pump (A-1) Panel
Quantity	2-panels
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
(The following quantities show the quantity of each one panel.)	
Motor starter-1	1-set
Adapted motor	450kW squirrel-cage motor
Electronic soft starter unit	1-set
MCCB 4P 1200AF	1-set
Electromagnetic contactor	2-sets
Current transformer	2-sets
Zero-phase current transformer	1-sets
Over current grand relay	1-sets
Thermal relay	1-set
Static capacitor	1-set
Mold type 150kVA with 6% series reactor	

Control circuit	1-lot
Other necessary equipment	1-lot
Motor starter-2	1-set
Adapted motor	0.2kW valve motor
Starter	Reversible starter
MCCB 3P 50AF	1-set
Electromagnetic contactor	2-sets
Zero-phase current transformer	1-sets
Over current grand relay	1-sets
Thermal relay	1-set
Control circuit	1-lot
Other necessary equipment	1-lot
Mounted equipment on the panel	
Ammeter with selector switch	1-set
Running time meter	1-set
Assembled indicating lamp	1 set
Control switch	1-lot
Change over switch	1-lot (09TPP11 only)
Setting switch	1-lot (09TPP11 only)
Indication lamp	1-lot
Inboard lighting	1-lot
Other necessary equipment	1 lot

E Transmission Pump (A-2) Panel

Tag No./Name	09TPP21/No.1 Transmission Pump (A-2) Panel
09TPP22 / No.2 Transmission Pump (A-2) Panel	
Quantity	2-panels
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
(The following quantities show the quantity of each one panel.)	
Motor starter-1	1-set
Adapted motor	90kW squirrel-cage motor
Electronic soft starter unit	1-set
MCCB 4P 225AF	1-set
Electromagnetic contactor	2-sets
Current transformer	2-sets
Zero-phase current transformer	1-sets
Over current grand relay	1-sets
Thermal relay	1-set
Static capacitor	1-set
Mold type 30kVA with 6% series reactor	
Control circuit	1-lot
Other necessary equipment	1-lot
Motor starter-2	1-set
Adapted motor	0.2kW valve motor
Starter	Reversible starter
MCCB 3P 50AF	1-set
Electromagnetic contactor	2-sets
Zero-phase current transformer	1-sets
Over current grand relay	1-sets
Thermal relay	1-set
Control circuit	1-lot
Other necessary equipment	1-lot
Mounted equipment on the panel	
Ammeter with selector switch	1-set

Running time meter	1-set
Assembled indicating lamp	1 set
Control switch	1-lot
Change over switch	1-lot (09TPP21 only)
Setting switch	1-lot (09TPP21 only)
Indication lamp	1-lot
Inboard lighting	1-lot
Other necessary equipment	1 lot

F Transmission Pump (A-3) Panel

Tag No./Name	09TPP31/No.1 Transmission Pump (A-3) Panel
09TPP32 / No.2 Transmission Pump (A-3) Panel	
Quantity	2-panels
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
(The following quantities show the quantity of each one panel.)	
Motor starter-1	1-set
Adapted motor	250kW squirrel-cage motor
Electronic soft starter unit	1-set
MCCB 4P 600AF	1-set
Electromagnetic contactor	2-sets
Current transformer	2-sets
Zero-phase current transformer	1-sets
Over current grand relay	1-sets
Thermal relay	1-set
Static capacitor	1-set
Mold type 75kVA with 6% series reactor	
Control circuit	1-lot
Other necessary equipment	1-lot
Motor starter-2	1-set
Adapted motor	0.2kW valve motor
Starter	Reversible starter
MCCB 3P 50AF	1-set
Electromagnetic contactor	2-sets
Zero-phase current transformer	1-sets
Over current grand relay	1-sets
Thermal relay	1-set
Control circuit	1-lot
Other necessary equipment	1-lot
Mounted equipment on the panel	
Ammeter with selector switch	1-set
Running time meter	1-set
Assembled indicating lamp	1 set
Control switch	1-lot
Change over switch	1-lot (09TPP31 only)
Setting switch	1-lot (09TPP31 only)
Indication lamp	1-lot
Inboard lighting	1-lot
Other necessary equipment	1 lot

G Booster Pump Panel for KAHAWATTA S.R. & P.S.

Tag No./Name	304BPP01 / No.1 Booster Pump Panel
304BPP02 / No.2 Booster Pump Panel	
Quantity	2-panels
Type	Indoor, self-supporting, metal enclosed, vermin-

	proof
Rated insulation voltage	AC600V
(The following quantities show the quantity of each one panel.)	
Motor starter	1-set
Adapted motor	55kW squirrel-cage motor
Autotransformer starter unit	1-set
MCCB 3P 225AF	1-set
Current transformer	2-sets
Zero-phase current transformer	1-set
Over current grand relay	1-set
Thermal relay	1-set
Static capacitor	1-set
Mold type 15kVA with 6% series reactor	
Control circuit	1-lot
Other necessary equipment	1-lot
Mounted equipment on the panel	
Ammeter with selector switch	1-set
Running time meter	1-set
Assembled indicating lamp	1 set
Control switch	1-lot
Change over switch	1-lot (304BPP01 only)
Indication lamp	1-lot
Inboard lighting	1-set
Electrical space heater	1-set
Other necessary equipment	1 lot

H Booster Pump Panel for KONDADENIYA S.R. & P.S.

Tag No./Name	310BPP01 / No.1, 2 Booster Pump Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Motor starter	2-sets
Adapted motor	30kW squirrel-cage motor
Autotransformer starter unit	2-sets
MCCB 3P 100AF	2-sets
Current transformer	4-sets
Zero-phase current transformer	2-sets
Over current grand relay	2-sets
Thermal relay	2-sets
Static capacitor	2-sets
Mold type 10kVA with 6% series reactor	
Control circuit	1-lot
Other necessary equipment	1-lot
Mounted equipment on the panel	
Ammeter with selector switch	2-sets
Running time meter	2-sets
Assembled indicating lamp	2 sets
Control switch	1-lot
Change over switch	1-lot
Indication lamp	1-lot
Inboard lighting	1-set
Electrical space heater	1-set
Other necessary equipment	1 lot

I Booster Pump Panel for ASGIRIYA P.S.

Tag No./Name	315BPP01 / No.1, 2 Booster Pump Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Motor starter	2-sets
Adapted motor	30kW squirrel-cage motor
Star-delta starter unit	2-sets
MCCB 3P 100AF	2-sets
Current transformer	4-sets
Zero-phase current transformer	2-sets
Over current grand relay	2-sets
Thermal relay	2-sets
Static capacitor	2-sets
Mold type 10kVA with 6% series reactor	
Control circuit	1-lot
Other necessary equipment	1-lot
Mounted equipment on the panel	
Ammeter with selector switch	2-sets
Running time meter	2-sets
Assembled indicating lamp	2-sets
Control switch	1-lot
Change over switch	1-lot
Indication lamp	1-lot
Inboard lighting	1-set
Electrical space heater	1-set
Other necessary equipment	1-lot

J Booster Pump Panel for R2 S.R. & P.S.

Tag No./Name	318BPP01 / No.1 Booster Pump Panel
318BPP02 / No.2 Booster Pump Panel	
Quantity	2-panels
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
(The following quantities show the quantity of each one panel.)	
Motor starter	1-set
Adapted motor	55kW squirrel-cage motor
Autotransformer starter unit	1-set
MCCB 3P 225AF	1-set
Current transformer	2-sets
Zero-phase current transformer	1-set
Over current grand relay	1-set
Thermal relay	1-set
Static capacitor	1-set
Mold type 15kVA with 6% series reactor	
Control circuit	1-lot
Other necessary equipment	1-lot
Mounted equipment on the panel	
Ammeter with selector switch	1-set
Running time meter	1-set
Assembled indicating lamp	1 set
Control switch	1-lot
Change over switch	1-lot (318BPP01 only)
Indication lamp	1-lot

Inboard lighting	1-set
Electrical space heater	1-set
Other necessary equipment	1 lot

K Booster Pump Panel for HEERASAGALA LOW S.R. & P.S.

Tag No./Name	320BPP01 / No.1, 2 Booster Pump Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Motor starter	2-sets
Adapted motor	37kW squirrel-cage motor
Autotransformer starter unit	2-sets
MCCB 3P 100AF	2-sets
Current transformer	4-sets
Zero-phase current transformer	2-sets
Over current grand relay	2-sets
Thermal relay	2-sets
Static capacitor	2-sets
Mold type 10kVA with 6% series reactor	
Control circuit	1-lot
Other necessary equipment	1-lot
Mounted equipment on the panel	
Ammeter with selector switch	2-sets
Running time meter	2-sets
Assembled indicating lamp	2-sets
Control switch	1-lot
Change over switch	1-lot
Indication lamp	1-lot
Inboard lighting	1-set
Electrical space heater	1-set
Other necessary equipment	1 lot

L Booster Pump Panel for HEERASAGALA MIDDLE S.R. & P.S.

Tag No./Name	321BPP01 / No.1, 2 Booster Pump Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Motor starter	2-set
Adapted motor	18.5kW squirrel-cage motor
Star-delta starter unit	2-sets
MCCB 3P 50AF	2-sets
Current transformer	4-sets
Zero-phase current transformer	2-sets
Over current grand relay	2-sets
Thermal relay	2-sets
Static capacitor	2-sets
Mold type 5kVA with 6% series reactor	
Control circuit	1-lot
Other necessary equipment	1-lot
Mounted equipment on the panel	
Ammeter with selector switch	2-sets
Running time meter	2-sets
Assembled indicating lamp	2-sets
Control switch	1-lot

Change over switch	1-lot
Indication lamp	1-lot
Inboard lighting	1-set
Electrical space heater	1-set
Other necessary equipment	1 lot

M Booster Pump (D-1) Panel for AMPITIYA S.R. & P.S.

Tag No./Name	324BPP01 / No.1, 2 Booster Pump (D-1) Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Motor starter	2-sets
Adapted motor	11kW squirrel-cage motor
Star-delta starter unit	2-sets
MCCB 3P 50AF	2-sets
Current transformer	4-sets
Zero-phase current transformer	2-sets
Over current grand relay	2-sets
Thermal relay	2-sets
Control circuit	1-lot
Other necessary equipment	1-lot
Mounted equipment on the panel	
Ammeter with selector switch	2-sets
Running time meter	2-sets
Assembled indicating lamp	2-sets
Control switch	1-lot
Change over switch	1-lot
Indication lamp	1-lot
Inboard lighting	1-set
Electrical space heater	1-set
Other necessary equipment	1 lot
Emergency stop box (324LOP01, 02)	2-sets

N Booster Pump (D-2) Panel for AMPITIYA S.R. & P.S.

Tag No./Name	324BPP02 / No.1, 2 Booster Pump (D-2) Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Motor starter	2-sets
Adapted motor	37kW squirrel-cage motor
Star-delta starter unit	2-sets
MCCB 3P 100AF	2-sets
Current transformer	4-sets
Zero-phase current transformer	2-sets
Over current grand relay	2-sets
Thermal relay	2-sets
Static capacitor	2-sets
Mold type 10kVA with 6% series reactor	
Control circuit	1-lot
Other necessary equipment	1-lot
Mounted equipment on the panel	
Ammeter with selector switch	2-sets
Running time meter	2-sets
Assembled indicating lamp	2-sets

Control switch	1-lot
Change over switch	1-lot
Indication lamp	1-lot
Inboard lighting	1-set
Electrical space heater	1-set
Other necessary equipment	1 lot
Emergency stop box (324LOP03, 04)	2-sets

O Booster Pump (D-3) Panel for AMPITIYA S.R. & P.S.

Tag No./Name	324BPP03 / No.1, 2 Booster Pump (D-3) Panel
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated insulation voltage	AC600V
Motor starter	2-sets
Adapted motor	37kW squirrel-cage motor
Star-delta starter unit	2-sets
MCCB 3P 100AF	2-sets
Current transformer	4-sets
Zero-phase current transformer	2-sets
Over current grand relay	2-sets
Thermal relay	2-sets
Static capacitor	2-sets
Mold type 10kVA with 6% series reactor	
Control circuit	1-lot
Other necessary equipment	1-lot
Mounted equipment on the panel	
Ammeter with selector switch	2-sets
Running time meter	2-sets
Assembled indicating lamp	2-sets
Control switch	1-lot
Change over switch	1-lot
Indication lamp	1-lot
Inboard lighting	1-set
Electrical space heater	1-set
Other necessary equipment	1 lot
Emergency stop box (324LOP05, 06)	2-sets

PS 16.10 Motor Control Centre (MCC) & Auxiliary Relay Panel

A. General

Structure

Structure Parts	Steel plate thickness
Side plate	2.3 mm
Bottom plate	1.6 mm
Ceiling	1.6 mm
Door	2.3 mm
Separator	1.6 mm

Standard Accessories

Name Plate	Plastic plate, with engraved black letter on white back-ground
Inboard Lighting	with lighting door switch (auxiliary relay panel only)

Door key (auxiliary relay panel only)

Spare parts

B. Motor Control Centre for INTAKE

Tag No. 01MCC01
Name INTAKE MCC
Quantity 1-set (3-panels)
Type Indoor, self-supporting, metal enclosed, vermin-proof, single face withdrawal
Rated insulation voltage AC600V
Composed units

Starter unit	Qty	MCCB	Mounted equipment
Incoming	1	4P 100AF	Voltmeter, Ammeter
Direct On Line -1	2	3P 50AF	OCG
Direct On Line -2	2	3P 50AF	Running hour meter, OCG
Star Delta	2	3P 50AF	Ammeter, Running hour meter, OCG
Power Supply -1	1	4P 50AF	OCG
Power Supply -2	2	4P 50AF	
Control Power Unit	1	2P 50AF	MCB

C. Auxiliary Relay Panel for INTAKE

Tag No. 01ARY01
Name INTAKE Auxiliary Relay Panel
Quantity 1-set
Type Indoor, self-supporting, metal enclosed, vermin-proof, both faces
Purpose To drive and control INTAKE facility. Manual operations of all electrical loads shall be done by hard relay.
Mounted equipment on the panel

Hard relay 1-lot
Indication lamp 1-lot
Other necessary equipment 1 lot

D. Motor Control Centre for SEDIMENTATION BASIN & FILTER UNIT

Tag No. 06MCC01
Name SEDI. & FILTER MCC
Quantity 1-set (5-panels)
Type Indoor, self-supporting, metal enclosed, vermin-proof single face withdrawal
Rated insulation voltage AC600V
Composed units

Starter unit	Qty	MCCB	Mounted equipment
Incoming	1	4P 100AF	Voltmeter, Ammeter
Direct On Line -1	1	3P 50AF	OCG
Reversible	20	3P 50AF	OCG
Power Supply -1	2	4P 50AF	OCG
Power Supply -2	2	4P 50AF	

Starter unit	Qty	MCCB	Mounted equipment
Control Power Unit	1	2P 50AF	MCB

E. Auxiliary Relay Panel for SEDIMENTATION BASIN

Tag No. 06ARY01
Name SEDIMENTATION Auxiliary Relay Panel
Quantity 1-set (3-panels)
Type Indoor, self-supporting, metal enclosed, vermin-proof, both faces
Purpose To drive and control SEDIMENTATION and FILTER facility. Manual operations of all electrical loads shall be done by hard relay.
Mounted equipment on the panel
Hard relay 1-lot
Indication lamp 1-lot
Other necessary equipment 1 lot

F. Motor Control Centre for BACKWASH FACILITY

Tag No. 07MCC01
Name BACKWASH MCC
Quantity 1-set (7-panels)
Type Indoor, self-supporting, metal enclosed, vermin-proof single face withdrawal
Rated insulation voltage AC600V
Composed units

Starter unit	Qty	MCCB	Mounted equipment
Incoming	1	4P 400AF	Voltmeter, Ammeter
Direct On Line -1	1	3P 50AF	OCG
Direct On Line -2	4	3P 50AF	Running hour meter, OCG
Star Delta –1	3	3P 50AF	Ammeter, Running hour meter, OCG
Star Delta -2	2	3P 100AF	Ammeter, Running hour meter, OCG
Auto Transformer	2	3P 225AF	Ammeter, Running hour meter, OCG
Inverter	2	3P 50AF	Running hour meter, OCG
Power Supply	2	4P 50AF	
Control Power Unit	1	2P 50AF	MCB

G. Auxiliary Relay Panel for BACKWASH

Tag No. 07ARY01
Name FILTER Auxiliary Relay Panel
Quantity 1-set (2-panels)
Type Indoor, self-supporting, metal enclosed, vermin-proof, both faces
Purpose To drive and control FILTER and BACKWASH RECOVERY facility. Manual operations of all electrical loads shall be done by hard relay.
Mounted equipment on the panel

Hard relay 1-lot
Indication lamp 1-lot
Other necessary equipment 1 lot

H. Motor Control Centre for CHEMICAL DOSING

Tag No. 10MCC01
Name CHEMICAL DOSING MCC
Quantity 1-set (5-panels)
Type Indoor, self-supporting, metal enclosed, vermin-proof single face withdrawal
Rated insulation voltage AC600V
Composed units

Starter unit	Qty	MCCB	Mounted equipment
Incoming	1	4P 100AF	Voltmeter, Ammeter
Direct On Line -1	5	3P 50AF	OCG
Direct On Line -2	2	3P 50AF	Running hour meter, OCG
Inverter	4	3P 50AF	Running hour meter, OCG
Power Supply -1	2	4P 50AF	OCG
Power Supply -2	1	4P 50AF	
Control Power Unit	1	2P 50AF	MCB

I. Auxiliary Relay Panel for CHEMICAL DOSING

Tag No. 10ARY01
Name CHEMICAL DOSING Auxiliary Relay Panel
Quantity 1-set (2-panels)
Type Indoor, self-supporting, metal enclosed, vermin-proof, both faces
Purpose To drive and control CHEMICAL DOSING facility. Manual operations of all electrical loads shall be done by hard relay.
Mounted equipment on the panel
Hard relay 1-lot
Indication lamp 1-lot
Other necessary equipment 1 lot

PS 16.11 Local Operation Panel

A. General
Structure

Structure Parts	Steel plate thickness
Side plate	2.3 mm
Bottom plate	1.6 mm
Roof	2.3 mm
Door	2.3 mm
and pole	2.3 mm
Stand pole base	6.0 mm

Standard Accessories
Name Plate Plastic plate, with engraved black letter on white back-ground
Door key

Spare parts

B. Fine Screen Local Operation Panel

Tag No.	01LOP01
Name	Fine Screen LOP
Quantity	1-panel
Type	Outdoor, with stand, metal enclosed, water-proof
Mounted equipment	
Assembled indicating lamp	1-set
Change over switch (2-point)	2-sets
Control switch (2-point)	2-sets
Indicating lamp (RL-GL)	2-sets
Push button switch (water proof)	1-set
Other necessary equipment	1-lot

C. Screen Wash Pump Local Operation Panel

Tag No.	01LOP02
Name	Screen Wash Pump LOP
Quantity	1-panel
Type	Outdoor, with stand, metal enclosed, water-proof
Mounted equipment	
Ammeter	2-sets
Assembled indicating lamp	1-set
Change over switch (2-point)	2-sets
Change over switch (3-point)	1-set
Control switch (2-point)	2-sets
Indicating lamp (RL-GL)	2-sets
240V plug socket	1-set
Other necessary equipment	1-lot

D Raw Water Pump Local Operation Panel

Tag No./Name	01LOP03 / No.1 Raw water Pump LOP 01LOP04 / No.2 Raw water Pump LOP
Quantity	2-panels
Type	Indoor, with stand, metal enclosed, vermin-proof

(The following quantities show the quantity of each one panel.)

Mounted equipment	
Push button switch	1-set
Other necessary equipment	1-lot

E Sump Drainage Pump Local Operation Panel

Tag No./Name	01LOP05 / Sump Drainage Pump LOP 07LOP07 / Sump Drainage Pump LOP 11LOP02 / Sump Drainage Pump LOP
Quantity	3-panels
Type	Indoor, wall-mounted, metal enclosed, vermin-proof

(The following quantities show the quantity of each one panel.)

Mounted equipment	
Assembled indicating lamp	1-set
Change over switch (2-point)	2-sets
Change over switch (3-point)	1-set
Control switch (2-point)	2-sets

Indicating lamp (RL-GL)	2-sets
Electrical space heater	1-set
Other necessary equipment	1-lot

F De-sludge Valve Local Operation Panel

Tag No./Name	06LOP01 / No.1 De-sludge Valve LOP 06LOP02 / No.2 De-sludge Valve LOP
Quantity	2-panels
Type	Indoor, with stand, metal enclosed, vermin-proof
(The following quantities show the quantity of each one panel.)	
Motor starter	4-set
Adapted motor	0.2kW single phase valve motor
Starter	Direct on line starter
MCCB 2P 30AF	
Electromagnetic contactor	
Thermal relay	
Zero-phase current transformer	
Over current grand relay	
Other necessary equipment	
Mounted equipment	
MCCB 2P 30AF	2-sets
Control circuit	1-lot
Assembled indicating lamp	1-set
Change over switch (2-point)	1-set
Control switch (2-point)	4-sets
Indicating lamp (RL-GL)	4-sets
Electrical space heater	1-set
Other necessary equipment	1-lot

G Sludge Collector Local Operation Panel

Tag No./Name	06LOP03 / No.1-1 Sludge Collector LOP 06LOP04 / No.1-2 Sludge Collector LOP 06LOP05 / No.2-1 Sludge Collector LOP 06LOP06 / No.2-2 Sludge Collector LOP
Quantity	4-panels
Type	Outdoor, with stand, metal enclosed, water-proof
(The following quantities show the quantity of each one panel.)	
Mounted equipment	
Assembled indicating lamp	1-set
Change over switch (2-point)	1-set
Control switch (2-point)	1-set
Indicating lamp (RL-GL)	1-set
Push button switch (water proof)	1-set
Other necessary equipment	1-lot

H Sampling Pump Local Operation Panel

Tag No./Name	06LOP07 / Sampling Pump LOP
Quantity	1-panel
Type	Outdoor, with stand, metal enclosed, water-proof
Mounted equipment	
Assembled indicating lamp	1-set
Change over switch (2-point)	1-set
Control switch (2-point)	1-set

Indicating lamp (RL-GL)	1-set
Other necessary equipment	1-lot

I Filter Backwash Local Operation Panel

Tag No./Name	07BWP01 / No.1-1, 3 Backwash LOP 07BWP02 / No.1-2, 4 Backwash LOP
Quantity	2-panels
Type	Indoor, self-supporting, metal enclosed, vermin-proof

(The following quantities show the quantity of each one panel.)

Mounted equipment

Assembled indicating lamp	3-sets
Change over switch (2-point)	3-sets
Push button control switch with lamp	16-sets
Push button switch	2-sets
Electrical space heater	1-set
Other necessary equipment	1-lot

J Backwash Pump Local Operation Panel

Tag No./Name	07LOP05 / Backwash Pump LOP
Quantity	1-panel
Type	Indoor, with stand, metal enclosed, vermin-proof

Mounted equipment

Ammeter	3-sets
Flow indicator	1-set (07IFM01)
Assembled indicating lamp	1-set
Change over switch (4-point)	1-set
Control switch (2-point)	3-sets
Indicating lamp (RL-GL)	3-sets
Push button switch	1-set
Electrical space heater	1-set
Other necessary equipment	1-lot

K Air Blower Local Operation Panel

Tag No./Name	07LOP06 / Air Blower LOP
Quantity	1-panel
Type	Indoor, with stand, metal enclosed, vermin-proof

Mounted equipment

Ammeter	2-sets
Flow indicator	1-set (07IFM02)
Assembled indicating lamp	1-set
Change over switch (3-point)	1-set
Control switch (2-point)	2-sets
Indicating lamp (RL-GL)	2-sets
Push button switch	1-set
Electrical space heater	1-set
Other necessary equipment	1-lot

L Post Lime Dosing Local Operation Panel

Tag No./Name	07LOP08 / Lime Dosing LOP
Quantity	1-panel
Type	Indoor, with stand, metal enclosed, vermin-proof

Mounted equipment

Assembled indicating lamp	1-set
Change over switch (2-point)	1-set
Change over switch (3-point)	1-set
Control switch (2-point)	3-sets
Indicating lamp (RL-GL)	3-sets
Push button switch	1-set
Electrical space heater	1-set
Other necessary equipment	1-lot

M Transmission Pump Local Operation Panel

Tag No./Name	09LOP11 / No.1 Transmission Pump (A-1) LOP 09LOP12 / No.2 Transmission Pump (A-1) LOP 09LOP21 / No.1 Transmission Pump (A-2) LOP 09LOP22 / No.2 Transmission Pump (A-2) LOP 09LOP31 / No.1 Transmission Pump (A-3) LOP 09LOP32 / No.2 Transmission Pump (A-3) LOP
Quantity	6-panels
Type	Indoor, with stand, metal enclosed, vermin-proof

(The following quantities show the quantity of each one panel.)

Mounted equipment

Assembled indicating lamp	1-set
Change over switch (2-point)	1-set
Control switch (3-point)	1-set
Control switch (2-point)	1-set
Indicating lamp (RL-GL)	1-set
Indicating lamp (RL-OL-GL)	1-set
Push button switch	1-set
Electrical space heater	1-set
Other necessary equipment	1-lot

N Sump Drainage Pump Local Operation Panel

Tag No./Name	09LOP01 / Sump Drainage Pump LOP
Quantity	1-panel
Type	Indoor, wall-mounted, metal enclosed, vermin-proof
Motor starter	2-set
Adapted motor	1.5kW submersible pump
Starter	Direct on line starter
MCCB 3P 30AF	
Electromagnetic contactor	
Thermal relay	
Zero-phase current transformer	
Over current grand relay	
Other necessary equipment	

Mounted equipment

MCCB 4P 50AF	1-set
MCCB 2P 30AF	1-set
Control circuit	1-lot
Assembled indicating lamp	1-set
Change over switch (2-point)	1-set
Change over switch (3-point)	1-set
Control switch (2-point)	2-sets
Indicating lamp (RL-GL)	2-sets
Running hour meter	2-sets
Electrical space heater	1-set

Other necessary equipment	1-lot

O Chlorination Booster Pump Local Operation Panel

Tag No./Name	09LOP02 / Chlorination Booster Pump LOP
Quantity	1-panel
Type	Indoor, with stand, metal enclosed, vermin-proof
Motor starter	2-set
Adapted motor	5.5kW squirrel-cage motor
Starter	Direct on line starter
MCCB 3P 30AF	
Electromagnetic contactor	
Thermal relay	
Zero-phase current transformer	
Over current grand relay	
Other necessary equipment	
Space for future	
Mounted equipment	
MCCB 4P 50AF	1-set
MCCB 2P 30AF	1-set
Control circuit	1-lot
Assembled indicating lamp	1-set
Change over switch (2-point)	1-set
Change over switch (4-point)	1-set
Control switch (2-point)	2-sets
Indicating lamp (RL-GL)	2-sets
Push button switch	1-set
Electrical space heater	1-set
Space for future	1-lot
Other necessary equipment	1-lot

P Alum Pump Local Operation Panel

Tag No./Name	10LOP01 / Alum Pump LOP
Quantity	1-panel
Type	Indoor, with stand, metal enclosed, vermin-proof
Mounted equipment	
Assembled indicating lamp	1-set
Change over switch (2-point)	1-set
Change over switch (3-point)	1-set
Control switch (2-point)	2-sets
Indicating lamp (RL-GL)	2-sets
Push button switch	1-set
Electrical space heater	1-set
Other necessary equipment	1-lot

Q Chemical Mixer Local Operation Panel

Tag No./Name	10LOP02 / Alum Mixer LOP 10LOP04 / Lime Mixer LOP
Quantity	2-panels
Type	Indoor, wall-mounted, metal enclosed, vermin-proof

(The following quantities show the quantity of each one panel.)

Mounted equipment	
Assembled indicating lamp	1-set
Change over switch (2-point)	1-set

Control switch (2-point)	2-sets
Indicating lamp (RL-GL)	2-sets
Push button switch	1-set
Electrical space heater	1-set
Other necessary equipment	1-lot

R Lime Pump Local Operation Panel

Tag No./Name	10LOP03 / Lime Pump LOP
Quantity	1-panel
Type	Indoor, with stand, metal enclosed, vermin-proof
Mounted equipment	
Assembled indicating lamp	1-set
Change over switch (2-point)	2-sets
Change over switch (3-point)	1-set
Control switch (2-point)	2-sets
Indicating lamp (RL-GL)	2-sets
Push button switch	1-set
Electrical space heater	1-set
Other necessary equipment	1-lot

S Pre Lime Dosing Pump Local Operation Panel

Tag No./Name	10LOP05 / Lime Dosing Pump LOP
Quantity	1-panel
Type	Indoor, with stand, metal enclosed, vermin-proof
Mounted equipment	
Assembled indicating lamp	1-set
Change over switch (2-point)	1-set
Change over switch (3-point)	1-set
Control switch (2-point)	2-sets
Indicating lamp (RL-GL)	2-sets
Push button switch	1-set
Electrical space heater	1-set
Other necessary equipment	1-lot

T Lime Dust Extract Fan Local Operation Panel

Tag No./Name	10LOP06 / Lime Dust Extract Fan LOP
Quantity	1-panel
Type	Indoor, with stand, metal enclosed, vermin-proof
Mounted equipment	
Assembled indicating lamp	1-set
Change over switch (2-point)	1-set
Control switch (2-point)	1-set
Indicating lamp (RL-GL)	1-set
Push button switch	1-set
Electrical space heater	1-set
Other necessary equipment	1-lot

U Backwash Recovery Pump Local Operation Panel

Tag No./Name	11LOP01 / Backwash Recovery Pump LOP
Quantity	1-panel
Type	Indoor, with stand, metal enclosed, vermin-proof
Mounted equipment	

Assembled indicating lamp	1-set
Level indicator	2-sets (11ILM01, 02)
Change over switch (2-point)	2-sets
Change over switch (3-point)	1-set
Control switch (2-point)	2-sets
Indicating lamp (RL-GL)	2-sets
Push button switch	1-set
Electrical space heater	1-set
Other necessary equipment	1-lot

Section 16450

PS 16.12 Earthing Systems

Earthing system shall be TT system. Earthing of the following equipment/system shall be carried out separately from the general earth.

Neutral
Lightning arrester
Lightning rod
Telephone system

Section 16470

PS 16.13 Distribution Board

A. There are 13 distribution boards as follows.

01 DB 01	Lighting distribution board	- Raw water pump house
01 DB 02	Lighting distribution board	- Intake electrical room
06 DB 01	Lighting distribution board	- Sedimentation basins
07 DB 01	Lighting distribution board	- Filtration units
10 DB 01	Lighting distribution board	- Chemical building
11 DB 01	Lighting distribution board	- Backwash recovery building
13 MDB 01	Main lighting distribution board	- Electrical sub station
13 DB 01	Lighting distribution board	- Electrical sub station
14 MDB 01	Main lighting distribution board	- Administration building
14 MDB 02	Main AC distribution board	- Administration building
14 DB 01	Lighting distribution board	- Administration building
14 DB 02	Lighting distribution board	- Guard house
15 DB 01	Lighting distribution board	- Maintenance building

B The distribution boards shall meet the operational and rating requirement as follows:

Purpose	to provide power for lighting, air conditioner and outlet at 400/230 V, 3 phase /single phase.
Type	Indoor self-standing, metal enclosed, vermin-proof 13 MDB 01 Indoor wall-mounted, metal enclosed, vermin proof 01DB01, 01DB02, 06DB01, 07DB01, 10DB01, 11DB01, 13DB01, 14MDB01, 14MDB02, 14DB01, 14DB02, 15DB01
Nameplate	plastic plate, with engraved black letter on white back-ground
Rated voltage	AC 600 V
Rated short time current	capable of withstanding the system short-time current
Accessories	Door key 1 set

Section 16500

PS 16.14 Lighting and Small Power

A There are four areas, as shown below, where different light fittings required. All items shall be of reputed makes, suitable for 400/230 V, 50 Hz operation and light fittings shall conform to BS 4533. Catalogues with polar curves, utilization curves and isolux curves shall be submitted for approval. Power factor of all the discharge lamps shall be more than 0.9.

1) Intake pump house
2) Office and guard house
3) Treatment plant process facilities
4) Yard lighting

B Administration Building and Guard House

1) Wall bracket lamps
2) Recess fluorescent lamps with parabolic mirror louvers
3) Fluorescent lamps with diffusers
4) Emergency lamps
5) Ceiling fans with regulators
6) 13A single phase outlets
7) AC outlets
8) Telephone outlets, exchange and telephones
9) Earth pipes
10) Lightning protection
11) Fire protection system

C Treatment plant process facilities

1) Outdoor wall bracket lamps
2) Fluorescent lamps with corrosion resistance enclosure
3) High bay lamps with metal halide bulbs
4) Cobra head type lamps with metal halide bulbs
5) Low bay lamps with metal halide bulbs
6) Cobra head type lamps with sodium vapour bulbs
7) Tungsten halogen lamps
8) Underwater lamps
9) Emergency lamps
10) 13A single phase outlets
11) 30A 3 phase outlets
12) Telephone outlets and telephones
13) GI octagonal tapered masts
14) Lightning protection
15) Fire protection system

D Yard lighting

1) Cobra head type lamps with sodium vapour bulbs
2) GI octagonal tapered masts
3) Low bay lamps with metal halide bulbs

E Minimum lighting levels

1)	Plant, workshop & process areas	150 Lux
2)	Road ways & storage	20 Lux
3)	Office, conference room & laboratory areas	250 Lux
4)	Control rooms	250 Lux
5)	Stores	100 Lux

Section 16610

PS 16.15 DC Power Supply & UPS System

A. General

Structure

Structure Parts	Steel plate thickness
Side plate	2.3 mm
Bottom plate	1.6 mm
Roof	2.3 mm
Ceiling	1.6 mm
Door	3.2 mm
Separator	1.6 mm

Standard Accessories

Name Plate Plastic plate, with engraved black letter on white back-ground

Door key

Spare parts

B. DC Power Source Equipment for INTAKE

Tag No.	01DCP01
Name	DC Power Source Equipment
Quantity	1-panel
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rectifier	1-set
Type	Thyristor or transistor type
Input voltage	400V 3phase
Output voltage	DC 100V
Charger capacity	15A
Silicon dropper	10A
Battery	1-set
Type	Cathode absorption seal type lead-acid battery
Rated capacity	50Ah/10h, 54cells
Mounted equipment	
MCCB 4P 50AF	1-set
MCCB 2P 100AF	2-sets
MCCB 2P 50AF	4-sets
DC ammeter with shunt	2-sets
DC voltmeter with change over switch	1-set
Protection relay set	1-lot
Indication lamp	1-lot
Inboard lighting	1-set
Other necessary equipment	1-lot

C UPS for INTAKE

Tag No.	01UPS01
Name	UPS
Quantity	1-set
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Specification	
Type	Producer standard
Input voltage	400V 3phase
Output voltage	AC 240V
Power supply method	Inverter continuous supply with no short break switching
Capacity	3kVA

Back up time	More than 1.0 hour
Other necessary equipment	1-lot

D UPS for WTP

Tag No.	04UPS01
Name	UPS Equipment
Quantity	1-set (3-panels)
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rectifier	1-set
Type	Thyristor or transistor type
Input voltage	400V 3phase
Output voltage	DC 100V
Charger capacity	250A
Silicon dropper	15A
Battery	1-set
Type	Cathode absorption seal type lead-acid battery
Rated capacity	300Ah/10h, 54cells
Back up time	More than 1.0 hour
Inverter	1-set
Type	Thyristor or transistor type
Input voltage	DC 100V
Output voltage	AC 240V
Power supply method	Inverter continuous supply with no short break switching
Rated capacity	20kVA
Mounted equipment	
MCCB 4P 100AF	1-set
MCCB 2P 400AF	2-sets
MCCB 2P 100AF	1-set
MCCB 2P 50AF	21-sets
DC ammeter with shunt	2-sets
DC voltmeter with change over switch	1-set
AC ammeter with CT	1-set
AC voltmeter with change over switch	1-set
Frequency meter	1-set
Protection relay set	1-lot
Indication lamp	1-lot
Inboard lighting	1-set
Other necessary equipment	1-lot

Section 16620

PS 16.16 Standby Diesel Generator Set

A. Standby Diesel Generator Set for INTAKE

Tag No.	01GEN01
Name	Standby Generator Set
Quantity	1-set
Diesel engine	
Type	4-cycle, compression ignition, water-cooled, turbocharger type, with charge air cooler
Rated output	600 kW or over
Rated speed	1500 rpm
Cooling system	radiator built-in, blower fun

Fuel system	electronic controlled unit injectors
Governing	electronic control
Starter	Motor driven by DC power or compression air
Synchronous generator	
Type	self-ventilating, revolving field, brush less type
Rated capacity	750 kVA
Rated voltage	415 V
Frequency	50 Hz
No. of poles	4
No. of phase	3 phase 4wire (neutral to be brought out)
Power factor	0.8 lagging
Voltage regulation	automatic and static
Insulation class	"F"
Fuel oil system	
Day tank	800 litres with level metre
Main tank	12,000 litre with level meter
Booster pump	with AC motor
Oil flow metre	
Oil filter	
Wing pump	
Engine silencer	85 dB at 1m away from generator
Radiator air sound attenuator	85 dB at 1m away from generator
Generator panel	
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated voltage	AC600 V
Rated current	2500 A
Control voltage	DC 100V
Air circuit breaker (ACB)	1-set
Type	withdrawal, 4-pole, auto-coupling type
Rated current	2500A
Rated breaking current	not less than 50kA (sym)
Over current relay	2-sets
Over voltage relay	1-set
Under voltage relay	1-set
Voltage transformer	2-sets
Current transformer	2-sets
Measuring instruments	
Ammeter	
Voltmeter	
Frequency meter	
Wattmeter	
Watt-hour meter	
Power factor meter	
Auto voltage regulator	
Battery and charger	
Be possible to start continuously more than 5 times.	
Be possible to recharge within 12 hours.	

B Standby Diesel Generator Set for WTP

Tag No.	04GEN01
Name	Standby Generator Set
Quantity	1-set
Diesel engine	
Type	4-cycle, compression ignition, water-cooled, turbocharger type, with charge air cooler

Rated output	1600 kW or over
Rated speed	1500 rpm
Cooling system	radiator built-in, blower fun
Fuel system	electronic controlled unit injectors
Governing	electronic control
Starter	Motor driven by DC power or compression air
Synchronous generator	
Type	self-ventilating, revolving field, brush less type
Rated capacity	2000 kVA
Rated voltage	415 V
Frequency	50 Hz
No. of poles	4
No. of phase	3 phase 4wire (neutral to be brought out)
Power factor	0.8 lagging
Voltage regulation	automatic and static
Insulation class	"F"
Fuel oil system	
Day tank	2,000 litres with level metre
Main tank	16,000 litre with level meter
Booster pump	with AC motor
Oil flow metre	
Oil filter	
Wing pump	
Engine silencer	85 dB at 1m away from generator
Radiator air sound attenuator	85 dB at 1m away from generator
Air exhaust fan	
(If the radiator is adopted separate type with engine, the exhaust fan would be adopted.)	
Air quantity	50,000 m^3/h *2sets
Noise level	85 dB
Accessory	Air Filter
Generator panel	
Type	Indoor, self-supporting, metal enclosed, vermin-proof
Rated voltage	AC600 V
Rated current	3000 A
Control voltage	DC 100V
Air circuit breaker (ACB)	1-set
Type	withdrawal, 4-pole, auto-coupling type
Rated current	3200A
Rated breaking current	not less than 50kA (sym)
Over current relay	2-sets
Over voltage relay	1-set
Under voltage relay	1-set
Voltage transformer	2-sets
Current transformer	2-sets
Measuring instruments	
Ammeter	
Voltmeter	
Frequency meter	
Wattmeter	
Watt-hour meter	
Power factor meter	
Auto voltage regulator	
Battery and charger	
Be possible to start continuously more than 5 times.	
Be possible to recharge within 12 hours.	

Section 16740

PS 16.17 Telephone System

A The PABX shall be provided in the Administration Building and shall have a capacity of ten direct exchange lines and seventy extensions. Telephone extensions shall be provided in the following locations.

1	Administration Building	19 no.
2	Filtration Unit	2 no.
3	High Lift Pump Station	2 no.
4	Chemical Building	1 no.
5	Electric Substation	2 no.
6	Maintenance Building	2 no.
7	Guard House	1 no.

B Dedicated line shall be provided between Intake and WTP

C Direct telephone lines shall be provided in the following locations.

1 Intake
2 Asgiriya P.S.
3 R2 P.S.
4 Heerassagala low P.S.
5 Heerassagala middle P.S.
6 Amitiya P.S.
7 Kondadeniya P.S.
8 Kahawatta P.S.

Section 16950

PS 16.18 Electrical Testing - General

A Works testing and inspection shall be carried out at the manufacturer's works in accordance with the Contract documents and the Contractor shall, in addition to any obligations under the Conditions of Contract, inform the Engineer's duly appointed representative of the date when the equipment will be ready for inspection and witness testing.

B The tests shall be carried out prior to delivery of the equipment to Site. The Contractor shall not deliver equipment to Site without the Engineer's prior approval in writing.

C If the tests are beyond the resources of the manufacturer he shall make arrangements for these to be carried out elsewhere. Any variation of this requirement shall be agreed and confirmation in writing obtained from the Engineer.

D The Contractor shall supply four un-priced copies of all sub-orders including those for items manufactured at his works. Two copies of each of these sub-orders shall be forwarded to the Engineer and two to the appointed representative. The sub-orders shall indicate the works for which the item is required, state in detail the inspection and test requirements, give sufficient information for ready identification and shall state that these items will be subject to witness test and inspection.

E Unless otherwise stated the Engineer reserves the right to witness test all equipment.

F Witnessed testing will normally be waived on standard types of small motors made by approved manufacturers and small components used in the manufacture of units of

equipment, minor installation materials and cable.

G Motors of 15 kW to 75 kW shall be witness tested for performance to IEC 34-1 in the proportion indicated unless otherwise specified.

H All motors of 75 kW and above shall be witness tested for performance to IEC 34-1 unless otherwise specified.

I The Contractor shall carry out tests as stated in the current appropriate International Standard; performance tests and such other tests as are necessary, in the opinion of the Engineer's Representative, to determine that the Plant comply with the Specification either under test conditions in the manufacturer's works, on site or elsewhere or in the ordinary working.

J All cast metal components designed for the retention of liquids, e.g. pump casings, gear boxes, engine crank cases, etc shall be checked for soundness after machining, etc, but before assembly or painting, by treating with paraffin or similar method.

K Where tests and inspection have been completed to the Engineer's satisfaction and when the test certificates, curves, etc have been checked, the Engineer will confirm acceptance in writing and the equipment shall not be incorporated in the work or delivered until this acceptance has been received.

L Four copies of all test certificates and curves shall be supplied to the Engineer's Representative within two weeks of completion of any witnessed tests.

M Where witness tests are not required the test certificates and curves shall be forwarded to the Engineer's Representative within two weeks after instructions to waive witness tests have been received.

N On each test certificate sufficient information to enable the Engineer to issue a release certificate including the specification contract number and details, shall be given for ready identification of the material or equipment to which the certificate refers.

O No inspection or passing by the Engineer or the Engineer's Representative of the work, equipment or materials covered by this Contract, whether carried out or supplied by the Contractor, shall release him from any of his obligations under the Contract.

P Electrical equipment shall be inspected for workmanship, suitability of purpose and functionality. The Contractor shall provide test equipment in order to simulate operation of the equipment under site conditions. A test plan shall be established and approved by the Engineer. The Engineer shall not be requested to inspect the equipment until the Contractor has satisfied himself that the equipment meets all requirements of the Specification and is functionally correct.

Q The Engineer reserves the right to require the Contractor to meet any extra costs which are occasioned by failure of the Contractor to comply with the above testing and inspection requirements, including the provision of test certificates, curves, etc, which in the opinion of the Engineer, are due to insufficient care having been taken by the Contractor or his sub-contractor before presenting the equipment for inspection or tests. If unauthorised delivery has taken place the Contractor may be required to arrange for the plant to be returned to the manufacturer for inspection and/or witness testing by the Engineer's Representative at the Contractor's expense.

R All apparatus, instruments and connections required for the tests shall have been tested for accuracy and safety and certified as such within the preceding twelve months.

S Any equipment used in the testing of the equipment shall in all respects comply with the appropriate safety regulations and/or requirements regarding electrical apparatus for the safety of the equipment and the men working thereon.

PS 16.19 Manufacturer's Works Acceptance Tests on Electrical Equipment

A The Contractor shall carry out further specified tests as follows in addition to any tests stated or implied by the foregoing general section of this clause.

B Switchgear and Motor Control Assemblies

The whole of the switch and control gear shall be witness tested as integral units for a complete sequence of operation and as laid down in BS 5486 and based on the completeness of the circuits in the final manufactured form within the manufacturer's works. The following tests shall be carried out:

1 Primary injection tests to ensure correct rates and polarity of current and voltage transformers and of the current operated protection relays and direct acting coils, over their full range of settings.
2 Balance earth fault stability test by primary current injection. Care must be taken to reproduce accurately the burdens of interconnecting cables. A further test to ensure correct polarity must be made after assembly.
3 Tests on auxiliary relays at normal operating voltages by operation of associated remote relays.
4 Correct operation of sequencing and control circuits at normal operating voltages by operation of local control switches, and simulation of operation from remote control positions.

C Circuit Breakers

All circuit breakers shall be subject to the following tests:

1 Routine tests including HV pressure test, millivolt drop tests and mechanical tests.
2 To ensure the operation of the dc closing coil and satisfactory closing of the circuit breaker with the voltage of the coil down to 80 percent of its rated voltage, and that mal-operation does not occur with a voltage on the coil of 120 percent of its rated voltage.
3 Interchangeability of withdrawable identically equipped circuit breakers, and checking of all mechanical and electrical interlocks.

Type test figures for heat test runs performed on identical panel types shall be made available.

D Transformers

Transformers shall be subject to works routine tests, which shall also include the following:

1 measurement of winding resistance;
2 ratio polarity and phase relationship;
3 impedance voltage;
4 load losses;
5 no load losses and no load current;
6 insulation resistance;
7 induced over-voltage withstand;
8 separate source voltage withstand.

Type test certificates shall be provided for the following:

1 impulse voltage withstand;
2 temperature rise.

E Cables

All HV cables and armoured cables shall be subject to routine tests in accordance with the relevant British Standard Specification. Test certificates shall be provided against each drum and/or cable length. The tests carried out on every cable length and/or drum at

manufacturer's premises shall include:

1 high voltage dc insulation pressure test, between cores, each core to earth, metallic sheath or armour as applicable;
2 insulation resistance test;
3 core continuity and identification;
4 conductor resistance test.

F Pressure Switches and Gauges
All pressure switches and vacuum and pressure gauges shall be subject to routine tests in accordance with the relevant British Standard Specification.

G Motors
Motor tests shall be carried out in accordance with the requirements of BS 4999 as applicable. The test shall obtain the overall efficiency and other figures in accordance with the guarantees given in the Technical Schedules.

PS 16.20 Manufacturer's Works Acceptance Tests on PLC Equipment and Associated Equipment

A The Contractor shall carry out further specified tests as follows in addition to any tests stated or implied by the foregoing general section of this clause. The tests shall be carried out on the fully assembled control panel containing the PLC and associated equipment in order to demonstrate correct functional operation of the hardware and software systems.

B The Contractor shall prepare for the approval of the Engineer a detailed Functional Acceptance Test (FAT) document which shall fully detail the scope of the tests to be carried out and the tests themselves.

C The tests shall encompass the normal modes of operation and failure modes and shall demonstrate correct functionality of the system or systems in accordance with the Functional Design Specification (FDS).

D The PLC programme or programmes shall be tested by means of a test rig designed to input and receive digital and analogue signals. Using this test rig it shall be possible to fully simulate the operation of the controlled equipment in order to demonstrate correct functional operation of the hardware and software systems.

E The analogue to digital conversion shall be tested by means of a calibrated current source, digital to analogue outputs shall be tested by means of ramping the output channel and measuring the current by means of a calibrated current meter.

F Common mode and series mode rejection on analogue inputs shall be tested by means of a calibrated signal generator producing an output voltage of 5 V minimum over the specified frequency range and a calibrated oscilloscope or ac voltmeter shall be connected to an appropriate second stage point on the analogue input channel being tested.

G All inputs and outputs to the PLC and associated equipment shall be made through the field terminal connections of the control panel containing the PLC and associated equipment.

H The Contractor shall demonstrate the rejection of the control system to radio frequency interference by means of a one Watt hand held radio transmitter held one metre from the control panels. The panel doors shall be open for this test with the operational programme running. There shall be no malfunctions of the system caused by the radio transmission which shall be in the UHF frequency range.

I Six weeks prior to these tests the Contractor shall submit for approval a test plan for the

logical sequence testing of the PLC and associated equipment.

PS 16.21 Manufacturer's Works Acceptance Tests on Uninterruptible Power Supplies

A The Contractor shall carry out further specified tests as follows in addition to any tests stated or implied by the foregoing general section of this clause and the tests shall be carried out on the fully assembled unit utilising the batteries that are to be supplied with the unit.

B The Contractor shall demonstrate the following:
1 change-over from full load with mains present to full load on battery supply;
2 carry out a discharge test on the system at full load and for the specified duty bridging time period;
3 carry out recharge test after operation for the specified duty bridging time at full load. The UPS shall supply the full load during the recharge cycle.

PS 16.22 Manufacturers' Works Acceptance Tests on Variable Speed Drives

A The Contractor shall carry out works tests in order to demonstrate the functionality of each variable speed drive unit over the speed range and power output required.

B A heat run shall be carried out on one of each type of variable speed drive offered at rated output and under conditions to be experienced within the motor control centre in order to demonstrate satisfactory operation.

C After successful completion of these tests the Contractor shall make available to others variable speed drive units in order that they may be utilised for `string' pumping tests at the works of the various pump suppliers.

D The Contractor shall ensure that the drive is enclosed within a housing which provides full screening of live parts and adequate ventilation.

E The Contractor shall be responsible for transportation of the drive units to and from the pump manufacturer's works and shall be present during the `string' tests on the pump and drive configurations.

Appendix to Particular Specifications

RDA Conditions

1. The Contractor shall be held responsible for reinstatement of all excavated section conforming to the RDA specification and entire satisfaction of the RDA. This shall include disposal of excess excavated materials and taking responsibility to any damages caused to the adjoining properties or road users etc.

2. The Contractor shall be held responsible for remedying of all the defects appearing as a result of trenching for a maintenance period of twelve calendar months from the date of handing over of the duly reinstated sections to the RDA.

3. A comprehensive programme of work shall be submitted prior to the commencement of trenching. Amended programme shall be submitted if, any deviation of 15 percent of the original programme.

4. Width of the trench shall be according to drawings forwarded by NWSDB.

5. Road surface shall be cut by the asphalt concrete rotary cutter wherever the asphalt concrete overlay sections exists on the road surface.

6. All excavated materials should be disposed and back filled with good quality river sand/ approved soil type 1 (CBR shall not less than 20). The sand or soil shall be compacted. (compaction to be not less than 100 percent) up to the road surface of the carriageway. Approve soil(s) and to be compacted in layers and watering to be done. (Maximum thickness of the each layers should not be exceeded 225 mm of this temporary filling must be done up to 3 days duration only).

7. Back filling on shoulders should be done in accordance with RDA specification (CBR shall not be less than 20 percent & degree of compaction 100 percent) up to the road surface level.

8. Excavation will not be allowed during the adverse weather condition which may cause deterioration the road surface and structures rapidly.

9. The Contractor shall compensate, or pay, for all the defects arising due to trenching (viz settlement adjoining to the trench, cracks and damages caused to the road surface and also due to breaking of other service lines, etc.).

10. Proper barricading and safety precautions shall be taken for the safety of the road users while trenching and until permanent reinstatement is done.

11. Proper illumination/ reflective signs shall be installed to identify the trenches during night time.

12. Any muck deposited on the road surface due to trenching should be removed and the road thoroughly cleaned.

13. Side drains of the road should not be blocked for any reasons.

14. Pipes should be buried at a minimum depth of 1000 mm from the road surface.

15. Permission from the relevant Police Station should be obtained prior to commencement of trenching.

16. Arrangements shall be made with Police in order to maintain the traffic for allowing free flow during the execution of the trenching work.

17. Prior approval should be taken from the Executive Engineer, Kandy for utilization of machinery on trenching work, or any other works related to road.

18. RDA is not held responsibilities for the damages caused to any property or party as a result of trenching. However damages caused to the RDA owned properties shall be repaired at your own cost.

19. All culvert crossings, the pipes should be laid below the invert level of the culvert and encased in a sheath. As an alternative, it may be laid out side the culvert below the invert level.

20. Length of excavation at a stretch should be limited to 250 m at one place and all reinstatement work should be carried out before commencement of the next trenching work.

21. Manholes should be located without obstructing the side drains and top surface of the manholes should be made to the same level with the road surface.

22. Trenching across the road for installation of service connections to houses etc., separate permission should be taken if necessary.

23. When excavation is in progress the excavated material should be loaded and removed from the site. On completion of work all excess material debris should be removed from road platform (i.e. carriageway, shoulder drains etc.)

24. Completed sections as per clause 19 should be properly handed-over to RDA officials after permanent reinstatement.

25. If there any night work to be carried out prior approval to be taken from Chief Engineer/ Kandy & the relevant police station.

26. Selections and checking of backfilling material for clause 2.4 & 2.5 should be carried out through Research & Development Laboratory, RDA. List of Borrow pits, gravel quarries etc., should be forwarded to RDA before commencement of the work & approval to be taken.

27. The Contractor will be liable to pay all the expenditure incurred as Holiday Pay, Overtime, Subsistence etc., for RDA staff in this connection.

28. If NWSDB or the Contractor is liable to award subcontract for Road Reinstatement except RC & DC (Pvt) Ltd., NWSDB should be forwarded sub-contractor's details to Provincial Director (C.P.)/ RDA for his approval before awarding the contract.

29. Separate specification for permanent reinforcement will be forwarded by RDA and NWSDB should agree to reinstate the trenches as per the same. (Sometimes this may very according to the ground/ site conditions etc., for place to place).

30. In the case of non-adherence to the aforementioned clauses, RDA will have the sole authority to stop the work.

31. 25 percent of the total estimated cost shall be deposited as a bond for the period of two years before commencement of the trenching work. This deposited money will be utilized for the corrections such as depressions, forming cracks etc. of the reinstatement sections during this two year bond period and if any balance will be returned after two years.

