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SECTION TS 25 ELECTRICAL WORKS

SECTION TS 25 . ELECTRICAL WORKS

25.1 GENERAL REQUIREMENTS

25.1.1 General

This section of the Technical Specification covers the general and specific requirements for electrical works for the Asin Pumping Station and Asin Gate and all electrical works associated with the mechanical works for the Asin Pumping Station and Asin Gate described in Section TS 24 which shall be read in conjunction with this section.

Unless otherwise specified, electrical works for Building Works, as defined in Clause 27.2 of TS 27, shall comply with the technical specification for electrical works appended to section TS 27.

The general requirements in clause TS 25.1 shall apply to all electrical works to be performed under the Contract including electrical works associated with the above-mentioned mechanical works.

25.1.2 Applicable Standards and Regulations

The following standards shall be applied to the design and manufacture of the electrical equipment and fittings:

- National Electrical Code (NEC)
- National Fire Protection Administration (NFPA)
- Applicable Regulation and Standard
- National Electrical Manufacturer's Association (NEMA)
- Underwriters' Laboratories (UL)
- Illuminating Engineering Society (IES)
- Japan Industrial Standards (JIS)
- Institute of Electronics and Electrical Engineers (IEEE)
- International Electrotechnical Commission (IEC)

25.1.3 Data Sheets

The completed data sheets E1 to E 7 shall form part of, and shall be read in conjunction with, this section of the Technical Specification.

25.1.4 Warranties

The Contractor shall provide warranties guaranteeing the plant supplied under the Contract from the manufacturers/suppliers of all electrical plant. Such warranties shall have a minimum duration of 2 years from the Completion Date and shall be made out in favour of the Employer. The warranties shall be consistent with the information provided by the Contractor in the approved data sheets forming part of the Contract.

25.1.5 Spare Parts

The Contractor shall supply spare parts for maintenance purposes suitable for 5-years operation, in accordance with the approved schedule, based on the accepted recommendations of the Contractor made in completed data sheets appended to his bid for all electrical plant provide under the Contract.

25.1.6 Maintenance Tools

The Contractor shall supply tools for maintenance purposes suitable for 5-years operation, in accordance with the approved schedule, based on the accepted recommendations of the Contractor made in completed data sheets appended to his bid.

25.1.7 Qualifications

All specialist sub-contractors performing work under the Contract shall meet the following criteria:

- They shall be companies which have regularly provided the similar type of works to that required for not less than 5
- Their workmen shall be well trained and experienced in the type of works required.

All specialist suppliers of equipment shall meet the following criteria:

- They shall have been regularly producing systems of types required for not less than 5 years before the date of submission of Bid.
- They shall be capable of providing immediate emergency service within three (3) days after notification by Employer.
- They shall be capable of entering into full service maintenance agreement with Employer after the expiration of warranties.
- Their workmen shall be well trained and experienced in type of works required and in direct employ of the manufacturer.
- They shall issue warranties for all plant supplied by then in accordance with the requirements of the Contract.

25.1.8 Codes, Inspections, Permits and Fees

The works under this Contract is to be installed according to the requirements of the latest Indonesian codes for electrical works, and the applicable ordinance and requirements of the power authority (PLN). Nothing contained in these Specifications or shown in the Drawings shall be construed as to conflict with National and Local Ordinances or Laws governing the installation of electrical works, and all such laws and ordinances are hereby made part of these Specifications. The Contractor is required to meet the requirements thereof.

All permits and electrical fees required for this works shall be obtained by and at the expense of the Contractor. The Contractor shall furnish the Engineer and the Employer final certificates of inspection and approval from the proper government authorities after the completion of the Works. The Contractor shall prepare all as-built drawings and all other paperwork required by the approving authorities.

25.1.9 As-Built Drawings

As-built Drawings shall be prepared by the Contractor in accordance with clause 1.4.4 of the General Specification

25.1.10 Shop Drawings and Samples

Shop Drawings and samples shall be submitted by the Contractor in accordance with requirements of clause 1.4.4. of the General Specification.

The Contractor shall submit to the Engineer for his approval samples of conduit, wire, wiring devices, finished plates and of any other items as may be requested by the Engineer.

25.1.11 Minor Modifications

The plant and equipment layout as drawn is based upon preliminary drawings and details and show conditions as accurately as possible. They are diagrammatic and do not necessarily show all fittings, etc., necessary to fit actual conditions. The locations of outlets, apparatus and appliance shown on the plans therefore are approximate. The Contractor shall, in consultation with the Engineer, be responsible for the detailing and proper location to make fit with architectural details and provide all necessary fittings and appurtenances as may be required by the Engineer at no extra cost. The Contractor shall be responsible for verifying the actual location of all items.