Technical Schedules

TS 1 Gates

Gates for Raw Water Intake/Water Treatment Plant (Mechanical Work)

Tag No.	Tag No.	Size mm	Invert to Floor (m)	Seat	Operation
01 : Raw water intake facility					
Inflow Gate	01 HG 11/21	1500 x 1500	6.20	on	handwheel, manual
Outflow Gate	01 HG 12/22	1500 x 1500	6.20	on	handwheel, manual
04 : Filtration units					
Inflow Gate	07 HG 11 to 41	400 x 400	2.09	on	electrically operated
Wash Drain Gate	01 HG 12/22	500 x 500	6.2	on	electrically operated

TS 2 Laboratory Equipment - Physical/chemical Laboratory

Ref	Description	Unit	Quantity
1	**Composite liquid sampler** Sampling pump : Peristaltic Pump body: Corrosion resistant Vertical height: 7 m (Minimum) Sample volume: Programmable in millimeters, 100 - 500 min. Sample volume Repeatability - 10 % max Sampling mode: Composite, time, programmable interval between samples: Selectable, 30 - 60 minutes min. Intake purge: Air purged automatically before and after each sample Working temperature: Ambient 40º C Collecting container: Polyethylene, Capacity 12 l minimum Sample bottle: Glass-10 L (min) 2 nos. Polypropylene 10 L (Min) 02 Nos. Sample Case: ABS double walled insulated base of fibre glass Power: 9 V, 12 V DC rechargeable battery Illuminator: 230 V, 50 Hz	Nr	1
2	**Electronic analytical balance** Readability: 0.0001 g Capacity: 100 g min Reproducibility Response Time: 3 sec. or less Weight pan: Stainless steel non corrosive metal dia 75 - 100 mm Calibration: Internal automatic calibration Operating temperature: Ambient 40 º C Space above the pan: 200 mm approx Power: AC 230 V, 50 Hz Standard features: Draught shield level indicator, sealed keypad for spill protection calibration certificate should be provided.	Nr	2
3	**UV - VIS spectrophotometer** Photometric system: Double beam system Light source: Tungsten and deuterium lamps Light source change over: Automatic Wave length range: 200 mm 1000 nm (min) Spectral Band Pass: 2 nm max Scanning speed: 15 - 5000 nm/minute (min) Detector: Silicon photodiode Operating temperature: 0-40 º C Power: 230 V, 50 Hz Monitor: SVG Colour, 400 mm (min) Facilities: User friendly software system for scanning calibration, report, preparation and printing. Printer: 80 Column dot matrix, or Bubble jet or laser. Paper width: Continuous feed - 100 to 250 mm (min) single-sheet-200 mm (min) Processor: Pentium 200 MMX (min) or equivalent.	Nr.	1
4	**Jar tester** Six stainless paddles, digital read out, variable speed (10 - 300 rpm), with illuminator, anti glare curtain and dust cover. Power: 230 V,50 Hz.	Nr	2

Ref	Description	Unit	Quantity
5	**Comparator for Residual Chlorine** Calibrated colored standards for D.P.D. Sample cells. Range 0.1 - 1.0 mg/l Sample volume: 10 ml Day light illumination system for the above comparator Light source: Tungsten lamp with calibrated colour temperature correction filter Power: 230 V,50 Hz.	Nr	1
6	**Electrical conductivity meter (for Laboratory)** Mode: EC/ TDS and Temperature Range; Conductivity 0 - 200 mS/cm Total Dissolved Solids 2000 mg/l Temperature 0 - 100 C Resolution: Conductivity 0.001 mS/cm; TDS 1mg/L Accuracy: +/- 0.5% min. of full scale Calibration: single point Cell content: 0.1 - 1.0 Temp. compensation: Automatic Power: 230 V,50 Hz	Nr	2
7	**Electrical Conductivity Meter (for Portable)** Mode: EC/ TDS and Temperature Range; Conductivity 0 - 200 mS/cm Total Dissolved Solids 2000 mg/l Temperature 0 - 100 ^{o} C Resolution: Conductivity 0.001 mS TDS 1mg/l Accuracy: +/- 0.5% min. of full scale Calibration: single point Cell content: 0.1 - 1.0 Temp. compensation: Automatic Power: DC with battery Charger 230 V,50 Hz.	Nr	2
8	**PH/mV meter with combined glass electrode (for Laboratory)** Range pH: 0 - 14 mV: +/- 1999 Accuracy pH: +/- 0.02 min. mV: +/- 1 min. Calibration: Manual/Automatic Calibration standards: pH 4, 7 and 10 Temperature compensation: Automatic Power: 230V, 50 Hz.	Nr	2
9	**pH/mV meter with combined glass electrode (for Potable)** Range pH: 0 - 14 mV: +/- 1999 Accuracy pH: +/- 0.02 min. mV: +/- 1 min. Calibration: Manual / Automatic Calibration standards: pH 4, 7 and 10 Temperature compensation: Automatic Power: DC with battery charger 230V, 50 Hz.	Nr	2

Ref	Description	Unit	Quantity
10	**Nessleriser.** For visual colorimetric analysis of dilute solution using a 50/100 ml of samples with provision for rotatable under mentioned colour discs and prism viewing head with white light cabinet containing day light correction filter. Power: 230V, 50 Hz.	Nr	1
10.1	Iron, Range 2 - 18 ug, Method: Thioglycolic acid	Nr	1
10.2	Manganese, Range .1 - 1.0 mg/l, Method: Formaldoxime	Nr	1
10.3	Nitrate, Range 5-10 ug, Method: Phenol 2:4 disulphonic acid	Nr	1
10.4	Nitrite, Range .1 -1.0 ug, Method: Cleve's acid	Nr	1
10.5	Ammonia, Range 0.02 - 0.2 mg/l, Method: Nessler's reagent	Nr	1
10.6	Fluoride, Range 0.2 - 1.5 mg/l, Method: Acid zirconium alizarin	Nr	1
10.7	Sulphate, Range 2 - 50 mg/l, Method: Potassium iodide/iodate	Nr	1
10.8	Phosphate, Range 10 - 100ug, Method: Ammonium molybdate/ascorbic acid	Nr	1
10.9	Colour, Range 5 - 70 mgPt/l, Method: Straight colour match to sample	Nr	1
10.10	Silica, Range 0.05 - 1.0 mg, Method: Ammonium molybdate	Nr	1
10.11	Aluminium, Range 0.5 - 4.0 ug, Method: Straight colour match to sample	Nr	1
10.12	Nessler cylinders, soda-lime glass, capacity 100 ml.	Nr	20
10.13	Stands for Nessler cylinders, with opal glass base plate, 5 place min.	Nr	5
11	**Oven** Capacity: 100 litre min. Temperature: 250º C min. Fluctuation +/- 0.5 C at 100 º C max. Control with standard dial temperature selection on a graduated scale and with safety thermostat for over heat protection. No. of shelves: 2 (min) Power: 230 V, 50 Hz Power rating: 1000 W max.	Nr	1
12	**Turbidimeter** Range: 0-175 JTU / NTU Resolution: 0.01 - 0.1 Unit Precision: 2% Detector: Silicon Photodiode Calibration standards: 2 minimum Sample Cells: 5 minimum Standardization: Turbid solutions with known turbidity values Power: DC or AC If DC battery charger should be provided. 230 V, 50 Hz.	Nr	2
13	**Centrifuge** Timer 0-30 minutes Capacity 4 x 100 ml (min) Speed 4000 rpm Safety Features: Should meet international Electrical Standards. Safety lock prevent start up unless lid is electrically closed access to chamber possible only when the rotor is stationary High strength guard bowl and lid Centrifuge tube - 4 no (min)	Nr	1
14	**Concentric ring steaming bath**		

Ref	Description	Unit	Quantity
	Operating diameter: 100 mm min. Operating temperature, bath: 100 C Adjustable water level regulator Stainless steel cabinet with flanged cabinet for table top installation Power: 230 V, 50 Hz. Power rating: 1000 W max.		
14.1	With six holes	Nr	1
14.2	With eight holes	Nr	1
15	**Water still with deioniser, bench mountable** Out put: 4 l/hr. min. Efficiency: 2 Mohm/cm min. Inlet feed: tap Automatic cut off for protection against low water operation. Auto reservoir control Reservoir Capacity: 30 l (min) Power 230V, 50 Hz	Nr	1
16	**Magnetic stirrer** top plate: 100 x 100 mm min., white polypropylene coated Heating: 1200º C Min (adjustable) Follower: PTFE coated, 25 mm length min. ,2 Nos. min Power: 230V, 50 Hz.		
16.1	Speed: 140-1200 rpm. min (with variable speed control)	Nr	1
16.2	Speed: 500 rpm. min (with variable speed control)	Nr	1
17	**Refrigerator** Automatic defrost, integral door lock, adjustable shelf levels Working temperature: 4º C min. Capacity: 200 l (min) No. of shelves: 3 (min) Power: 230V, 50 Hz.	Nr	1
18	**Incubator for BOD** Temperature range: 0 - 50 º C Temperature stability: +/- 0.2 Capacity: 125 litres minimum No. of shelves: 2 minimum Power: 230 V, 50 Hz	Nr	1
19	**C.O.D. Distillation Apparatus (for opened reflux method)** Temperature: ambient to 250 º C min. Temperature accuracy: +/- 1.0 º C Heat up time: 90 min. maximum Dry - block: solid state with temperature controller, and indicator Tube rack and condenser rack: 20 positions minimum, Non corrosive Power: 230 V, 50 Hz.	Nr	1
19.1	Digestion tubes: Borosilicate glass, 100 ml min.	Nr	20
19.2	Condenser: Borosilicate glass, open refluxed	Nr	20

Ref	Description	Unit	Quantity
20	**Water bath** Corrosion resistant construction, with temperature controller, display and over temperature protection. Working temperature range: Ambient - 90 º C Temperature uniformity: +/- 0.5 º C Capacity: 5 litre (min) Power: 230 V, 50 Hz.	Nr	1
21	**Dispenser, acid** All component should be acid resistant material, double valve combination for prevention of vapour scraping., Dispenser for	Nr	5
	500 ml, 1000 ml and for 1000 ml acid bottles. Volume, adjustable 1-10 ml		
22	**Safety vented goggles** Polycarbonate fog-free lens with lens with superior impact protection, wild field of vision. Full face flange for comfortable wear.	Nr	5
23	**Muffle furnace** Digital temperature control, Insulation made of material with a low thermal mass, Heating element-Silicon carbide rods Door - With insulating brick plug, opens outwards and upwards keeping the hot face away from the operator. A switch isolates power from the elements whenever the door is opened. Capacity - 1500 ml. Working temperature: 1400C Temperature accuracy: +/-5C Reaching time to max. temperature - 70 min. Max Safety devise - Over temperature cut off Power: 230V, 50 Hz, Single phase	Nr	1
24	**Horizontal shaker** Shaking motion: Horizontal Orbital diameter: 20 mm (approx.) Shaking weight: 5 kg min Speed range: 0-250 1/min (minimum) Timer: 0-50 min (Minimum) Power: 230 V, 50 Hz.	Nr	1
25	**Kjeldahl Nitrogen distillation apparatus** Digesting system, Complete with lift motor No. of places: 40 min. for 100 ml tubes. Power: 230V, 50 Hz.	Nr	1
26	**Ultra sonic pipette washer** Capacity: 6 litre (minimum) Frequency: 35 kHz Internal construction: Stainless steel Temperature: 60º C min, (adjustable) Timer: 30 min (minimum)	Nr	1
27	**Ultra sonic washer with lid** Capacity: 8 litre (min) Frequency: 35 kHz Internal construction: Stainless steel Temperature: 60º C min, (adjustable) Timer: 30 min (minimum)	Nr	1

Ref	Description	Unit	Quantity
28	**DO meter** Measuring range: 0-19.99 mg/l Sensor cable length: 1.5 m (min) Temperature: 0 -40 ^{o} C Accuracy: O^2 Concentration +/- 0.5 % of value Accuracy: Temperature +/- 0.1 ^{o} K Salinity correction: Automatic Display: LCD Power: DC - Rechargeable batteries, Battery charger: 230V, 50 Hz.	Nr	1

TS 3 Glassware - Physical/chemical Laboratory

Ref	Description	Unit	Quantity
1	**Evaporating basing**		
1.1	Borosilicate glass, round bottom, with spout, capacity 150ml.	Nr	10
1.2	Porcelain, round bottom, deep form with spout, 150 ml.	Nr	10
2	**Beakers - Borocilicate glass, low form, with graduation and spout, Conform to ISO 3819**		
2.1	Capacity, 50 ml	Nr	10
2.2	Capacity, 100 ml.	Nr	10
2.3	Capacity, 200 ml.	Nr	10
2.4	Capacity, 500 ml	Nr	10
2.5	Capacity, 800 ml	Nr	10
2.6	Capacity, 1000 ml	Nr	10
2.7	Capacity, 2000 ml	Nr	10
3	**Glass bottles - Amber, Winchester with plastic cap and PVC liner**		
3.1	Capacity 1000 ml	Nr	5
3.2	Capacity 500 ml.	Nr	10
4	**Reagent bottles**		
4.1	Clear glass, glass stopper, with dust proof cap., Capacity 250 ml	Nr	10
4.2	do Capacity 500 ml	Nr	10
4.3	Amber glass, glass stopper, with dust proof cap., Capacity 250 ml	Nr	10
4.4	do Capacity 500 ml	Nr	10
4.5	Clear glass, Narrow mouth, interchangeable glass stopper, Capacity 250 ml	Nr	10
4.6	Clear glass, Narrow mouth, interchangeable glass stopper, Capacity 500 ml	Nr	10
4.7	Bottles, BOD. With glass stopper, Capacity 300 ml.	Nr	30
5	**Bottles**		
5.1	Bottles, polypropylene, translucent, narrow neck, screw cap, capacity 500 ml	Nr	10
5.2	Bottles, polypropylene, translucent, narrow neck, screw cap, capacity 1000 ml	Nr	10
6	**Glass dropping bottles**		
	Amber soda - lime glass. Hexagonal with plastic cap, rubber teat and glass pipette		
6.1	do Capacity 10 ml	Nr	10
6.2	do Capacity 10 ml	Nr	10

Ref	Description	Unit	Quantity
6.3	Clear glass with stopper, vinyl teat and glass stopper. Capacity 125 ml	Nr	10
6.4	Clear glass with plastic stopper, vinyl teat and graduated pipette, capacity 125 ml, pipette 1 x 0.5 ml	Nr	10
6.5	do Capacity 250 ml, pipette 8 x 0.2 ml.	Nr	10
6.6	do Capacity 500 ml, pipette 10 x 0.2 ml.	Nr	10
7	**Brushes**		
7.1	Brushes, beakers bristle head 70 mm dia x 150 mm long, on wood handle.	Nr	10
7.2	Brushes, bottle, bristle or nylon head on wire handle 50 x 60 mm 300 mm length		10
7.3	Brushes, burette, do dia 19 mm length 750 m.	Nr	10
7.4	Brushes, Cylinder, Nylon fan shaped end of wire handle 75 x 140 mm	Nr	10
7.5	Brushes, Tube , Nylon 70 mm long set in the centre of wire handle.	Nr	10
8	**Buckets -** plastic with spout and lid, capacity 5 l.	Nr	2
9	**Bulbs**		
9.1	PVC pear shape, Capacity 60 ml	Nr	10
9.2	do Capacity 100 ml	Nr	10
9.3	Pipettes , Chemically resistant rubber with valves for suction, emptying and air release, universal model.	Nr	10
10	**Burette** with glass stopcock, soda lime, Class A, Capacity 50 x 0.10 ml	Nr	20
11	**Burners**		
11.1	with air regulator for LPG, 10 mm. dia.	Nr	2
11.2	maker pattern for LPG 20 mm. dia.	Nr	2
11.3	burner, Liquid fuel ,glass reservoir with wick and glass capacity 50 ml.	Nr	2
12	**Cylinders measuring, glass with spout and glass foot, with amber colour graduation, Class A**		
12.1	Capacity 5 ml. subdivision 0.1	Nr	10
12.2	Capacity 10 ml. subdivision 0.2	Nr	10
12.3	Capacity 25 ml. subdivision 0.5	Nr	10
12.4	Capacity 50 ml. subdivision 1.0	Nr	10
12.5	Capacity 100 ml. subdivision 1.0	Nr	10
12.6	Capacity 250 ml. subdivision 2.0	Nr	10
12.7	Capacity 500 ml. subdivision 5.0	Nr	10
12.8	Capacity 1000 ml subdivision 10.0	Nr	5
12.9	Capacity 2000 ml. subdivision 20.0	Nr	5
13	**Filter papers, quantitative grades**		
13.1	Whatman No. 40 or equivalent	Nr	1000
13.2	Whatman No. 41 or equivalent	Nr	1000
13.3	Whatman No. 42 or equivalent	Nr	1000
13.4	Whatman No. 44 or equivalent	Nr	1000
13.5	Hardened ashless, Whatman No. 540 or equivalent	Nr	1000
14	**Flask, borosilicate glass, flat bottom, narrow neck, comply with ISO 1773**		
14.1	Capacity 50 ml	Nr	10
14.2	Capacity 100 ml	Nr	10

Ref	Description	Unit	Quantity
14.3	Capacity 250 ml	Nr	10
14.4	Capacity 500 ml	Nr	10
14.5	Capacity 1000 ml	Nr	10
14.6	Capacity 2000 ml	Nr	10
15	**Flask, borocilicate glass, round bottom, wide neck, comply with ISO 1773**		
15.1	Capacity 50 ml	Nr	10
15.2	Capacity 100 ml	Nr	10
15.3	Capacity 250 ml	Nr	10
15.4	Capacity 500 ml	Nr	10
15.5	Capacity 1000 ml	Nr	10
15.6	Capacity 2000 ml	Nr	10
16	**Supports for above flasks, cork rings, compressed, thickness 45 mm, approx.**		
16.1	o.d. 75 x i.d. 45 mm. approximately	Nr	5
16.2	o.d. 115 x i.d. 85 mm. approximately	Nr	5
16.3	o.d. 150 x i.d. 120 mm. approximately	Nr	5
16.4	o.d. 195 x i.d. 160 mm. approximately	Nr	5
16.5	o.d. 240 x i.d. 200 mm. approximately	Nr	5
17	**Flask, Erlenmeyer, narrow neck, graduated, comply with ISO 1773**		
17.1	Capacity 5 ml.	Nr	10
17.2	Capacity 10 ml.	Nr	10
17.3	Capacity 25 ml.	Nr	10
17.4	Capacity 50 ml.	Nr	10
17.5	Capacity 100 ml.	Nr	10
17.6	Capacity 200 ml.	Nr	10
17.7	Capacity 250 ml.	Nr	10
17.8	Capacity 300 ml.	Nr	10
17.9	Capacity 500 ml.	Nr	10
17.10	Capacity 1000 ml.	Nr	10
17.11	Capacity 2000 ml.	Nr	5
18	**Flask, erlenmeyer, wide neck, graduated, comply with ISO 1773**		
18.1	Capacity 5 ml.	Nr	10
18.2	Capacity 10 ml.	Nr	10
18.3	Capacity 25 ml.	Nr	10
18.4	Capacity 50 ml.	Nr	10
18.5	Capacity 100 ml.	Nr	10
18.6	Capacity 200 ml.	Nr	10
18.7	Capacity 250 ml.	Nr	10
18.8	Capacity 300 ml.	Nr	10
18.9	Capacity 500 ml.	Nr	10
18.10	Capacity 1000 ml.	Nr	5
19	**Flask, Buchner filter, heavy wall, integral side arm for 9 mm. bore, comply with ISO 6556**		
19.1	Capacity 500 ml.	Nr	5
19.2	Capacity 1000 ml.	Nr	5
20	**Flask, volumetric, clear glass, borosilicate, with polypropylene stopper, flat bottom, Class A**		

Ref	Description	Unit	Quantity
20.1	Capacity 5 ml.	Nr	10
20.2	Capacity 10 ml.	Nr	10
20.3	Capacity 20 ml.	Nr	10
20.4	Capacity 25 ml.	Nr	10
20.5	Capacity 50 ml.	Nr	10
20.6	Capacity 100 ml.	Nr	10
20.7	Capacity 200 ml.	Nr	10
20.8	Capacity 250 ml.	Nr	10
20.9	Capacity 500 ml.	Nr	10
20.10	Capacity 1000 ml.	Nr	10
21	**Flask, volumetric, flat bottom, clear glass, borocilicate, with glass stopper, Class A.**		
21.1	Capacity 5ml	Nr	10
21.2	Capacity 10 ml.	Nr	10
21.3	Capacity 20 ml	Nr	10
21.4	Capacity 25 ml	Nr	10
21.5	Capacity 50 ml	Nr	10
21.6	Capacity 100 ml	Nr	10
21.7	Capacity 200 ml	Nr	10
21.8	Capacity 250 ml	Nr	10
21.9	Capacity 500 ml	Nr	10
21.10	Capacity 1000 ml	Nr	10
22	**Glass funnels**		
22.1	Top diameter 50 mm. approximately.	Nr	10
22.2	Top diameter 75 mm. approximately.	Nr	10
22.3	Top diameter 100 mm. approximately.	Nr	10
22.4	Top diameter 200 mm. approximately.	Nr	10
23	**Funnels, separating, with glass stopper, conical shape.**		
23.1	Capacity 50 ml.	Nr	10
23.2	Capacity 100 ml.	Nr	10
23.3	Capacity 250 ml.	Nr	10
23.4	Capacity 500 ml.	Nr	10
23.5	Capacity 1000 ml.	Nr	10
24	Gauzes. iron wire with ceramic centre 150 x 150 mm. approx	Nr	10
25	Safety gloves, provide protection at high temperature, washable terry clothe, size medium.	Pair	5
26	Safety goggles, light weight	Pair	2
27	Mortar and pestles, porcelain, unglazed, dia. 100 mm. approx.	Nr	5
28	**Pipettes, bulb. borosilicate glass, ring mark amber stain., Class A**		
28.1	1 ml.	Nr	10
28.2	2 ml.	Nr	10
28.3	3 ml.	Nr	10
28.4	5 ml.	Nr	10
28.5	10 ml.	Nr	10
28.6	20 ml.	Nr	10

Ref	Description	Unit	Quantity
28.7	25 ml.	Nr	10
28.8	50 ml.	Nr	10
29	**Pipettes, graduated, borosilicate glass, calibrated for delivery from zero at top.**		
29.1	Capacity 1 ml. grad. 0.10	Nr	10
29.2	Capacity 2 ml. grad. 0.02	Nr	10
29.3	Capacity 5 ml. grad. 0.10	Nr	10
29.4	Capacity 10 ml. grad. 0.10	Nr	10
30	Pipette stand, hard wood, for holding up to 10 min. horizontally.	Nr	5
31	Pipette rinser. for pipettes up to 460 mm long. with automatic fill/drain repeat siphoning cycle, made of polyethylene.	Nr	2
32	Water sampler, depth made with stainless steel or olypropylene, with inlet and outlet ports nylon cord 10 m, accept BOD bottles, autoclavable.	Nr	1
33	**Spatula**		
33.1	Chattaway pattern, length 100 mm.	Nr	5
33.2	Chattaway pattern, length 150 mm.	Nr	5
33.3	Chattaway pattern, length 200 mm.	Nr	5
33.4	Stainless steel, spoon one end. length 150 mm.	Nr	5
33.5	Stainless steel, spoon one end. length 200 mm.	Nr	5
34	Funnel stand, hard wood or polyethylene, base 300 x 200 mm approx. for two conical funnels.	Nr	5
35	Clamp for burettes, hold two burettes, with rubber grips	Nr	5
36	Stand for separating funnels Stand, corrosion resistant, rod position edge, base 170 x 250 x 50 mm and rod 750 x 12 mm approx.	Nr	5
37	**Retort rings**		
37.1	Retort rings (section cut out and rubber coating) for above dia. 50 mm. approx. dia. 75 mm..	Nr	5
37.2	do dia. 100 mm. Approximately	Nr	5
38	Tripods, cast iron, rectangular top, side length 125 mm.	Nr	5
39	**Tongs**		
39.1	Tongs for crucible, stainless steel, with bow. Length 200mm. Approximately	Nr	2
39.2	Tongs for beaker, stainless steel, with bow. Length 350 mm. Approximately	Nr	2
39.3	Tongs for flask, stainless steel, extended handle, Length 350 mm. Approximately	Nr	2
40	Wash bottles, narrow neck, with swan neck jet and screw cap, made with polyethylene. capacity 250 ml.	Nr	10
41	**Distillation unit, quick fit.**		
41.1	Flask boiling, borosilicate glass, narrow long neck, capacity 500 ml. 24/29	Nr	5
41.2	Adapter, borosilicate, receiver for above, socket size 24/29 cone 24/29	Nr	5
41.3	Condenser, borosilicate, outer water jacket, one end plane,	Nr	5
	upper end socket 24 / 29		
41.4	Flask boiling, borosilicate glass, narrow long neck, capacity 50 ml. 24/29	Nr	5
41.5	Flask boiling, borosilicate glass, narrow long neck, capacity 100 ml. 24/30	Nr	5
42	Flexible vacuum tubing, dia 9 mm.	metre	10

Ref	Description	Unit	Quantity
43	Glass beads to prevent bumping while boiling liquids	Pack	1
44	**Desiccators borosilicate Glass, Knob Lid, with disc**		
44.1	Internal diameter - 100 mm	Nr	2
44.2	internal diameter - 200 mm	Nr	2
44.3	Internal diameter - 250 mm	Nr	2
45	**Thermometer general purpose, Nominal length 300mm., White back, Mercury filled.**		
45.1	Range -10 -100 C	Nr	5
45.2	Range -10 -250 C	Nr	5
46	Stirring rods borosilicate glass, dia. 0.6 mm. Length 200 mm. approximately	Nr	20

TS 4 Glassware - Microbiological Laboratory

Ref	Description	Unit	Quantity
1	**Bottles**		
1.1	Borosilicate glass, wide mouth, glass stopper, autoclavable at 120° C, capacity 300 ml	Nr	50
1.2	Borosilicate glass, wide mouth, with aluminium screw cap, autoclavable at 120° C, capacity 14 ml min.	Nr	100
2	**Beakers, borosilicate glass, low form, with graduation and spout, conform to ISO 3819**		
2.1	Capacity 50 ml.	Nr	5
2.2	Capacity 50 ml.	Nr	5
2.3	Capacity 50 ml.	Nr	5
2.4	Capacity 50 ml.	Nr	5
2.5	Capacity 50 ml.	Nr	5
2.6	Capacity 50 ml.	Nr	5
2.7	Capacity 50 ml.	Nr	5
3	**Brushes**		
3.1	Brushes, beakers bristle or nylon head 70 mm. dia. x 150 mm long, on wood handle	Nr	5
3.2	Brushes, bottle, bristle or nylon head on wire handle 50 x 60 mm. 300 mm long.	Nr	5
3.3	Brushes, cylinder, bristle or nylon head on wire handle 75 x 140 mm. 300 mm long.	Nr	5
4	**Bulbs**		
4.1	Bulbs. PVC or rubber, pear shape, capacity 60 ml	Nr	5
4.2	Bulbs. PVC or rubber, pear shape, capacity 100 ml	Nr	5
5	**Burner with air regulator for LPG, 11mm. Dia.**	Nr	2
6	**Cylinders measuring, glass with spout and glass foot, with amber colour graduation.**		
6.1	capacity 5 ml. Sub division 0.1	Nr	5
6.2	capacity 10 ml. Sub division 0.2	Nr	5
6.3	capacity 25 ml. Sub division 0.5	Nr	5
6.4	capacity 50 ml. Sub division 1.0	Nr	5
6.5	capacity 100 ml. Sub division 1.0	Nr	5
6.6	capacity 250 ml. Sub division 2.0	Nr	5
6.7	capacity 500 ml. Sub division 5.0	Nr	5

6.8	capacity 1000 ml. Sub division 10.0	Nr	5
7	**Flask, borosilicate glass, round bottom, wide neck, comply with ISO 1773**		
7.1	capacity 250 ml.	Nr	5
7.2	capacity 500 ml.	Nr	5
7.3	capacity 1000 ml.	Nr	5
8	**Flask, Erlenmeyer, wide neck, graduated, comply with ISO 1773**		
8.1	capacity 250 ml.	Nr	5
8.2	capacity 500 ml.	Nr	5
8.3	capacity 1000 ml.	Nr	5
9	Gauzes, iron wire with ceramic centre 150*150 mm. (approx)	Nr	5
10	**Pipettes, graduated, borosilicate glass, calibrated for delivery from zero.**		
10.1	capacity 1 ml.	Nr	25
10.2	capacity 2 ml.	Nr	25
10.3	capacity 5 ml.	Nr	25
10.4	capacity 10 ml.	Nr	25
11	Pipettes rinser, for pipettes up to 460 mm long with automatic fill/drain repeat siphoning cycle, made of polyethylene.	Nr	1
12	**Spatula**		
12.1	stainless steel, spoon one end, length 150 mm.	Nr	5
12.2	stainless steel, spoon one end, length 200 mm.	Nr	5
13	Tripod, cast iron, rectangular top, side length 125 mm	Nr	5
14	Tongs for beaker, stainless steel, with bow length 350 mm. Approx.	Nr	2
15	LP Gas cylinder with regulator and rubber tubes, standard	Nr	1

TS 5 Microbiological Equipment

Ref	Description	Unit	Quantity
1	**Autoclave** Capacity:- 15 litres min. Pressure setting :- 1.0 bar min. Working temperature:- 120^{o} C min. Power :- 230V, 50Hz.	Nr	1
2	**Filter funnel set**		
2.1	47mm membrane filters - % Borosilicate glass. capacity 300 ml. min.	Nr	5
2.2	Flask- % Borosilicate glass, capacity 1L min. ,graduated in 50 ml increments,	Nr	5
2.3	Stopper for above flask and funnel :- silicone rubber	Nr	5
2.4	Clamp for above :- aluminium or stainless	Nr	5
2.5	Forceps - stainless steel, flat tips, smooth surface, polypropylene finger grips	Nr	5
2.6	Membrane filters with absorbent pads - sterile, pore size 0.45 um, diameter 47 mm.	Nr	500
3	Petri dishes sterile polystyrene, height 9 mm, min. diameter 50 mm., filter size 47 mm.	Nr	1000
4	Vacuum pump free sir flow-400 cm^3/s, Power 230V, 50 Hz.	Nr	1
5	**Incubator** Thermostatic control and an independent cut-out to provide over temperature protection, with thermometer, inner glass door, fan convection, temperature range - ambient - 50^{o} C +/- 0.2 min, Capacity- 50 L min. Power - 230V. 50Hz.	Nr	2

Ref	Description	Unit	Quantity
6	**Oven** Thermostatic control and an independent cut-off to provide over temperature protection. Temperature range 50 - 200 ° C. min, capacity - 75 l (min), power - 230V, 50Hz.	Nr	1
7	**Portable colony counter** Hand - held, battery operated, with felt tip to mark on glass, electronic bleep to conform each record should be emitted.	Nr	1
8	**UV or gama sterilization box** Transparent, front door, Capacity 15 l (min) Power 230 V, 50 Hz.	Nr	1
9	**Pipette canister** for holding pipettes for autoclaving up to 180 C. with lid, dia. 60, length 400 mm (min)	Nr	4
10	**Electromantles** Incorporating heater cartridge, power on indicator lamp and internal fuse, capacity up to 1 litre solid state controller with earthed screen. Power :- 230V, 50 Hz, 300 W	Nr	1
11	**Electronic top loading balance** Standard features :- draught shield level indicator, sealed keypad for spill protection Calibration certificate should be provided. Readability :- 0.01 g, Capacity :- 400 g min Reproducibility - 0.01, Response time :- 4 sec. or less Weight pan :- stainless steel on corrosive metal dia. 75 - 100 mm Calibration :- internal automatic calibration Operating temperature :- ambient - 40° C Space above the pan :- 200 mm approx. Power :- AC 230 V , 50 Hz	Nr	1
12	**Hot plate** With illuminated on/off switch and over temperature cut off switch. size :- 200 x 300 x 100 mm. approx. Working temperature: 300C Min. Power:- 230V, 50 Hz, 1000W Max.	Nr	1
13	**Microscope** Head - Monocular/Binocular Eyepieces - W10 x (15.5 mm eye point) Objectives - triple/quadruple changer (4x, 10x, 40 x R) Condenser - focusing able, diaphragm, and filter holder.	Nr	1
14	**Microscope lamp** Firm base, lamp head should be able to move horizontally or vertically for optimum positioning. 40 W bulb, power 230V, 50 Hz.	Nr	1
15	**Electromentals** Regulated and screened operating temperature 450° C	Nr	5
16	**Flask**		
16.1	capacity 500 ml	Nr	1
16.2	capacity 1000 ml	Nr	1
17	**Bunsen burner** for use with LPG, serrated gas inlet connection, adjustable, with fine pitch threaded needle valve and flame stabilizer. Mixing tube O.D. 1.0 mm (approx.) height 150 mm (approx.), gas inlet 10 mm	Nr	2
18	**LPG cylinder with gas, regulator, connecting tube** Cap. - 13.5 kg**.**	Nr	1

Ref	Description	Unit	Quantity
19	**Refrigerator** Automatic defrost, integral door lock, adjustable shelf levels Working temperature :- -4° C min. Capacity :- 200 l (min) No. of shelves :- 3 (min) Power :- 230V, 50 Hz.	Nr	1
20	**Forceps** Stainless steel, autoclavable, Tips should be rounded to prevent membrane filters damage, slip-proof plastic finger grips	Nr	2
21	**Pipette** Unbrakeable, uses disposable polypropylene tips, dispenses fluids in 10 distinct preset volumes, with single-stroke uptake and dispensing. change volume setting.	Nr	2
21.1	Sterile pipettes for the above, cap. 1.0-10.0 ml in 1.0 ml increments	Nr	500
22	**Automatic water still** Output 4.5 (approx.) litres/hour. stainless steel boiling chamber, condenser weir and inner baffles and borosilicate glass outer lid and inner baffle cup. with bracket for wall mounting, power - 230 V, 50 Hz.	Nr	1
23	**Pipette filler** Single bulb size which accepts 0.1 to 100 ml pipettes valve can be removed for cleaning interior of the bulb.	Nr	5
24	**Drying Sterilizer** Thermostatic control and an independent cut-off to provide over temperature protection Temperature range 50 - 300C. min. No. of shelves 03 min. capacity - 100 litres min. Power - 230V, 50 Hz, single phase	Nr	1
25	**Colony Counter** For counting bacterial colonies - length 100 mm Magnification 1.5X, Wolffhuegel guide plate, Illumination - 40 W, tungsten bulb. 230V, 50 Hz.	Nr	1

TS 6 Consumables

A Glass Fibre Filter Paper

Size	Number
ø 47 mm	1000 pcs.

B Paraffin Paper

Thickness	:	20 micron
Size	:	105 mm x 105 mm
Content per box	:	500 pcs.
Number	:	50 boxes

C Filter Paper

Round Type Filter Paper for Quantitative Analysis

Purpose	:	General use
Packing	:	100 pcs./ pack

Size	Number of package
90 mmø	50
100 mmø	50
125 mmø	50

Round Type Filter Paper for Quantitative Analysis

Purpose	:	General use
Packing	:	100 pcs./ pack

Size	Number of package
90 mmø	50
100 mmø	50

125 mm$^{\phi}$	50

D pH Test Paper

Made	:	Full scale reading roll type
Measuring range	:	1.0 to 14.0 pH
Roll Size	:	9mm^{W} x 6.0 m^{L}
Accessories	:	Standard color comparison chart
Number	:	30 rolls

E Plastic Film

Made	:	Elastic type, chemical resist, water proof, air tight
Temperature range	:	-70 to 50 ^{0}C (under normal use)
Roll Size	:	100 mm^{W} x 40.0 m^{L}
Number	:	10 rolls

TS 7 Laboratory Furniture

The furniture to be procured and installed in the Administration Building shall conform to the requirements listed below or equivalent. Dimensions show approximate sizes.

Qty	Descriptions
For Laboratory Room	
3	Chemical storage cabinet, to keep no-flammable and no-aggressive chemicals width: 1200mm, height: 1920mm, depth: 520mm Materials:steel, electrolytically galvanized, epoxy coated. 3 shelves, 2 of them adjustable with ventilator of PVC (2600rpm)
1	Tall cabinet plinth-mounted. Height: 1920 mm, Width: 1200 mm, depth 520 mm above: 2 sliding doors safety glass, lockable below: 2 doors, lockable 3 shelves
1	1 Wall work bench on pedestal, Height: 1320/900 mm, Width: 9250 mm, Depth: 750 mm Consisting of: 1-Work top, toplab depth: 750mm 1-Stainless steel sink, 445 x 445 x 200 mm. 1-PP-Drip cup-type sink, suspended dimension: 290x126x165mm dimension: 250x90mm sink depth: 155mm 1-Draining rack, Polystyrene, 72 removable push in pegs, dimensions: 630x450 mm 1-Underbench pedestal cabinet width: 1200mm, height: 870mm, for table height: 900mm, depth 520mm, 2-doors for sink installation 4- Underbench pedestal cabinet width: 450mm, height: 870mm, for table height 900mm, depth: 520mm 4-Knee space cover panel, 600 mm wide, 870 mm high. 2-Underbench pedestal cabinet width: 450mm, height: 870mm, for table height 900mm, depth: 520mm 1-Underbench pedestal cabinet

Qty	Descriptions
For Laboratory Room (continued)	
	width: 1200mm, height: 870mm, for table height 900mm, depth: 520mm, 2-doors and 2-drawers 2-Underbench pedestal cabinet width: 450mm, height: 870mm, for table height:900mm, depth: 520mm, 1-door and 1-shelf 1-Adjustable panel, Width 400 mm, Height 870 mm. 1-Underbench pedestal cabinet width: 600mm, height: 870mm, for table height 900mm, depth: 520mm, 1-door and 1-sheld 1-Foot rest for office table, height 870 mm, 2- electric cabling feed-in 230V and connections
1	Set service column, consisting of: 1-inner corner panel for pedestal unit, height 870 mm. 1-table-mounted column, H 420 mm, height: 150mm, depth: 150mm 1-Panel for service column with preparation for attachment of two water fittings. 2x1/2"
1	Set of Zelle TH90 consisting of: 1-table-mounted column, H 420 mm, height: 150mm, depth: 150mm 1-Blank Media cassette, 150 x 300 mm 1-Reagent shelf for service cell, straight sides, width 1500 mm, depth 150 mm, glass insert. 1-table-mounted column, H 420 mm, height: 150mm, depth: 150mm with socket panel
1	Set of Zelle TH90 consisting of: 1-table-mounted column, H 420 mm, height: 150mm, depth: 150mm 1-Panel for service column with preparation for attachment of two gas fittings 1-Gas fitting 1-Fitting for compressed air 1-Reagent shelf for Service cell, straight sides, width 1500 mm, depth 150 mm 1-table-mounted column, H 420 mm, height: 150mm, depth: 150mm with socket panel
1	Set Zelle TH90 consisting of: 1-table-mounted column, H 420 mm, height: 150mm, depth: 150mm 1-Service cassette 150x300, 1x1/2" with preparation for attachment of one water fitting. 1-Reagent shelf for service cell, straight sides, width 1200 mm, depth 150 mm, 1-table-mounted column, H 420 mm, height: 150mm, depth: 150mm with socket panel
1	Set Zelle TH90 consisting of: 1-table-mounted column, H 420 mm, height: 150mm, depth: 150mm 1-Panel for Service column with preparation for attachment of two gas fittings

Qty	Descriptions
For Laboratory Room (continued)	
	1-Gas-Fitting 1-Fitting for compressed air 1-Reagent shelf for Service cell, straight sides, width 1500 mm, depth 150 mm, glass insert. 1-table-mounted column, H 420 mm, height: 150mm, depth: 150mm with socket panel
1	Set Zelle TH90 consisting of: 1- Table-mounted column, H 420 mm, height: 150mm, depth: 150mm 1- Blank Media cassette, 150 x 300 mm 1- Reagent shelf for Service cell, straight sides, width 1500 mm, depth 150 mm, 1- table-mounted column, H 420 mm, height: 150mm, depth: 150mm with socket panel
1	Set service column consisting of: 1-Table-mounted column, H 420 mm, height: 150mm, depth: 150mm 1-Blank Media cassette, 150 x 300 mm 2-Wall mounted cabinet, width: 1500mm, height: 630mm, depth: 340mm, open front 2-Wall mounted cabinet, width: 1500mm, height: 630mm, depth: 340mm 2 sliding glass doors, doors lockable,1 shelf 1-Wall mounted cabinet, width: 1200mm, height: 630mm, depth: 340mm open front,1 shelf
1	Wall work bench on pedestal, Height 1320/900 mm Width 8250 mm Depth 750 mm consisting of: 1-Work top, toplab,depth: 750mm, running meter 2-Stainless steel sink, 445 x 445 x 200 mm. 2-Draining rack, Polystyrene, 72 removable push in pegs,,630x450 mm, Wall mounted 2-Underbench pedestal cabinet, width: 1200mm, height: 870mm, for table height: 900mm, depth: 520mm, 2 doors, for sink installation 3-Underbench pedestal cabinet, width: 450mm, height: 870mm,for table height 900mm, depth: 520mm, 5 drawers 150mm, central locking 2-Knee space cover panel, 600 mm wide, 870 mm high. 1-Underbench pedestal cabinet, width: 450mm, height: 870mm,for table height 900mm, depth: 520mm,1 door right hand hinge,1 drawer 150mm,1 shelf 2-Underbench pedestal cabinet, width: 1200mm, height: 870mm, for table height 900mm, depth: 520mm, 2 doors, 2 drawers 150mm, 1 shelf, both lockable 1-Underbench pedestal cabinet, width: 450mm, height: 870mm,for table, height:900mm, depth: 520mm, 1 door left hand hinge, 1 drawer 150mm,1 shelf
1	Set service column consisting of: 1-table-mounted column, H 420 mm, height: 150mm, depth: 150mm, for bench mounting 1-Panel for Service column with preparation for attachment of two water fittings.

Qty	Descriptions
For Laboratory Room (continued)	
	2x1/2"
1	Set Zelle TH90 consisting of: 1-table-mounted column, H 420 mm, height: 150mm, depth: 150mm, for bench mounting 1-Blank Media cassette, 150 x 300 mm 1-Reagent shelf for Service cell, straight sides, width 1500 mm, depth 150 mm, glass insert. 1-Table-mounted column, H 420 mm, height: 150mm, depth: 150mm, for bench mounting with socket panel
1	Set Zelle TH90 consisting of: 1-Table-mounted column, H 420 mm, height: 150mm, depth: 150mm, for bench mounting 1-Panel for service column with preparation for attachment of two gas fittings 1-Gas-Fitting 1-Fitting for compressed air 1-Reagent shelf for Service cell, straight sides, width 1200 mm, depth 150 mm, glass insert. 1-Table-mounted column, H 420 mm, height: 150mm, depth: 150mm, for bench mounting
1	Set Zelle TH90 consisting of: 1-Table-mounted column, H 420 mm, height: 150mm, depth: 150mm, for bench mounting 1-Panel for Service column with preparation for attachment of two gas fittings 1-Gas-Fitting 1-Fitting for compressed air 1-Reagent shelf for Service cell, straight sides, width 1200 mm, depth 150 mm, glass insert. 1-Table-mounted column, H 420 mm, height: 150mm, depth: 150mm, for bench mounting with socket panel
1	Set Zelle TH90 consisting of: 1-Table-mounted column, H 420 mm, height: 150mm, depth: 150mm, for bench mounting 1-Blank Media cassette, 150 x 300 mm 1-Reagent shelf for Service cell, straight sides, width 1500 mm, depth 150 mm, glass insert. 1-Table-mounted column, H 420 mm, height: 150mm, depth: 150mm for bench mounting, with socket panel
1	Set Service column consisting of: 1-Table-mounted column, H 420 mm, height: 150mm, depth: 150mm, for bench mounting 1-Panel for Service column with preparation for attachment of two water fittings. 2x1/2" 2-Wall mounted cabinet, width: 1500mm, height: 630mm, depth: 340mm 2 sliding glass doors, doors lockable, 1 shelf 2-Wall mounted cabinet, width: 1200mm, height: 630mm, depth: 340mm open front, 1 shelf

Qty **Descriptions**

For Laboratory Room (continued)

1 Double work bench
plinth-mounted.
Height 1620/900 mm
Width 4500 mm
Depth 1500 mm
consisting of:

1 Set Zelle TH90
consisting of:
1-Service column, 1620 mm high, 150 mm deep, Colour, Grey, incl. pipe 1/2" pre mounting for attaching a single water fitting.
1-Panel 146x1571 to be mounted on Service column.
1-Fitting for cold water, short arm.
1-Bridge for service cell with drip cup left, sloped sides for service columns, width 1500 mm, depth 150 mm
1-Reagent shelf for service cell, straight sides, width 1500 mm, depth 150 mm, glass insert.
1-Reagent shelf for service cell, width 1500 mm, depth 150 mm, slanted edges, glass insert.
1-Service column 1620 mm high, 150 mm deep, incl. protective casing IP44, with one Media cassette 4 x 230V, 1. circuit.

1 Set Zelle TH90
consisting of:
1-Column without panels, 1620 mm, height, 150 mm deep,
1-Blank Media cassette, 150 x 300 mm
1-Panel for service column with preparation for attachment of two gas fittings
1-Gas-Fitting
1-Fitting for compressed air
1-Blank media cassette, 150 x 300 mm
1-Bridge for service column, slanted sides, 1500 mm wide, 150 mm deep,
1-Reagent shelf for service cell, straight sides, width 1500 mm, depth 150 mm, glass insert.
1-Reagent Shelf for Service cell, width 1500 mm, depth 150 mm, slanted edges, glass insert.
1-Column without panels, 1620 mm, height, 150 mm deep,
1-Blank Media cassette, 150 x 300 mm
1-Blank Media cassette, 150 x 300 mm
1-Blank Media cassette, 150 x 300 mm

1 Set Zelle TH90
consisting of:
1-Service column, 1620 mm high, 150 mm deep, with 3 Media cassettes.
1-Bridge for service column, slanted sides, 1500 mm wide, 150 mm deep
1-Reagent shelf for service cell, straight sides, width 1500 mm, depth 150 mm, glass insert.
1-Reagent shelf for service cell, width 1500 mm, depth 150 mm, slanted edges, glass insert.
1-Service column 1620 mm high, 150 mm deep, incl. protective casing IP44, with one Media cassette 4 x 230V, 1. circuit.
1-Panel 146x1571 to be mounted on Service column.

Qty		Descriptions
For Laboratory Room (continued)		
1	Set	Zelle TH90 consisting of: 1-Service column, 1620 mm high, 150 mm deep, incl. pipe 1/2" pre mounting for attaching a single water fitting. 1-Fitting for cold water, short arm. 1-Panel 146x1571 to be mounted on Service column. 1-Bridge for service cell with Drip cup left, sloped sides for service columns, width 1500 mm, Depth 150 mm, 1-Reagent shelf for service cell, straight sides, width 1500 mm, depth 150 mm, glass insert. 1-Reagent shelf for service cell, width 1500 mm, depth 150 mm, slanted edges, glass insert. 1-Service column 1620 mm high, 150 mm deep, incl. protective casing IP44, with one Media cassette 4 x 230V, 1. circuit. 1-Electric cabling feed-in 230 V
1		Set Zelle TH90 consisting of: 1-Column without panels, 1620 mm Height, 150 mm deep 1-Blank Media cassette, 150 x 300 mm 1-Panel for Service column with preparation for attachment of two gas fittings 1-Gas-Fitting 1-Fitting for compressed air 1-Blank Media cassette, 150 x 300 mm 1-Bridge for Service column, slanted sides, 1500 mm wide, 150 mm deep 1-Reagent shelf for Service cell, straight sides, width 1500 mm, depth 150 mm, glass insert. 1-Reagent Shelf for Service cell, width 1500 mm, depth 150 mm, slanted edges, glass insert. 1-Column without panels, 1620 mm Height, 150 mm deep 1-Blank Media cassette, 150 x 300 mm 1-Blank Media cassette, 150 x 300 mm 1-Blank Media cassette, 150 x 300 mm
1	Set	Zelle TH90 consisting of: 1-Service column, 1620 mm high, 150 mm deep, with 3 Media cassettes. 1-Bridge for service column, slanted sides, 1500 mm wide, 150 mm deep 1-Reagent shelf for service cell, straight sides, width 1500 mm, depth 150 mm, glass insert. 1-Reagent shelf for service cell, width 1500 mm, depth 150 mm, slanted edges, glass insert. 1-Service column 1620 mm high, 150 mm deep,incl. protective casing IP44, with one Media cassette 4 x 230V, 1. circuit. 1-Panel 146x1571 to be mounted on Service column. 2-Work top, toplab, depth: 700mm, running meter 4-Side panel for work bench for pedestal system, Width 60 mm, Height 870 mm. 2-Underbench pedestal cabinet, width: 450mm, height: 870mm, for table height: 900mm, depth: 520mm, 1 door left hand hinge,1 drawer 150mm,1 shelf 4-Knee space cover panel, 600 mm wide, 870 mm high.

Qty	Descriptions
For Laboratory Room (continued)	
	4-Underbench pedestal cabinet, width: 450mm, height: 870mm for table height 900mm, depth: 520mm, 5 drawers 150mm central locking 2-Underbench pedestal cabinet, width: 900mm, height: 870mm,for table height 900mm, depth: 520mm, 2 doors, 2 drawers 150mm, both lockable,1 shelf 1-Underbench pedestal cabinet, width: 600mm, height: 870mm,for table height 900mm, depth: 520mm, 1 door right hand hinge, 1 drawer 150mm,1 shelf both lockable 2-Underbench pedestal cabinet, width: 450mm, height: 870mm,for table height 900mm, depth: 520mm, 1 door right hand hinge,1 drawer 150mm,1 shelf 1-Underbench pedestal cabinet, width: 600mm, height: 870mm,for table height 900mm, depth: 520mm,1 door left hand hinge,1 drawer 150mm,1 shelf both lockable
1	Double work bench plinth-mounted. Height 900 mm Width 3600 mm Depth 1500 mm consisting of: 3-Work top, toplab, depth: 750mm, running meter 1-Stainless steel sink, 445 x 445 x 200 mm. 1-Bench mounted Hot/Cold water fitting, Height 300 mm 2-Free-standing columns for electric 80x200mm with 4 sockets -D- 230V/16A 1-Underbench pedestal cabinet, width: 600mm, height: 870mm,for table height: 900mm, depth: 520mm, 1 door left hand hinge for sink installation 2-Underbench pedestal cabinet, width: 450mm, height: 870mm,for table height:900mm,depth: 520mm, 1 door left hand hinge,1 drawer 150mm 1 shelf 4-Knee space cover panel, 600 mm wide, 870 mm high. 2-Underbench pedestal cabinet,width: 900mm,height: 870mm,for table height 900mm, depth: 520mm, 2 doors, 2 drawers 150mm,1 shelf 2-Underbench pedestal cabinet, width: 450mm,height: 870mm,for table height 900mm, depth: 520mm, 1 door right hand hinge, 1 drawer 150mm,1 shelf 2-Side panel for double work bench for pedestal system, Width 60 mm, Height 870 mm. 1-Underbench pedestal cabinet, width: 600mm, height: 870mm,for table height: 900mm, depth: 520mm, 1 door right hand hinge for sink installation
1	Double work bench plinth-mounted. Height 0/900 mm Width 3000 mm Depth 1500 mm consisting of: 1-Work top, toplab, 180° octagonal shape, depth: 1500mm conneciton depth: 750mm 2-Work top, toplab, depth: 750mm, running meter 1-Work top, toplab, 180° octagonal shape, depth: 1500mm 1-C Frame, (complete) suitable for Corner / Octagonal, Width 600 mm, Top Height 900 mm,

Qty **Descriptions**

For Laboratory Room (continued)

4-Screening panel for octagonal corner, height: 900mm,depth: 600mm
3-C frame, (add on)
suitable for corner/octagonal,Width: 600mm,for table height. 900mm
2-C Frame, (add on), Width 1500 mm, Top Height 900 mm,
Intermediate section,
2-Panel for C frame , table height 900 mm, width 900 mm.
2-Panel for C frame , table top height 900 mm, width 600 mm.

For Chemical Room/Biological Room

(The following items shall be installed for chemical room and biological room each. Therefore, total number shall be double of the following numbers.)

1 Wall work bench on pedestal,
Height 1320/900 mm
Width 5000 mm
Depth 750 mm
consisting of:
1-Work top, toplab depth: 750mm
2-Stainless steel sink, 445 x 445 x 200 mm.
1-Draining rack, Polystyrene, 72 removable push in pegs,
Dimensions: 630x450 mm, Wall mounted
1-Adjustable panel, Width 400 mm, Height 870 mm.
2-Underbench pedestal cabinet, width: 1200mm, height: 870mm,for table height: 900mm, depth: 520mm, 2 doors for sink installation
1-Underbench pedestal cabinet, width: 900mm, height: 870mm,for table height 900mm, depth: 520mm, 2 doors, 2 drawers 150mm, 1 shelf
1-Underbench pedestal cabinet, width: 900mm, height: 870mm,for table height 900mm, depth: 520mm, 2 doors, 2 drawers 150mm, both lockable, 1 shelf
1- Inner corner panel for pedestal unit, height 870 mm.