25.1.12 Approvals and Substitutions

Wherever hereinafter the words "for approval", or "approved" (make, type, size, arrangement, etc.) are used, especially with regard to manufactured specialised equipment, etc., or wherever it is desired to substitute a different make or type of apparatus for the one specified, all information pertinent to the adequacy and adaptability of the proposed apparatus, shall be submitted to the Engineer for approval but based on the Drawing details. All location for the electrical equipment shall be subject to the approval of the Engineer.

25.1.13 Subcontractors

The Contractor shall be held fully responsible for the work of any subcontractors performing work or for manufacturers supplying materials, as it is intended that the Electrical Works, when finally delivered to the Employer shall be ready in every respect for satisfactory and efficient operation.

25.1.14 Workmanship

The work throughout shall be executed in the best and most through manner under the direction of and to the satisfaction of the Engineer, who will interpret the meaning of the Drawings and Specifications and shall have power to reject any work and materials which in his judgement are not in full accordance with the Drawings and/or Specifications.

25.1.15 Standards of Materials

All materials shall be new and shall conform with the standards listed in clause 25.1.2 for every case where such standard has been established for the particular type of material in question.

All materials on all systems shall comply with the Specifications, unless specially excepted and all materials where not specified shall be of the best of their respective kind.

Details of specified materials shown on the Drawing shall be submitted for approval as required by the Engineer.

25.1.16 Approval of Materials

All materials shall be new and shall meet the requirements and shall bear the inspection label wherever standards have been established. Within thirty (30) days after the issuance of Letter of Acceptance, and before any materials or equipment are ordered, the Contractor shall submit to the Engineer for his approval, a complete list of materials, apparatus and

equipment, in triplicate, giving the manufacturer's name, address, descriptive data, trade name of item, rated capacities, certified analysis, catalogue numbers, etc., and when called upon to do so, complete specifications, Drawings or samples which he proposed to use or install.

25.1.17 Ground Test

The entire installation shall be free from improper grounds and from short circuits. Tests shall be made in the presence of the Engineer. Each panel shall be tested with mains connected to the feeder branches, and switches closed, all fixtures in place and permanently connected, lamps removed or omitted from the sockets and all wall switches closed. Each individual power feeder shall be tested with the power equipment connected for proper and intended operation. In no case shall the resistance be less than that allowed by the Regulations for Electrical Equipment of Buildings. Failure shall be corrected in a manner satisfactory to the Engineer.

25.1.18 Performance Test

It shall be the responsibility of the Contractor to test all systems of the entire electrical installation for proper operational conditions. These conditions shall apply to the power and lighting installation as well as low voltage and alarm, control, and signal systems. Where sequence operation is required, the Contractor shall test for proper sequence for the entire electrical installation and for satisfactory working condition as approved by the Engineer.

25.1.19 Related Documents

General:

Materials and equipment shall not be ordered or fabricated until submittals have been approved.

Shop-Drawings:

Shop Drawings shall be completed in accordance with the requirements of clause 1.4 of the General Specification and shall indicate the following:

- Complete dimensional data.
- Elevation views for complete representation.
- Construction details for anchorages to structures.
- Arrangement of devices and appurtenances.
- Waterproofing details for exterior and underground works and penetrations.
- Location and size of connections.
- Identification schedules.
- Substituted equipment or materials requiring changes in sizes, connections, arrangements, installations or wiring.
- Wiring diagrams as specified elsewhere herein for work and systems as proposed.
- Manufacturer's certified drawings for all major equipment items.
- Detail wiring plans for all electrical systems.
- Material/Colour Samples: Provide for primary materials or finishes or other components and when requested by the Engineer.

Certification of Materials:

Certificates shall be obtained from equipment or system manufacturers or from independent testing or agencies employed by them, indicating compliance with requirements specified herein for various items of equipment and system.

25.1.20 Supervision of Electrical Works

General Electrical Works: Contractor shall furnish full-time services of one or more experienced professional electrical engineers well qualified in directing and overseeing all phases of works of type required.

The Contractor shall provide the services of manufacturers' specialised engineers in full-time service as necessary to supervise equipment installation and for the execution of testing and commissioning specialised equipment supplied.

Supervisory Personnel: The Contractor shall maintain the supervisory personnel at the Site, for as long as necessary to continuously supervise all of various phases of Works required, including installations, erection, testing, commissioning, start-up adjusting and initial operations, and for instruction of Employer's operating personnel.

Retaining or arranging for manufacturer's representative shall not be construed as waiver of responsibilities of the Contractor under the terms of the Contract.