1 Set service column
consisting of:
1-table-mounted column, H 420 mm, height: 150mm, depth: 150mm
for bench mounting
1-Panel for Service column with preparation for attachment of two water fittings. 2x1/2"

1 Set Zelle TH90
consisting of:
1-Table-mounted column, H 420 mm, height: 150mm, depth: 150mm
for bench mounting
1-Blank Media cassette, 150 x 300 mm
1-Reagent shelf for Service cell, straight sides, width 900 mm,
depth 150 mm, glass insert.
1-table-mounted column, H 420 mm, height: 150mm, depth: 150mm
for bench mounting, socket panle

1 Set Zelle TH90
consisting of:
1-Table-mounted column, H 420 mm, height: 150mm, depth: 150mm
for bench mounting
1-Panel for Service column with preparation for attachment of two gas fittings

Qty		Descriptions
For Chemical/Biological Rooms		
		1-Gas-Fitting 1-Fitting for compressed air 1-Reagent shelf for Service cell, straight sides, width 900 mm, depth 150 mm, glass insert. 1-table-mounted column, H 420 mm, height: 150mm, depth: 150mm for bench mounting, socket panel
1	Set	Service column consisting of: 1-table-mounted column, H 420 mm, height: 150mm, depth: 150mm for bench mounting 1-Panel for Service column with preparation for attachment of two water fittings. 2x1/2" 2-Wall mounted cabinet, width: 900mm, height: 630mm, depth: 340mm 2 sliding glass doors, doors lockable, 1 shelf 1-Foot rest for office table height 870 mm, made of steel rod, diameter 40 x 1,5 mm with level stud,
1		Wall work bench on pedestal, Height 900 mm Width 2500 mm Depth 750 mm consisting of: 1-Work top, toplab depth: 750mm, running meter 1-Underbench pedestal cabinet, width: 600mm, height: 870mm,for table height 900mm, depth: 520mm, 1 shelf, 1 door left hand hinge 1-Adjustable panel, Width 400 mm, Height 870 mm. 1-Underbench pedestal cabinet, width: 450mm, height: 870mm,for table height 900mm, depth: 520mm, 5 drawers 150mm, central locking 1-Underbench pedestal cabinet, width: 600mm, height: 870mm,for table height 900mm, depth: 520mm, 1 shelf, 1 door right hand hinge 1- Inner corner panel for pedestal unit, height 870 mm.
1		Set Electrical wall trunking consisting of: 2-Electrical wall trunking, PVC, 2000 mm. 1-Interior corner, PVC. 2-Electrical wall trunking, PVC, 2000 mm. 2-supply points 4-socket boxes
1		1 Wall work bench on pedestal, Height 900 mm Width 2550 mm Depth 750 mm consisting of: 1-Work top, toplab depth: 750mm, running meter 1-Table work top 1-Foot rest for office table, height 870 mm, made of steel rod, diameter 40 x 1,5 mm with level stud, 2-Underbench pedestal cabinet

Qty	Descriptions
For Chemical/Biological Rooms	
	width: 900mm, height: 870mm,for table height 900mm, depth: 520mm 2 doors, 2 drawers 150mm, 1 shelf 1-Underbench pedestal cabinet width: 1000mm, height: 870mm,for table height. 900mm, depth: 500mm octagonal shape 1 door right hand hinge
1	Additional table, 1500 mm wide, 600 mm deep, 900 mm high, one shelf below, four rollers which can be fixed.
1	Work top, toplab depth: 750mm, running meter

TS 8 Chemicals/Reagents

The grade of chemical shall be the special grade as specified in JIS K-series "Chemical Engineering" or equivalent unless otherwise specified below. The chemicals and agents to be procured shall conform to the following requirements and quantity:

Chemical Name	Composition	Unit	Grade	Quantity No.
2-Chloro-6- (trichloro methyl)-pyridine, inhibitor		25 g		6
Acetic Acid	CH_3COOH	500 ml		10
Acetone		500 ml		10
Agar		250 g		5
Aluminum Potassium sulfate 12-water	$AlK(SO_4)_2.12H_20$	500 g		5
Ammonium Acetate	$NH_4C_2H_30_2$	500 g		4
Ammonium Chloride	NH_4Cl	500 g		10
Ammonium hydroxide	NH_4OH	500 ml		20
Ammonium hydroxide	NH_4OH	500 ml	for metal analysis	2
Ammonium oxalate monohydrate	$(NH_4)_2C_2O_4.H_2O$	500 g		5
Ammonium persulfate	$(NH_4)_2S_2O_8$	500 g		3
Anhydrous sodium sulfate	Na_2SO_3	500 g		5
Arsenic III trioxide	As_2O_3	250 g	First grade	2
L-(+) –Ascorbic Acid		500 g		3
Aluminum ammonium sulfate	$AlNH_4(SO_4)_2.12H_2O$	500 g		2
Barbituric acid		25 g		3
Barium hydroxide octahydrate	$Ba(OH)_2.8H_2O$	500 g		3
Beef Extract (Yeast extract)		500 g		5
Beef Extract		100 g		5
Bile salts mixture		250 g		3
Boric acid	H_3BO_3	500 g		2
Brilliant green bile 2% broth		500 g		2
Bromcresol green, sodium salt		10 g		5
Bromphenol blue		25 g		5
Barium chloride dehydrate	$BaCl_2.2H_2O$	500 g		3
Cadmium, granules, 40-60 mesh		1 column		5
Calcium carbonate	$CaCO_3$	500 g		5
Calcium chloride	$CaCl_2$	500 g		5
Calcium hydroxide	$Ca(OH)_2$	500 g		3

Carbon disulfide	CS_2	500 ml		2
Carbon tetrachloride	CCl_4	500 ml		20
CDTA		25 g		20
Cd, pure		500 g	First grade	1
Chloramine-T, water-soluble powder		500 g		3
Chloroform	$CHCl_3$	500 ml		20
Cobaltous chloride	$CoCl_2.6H_2O$	500 g		3
Congo red paper		25 g		5
Copper II sulfate	$CuSO_4.5H_2O$	500 g		3
Copper (II) sulfate, anhydrous	$CuSO_4$	500 g		3
Crystal violet		25 g		5
Crystallized cobaltous chloride	$CoCl_2.6H_2O$	500 g		2
Copper, polished electrolytic copper wire		250 g		2
Cupferron	$C_6H_5N(NO)ONH_4$	250 g		2
Cyclohexyanone, purified	$C_6H_{10}O$	500 ml		5
Dibasic ammonium citrate	$(NH_4)_2HC_6H_5O_7$	500 g		5
Diethanolamine		500 ml		3
Diisopropyl ether		500 ml		5
Diphenylcarbazide: 1.5-diphenylcarbazide		25 g		2
Dipotassium hydrogen phosphate	K_2HPO_4	500 g		3
Dithizone		25 g		5
Dithizone		5 g		5
DPD oxalate		25 g		8
DPD sulfate anhydrous		25 g		16
DPD sulfate pentahydrate		25 g		16
EPT Erichrome Black T, sodium salt		25 g		5
EDTA	EDTA-2Na.$2H_2O$	500 g		5
EDTA, magnesium salt		25 g		5
Eriochrome cyanine R(of Pfaltz & Bauer Inc. or EM Science)		25 g		3
Ethyl alcohol 95 %		500 ml		10
Iron (II) Ferrous ammonium sulfate	$Fe(NH_4)_2(SO_4)_2.6H_2O$	500 g		3
Glucose, dry reagent-grade		500 g		5
L-Glutamic acid, reagent-grade		500 g		5
Hexamethylenetetramine	$(CH_2)_6.N_4$	500 g		1
Hydrazine sulfate	$(NH_2)_2.H_2SO_4$	500 g		1
Hydrochloric acid	HCl	500 ml		20
Hydrochloric acid	HCl	500 ml	for Iron Test	5
Hydrochloric acid	HCl	500 ml	for Arsenic Test	2
Hydrogen peroxide	H_2O_2 (30%)	500 g		5
Hydroxylamine hydrochloride	$NH_2OH.HCl$	500 g		5
Hypochlorous acid	NaOCl	500 ml	first grade	2
Iodine crystals	I_2	500 g		1
Iron (II) ammonium sulfate hexahydrate	$FeSO_4(NH_4)_2SO_4.6H_2O$	500 g		3
Iron (II) sulfate heptahydrate	$FeSO_4.7H_2O$	500 g		3
Iron (III) chloride hexahydrate	$FeCl_3.6H_2O$	500 g		3
Isopropyl ether		500 ml		5
Lactose		500 g		5
Lead acetate	$Pb(C_2H_3O_2)_2.3H_2O$	500 g		2
Lead nitrate	$Pb(NO_3)_2$	500 g		2
Magnesium sulfate heptahydrate	$MgSO_4.7H_2O$	500 g		3
Manganous sulfate	$MnSO_4.H_2O$	500 g		3
Mercuric chloride	$HgCl_2$	500 g		2
Mercuric oxide, red	HgO	500 g		2

Mercuric sulfate	$HgSO_4$	500 g	first grade	3
Mercuric sulfate, crystal or powder	$HgSO_4$	100 g	first grade	1
Mercury iodide, red	HgI_2	500 g		1
Mercury (II) chloride	$HgCl_2$	500 g		2
Metacresol purple		25 g		5
Methanol	CH_3OH	500 ml		10
Methyl alcohol	C_2H_5OH	500 ml	for spectrum analysis	2
Methyl orange		25 g		5
Methyl red sodium salt		500 ml		5
MgCDTA, Magnesium salt of 1,2-cyclohexanediamine tetra acetic acid		100 pillows		10
N-(1-naphtyl) – ethylendiamine dihydrochloride (NED dihydrochloride)		25 g		3
Neocuproine 2, 9-dimethyl-1, 10-phenanthroline hemihydrate		1 g		5
Nitric acid 1.40	HNO_3	500 ml		30
Nutrient agar		500 g		3
Oxgall		500 g		5
p-dimethlaminobenzal rhodanine		25 g		3
Peptone		500 g	For micro biological analysis	5
Phenolphthalein		500 g		3
Phenanthroline; 1, 10-phenanthroline monohydrate	$C_{12}H_8N_2.H_2O$	25 g		5
Phenol	C_6H_5OH	500 g		5
Phenylarsine oxide, powder	C_6H_5AsO	5 g		3
Phosphoric acid	H_3PO_4	500 ml		5
Potassium bromide	KBr	500 g		2
Potassium chloroplatinate	K_2PtCl_6	1 g		5
Potassium carbonate anhydrous	K_2CO_3	500 g		2
Potassium chloroplatinate	K_2PtCl_6	1 g		5
Potassium chromate	K_2CrO_4	500 g		5
Potassium cyanide	KCN	500 g		2
Potassium dichromate	$K_2Cr_2O_7$	500 g		5
Potassium dehydrogen phosphate	KH_2PO_4	500 g		5
Potassium bi-iodate	$KH(IO_3)_2$	25 g		3
Potassium hydrogen phthalate	$KHC_8H_4O_4$	500 g		2
Potassium iodate	KIO_3	500 g		5
Potassium iodate	KI	500 g		5
Potassium nitrate	KNO_3	500 g		5
Potassium permanganate	$KMnO_4$	500 g		5
Potassium persulfate	$K_2S_2O_8$	500 g		2
Potassium phosphate diabasic	K_2HPO_4	500 g		3
Potassium phosphate monobasic	KH_2PO_4	500 g		3
Potassium sulfate	K_2SO_4	500 g		2
Pyridine		500 ml		5
Peptone		500 g		4
Rochelle salt: Potassium sodium tartrate tetrahydrate	$KNaC_4H_4O_6.4H_2O$	500 g		5
Safranin dye		25 g		3
Salicylic acid	$C_6H_4(OH)COOH$	250 g		3
Silver diethyldithiocarbamate	$(C_2H_5)_2NCS_2Ag$	25 g		5
Silver nitrate	$AgNO_3$	500 g		5
Silver sulfate	Ag_2SO_4	500 g		2
Silver nitrate	$AgNO_3$	100 g	first grade	5

Sodium acetate	$NaC_2H_3O_2.3H_2O$	500 g		5
Sodium acetate, anhydrous	CH_3COONa	500 g		3
Sodium arsenite	$NaAsO_2$	500 g		2
Sodium L-ascorbate		500 g		2
Sodium bisulfite	$NaHSO_3$	500 g		5
Sodium carbonate, anhydrous	Na_2CO_3	500 g		5
Sodium chloride	NaCl	500 g		5
Sodium cyanide	NaCN	500 g		2
Sodium citrate	$Na_3C_6H_5O_7.2H_2O$	500 g		5
Sodium dihydrogen phosphate	NaH_2PO_4	500 g		3
Sodium fluoride	NaF	500 g		2
Sodium hydroxide	NaOH	500 g		20
Sodium lauryl sulfate		250 g	first grade	5
Sodium nitrite	$NaNO_2$	500 g		5
Sodium oxalate primary standard grade	$Na_2C_2O_4$	500 g		5
Sodium phosphate dibasic 12 water	$Na_2HPO_4.12H_2O$	500 g		5
Sodium phosphate dibasic, anhydrous	Na_2HPO_4	500 g		2
Sodium potassium tartrate	$NaKC_4H_4O_6.4H_2O$	500 g		5
Sodium propionate	CH_3CH_2COONa	500 g		2
Sodium sulfate	Na_2SO_4	500 g		5
Sodium sulfide monohydrate	$Na_2S.9H_2O$	500 g		5
Sodium sulfite, anhydrous	Na_2SO_3	500 g		3
Sodium tetraborate	$Na_2B_4O_7.10H_2O$	500 g		2
Sodium tetraborate, anhydrous	$Na_4B_4O_7$	250 g		2
Sodium thiosulfate	$Na_2S_2O_3$	100 g		5
Sodium thiosulfate pentahydrate	$Na_2S_2O_3.5H_2O$	500 g		1
Silicone fluid ('Desicote' (Beckman) or equivalent)		50 g		5
SPADNS		25 g		2
Stannous chloride, arsenic free	$SnCl_2.2H_2O$	500 g		2
Starch, corn		500 g		2
Sulfamic acid		500 g		2
Sulfanilamide		500 g		2
Sulfuric acid	H_2SO_4	500 ml		40
Sodium aside	NaN_3	500 g		5
Sodium oxalate	$Na_2C_2O_4$	500 g		3
L-(+)-Tartaric acid	$H_2C_4H_4O_6$	500 g		2
Thioacetamide	CH_3CSNH_2	25 g		3
Thymol blue		25 g		2
Triethanolamine		500 ml	first grade	5
Tryptose		500 g		3
Zinc chloride	$ZnCl_2$	500 g		3
Zinc, metal, pure		500 g		2
Zinc sulfate	$ZnSO_4.7H_2O$	500 g		5
Zinc, arsenic free		500 g		2
Zircon		25 g		3
Zirconyl chloride octahydrate		500 g		2

TS 9 Valves

1. Valves for Raw Water Intake/Water Treatment Plant/Service Reservoirs (Mechanical Work)

Only major valves are listed below. The Contractor should design the facilities and provide all necessary valves, especially valves in chemical building.

Facility/Equipment	Valve No.	Q'ty	Type	Diameter (mm)	Pressure (MPa)	Purpose
01-Raw Water Intake Facility						
Suction Valve	01 HV 11 to 14	4	Manual Sluice	600	1.0	Intake Pump
Discharge Valve	01 MV 11/21	2	Motorized Butterfly	400	1.0	Intake Pump
Check Valve	01 CV 11/21	2	Swing	400	1.0	Intake Pump
Isolation Valve	01 HV 32/42	2	Manual Sluice	400	1.0	Intake Pump
Isolation Valve	01 HV 01/02	2	Manual Butterfly	800	1.0	Transmission
Check Valve	01 CV 01/02	2	Swing	150	1.0	Washing Pump
Discharge Valve	01 HV 06/07	2	Manual Sluice	150	1.0	Washing Pump
Check Valve	01 CV 03/04	2	Swing	50	1.0	Sump Pump
Discharge Valve	01 HV 08/09	2	Manual Sluice	50	1.0	Sump Pump
05-Distribution Chamber						
De-Sludge Valve	05 HV 11/21	2	Manual Sluice	600	1.0	De-Sludge
06-Flocculation/Sedimentation Basins						
De-Sludge Valve	06 MV 11 to 24	8	Motorized Eccentric	150	1.0	De-Sludge
De-Sludge Valve	06 HV 11 to 24	8	Manual Sluice	150	1.0	De-Sludge
Foot Valve	06 FV 01	1	Manual Sluice	50	1.0	Sampling Pump
Check Valve	06 CV 01	1	Swing	50	1.0	Sampling Pump
Discharge Valve	06 HV 01	1	Manual Sluice	50	1.0	Sampling Pump
07-Filtration Units						
Effluent Valve	07 MV 11 to 41	4	Motorized Butterfly	350	1.0	Filter
Backwash Valve	07 MV 11 to 41	4	Motorized Butterfly	350	1.0	Filter
Air Scouring Valve	07 MV 11 to 41	4	Motorized Butterfly	250	1.0	Filter
Drain Valve	07 MV 11 to 41	4	Manual Sluice	150	1.0	Filter
Suction Valve	07 HV 11 to 13	3	Manual Butterfly	250	1.0	Backwash Pump
Check Valve	07 CV 11 to 13	3	Swing	200	1.0	Backwash Pump
Delivery Valve	07 HV 21 to 22	3	Manual Butterfly	200	1.0	Backwash Pump
Delivery Valve (Air)	07 HV 31/32	2	Manual Sluice	200	1.0	Air Blower
Check Valve (Air)	07 CV 21/22	2	Swing	200	1.0	Air Blower
Check Valve	07 CV 31/31	2	Swing	50	1.0	Sump Pump
Discharge Valve	07 HV 41/42	2	Manual Sluice	50	1.0	Sump Pump
09-Clear Water Pump Station						
Suction Valve (A-1)	09 HV 11 to 14	4	Manual Sluice	300	1.0	Pump (A-1)
Delivery Valve (A-1)	09 MV 11 to 12	2	Motorized Butterfly	300	2.0	Pump (A-1)
Delivery Valve (A-1)	09 HV 13 to 14	2	Manual Sluice	300	2.0	Pump (A-1)
Check Valve (A-1)	09 CV 11 to 12	2	Swing	300	2.0	Pump (A-1)
Suction Valve (A-2)	09 HV 21/22	2	Manual Sluice	150	1.0	Pump (A-2)
Delivery Valve (A-2)	09 MV 21 to 22	2	Motorized Butterfly	150	2.0	Pump (A-2)
Check Valve (A-2)	09 CV 21/22	2	Swing	150	2.0	Pump (A-2)
Suction Valve (A-3)	09 HV 31 to 34	4	Manual Sluice	300	1.0	Pump (A-3)
Delivery Valve (A-3)	09 MV 31 to 32	2	Motorized Butterfly	300	2.0	Pump (A-3)
Delivery Valve (A-1)	09 HV 33 to 34	2	Manual Sluice	300	2.0	Pump (A-3)
Check Valve (A-3)	09 CV 31 to 34	2	Swing	300	2.0	Pump (A-3)
Suction Valve (A-4)	09 HV 41 to 42	1	Manual Sluice	400	1.0	Pump (A-4)
Suction Valve	09 HV 91 to 93	3	Manual Sluice	50	1.0	Booster Pump
Check Valve	09 CV 71 to 73	2	Swing	50	1.0	Booster Pump
Delivery Valve	09 HV 94 to 96	2	Manual Sluice	50	1.0	Booster Pump
Check Valve	09 CV 61/62	2	Swing	50	1.0	Sump Pump

Facility/Equipment	Valve No.	Q'ty	Type	Diameter (mm)	Pressure (MPa)	Purpose
Discharge Valve	09 HV 61/62	2	Manual Sluice	50	1.0	Sump Pump
11-Backwash Recovery Facility						
Isolation Valve	11 HV 01/02	2	Manual Sluice	300	1.0	Flow meter
Suction Valve	11 HV 11/21	2	Manual Sluice	200	1.0	Recovery Pump
Check Valve	11 CV 11/21	2	Swing	200	1.0	Recovery Pump
Discharge Valve	11 HV 12/22	2	Manual Sluice	200	1.0	Recovery Pump
304-Kahawatta (E)						
Isolation Valve	304 HV 01	1	Manual Sluice	300	1.0	Pump House
Suction Valve	304 HV 11 & 21	2	Manual Sluice	100	1.0	Booster Pump
Check Valve	304 CV 11 & 21	2	Swing	150	2.0	Booster Pump
Delivery Valve	304 HV 12 & 22	2	Manual Sluice	150	2.0	Booster Pump
Isolation Valve	304 HV 31 to 33	3	Manual Sluice	250	2.0	Flow Meter
310-Kondadeniya (H)						
Isolation Valve	310 HV 01	1	Manual Sluice	150	1.0	Pump House
Suction Valve	310 HV 11 & 21	2	Manual Sluice	80	1.0	Booster Pump
Check Valve	310 CV 11 & 21	2	Swing	100	1.0	Booster Pump
Delivery Valve	310 HV 12 & 22	2	Manual Sluice	100	1.0	Booster Pump
Isolation Valve	310 HV 31 to 33	3	Manual Sluice	100	1.0	Flow Meter
315-Asgiriya (G)						
Isolation Valve	315 HV 01	1	Manual Sluice	250	1.0	Pump House
Suction Valve	315 HV 11 & 21	2	Manual Sluice	100	1.0	Booster Pump
Check Valve	315 CV 11 & 21	2	Swing	150	2.0	Booster Pump
Delivery Valve	315 HV 12 & 22	2	Manual Sluice	150	2.0	Booster Pump
Isolation Valve	315 HV 31 to 33	3	Manual Sluice	150	2.0	Flow Meter
318-R2 (F)						
Isolation Valve	318 HV 01	1	Manual Sluice	200	1.0	Pump House
Suction Valve	318 HV 11 & 21	2	Manual Sluice	100	1.0	Booster Pump
Check Valve	318 CV 11 & 21	2	Swing	150	2.0	Booster Pump
Delivery Valve	318 HV 12 & 22	2	Manual Sluice	150	2.0	Booster Pump
Isolation Valve	318 HV 31 to 33	3	Manual Sluice	100	2.0	Flow Meter
320-Heerasagala Low (B)						
Isolation Valve	320 HV 01	1	Manual Sluice	200	1.0	Pump House
Suction Valve	320 HV 11/21	2	Manual Sluice	100	1.0	Booster Pump
Check Valve	320 CV 11/21	2	Swing	150	1.0	Booster Pump
Delivery Valve	320 HV 12/22	2	Manual Sluice	150	1.0	Booster Pump
Isolation Valve	320 HV 31 to 33	3	Manual Sluice	150	1.0	Flow Meter
321-Heerasagala Middle (C)						
Isolation Valve	321 HV 01	1	Manual Sluice	100	1.0	Pump House
Suction Valve	321 HV 11/21	2	Manual Sluice	80	1.0	Booster Pump
Check Valve	321 CV 11/21	2	Swing	80	1.0	Booster Pump
Delivery Valve	321 HV 12/22	2	Manual Sluice	80	1.0	Booster Pump
Isolation Valve	321 HV 31 to 33	3	Manual Sluice	80	1.0	Flow Meter
324-Ampitiya (D)						
Ampitiya (D-1) (To Elhena)						
Isolation Valve	324 HV 01	1	Manual Sluice	250	1.0	Pump House
Suction Valve	324 HV 11/21	2	Manual Sluice	80	1.0	Booster Pump
Check Valve	324 CV 11/21	2	Swing	80	1.0	Booster Pump

Facility/Equipment	Valve No.	Q'ty	Type	Diameter (mm)	Pressure (MPa)	Purpose
Delivery Valve	324 HV 12/22	2	Manual Sluice	100	1.0	Booster Pump
Isolation Valve	324 HV 13/14	2	Manual Sluice	100	1.0	Flow Meter
Ampitiya (D-2) (To Mullepitiya)						
Suction Valve	324 HV 31/41	2	Manual Sluice	80	1.0	Booster Pump
Check Valve	324 CV 31/41	2	Swing	80	2.0	Booster Pump
Delivery Valve	324 HV 32/42	2	Manual Sluice	80	2.0	Booster Pump
Isolation Valve	324 HV 33/34	2	Manual Sluice	100	2.0	Flow Meter
Ampitiya (D-3) (To Meekanuwa)						
Suction Valve	324 D3 HV 51/61	2	Manual Sluice	100	1.0	Booster Pump
Check Valve	324 D3 CV 51/61	2	Swing	150	2.0	Booster Pump
Delivery Valve	324 D3 HV 52/62	2	Manual Sluice	150	2.0	Booster Pump
Isolation Valve	324 D3 HV 53/54	2	Manual Sluice	100	2.0	Flow Meter

2. Valves for Service Reservoirs (Civil Work)

Service Reservoir	Quantity	Type	Diameter (mm)	Pressure (MP)	Purpose
301-Kurugoda S.R					
Ball Valve	2	Manual	100	0.1	Inlet
Butterfly Float Valve	2	Horizontal, Downward	125	0.1	Inlet
Butterfly Valve	2	Manual with Handle, Horizontal	350	0.1	Drain
Single Orifice Air Valve	2	Single Orifice	100	0.1	Inlet
Sluice Valve	2	Manual with Handle	150	0.1	Inlet
Sluice Valve	2	Manual with Handle	200	0.1	Outlet
Sluice Valve	2	Manual with Handle	200	0.1	Outlet
Toothed Vane Butterfly Valve	1	Manual with Handle, Horizontal	150	0.1	Inlet
302-Akurana S.R					
Float Valve	2	Horizontal, Downward	200	0.1	Inlet
Sluice Valve	2	Manual without Handle	200	0.1	Inlet
Toothed Vane Vale	1	Manual with Handle	200	0.1	Inlet
303-Thelambugahawatta S.R					
Butterfly Float Valve	1	Vertical, Upward	125	0.1	Inlet
Sluice Valve	3	Manual with Handle	200	0.1	Inlet
Sluice Valve	1	Manual with Handle	250	0.1	Outlet
Sluice Valve	1	Manual with Handle	250	0.1	Drain
Toothed Vane Butterfly Valve	1	Manual with Handle, Horizontal	150	0.1	Inlet
304-Kahawatta					
Butterfly Float Valve	1	Vertical, Upward	300	0.1	Inlet
Butterfly Valve	1	Manual with Handle	300	0.1	Pump Suction
Butterfly Valve	2	Manual with Handle, Horizontal	400	0.1	Inlet
Butterfly Valve	1	Manual with Handle, Horizontal	500	0.1	Drain
Sluice Valve	1	Manual with Handle	300	0.1	Inlet
Sluice Valve	1	Manual with Handle	300	0.1	Outlet
Toothed Vane Butterfly Valve	1	Manual with Handle, Horizontal	400	0.1	Inlet
305-Kahalla					
Butterfly Float Valve	1	Vertical, Upward	125	0.1	Inlet
Sluice Valve	1	Manual without Handle	150	0.1	Inlet
Sluice Valve	1	Manual without Handle	200	0.1	Inlet
Sluice Valve	1	Manual without Handle	200	0.1	Drain
Sluice Valve	1	Manual with Handle	200	0.1	Outlet

Service Reservoir	Quantity	Type	Diameter (mm)	Pressure (MP)	Purpose
Toothed Vane Butterfly Valve	1	Manual with Handle, Horizontal	200	0.1	Inlet
306-Balanagala					
Toothed Vane Butterfly Valve	1	Manual with Handle, Horizontal	150	0.1	Inlet
307-Bangalawatta					
Ball Valve	2	Manual	100	0.1	Inlet
Butterfly Float Valve	2	Horizontal, Downward	100	0.1	Inlet
Single Orifice Air Valve	2	Single Orifice	100	0.1	Inlet
Sluice Valve	4	Manual with Handle	150	0.1	Inlet
Sluice Valve	2	Manual without Handle	150	0.1	Inlet
Sluice Valve	2	Manual with Handle	200	0.1	Outlet
Sluice Valve	1	Manual without Handle	200	0.1	Outlet
Sluice Valve	2	Manual with Handle	250	0.1	Outlet
Sluice Valve	2	Manual with Handle	250	0.1	Drain
Toothed Vane Butterfly Valve	1	Manual with Handle, Horizontal	150	0.1	Inlet
308-Pihilladeniya					
Ball Valve	1	Manual	100	0.1	Inlet
Butterfly Float Valve	1	Horizontal, Downward	80	0.1	Inlet
Single Orifice Air Valve	1	Single Orifice	100	0.1	Inlet
Sluice Valve	2	Manual with Handle	100	0.1	Inlet
Sluice Valve	1	Manual without Handle	150	0.1	Inlet
Sluice Valve	2	Manual with Handle	200	0.1	Inlet
Sluice Valve	1	Manual with Handle	200	0.1	Outlet
Sluice Valve	1	Manual with Handle	200	0.1	Drain
309-Kurugammana					
Ball Valve	1	Manual	150	0.1	Inlet
Butterfly Float Valve	1	Horizontal, Downward	100	0.1	Inlet
Single Orifice Air Valve	1	Single Orifice	150	0.1	Inlet
Sluice Valve	1	Manual with Handle	150	0.1	Inlet
Sluice Valve	1	Manual with Handle	150	0.1	Drain
Sluice Valve	1	Manual without Handle	200	0.1	Inlet
Sluice Valve	1	Manual with Handle	250	0.1	Outlet
310-Kondadeniya					
Ball Valve	1	Manual	100	0.1	Inlet
Butterfly Float Valve	1	Horizontal, Downward	125	0.1	Inlet
Single Orifice Air Valve	1	Single Orifice	100	0.1	Inlet
Sluice Valve	1	Manual with Handle	200	0.1	Inlet
Sluice Valve	2	Manual without Handle	200	0.1	Inlet
Sluice Valve	1	Manual with Handle	200	0.1	Outlet
Sluice Valve	1	Manual with Handle	200	0.1	Drain
Toothed Vane Butterfly Valve	1	Manual with Handle, Horizontal	200	0.1	Inlet
311-Gohagoda (Wegiriya)					
Toothed Vane Butterfly Valve	1	Manual with Handle, Horizontal	150	0.1	Inlet
312-Gohagoda (Pallemulla)					
Ball Valve	1	Manual	150	0.1	Inlet
Butterfly Float Valve	1	Horizontal, Downward	80	0.1	Inlet
Single Orifice Air Valve	1	Single Orifice	150	0.1	Inlet
Sluice Valve	2	Manual with Handle	150	0.1	Inlet
Sluice Valve	2	Manual without Handle	150	0.1	Inlet
Sluice Valve	1	Manual with Handle	150	0.1	Outlet
Sluice Valve	1	Manual with Handle	150	0.1	Drain
Toothed Vane Butterfly Valve	1	Manual with Handle, Horizontal	150	0.1	Inlet
313-Gohagoda (Pallemulla)					
Ball Valve	1	Manual	150	0.1	Inlet
Butterfly Float Valve	1	Horizontal, Downward	80	0.1	Inlet
Single Orifice Air Valve	1	Single Orifice	150	0.1	Inlet

Service Reservoir	Quantity	Type	Diameter (mm)	Pressure (MP)	Purpose
Sluice Valve	2	Manual with Handle	150	0.1	Inlet
Sluice Valve	2	Manual without Handle	150	0.1	Inlet
Sluice Valve	1	Manual with Handle	150	0.1	Outlet
Sluice Valve	1	Manual with Handle	150	0.1	Drain
Toothed Vane Butterfly Valve	1	Manual with Handle, Horizontal	150	0.1	Inlet
314-Asgiriya					
Butterfly Float Valve	2	Vertical, Upward	350	0.1	Inlet
Butterfly Valve	2	Manual with Handle, Horizontal	450	0.1	Outlet
Butterfly Valve	2	Manual with Handle, Horizontal	500	0.1	Inlet
Butterfly Valve	2	Manual with Handle, Horizontal	500	0.1	Drain
Butterfly Valve	2	Manual with Handle, Horizontal	600	0.1	Outlet
Toothed Vane Butterfly Valve	1	Manual with Handle, Horizontal	500	0.1	Inlet
316-Bahilawakanda					
Butterfly Float Valve	1	Vertical, Upward	125	0.1	Inlet
Sluice Valve	2	Manual with Handle	150	0.1	Inlet
Sluice Valve	1	Manual with Handle	150	0.1	Outlet
Sluice Valve	2	Manual with Handle	250	0.1	Inlet
Sluice Valve	2	Manual with Handle	250	0.1	Outlet
Sluice Valve	1	Manual with Handle	250	0.1	Drain
317-Uplands					
Butterfly Float Valve	2	Vertical, Upward	200	0.1	Inlet
Butterfly Valve	2	Manual with Handle, Horizontal	400	0.1	Inlet
Butterfly Valve	2	Manual with Handle, Horizontal	400	0.1	Drain
Butterfly Valve	2	Manual with Handle, Horizontal	500	0.1	Outlet
Toothed Vane Butterfly Valve	1	Manual with Handle, Horizontal	300	0.1	Inlet
319-Dangolla					
Ball Valve	2	Manual	100	0.1	Inlet
Butterfly Float Valve	2	Horizontal, Downward	125	0.1	Inlet
Single Orifice Air Valve	2	Single Orifice	100	0.1	Inlet
Sluice Valve	2	Manual with Handle	200	0.1	Inlet
Sluice Valve	2	Manual with Handle	200	0.1	Drain
Sluice Valve	2	Manual with Handle	250	0.1	Outlet
320-Heerassagala Low					
Ball Valve	1	Manual	100	0.1	Inlet
Butterfly Float Valve	1	Horizontal, Downward	150	0.1	Inlet
Butterfly Valve	1	Manual with Handle, Horizontal	350	0.1	Inlet
Butterfly Valve	1	Manual with Handle, Horizontal	350	0.1	Drain
Single Orifice Air Valve	1	Single Orifice	100	0.1	Inlet
Sluice Valve	1	Manual with Handle	200	0.1	Inlet
Sluice Valve	1	Manual with Handle	200	0.1	Outlet
321-Heerassagala Middle					
Butterfly Float Valve	2	Horizontal, Upward	125	0.1	Inlet
Sluice Valve	1	Manual with Handle	150	0.1	Pump Suction
Sluice Valve	2	Manual with Handle	200	0.1	Inlet
Sluice Valve	1	Manual with Handle	200	0.1	Outlet
Sluice Valve	2	Manual without Handle	200	0.1	Drain
Sluice Valve	2	Manual without Handle	250	0.1	Outlet
322-Heerassagala Upper					
Ball Valve	1	Manual	150	0.1	Inlet
Butterfly Float Valve	1	Horizontal, Downward	80	0.1	Inlet
Single Orifice Air Valve	1	Single Orifice	150	0.1	Inlet
Sluice Valve	2	Manual with Handle	150	0.1	Inlet
Sluice Valve	1	Manual with Handle	150	0.1	Drain
Sluice Valve	1	Manual with Handle	200	0.1	Outlet
323-Hantana Place					

Service Reservoir	Quantity	Type	Diameter (mm)	Pressure (MP)	Purpose
Ball Valve	1	Manual	100	0.1	Inlet
Butterfly Float Valve	1	Horizontal, Downward	100	0.1	Inlet
Single Air Valve	1	Single Orifice	100	0.1	Inlet
Single Air Valve with Cock	1	Manual, Single Orifice	100	0.1	Inlet
Sluice Valve	1	Manual with Handle	125	0.1	Inlet
Sluice Valve	3	Manual with Handle	200	0.1	Inlet
Sluice Valve	1	Manual with Handle	200	0.1	Outlet
Sluice Valve	1	Manual with Handle	200	0.1	Drain
Sluice Valve	1	Manual with Handle	200	0.1	Pump Suction
324-Ampitiya					
Butterfly Float Valve	1	Horizontal, Upward	300	0.1	Inlet
326-Mullepihilla Low New					
Ball Valve	1	Manual	150	0.1	Inlet
Butterfly Float Valve	1	Horizontal, Downward	80	0.1	Inlet
Single Orifice Air Valve	1	Single Orifice	150	0.1	Inlet
Sluice Valve	3	Manual without Handle	150	0.1	Inlet
Sluice Valve	1	Manual without Handle	150	0.1	Outlet
Sluice Valve	1	Manual without Handle	150	0.1	Drain
327-Elhena					
Ball Valve	2	Manual	100	0.1	Inlet
Butterfly Float Valve	2	Horizontal, Downward	80	0.1	Inlet
Single Orifice Air Valve	2	Single Orifice	100	0.1	Inlet
Sluice Valve	1	Manual without Handle	100	0.1	Inlet
Sluice Valve	2	Manual without Handle	200	0.1	Inlet
Sluice Valve	2	Manual without Handle	200	0.1	Drain
Sluice Valve	2	Manual without Handle	250	0.1	Outlet

Remarks: Valves for raw water transmission pipeline, yard piping in the water treatment plant, transmission pipelines and distribution pipelines are indicated in Drawings.

TS 10 Mechanical Type Flowmeters (Water meter)

1. Flowmeters for Booster Pump Station – Mechanical Work

Facility/Equipment	Quantity	Type	Diameter (mm)	Pressure (MPa)	Purpose
304-Kahawatta (E)					
Flow Meter	1	Real Time & Cumulate	250	2.0	Pump discharge
310-Kondadeniya (H)					
Flow Meter	1	Real Time & Cumulate	100	1.0	Pump discharge
315-Asgiriya P/S (G)					
Flow Meter	1	Real Time & Cumulate	150	2.0	Pump discharge
318-R2 (F)					
Flow Meter	1	Real Time & Cumulate	100	2.0	Pump discharge
320-Heerassagala Low (B)					
Flow Meter	1	Real Time & Cumulate	150	1.0	Pump discharge
321-Heerassagala Middle (C)					
Flow Meter	1	Real Time & Cumulate	80	1.0	Pump discharge
324-Ampitiya (D)					
Flow Meter (D-1)	1	Real Time & Cumulate	100	1.0	Pump discharge
Flow Meter (D-2)	1	Real Time & Cumulate	100	2.0	Pump discharge
Flow Meter (D-3)	1	Real Time & Cumulate	150	2.0	Pump discharge

2. Flowmeters for Service Reservoirs – Civil Work

Facility/Equipment	Quantity	Type	Diameter (mm)	Pressure (MPa)	Purpose
301-Kurugoda S.R					
Flow Meter	1	Real Time & Cumulate	150	1.0	Inlet
Flow Meter	1	Real Time & Cumulate	200	1.0	Outlet
302-Akurana S.R					
Flow Meter	1	Real Time & Cumulate	150	1.0	Inlet
303-Thelambugahawatta S.R					
Flow Meter	1	Real Time & Cumulate	150	1.0	Inlet
Flow Meter	1	Real Time & Cumulate	200	1.0	Outlet
304-Kahawatta					
Flow Meter	1	Real Time & Cumulate	400	1.0	Inlet
Flow Meter	1	Real Time & Cumulate	200	1.0	Outlet
305-Kahalla					
Flow Meter	1	Real Time & Cumulate	150	1.0	Inlet
Flow Meter	1	Real Time & Cumulate	200	1.0	Outlet
306-Balanagala					
Flow Meter	1	Real Time & Cumulate	125	1.0	Outlet
307-Bangalawatta					
Flow Meter	1	Real Time & Cumulate	125	1.0	Inlet
Flow Meter	1	Real Time & Cumulate	200	1.0	Outlet
308-Pihilladeniya					
Flow Meter	2	Real Time & Cumulate	100	1.0	Inlet
Flow Meter	1	Real Time & Cumulate	125	1.0	Outlet
309-Kurugammana					
Flow Meter	1	Real Time & Cumulate	150	1.0	Outlet
310-Kondadeniya					
Flow Meter	2	Real Time & Cumulate	200	1.0	Inlet
Flow Meter	1	Real Time & Cumulate	200	1.0	Outlet
311-Gohagoda (Wegiriya)					
Flow Meter	1	Real Time & Cumulate	100	1.0	Inlet
312-Gohagoda (Pallemulla)					
Flow Meter	1	Real Time & Cumulate	65	1.0	Inlet
Flow Meter	1	Real Time & Cumulate	80	1.0	Inlet
Flow Meter	1	Real Time & Cumulate	125	1.0	Outlet
313-Gohagoda (Pallemulla)					
Flow Meter	1	Real Time & Cumulate	65	1.0	Inlet
Flow Meter	1	Real Time & Cumulate	80	1.0	Inlet
Flow Meter	1	Real Time & Cumulate	125	1.0	Outlet
314-Asgiriya					
Flow Meter	1	Real Time & Cumulate (for Large Flow)	450	1.0	Outlet
Flow Meter	1	Real Time & Cumulate	500	1.0	Inlet
316-Bahilawakanda					
Flow Meter	1	Real Time & Cumulate	150	1.0	Inlet
Flow Meter	1	Real Time & Cumulate	150	1.0	Outlet
317-Uplands					
Flow Meter	1	Real Time & Cumulate	300	1.0	Inlet
Flow Meter	1	Real Time & Cumulate	350	1.0	Outlet
319-Dangolla					
Flow Meter	1	Real Time & Cumulate	200	1.0	Outlet
320-Heerassagala Low					
Flow Meter	1	Real Time & Cumulate	200	1.0	Outlet
321-Heerassagala Middle					
Flow Meter	1	Real Time & Cumulate	200	1.0	Outlet
322-Heerassagala Upper					

Facility/Equipment	Quantity	Type	Diameter (mm)	Pressure (MPa)	Purpose
Flow Meter	1	Real Time & Cumulate	100	1.0	Outlet
323-Hantana Place					
Flow Meter	1	Real Time & Cumulate	125	1.0	Inlet
Flow Meter	1	Real Time & Cumulate	125	1.0	Outlet
326-Mullepihilla Low New					
Flow Meter	1	Real Time & Cumulate	100	1.0	Inlet
Flow Meter	1	Real Time & Cumulate	125	1.0	Outlet
327-Elhena					
Flow Meter	1	Real Time & Cumulate	100	1.0	Inlet
Flow Meter	1	Real Time & Cumulate	125	1.0	Outlet

TS 11 Induction Motors (list excludes motorised valves and gates)

Tag Numbers	01 FS 11, 01 FS 21	01 RP 11, 01 RP 21	01 MH 01
Equipment	fine screens	pumps	hoists
Type	totally enclosed, fan-cooled, squirrel cage	vertical, drip-proof, squirrel cage	drip-proof, fan-cooled, squirrel cage
Min. rated output kW	2.2	280	0.75 + 0.4
Poles	4-P	8-P	4-P
Supply	400 V	400 V	400 V
Enclosure	IP 55	IP 55	IP 55
Insulation	F	F	F
Rating	continuous	continuous	continuous
Starting	direct on line	VVVF	direct on line

Tag Numbers	01 DP 01,01 DP 02	01 SW 01, 01 SW 02	06 SC 11, 06 SC 12, 06 SC 21, 06 SC 22
Equipment	sump drainage pumps	screen wash pump	scrapers
Type	submersible	submersible	totally enclosed, fan-cooled, squirrel cage
Min. rated output kW	1.5	11	0.75
Poles	2-P	2-P	4-P
Supply	400 V	400 V	400 V
Enclosure	IP 68	IP 68	IP 55
Insulation	Y	Y	F
Rating	continuous	continuous	Continuous
Starting	direct on line	star-delta	VVVF

Tag Numbers	06 SP 01	07 BP 11, 07 BP 21, 07 BP 31,	07 AB 11, 07 AB 21, 07 AB 31,
Equipment	sampling pump	backwash pumps	air blowers
Type	totally enclosed, fan-cooled, squirrel cage	totally enclosed, fan-cooled, squirrel cage	drip-proof, fan-cooled, squirrel cage
Min. rated output kW	0.4	18.5	55
Poles	2-P	4-P	2-P
Supply	400 V	400 V	400 V
Enclosure	IP 55	IP 55	IP 55
Insulation	F	F	F
Rating	Continuous	Continuous	Continuous
Starting	direct on line	Star delta	Auto-transformer

Tag Numbers	07 DP 01, 07 DP 02	07 MM 11	07 LP 11, 10 LP 21
Equipment	sump drainage pumps	lime mixers	lime feed pump
Type	submersible	totally enclosed, fan-cooled, squirrel cage	totally enclosed, fan-cooled, squirrel cage
Min. rated output kW	1.5	0.4	0.4
Poles	2-P	4-P	4-P
Supply	400 V	400 V	400 V
Enclosure	IP 68	IP 55	IP 55
Insulation	Y	F	F
Rating	continuous	continuous	continuous
Starting	direct on line	direct on line	VVVF

Tag Numbers	09 CP 11, 09 CP 12	09 CP 21, 09 CP 22	09 CP 31, 09 CP 32
Equipment	clear water pumps	clear water pumps	clear water pumps
Type	horizontal, drip-proof, fan-cooled, squirrel cage	horizontal, drip-proof, fan-cooled, squirrel cage	horizontal, drip-proof, fan-cooled, squirrel cage
Min. rated output kW	450	90	250
Poles	4-P	4-P	4-P
Supply	400 V	400 V	400 V
Enclosure	IP 55	IP 55	IP 55
Insulation	F	F	F
Rating	continuous	continuous	continuous
Starting	soft starting	soft starting	soft starting

Tag Numbers	09 PP 11, 09 PP 21	09 PU 01	09 DP 01, 09 DP 02
Equipment	chlorination booster pump	plant water pumps	sump drainage pumps
Type	totally enclosed, fan-cooled, squirrel cage	totally enclosed, fan-cooled, squirrel cage	submersible
Min. rated output kW	5.5	7.5 x 2	1.5
Poles	2-P	4-P	2-P
Supply	400 V	400 V	400 V
Enclosure	IP 55	IP 55	IP 68
Insulation	F	F	Y
Rating	continuous	continuous	continuous
Starting	direct on line	direct on line	direct on line

Tag Numbers	10 MM 11, 10 MM 12	10 MM 21, 10 MM 22	10 AP 11, 10 AP 21
Equipment	alum mixers	lime mixers	alum pump
Type	totally enclosed, fan-cooled, squirrel cage	totally enclosed, fan-cooled, squirrel cage	totally enclosed, fan-cooled, squirrel cage
Min. rated output kW	1.5	2.2	0.4
Poles	4-P	4-P	4-P
Supply	400 V	400 V	400 V
Enclosure	IP 55	IP 55	IP 55
Insulation	F	F	F
Rating	continuous	continuous	continuous
Starting	direct on line	direct on line	VVVF

Tag Numbers	10 LP 11, 10 LP 21	10 LP 31, 10 LP 41	10 MC 01
Equipment	lime pump	lime feed pump	chemical crane
Type	totally enclosed, fan-cooled, squirrel cage	totally enclosed, fan-cooled, squirrel cage	drip-proof, fan-cooled, squirrel cage
Min. rated output kW	5.5	2.2	0.75 + 0.4
Poles	4-P	4-P	4-P
Supply	400 V	400 V	400 V
Enclosure	IP 55	IP 55	IP 55
Insulation	F	F	F
Rating	continuous	continuous	continuous
Starting	direct on line	VVVF	direct on line

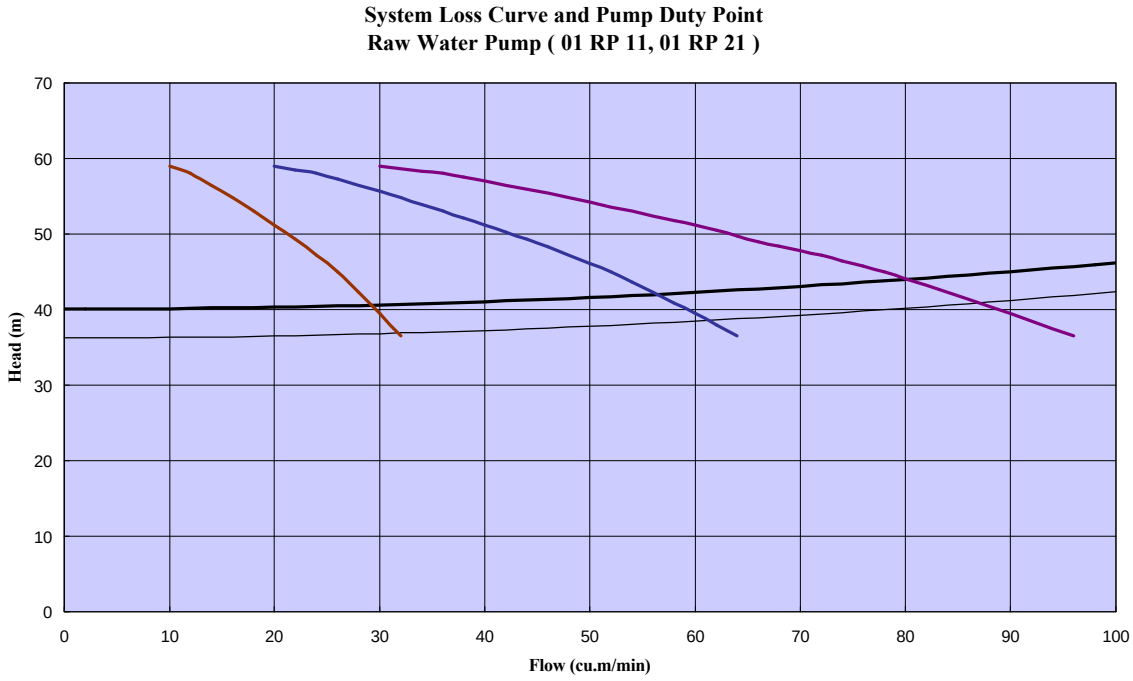
Tag Numbers	10 MC 02	10 EF 01	11 WP 11, 11 WP 21
Equipment	chlorine crane	lime dust extract fans	backwash recovery pump
Type	drip-proof, fan-cooled, squirrel cage	drip-proof, fan-cooled, squirrel cage	totally enclosed, fan-cooled, squirrel cage
Min. rated output kW	0.75 + 0.4	0.75	30
Poles	4-P	4-P	4-P
Supply	400 V	400 V	400 V
Enclosure	IP 55	IP 55	IP 55
Insulation	F	F	Y
Rating	continuous	continuous	continuous
Starting	direct on line	direct on line	star delta

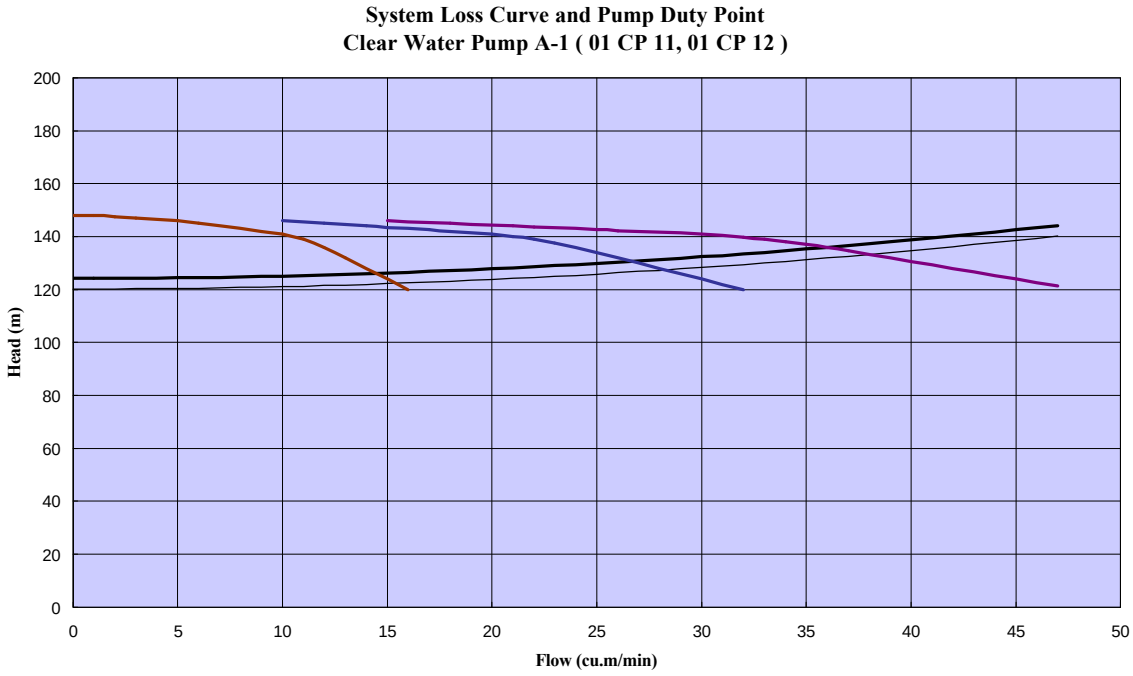
Tag Numbers	304 BP 11, 304 BP 21	310 BP 11, 310 BP 21	315 BP 11, 315 BP 21
Equipment	Booster Pump	Booster Pump	Booster Pump
Type	totally enclosed, fan-cooled, squirrel cage	totally enclosed, fan-cooled, squirrel cage	totally enclosed, fan-cooled, squirrel cage
Min. rated output kW	55	30	30
Poles	2-P	2-P	2-P
Supply	400 V	400 V	400 V
Enclosure	IP 55	IP 55	IP 55
Insulation	F	F	Y
Rating	continuous	continuous	continuous
Starting	soft starter	star delta	star delta

Tag Numbers	318 BP 11, 318 BP 21	320 BP 11, 320 BP 21	321 BP 11, 321 BP 21
Equipment	Booster Pump	Booster Pump	Booster Pump
Type	totally enclosed, fan-cooled, squirrel cage	totally enclosed, fan-cooled, squirrel cage	totally enclosed, fan-cooled, squirrel cage
Min. rated output kW	55	37	18.5
Poles	2-P	2-P	2-P
Supply	400 V	400 V	400 V
Enclosure	IP 55	IP 55	IP 55
Insulation	F	F	Y
Rating	continuous	continuous	continuous
Starting	soft starter	star delta	star delta

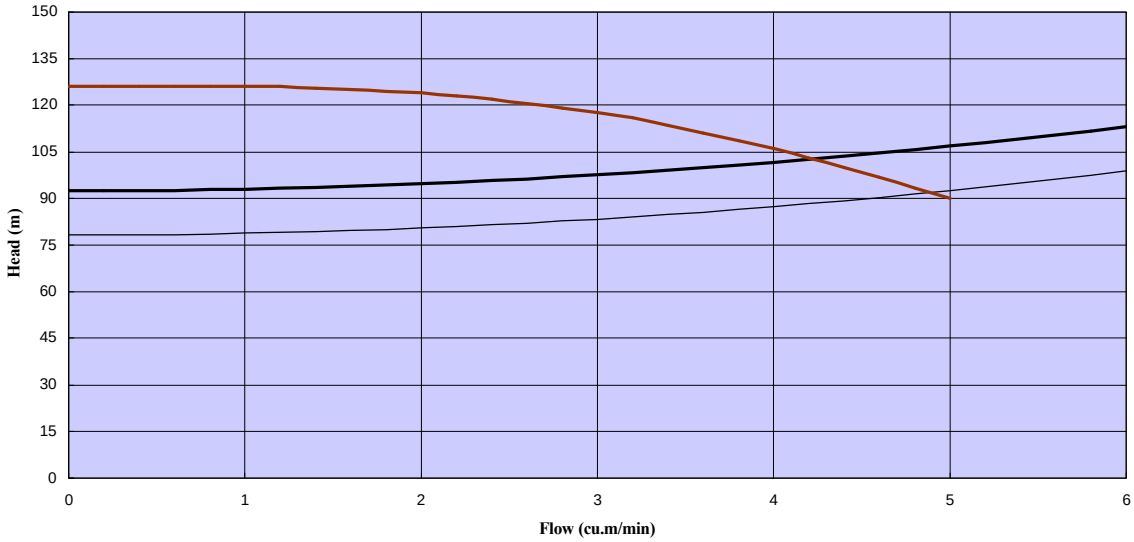
Tag Numbers	324 BP 11, 324 BP 21	324 BP 31, 324 BP 41	324 BP 51, 324 BP 61
Equipment	Booster Pump	Booster Pump	Booster Pump
Type	totally enclosed, fan-cooled, squirrel cage	totally enclosed, fan-cooled, squirrel cage	totally enclosed, fan-cooled, squirrel cage
Min. rated output kW	11	37	37
Poles	2-P	2-P	2-P
Supply	400 V	400 V	400 V
Enclosure	IP 55	IP 55	IP 55
Insulation	F	F	Y
Rating	continuous	continuous	continuous
Starting	star delta	star delta	star delta

TS 12 System Loss Curve and Pump Duty Point

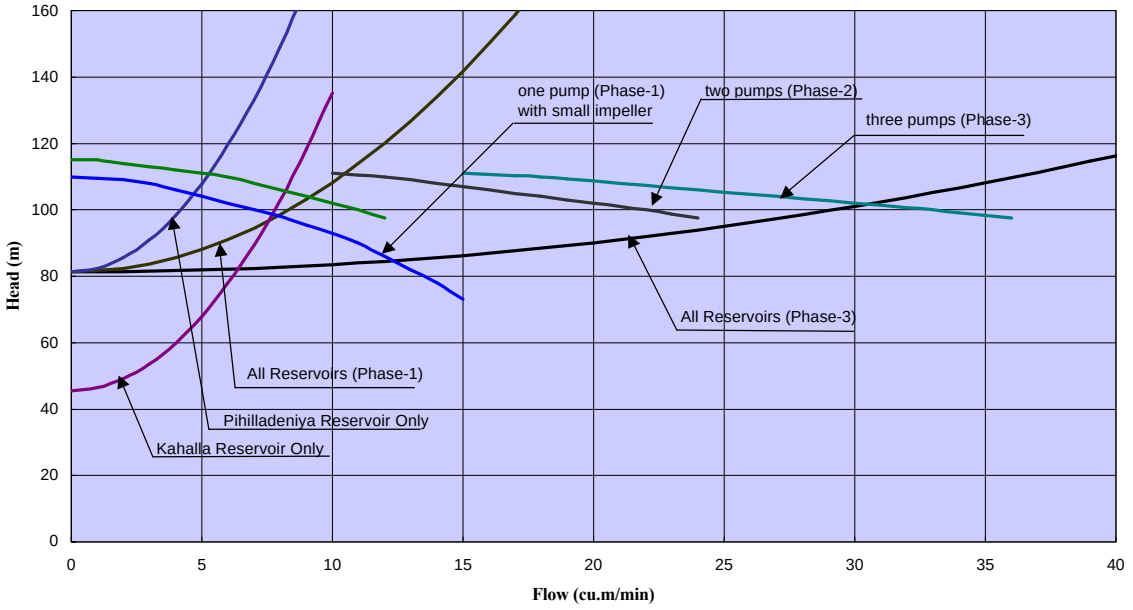




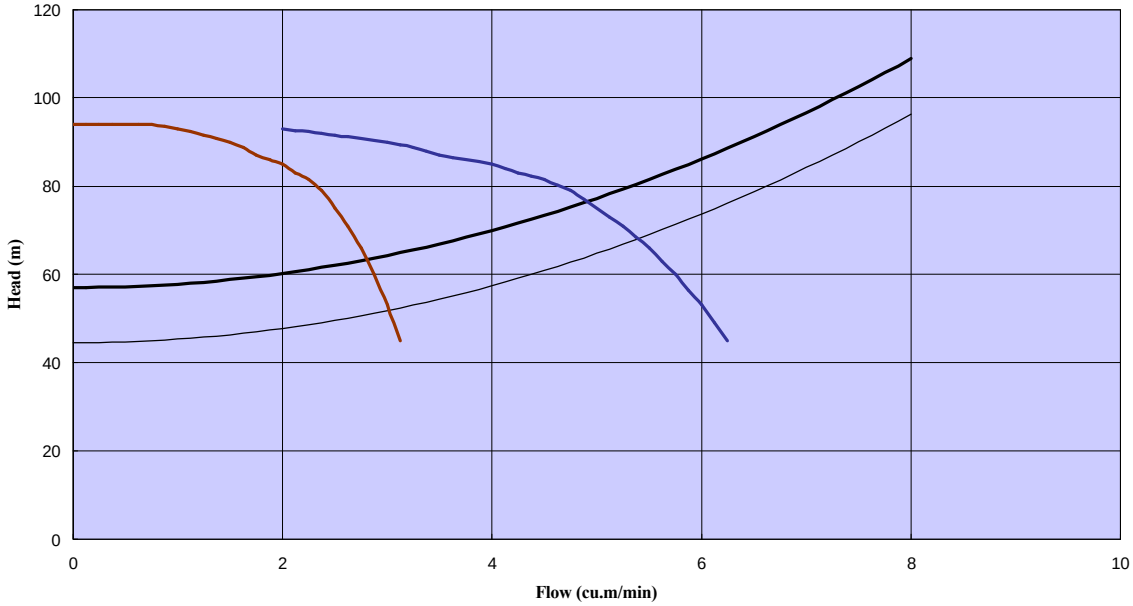
System Loss Curve and Pump Duty Point
Clear Water Pump A-2 (01 CP 21, 01 CP 22)



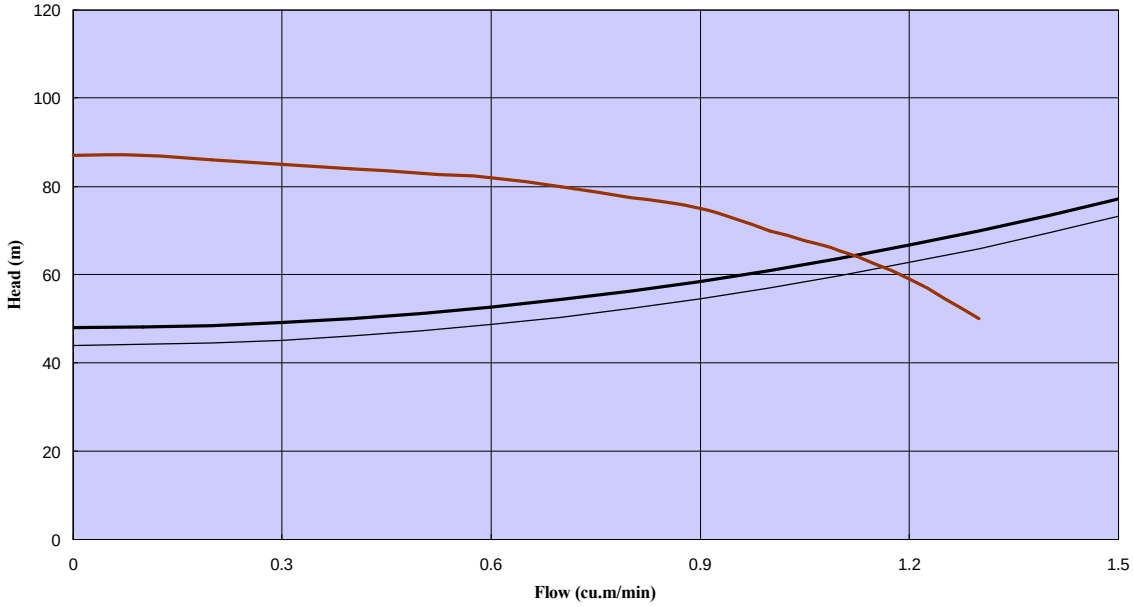
System Loss Curve and Pump Duty Point
Clear Water Pump A-3 (01 CP 31, 01 CP 32)



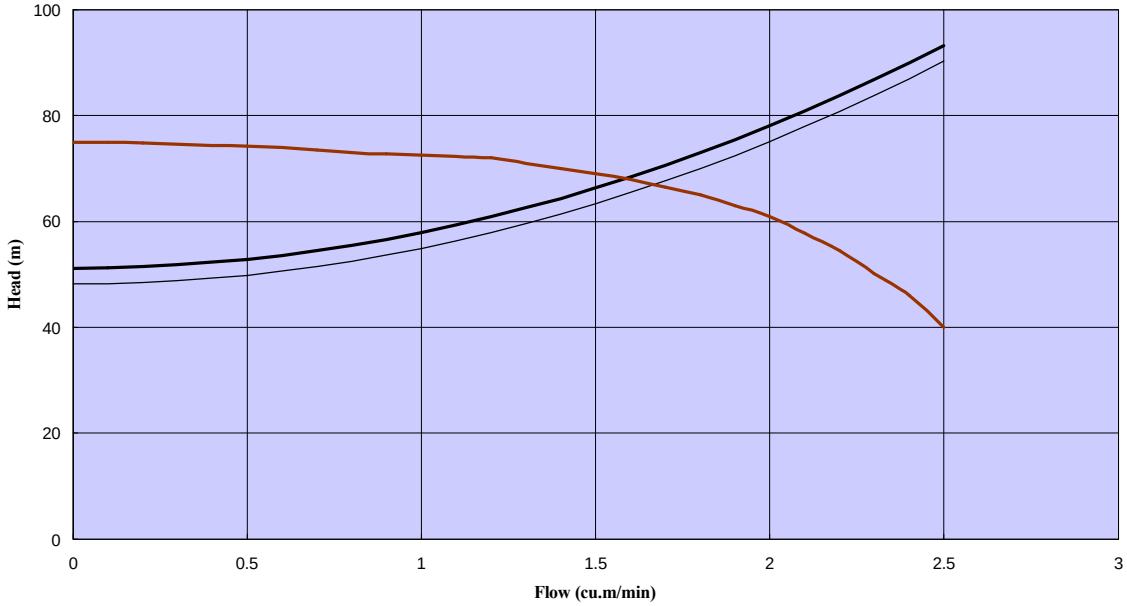
System Loss Curve and Pump Duty Point
Booster Pump E (304 RP 11, 304 RP 21)



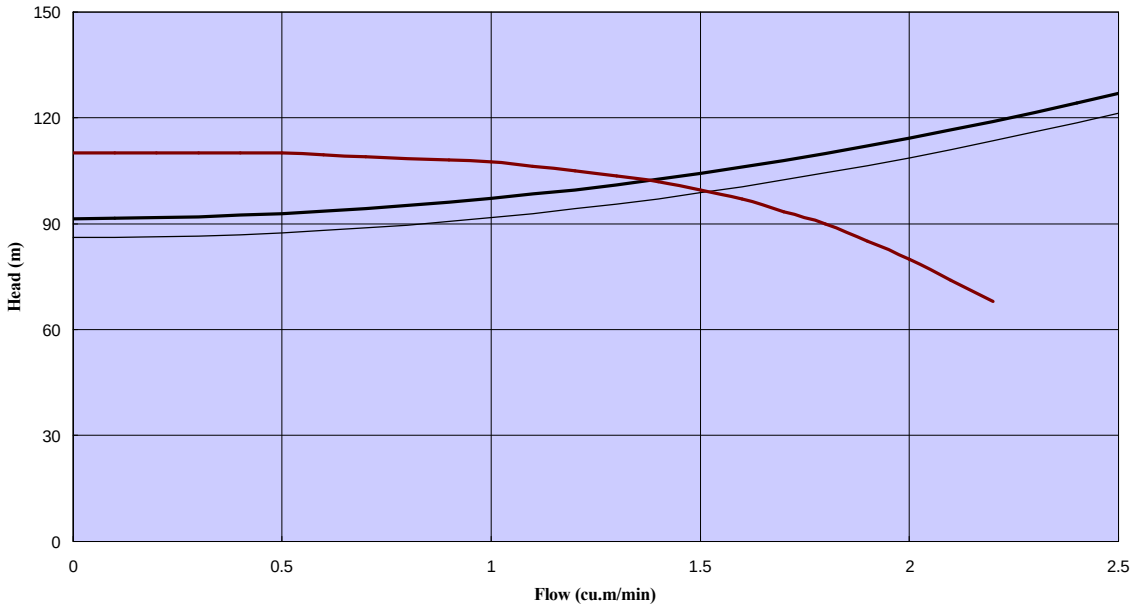
System Loss Curve and Pump Duty Point
Booster Pump H (310 BP 11, 310 BP 21)



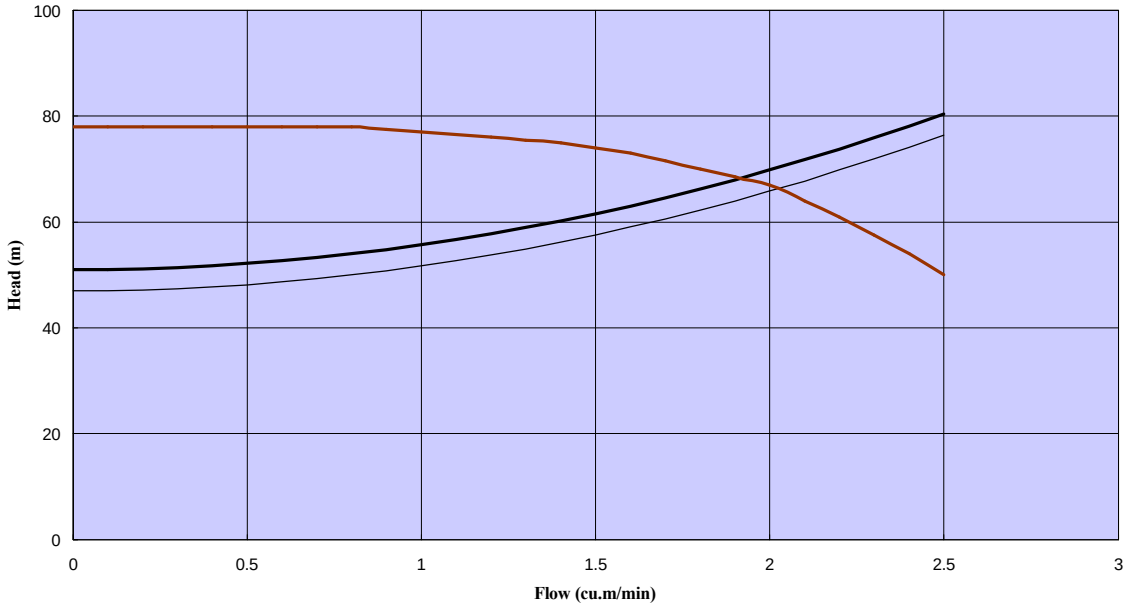
System Loss Curve and Pump Duty Point
Booster Pump G (315 BP 11, 315 BP 21)



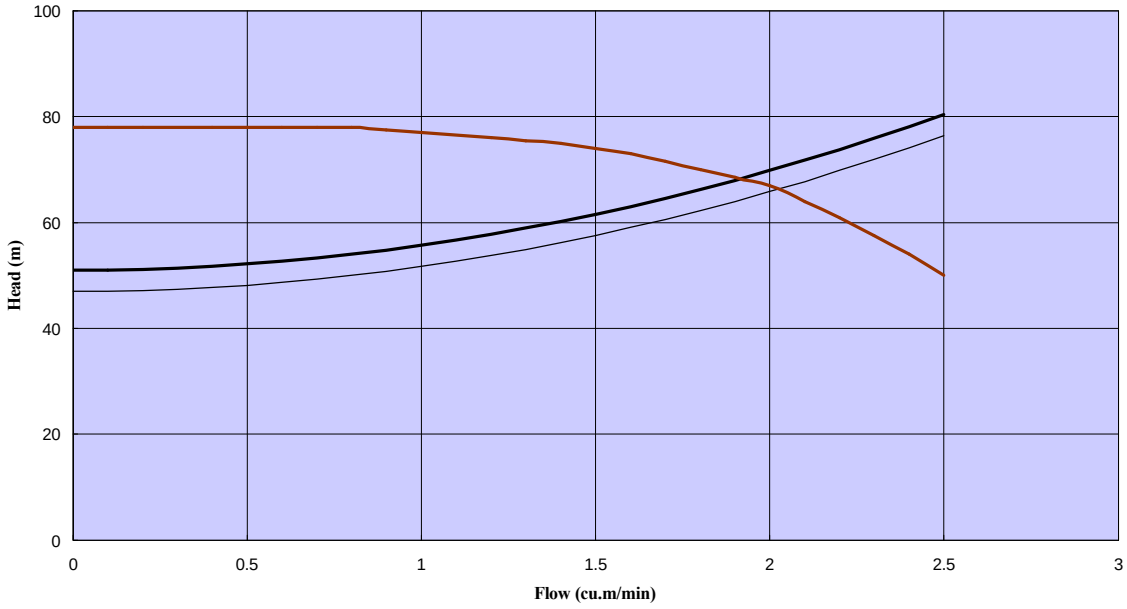
System Loss Curve and Pump Duty Point
Booster Pump F (318 BP 11, 318 BP 21)



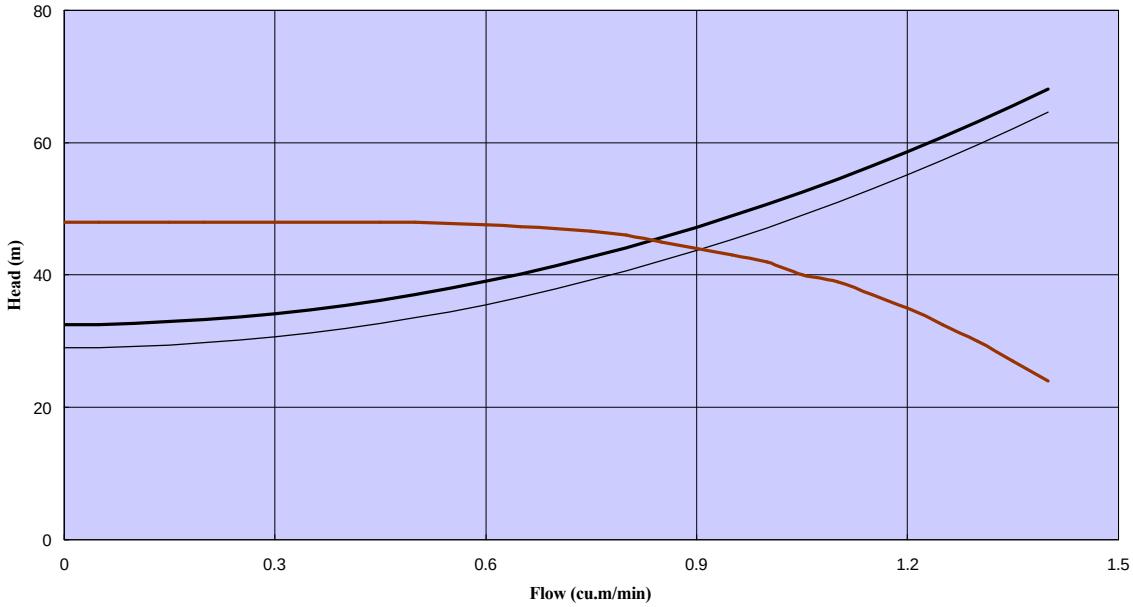
System Loss Curve and Pump Duty Point
Booster Pump B (320 BP 11, 320 BP 21)



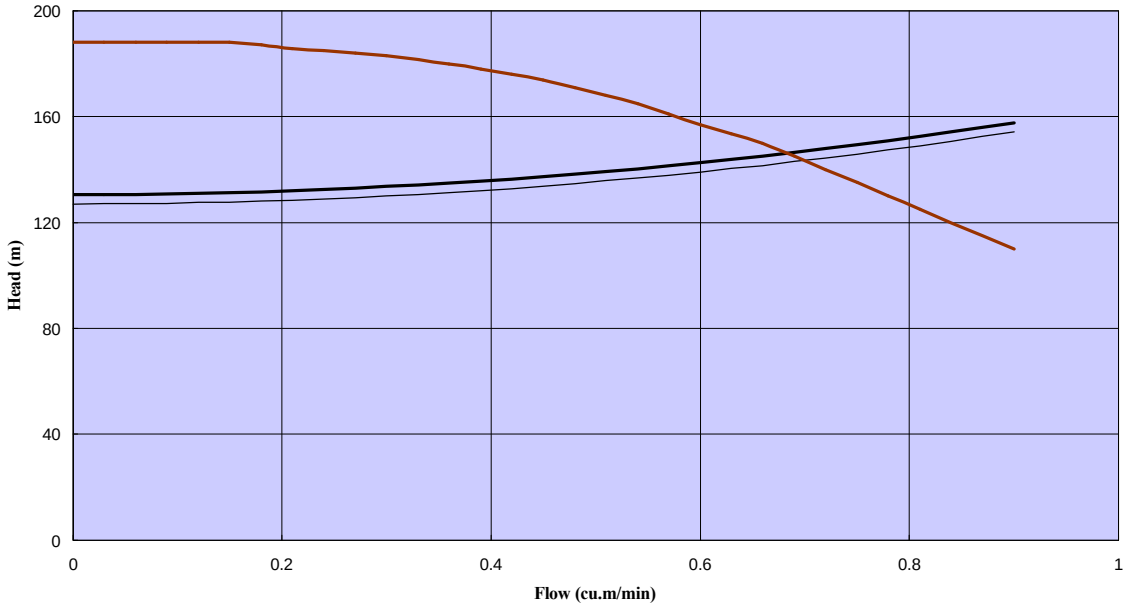
System Loss Curve and Pump Duty Point
Booster Pump C (321 BP 11, 321 BP 21)



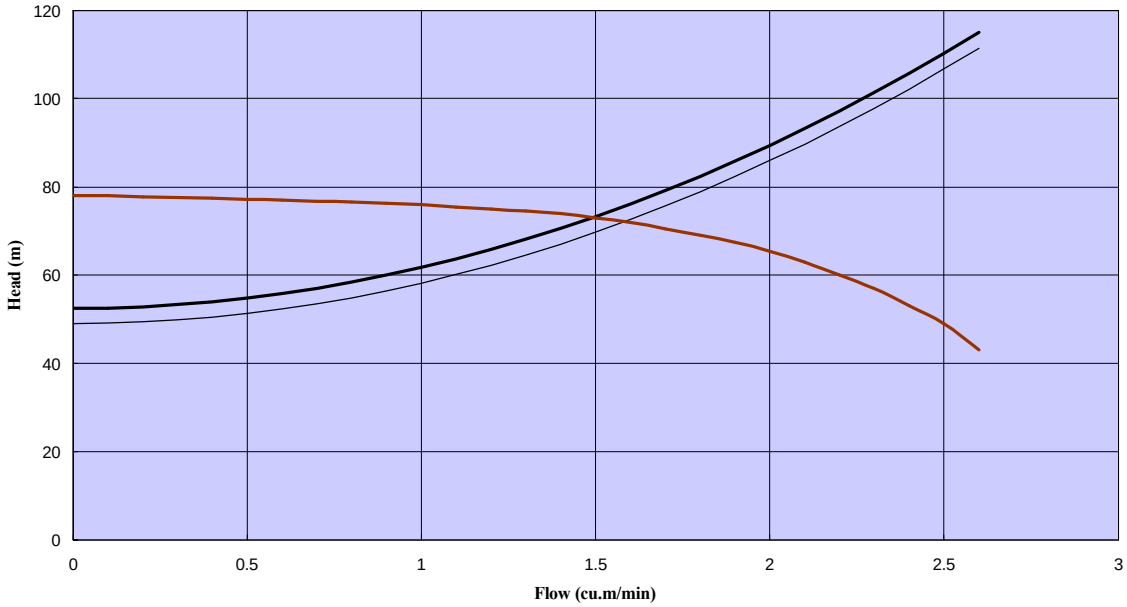
System Loss Curve and Pump Duty Point
Booster Pump D-1 (324 BP 11, 324 BP 21)



System Loss Curve and Pump Duty Point
Booster Pump D-2 (324 BP 31, 324 BP 41)

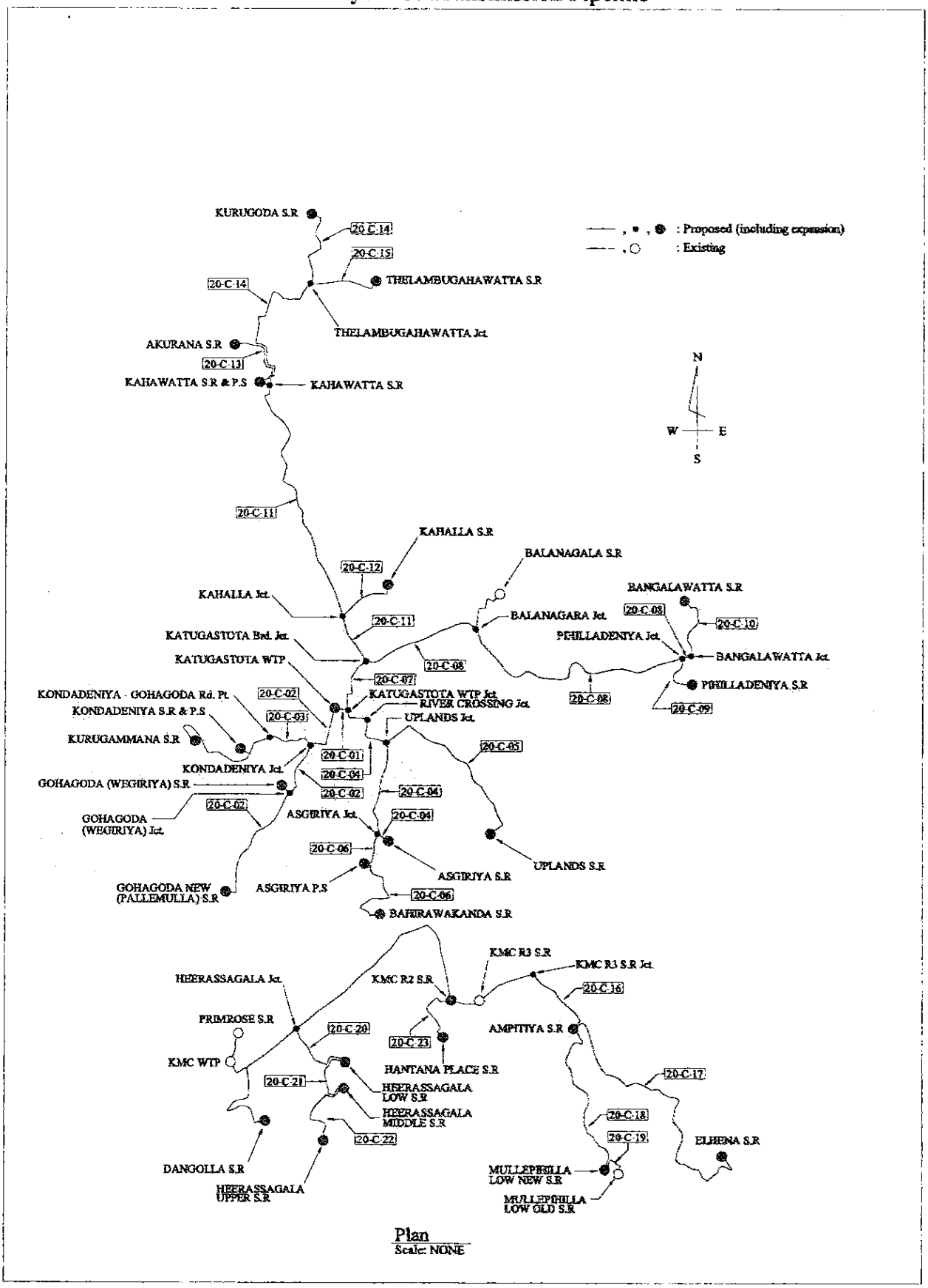


System Loss Curve and Pump Duty Point
Booster Pump D-3 (324 BP 51, 324 BP 61)



TS 13 Transmission Pipeline Profile Diagrams

Layout of Transmission Pipeline



List of Transmission Pipeline

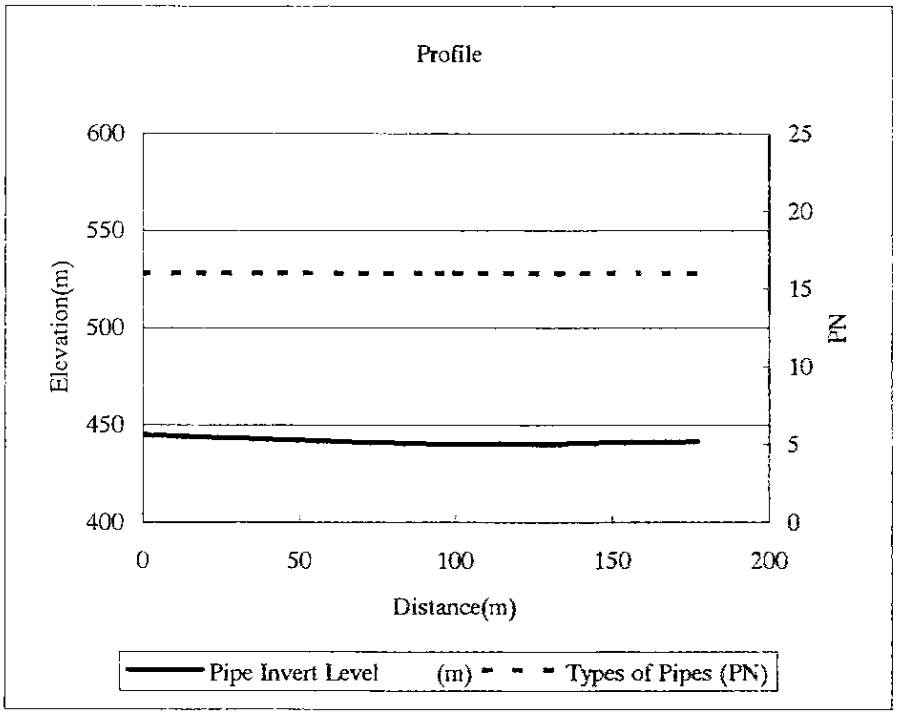
Drawing Number	From		To		Pipe Diameter	Material DI/PVC	Pipeline Length	25Bar		16Bar		10Bar	
	Name of the point	Elevation (m)	Name of the point	Elevation (m)	(mm)		(m)	Length (m)	Elevation (m)	Length (m)	Elevation (m)	Length (m)	Elevation (m)
20-C-01	Katugastota WTP	+441.34	WTP Jct.	+443.09	600	DI	177.30			0.00 - 177.30	+441.34 - +443.09		
20-C-02	Katugastota WTP	+442.97	Kondadeniya Jct.	+468.41	350	DI	487.00			0.00 - 487.00	+442.97 - +468.41		
	Kondadeniya Jct.	+468.41	Gohagoda (Wegiliya Jct.)	+490.31	250		793.00			487.00 - 1,280.00	+468.41 - +490.31		
	Gohagoda (Wegiliya Jct.)	+490.31	Gohagoda New (Pallemtilla) S.R	+504.91	200		1,305.00			1,280.00 - 2,685.00	+490.31 - +504.91		
							380.80					2,685.00 - 3,065.80	+504.91 - +504.91
20-C-03	Kondadeniya Jct.	+468.41	Kondadeniya - Gohagoda Rd. Pt.	+505.18	300	DI	890.00			0.00 - 890.00	+468.41 - +505.18		
20-C-04	Katugastota WTP	+441.34	River Crossing Jct.	+442.77	800	DI	415.00	0.00 - 415.00	+441.34 - +442.77				
	River Crossing Jct.	+442.77	Uplands Jct.	+453.65			564.75	415.00 - 979.75	+442.77 - +453.65				
	Uplands Jct.	+453.65	Asgiriya Jct.	+564.48	700		309.14	979.75 - 1,288.89	+453.65 - +470.34				
							858.23			1,288.89 - 2,147.12	+470.34 - +521.60		
							117.88					2,147.12 - 2,265.00	+521.60 - +526.49
	Asgiriya Jct.	+526.49	Asgiriya S.R	+564.48	500		203.55					2,265.00 - 2,468.55	+526.49 - +564.48
20-C-05	Uplands Jct.	+453.65	Uplands S.R	+560.78	400	DI	655.00	0.00 - 655.00	+453.65 - +496.36				
							987.36			655.00 - 1,642.36	+496.36 - +520.10		
							377.50					1,642.36 - 2,019.86	+520.10 - +560.78
20-C-06	Asgiriya Jct.	+527.40	Asgiriya P.S	+528.42	500	DI	491.00					0.00 - 491.00	+527.40 - +528.42
	Asgiriya P.S	+528.42	Bahirawakanda S.R	+606.00	250		952.15			491.00 - 1,443.15	+528.42 - +570.15		
							848.56					1,443.15 - 2,291.71	+570.15 - +606.00
20-C-07	Katugastota WTP Jct.	+443.09	Katugastota Brd. Jct.	+444.02	600	DI	421.53			0.00 - 421.53	+443.09 - +444.02		
20-C-08	Katugastota Brd. Jct.	+443.09	Balanagala Jct.	+442.25	600	DI	1,786.57			0.00 - 1,786.57	+443.09 - +442.25		
	Balanagala Jct.	+442.25	Pihilladeniya Jct.	+455.24	300		3,527.04			1,786.57 - 5,313.61	+442.25 - +455.24		
	Pihilladeniya Jct.	+455.24	Bangalawatta Jct.	+457.74			188.31			5,313.61 - 5,501.92	+455.24 - +457.74		
20-C-09	Pihilladeniya Jct.	+455.22	Pihilladeniya S.R	+514.50	200	DI	100.01			0.00 - 100.01	+455.22 - +459.46		
					225	PVC	491.76					100.01 - 591.77	+459.46 - +514.50
20-C-10	Bangalawatta Jct.	+457.74	Bangalawatta S.R	+514.92	250	DI	46.01			0.00 - 46.01	+457.74 - +460.50		
							1,073.31					46.01 - 1,119.32	+460.50 - +514.92
20-C-11	Katugastota Brd. Jct.	+444.02	Kahalla Jct.	+443.00	600	DI	887.00			0.00 - 887.00	+444.02 - +443.00		
	Kahalla Jct.	+443.02	Kahawatta S.R	+500.50	500		3,034.74			887.00 - 3,921.74	+443.02 - +454.72		
							660.86					3,921.74 - 4,582.60	+454.72 - +500.50
20-C-12	Kahalla Jct.	+443.00	Kahalla S.R	+462.38	200	DI	232.11			0.00 - 232.11	+443.00 +454.99		
							599.83					232.11 - 831.94	+454.99 - +462.38
20-C-13	Kahawatta S.R	+488.35	Akurana S.R	+509.11	200	DI	1,222.08					0.00 - 1,222.08	+488.35 - +509.11
20-C-14	Kahawatta S.R	+499.60	Thelambugahawatta Jct.	+455.03	350	DI	2,428.55			0.00 - 2,428.55	+499.60 - +455.03		
	Thelambugahawatta Jct.	+455.03	Kurugoda S.R	+566.01			786.45			2,428.55 - 3,215.00	+455.03 - +515.75		
							606.55					3,215.00 - 3,821.55	+515.75 - +566.01
20-C-15	Thelambugahawatta Jct.	+455.03	Thelambugahawatta S.R	+515.53	250	DI	645.00			0.00 - 645.00	+455.03 - +515.53		
							265.79					645.00 - 910.79	+515.53 - +548.70
20-C-16	KMC R3 S.R Jct.	+571.45	Ampitiya S.R	+581.72	300	DI	1,782.43			0.00 - 1,782.43	+571.45 - +581.72		
20-C-17	Ampitiya S.R & P.S	+583.31	Elhena S.R	+605.75	225	PVC	235.00					0.00 - 235.00	+583.31 - +555.17
					200	DI	3,095.00			235.00 - 3,330.00	+555.17 - +555.62		
					225	PVC	586.00					3,330.00 - 3,916.00	+555.62 - +605.75
20-C-18	Ampitiya S.R	+590.00	Mullepihilla Low New S.R	+707.00	150	DI	930.69	0.00 - 930.69	+590.00 - +620.47				
							961.85			930.69 - 1,892.54	+620.47 - +707.00		
20-C-19	Mullepihilla Low New S.R	+707.00	Mullepihilla Low Old S.R	+670.91	160	PVC	74.30					0.00 - 74.30	+707.00 - +664.33
					90		160.50					74.30 - 234.80	+664.33 - +670.91
20-C-20	Heerassagala Jct.	+480.47	Heerassagala Low S.R	+562.81	350	DI	1,001.50			0.00 - 1,001.50	+480.47 - +562.81		
20-C-21	Heerassagala Low S.R	+562.81	Heerassagala Middle S.R	+610.50	200	DI	626.28			0.00 - 626.28	+562.81 - +554.84		
					225	PVC	587.23					626.28 - 1,213.51	+554.84 - +610.50
20-C-22	Heerassagala Middle S.R	+610.50	Heerassagala Upper S.R	+675.20	150	DI	80.00			0.00 - 80.00	+610.50 - +610.64		
					160	PVC	680.70					80.00 - 760.70	+610.64 - +675.20
20-C-23	KMC R2 S.R & P.S	+547.51	Hantana Place S.R	+636.00	200	DI	77.12			0.00 - 77.12	+547.51 - +565.93		
							738.63					77.12 - 815.75	+565.93 - +636.00
						Total	41,533.95						

Data for Surge Analysis

Drawing No. **20-C-01**

Route: **WTP** **to** **WTP Junction**

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
				442.61			LWL
				445.61			HWL
1	0.00	0.00	446.50	444.85	600	16	WTP
2	100.00	100.00	443.00	440.00	600	16	
3	77.30	177.30	443.00	441.45	600	16	WTP Jct.

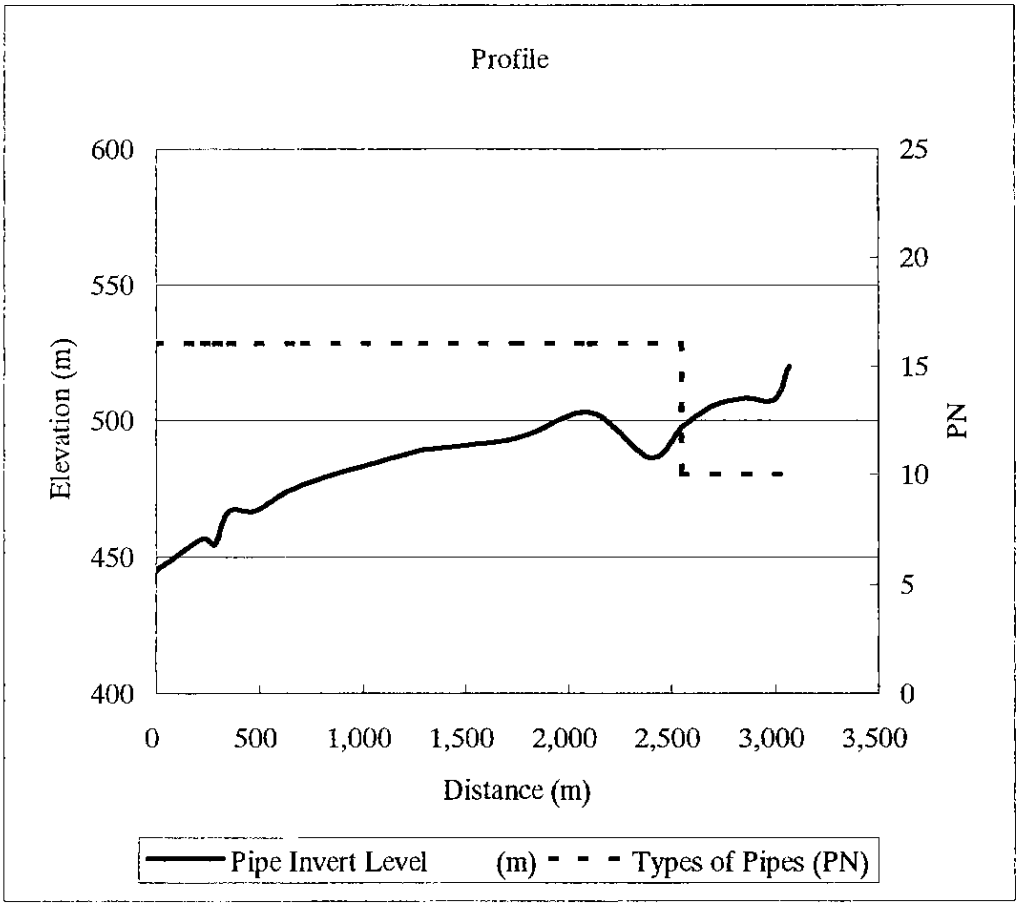


Data for Surge Analysis

Drawing No. **20-C-02**

Route: **WTP** **to** **Gohagoda New Reservoir**

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
				442.61			LWL
				445.61			HWL
1	0.00	0.00	446.05	444.67	350	16	WTP
2	225.05	225.05	458.00	456.51	350	16	
3	57.10	282.15	455.62	454.34	350	16	
4	67.50	349.65	468.09	466.71	350	16	
5	137.35	487.00	468.41	467.00	350	16	Kondadeniya Jct.
6	221.65	708.65	477.61	476.33	250	16	
7	571.35	1,280.00	490.49	489.06	250	16	Gohagoda Old SR.
7'	0.00	1,280.00	490.49	489.06	200	16	
8	467.07	1,747.07	494.61	493.39	200	16	
9	358.65	2,105.72	503.95	502.73	200	16	
10	291.18	2,396.90	487.48	486.26	200	16	
11	150.51	2,547.41	498.76	497.54	200	16	
11'	0.00	2,547.41	498.76	497.54	200	10	
12	152.44	2,699.85	506.45	505.23	200	10	
13	154.91	2,854.76	509.20	507.98	200	10	
14	144.28	2,999.04	508.64	507.42	200	10	
15	66.76	3,065.80	520.81	519.59	200	10	Gohagoda New SR. Jct.

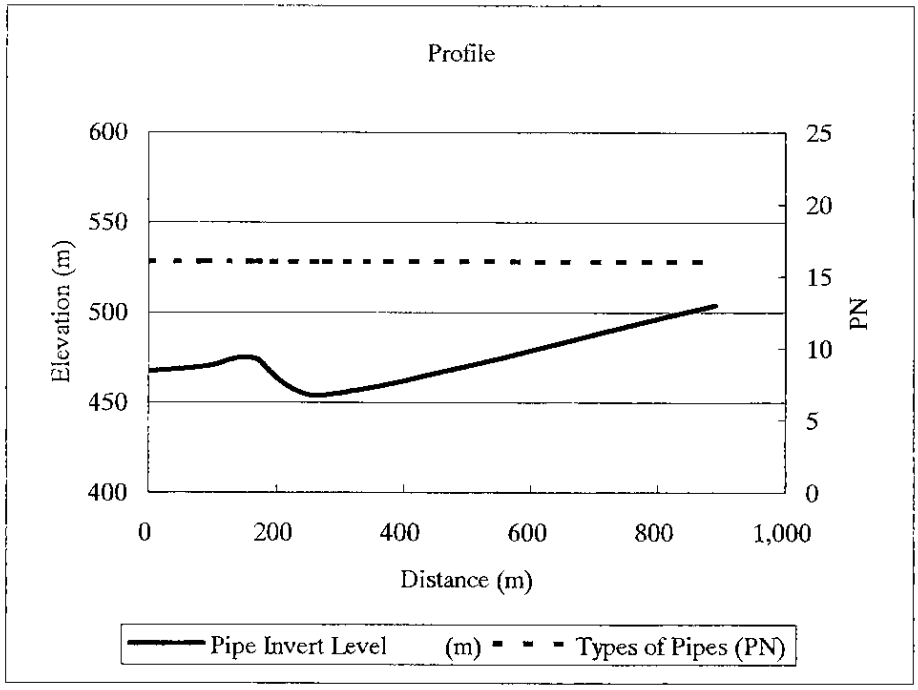


Data for Surge Analysis

Drawing No. **20-C-03**

Route: **Kondadeniya Junction** **to** **Kondadeniya Connection**

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
1	0.00	0.00	468.41	467.10	300	16	Kondadeniya Jct.
2	87.33	87.33	471.16	469.83	300	16	
3	79.76	167.09	475.67	474.34	300	16	
4	108.77	275.86	455.07	453.74	300	16	
5	614.14	890.00	505.18	503.85	300	16	Kondadeniya Connct.

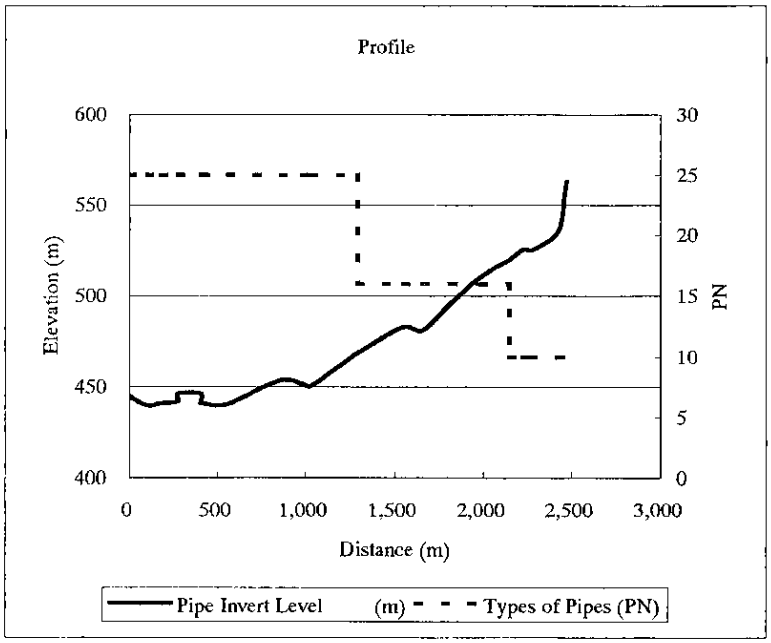


Data for Surge Analysis

Drawing No. 20-C-04

Route: WTP to Asgiriya Reservoir

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
				442.61			LWL
				445.61			HWL
1	0.00	0.00	446.50	444.65	800	25	WTP
2	100.00	100.00	443.00	439.80	800	25	
3	77.30	177.30	442.60	440.75	800	25	WTP Jct.
4	99.01	276.31	442.40	442.00	800	25	Before Rv. Crossing
5	0.00	276.31	442.40	446.30	800	25	ditto
6	128.29	404.60	442.45	446.30	800	25	After Rv. Crossing
7	0.00	404.60	442.45	441.10	800	25	ditto
8	13.35	417.95	442.79	441.02	800	25	
8'	0.00	417.95	442.79	441.02	700	25	
9	140.39	558.34	442.40	440.38	700	25	
10	301.12	859.46	455.50	453.50	700	25	
11	120.29	979.75	453.65	451.38	700	25	Upland Jct.
12	52.86	1,032.61	452.20	450.46	700	25	
13	256.28	1,288.89	470.34	468.62	700	25	
13'	0.00	1,288.89	470.34	468.62	700	16	
14	258.15	1,547.04	484.75	482.80	700	16	
15	110.08	1,657.12	483.63	481.15	700	16	
16	156.99	1,814.11	497.45	495.71	700	16	
17	172.12	1,986.23	512.20	510.49	700	16	
18	160.89	2,147.12	521.60	519.86	700	16	
18'	0.00	2,147.12	521.60	519.86	700	10	
19	76.16	2,223.28	527.30	525.35	700	10	
20	41.72	2,265.00	525.90	524.81	700	10	Asgiriya Jct.
20'	0.00	2,265.00	525.90	524.81	500	10	
21	157.55	2,422.55	537.08	535.53	500	10	
22	46.00	2,468.55	564.48	562.93	500	10	Asgiriya SR.
				561.50			LWL
				567.00			HWL

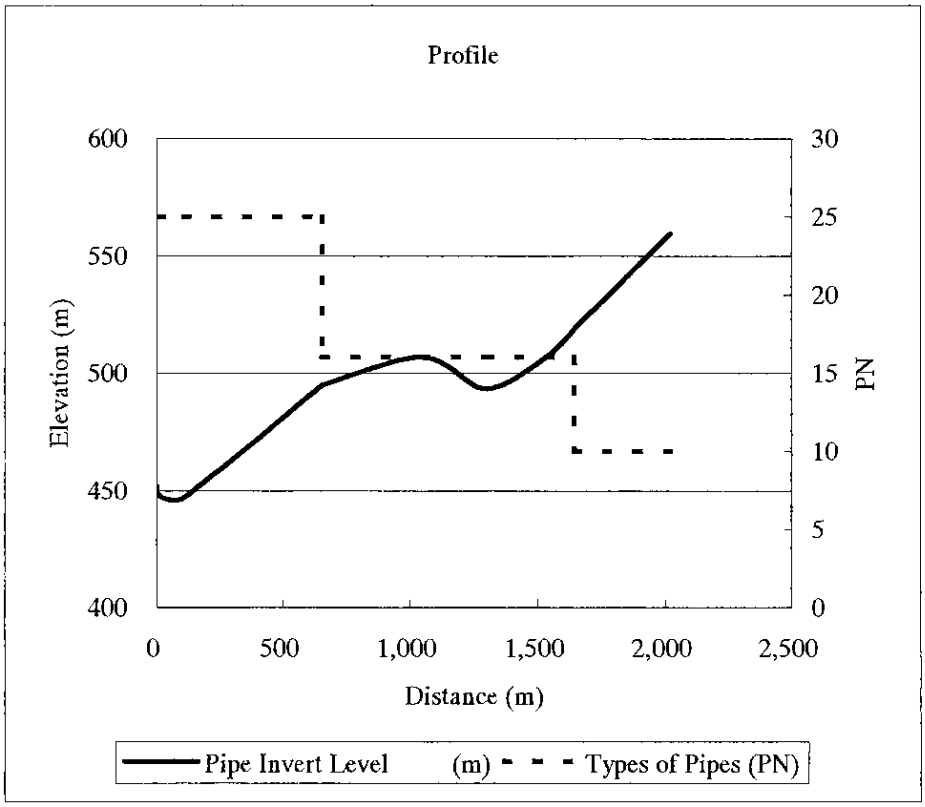


Data for Surge Analysis

Drawing No. **20-C-05**

Route: **Upland Junction** **to** **Upland Reservoir**

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
1	0.00	0.00	453.65	451.46	400	25	Upland Jct.
2	6.72	6.72	449.39	447.90	400	25	
3	100.44	107.16	448.53	446.90	400	25	
4	547.84	655.00	496.36	494.80	400	25	
4'	0.00	655.00	496.36	494.80	400	16	
5	394.22	1,049.22	508.30	506.66	400	16	
6	250.13	1,299.35	495.54	493.25	400	16	
7	235.65	1,535.00	508.65	507.14	400	16	Future Extension Jct. for Tennekumbura
8	107.36	1,642.36	520.11	518.68	400	16	
8'	0.00	1,642.36	520.11	518.68	400	10	
9	377.50	2,019.86	560.78	559.35	400	10	Upland SR.
				560.09			LWL
				566.00			HWL

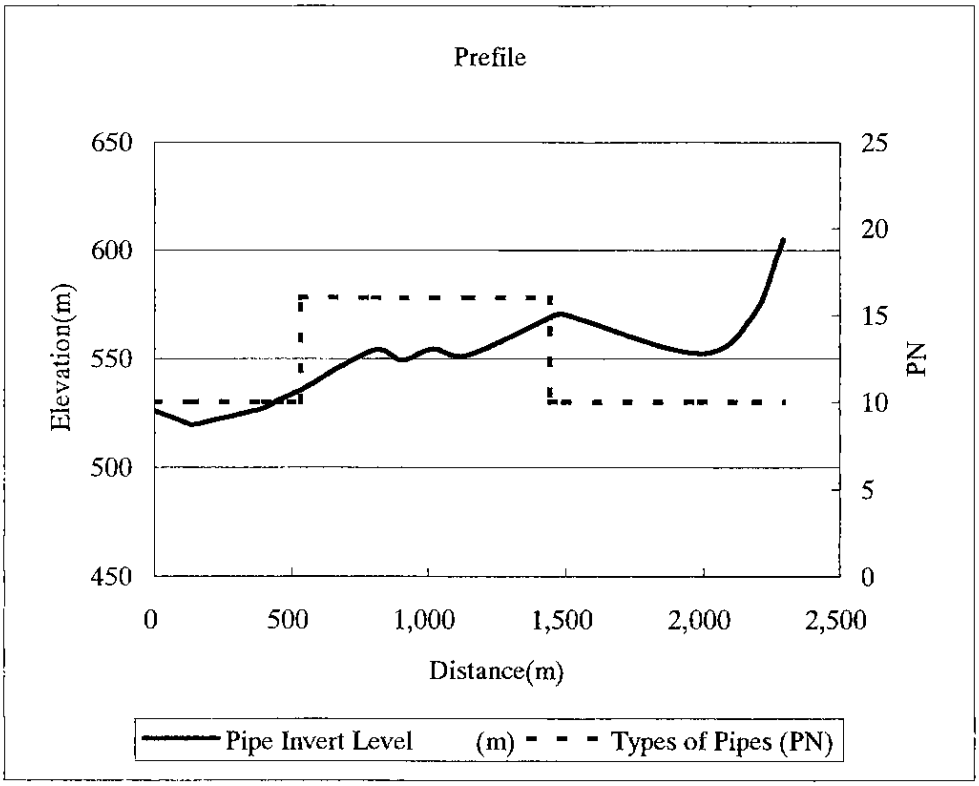


Data for Surge Analysis

Drawing No. 20-C-06

Route: Asgiriya Junction to Bahirawakanda Reservoir

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
1	0.00	0.00	527.40	526.02	500	10	Asgiriya Jct.
2	134.23	134.23	520.92	519.54	500	10	
2'	0.00	134.23	520.92	519.54	250	10	
3	263.26	397.49	528.30	527.02	250	10	Future Extension Jct. for R2 SR.
4	44.90	442.39	531.48	530.21	250	10	
5	48.61	491.00	534.43	533.07	250	10	
6	40.35	531.35	-	535.31	250	10	Asgiriya PS.
6'	0.00	531.35	-	535.31	250	16	
7	269.24	800.59	555.08	553.80	250	16	
8	100.74	901.33	550.40	549.12	250	16	
9	116.36	1,017.69	555.72	554.44	250	16	
10	124.96	1,142.65	552.75	551.47	250	16	
11	300.50	1,443.15	570.15	568.87	250	16	
11'	0.00	1,443.15	570.15	568.87	250	10	
12	50.30	1,493.45	571.53	570.25	250	10	
13	492.41	1,985.86	553.75	552.47	250	10	
14	200.41	2,186.27	571.70	570.57	250	10	
15	105.44	2,291.71	606.00	604.72	250	10	Bahirawakanda SR.
				625.00			LWL
				629.00			HWL

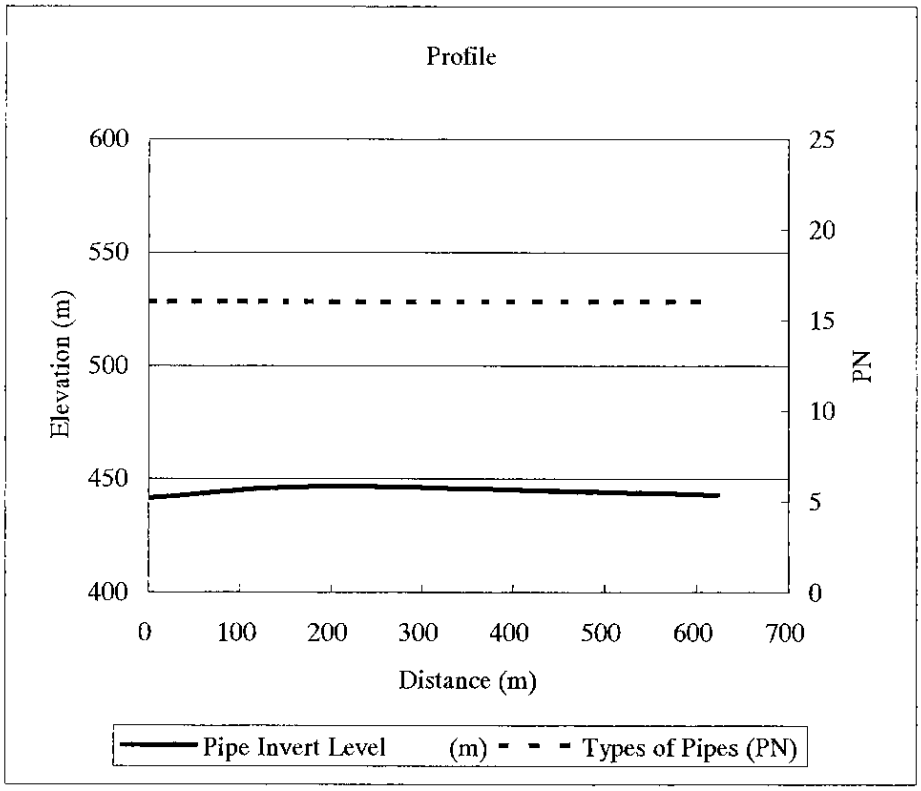


Data for Surge Analysis

Drawing No. **20-C-07**

Route: **WTP Junction** **to** **Katugastota Bridge Junction**

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
1	0.00	0.00	443.09	441.45	600	16	WTP. Jct.
2	201.23	201.23	448.35	446.57	600	16	
3	421.53	622.76	444.07	442.83	600	16	Katugastota Brd. Jct.

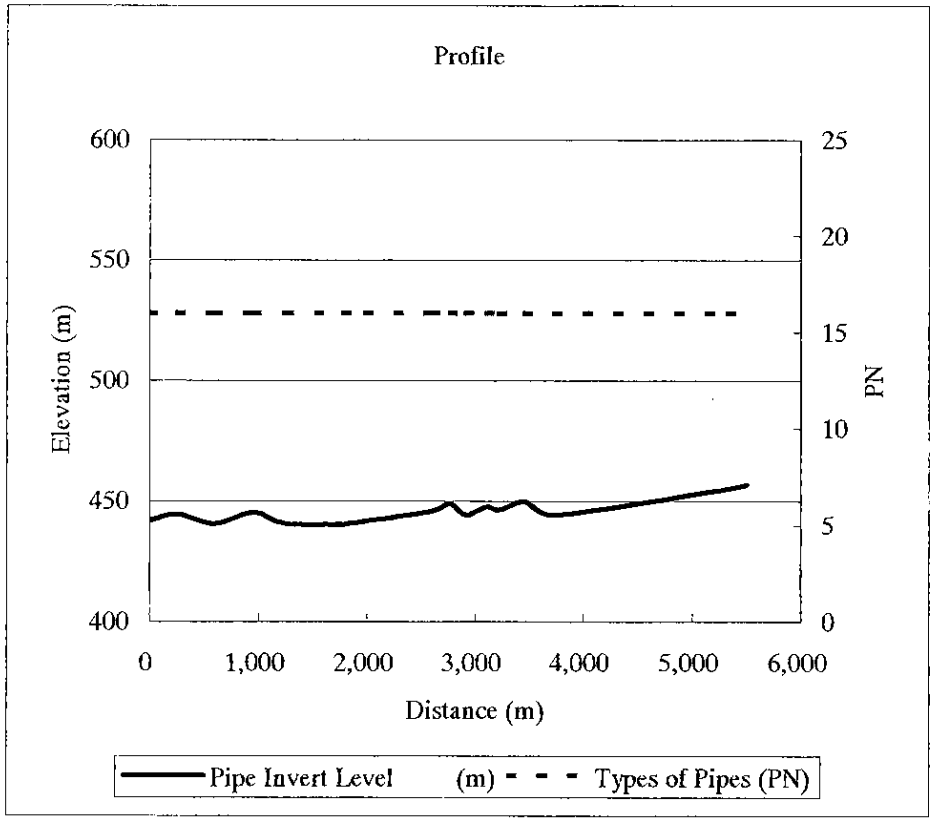


Data for Surge Analysis

Drawing No. **20-C-08**

Route: **Katugastota Bridge Junction to Bangalawatta Junction**

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
1	0.00	0.00	444.02	441.78	600	16	Katugastota Bridge Jct.
2	260.35	260.35	446.07	444.30	600	16	
3	335.73	596.08	442.34	440.32	600	16	
4	358.76	954.84	446.86	445.23	600	16	
5	299.59	1,254.43	442.16	440.53	600	16	
6	532.14	1,786.57	442.24	440.18	600	16	Balanagala Jct.
6'	0.00	1,786.57	442.24	440.18	300	16	
7	199.89	1,986.46	442.55	441.55	300	16	
8	619.45	2,605.91	447.52	445.79	300	16	
9	161.65	2,767.56	450.22	448.89	300	16	
10	155.82	2,923.38	445.36	444.03	300	16	
11	182.82	3,106.20	448.93	447.60	300	16	
12	118.66	3,224.86	447.51	446.18	300	16	
13	241.30	3,466.16	450.96	449.63	300	16	
14	271.28	3,737.44	445.37	444.04	300	16	
15	1,593.17	5,330.61	455.22	454.89	300	16	Pihiladeniya Jct.
16	171.31	5,501.92	457.74	456.41	300	16	Bangalawatta Jct.