25.1.21 Product Requirements

Electrical Materials, Assemblies and System unless or except as otherwise shown, specified or approved, shall conform to the followings:

Manufacturer's first quality line of standard and/or series or factory fabricated items as shown in the Drawings or specified.

Comparable materials, assemblies and system of manufacturers other than as specified may be proposed where differing in minor details only and otherwise comply with requirements shown or specified subject to prior approval by the Engineer.

Materials and equipment shown or specified shall be essentially standard catalogue products or approved manufacturers and variations there from shall be only as specified or approved by the Engineer.

Where two or more units of same class, type or kind are required, units shall be products of a single manufacturer. However, component parts of a system need not be products of same manufacturer.

Where a device, part of piece of equipment is referred to in singular number, such reference shall apply to all services or parts required to complete the works.

Electrical parts and components identical throughout each electrical system shall be readily interchangeable.

25.1.22 Equipment Work Requirements

Equipment shall be especially designed for particular use, function or operation intended and items of the same kind shall be designed, fabricated and supplied by a single manufacturer for all works under this Contract.

Each system of equipment shall be designed, fabricated, and furnished by a single manufacturer.

Equipment, materials and appurtenances specified shall be new, and shall be installed as indicated; shall conform to respective specifications and

requirements as specified or approved; and shall be installed complete, tested and made ready for services intended.

Products for Works under this Contract shall be designed, fabricated and constructed for the purpose and use intended; and in accordance with or capable of meeting standards for Electrical Works as specified herein or under other Technical Sections as approved by the Engineer.

Compliance shall be substantiated by sufficient and adequate prototype testing or otherwise evidenced by such operational reports and data as may be required by the Engineer to fully demonstrate performance characteristics, operational qualities, reliability, safety and other relevant considerations.

25.1.23 Execution Requirements

Prior to commencing electrical works the Contractor shall review details of electrical works with the Engineer, incorporating adjustments deemed necessary and as directed.

For interior works, building shall be adequately closed and/or protected.

For installation of equipment or other sensitive equipment or components, building shall be entirely enclosed and fully protected; and specific interior protection arranged for and installed.

Works shall not proceed until the Contractor has verified the following:

- Supporting construction to be in proper condition and any improper construction conditions have been corrected, re-inspected and approved.
- Layouts, locations and tolerances are correct for this Work.
- Respective areas receiving works have been inspected and approved by the Engineer.

25.1.24 Completion Requirements

General:

Remove waste and debris resulting from this works; as work progresses and upon completion.

Service and adjust moving or mechanical parts for smooth, quiet and proper operating condition.

Touch-up abraded or damaged painting or galvanizing.

When Completed:

Exposed surfaces shall be clean and free from dust, dirt, scratches, dents, broken parts, misaligned or improperly fitted joints, stains, discoloration or other defects or damages.

Installation shall be free from exposed fastening, unnecessary cuts, holes, blank plates, advertising labels or signs; other than as particularly specified or approved.

Each hole and all openings required for the pulling of wire inside cable pit shall be sealed off after the works for possible entry of insects and foreign materials.

Exterior or below grade installation shall be watertight throughout and free from leaks or entry of water into or through interior or concealed spaces of structures.

Each item, unit or assembly shall be tightly and rigidly secured in place free from unnecessary movement, squeak or rattle.

Each item, unit or assembly shall be set straight, plumb and level; accurately positioned at locations required; adjacent similar units shall be accurately aligned.

Movable mechanical items or devices shall be serviced and adjusted to operate smoothly, quietly, easily and without binding.

Mechanical assemblies or system shall be serviced and adjusted to operate in compliance with performance requirements shown or specified, and tested as specified.

Electrical devices, assemblies or systems shall be properly connected and grounded, operating in compliance with performance requirements shown or specified, and tested as specified.

25.1.25 Servicing Requirements

Lubrication:

Lubrication facilities shall be incorporated for all parts involving friction and wear, other than where suitably covered or protected by resilient materials or provided with life-time packing or fittings, at no extra cost.

Include all necessary grease fittings, oiling caps or other like facilities as required to maintain equipment properly protected. The same lubrication system should be used for items of similar equipment.

Locate lubrication facilities where they are readily visible and positioned where easily accessible.

Service Tools:

Two complete sets as required for each equipment, item or system or work.

Tools shall include all necessary lubricating tools and supplies and any specialised hand tools necessary for operation, adjustments or regular up-keep service.

Each set shall be contained in a suitable metal box or panel. The outside of the tool container shall be clearly identify the respective equipment for which the tools are required.

25.1.26 Maintenance Services

The Contractor shall furnish maintenance and call-back service for all electrical systems after completion and placed in operation for the duration of the two-year warranty period applicable to all mechanical equipment.