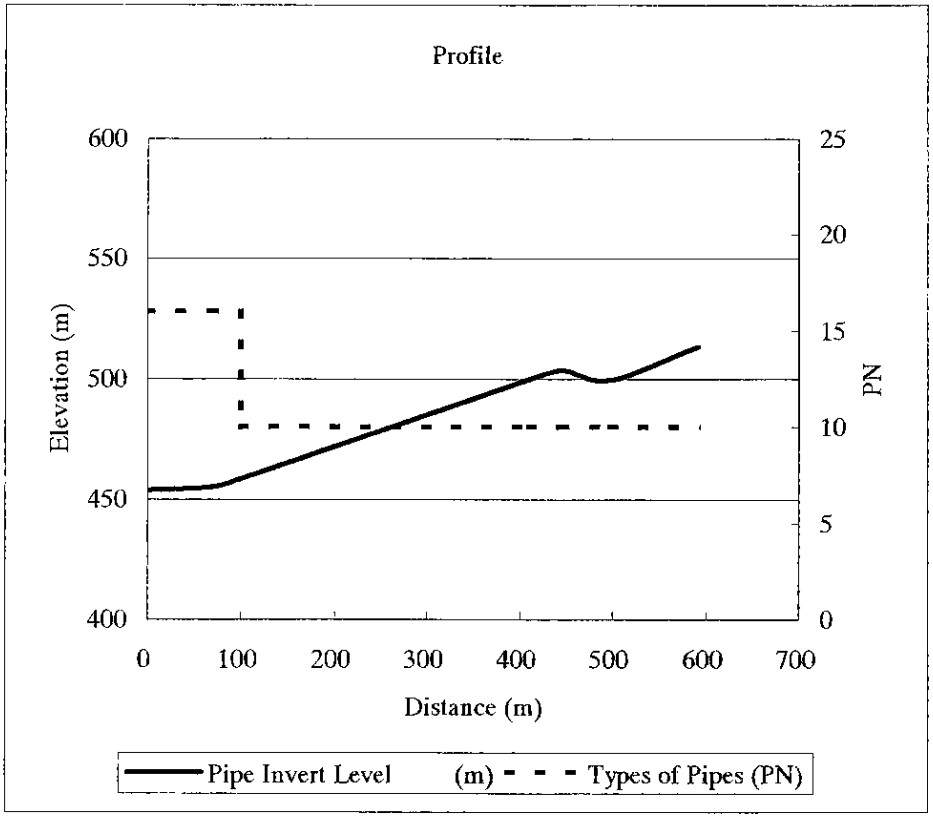


Data for Surge Analysis

Drawing No. **20-C-09**

Route: **Pihiladeniya Junction** **to** **Pihiladeniya Reservoir**

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
1	0.00	0.00	455.22	453.65	200	16	Pihiladeniya Jct.
2	68.53	68.53	456.73	455.00	200	16	
3	31.48	100.01	459.46	458.28	200	16	
3'	0.00	100.01	459.46	458.28	225	10	
4	309.99	410.00	500.50	499.58	225	10	
5	35.62	445.62	504.70	503.48	225	10	
6	52.12	497.74	500.69	499.47	225	10	
7	94.03	591.77	514.50	513.28	225	10	Pihiladeniya SR.
				522.14			LWL
				524.14			HWL

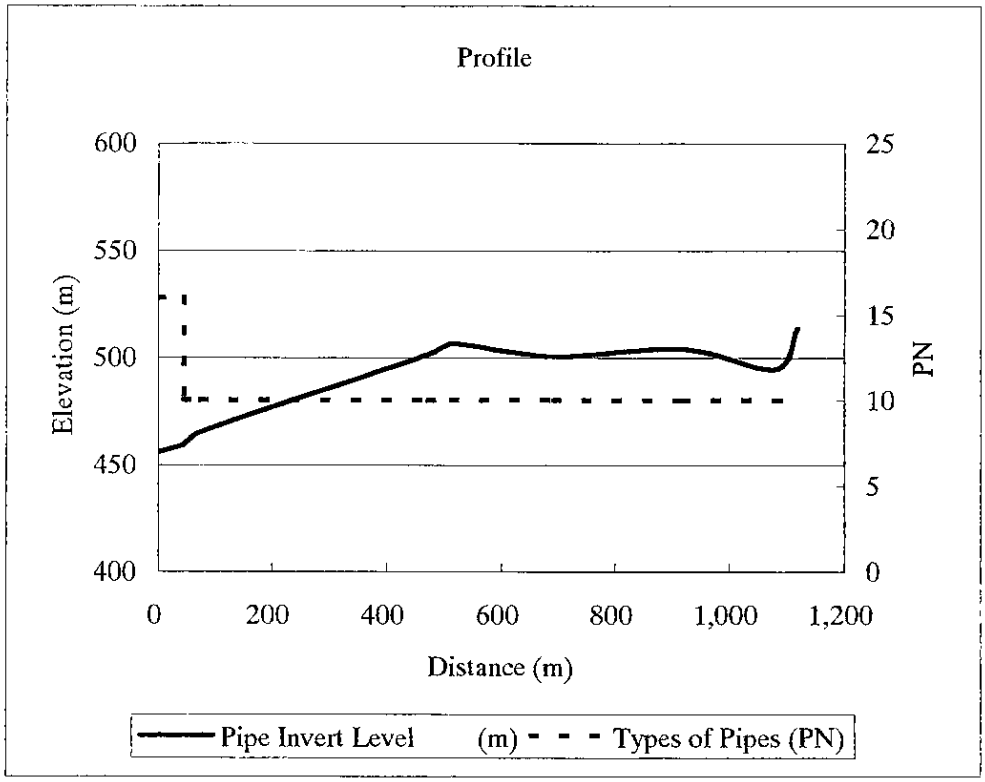


Data for Surge Analysis

Drawing No. **20-C-10**

Route: **Bangalawatta Junction** **to** **Bangalawatta Reservoir**

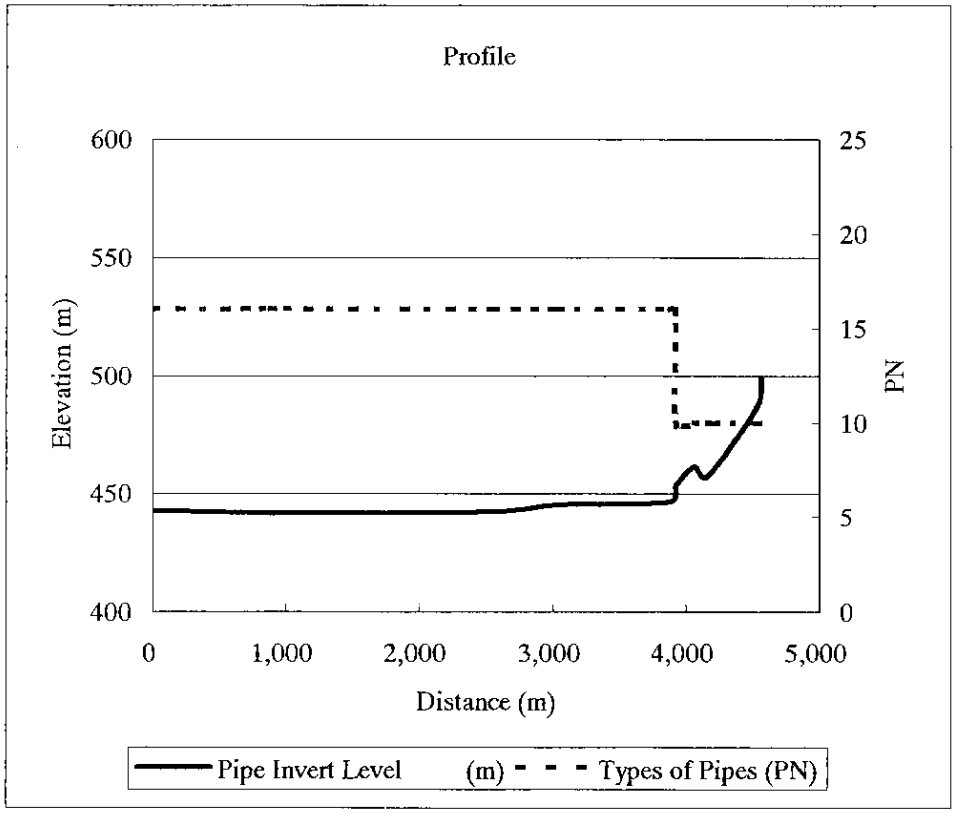
No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
1	0.00	0.00	456.99	455.79	250	16	Bangalawatta Jct.
	46.01	46.01	460.50	459.22	250	16	
	0.00	46.01	460.50	459.22	250	10	
2	75.28	75.28	467.70	465.35	250	10	
3	397.13	472.41	502.58	501.36	250	10	
4	40.52	512.93	507.94	506.66	250	10	
5	179.87	692.80	502.30	500.50	250	10	
6	226.89	919.69	505.46	504.18	250	10	
7	160.60	1,080.29	496.00	494.73	250	10	
8	39.03	1,119.32	514.92	513.64	250	10	Bangalawatta SR.
				518.28			LWL
				521.28			HWL



Drawing No. **20-C-11**

Route: **Katugastota Bridge Junction to Kahawatta Reservoir**

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
1	0.00	0.00	444.02	442.83	600	16	Katugastota Brd. Jct.
2	887.70	887.70	443.00	441.64	600	16	Kahalla Jct.
2'	0.00	887.70	443.00	441.64	500	16	
3	1,655.18	2,542.88	443.92	442.38	500	16	
4	484.40	3,027.28	446.82	445.15	500	16	
5	854.83	3,882.11	447.97	446.44	500	16	
	39.63	3,921.74	454.72	453.19	500	16	
	0.00	3,921.74	454.72	453.19	500	10	
6	178.45	4,060.56	462.78	461.25	500	10	
7	98.31	4,158.87	458.62	457.09	500	10	
8	377.23	4,536.10	488.45	486.92	500	10	
9	27.40	4,563.50	500.50	498.97	500	10	Kahawatta SR.
				516.00			LWL
				522.25			HWL

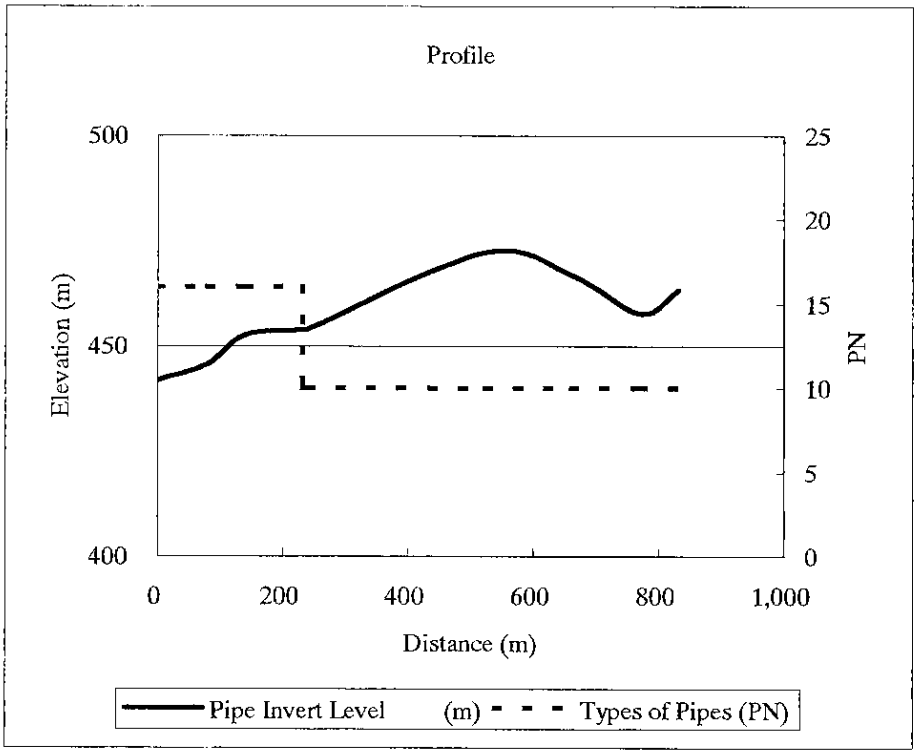


Data for Surge Analysis

Drawing No. **20-C-12**

Route: **Kahalla Junction** **to** **Kahalla Reservoir**

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
1	0.00	0.00	443.00	441.78	200	16	Kahalla Jct.
2	81.00	81.00	446.83	445.61	200	16	
3	59.71	140.71	453.79	452.57	200	16	
4	91.40	232.11	454.99	453.74	200	16	
4'	0.00	232.11	454.99	453.74	200	10	
5	100.19	240.90	455.19	453.97	200	10	
6	282.31	523.21	473.40	472.18	200	10	
7	138.35	661.56	468.14	466.90	200	10	
8	109.09	770.65	459.54	457.69	200	10	
9	61.29	831.94	464.58	463.36	200	10	Kahalla SR.
				485.00			LWL
				491.25			HWL

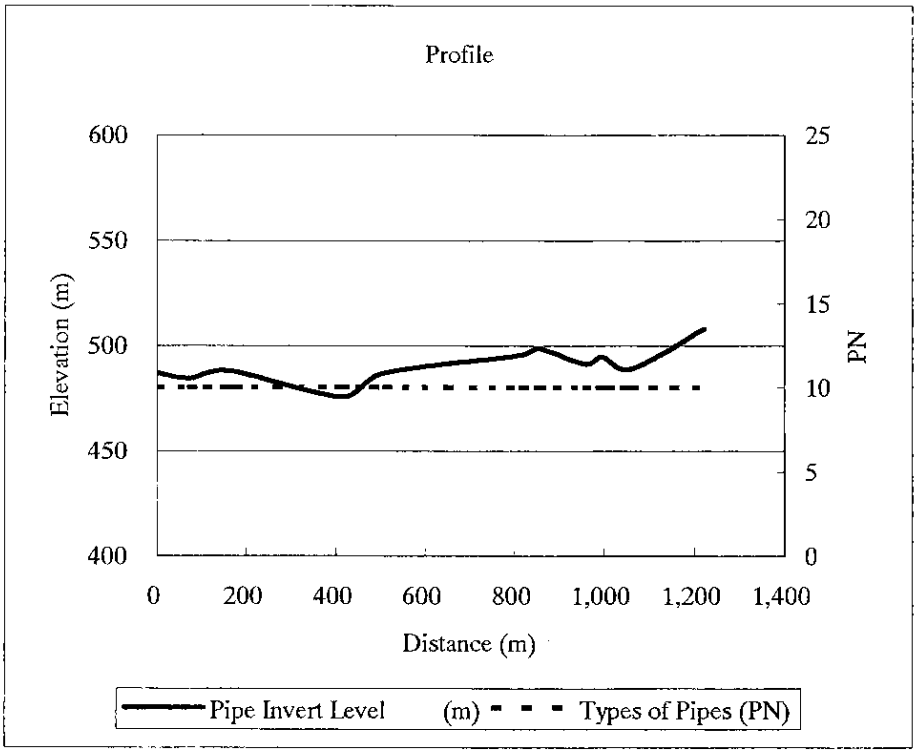


Data for Surge Analysis

Drawing No. 20-C-13

Route: **Kahawatta Reservoir Jct.** **to** **Akurana Reservoir**

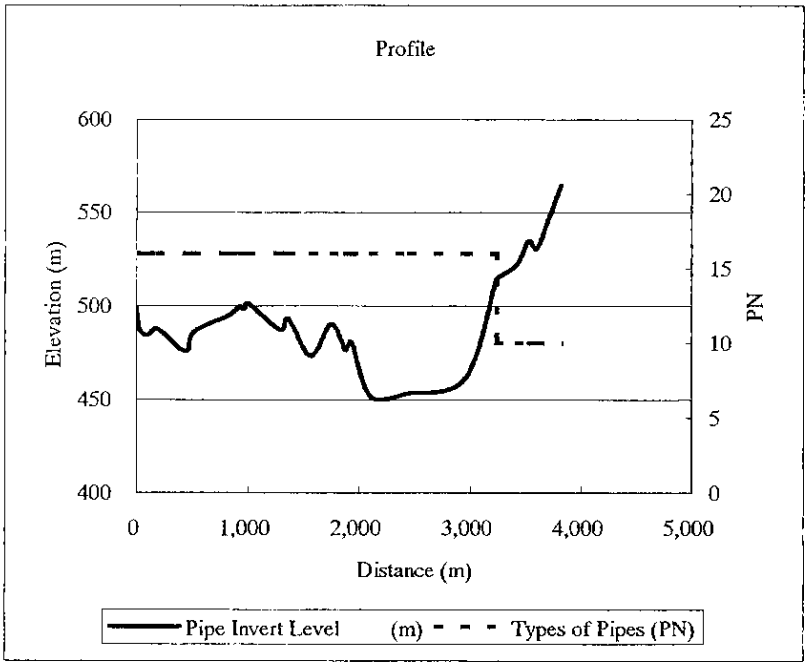
No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
1	0.00	0.00	488.45	486.91	200	10	Kahawatta SR. Jct.
2	74.01	74.01	485.60	484.37	200	10	
3	88.31	162.32	489.02	487.79	200	10	
4	251.26	413.58	476.82	475.59	200	10	
5	97.98	511.56	488.29	487.06	200	10	
6	302.17	813.73	496.62	495.40	200	10	Akurana Jct.
7	40.25	853.98	499.93	498.70	200	10	
8	102.53	956.51	492.37	491.14	200	10	
9	38.31	994.82	495.90	494.67	200	10	
10	63.40	1,058.22	490.25	488.75	200	10	
11	163.86	1,222.08	509.11	507.88	200	10	Akurana SR.
				508.00			LWL
				512.00			HWL



Drawing No. 20-C-14

Route: **Kahawatta Reservoir** to **Kurugoda Reservoir**

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
		-20.00		516.00			LWL
				522.25			HWL
1	0.00	0.00	499.60	498.21	350	16	Kahawatta SR.
2	28.00	28.00	488.35	486.96	350	16	
3	74.01	102.01	485.60	484.22	350	16	
4	88.31	190.32	489.02	487.52	350	16	
5	251.26	441.58	476.82	475.44	350	16	
6	78.29	519.87	487.35	485.97	350	16	
7	321.86	841.73	496.82	495.25	350	16	Akurana Jct.
8	82.62	924.35	501.38	499.70	350	16	
9	37.89	962.24	500.33	497.90	350	16	
10	40.43	1,002.67	502.86	501.36	350	16	
11	286.86	1,289.53	488.86	487.00	350	16	
12	81.97	1,371.50	494.77	493.26	350	16	
13	198.17	1,569.67	474.40	473.02	350	16	
14	183.54	1,753.21	492.05	490.55	350	16	
15	125.57	1,878.78	477.91	476.50	350	16	
16	57.99	1,936.77	481.84	480.33	350	16	
17	170.31	2,107.08	453.39	451.60	350	16	
18	349.77	2,456.85	455.03	453.52	350	16	Thelumbgasawatta Jct.
19	503.37	2,960.22	462.80	461.42	350	16	
20	280.08	3,240.30	515.53	514.34	350	16	
20'	0.00	3,240.30	515.53	514.34	350	10	
21	182.35	3,422.65	523.11	521.89	350	10	
22	110.13	3,532.78	536.41	534.91	350	10	
23	75.83	3,608.61	531.96	530.98	350	10	
24	212.94	3,821.55	566.01	564.63	350	10	Kurugoda SR.
				569.00		10	LWL
				573.00		10	HWL

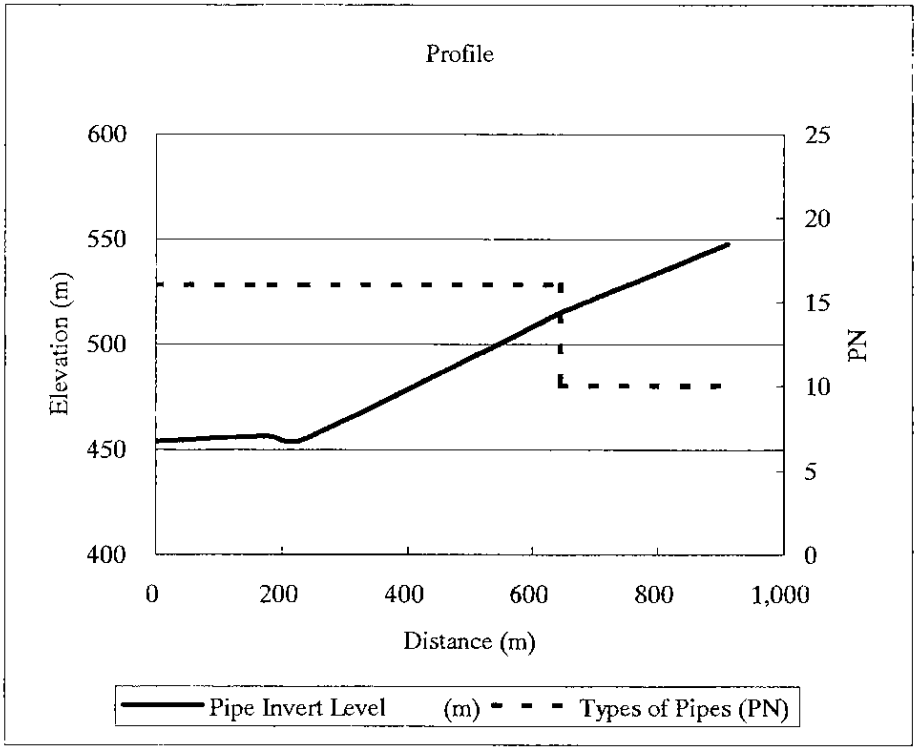


Data for Surge Analysis

Drawing No. **20-C-15**

Route: **Thelumbugasawatta Junction** **to** **Thelumbugasawatta Reservoir**

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
1	0.00	0.00	455.03	453.65	250	16	Thelumbugasawatta Jct.
2	180.38	180.38	457.40	456.12	250	16	
3	51.89	232.27	456.14	454.36	250	16	
4	412.73	645.00	515.53	514.78	250	16	
4'	0.00	645.00	515.53	514.78	250	10	
5	265.79	910.79	548.70	547.42	250	10	Thelumbugasawatta SR.
				561.50			LWL
				566.75			HWL

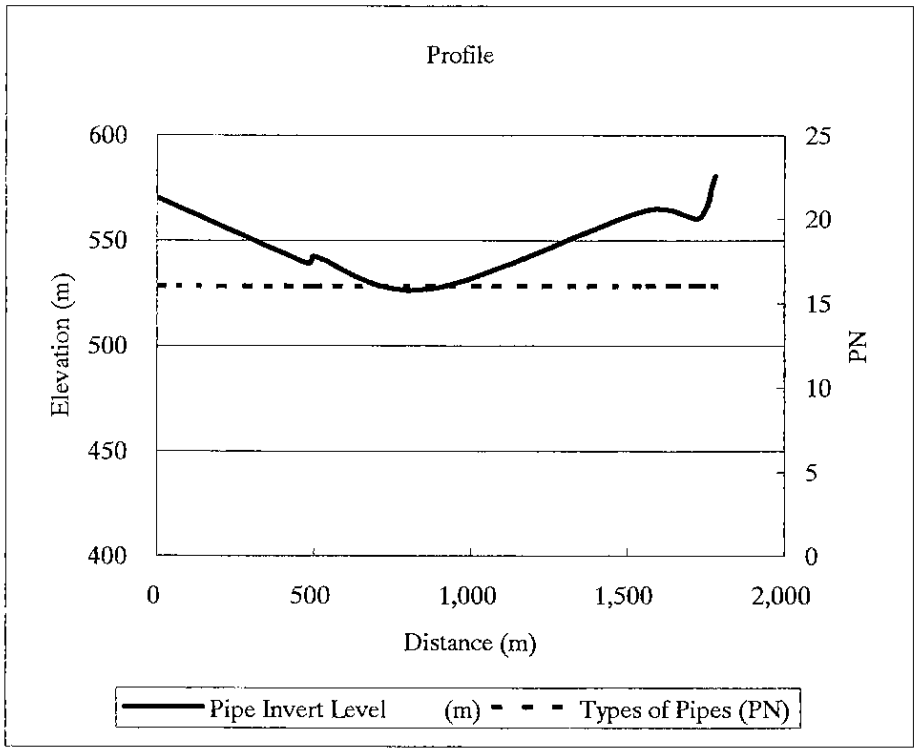


Data for Surge Analysis

Drawing No. **20-C-16**

Route: **KMC R3 Reservoir Junction** **to** **Ampitiya Reservoir**

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
1	0.00	0.00	571.45	570.13	300	16	R3 SR. Jct.
2	6.00	6.00	571.12	569.97	300	16	Future Extension Jct.
3	475.24	481.24	540.41	539.09	300	16	
4	19.67	500.91	543.51	542.19	300	16	
5	362.63	863.54	527.87	526.55	300	16	
6	702.85	1,566.39	565.75	564.43	300	16	
7	161.38	1,727.77	561.56	560.24	300	16	
8	54.66	1,782.43	581.72	580.40	300	16	Ampitiya SR.
				582.50			LWL
				586.00			HWL

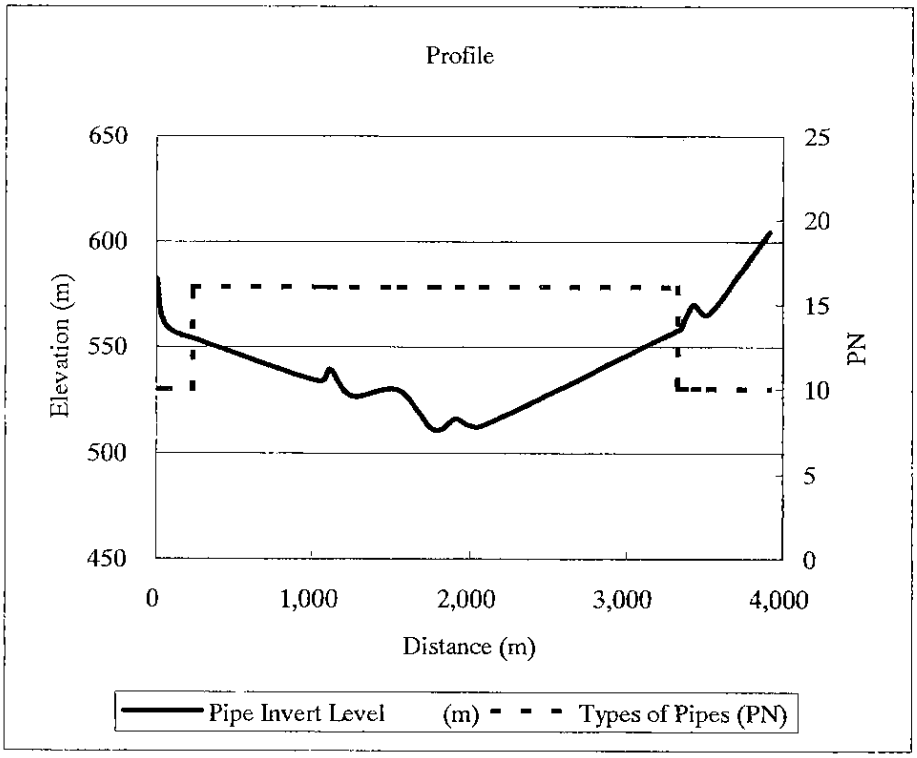


Data for Surge Analysis

Drawing No. 20-C-17

Route: **Ampitiya Reservoir** to **Elhena Reservoir**

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
			-12.00	582.50			LWL
				586.00			HWL
1	0.00	0.00	583.31	582.08	225	10	Ampitiya SR.
2	57.51	57.51	561.78	560.55	225	10	
3	177.49	235.00	555.17	553.92	225	10	
3'	0.00	235.00	555.17	553.92	225	16	
4	808.64	1,043.64	535.70	533.80	200	16	
5	64.64	1,108.28	540.71	539.48	200	16	
6	141.73	1,250.01	527.94	526.64	200	16	
7	300.95	1,550.96	531.02	529.39	200	16	
8	216.10	1,767.06	512.07	510.75	200	16	
9	148.08	1,915.14	517.47	516.25	200	16	
10	154.03	2,069.17	513.66	512.64	200	16	
11	1,260.83	3,330.00	559.91	557.89	200	16	
11'	0.00	3,330.00	559.91	557.89	200	10	
12	18.91	3,348.91	559.81	558.59	225	10	
13	79.88	3,428.79	571.24	570.02	225	10	
14	99.45	3,528.24	567.00	565.28	225	10	
15	388.65	3,916.89	605.75	604.53	225	10	Elhena SR.
				611.00			LWL
				615.00			HWL

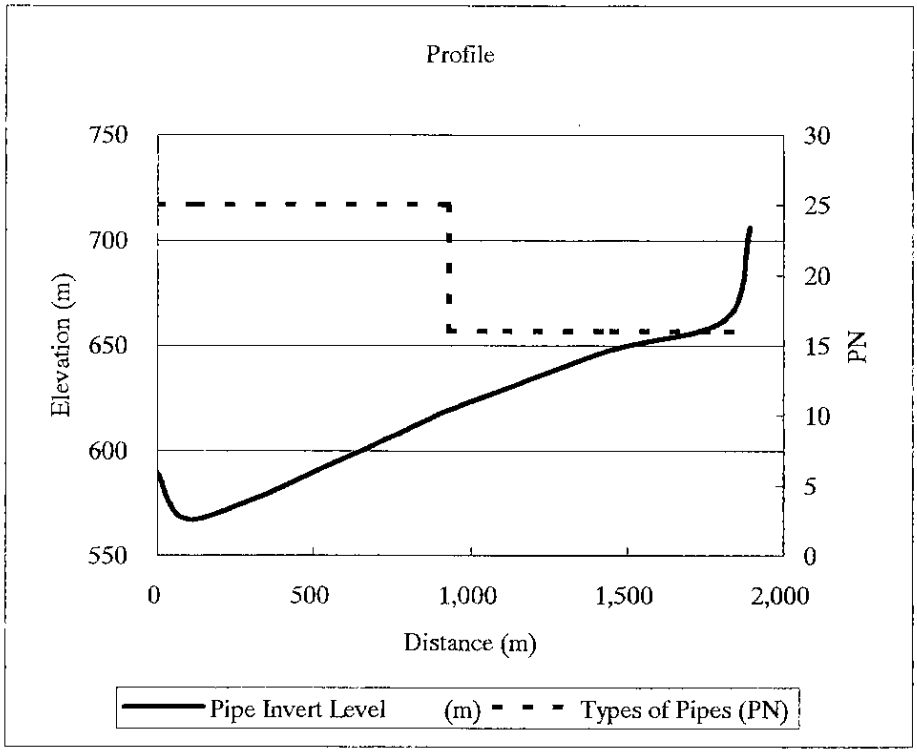


Data for Surge Analysis

Drawing No. 20-C-18

Route: **Ampitiya Reservoir** to **Mullepihila New Reservoir**

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
		-33.00		582.50			LWL
				586.00			HWL
1	0.00	0.00	590.00	588.83	150	25	Ampitiya SR.
2	127.00	127.00	568.24	567.07	150	25	
3	803.69	930.69	620.47	619.30	150	25	
3'	0.00	930.69	620.47	619.30	150	16	
4	178.25	1,108.94	630.30	629.14	150	16	
5	341.06	1,450.00	648.76	647.84	150	16	
6	368.24	1,818.24	664.33	663.13	150	16	
7	74.30	1,892.54	707.00	705.80	150	16	Mullepihila New SR.
				709.00			LWL
				713.00			HWL

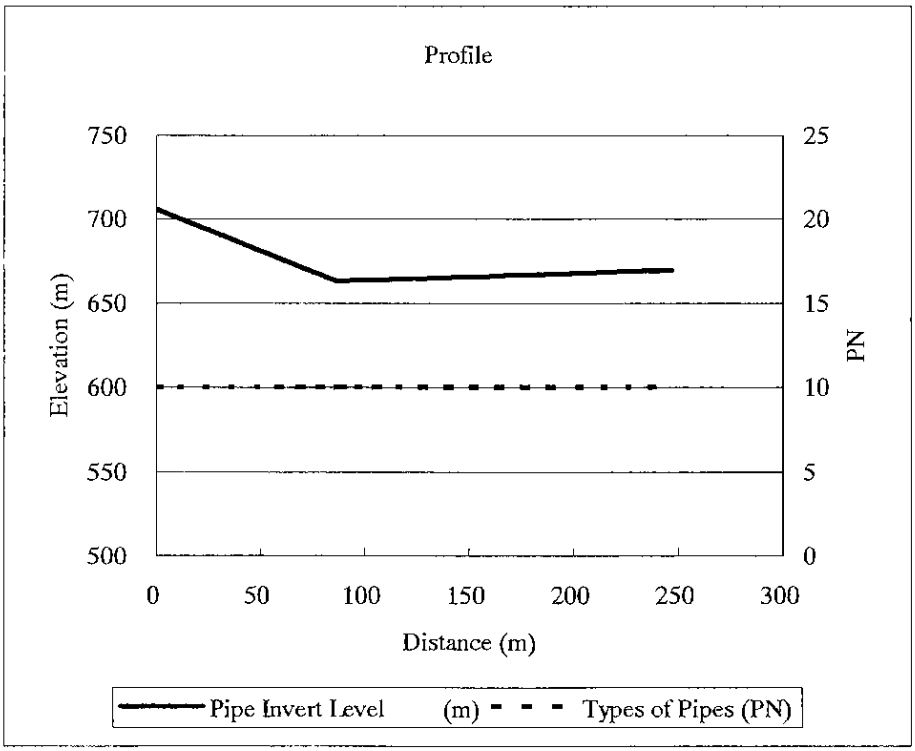


Data for Surge Analysis

Drawing No. **20-C-19**

Route: **Mullepihila New Reservoir** **to** **Mullepihila Old Reservoir**

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
		-11.00		709.00			LWL
				713.00			HWL
1	0.00	0.00	707.00	705.91	160	10	Mullepihila New SR.
2	86.30	86.30	664.33	663.17	160	10	
2'	0.00	86.30	664.33	663.17	90	10	
3	1.70	88.00	664.42	663.26	90	10	
4	158.80	246.80	670.91	669.75	90	10	Mullepihila Old SR.
				672.50			LWL
				674.36			HWL

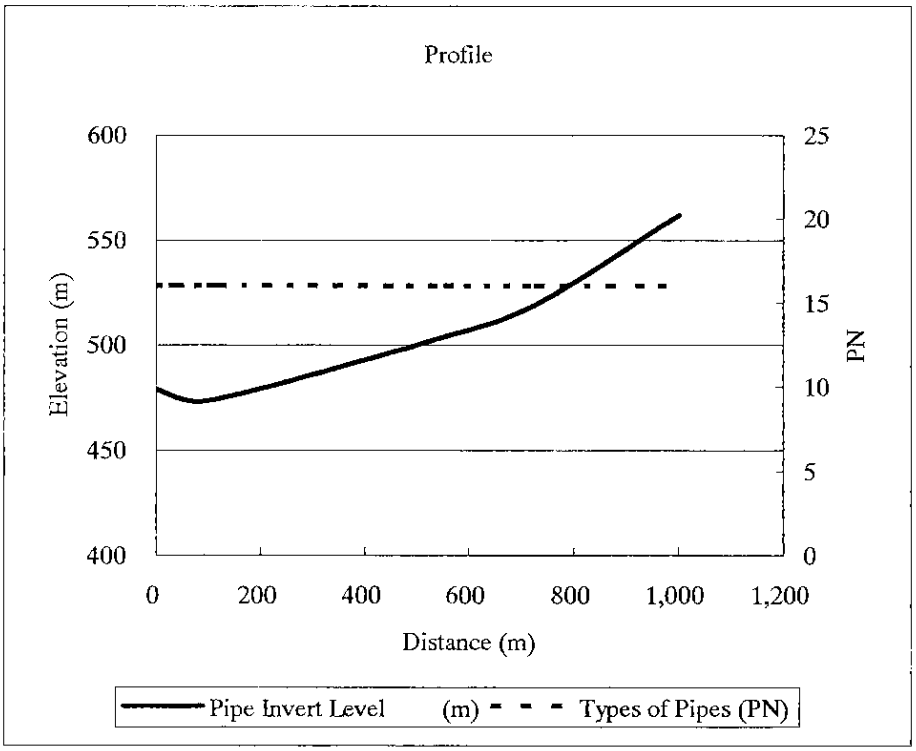


Data for Surge Analysis

Drawing No. **20-C-20**

Route: **Heerassagala Junction** **to** **Heerassagala Low Reservoir**

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
1	0.00	0.00	480.47	478.89	350	16	Heerassagala Jct.
2	100.28	100.28	474.89	473.51	350	16	
3	456.91	557.19	505.18	503.80	350	16	
4	172.19	729.38	520.62	519.24	350	16	
5	272.12	1,001.50	562.81	561.50	350	16	Heerassagala Low SR.
				566.00			LWL
				570.00			HWL

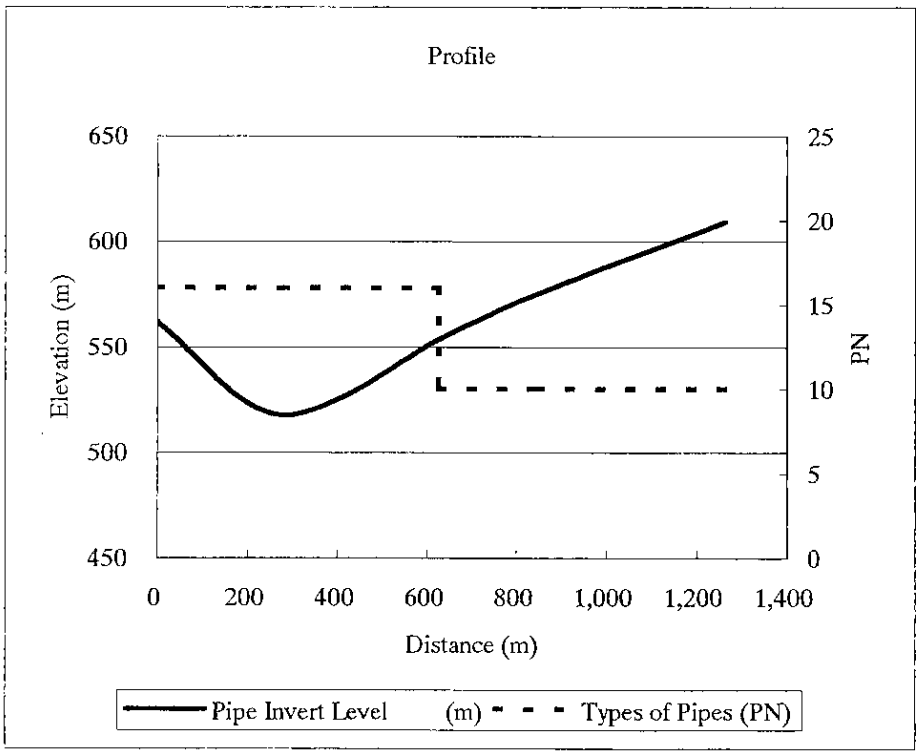


Data for Surge Analysis

Drawing No. **20-C-21**

Route: **Heerassagala Low Reservoir** **to** **Heerassagala Middle Reservoir**

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
		-5.00		566.00			LWL
				570.00			HWL
1	0.00	0.00	562.81	561.66	200	16	Heerassagala Low SR.
2	277.93	277.93	519.99	517.80	200	16	
3	348.35	626.28	554.84	553.75	200	16	
3'	0.00	626.28	554.84	553.75	225	10	
4	218.72	845.00	576.33	574.91	225	10	
5	419.05	1,264.05	610.50	609.34	225	10	Heerassagala Middle SR.
				613.00			LWL
				617.00			HWL

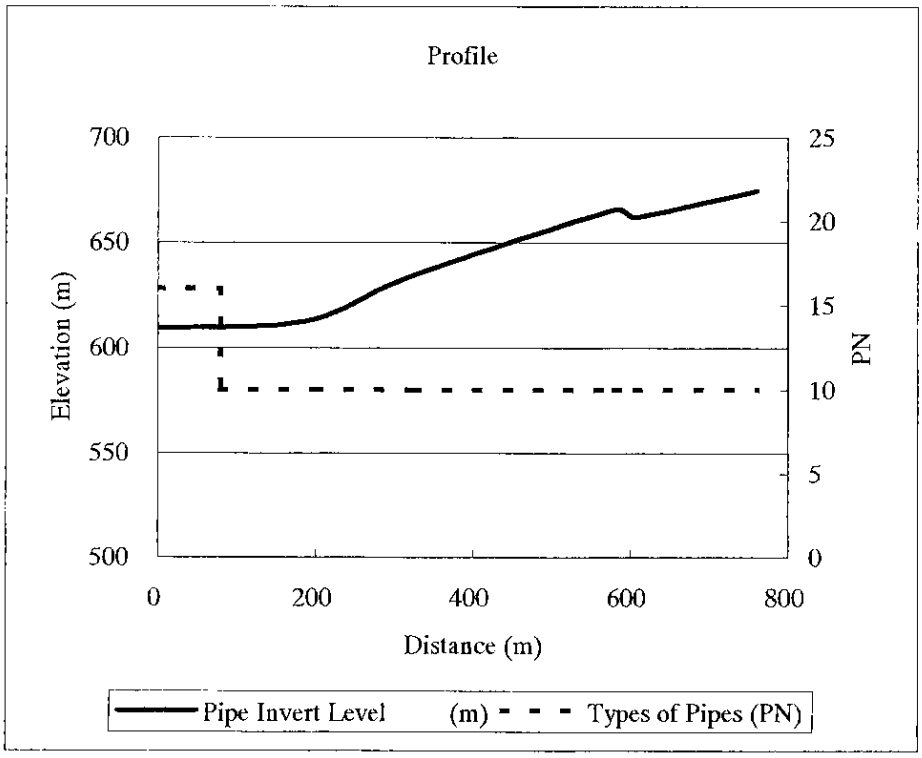


Data for Surge Analysis

Drawing No. 20-C-22

Route: Heerassagala Middle Reservoir **to** Heerassagala Upper Reservoir

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
		-13.00		613.00			LWL
				617.00			HWL
1	0.00	0.00	610.50	609.34	150	16	Heerassagala Middle SR.
2	80.00	80.00	610.64	609.58	150	16	
2'	0.00	80.00	610.64	609.58	160	10	
3	200.00	200.00	614.74	613.58	160	10	
4	125.00	325.00	636.35	634.42	160	10	
5	254.93	579.93	666.35	665.44	160	10	
6	27.29	607.22	663.17	662.01	160	10	
7	153.48	760.70	675.20	674.60	160	10	Heerassagala Upper SR.
				674.00			LWL
				678.00			HWL

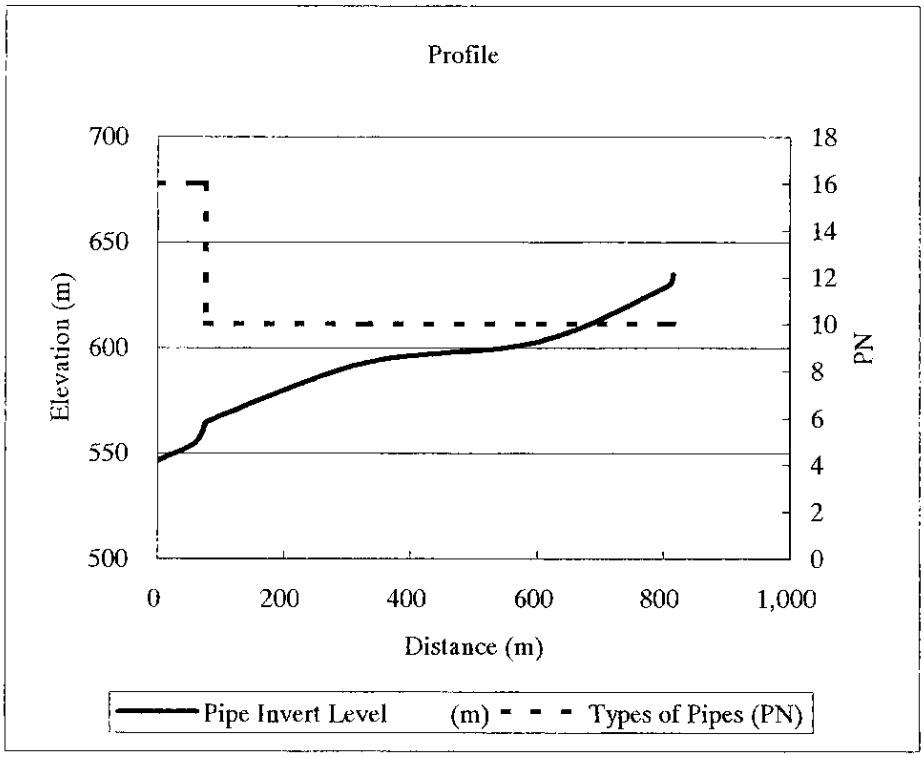


Data for Surge Analysis

Drawing No. **20-C-23**

Route: **KMC R2 Reservoir** **to** **Hantana Place Reservoir**

No.	Single Distance (m)	Cumulative Distance (m)	Ground Elavation (m)	Pipe Invert Level (m)	Pipe Dia. (mm)	Types of Pipes (PN)	Location
1	0.00	0.00	547.51	546.27	200	16	KMC R2 SR.
2	60.03	60.03	557.87	554.85	200	16	
3	17.09	77.12	565.93	564.70	200	16	
3'	0.00	77.12	565.93	564.70	200	10	
4	251.51	328.63	594.07	592.84	200	10	
5	273.42	602.05	603.87	602.64	200	10	
6	206.66	808.71	630.64	629.40	200	10	
7	7.04	815.75	636.00	634.75	200	10	Hantana Place SR.
				637.00			LWL
				641.00			HWL

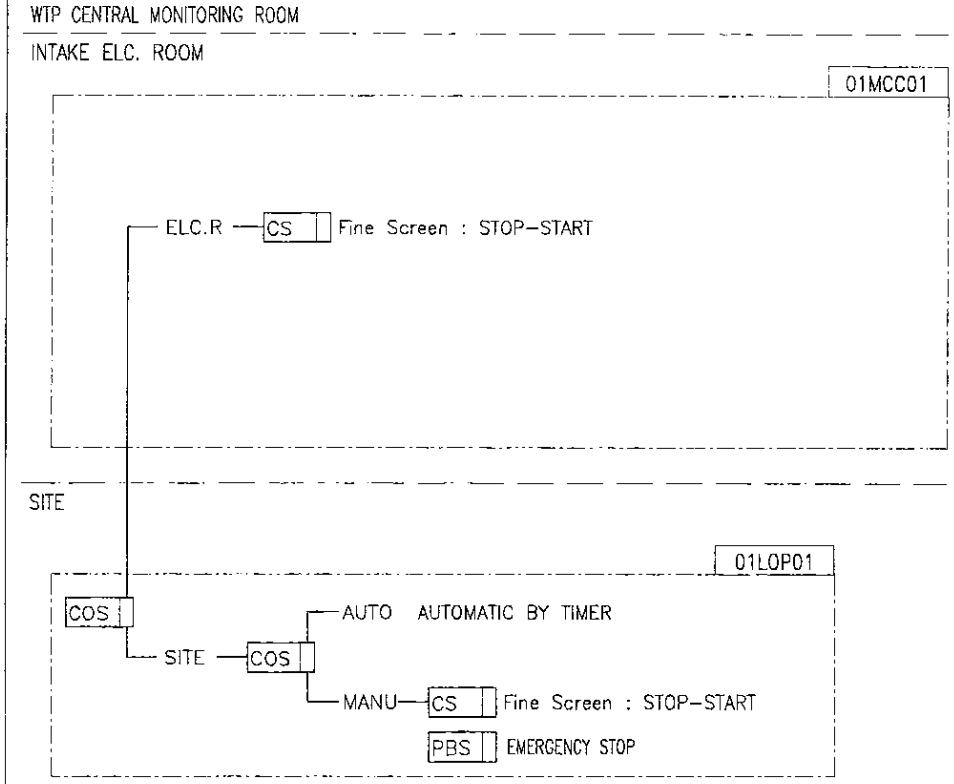


TS 14 Electrical Operation Diagrams

Abbreviations

ADMI	: Administration Building
AUTO	: Automatic Operation
BPP	: Booster Pump Panel
BWP	: Filter Backwash Panel
COS	: Change Over Switch
CS	: Control Switch
ELC.	: Electrical
GEN.	: Generator
H.H.	: High-high (Emergency high)
INST.	: Instrumentation
IP	: Instrumentation Panel
L.L.	: Low-low (Emergency low)
LOP	: Local Operation Panel
MONI.	: Monitor
MANU	: Manual Operation
MCC	: Motor Control Center
PBS	: Push Button Switch
PRN.	: Printer
PRP	: Power Receiving Panel
RPP	: Raw water Pump Panel
SW	: Switch
T	: Trip
TPP	: Transmission Pump Panel
VS	: Volume Switch
VVF	: VVVF Panel

FACILITY	1.RAW WATER INTAKE				
LOAD NAME	Fine Screen [01FS11/12]	CAPACITY	2.2kW	NUMBERS	2

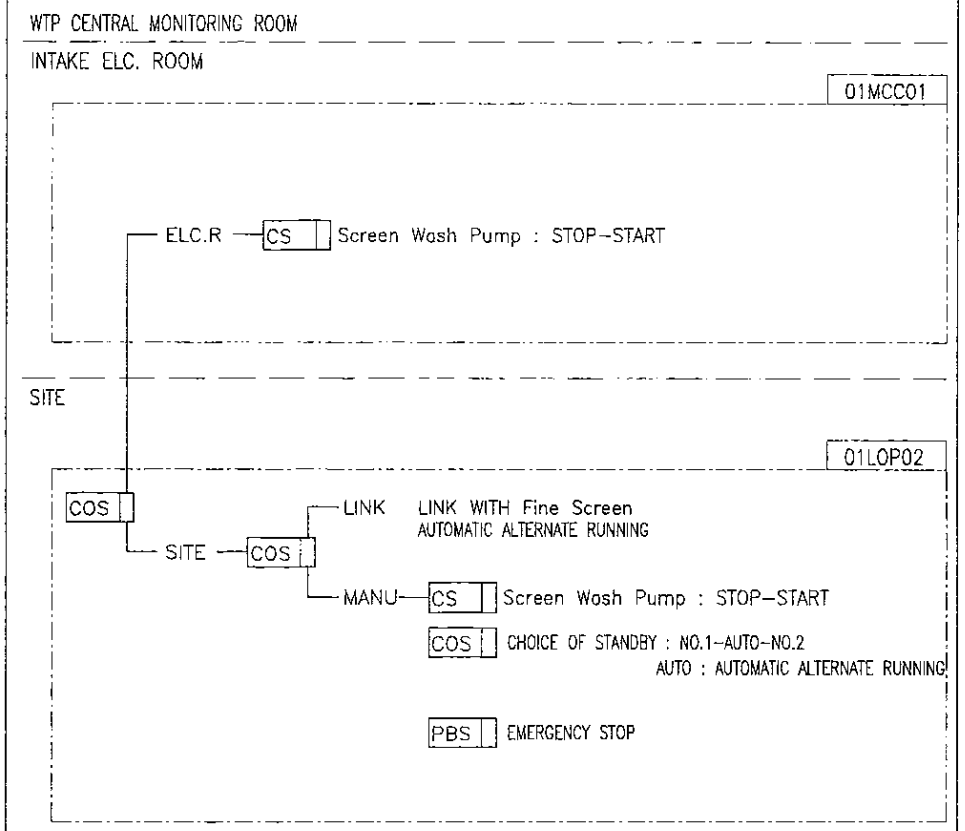


OPERATING CONDITIONS

1.Protection relay nomal.
2.Torque nomal.

	ITEMS	ALARM	GOHAGODA INTAKE SITE LOP	GOHAGODA INTAKE ELC.ROOM MCC	GOHAGODA INTAKE ELC.ROOM	GOHAGODA INTAKE ELC.ROOM IP	KATUGASTOTA WTP CENTRAL MONI. ROOM MONI.	KATUGASTOTA WTP CENTRAL MONI. ROOM PRN.	KATUGASTOTA WTP CENTRAL MONI. ROOM	REMARKS
STATUS INDICATION	OPERATING LOCATION [ELC.R]			O						
	OPERATING LOCATION [SITE]			O						
	Fine Screen START		O	O			O			
	Fine Screen STOP		O	O			O			
OPERATION SWITCH	CS : STOP-START		O	O						
	COS : ELC.R-SITE		O							
	COS : MANU-AUTO		O							
	PBS : EMERGENCY STOP		O							
FAULT INDICATION	EARTH FAULT	T	O	O			O	O		
	OVER LOAD	T	O	O		O	O	O		
	OVER TORQUE	T	O	O			O	O		
	SCREEN PIT LEVEL L.L.	T	O	O		O	O	O		
	EMERGENCY STOP	T	O	O			O	O		
INST. INDICATION										

FACILITY	1.RAW WATER INTAKE				
LOAD NAME	Screen Wash Pump [01SW01/02]	CAPACITY	11kW	NUMBERS	2(1)

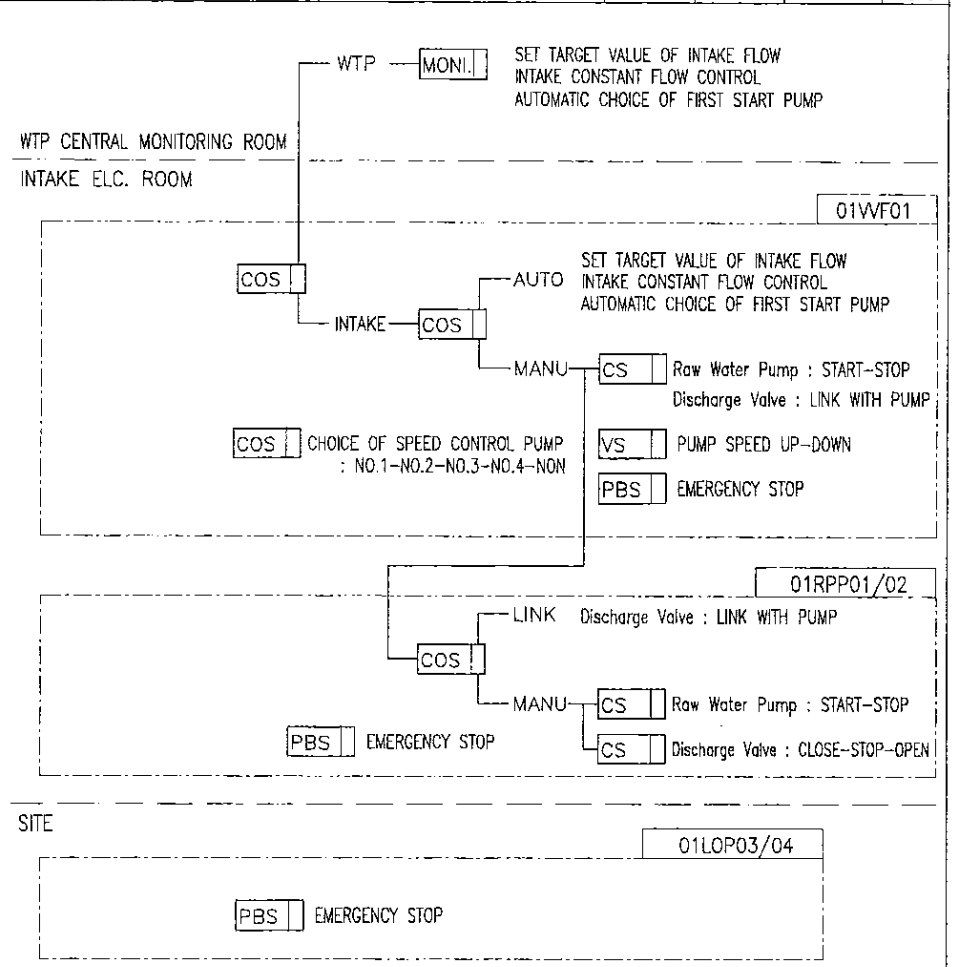


OPERATING CONDITIONS

1.Protection relay nomal.
2.Pump is not OVERHEAT
3.Water level in pump well above L.L.

	ITEMS	ALARM	GOHAGODA INTAKE				KATUGASTOTA WTP			REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP	MCC		IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]			O						
	OPERATING LOCATION [SITE]			O						
	Screen Wash Pump START		O	O			O			
	Screen Wash Pump STOP		O	O			O			
OPERATION SWITCH	CS : STOP-START		O	O						
	COS : ELC.R-SITE		O							
	COS : MANU-LINK		O							
	COS : NO.1-AUTO-NO.2		O							
	PBS : EMERGENCY STOP		O							
FAULT INDICATION	EARTH FAULT	T	O	O			O	O		
	OVER LOAD	T	O	O		O	O	O		
	OVERHEAT	T	O	O			O	O		
	RAW WATER WET WELL LEVEL L.L.	T	O	O						
	EMERGENCY STOP	T	O	O			O	O		
INST. INDICATION	AMMETER		O	O						
	RUNNING HOUR METER			O						

FACILITY	1.RAW WATER INTAKE				
LOAD NAME	Raw Water Pump [01RP01/02]	CAPACITY	280kW	NUMBERS	2(1)
	Discharge Valve [01MV01/02]		0.2kW		2(1)

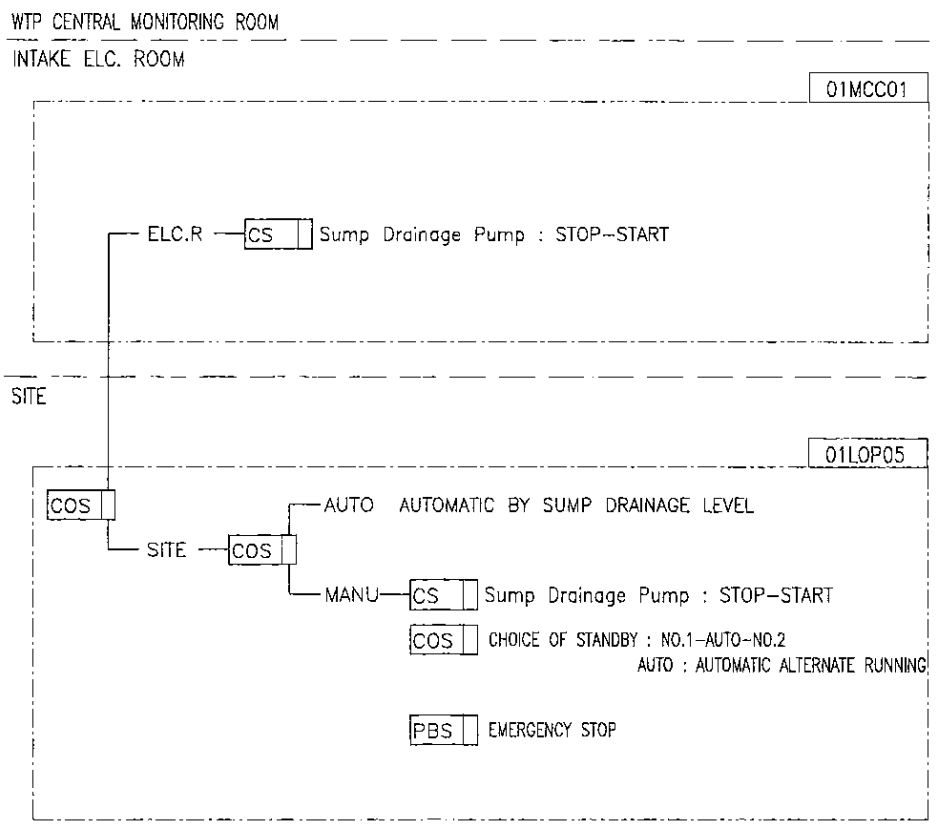


OPERATING CONDITIONS

1.Protection relay nomal.
2.Water level in pump well above L.L.
3.Valve is not over torque.
4.Pump is not over load.

	ITEMS	ALARM	GOHAGODA INTAKE				KATUGASTOTA WTP			REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP	RPP	VVF	IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [WTP]			○	○		○			
	OPERATING LOCATION [INTAKE]			○	○		○			
	OPERATING MODE [AUTO]						○			
	OPERATING MODE [MANU]						○			
	Raw Water Pump START			○	○		○			
	Raw Water Pump STOP			○	○		○			
	Discharge Valve FULLY OPEN			○			○			
	Discharge Valve FULLY CLOSE			○			○			
OPERATION SWITCH	CS : STOP-START			○	○					
	CS : CLOSE-STOP-OPEN			○						
	COS : WTP-INTAKE				○					
	COS : MANU-AUTO				○					
	COS : NO.1-NO.2-NO.3-NO.4-NON				○					
	VS : UP-DOWN				○					
	PBS :EMERGENCY STOP		○	○	○					
	SETTING SW. :FLOW				○		○			
FAULT INDICATION	EARTH FAULT	T		○			○	○		
	OVER LOAD	T		○		○	○	○		
	OVER TORQUE	T		○			○	○		
	VVF TROUBLE	T			○		○	○		
	RAW WATER WET WELL LEVEL L.L.	T		○		○	○	○		
	EMERGENCY STOP	T		○	○		○	○		
	INTAKE FLOW RATE DROP					○				
	Distribution Chamber LEVEL H.H.					○				
INST. INDICATION	AMMETER			○	○					
	RUNNING HOUR METER			○						
	RAW WATER INTAKE FLOW				○	○	○	○		
	RAW WATER WET WELL LEVEL					○	○			
	PUMP SPEED				○					

FACILITY	1.RAW WATER INTAKE				
LOAD NAME	Sump Drainage Pump [01DP01/02]	CAPACITY	1.5kW	NUMBERS	2(1)



OPERATING CONDITIONS

1.Protection relay nomal.
2.Sump drainage level above L.L.

	ITEMS	ALARM	GOHAGODA INTAKE				KATUGASTOTA WTP			REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP	MCC		IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]			○						
	OPERATING LOCATION [SITE]			○						
	Sump Drainage Pump START		○	○			○			
	Sump Drainage Pump STOP		○	○			○			
OPERATION SWITCH	CS : STOP-START		○	○						
	COS : ELC.R-SITE		○							
	COS : MANU-AUTO		○							
	COS : NO.1-AUTO-NO.2		○							
	PBS : EMERGENCY STOP		○							
FAULT INDICATION	EARTH FAULT	T	○	○		○	○	○		
	OVER LOAD	T	○	○			○	○		
	SUMP DRAINAGE LEVEL H.H.		○	○		○	○			
	SUMP DRAINAGE LEVEL L.L.	T	○	○						
	EMERGENCY STOP	T	○	○			○	○		
INST. INDICATION	RUNNING HOUR METER			○						

FACILITY	1.RAW WATER INTAKE				
LOAD NAME	Screening Hoist [01MH01]	CAPACITY	1.2kW	NUMBERS	1

WTP CENTRAL MONITORING ROOM

INTAKE ELC. ROOM

POWER SUPPLY ONLY

SITE

Mechanical Standard Equipped

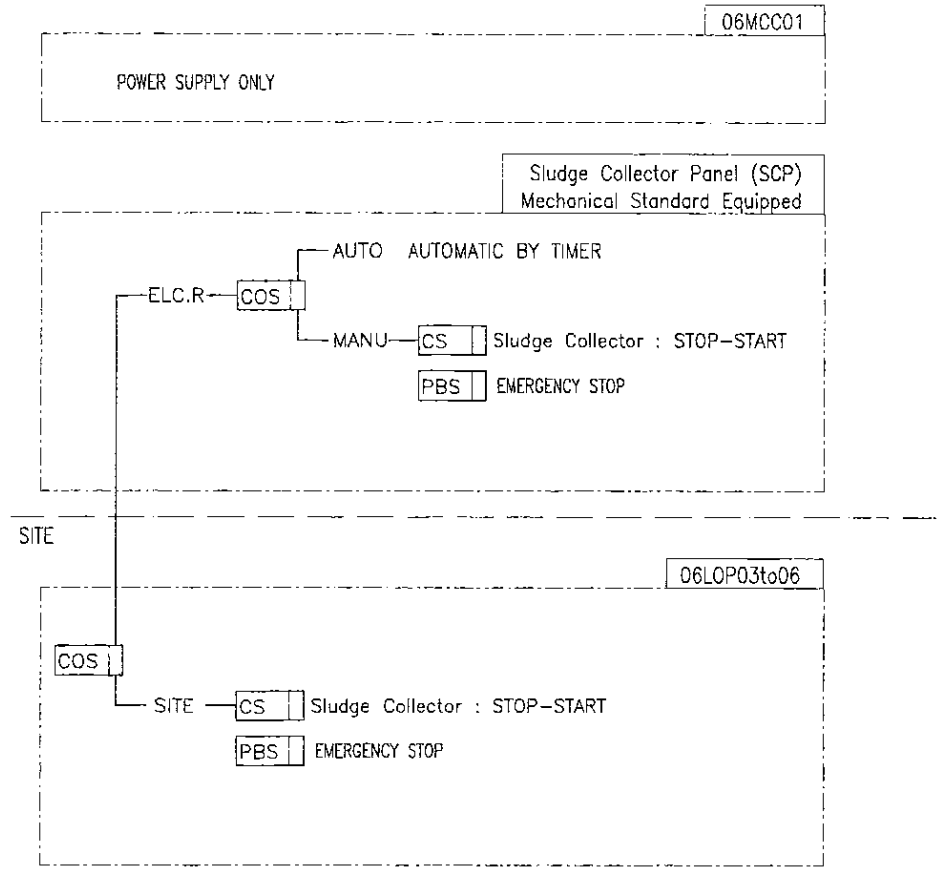
CS Screening Hoist : FORWARD-STOP-REVERSE

OPERATING CONDITIONS

1.Protection relay nomal.

	ITEMS	ALARM	GOHAGODA INTAKE				KATUGASTOTA WTP			REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP	MCC	IP		MONI.	PRN.		
STATUS INDICATION										
OPERATION SWITCH	CS :FORWARD-STOP-REVERSE		O							
FAULT INDICATION	EARTH FAULT	T		O			O	O		
	OVER LOAD	T		O			O	O		
	TROUBLE	T	O							
INST. INDICATION										

FACILITY	2.FLOCCULATION & SEDIMENTATION				
LOAD NAME	Sludge Collector [06SC11to 41]	CAPACITY	0.75kW	NUMBERS	4



OPERATING CONDITIONS

1.Protection relay nomal.
2.Torque nomal.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP	MCC	SCP	IP	MONI.	PRN.		
STATUS INDICATION	Sludge Collector START		O	O	O		O			
	Sludge Collector STOP		O	O	O		O			
OPERATION SWITCH	CS : STOP-START		O			O				
	COS : ELC.R-SITE		O							
	COS : MANU-AUTO					O				
	PBS : EMERGENCY STOP		O			O				
FAULT INDICATION	EARTH FAULT	T	O	O	O		O	O		
	OVER LOAD	T	O	O	O		O	O		
	OVER TORQUE	T	O		O		O	O		
	EMERGENCY STOP	T	O	O	O		O	O		
INST. INDICATION										

FACILITY	2.FLOCCULATION & SEDIMENTATION				
LOAD NAME	De-sludge Valve [06MV11to24]	CAPACITY	1ø0.2kW	NUMBERS	8

FILTER ELC. ROOM

Power supply from UPS

SITE

06LOP01,02

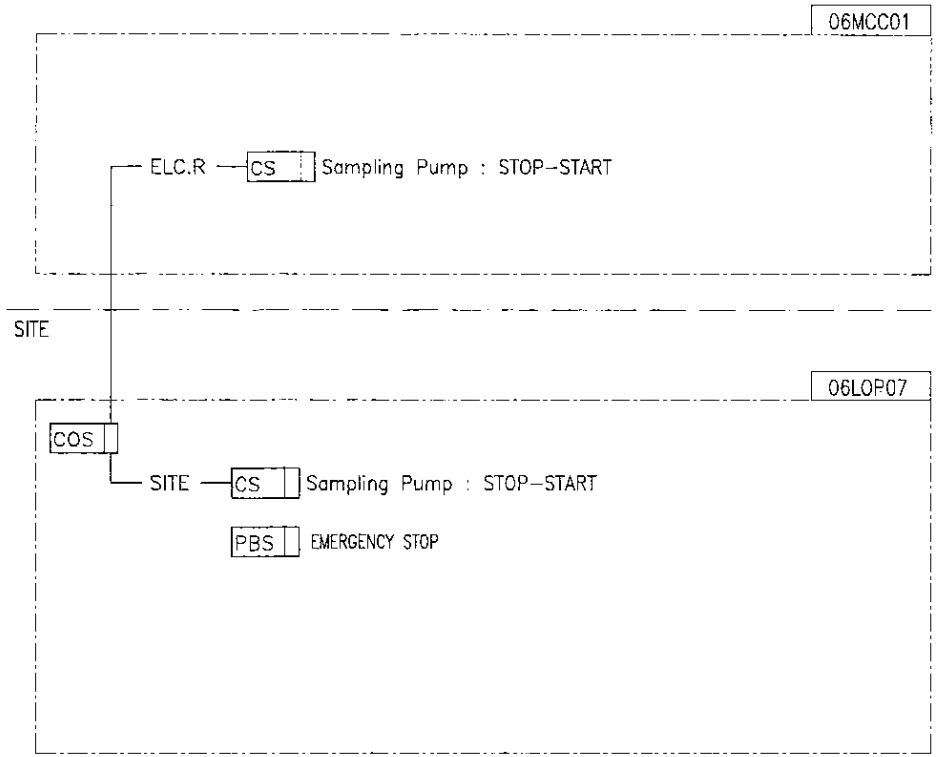
COS
- AUTO AUTOMATIC BY TIMER
- MANU — CS De-sludge Valve : CLOSE-OPEN

OPERATING CONDITIONS

1.Protection relay nomal.
2.Torque nomol.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP	MCC		IP	MONI.	PRN.		
STATUS INDICATION	De-sludge valve FULLY OPEN		O				O			
	De-sludge valve FULLY CLOSE		O				O			
OPERATION SWITCH	CS : CLOSE-OPEN		O							
	COS : MANU-AUTO		O							
FAULT INDICATION	EARTH FAULT	T	O				O	O		
	OVER LOAD	T	O				O	O		
	UPS FAILURE		O							
INST. INDICATION										

FACILITY	2.FLOCCULATION & SEDIMENTATION				
LOAD NAME	Sampling Pump [06SP01]	CAPACITY	0.4kW	NUMBERS	1

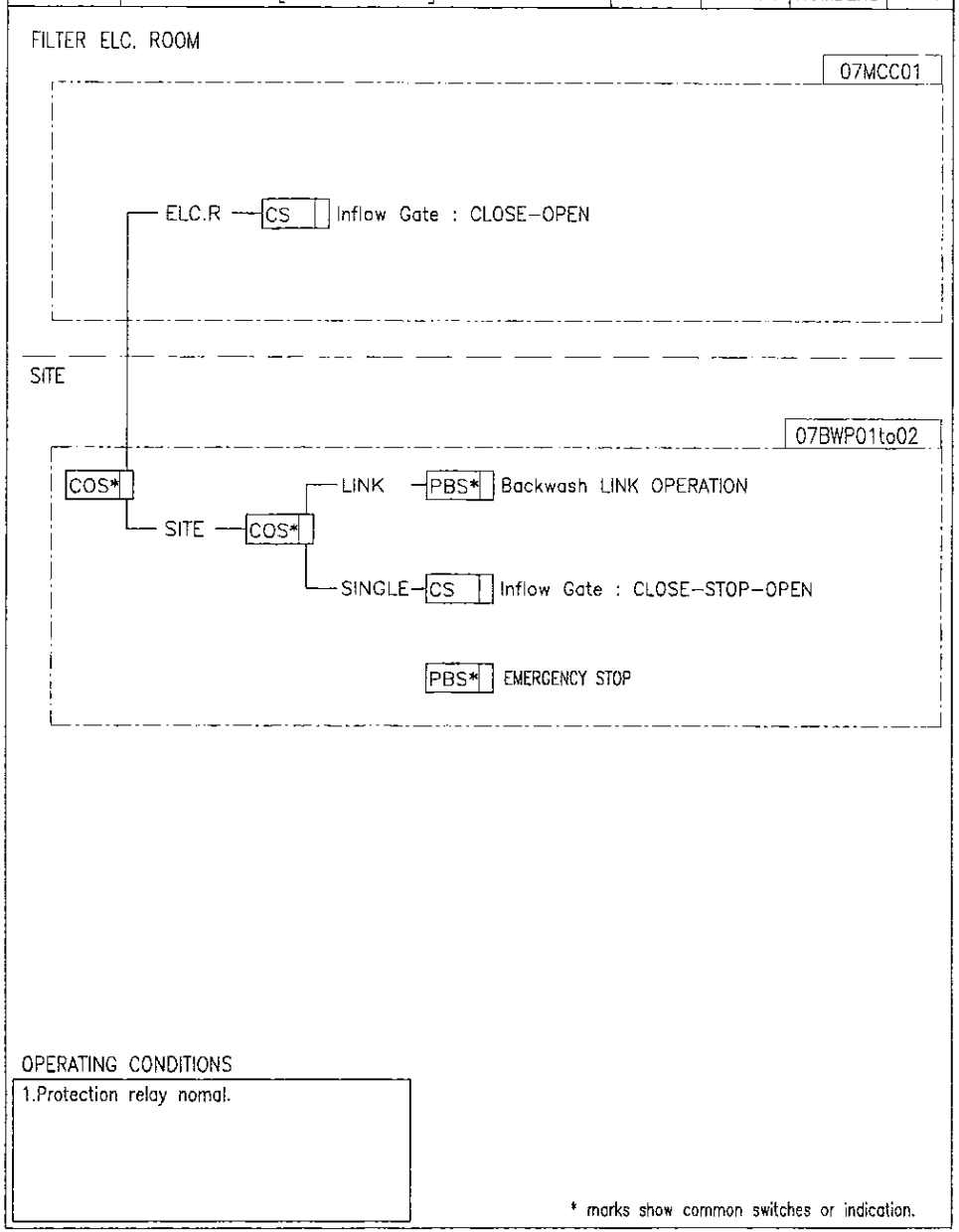


OPERATING CONDITIONS

1.Protection relay nomal.
2.Pump is not OVERHEAT or INUNDATION.
3.Sump drainage level above L.L.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP	MCC	IP		MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]			○						
	OPERATING LOCATION [SITE]			○						
	Sampling Pump START		○	○			○			
	Sampling Pump STOP		○	○			○			
OPERATION SWITCH	CS : STOP-START		○	○						
	COS : ELC.R-SITE		○							
	PBS : EMERGENCY STOP		○							
FAULT INDICATION	EARTH FAULT	T	○	○			○	○		
	OVER LOAD	T	○	○			○	○		
	SEDI. BASIN WATER LEVEL L.L.	T	○	○						
	EMERGENCY STOP	T	○	○			○	○		
INST. INDICATION										

FACILITY	3.FILTER UNITS				
LOAD NAME	Inflow Gate [07MG11to41]	CAPACITY	0.4kW	NUMBERS	4



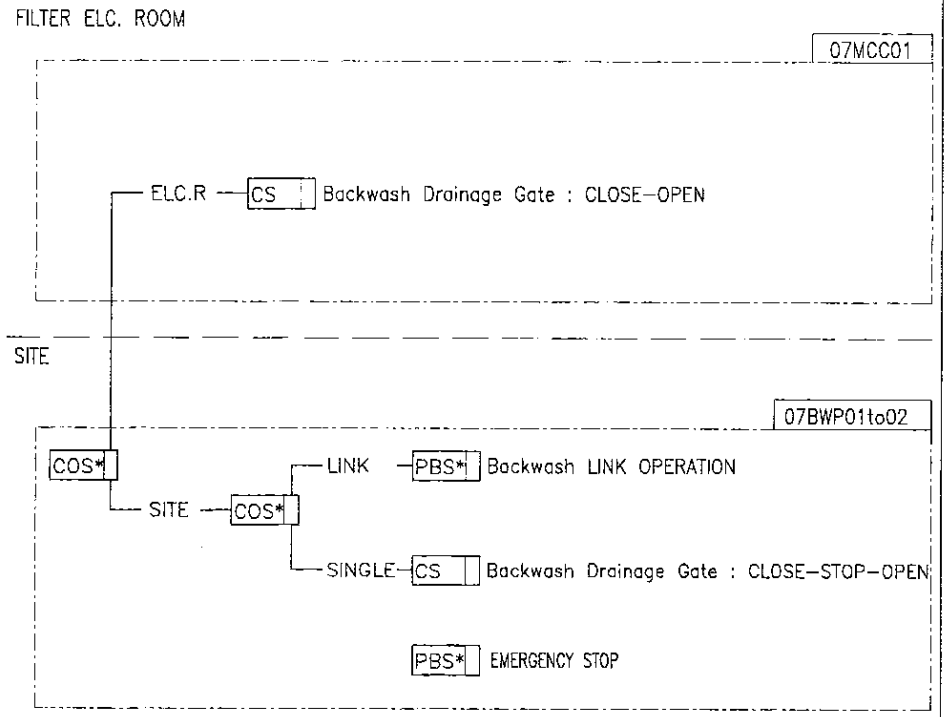
OPERATING CONDITIONS

1.Protection relay nomal.

* marks show common switches or indication.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE		ELC.ROOM		CENTRAL MONI. ROOM			
			LOP	BWP	MCC	IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]				○					
	OPERATING LOCATION [SITE]				○					
	Inflow Gate FULLY OPEN			○	○		○			
	Inflow Gate FULLY CLOSE			○	○		○			
	FILTERING*						○			
	BACKWASHING*						○			
OPERATION SWITCH	CS : STOP–START*			○						
	CS : CLOSE–STOP–OPEN			○						
	CS : CLOSE–OPEN				○					
	COS : ELC.R–SITE*			○						
	COS : SINGLE–LINK*			○						
	PBS : EMERGENCY STOP*			○						
FAULT INDICATION	EARTH FAULT	T			○		○	○		
	OVER LOAD	T		○	○		○	○		
	OVER TORQUE	T			○		○	○		
	FILTER LEVEL L.*			○						
	FILTER LEVEL H.*			○						
	EMERGENCY STOP*	T		○	○		○	○		
INST. INDICATION	FILTER WATER LEVEL*					○				

FACILITY	3.FILTER UNITS				
LOAD NAME	Backwash Drainage Gate [07MG12to42]	CAPACITY	0.4kW	NUMBERS	4



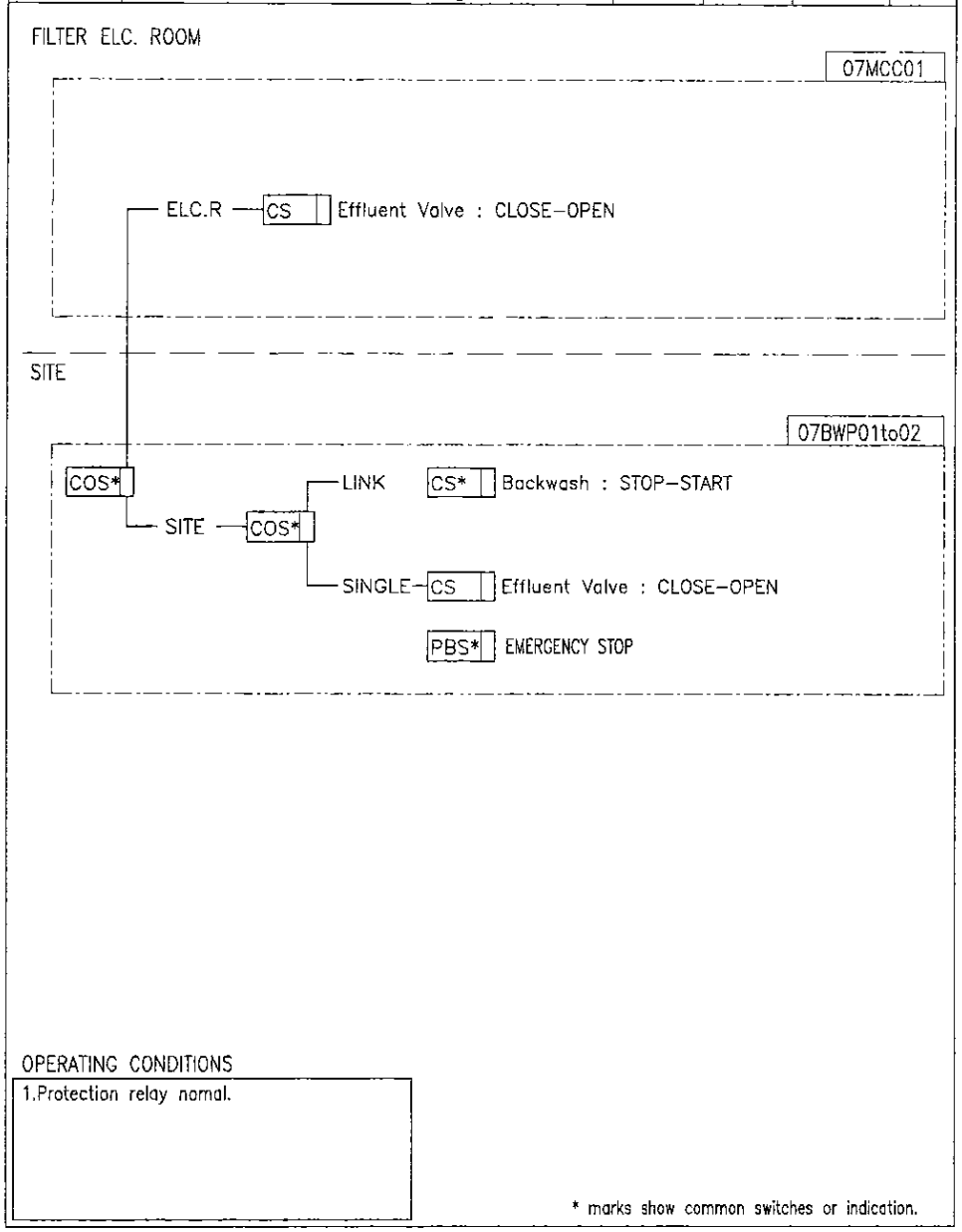
OPERATING CONDITIONS

1.Protection relay nomal.
2.Torque nomal.

* marks show common switches or indication.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE		ELC.ROOM		CENTRAL MONI. ROOM			
			LOP	BWP	MCC	IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]				○					
	OPERATING LOCATION [SITE]				○					
	B.W. Drainage Gate FULLY OPEN			○	○		○			
	B.W. Drainage Gate FULLY CLOSE			○	○		○			
	FILTERING*						○			
	BACKWASHING*						○			
OPERATION SWITCH	CS : STOP–START*			○						
	CS : CLOSE–STOP–OPEN			○						
	CS : CLOSE–OPEN				○					
	COS : ELC.R–SITE*			○						
	COS : SINGLE–LINK*			○						
	PBS : EMERGENCY STOP*			○						
FAULT INDICATION	EARTH FAULT	T			○		○	○		
	OVER LOAD	T		○	○		○	○		
	OVER TORQUE	T			○		○	○		
	EMERGENCY STOP*	T		○	○		○	○		
INST. INDICATION										

FACILITY	3.FILTER UNITS				
LOAD NAME	Effluent Valve [07MV11to41]	CAPACITY	0.2kW	NUMBERS	4



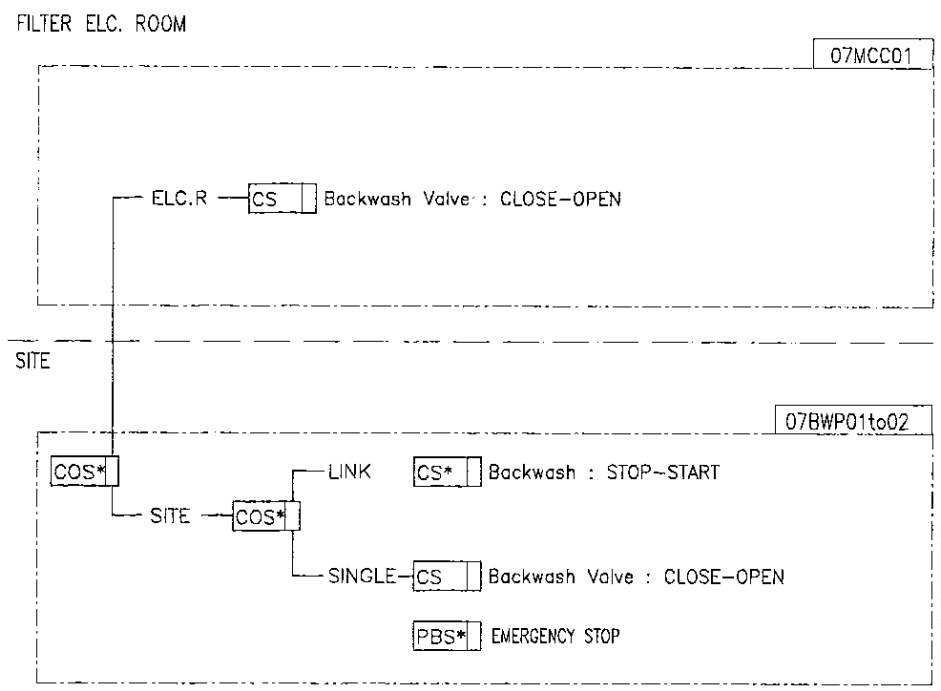
OPERATING CONDITIONS

1.Protection relay nomal.

* marks show common switches or indication.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE		ELC.ROOM		CENTRAL MONI. ROOM			
			LOP	BWP	MCC	IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]				○					
	OPERATING LOCATION [SITE]				○					
	Effluent Valve FULLY OPEN			○	○		○			
	Effluent Valve FULLY CLOSE			○	○		○			
	FILTERING*						○			
	BACKWASHING*						○			
OPERATION SWITCH	CS : STOP-START*			○						
	CS : CLOSE-STOP-OPEN									
	CS : CLOSE-OPEN			○	○					
	COS : ELC.R-SITE*			○						
	COS : SINGLE-LINK*			○						
	PBS : EMERGENCY STOP*			○						
FAULT INDICATION	EARTH FAULT	T		○	○		○	○		
	OVER LOAD	T			○		○	○		
	EMERGENCY STOP*	T		○	○		○	○		
INST. INDICATION										

FACILITY	3.FILTER UNITS				
LOAD NAME	Backwash Valve [07MV12to42]	CAPACITY	0.2kW	NUMBERS	4



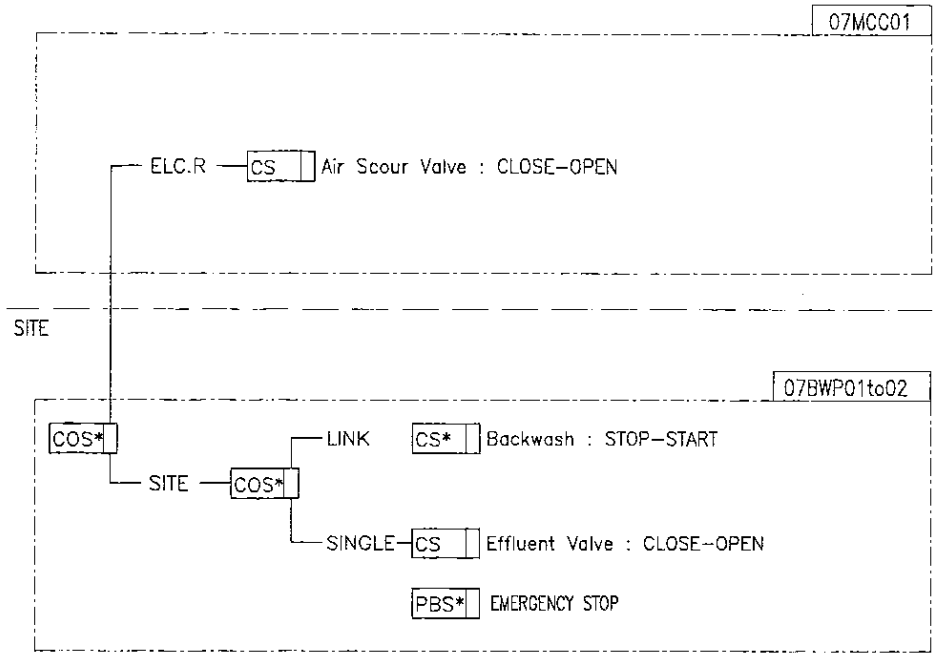
OPERATING CONDITIONS

1.Protection relay nomal.
2.Torque nomal.

* marks show common switches or indication.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE		ELC.ROOM		CENTRAL MONI. ROOM			
			LOP	BWP	MCC	IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]				○					
	OPERATING LOCATION [SITE]				○					
	Backwash Valve FULLY OPEN			○	○		○			
	Backwash Valve FULLY CLOSE			○	○		○			
	FILTERING*			○			○			
	BACKWASHING*			○			○			
OPERATION SWITCH	CS : STOP-START*			○						
	CS : CLOSE-STOP-OPEN									
	CS : CLOSE-OPEN			○	○					
	COS : ELC.R-SITE*			○						
	COS : SINGLE-LINK*			○						
	PBS : EMERGENCY STOP*			○						
FAULT INDICATION	EARTH FAULT	T		○	○		○	○		
	OVER LOAD	T			○		○	○		
	EMERGENCY STOP*	T		○	○		○	○		
INST. INDICATION										

FACILITY	3.FILTER UNITS				
LOAD NAME	Air Scour Valve [07MV13to43]	CAPACITY	0.2kW	NUMBERS	4



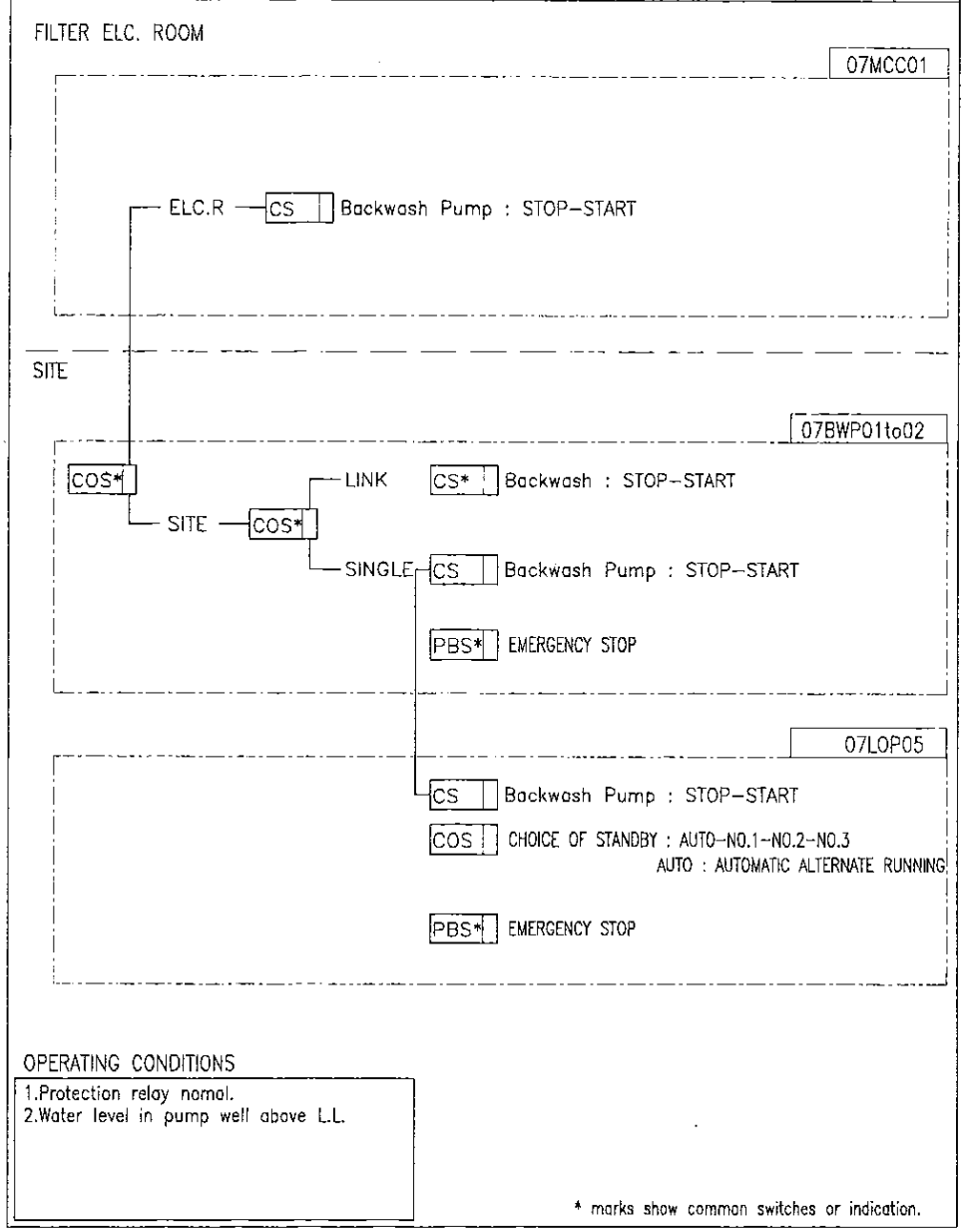
OPERATING CONDITIONS

1.Protection relay nomal.
2.Torque nomal.

* marks show common switches or indication.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE		ELC.ROOM		CENTRAL MONI. ROOM			
			LOP	BWP	MCC	IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]				○					
	OPERATING LOCATION [SITE]				○					
	Air Scour Valve FULLY OPEN			○	○		○			
	Air Scour Valve FULLY CLOSE			○	○		○			
	FILTERING*			○			○			
	BACKWASHING*			○			○			
OPERATION SWITCH	CS : STOP-START*			○						
	CS : CLOSE-STOP-OPEN									
	CS : CLOSE-OPEN			○	○					
	COS : ELC.R-SITE*			○						
	COS : MANU-LINK*			○						
				○						
FAULT INDICATION	EARTH FAULT	T		○	○		○	○		
	OVER LOAD	T			○		○	○		
	EMERGENCY STOP*	T		○	○		○	○		
INST. INDICATION										

FACILITY	3.FILTER UNITS				
LOAD NAME	Backwash Pump [07FP11to31]	CAPACITY	18.5kW	NUMBERS	3(1)



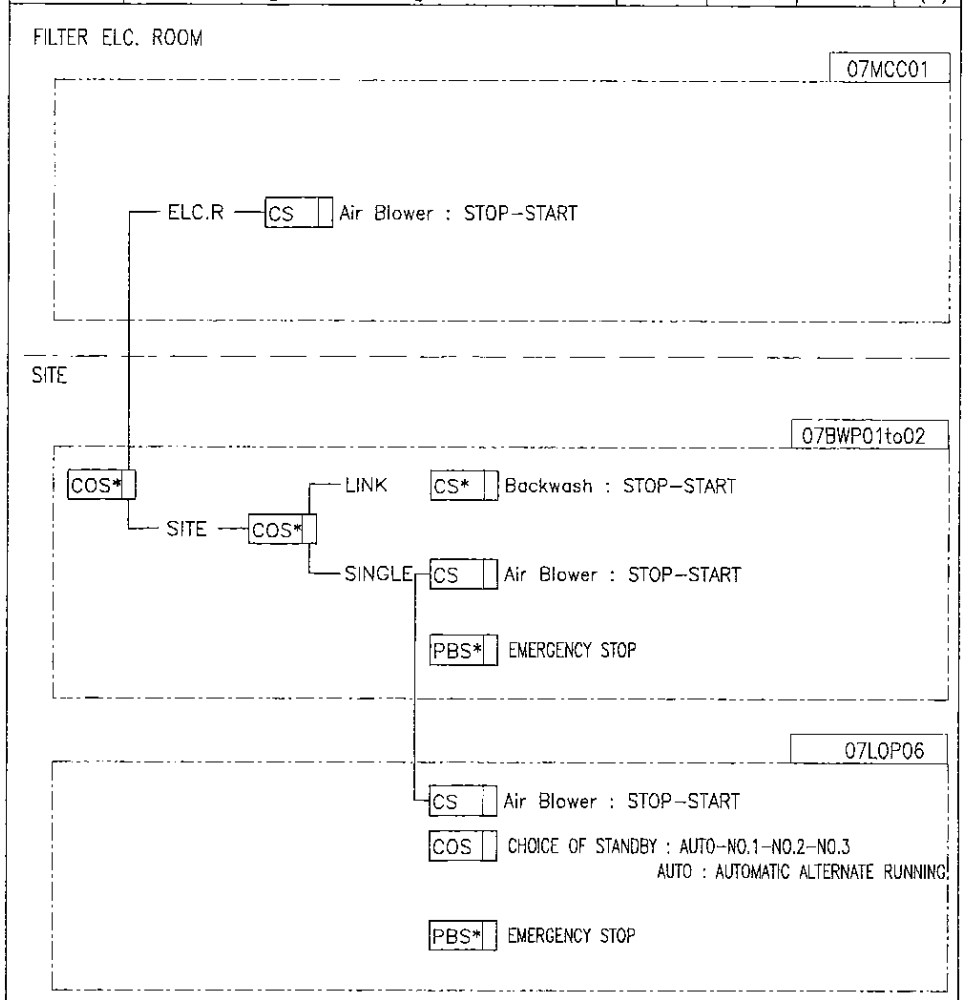
OPERATING CONDITIONS

1.Protection relay nomal.
2.Water level in pump well above L.L.

* marks show common switches or indication.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE		ELC.ROOM		CENTRAL MONI. ROOM			
			LOP	BWP	MCC	IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]				○					
	OPERATING LOCATION [SITE]				○					
	Backwash Pump START		○	○	○		○			
	Backwash Pump STOP		○	○	○		○			
	FILTERING*						○			
	BACKWASHING*						○			
OPERATION SWITCH	CS : STOP-START*			○						
	CS : STOP-START		○	○	○					
	COS : ELC.R-SITE*			○						
	COS : SINGLE-LINK*			○						
	COS : AUTO-NO.1-NO.2-NO.3		○							
	PBS : EMERGENCY STOP*		○	○						
FAULT INDICATION	EARTH FAULT	T	○	○	○		○	○		
	OVER LOAD	T	○		○		○	○		
	BACKWASH WATER TANK LEVEL L.L.	T	○	○	○		○	○		
	EMERGENCY STOP*	T	○	○	○		○	○		
INST. INDICATION	AMMETER		○		○					
	RUNNING HOUR METER				○					
	BACKWASH WATER TANK LEVEL					○				
	BACKWASH WATER FLOW		○			○				

FACILITY	3.FILTER UNITS				
LOAD NAME	Air Blower [07AB11to21]	CAPACITY	55kW	NUMBERS	2(1)



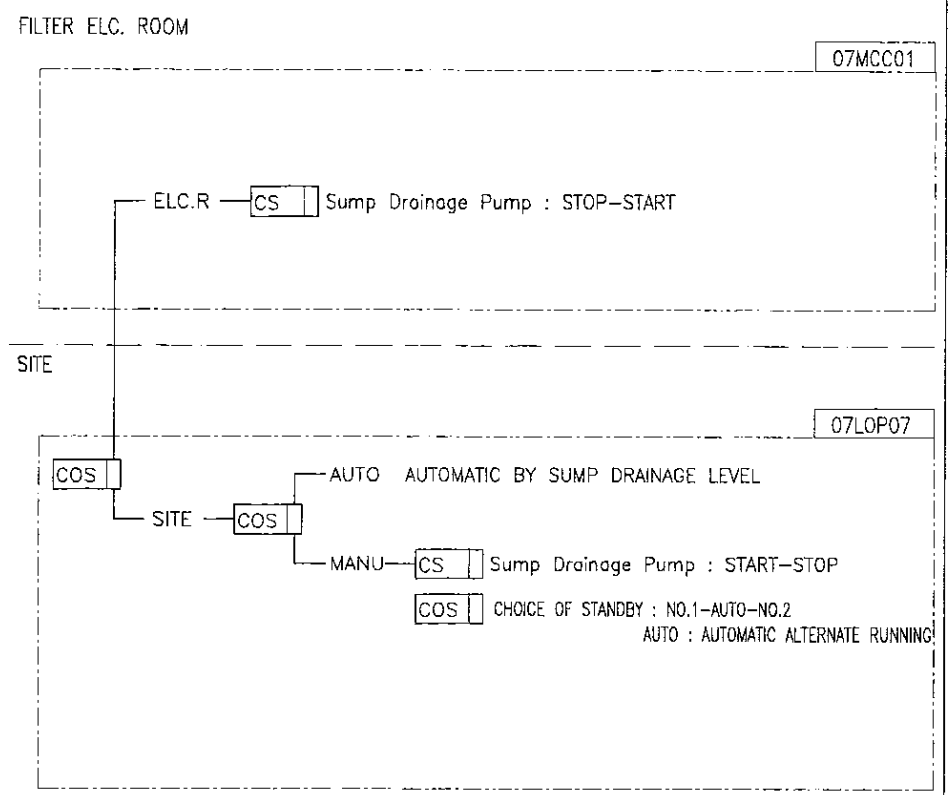
OPERATING CONDITIONS

1.Protection relay nomal.

* marks show common switches or indication.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE		ELC.ROOM		CENTRAL MONI. ROOM			
			LOP	BWP	MCC	IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]				○					
	OPERATING LOCATION [SITE]				○					
	Air Blower START		○	○	○		○			
	Air Blower STOP		○	○	○		○			
	FILTERING*			○			○			
	BACKWASHING*			○			○			
OPERATION SWITCH	CS : STOP-START*			○						
	CS : STOP-START		○	○	○					
	COS : ELC.R-SITE*			○						
	COS : SINGLE-LINK*			○						
	COS : AUTO-NO.1-NO.2-NO.3		○							
	PBS : EMERGENCY STOP*		○	○						
FAULT INDICATION	EARTH FAULT	T	○		○		○	○		
	OVER LOAD	T	○	○	○		○	○		
	OVER HEAT	T	○		○		○	○		
	EMERGENCY STOP*	T	○	○	○		○	○		
INST. INDICATION	AMMETER		○		○					
	RUNNING HOUR METER				○					
	AIR SCOURING FLOW		○			○				

FACILITY	3.FILTER UNITS				
LOAD NAME	Sump Drainage Pump [07DP01/02]	CAPACITY	1.5kW	NUMBERS	2(1)

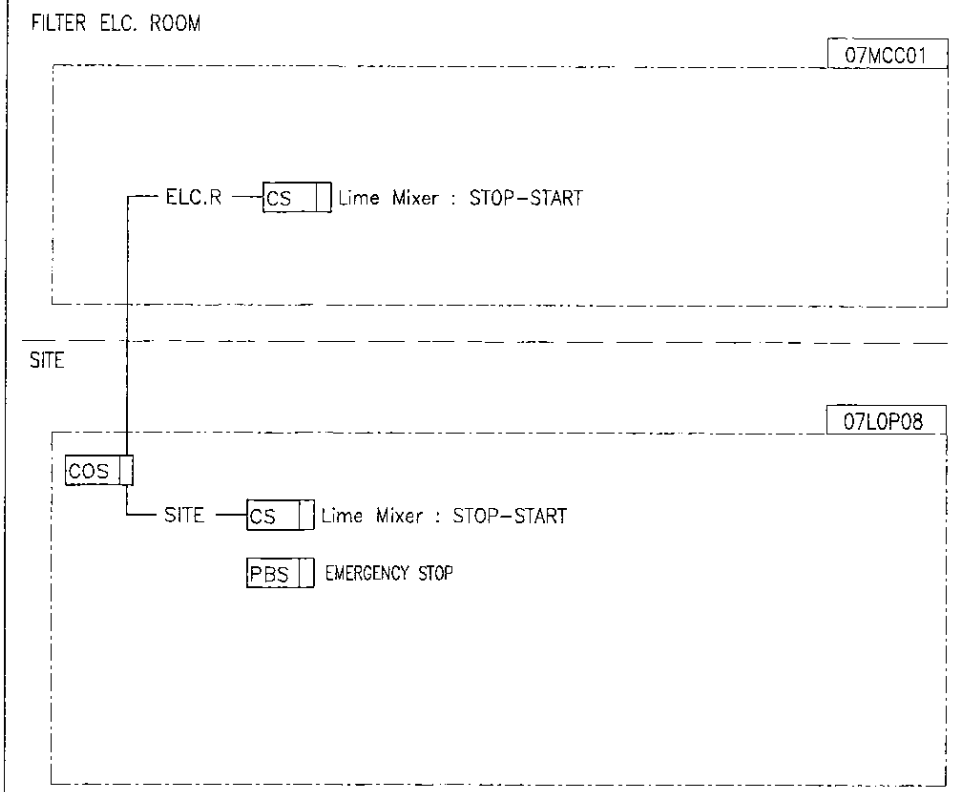


OPERATING CONDITIONS

1.Protection relay nomal.
2.Sump drainage level above L.L.

	ITEMS	ALARM	KATUGASTOTA WTP								REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM				
			LOP	MCC	IP		MONI.	PRN.			
STATUS INDICATION	OPERATING LOCATION [ELC.R]			○							
	OPERATING LOCATION [SITE]			○							
	Sump Drainage Pump START		○	○			○				
	Sump Drainage Pump STOP		○	○			○				
OPERATION SWITCH	CS : START-STOP		○	○							
	COS : ELC.R-SITE		○								
	COS : MANU-AUTO		○								
	COS : NO.1-AUTO-NO.2		○								
	PBS : EMERGENCY STOP		○								
FAULT INDICATION	EARTH FAULT	T	○	○			○	○			
	OVER LOAD	T	○	○			○	○			
	SUMP DRAINAGE LEVEL H.H.		○	○			○				
	SUMP DRAINAGE LEVEL L.L.	T	○	○							
INST. INDICATION	RUNNING HOUR METER			○							

FACILITY	FILTER UNITS				
LOAD NAME	Lime Mixer [07MM11]	CAPACITY	0.4kW	NUMBERS	1

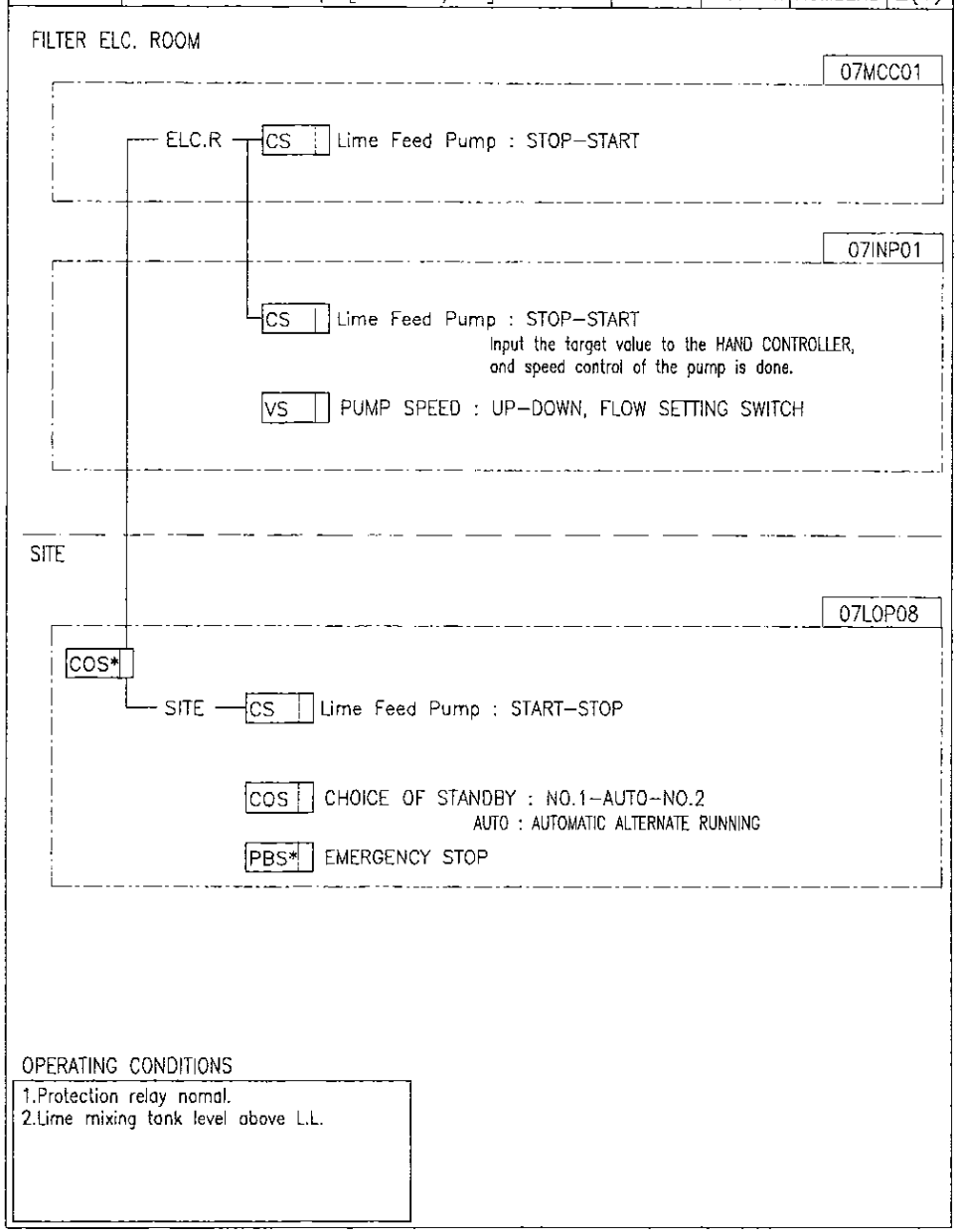


OPERATING CONDITIONS

1.Protection relay nomal.
2.Lime mixing tank level above L.L.

	ITEMS	ALARM	KATUGASTOTA WTP								REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM				
			LOP	MCC	IP		MONI.	PRN.			
STATUS INDICATION	OPERATING LOCATION [ELC.R]			O							
	OPERATING LOCATION [SITE]			O							
	Lime Mixer START		O	O			O				
	Lime Mixer STOP		O	O			O				
OPERATION SWITCH	CS : STOP-START		O	O							
	COS : ELC.R-SITE		O								
	PBS : EMERGENCY STOP*		O								
FAULT INDICATION	EARTH FAULT	T	O	O	O		O	O			
	OVER LOAD	T	O	O			O	O			
	LIME MIXING TANK LEVEL L.L.	T	O	O			O				
	LIME MIXING TANK LEVEL H.H.		O				O				
	EMERGENCY STOP	T	O	O			O	O			
INST. INDICATION											

FACILITY	3.FILTER UNITS				
LOAD NAME	Lime Feed Pump [07LP11/21]	CAPACITY	0.4kW	NUMBERS	2(1)

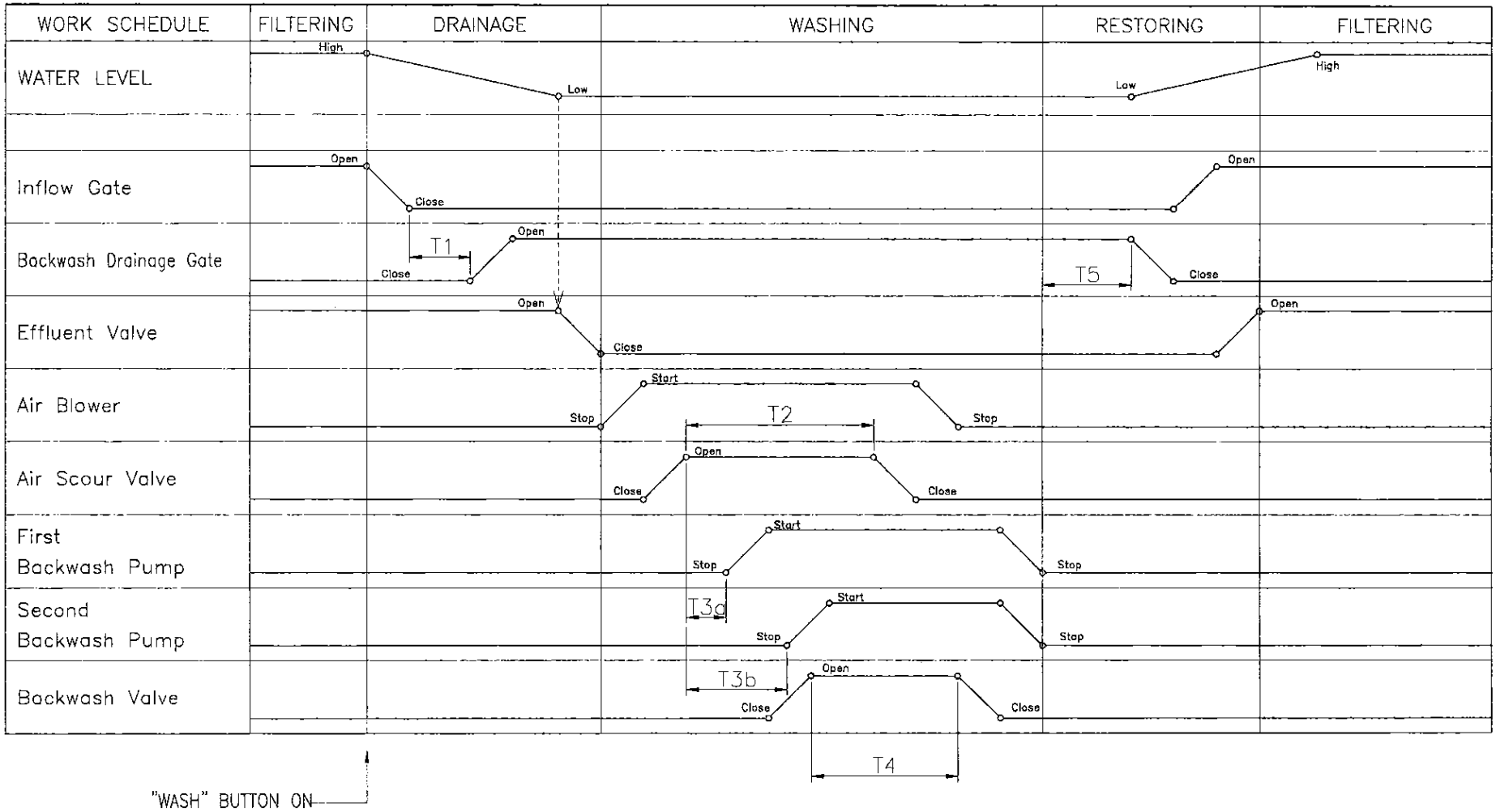


OPERATING CONDITIONS

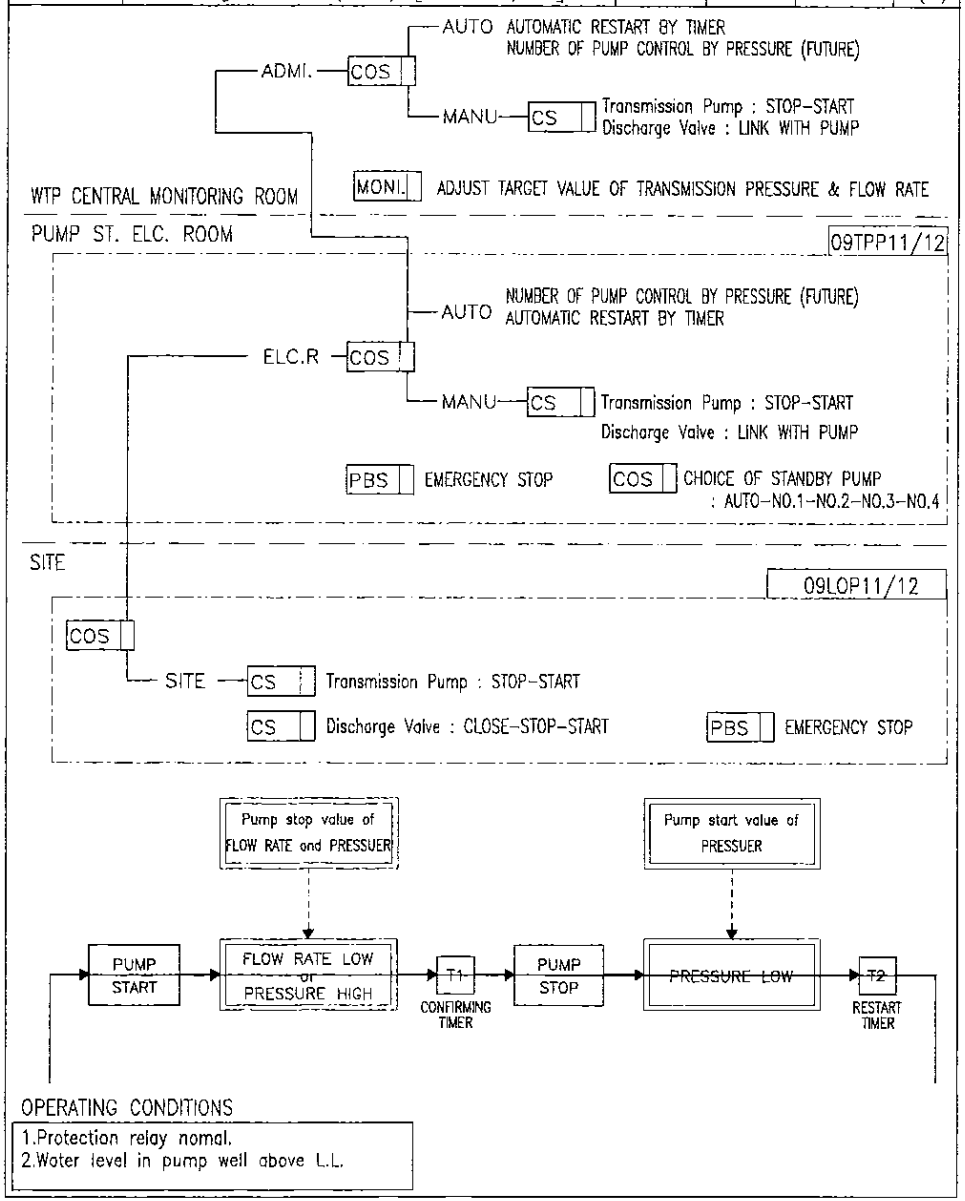
1.Protection relay normal.
2.Lime mixing tank level above L.L.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP	MCC		IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]			○						
	OPERATING LOCATION [SITE]			○						
	Lime Feed Pump START		○	○		○	○			
	Lime Feed Pump STOP		○	○		○	○			
OPERATION SWITCH	CS : START–STOP		○	○		○				
	COS : ELC.R–SITE*		○							
	COS : NO.1–AUTO–NO.2		○							
	VS : UP–DOWN					○				
	FLOW SETTING SWITCH					○				
	PBS : EMERGENCY STOP*		○							
FAULT INDICATION	EARTH FAULT	T	○	○		○	○	○		
	OVER LOAD	T	○	○			○	○		
	LIME MIXING TANK LEVEL L.L.*	T	○	○		○	○			
	LIME MIXING TANK LEVEL H.H.*		○				○			
	EMERGENCY STOP*	T	○	○			○	○		
INST. INDICATION	RUNNING HOUR METER			○						
	PRE LIME DOSING FLOW					○	○			

FILTER WASHING TIME SCHEDULE



FACILITY	4.CLEAR WATER PUMP STATION				
LOAD NAME	Transmission Pump (A-1) [09CP11/12]	CAPACITY	450kW	NUMBERS	2(1)
	Discharge Valve (A-1) [09MV11/12]		0.2kW		2(1)

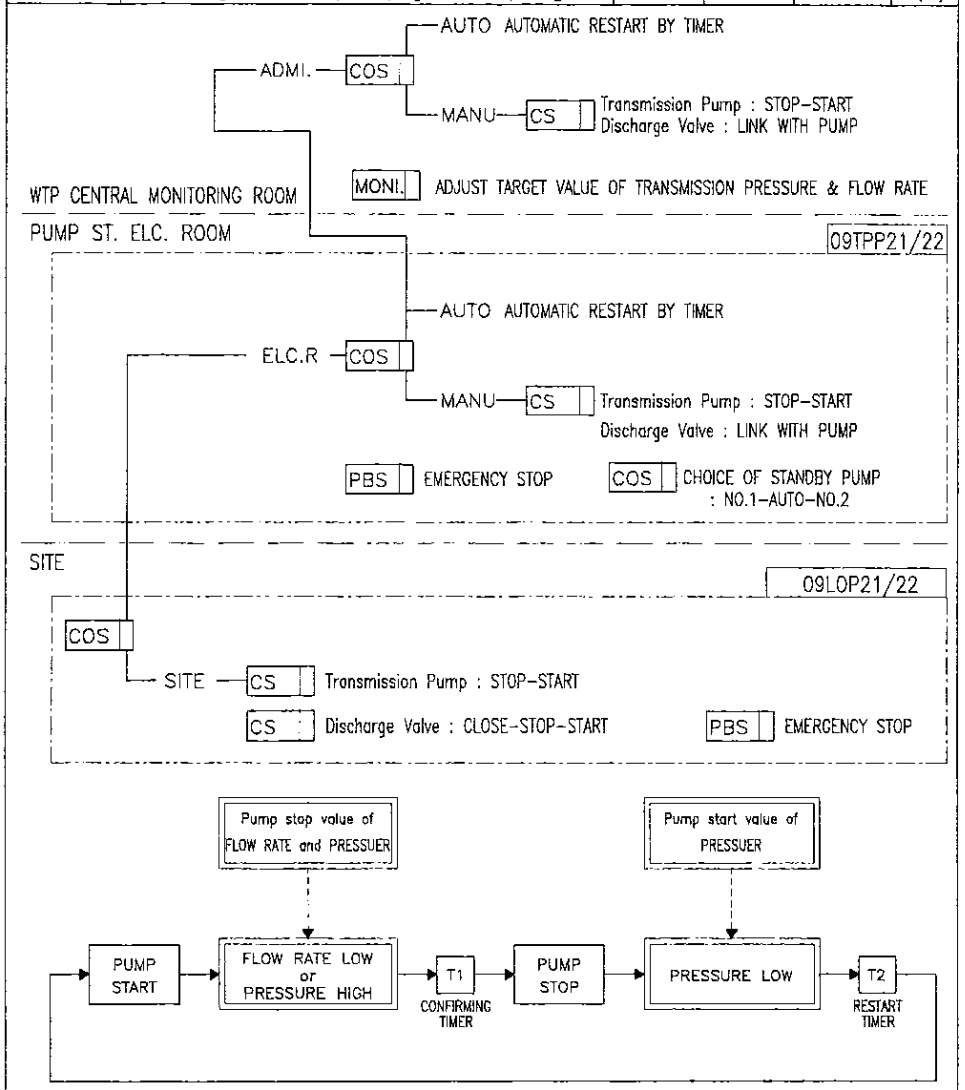


OPERATING CONDITIONS

1.Protection relay nomal.
2.Water level in pump well above L.L.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP	TPP		IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]			○			○			
	OPERATING LOCATION [SITE]			○			○			
	OPERATING MODE [AUTO]						○			
	OPERATING MODE [MANU]						○			
	Transmission Pump START		○	○			○			
	Transmission Pump STOP		○	○			○			
	Discharge Valve FULLY OPEN		○	○			○			
	Discharge Valve FULLY CLOSE		○	○			○			
OPERATION SWITCH	CS : STOP-START		○	○			○			
	CS : CLOSE-STOP-OPEN		○							
	COS : ELC.R-SITE		○							
	COS : MANU-AUTO-ADMI.			○						
	COS : AUTO-NO.1-NO.2-NO.3-NO.4			○						
	PBS :EMERGENCY STOP		○	○						
	SETTING SW. : PRESSURE for STOP						○			
	SETTING SW. : FLOW RATE for STOP						○			
	SETTING SW. : PRESSURE for START						○			
FAULT INDICATION	EARTH FAULT	T		○			○	○		
	OVER LOAD	T	○	○			○	○		
	OVER HEAT	T		○			○	○		
	CLEAR WATER RESERVOIR LEVEL L.L	T	○	○			○	○		
	TRANSMISSION FLOW RATE LOW	T		○			○			
	TRANSMISSION PRESSURE HIGH	T		○			○			
	EMERGENCY STOP	T	○	○			○	○		
INST. INDICATION	AMMETER			○						
	RUNNING HOUR METER			○						
	TRANSMISSION FLOW					○	○			
	TRANSMISSION PRESSURE					○	○			
	CLEAN WATER RESERVOIR LEVEL					○	○			

FACILITY	4.CLEAR WATER PUMP STATION				
LOAD NAME	Transmission Pump (A-2) [09CP21/22]	CAPACITY	90kW	NUMBERS	2(1)
	Discharge Valve (A-2) [09MV21/22]		0.2kW		2(1)

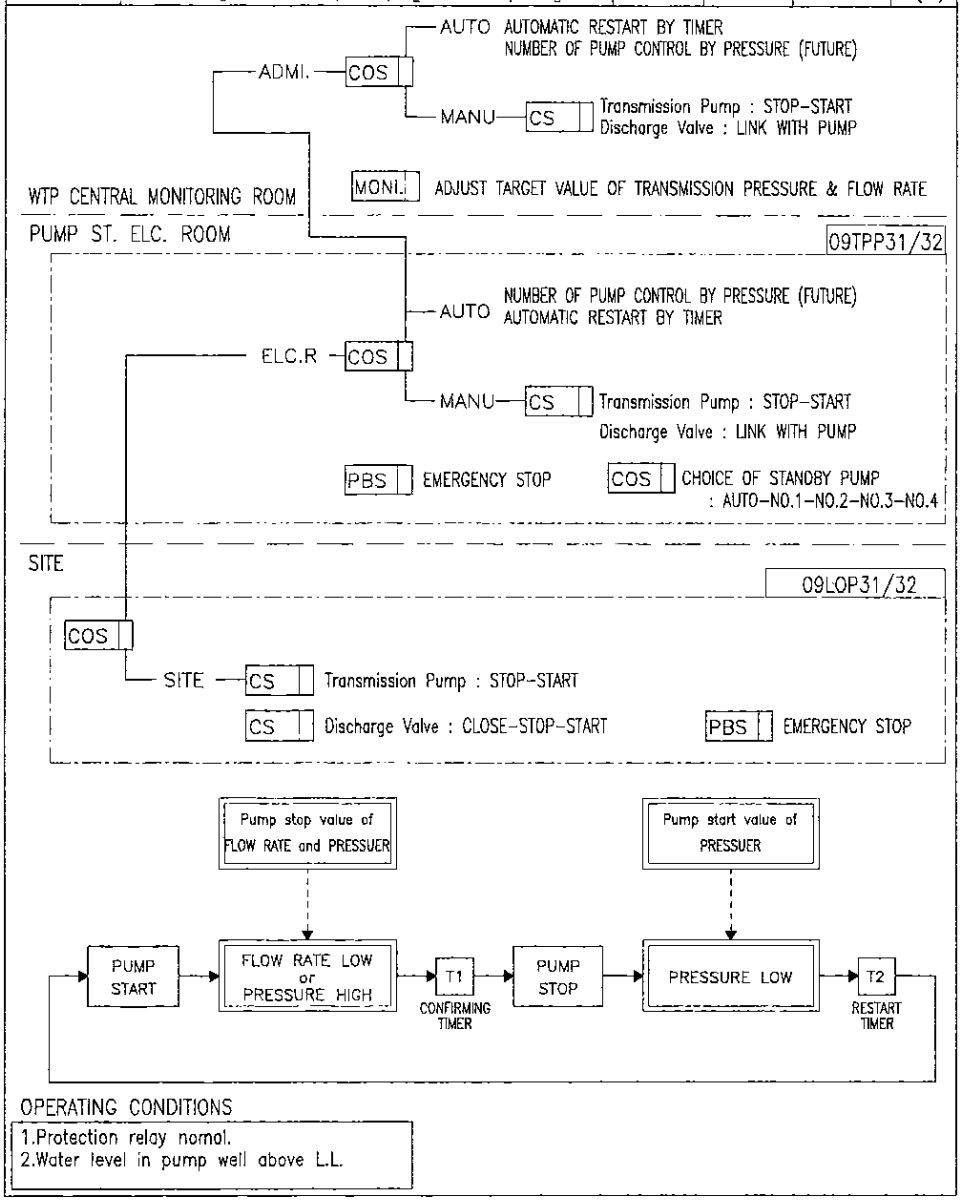


OPERATING CONDITIONS

1.Protection relay nomal.
2.Water level in pump well above L.L.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP	TPP	VVF	IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]			O			O			
	OPERATING LOCATION [SITE]			O			O			
	OPERATING MODE [AUTO]						O			
	OPERATING MODE [MANU]						O			
	Transmission Pump START		O	O			O			
	Transmission Pump STOP		O	O			O			
	Discharge Valve FULLY OPEN		O	O			O			
	Discharge Valve FULLY CLOSE		O	O			O			
OPERATION SWITCH	CS : STOP-START		O	O			O			
	CS : CLOSE-STOP-OPEN		O							
	COS : ELC.R-SITE		O							
	COS : MANU-AUTO-ADMI.			O						
	COS : NO.1-AUTO-NO.2			O						
	COS : MANU-AUTO						O			
	PBS :EMERGENCY STOP		O	O						
	SETTING SW. : PRESSURE for STOP						O			
	SETTING SW. : FLOW RATE for STOP						O			
	SETTING SW. : PRESSURE for START						O			
FAULT INDICATION	EARTH FAULT	T		O			O	O		
	OVER LOAD	T	O	O			O	O		
	OVER HEAT	T		O			O	O		
	CLEAR WATER RESERVOIR LEVEL L.L.	T	O	O			O	O		
	TRANSMISSION FLOW RATE LOW	T		O			O			
	TRANSMISSION PRESSURE HIGH	T		O			O			
	EMERGENCY STOP	T	O	O			O	O		
INST. INDICATION	AMMETER			O						
	RUNNING HOUR METER			O						
	TRANSMISSION FLOW					O	O			
	TRANSMISSION PRESSURE					O	O			
	CLEAN WATER RESERVOIR LEVEL					O	O			

FACILITY	4.CLEAR WATER PUMP STATION				
LOAD NAME	Transmission Pump (A-3) [09CP31/32]	CAPACITY	250kW	NUMBERS	2(1)
	Discharge Valve (A-3) [09MV31/32]		0.2kW		2(1)



OPERATING CONDITIONS

1.Protection relay nomal.
2.Water level in pump well above L.L.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP	TPP	WF	IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]			O			O			
	OPERATING LOCATION [SITE]			O			O			
	OPERATING MODE [AUTO]						O			
	OPERATING MODE [MANU]						O			
	Transmission Pump START		O	O			O			
	Transmission Pump STOP		O	O			O			
	Discharge Valve FULLY OPEN		O	O			O			
	Discharge Valve FULLY CLOSE		O	O			O			
OPERATION SWITCH	CS : STOP-START		O	O			O			
	CS : CLOSE-STOP-OPEN		O							
	COS : ELC.R-SITE		O							
	COS : MANU-AUTO-ADMI.			O						
	COS : AUTO-NO.1-NO.2-NO.3-NO.4			O						
	PBS :EMERGENCY STOP		O	O						
	SETTING SW. : PRESSURE for STOP						O			
	SETTING SW. : FLOW RATE for STOP						O			
	SETTING SW. : PRESSURE for START						O			
FAULT INDICATION	EARTH FAULT	T		O			O	O		
	OVER LOAD	T	O	O			O	O		
	OVER HEAT	T		O			O	O		
	CLEAR WATER RESERVOIR LEVEL L.L.	T	O	O			O	O		
	TRANSMISSION FLOW RATE LOW	T		O			O			
	TRANSMISSION PRESSURE HIGH	T		O			O			
	EMERGENCY STOP	T	O	O			O	O		
INST. INDICATION	AMMETER			O						
	RUNNING HOUR METER			O						
	TRANSMISSION FLOW					O	O			
	TRANSMISSION PRESSURE					O	O			
	CLEAN WATER RESERVOIR LEVEL					O	O			

FACILITY	4.CLEAR WATER PUMP STATION				
LOAD NAME	Sump Drainage Pump [09DP01/02]	CAPACITY	1.5kW	NUMBERS	2(1)

MAIN ELEC. ROOM

POWER SUPPLY ONLY

SITE

09LOP01

COS
- AUTO AUTOMATIC BY SUMP DRAINAGE LEVEL
- MANU — CS Sump Drainage Pump : STOP--START
- COS CHOICE OF STANDBY : NO.1-AUTO-NO.2
  AUTO : AUTOMATIC ALTERNATE RUNNING
- PBS EMERGENCY STOP

OPERATING CONDITIONS

1.Protection relay normal.
2.Sump drainage level above L.L.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP				MONI.	PRN.		
STATUS INDICATION	Sump Drainage Pump START		O				O			
	Sump Drainage Pump STOP		O				O			
OPERATION SWITCH	CS : STOP--START		O							
	COS : ELC.R-SITE		O							
	COS : MANU-AUTO		O							
	COS : NO.1-AUTO-NO.2		O							
	PBS : EMERGENCY STOP		O							
FAULT INDICATION	EARTH FAULT	T	O				O	O		
	OVER LOAD	T	O				O	O		
	SUMP DRAINAGE LEVEL H.H.		O				O			
	SUMP DRAINAGE LEVEL L.L.	T	O							
	EMERGENCY STOP	T	O				O	O		
INST. INDICATION	RUNNING HOUR METER		O							

FACILITY	4.CLEAR WATER PUMP STATION				
LOAD NAME	Plant Water Supply Unit [09PU01]	CAPACITY	11kW*2	NUMBERS	1

MAIN ELEC. ROOM

POWER SUPPLY ONLY

SITE

Mechanical Standard Equipped

CS Plant Water Supply Unit : STOP-START

OPERATING CONDITIONS

1.Protection relay nomal.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP				MONI.	PRN.		
STATUS INDICATION	Plant Water Supply Unit START		○				○			
	Plant Water Supply Unit STOP		○				○			
OPERATION SWITCH	CS : STOP-START		○							
FAULT INDICATION	EARTH FAULT	T	○				○	○		
	OVER LOAD	T	○				○	○		
	TROUBLE	T	○				○	○		
INST. INDICATION										

FACILITY	4.CLEAR WATER PUMP STATION				
LOAD NAME	Chlorination Booster Pump [09PP11/21]	CAPACITY	5.5kW	NUMBERS	2(1)

MAIN ELEC. ROOM

POWER SUPPLY ONLY

PUMP STATION

09LOP02

CS Chlorination Booster Pump : STOP-START

COS CHOICE OF STANDBY : AUTO-NO.1-NO.2-NO.3
AUTO : AUTOMATIC ALTERNATE RUNNING

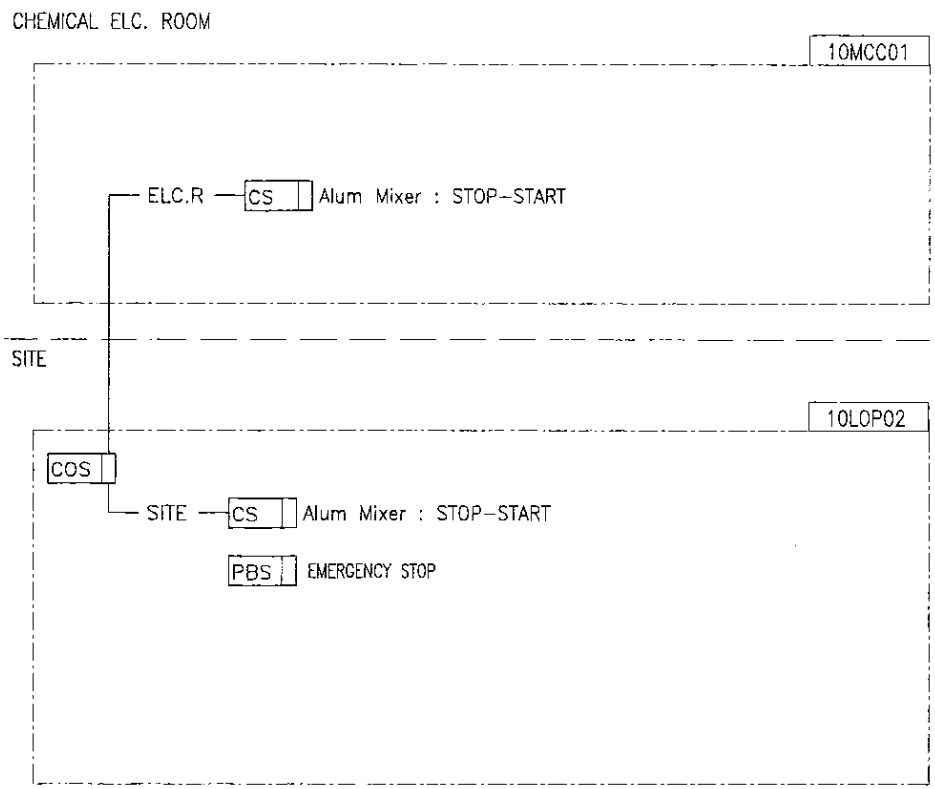
PBS EMERGENCY STOP

OPERATING CONDITIONS

1.Protection relay nomal.
2.Pump is not OVERHEAT or INUNDATION.
3.Water level in pump well above L.L.

	ITEMS	ALARM	KATUGASTOTA WTP								REMARKS
			P St.		ELC.ROOM		CENTRAL MONI. ROOM				
			LOP			IP	MONI.	PRN.			
STATUS INDICATION	Chlorination Booster Pump START		O				O				
	Chlorination Booster Pump STOP		O				O				
OPERATION SWITCH	CS : STOP-START		O								
	COS : AUTO-NO.1-NO.2-NO.3		O								
	PBS : EMERGENCY STOP		O								
FAULT INDICATION	EARTH FAULT	T	O				O	O			
	OVER LOAD	T	O				O	O			
	PUMP WET WELL LEVEL L.L.	T	O								
	EMERGENCY STOP	T	O				O	O			
INST. INDICATION	RUNNING HOUR METER		O								

FACILITY	5.CHEMICAL DOSING				
LOAD NAME	Alum Mixer [10MM11/21]	CAPACITY	1.5kW	NUMBERS	2

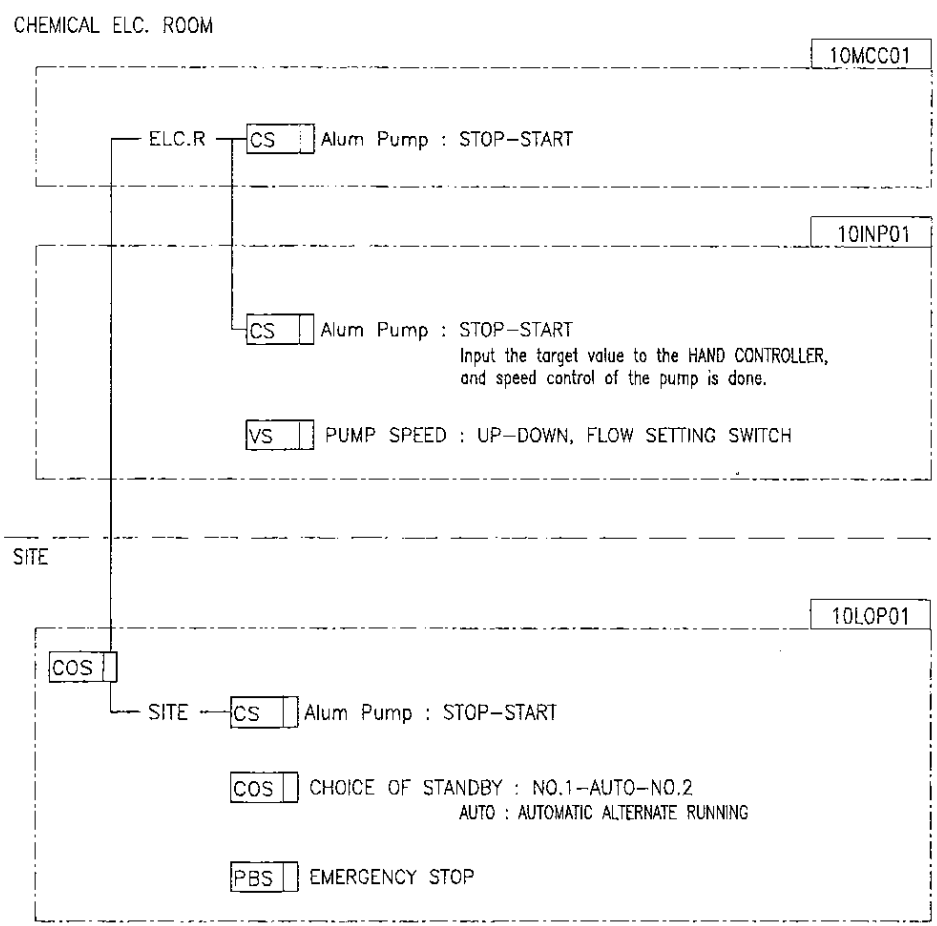


OPERATING CONDITIONS

1.Protection relay nomal.
2.Alum mixing tank level above L.L.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP	MCC		IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]			○						
	OPERATING LOCATION [SITE]			○						
	Alum Mixer START		○	○			○			
	Alum Mixer STOP		○	○			○			
OPERATION SWITCH	CS : STOP-START		○	○						
	COS : ELC.R-SITE		○							
	PBS : EMERGENCY STOP		○							
FAULT INDICATION	EARTH FAULT	T	○	○		○	○	○		
	OVER LOAD	T	○	○			○	○		
	ALUM MIXING TANK LEVEL L.L.	T	○	○		○	○			
	ALUM MIXING TANK LEVEL H.H.					○	○			
	EMERGENCY STOP	T	○	○			○	○		
INST. INDICATION										

FACILITY	5.CHEMICAL DOSING				
LOAD NAME	Alum Pump [10AP11/21]	CAPACITY	0.4kW	NUMBERS	2(1)

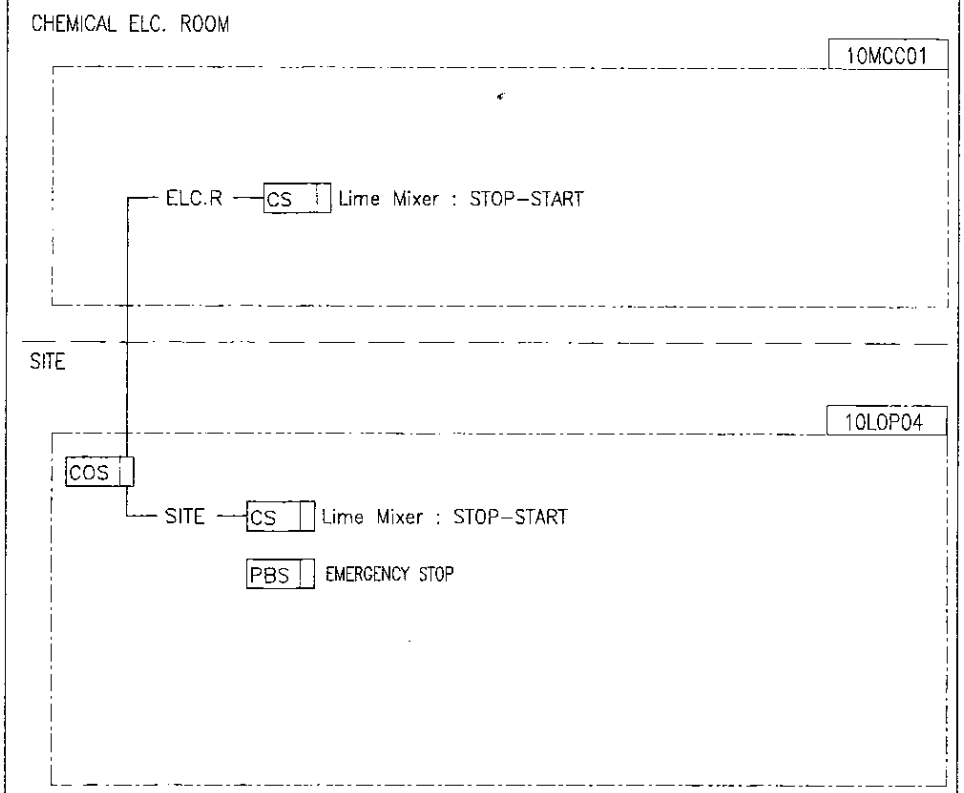


OPERATING CONDITIONS

1.Protection relay nomal.
2.Alum mixing tank level above L.L.

	ITEMS	ALARM	KATUGASTOTA WTP								REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM				
			LOP	MCC		IP	MONI.	PRN.			
STATUS INDICATION	OPERATING LOCATION [ELC.R]			○							
	OPERATING LOCATION [SITE]			○							
	Alum Pump START		○	○			○				
	Alum Pump STOP		○	○			○				
OPERATION SWITCH	CS : STOP-START		○	○		○					
	COS : ELC.R-SITE		○								
	COS : NO.1-AUTO-NO.2		○								
	VS : UP-DOWN					○					
	PBS : EMERGENCY STOP		○								
	SETTING SW : FLOW					○					
FAULT INDICATION	EARTH FAULT	T	○	○		○	○	○			
	OVER LOAD	T	○	○			○	○			
	ALUM LEVEL TANK LEVEL L.L.	T	○	○		○	○				
	EMERGENCY STOP	T	○	○			○	○			
INST. INDICATION	RUNNING HOUR METER			○							
	ALUM DOSING FLOW		○			○	○				

FACILITY	5.CHEMICAL DOSING				
LOAD NAME	Lime Mixer [10LM11/21]	CAPACITY	2.2kW	NUMBERS	2

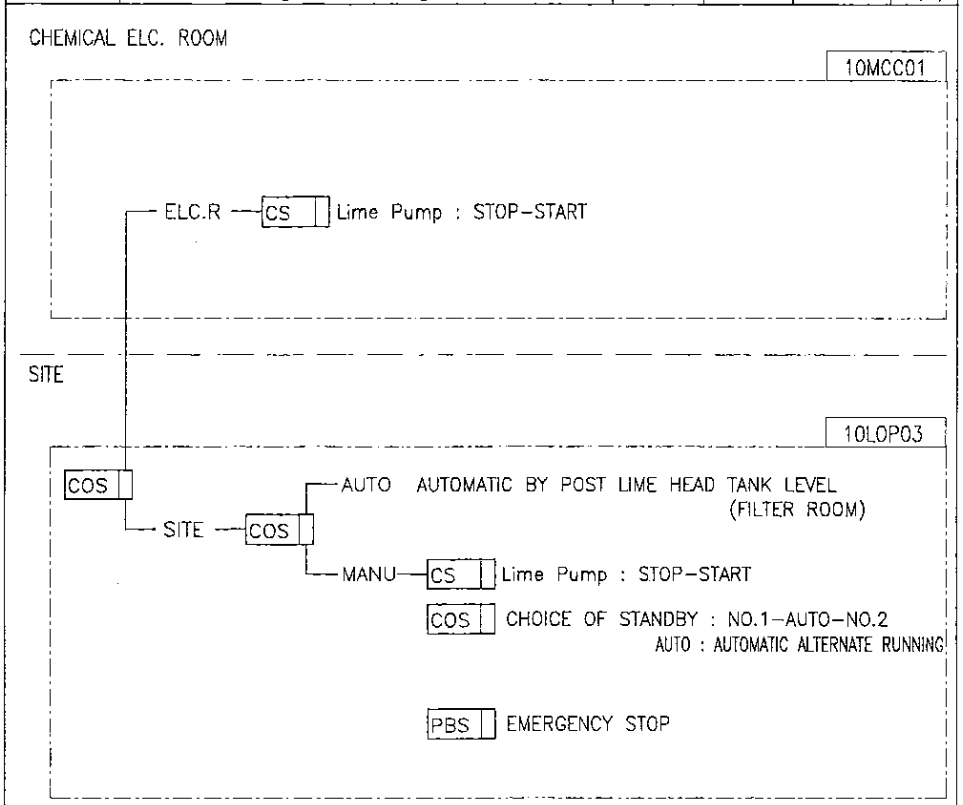


OPERATING CONDITIONS

1.Protection relay normal.
3.Lime mixing tank level above L.L.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP	MCC		IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]			○						
	OPERATING LOCATION [SITE]			○						
	Lime Mixer START		○	○			○			
	Lime Mixer STOP		○	○			○			
OPERATION SWITCH	CS : STOP-START		○	○						
	COS : ELC.R-SITE		○							
	PBS : EMERGENCY STOP		○							
FAULT INDICATION	EARTH FAULT	T	○	○		○	○	○		
	OVER LOAD	T	○	○			○	○		
	LIME MIXING TANK LEVEL L.L.	T	○	○		○	○			
	LIME MIXING TANK LEVEL H.H.					○	○			
	EMERGENCY STOP	T	○	○			○	○		
INST. INDICATION										

FACILITY	5.CHEMICAL DOSING				
LOAD NAME	Lime Pump [10LP11/21]	CAPACITY	5.5kW	NUMBERS	2(1)

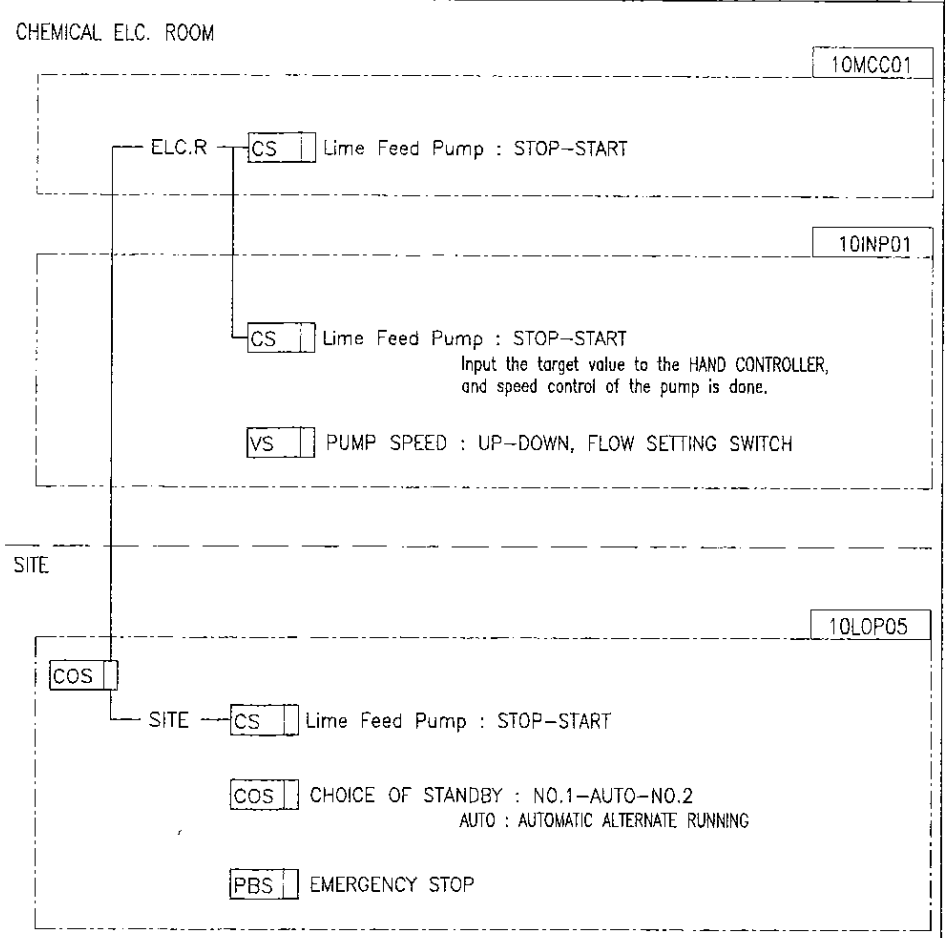


OPERATING CONDITIONS

1.Protection relay nomal.
2.Lime level tank level above L.L.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP	MCC		IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]			○						
	OPERATING LOCATION [SITE]			○						
	Lime Feed START		○	○			○			
	Lime Feed STOP		○	○			○			
OPERATION SWITCH	CS : STOP-START		○	○						
	COS : ELC.R-SITE		○							
	COS : MANU-AUTO		○							
	COS : NO.1-AUTO-NO.2		○							
	PBS : EMERGENCY STOP		○							
FAULT INDICATION	EARTH FAULT	T	○	○		○	○	○		
	OVER LOAD	T	○	○			○	○		
	LIME LEVEL TANK LEVEL L.L.	T	○	○						
	POST LIME HEAD TANK LEVEL H.H.		○			○	○			
	POST LIME HEAD TANK LEVEL L.L.	T	○	○			○			
	EMERGENCY STOP	T	○	○			○	○		
INST. INDICATION	RUNNING HOUR METER			○						

FACILITY	5.CHEMICAL DOSING				
LOAD NAME	Lime Feed Pump [10LP31/41]	CAPACITY	0.4kW	NUMBERS	2(1)

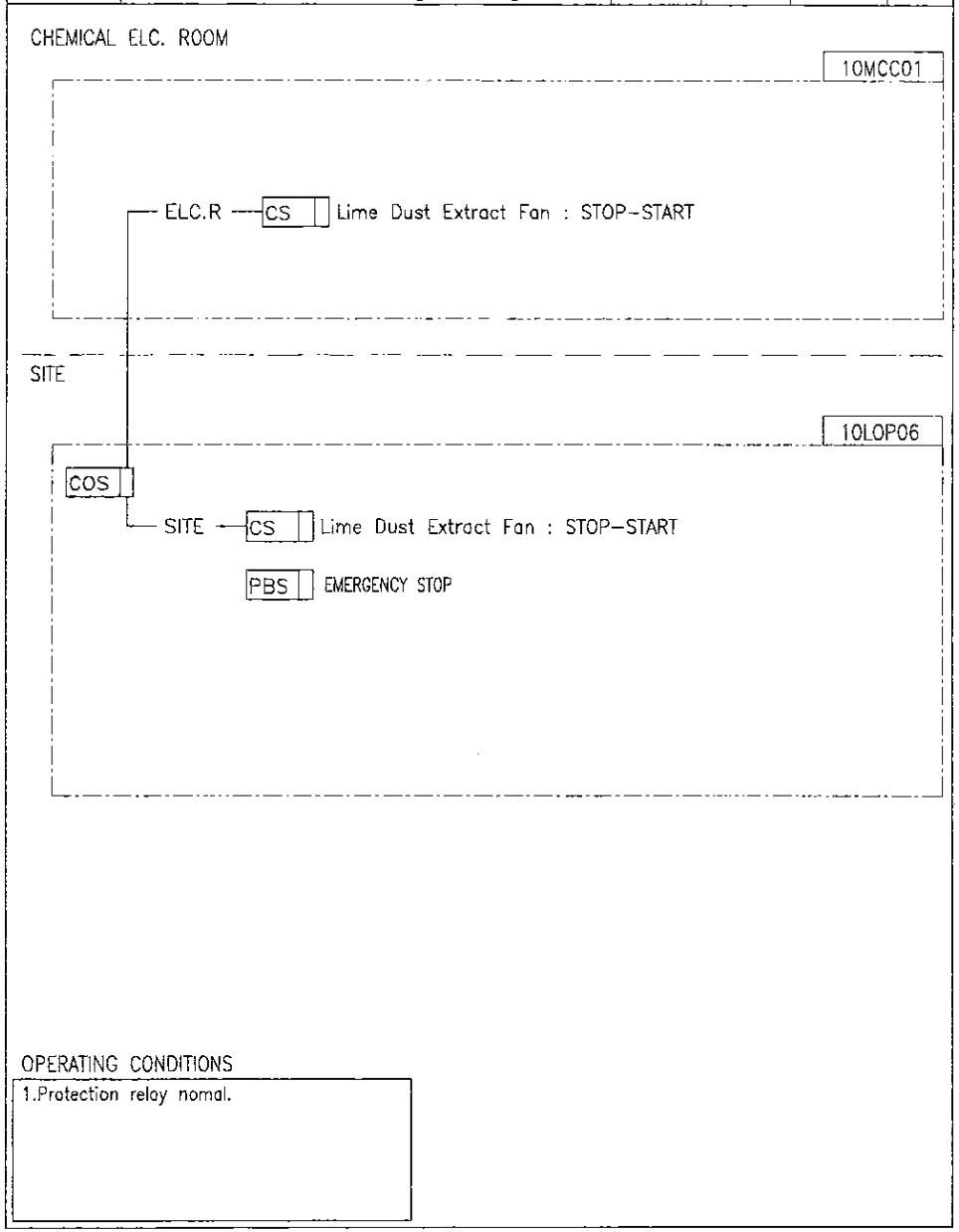


OPERATING CONDITIONS

1.Protection relay normal.
2.Lime mixing tank level above L.L.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP	MCC		IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]			○						
	OPERATING LOCATION [SITE]			○						
	Lime Feed Pump START		○	○			○			
	Lime Feed Pump STOP		○	○			○			
OPERATION SWITCH	CS : START–STOP		○	○		○				
	COS : ELC.R–SITE		○							
	COS : NO.1–AUTO–NO.2		○							
	VS : UP–DOWN					○				
	PBS : EMERGENCY STOP		○							
	SETTING SW : FLOW					○				
FAULT INDICATION	EARTH FAULT	T	○	○		○	○	○		
	OVER CURRENT	T	○	○			○	○		
	LIME LEVEL TANK LEVEL L.L.	T	○	○		○	○			
	EMERGENCY STOP	T	○	○			○	○		
INST. INDICATION	RUNNING HOUR METER			○						
	PRE LIME DOSING FLOW		○			○	○			

FACILITY	5.CHEMICAL DOSING				
LOAD NAME	Lime Dust Extract Fan [10LM01]	CAPACITY	0.75kW	NUMBERS	1



OPERATING CONDITIONS

1.Protection relay nomal.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP	MCC		IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]			○						
	OPERATING LOCATION [SITE]			○						
	Lime Dust Extract Fan START		○	○			○			
	Lime Dust Extract Fan STOP		○	○			○			
OPERATION SWITCH	CS : STOP-START		○	○						
	COS : ELC.R-SITE		○							
	PBS : EMERGENCY STOP		○							
FAULT INDICATION	EARTH FAULT	T	○	○			○	○		
	OVER LOAD	T	○	○			○	○		
	EMERGENCY STOP	T	○	○			○	○		
INST. INDICATION										

FACILITY	5.CHEMICAL DOSING				
LOAD NAME	Chemical Crane [10MC01]	CAPACITY	1.15kW	NUMBERS	1

CHEMICAL ELC. ROOM

10MCC01

POWER SUPPLY ONLY

SITE

Mechanical Standard Equipped

CS | Screening Hoist : FORWARD-STOP-REVERSE

OPERATING CONDITIONS

1.Protection relay nomal.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP	MCC		IP	MONI.	PRN.		
STATUS INDICATION										
OPERATION SWITCH	CS : FORWARD-STOP-REVERSE		O							
FAULT INDICATION	EARTH FAULT	T	O	O			O	O		
	OVER LOAD	T	O	O			O	O		
	TROUBLE	T	O							
INST. INDICATION										

FACILITY	6.BACKWASH RECOVERY				
LOAD NAME	Backwash Recovery Pump [11WP11/21]	CAPACITY	30kW	NUMBERS	2(1)

FILTER ELC. ROOM

07MCC01

ELC.R — CS — Backwash Recovery Pump : STOP–START

SITE

11LOP01

COS

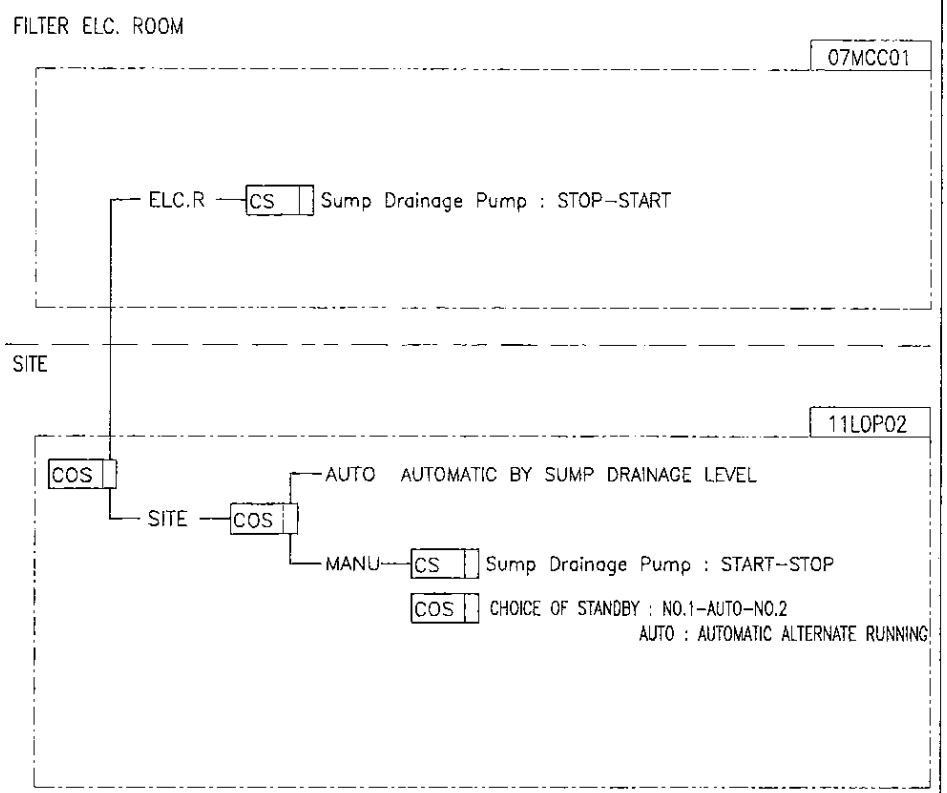
- AUTO — AUTOMATIC BY BACKWASH RECOVERY TANK LEVEL
- SITE — COS
  - MANU — CS — Backwash Recovery Pump : STOP–START
  - COS — CHOICE OF STANDBY : NO.1–AUTO–NO.2
    AUTO : AUTOMATIC ALTERNATE RUNNING
  - PBS — EMERGENCY STOP

OPERATING CONDITIONS

1.Protection relay nomal.
2.Backwash recovery tank level above L.L.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP	MCC		IP	MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]			○						
	OPERATING LOCATION [SITE]			○						
	Backwash Recovery Pump START		○	○			○			
	Backwash Recovery Pump STOP		○	○			○			
OPERATION SWITCH	CS : STOP–START		○	○						
	COS : ELC.R–SITE		○							
	COS : MANU–AUTO		○							
	COS : NO.1–AUTO–NO.2		○							
	PBS : EMERGENCY STOP		○							
FAULT INDICATION	EARTH FAULT	T	○	○			○	○		
	OVER LOAD	T	○	○			○	○		
	BW RECOVERY TANK LEVEL H.H.		○	○			○			
	BW RECOVERY TANK LEVEL L.L.	T	○	○						
							○	○		
	EMERGENCY STOP	T	○	○						
INST. INDICATION	RUNNING HOUR METER			○						
	BW RECOVERY TANK LEVEL		○			○	○			
	BW WATER RETURN FLOW					○	○			

FACILITY	6. BACKWASH RECOVERY				
LOAD NAME	Sump Drainage Pump [11DP01/02]	CAPACITY	1.5kW	NUMBERS	2(1)



OPERATING CONDITIONS

1.Protection relay nomal.
2.Sump drainage level above L.L.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE	ELC.ROOM			CENTRAL MONI. ROOM			
			LOP	MCC	IP		MONI.	PRN.		
STATUS INDICATION	OPERATING LOCATION [ELC.R]			O						
	OPERATING LOCATION [SITE]			O						
	Sump Drainage Pump START		O	O			O			
	Sump Drainage Pump STOP		O	O			O			
OPERATION SWITCH	CS : START–STOP		O	O						
	COS : ELC.R–SITE		O							
	COS : MANU–AUTO		O							
	COS : NO.1–AUTO–NO.2		O							
	PBS : EMERGENCY STOP		O							
FAULT INDICATION	EARTH FAULT	T	O	O			O	O		
	OVER LOAD	T	O	O			O	O		
	SUMP DRAINAGE LEVEL H.H.		O	O			O			
	SUMP DRAINAGE LEVEL L.L.	T	O	O						
INST. INDICATION	RUNNING HOUR METER			O						

FACILITY	7.POWER RECEIVING				
LOAD NAME	Power Receiving For INTAKE	CAPACITY		NUMBERS	

INTAKE ELEC. ROOM

01GCP01

LINK GENERATOR SEQUENTIAL OPERATION

COS

SINGLE — CS — Gen. Connection ACB : ON–OFF

INTERLOCKING

01LRP01

CS — LV Receiving ACB : OFF–ON

OPERATING CONDITIONS

1.Protection relay normal.

	ITEMS	ALARM	GOHAGODA INTAKE				KATUGASTOTA WTP			REMARKS
			GEN. ROOM	ELC.ROOM			CENTRAL MONI. ROOM			
							MONI.	PRN.		
STATUS INDICATION	Gen. Conection ACB ON			O						
	Gen. Conection ACB OFF			O						
	LV Receiving ACB ON			O						
	LV Receiving ACB OFF			O						
OPERATION SWITCH	CS : Gen. Connection ACB ON–OFF			O						
	CS : LV Receiving ACB OFF–ON			O						
	COS : SINGLE–LINK			O						
FAULT INDICATION	Gen. Connection ACB FAULT			O			O	O		
	LV Receiving ACB FAULT			O			O	O		
INST. INDICATION	CEB VOLTMETER			O			O			
	CEB AMMETER			O			O			
	CEB POWER FACTOR METER			O						
	Generator VOLTMETER			O			O			
	Generator AMMETER			O			O			
	Generator POWER FACTOR METER			O						

FACILITY	7.POWER RECEIVING				
LOAD NAME	INTAKE Generator	CAPACITY		NUMBERS	

INTAKE GEN. ROOM

01GEN01

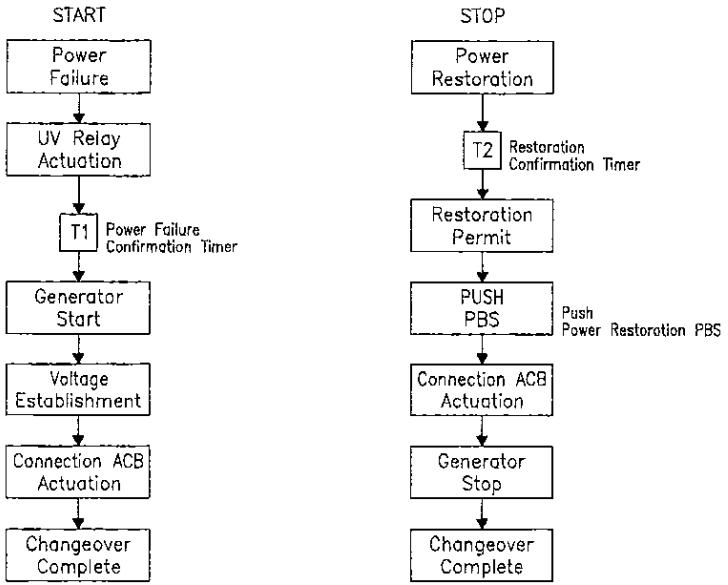
COS — AUTO AUTOMATIC START BY UNDER VOLTAGE RELAY

MANU — CS Generator : STOP–START

PBS POWER RESTORATION

PBS EMERGENCY STOP

SEQUENTIAL OPERATION



OPERATING CONDITIONS

1.Protection relay nomal.
2.Fuel tank level above L.L.

	ITEMS	ALARM	GOHAGODA INTAKE				KATUGASTOTA WTP			REMARKS
			GEN. ROOM	ELC.ROOM IP			CENTRAL MONI. ROOM MONI.	PRN.		
STATUS INDICATION	GENERATOR START MOOD [AUTO]		O							
	GENERATOR START MOOD [MANU]		O							
	GENERATOR CONNECTION ACB MOOD									
	[LINK]		O							
	[SINGLE]		O							
	GENERATOR START		O				O			
	GENERATOR STOP		O				O			
OPERATION SWITCH	CS : STOP–START		O							
	COS : MANU–AUTO		O							
	PBS : POWER RESTORATION		O							
	PBS : EMERGENCY STOP		O							
FAULT INDICATION	GENERATOR TROUBLE	T	O				O	O		
	LOW OIL PRESSURE	T	O				O	O		
	HIGH WATER TEMPERTURE	T	O	O			O	O		
	BOOSTER PUMP TROUBLE		O				O	O		
	STARTER TROUBLE		O				O	O		
	MAIN TANK FUEL LEVEL LOW		O	O			O			
	HEAD TANK FUEL LEVEL LOW		O	O			O			
	POWER FAILURE		O	O			O	O		
	EMERGENCY STOP	T	O	O			O	O		
INST. INDICATION	VOLTMETER		O							
	AMMETER		O							
	FRQUENCY METER		O							
	TACHOMETER		O							
	WATER TEMPERATURE GAUGE		O							
	OIL PRESSURE GAUGE		O							
	RUNNING HOUR METER		O							
	MAIN TANK FUEL LEVEL		O							
	HEAD TANK FUEL LEVEL		O							

FACILITY	7.POWER RECEIVING				
LOAD NAME	Power Receiving For WTP	CAPACITY		NUMBERS	

MAIN ELEC. ROOM

04HTP01

COS
- AUTO AUTOMATIC BY UNDER VOLTAGE RELAY
- MANU — CS : HT Power Receiving VCB : ON–OFF

04HTP02

CS : No.1 HT Feeder VCB : OFF–ON

OPERATING CONDITIONS

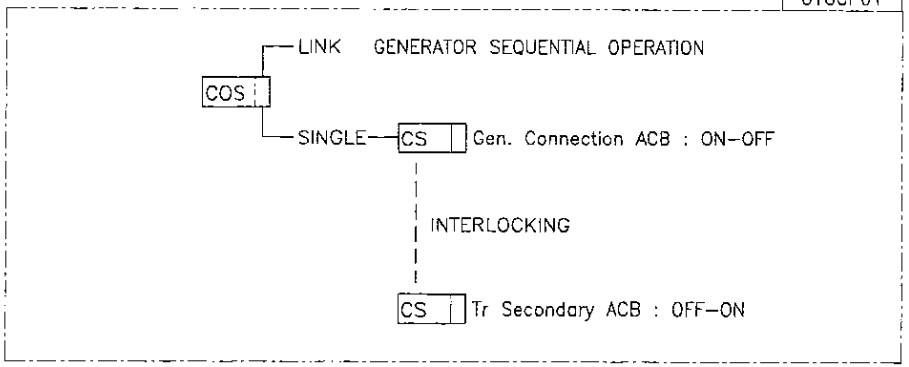
1.Protection relay nomal.

	ITEMS	ALARM	KATUGASTOTA WTP								REMARKS
			SITE		ELC.ROOM		CENTRAL MONI. ROOM				
			LOP	BWP			MONI.	PRN.			
STATUS INDICATION	HT Power Receiving VCB ON				○						
	HT Power Receiving VCB OFF				○						
	No.1 HT Feeder VCB ON				○						
	No.1 HT Feeder VCB OFF				○						
OPERATION SWITCH	CS : HT Power Receiving VCB ON–OFF				○						
	COS : MANU–AUTO				○						
	CS : No.1 HT Feeder VCB OFF–ON				○						
FAULT INDICATION	POWER FAILURE				○		○	○			
	UNDER VOLTAGE				○		○	○			
	OVER CURRENT				○		○	○			
	HT Power Receiving VCB FAULT				○		○	○			
	No.1 HT Feeder VCB FAULT				○		○	○			
INST. INDICATION	VOLTMETER (INCOMING)				○		○				
	AMMETER (INCOMING)				○		○				

FACILITY	7.POWER RECEIVING				
LOAD NAME	Power Receiving For WTP	CAPACITY		NUMBERS	

MAIN ELEC. ROOM

01GCP01



OPERATING CONDITIONS

1.Protection relay nomal.

	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE		ELC.ROOM		CENTRAL MONI. ROOM			
			LOP	BWP			MONI.	PRN.		
STATUS INDICATION	Gen. Conection ACB ON				○					
	Gen. Conection ACB OFF				○					
	Tr Secondary ACB ON				○					
	Tr Secondary ACB OFF				○					
OPERATION SWITCH	CS : Gen. Connection ACB ON–OFF				○					
	CS : Tr Secondary ACB OFF–ON				○					
	COS : SINGLE–LINK				○					
FAULT INDICATION	Gen. Connection ACB FAULT				○		○	○		
	Tr Secondary ACB FAULT				○		○	○		
INST. INDICATION	CEB VOLTMETER				○		○			
	CEB AMMETER				○		○			
	CEB POWER FACTOR METER				○					
	Generator VOLTMETER				○		○			
	Generator AMMETER				○		○			
	Generator POWER FACTOR METER				○					

FACILITY	7.POWER RECEIVING				
LOAD NAME	WTP Generator	CAPACITY		NUMBERS	

WTP GEN. ROOM

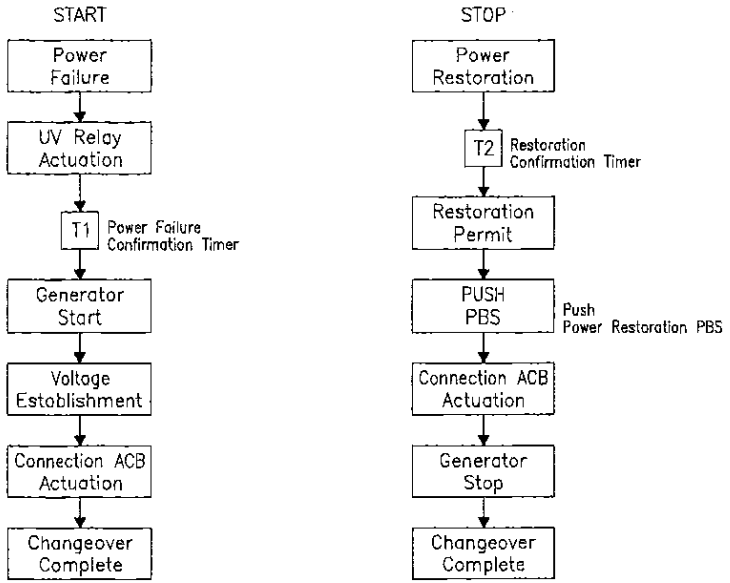
04GEN01

COS
- AUTO AUTOMATIC START BY UNDER VOLTAGE RELAY
- MANU — CS Generator : STOP–START

PBS POWER RESTORATION

PBS EMERGENCY STOP

SEQUENTIAL OPERATION



OPERATING CONDITIONS

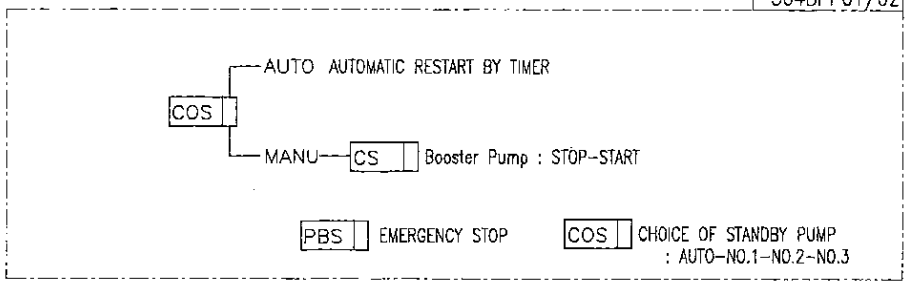
1.Protection relay nomal.
2.Fuel tank level above L.L.

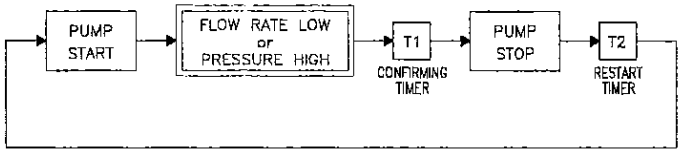
	ITEMS	ALARM	KATUGASTOTA WTP							REMARKS
			SITE		ELC.ROOM		CENTRAL MONI. ROOM			
			LOP	BWP	MCC	IP	MONI.	PRN.		
STATUS INDICATION	GENERATOR START MOOD [AUTO]				○					
	GENERATOR START MOOD [MANU]				○					
	GENERATOR CONNECTION ACB MOOD									
	[LINK]				○					
	[SINGLE]				○					
	GENERATOR START				○		○			
	GENERATOR STOP				○		○			
OPERATION SWITCH	CS : STOP–START				○					
	COS : MANU–AUTO				○					
	PBS : POWER RESTORATION				○					
	PBS : EMERGENCY STOP				○					
FAULT INDICATION	GENERATOR TROUBLE	T			○		○	○		
	LOW OIL PRESSURE	T			○		○	○		
	HIGH WATER TEMPERTURE	T			○		○	○		
	BOOSTER PUMP TROUBLE				○		○	○		
	STARTER TROUBLE				○		○	○		
	MAIN TANK FUEL LEVEL LOW				○		○			
	HEAD TANK FUEL LEVEL LOW				○		○			
	POWER FAILURE				○		○	○		
	EMERGENCY STOP	T			○		○	○		
INST. INDICATION	VOLTMETER				○					
	AMMETER				○					
	FRQUENCY METER				○					
	TACHOMETER				○					
	WATER TEMPERATURE GAUGE				○					
	OIL PRESSURE GAUGE				○					
	RUNNING HOUR METER				○					
	MAIN TANK FUEL LEVEL				○					
	HEAD TANK FUEL LEVEL				○					

FACILITY	8.CLEAR WATER PUMP STATION				
LOAD NAME	Booster Pump [304BP11/21]	CAPACITY	55kW	NUMBERS	2(1)

KAHAWATTA S.R. & P.S.

304BPP01/02





The timer shall be possible to set up by manual.

OPERATING CONDITIONS

1.Protection relay normal.
2.Water level in S.R. above L.L.

	ITEMS	ALARM	KAHAWATTA S.R. & P.S. PRP	KAHAWATTA S.R. & P.S. BPP	REMARKS
STATUS INDICATION	OPERATING MODE [AUTO]				
	OPERATING MODE [MANU]				
	Booster Pump START			○	
	Booster Pump STOP			○	
	POWER FROM CEB		○		
	POWER FROM GENERATOR		○		
OPERATION SWITCH	CS : STOP-START			○	
	COS : MANU-AUTO			○	
	COS : AUTO-NO.1-NO.2-NO.3			○	
	COS : CEB-GENERATOR		○		
	PBS :EMERGENCY STOP			○	
FAULT INDICATION	EARTH FAULT	T		○	
	OVER LOAD	T		○	
	OVER HEAT	T		○	
	SERVICE RESERVOIR LEVEL L.L.	T		○	
	SERVICE RESERVOIR LEVEL H.H.			○	
	TRANSMISSION FLOW RATE LOW			○	
	TRANSMISSION PRESSURE HIGH			○	
	POWER FILURE		○		
	EMERGENCY STOP	T		○	
INST. INDICATION	RUNNING HOUR METER			○	
	VOLTMETER		○		
	AMMETER			○	

FACILITY	8.CLEAR WATER PUMP STATION				
LOAD NAME	Booster Pump [310BP11/21]	CAPACITY	37kW	NUMBERS	2(1)

KONDADENIYA S.R. & P.S.

310BPP01/02

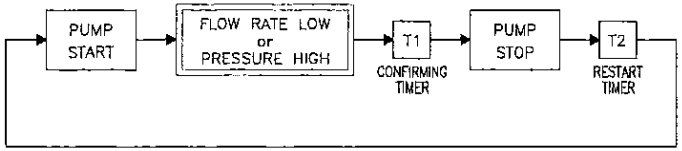
AUTO AUTOMATIC RESTART BY TIMER

COS

MANU — CS — Booster Pump : STOP-START

PBS — EMERGENCY STOP

COS — CHOICE OF STANDBY PUMP : NO.1-AUTO-NO.2



The timer shall be possible to set up by manual.

OPERATING CONDITIONS

1.Protection relay nomal.
2.Water level in S.R. above L.L.

	ITEMS	ALARM	KONDADENIYA S.R. & P.S. PRP	KONDADENIYA S.R. & P.S. BPP	REMARKS
STATUS INDICATION	OPERATING MODE [AUTO]				
	OPERATING MODE [MANU]				
	Booster Pump START			○	
	Booster Pump STOP			○	
	POWER FROM CEB		○		
	POWER FROM GENERATOR		○		
OPERATION SWITCH	CS : STOP-START			○	
	COS : MANU-AUTO			○	
	COS : NO.1-AUTO-NO.2			○	
	COS : CEB-GENERATOR		○		
	PBS :EMERGENCY STOP			○	
FAULT INDICATION	EARTH FAULT	T		○	
	OVER LOAD	T		○	
	SERVICE RESERVOIR LEVEL L.L.	T		○	
	SERVICE RESERVOIR LEVEL H.H.			○	
	TRANSMISSION FLOW RATE LOW			○	
	TRANSMISSION PRESSURE HIGH			○	
	POWER FILURE		○		
	EMERGENCY STOP	T		○	
INST. INDICATION	RUNNING HOUR METER			○	
	VOLTMETER		○		
	AMMETER			○	

FACILITY	8.CLEAR WATER PUMP STATION				
LOAD NAME	Booster Pump [315BP11/21]	CAPACITY	30kW	NUMBERS	2(1)

ASGIRIYA P.S.

315BPP01

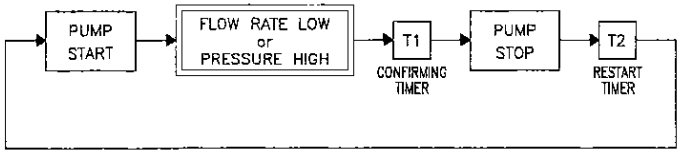
AUTO AUTOMATIC RESTART BY TIMER

COS

MANU — CS — Booster Pump : STOP-START

PBS — EMERGENCY STOP

COS — CHOICE OF STANDBY PUMP : NO.1-AUTO-NO.2



The timer shall be possible to set up by manual.

OPERATING CONDITIONS

1.Protection relay nomal.
2.Suction FLOW or PRESSURE above LOW

	ITEMS	ALARM	ASGIRIYA P.S. PRP	ASGIRIYA P.S. BPP	REMARKS
STATUS INDICATION	OPERATING MODE [AUTO]				
	OPERATING MODE [MANU]				
	Booster Pump START			○	
	Booster Pump STOP			○	
	POWER FROM CEB		○		
	POWER FROM GENERATOR		○		
OPERATION SWITCH	CS : STOP-START			○	
	COS : MANU-AUTO			○	
	COS : NO.1-AUTO-NO.2			○	
	COS : CEB-GENERATOR		○		
	PBS :EMERGENCY STOP			○	
FAULT INDICATION	EARTH FAULT	T		○	
	OVER LOAD	T		○	
	SUCTION FLOW LOW	T		○	
	SUCTION PRESSURE LOW	T		○	
	TRANSMISSION FLOW RATE LOW			○	
	TRANSMISSION PRESSURE HIGH			○	
	POWER FILURE		○		
	EMERGENCY STOP	T		○	
INST. INDICATION	RUNNING HOUR METER			○	
	VOLTMETER		○		
	AMMETER			○	

FACILITY	8.CLEAR WATER PUMP STATION				
LOAD NAME	Booster Pump [318BP11/21]	CAPACITY	55kW	NUMBERS	2(1)

R2 S.R. & P.S.

318BPP01/02

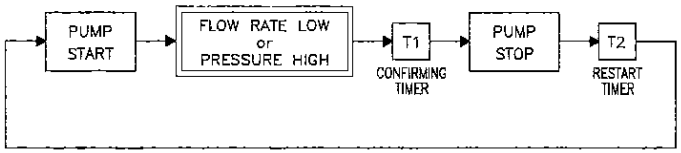
AUTO AUTOMATIC RESTART BY TIMER

COS

MANU — CS — Booster Pump : STOP–START

PBS — EMERGENCY STOP

COS — CHOICE OF STANDBY PUMP : NO.1–AUTO–NO.2



The timer shall be possible to set up by manual.

OPERATING CONDITIONS

1.Protection relay nomal.
2.Water level in S.R. above L.L.

	ITEMS	ALARM	R2 S.R. & P.S. PRP	R2 S.R. & P.S. BPP	REMARKS
STATUS INDICATION	OPERATING MODE [AUTO]				
	OPERATING MODE [MANU]				
	Booster Pump START			O	
	Booster Pump STOP			O	
	POWER FROM CEB		O		
	POWER FROM GENERATOR		O		
OPERATION SWITCH	CS : STOP–START			O	
	COS : MANU–AUTO			O	
	COS : NO.1–AUTO–NO.2			O	
	COS : CEB–GENERATOR		O		
	PBS :EMERGENCY STOP			O	
FAULT INDICATION	EARTH FAULT	T		O	
	OVER LOAD	T		O	
	OVER HEAT	T		O	
	SERVICE RESERVOIR LEVEL L.L.	T		O	
	SERVICE RESERVOIR LEVEL H.H.			O	
	TRANSMISSION FLOW RATE LOW			O	
	TRANSMISSION PRESSURE HIGH			O	
	POWER FILURE		O		
	EMERGENCY STOP	T		O	
INST. INDICATION	RUNNING HOUR METER			O	
	VOLTMETER		O		
	AMMETER			O	

FACILITY	8.CLEAR WATER PUMP STATION				
LOAD NAME	Booster Pump [320BP11/21]	CAPACITY	37kW	NUMBERS	2(1)

HEERASSAGALA LOW S.R. & P.S.

320BPP01/02

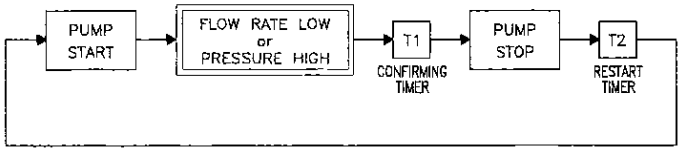
AUTO AUTOMATIC RESTART BY TIMER

COS

MANU — CS — Booster Pump : STOP-START

PBS — EMERGENCY STOP

COS — CHOICE OF STANDBY PUMP : NO.1-AUTO-NO.2



The timer shall be possible to set up by manual.

OPERATING CONDITIONS

1.Protection relay normal.
2.Water level in S.R. above L.L.

	ITEMS	ALARM	HEERASSAGALA LOW S.R. & P.S. PRP	HEERASSAGALA LOW S.R. & P.S. 8PP	REMARKS
STATUS INDICATION	OPERATING MODE [AUTO]				
	OPERATING MODE [MANU]				
	Booster Pump START			○	
	Booster Pump STOP			○	
	POWER FROM CEB		○		
	POWER FROM GENERATOR		○		
OPERATION SWITCH	CS : STOP-START			○	
	COS : MANU-AUTO			○	
	COS : NO.1-AUTO-NO.2			○	
	COS : CEB-GENERATOR		○		
	PBS :EMERGENCY STOP			○	
FAULT INDICATION	EARTH FAULT	T		○	
	OVER LOAD	T		○	
	OVER HEAT	T		○	
	SERVICE RESERVOIR LEVEL L.L.	T		○	
	SERVICE RESERVOIR LEVEL H.H.			○	
	TRANSMISSION FLOW RATE LOW			○	
	TRANSMISSION PRESSURE HIGH			○	
	POWER FILURE		○		
	EMERGENCY STOP	T		○	
INST. INDICATION	RUNNING HOUR METER			○	
	VOLTMETER		○		
	AMMETER			○	

FACILITY	8.CLEAR WATER PUMP STATION				
LOAD NAME	Booster Pump [321BP11/21]	CAPACITY	18.5kW	NUMBERS	2(1)

HEERASSAGALA MIDDLE S.R. & P.S.

321BPP01

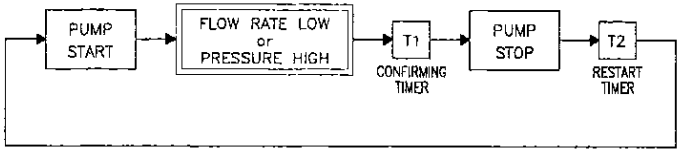
AUTO AUTOMATIC RESTART BY TIMER

COS

MANU — CS — Booster Pump : STOP–START

PBS — EMERGENCY STOP

COS — CHOICE OF STANDBY PUMP : NO.1–AUTO–NO.2



The timer shall be possible to set up by manual.

OPERATING CONDITIONS

1.Protection relay nomal.
2.Water level in S.R. above L.L.

	ITEMS	ALARM	HEERASSAGALA MIDDLE S.R. & P.S.							REMARKS
			PRP	BPP						
STATUS INDICATION	OPERATING MODE [AUTO]									
	OPERATING MODE [MANU]									
	Booster Pump START			○						
	Booster Pump STOP			○						
	POWER FROM CEB		○							
	POWER FROM GENERATOR		○							
OPERATION SWITCH	CS : STOP–START			○						
	COS : MANU–AUTO			○						
	COS : NO.1–AUTO–NO.2			○						
	COS : CEB–GENERATOR		○							
	PBS :EMERGENCY STOP			○						
FAULT INDICATION	EARTH FAULT	T		○						
	OVER LOAD	T		○						
	OVER HEAT	T		○						
	SERVICE RESERVOIR LEVEL L.L.	T		○						
	SERVICE RESERVOIR LEVEL H.H.			○						
	TRANSMISSION FLOW RATE LOW			○						
	TRANSMISSION PRESSURE HIGH			○						
	POWER FILURE		○							
	EMERGENCY STOP	T		○						
INST. INDICATION	RUNNING HOUR METER			○						
	VOLTMETER		○							
	AMMETER			○						

FACILITY	8.CLEAR WATER PUMP STATION				
LOAD NAME	Booster Pump (D-1) [324BP11/12]	CAPACITY	11kW	NUMBERS	2(1)

AMPITIYA S.R. & P.S.

324BPP01

AUTO AUTOMATIC RESTART BY TIMER

COS

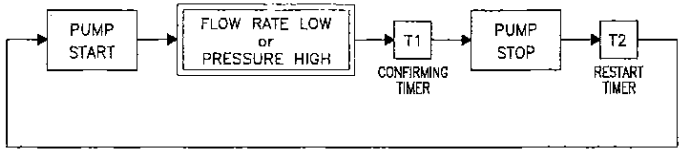
MANU — CS — Booster Pump : STOP-START

COS — CHOICE OF STANDBY PUMP : NO.1-AUTO-NO.2

SITE

324LOP01/02

PBS — EMERGENCY STOP



The timer shall be possible to set up by manual.

OPERATING CONDITIONS

1.Protection relay nomal.
2.Water level in S.R. above L.L.

	ITEMS	ALARM	AMPITIYA S.R. & P.S. PRP	BPP	LOP					REMARKS
STATUS INDICATION	OPERATING MODE [AUTO]									
	OPERATING MODE [MANU]									
	Booster Pump START			○						
	Booster Pump STOP			○						
	POWER FROM CEB		○							
	POWER FROM GENERATOR		○							
OPERATION SWITCH	CS : STOP-START			○						
	COS : MANU-AUTO			○						
	COS : NO.1-AUTO-NO.2			○						
	COS : CEB-GENERATOR		○							
	PBS :EMERGENCY STOP				○					
FAULT INDICATION	EARTH FAULT	T		○						
	OVER LOAD	T		○						
	OVER HEAT	T		○						
	SERVICE RESERVOIR LEVEL L.L.	T		○						
	SERVICE RESERVOIR LEVEL H.H.			○						
	TRANSMISSION FLOW RATE LOW			○						
	TRANSMISSION PRESSURE HIGH			○						
	POWER FILURE		○							
	EMERGENCY STOP	T			○					
INST. INDICATION	RUNNING HOUR METER			○						
	VOLTMETER		○							
	AMMETER			○						

FACILITY	8.CLEAR WATER PUMP STATION				
LOAD NAME	Booster Pump (D-2) [324BP21/22]	CAPACITY	30kW	NUMBERS	2(1)

AMPITIYA S.R. & P.S.

324BPP02

AUTO AUTOMATIC RESTART BY TIMER

COS

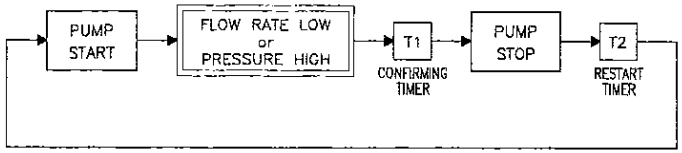
MANU — CS — Booster Pump : STOP-START

COS — CHOICE OF STANDBY PUMP : NO.1-AUTO-NO.2

SITE

324LOP03/04

PBS — EMERGENCY STOP



The timer shall be possible to set up by manual.

OPERATING CONDITIONS

1.Protection relay nomal.
2.Water level in S.R. above L.L.

	ITEMS	ALARM	AMPITIYA S.R. & P.S. BPP	AMPITIYA S.R. & P.S. LOP	REMARKS
STATUS INDICATION	OPERATING MODE [AUTO]				
	OPERATING MODE [MANU]				
	Booster Pump START		O		
	Booster Pump STOP		O		
OPERATION SWITCH	CS : STOP-START		O		
	COS : MANU-AUTO		O		
	COS : NO.1-AUTO-NO.2		O		
	PBS :EMERGENCY STOP			O	
FAULT INDICATION	EARTH FAULT	T	O		
	OVER LOAD	T	O		
	OVER HEAT	T	O		
	SERVICE RESERVOIR LEVEL L.L.	T	O		
	SERVICE RESERVOIR LEVEL H.H.		O		
	TRANSMISSION FLOW RATE LOW		O		
	TRANSMISSION PRESSURE HIGH		O		
	EMERGENCY STOP	T		O	
INST. INDICATION	RUNNING HOUR METER		O		
	AMMETER		O		

FACILITY	8.CLEAR WATER PUMP STATION				
LOAD NAME	Booster Pump (D-3) [324BP31/32]	CAPACITY	37kW	NUMBERS	2(1)

AMPITIYA S.R. & P.S.

324BPP03/04

COS — AUTO AUTOMATIC RESTART BY TIMER

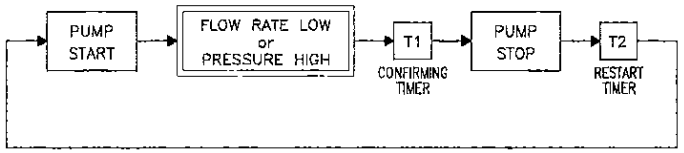
COS — MANU — CS — Booster Pump : STOP-START

COS — CHOICE OF STANDBY PUMP : NO.1-AUTO-NO.2

SITE

324LOP05/06

PBS — EMERGENCY STOP



The timer shall be possible to set up by manual.

OPERATING CONDITIONS

1.Protection relay normal.
2.Water level in S.R. above L.L.

	ITEMS	ALARM	AMPITIYA S.R. & P.S. BPP	AMPITIYA S.R. & P.S. LOP	REMARKS
STATUS INDICATION	OPERATING MODE [AUTO]				
	OPERATING MODE [MANU]				
	Booster Pump START		O		
	Booster Pump STOP		O		
OPERATION SWITCH	CS : STOP-START		O		
	COS : MANU-AUTO		O		
	COS : NO.1-AUTO-NO.2		O		
	PBS :EMERGENCY STOP			O	
FAULT INDICATION	EARTH FAULT	T	O		
	OVER LOAD	T	O		
	OVER HEAT	T	O		
	SERVICE RESERVOIR LEVEL L.L.	T	O		
	SERVICE RESERVOIR LEVEL H.H.		O		
	TRANSMISSION FLOW RATE LOW		O		
	TRANSMISSION PRESSURE HIGH		O		
	EMERGENCY STOP	T		O	
INST. INDICATION	RUNNING HOUR METER		O		
	AMMETER		O		

Contract GK/JBIC/04

Functional Design Specification (Sequence of Operation)

FDS 1 General

A. The treatment plant will form the first phase of a three-phase development. Allowances may be included in some facilities to accommodate Phase 3. Future development beyond the Phase 3 is not considered herein.

B. The tag number of the equipment comprise three designations (01 C5 01), where the three designations refer to plant area, equipment type and sequence number as follows:

Area designation		Equipment		Sequence Number
00	general	AB	air blower	
01	raw water intake and balancing tank	AC	air conditioning	
02	miscellaneous for raw water intake	AM	alum mixer	
03	raw water transmission main	AP	alum pump	
04	overall system of WTP	AS	air strainer	
05	distribution chamber	AT	alum tank	
06	flocculation basins and sedimentation basins	AV	air valve	
		BP	booster pump	
07	filtration units	CD	chlorine detector	
08	clear water reservoir	CP	Clear water pump	
09	clear water pump station	CS	coarse screen	
10	chemical building	CV	check valve	
11	backwash water recovery facility	DP	sump drainage pump	
12	sludge lagoons	EF	exhaust fan	
13	electrical substation and generator building	EG	electrical generator	
		IFM	flow meter	
14	administration building	FP	backwash pump	
15	maintenance building	FS	fine screen	
16	yard pipe for WTP	FV	flap valve	
17	miscellaneous for WTP	GW	gas scrubber (washer)	
20	transmission pipelines	HC	hand operated crane	
30	service reservoirs	HG	hand operated gate	
31	yard piping for service reservoirs	HH	hand operated hoist	
32	miscellaneous for service reservoirs	HV	hand operated valve	
40	distribution pipelines	IJ	Injector for chlorinator	
50	miscellaneous	LOP	Local operation panel	
		ILM	level meter	
		ILS	level switch	
		LM	lime mixer	
		LP	lime pump	
		LT	lime tank	
		MC	motorised crane	
		MG	motorised gate	
		MH	motorised hoist	
		MV	motorised valve	
		PP	chlorine booster pump	
		PR	pressure reduction valve	
		PU	plant water supply unit	
		RP	raw water pump	

Area designation	Equipment	Sequence No.
	SC sludge collector SF supply fan SL stop log SP sampling pump ST screen trough SW screen wash pump WE weighing element (device) WP backwash recovery pump PLC programmable logic controller INP instrumentation panel MON central monitoring system	

FDS 2 Raw Water Intake Facility

A. Raw water enters the intake from the Mahaweli Ganga through two inlet channels. From each inlet, which is provided with stop logs for isolation during periods of maintenance, flow passes through two coarse screen (01 CS 11 and 01 CS 21) arrangements to remove gross solids. Screenings removed from these screens are lifted to ground level by an electrically operated hoist (01 MH 01) from the platform for screens. Screenings are deposited into a skip at ground level for ultimate disposal to landfill.

B. After the coarse screens, flow passes to fine screens through manually operated gates (01 HG 11 and 01 HG 21), which can isolate and empty the grit chambers. The fine screens (01 FS 11 and 01 FS 21) comprise a travelling mesh screen which raise debris to the cleaning mechanism located at ground level. The cleaning mechanism works, normally, on a manually adjusted pre-set timing sequence. The screens are washed using water provided from screen wash water pumps (01 SW 01 and 01 SW 02). Debris removed from the screens is discharged in to the trough and deposited into a skip for ultimate disposal to landfill.

C. For two wash water pumps, check valves and manual gate valves are provided in the pump dry well for drainage (01 CV 01, 01 CV 02, 01 HV 01 and 01 HV 02 respectively) and are controlled from level monitor (01 LE 02). The selection of duty/standby pump is automatically determined at the local electrical control panel (01 LOP 02).

D. Emergency stop switches are provided at each fine screen (01 HS 01 and 01 HS 02 respectively) and wash water pump (01 SW 01 and 01 SW 02).

E. After the grit chamber, flow passes into pump sump through manually operated gates (01 HG 12 and 01 HG 22), which can isolate and empty the grit chambers incorporate with the inflow gates (01 HG 11 and 01 HG 21).

F. Under normal operation, both screening channels are open and the stop logs and gates are closed only for maintenance.

G. The pump station includes space for four vertically mounted centrifugal pumps. Two pumps are installed in Phase 1(01 RP 11 and 01 RP 21) with space left for the third and fourth pumps. Each pump system comprises a manually operated suction gate valve (01 HV 11 and 01 HV 21), check valve (01 CV 11 and 01 CV 21) and electrically operated discharge butterfly valve (01 MV 11 and 01 MV 21). The suction and delivery pipework and valves (01 HV 31 and 01 HV 32) for the third pump and for the fourth pump (01 HV 41 and 01 HV 42) are installed in this phase and blanked off but the check valve is not

included in this phase. Pressure gauges with an isolating valve and diaphragm are mounted on the suction and discharge side of each pump (01 PG 11 and 01 PG 21, etc).

H. The pumps (01 RP 11 and 01 RP 21) are controlled automatically at the local electrical control panel (01 RPP 01, 02). When the third and fourth pumps are installed, three pumps will be duty and one standby. The standby pump will automatically operate on failure of the duty pump(s). Emergency stop switches are provided at each pump and each motor (01 LOP 01, 02, 03, and 04). The pumps have variable speed motors and speed control is effected by flow measurement from the flow meter (01 IFM 01) located on the raw water transmission main in the raw water pump room. The wide variation in the levels of the Mahaweli Ganga require speed control to provide stability of flow from the pump (s). The flow will be monitored and recorded at the instrumentation panel (01 INP 01) in the raw water pump station and at the monitor (01 MON 01) in the administration building. Also the required flow will be set manually at the panels (01 VVF 01 or 01 MON 01) and the system will automatically maintain this flow by speeding up the pumps if flow drops below the pre-set value and slowing down the pumps if flow increases.

I. The water level in the wet well is monitored continuously by level monitor (01 ILM 01). On manually pre-set high, or low water levels the pumps are switched off and an alarm condition initiated.

J. Two sump drainage pumps, check valves and manual gate valves are provided in the pump dry well for drainage (01 DP 01, 01 DP 02, 01 CV 03, 01 CV 04, 01 HV 03 and 01 HV 04 respectively) and are controlled by level switch (01 ILS 03). The selection of duty/standby pump is automatically or manually determined at the local operation control panel (01 LOP 05).

K. One manually controlled supply fan (01 SF 01) provides air to the lower level of the pump station. Three manually controlled supply fans (01 SF 02, 01 SF 03 and 01 SF 04) provide air to the upper level. Three manually controlled exhaust fans (01 EF 01, 01 EF 02 and 01 EF 03) extract air from high level.

L. A manually operated overhead crane (01 HC 01) is provided in the pump station for maintenance.

M. The raw water is conveyed to a balancing tank and flow into the conveyance pipe from the tank to the distribution chamber by gravity.

N. Manually operated valves and an orifice plates regulate the excess pressure for the conveyance main during Phase 1 and 2.

FDS 3 Distribution Chamber

A. Raw water delivered to the distribution chamber from the raw water conveyance main flows over a control weir to the coagulation (rapid mixing) basin. Two weirs are provided, one for each flocculation basin for Phase 1 and four additional weirs are provided for future flocculation basins. These weirs are blocked off in this stage.

B. A manually operated valve is provided on each outlet pipe from the distribution chamber to the flocculation basins for isolation and maintenance purposes (05 HV 11 and 05 HV 21 respectively). Two interconnection pipes between the distribution chamber and flocculation basins will be installed in this Phase and four pipes will be blanked off and to be connected in Phase 2 and 3.

C. Drainage facilities, controlled by manually operated valves, are provided in the receiving well.

D. Chemicals – alum, lime and chlorine are also dosed into the raw water at the distribution chamber. Mixing is effected hydraulically by the weirs and the dosages (in mg/l) of each chemical at the distribution chamber will be:

	Max.	Ave.	Min.	
10% Alum ($Al_2(SO_4)_3 18H_2O$)	60	15	10	
10% Lime ($Ca(OH)_2$)	30	10	5	(pre-lime)
Chlorine (99% Cl_2)	5	2	1	(pre-chlorine)

E. Control of the chemical dosing system is described in the Chemical Building section although the relevant facilities are located at the distribution chamber.

F. A tapping is provided on the raw water transmission main in the meter chamber to deliver water for quality monitoring to the Administration Building through valve (01 HV 06).

FDS 4 Flocculation/Sedimentation Basins

A. From the distribution chamber the coagulated raw water flows into the flocculation basins. Two basins are provided so that in case of lower flows than the designed capacity one train may be shut down to attain a suitable flocculation intensity, or maintenance work is undertaken on any one of the two basins, the remaining one can provide adequate capacity. Flocculation intensity G-value range from 70 to $10s^{-1}$. The flocculation will be effected in vertical-flow baffled channels with three staged tapered flocculation. From each flocculation basin flocculated water flows to the attached sedimentation tank where the solids settle out as sludge.

B. The solids settle in the sedimentation tanks and are moved to the inlet end of the tanks by means of sludge collectors (06 SC 11, 06 SC 12, 06 SC 21and 06 SC 22). The collector will be continuously operated to scrape the tank.

C. Sludge is withdrawn hydrostatically from each tank through four electrically operated desludging valves (06 MV 11, 06 MV 12, 06 MV 13, 06 MV 14, 06 MV 21, 06 MV 22, 06 MV 23, and 06 MV 24 respectively). The valves in each basin shall be manually pre-set to open and shall close automatically after a manually pre-set time interval. Valves shall be interlocked such that only one of those in one basin can open. The valves discharge into the sludge header pipe which conveys the sludge to the sludge lagoons.

D. Each electrically operated valve has a manually operated maintenance valve upstream on the sludge withdrawal pipeline (06 HV 11, 06 HV 12, 06 HV 13, 06 HV, 14, 06 HV 21, 06 HV 22, 06 HV 23, and 06 HV 24 respectively).

E. Intermediate chlorination is provided at the settled water effluent channel

F. A settled water sampling pump is provided at the settled water effluent channel. The pump (06 SP 01) with foot valve (06 FV 05), manually operated valve (06 HV 05) and check valve (06 CV 01) deliver water for quality monitoring to the Administration Building.

FDS 5 Filters

A. The filtration flow rate is to be maintained and distributed into each of the four filters by an influent weir installed at the inlet to each filter from the distribution channel, which receives flow from the sedimentation tanks. The highest filtration level at which back washing will start will be controlled by means of the water level in each filter and backwashing will then run for a pre-set time period. Thus the head of water above the

sand level of the filter will increase during the filtration cycle until backwashing is required.

B. Settled water from the sedimentation basins flows into the filter distribution channel where four electrically operated gates (07 MG 11, 07 MG 21, 07 MG 31, 07 MG 41 respectively) distribute flows to each of the four filters. Stop logs are provided upstream of each gate for maintenance purposes. Flow exits each filter into the filtered water channel through electrically operated effluent butterfly valves (07 MV 11, 07 MV 21, 07 MV 31, 07 MV 41 respectively) and then passes through the backwash water tank to the clear water reservoir. The backwash water tank is located adjacent to the filters and provides a sufficient on-line storage capacity for backwash pump operation.

C. Four electrically operated gates for washwater discharge (07 MG 12, 07 MG 22, 07 MG 32 and 07 MG 42), four electrically operated butterfly valves for washwater supply (07 MV 12, 07 MV 22, 07 MV 32 and 07 MV 42) and four electrically operated butterfly valves for scouring air supply (07 MV 13, 07 MV 23, 07 MV 33 and 07 MV 43) are provided for filter washing.

D. The water level is monitored in each filter by level detectors (07 ILM 11, 07 ILM 12, 07 ILM 13, 07 ILM 14 respectively). The filter backwashing requirement will be by pre-determined time on at manually pre-determined high water level from (07 BWP 01 and 02). Only backwashing of one filter will be undertaken at any one time.

E. On actuation of the backwash cycle for the first filter, the inlet gate (07 MG 11) and the effluent butterfly valve (07 MV 11) will close and the backwash drainage gate (07 MG 12) will open. The selected air blowers will start and air scour valve (07 MV 13) will open. After a manually pre-set time the backwash water pumps will start, backwash valve (07 MV 12) will open and backwashing will be effected by a combination of wash water and air scour. After a manually pre-set time the air scour blowers will stop air scour valve 04 MV 13 will close and backwashing will continue with wash water. After a further manually pre-set time the backwash pumps will stop, backwash valve (07 MV 12) will close and backwashing will cease. Backwash water drainage gate (07 MG 12) will close and inflow gate (07 MG 11) and effluent valve (07 MV 11) will open to recommence filter operation.

F. The sequencing for the other filters will be a similar operation.

G. Filter drainage for maintenance purposes can be effected through the drainage valve (07 HV 11, 07 HV 21, 07 HV 31 and 07 HV 41 respectively).

H. The backwash pumps include three horizontally mounted centrifugal pumps (07 FP 51, 07 FP 61 and 07 FP 71). Each pump system comprises a suction valve (07 HV 51, 07 HV 61 and 07 HV 71), check valve (07 CV 51, 07 CV 61 and 07 CV 71and discharge valve (07 HV 52, 07 HV 62 and 07 HV 72). Pressure gauges with an isolating valve and diaphragm are mounted on the delivery side of each pump (07 PG 11, 07 PG 21 and 07 PG 31).

I. The pumps (07 FP 51, 07 FP 61 and 07 FP 71) are controlled automatically with two pumps as duty and the third pump as standby. The standby pump will automatically operate on failure of one of the duty pumps. An emergency stop switch is provided at (07 LOP 05) for the three pumps/motors. Water level is monitored in the backwash water tank by level switch (07 ILS 01). On manually pre-set low water level the pumps are switched off and an alarm condition initiated.

J. Backwash flow measurement is effected by the flow meter (07 IFM 01). The flow will be monitored and recorded at (07 INP 01) in the filter building or (00 MON 01) in the

administration building. Manually operated valves will be provided both upstream and downstream of the flow meter for maintenance purposes (07 HV 01 and 07 HV 02).

K. The air scour system includes two air blowers (07 AB 11 and 07 AB 21) each including an air filter (07 AS 11 and 07 AS 21), check valve (07 CV 81 and 07 CV 91) and discharge valve (07 HV 81 and 07 HV 91).

L. The air blowers (07 AB 11 and 07 AB 21) are controlled automatically with one blower as duty and the other as standby. The standby blower will automatically operate on failure of the duty blower. An emergency stop switch is provided at (07 LOP 06) for the two blowers/motors.

M. The quantity of air for scouring is measured by orifice flow meter (07 IFM 02). The flow will be monitored and recorded at (07 INP 01) in the filter building or (00MON 01) in the administration building.

N. Spent backwash water is discharged to the backwash recovery tank for further treatment.

O. Two sump drainage pumps, check valves and manual gate valves are provided in the pump dry well for drainage (07 DP 01, 07 DP 02, 07 CV 01, 07 CV 02, 07 HV 03 and 04 HV 02 respectively) and are controlled from level switch (07 ILS 02). The selection of duty/standby pump is automatically or manually determined at (07 LOP 07).

P. Stop logs are provided and blanked off for future extensions to the settled water channels and the backwash water tank.

FDS 6 Clearwater Reservoir

A. Filtered water from the filtered water channel in the filter complex passes through the backwash water tank and then to the clear water reservoir through two 600 mm diameter pipes. At the reservoir two manually operated inflow butterfly valves are.

B. Two manually operated butterfly valves are installed on the suction header pipe. Under normal operation all inter valves are open. During shut-down of either chamber of the clear water reservoir the appropriate valves are closed to isolate the chamber.

C. An overflow is provided from each chamber.

FDS 7 Clearwater Pump Station

A. The clearwater pump station includes space for five horizontally mounted centrifugal pumps. Six pumps are installed in stage 1; two pumps for three service reservoirs at Upland and Asgiriya(09 CP 11 and 09 CP 12), two pumps for three service reservoirs at Gohagoda and Kondadeniya (09 CP 21 and 09 CP 22) and two pumps for six service reservoirs at Kahawatta and others (09 CP 31, and 09 CP 32) with space left for six further pumps. One unit each is standby. Each pump system comprises a suction valves (09 HV 11, 09 HV 12, 09 HV 21, 09 HV 22, 09 HV 31 and 09 HV 32), check valves (09 CV 11, 09 CV 12, 09 CV 21, 09 CV 22, 09 CV 31 and 09 CV 32) and electrically operated discharge valve (09 MV 11, 09 MV 12, 09 MV 21, 09 MV 22, 09 MV 31 and 09 MV 32). The suction and delivery valves (09 HV 13, 09 HV 14, 09 HV 33, 09 HV 34 and 09 HV 40) for the future pumps are installed in this phase and blanked off for future extension. Pressure gauges with isolating valves are mounted on the delivery side of each pump (09 HP 11, 09 HP 12, 09 HP 21, 09 HP 22, 09 HP 31 and 09 HP 32).

B. The pumps ((09 CP 11, 09 CP 12, 09 CP 21, 09 CP 22, 09 CP 31 and 09 CP 32) are controlled automatically with three pumps as duty and the remaining three pump as

standby. When the remaining six pumps are installed three pumps will be duty and other three will be standby. The standby pump will automatically operate on failure of one of the duty pumps. Emergency stop switches are provided at (09 LOP 11, 09 LOP 12, 09 LOP 21, 09 LOP 22, 09 LOP 31, 09 LOP 32) for each pump/motor (09 HP 11, 09 HP 12, 09 HP 21, 09 HP 22, 09 HP 31 and 09 HP 32 respectively)

C. Pumps are stopped automatically from level sensors (08 ILM 01 and 08 ILM 02) in both the clear water reservoir and the pre-determined flow rate which will be detected by flow meters (09 IFM 01, 09 IFM 02, and 09 IFM 03) and pressure gages (09 IPM 01, 09 IPM 02, and 09 IPM 03) with isolating valves are mounted on the delivery side of each pump (09 HP 11, 09 HP 12, 09 HP 21, 09 HP 22, 09 HP 31 and 09 HP 32). The level sensor in the clear water reservoir (08 ILM 01 and 08 ILM 02) continuously monitors the levels in the two chambers of the clear water reservoir, which are normally operated as one unit. On pre-set falling levels at the clearwater reservoir the clear water pumps are shut down in a manually pre-determined sequence and on rising levels the pumps are started in a manually pre-determined sequence from (09 PLC 01), but subject to capacity available in the clearwater reservoir.

D. The pumps will be manually controlled to lower the water level and empty each chamber for maintenance of the reservoir.

E. Clear water from the clear water reservoir is pumped to Upland/Asgiriya, Kondadeniya, Gohagoda, and Kahawatte/Akurana/Kahalla/Bangalawatte/Philladeniya by the six pumps through a 600 mm, 350 mm, and 800 mm diameter pipes, respectively.

F. The flow rates for each direction are measured by flow meter (09 IFM 01, 10 IFM 02, 10 IFM 03 and 10 IFM 04).

G. Water for in-plant use is provided by the plant water supply unit (09 PU 01).

H. Chlorination booster pumps are provided at the clear water pump station suction pipe manifold for chlorination motive water. The pumps (09 PP 11 and 09 PP 21) and manually operated valves (09 HV 91, 09 HV 92, and 09 HV 102, 09 HV 102 and 09 HV 103 respectively) and check valves (09 CV 71 and 09 CV 71) deliver water for chlorination to the Chemical Building Space is available for a future third pump and manually operated valves (09 HV 94 and 09 HV 104) shall be provided for future connection.

I. Three manually controlled supply fans (09 CF 01, 09 AF 01 and 09 AF 02) provide air to the lower level of the pump station and to the control area. Eleven manually controlled exhaust fans (09 EF 01, 09 FE 02, 09 EF 03, 09 EF 04, 09 EF 05, 09 EF 06, 09 EF 07, 09 EF 08, 09 EF 09, 09 EF 10 and 09 EF 11) extract air from high level.

J. Two sump drainage pumps, check valves and manual gate valves are provided in the clear water pump station for drainage (09 DP 01, 09 DP 02, 09 CV 01, 09 CV 02, 09 HV 01 and 09 HV 02, respectively) controlled from level switch (09 ILS 01).

K. A manually operated overhead crane (09 HC 01) is provided in the pump station for maintenance.

FDS 8 Chemical Building

FDS 8.1 General

A. The chemical building comprises three independent sections for alum, lime and chlorine preparation and dosing facilities. An electrically operated overhead crane (10 MC 01) is

provided in the alum and lime storage area for transporting bags of chemicals. Another electrically operated overhead crane (10 MC 02) is provided in the chlorine container storage area for lifting of chlorine tonne containers.

FDS 8.2 Alum Dosing System

A. Bagged alum will be manually transported from the storage area to the dissolving tank area using the overhead crane (10 MC 01). Bags will be manually opened and the contents emptied into the dissolving tanks. Four dissolving tanks are provided, two for the Phase 1 operations and two for future operations.

B. The two storage tanks are provided with mixers (10 MM 11 and 10 MM 21) to assist in dissolving the alum in water. Water is added to the dissolving tanks through manually operated valves from the plant water system. Valves are installed and blanked off for the Phase 2 and 3 expansions. An emergency stop switch is provided at (10 LOP 02) for two each mixers/motors.

C. Alum solution is discharged from each tank through a manually operated valve to the solution pump header pipe through alum level tank (10 AT 01). Valves are installed and blanked off for the stage two expansions. Solution is pumped to the distribution chamber by pumps (10 AP 11 and 10 AP 21). Each pump system comprises of a suction valve and discharge valve.

D. Manually operated drain valves are provided from each tank .

E. Plant water can be flushed through the alum suction system from valve on plant water supply pipe and discharged to drain through valve on drain pipe.

F. The pumps (10 AP 11 and 10 AP 21) are manually set to discharge the required flow by speed control at (10 INP 01). Emergency stop switches are provided at (10 LOP 01) for each pump motor (10 HS 11 and 10 HS 21, respectively).

G. The levels in the alum tanks are monitored by level switch (10 ILS 11 and 10 ILS 21, respectively).

H. The alum solution to the distribution chamber is measured by (10 IFM 01) and is monitored at (10 INP 01) installed in the chemical control room and at (00 MON 01) installed in the administration building monitoring room.

I. At the distribution chamber the alum solution discharges to alum tank (05 AT 01) containing six v-notch weirs to equalise flow to each dosing point. The tank is isolated by valves. Valves are blanked off for future use.

FDS 8.3 Lime Dosing System

A. Bagged lime will be manually transported from the storage area to the dissolving tank area using the overhead crane (10 MC 01). Bags are opened and the contents emptied into the dissolving tanks. Four dissolving tanks are provided, two for the Phase 1 operation and two for future operation.

B. The two first stage tanks are provided with mixers (10 LM 11 and 10 LM 21) to assist in dissolving the lime in water. Water is added to the dissolving tanks through manually operated valves (10 HV 51 and 10 HV 61) from the plant water system. Valves (10 HV 71 and 10 HV 81) are installed and blanked off for the stage two expansions. An emergency stop is provided at (10 LOP 04) for each of the two mixer/motors.

C. Dust is controlled by an extract fan (10 EF 01) and a scrubber (10 GW 01).

D. Lime solution is discharged from each tank through a manually operated valve to the solution pump header pipe. Valves are installed and blanked off for the stage two expansions. Solution is pumped to the mixing tank at the filter building by pumps (10 LP 11, 10 LP 21 and 10 LP 31). Each pump system comprises a suction valve, a check valve and a discharge valve.

E. Manually operated drain valves are provided from each tank.

F. The levels in the lime tanks are monitored by level switch (10 ILS 21 and 10 ILS 22, respectively). In lime level tank (10 LT 01) is monitored by level switch (20 ILS 23).

G. The pumps (10 LP 11and 10 LP 21) are controlled automatically. The standby pump will automatically operate on failure of the duty pumps. An emergency stop switch is provided at (10 LOP 03) for the two pump/motors (10 LP 03 and 10 LP 21, respectively). The duty pumps operate when the level in the local mixing tanks (07 LT 01) drop and are shut off on manually pre-set high levels. The levels in the local mixing tank are monitored by level switch (07 ILS 03).

H. Manually operated valves are provided from the plant water system to flush out the lime suction systems and which can be discharged to drain through valve.

I. From the lime mixing at the distribution chamber the solution is fed to the mixing basins by lime feed pumps (10 LP 31 and 10 LP 41). Each pump system comprises a suction valve and discharge valve and common suction valve. Manually operated valve is provided from the plant water system and manually operated drain valve is provided to flush out the lime suction systems.

J. The lime solution to the distribution chamber is measured by (05 IFM 21) and monitored at (10 INP 01) and (00 MON 01).

K. From the lime mixing tank at the filter building the solution is fed for post-lime addition by lime feed pumps (07 LP 11) and (07 LP 21). Each pump system comprises a suction valve and discharge valve. Plant water can be flushed through the lime suction system from valve and discharged to drain through valve.

L. The lime feed pumps (07 LP 11 and 07 LP 21) are manually set for flow discharge by speed control and are set as duty or standby at (07 LOP 08).

M. The lime solution to the sand filter building is measured by (07 IFM 03) and is monitored at (07 INP 01 and 00 MON 01).

FDS 8.4 Chlorination System

A. Chlorine will be stored in one tonne containers and two duty containers will be coupled to the system. The duty cylinders will be placed on a weighing device (10 WD 01) using overhead crane (10 MC 01). Change over from the duty to the other containers will be effected manually.

B. Gaseous chlorine will be drawn off from the top of the cylinders through flexible pipes into a pipe manifold from where it will be fed to four chlorinators. Two chlorinators (10 CL 11 and 10 CL 12) are manually selected as duty/standby to regulate the amount of chlorine solution delivered for pre-chlorination at the distribution chamber or upstream of the filters and two chlorinators (10 CL 21 and 10 CL 22) for post chlorination at the filtered water channel prior to discharge to the clear water reservoir.

C. Pre chlorinators and post chlorinators can be isolated by manually operated valves.

D. Water will be supplied from the chlorinator booster pumps to injectors (10 IJ 11 and 10 IJ 21) into which chlorine will be drawn from the respective chlorinators to form a chlorine solution for pre and post chlorination respectively.

E. The injectors can be isolated by manually operated valves.

F. Extract fans (10 EF 01), which is activated by chlorine detector (10 CD 01) removes air from the chlorinator room and extract fans (10 EF 03 and 10 EF 04) which are activated by chlorine detector (10 GD 02), remove air from the chlorine drum area.

FDS 9 Backwash Recovery Facility

A. Spent backwash water is discharged to the backwash receiving tanks. Spent backwash water is discharged to the receiving tanks through a normally open, manually operated inlet valves in each tank (11 HV 11 and 11 HV 21).

B. The tank contains two pumps to pump recycled backwash water to the distribution chamber. The pumps (11 WP 11 and 11 WP 21) are provided one for duty and another for standby. Each pump system comprises the pump, inflow valve (11 HV 01 and 01 HV 21), check valve (11 CV 11 and 11 CV 21) and manually operated discharge valve (11 HV 11 and 11 HV 21).

C. The flow to the distribution chamber is measured by flow meter (11 IFM 01). Maintenance of the flow meter is effected by valves.

D. The pumps (11 WP 11 and 11 WP 21) are controlled automatically by level device (11 ILM 01 and 11 ILM 02) which continuously monitor the levels in the two tanks. On manually pre-set rising levels the pumps are started and on manually pre-set falling levels the pumps are stopped from (07 PLC 01).

E. An emergency stop switch is provided at (11 LOP 01) for the two pump/motors.

FDS 10 Sludge Lagoon

A. Two sludge lagoons will be constructed in Phase 1 and additional two will be expanded in future. A 700 mm for inflow and a 300 mm discharge pipes will be provided with each lagoon.

B. Sludge is discharged from the sedimentation basins to the sludge lagoons where it is directed into the appropriate lagoon through manually operated butterfly valves (12 HV 11 and 12 HV 21, respectively). Lagoons are filled in sequence until a lagoon is full. A series of stop logs at the discharge end of each lagoon are removed to drain off supernatant water until only solids remain. The dried solids are removed from the lagoon by a loader/backhoe and truck for disposal to land fill

FDS 11 Service Reservoir (Kahawatta – Typical)

A. The reservoir comprises two chambers. Flow enters the reservoir through two manually operated valves and exits through two manually operated valves. An overflow and drain are also provided from each chamber.

B. The butterfly valve (toothed vane valve type) is installed on the inlet pipe for dissipation of the residual pressure to avoid the cavitation occurring at the float valve, so that incoming flow to the reservoir could be controlled.

C. An overflow connection, set at the high water level will allow excess water to flow out of the reservoir, and is usually connected to a drain line leading to a local stream or a waterway. Similarly, a washout connection is provided at the bottom to drain the tank for emptying for maintenance or in an emergency.

D. The flow meter on the inlet and outlet pipe is equipped to measure the quantity of incoming and outgoing water into the distribution system.

E. The level indicator in the service reservoir continuously monitor the water levels in the two chambers.

F. The service reservoir contains two pumps to pump clear water to the next service reservoirs at Kurugoda and Thelambugahawatta. The pumps (304 BP 11 and 304 BP 21) are provided one for duty and another for standby. Each pump system comprises the pump, inflow valve (304 HV 01 and 304 HV 21), check valve (304 CV 11 and 304 CV 21) and manually operated discharge valve (304 HV 11 and 304 HV 21).

G. The flow to the service reservoirs is measured by flow meter. Maintenance of the flow meter is effected by valves.

H. The pumps (304 BP 11 and 304 BP 21) are controlled automatically by level device (304 ILS 01) which monitor the level in the reservoir. On manually pre-set timer the pumps are started and on manually pre-set pressure or no-flow signal by flow switch on delivery pipe, the pumps are stopped from (304 BPP 01, 02, 03).

I. An emergency stop switch is provided at (304 BPP 01, 02, 03) for the two pump/motors.

FDS 12 Miscellaneous

A. Sampling pumps deliver water from various locations on the treatment plant site to the administration building laboratory to enable water quality to be continuously monitored. The pumps are located at the outlet end of the sedimentation basins (06 SP 01) and with valves (03 FV 06, 03 CV 01 and 03 HV 07). In addition tapings are provided on the raw water pumping main and clear water pumping main.

End of Functional Design Specification

Contract GK/JBIC/04

Particular Specifications（Addition）

Section 02222 (Add final sentence to PS 2.07)

PS 2.07 Structure Excavation and Backfill

For the construction of the Upland Service Reservoir, the Environmental Impact Assessment (EIA) thereon proposes environmental protection measures as shown in the Appendix to these Particular Specifications (Addition). The contractor shall consider the proper measures to minimize such environmental impact. The cost of such environmental protection measures shall be born by the Contractor.

Appendix to Particular Specifications (Addition)

Proposed Environmental Protection Measures for Construction of The Upland Service Reservoir

1.1 Proposed Protection Measures

As noted in section 4.2.1, soil erosion and land slides can be a serious problem during construction of the reservoir. To eliminate this problem, PP should include strict conditions in construction contract to prevent erosion by placing earth embankments, silt traps, Gabion walls and drain trenches etc., at appropriate places around the construction area. As the main project components are sited on geologically well suited locations, other geological hazards such as subsidence are very unlikely. Following protection measures are to be taken during construction of the reservoir.

1. Ensure the disturbance of soil etc., is limited to a bare minimum.
2. The weathered rock outcrop is to be removed by light machinery without blasting
3. Deposit the removed larger outcrops rock boulders on the uphill slope of the unsurfaced road traversing on the east side of the proposed reservoir
4. Replanting trees and turf sod placing around the reservoir to match the rest of the jungle.
5. Disposal of rain water collected on the roof of the tank in such a manner (propose equal spread with reduced velocity to the surrounding of the tank.
6. Carting away methods of blasted rock.
7. Rock blasting; adopting methods that control the effect to the surrounding rock mass and also that prohibits projectiles.

1.1.1 Excavation of earth, rock removal and disposal

About 50% of the surface area is occupied by the rock outcrop. Therefore the removal of outcrops and soil has to be done simultaneously in the soil column of about 1.0 – 3.0m. The recommendation is to use medium capacity earth work and hauling machinery to ensure excavation to the exact lines of foundations and minimise disturbance to the surrounding. The outcrops that can be removed in large sizes may be placed in neatly order on the uphill slope of the cut of the road situated on the east

side of the proposed tank.

The working of machinery should be limited to day time hours of 8.00 – 5.00 p.m. so that the population around the reservoir is not disturbed. The surface of the ground or the cut surface of earth before removal and after the loading to trucks for disposal, should be water sprayed to minimise the formation of dust. The earth should not be allowed to expose but covered with a tarpaulin cloth while in hauling to prevent the dust spreading to the environment.

It is also recommended to use machine drilling and adopt shorter depth of drill holes. The blasting material charging must be of light strength and the blasting pattern should be concentric around the centre of the foundation area. Use of delay detonators will ensure concentric blast of the rock mass. The entire rock surface should be laid with sand bags to prevent the splash of rock pieces of the blast beyond the work area.

The removal of the blasted rock should also be done in the same manner described for the removal of earth.

1.1.2 Concreting

The structural concrete is proposed to be pre-mixed and brought to site from the plant located outside. This action will prohibit the nomenclatures of the portable concrete mixers. In order to minimise the obstruction to the traffic movement of the residents, the use of the approach road for construction work purposes should be limited to the 9.00 a.m. to 4.30 p.m. period. As a measure to avoid vehicle congestion or crossing difficulties due to the haul of concrete, it is proposed to operate a lead vehicle which can stop any confronting vehicle with concrete mix trucks at suitable (wider) locations of the road.

1.1.3 Blending the Project Environment to the Background

In order to minimise the aesthetic loss of the environment, trees of the similar specie of the surrounding jungle shall be planted around the reservoir on the filled earth surfaces to match with the existing jungle.

After the construction of the reservoir, it is necessary to dispose the rain water that falls on the tank surface and on the filled earth and slopes around the reservoir must be allowed to flow evenly and at reduced velocities to the surrounding ground to mitigate

the erosion. The excavation of a drain to a depth of about 0.6m and width of 1.0 m and fill subsequently with rock fragments or gravel will help the evenly distribution of rain water spread around the periphery of the reservoir and prevention of soil erosion.

It is further recommended to select machinery and construction methods so that the emission of fumes and sounds are minimum. The waste and excess water mixed with construction material such as cement shall not be allowed to be wasted within the jungle area but should be disposed away after collecting into tanks or barrels. The approach road which is for the community convenience has to be maintained well so that residents should not suffer due to possible deterioration of road surface when heavy hauling equipment are deployed for construction work.

1.2 Overview/Synthesis

1.2.1 Public Participation

The involvement of the public in the EIA process is one of the most important aspects highlighted by previous workers. Public participation is vital at two stages, first at the time of screening (or scooping) for SEIs and finally at the time of granting approval by the PAA. Provision for public participation is included ion the National Environment Act. As mentioned in the Act, within 30 days after the statutory public notice, the PAA must decide whether to have a public hearing. Public comments received during this 30 day period have to be considered by the PP for review and response. All substantial comments shall be given due consideration and included in the final EIA.

1.2.2 Compliance with Environmental Laws

The present EIA report has been prepared with due attention paid to the requirements of the Environmental Act and other relevant laws and regulations prevail in Sri Lanka. The first ordinance appeared to have influence over the existence of Udawattekelle has been the Ordinance No. 24 of 1848 entitled “To regulate the felling and removal of Timber grown on the Crown Lands in the Island “ and its proclamation as a forest reserve in 1856. Table 5.2.2-1 lists all the relevant laws having bearing on EIA reports.

Table 1.1-1 Environmental Protection Measures

Excavations and earth moving	Controlled rock blasting is needed to minimise damage to the habitat. Excavation faces caused by construction of the tank and the access roads should be finally finished with masonry work, grass cover, concrete walls etc. It is recommended to select machinery and construction methods so that the emission of fumes and sounds are minimum. The waste and excess water mixed with construction material such as cement shall not be allowed to be wasted within the jungle area but should be disposed away after collecting into tanks or barrels. The approach road which is for the community convenience has to be maintained well so that residents should not suffer due to possible deterioration of road surface when heavy hauling equipment are deployed for construction work.
Landslide protection	NE and SW slopes of the site are very steep and requires consolidation by e.g. Line planting of Gliricidia, sand bags, gabion walls, drain trenches etc., during construction and with permanent measures afterwards.
Wastewater/ runoff water	Waste water and rainwater runoff from construction area should be properly de-silted before discharge into common drains in the vicinity.
Dust and noise control	Dust and noise generated by construction works, including supplies and disposal transportation should be controlled by appropriate measures such as watering, sound barrier walls etc.
Safety management	Local dwellers and the workers in the project area should be protected from dangers from construction work by setting proper alarm systems, traffic control and health care and proper first aid facilities.
Preservation of the Ecosystem	Limit the site clearing to the bare minimum. Use only the access from Upland Road. Restrict illumination in the night time only to the construction area. Do not use bright coloured objects in the site or camouflage them so as not to distract animals and keep the wilderness quality. Maintenance of plant animal interactions is important to enhance the quality of the habitat. Do not leave any excess material after construction in the vicinity. Do not allow vehicles to move into the forest and provide wider turning area at the end of the Upland road.