The maintenance services shall consist of examinations of equipment, adjustments, lubrication, cleaning, provision of supplies and parts to keep the equipment in proper operation.

When such adjustments, parts or repairs are made necessary by abuse, misuse or other cause beyond control of Contractor, or manufacturer, same shall be provided except that an additional reasonable cost shall be paid by Employer subject to his prior consent.

All works will be done by trained employees of the Contractor or manufacturer during regular working hours of the trade.

Emergency services shall be available when called for, at additional cost to Employer except where cause are attributable to Contractor or manufacturer.

25.1.27 Certification of Installation

Certification of the installation is required for all general equipment work and systems.

It shall be prepared by the Contractor or by independent testing agencies regularly providing test and inspection type works required and as retained by the Contractor.

25.1.28 Maintenance Instructions

Maintenance instructions are required for each of the various electrical systems.

They shall include manufacturer's recommendations for daily/weekly/monthly maintenance or up-keep which should be performed by the Employer between times of manufacturer's service maintenance calls.

25.1.29 Operating Instructions

The Contractor shall provide operating instructions for general use and operation of various items of equipment and systems.

Each set of instructions shall be specifically prepared for equipment or systems as installed.

25.1.30 Service Manuals

The Contractor shall provide Basic Service Manuals: These shall be provided as part of initial submittals and shall include:

- Complete list of spare parts and current price lists thereof.
- List of especially critical parts recommended by manufacturer which are being supplied by the Contractor under the Contract.

The Contractor shall provide Complete Service Manuals which shall include the following :

- All data as required for Basic Service Manuals.
- Other data as may be particularly required.
- Wiring diagrams for Works as installed.
- Complete Equipment Identification Schedule for Work as installed.

25.1.31 Equipment Identification Signs

Equipment identification signs are to be provided for each item of electrical equipment item in readily visible locations. Each sign shall be installed level and symmetrically positioned. Signs shall be prepared in accordance with the following:

Sign Description:

Size: Suitable for size of equipment upon which sign is mounted.

Type: Laminated bakelite with engraved letters or other standard with equipment manufacturer as approved by the Engineer.

Colours: Black plaque, white letters, unless otherwise directed or approved by the Engineer.

Letters: Plain block or gothic style only.

Designation

Named acrylic resin plates shall be posted at the upper part on front surface of all panelboards such as distribution boards equipped with circuit breakers, relays, fuses, etc., lighting panels, motor control panels and terminal boards for grounding and communication wiring.

Named acrylic or metal plates shall be posted near meters, relays, switches on the front surfaces of all panelboards.

Pilot lamps and indication lamps on front surface of all panelboards shall be etched and imprinted.

Acrylic resin name plates shall be posted on circuit breakers, relays, connection terminals and other parts in all panelboards.

Identify individually:

Each motor control centre and control panels

Each panelboard

Each disconnect switch or circuit breaker regardless if whether separately mounted or grouped with others in a single housing.

Each wire or cable in each secondary feeder

Each wire or cable in a feeder and control shall be identified at its terminal points of connection and in each pullbox, junction box, wireway, cable rack, cable trench and panel gutter through which it passes.

The nomenclature used to identify switchboards and panelboards shall designate the numbers assigned to them.

The nomenclature used to identify switches or circuit breakers shall:

Where they disconnect mains or services, it shall designate this fact together with suitable differentiating nomenclature where more than one service or mains is involved.

Where they control feeders, it shall designate the feeder number and the name of the load supplied.

25.1.32 Manufacturer's Identification

Manufacturer's identification is required for each factory fabricated fixture or equipment item. It shall be applied on items to be concealed when installed and normally closed, shall be readily visible and readable when opened.

Such labels or nameplates must be those standard with manufacture, shall be non-corrosive and durable, and permanently attached.

Labels or nameplates shall state fixture or equipment item type, model, number, rating, current characteristics etc.

25.1.33 Circuit Directories

Current directories are required for each panel containing electrical control or safety devices and shall be installed at the back of panel doors.

Each directory correlated with panel as arranged and installed and in type-written form only.

Each directory shall be protected and retained by suitable frame and clear glass or plastic cover.

25.1.34 Keyed Locks and Switches

Locks and switches required to be keyed shall be master-keyed to one set or sets for common types of facilities such as panelboards and for various different locations such as different buildings or areas of usage.

The Contractor shall submit proposals for keying for the Engineer's approval.

Keys Required:

Master keys and change keys: not less than 6 each shall be provided.

Duplicate sets of all keys shall be provided by the Contractor.

25.1.35 Attachment to Structures

General:

Types of attachments shall be appropriate for materials and conditions encountered and only as shown, specified or approved.

Sizes shall be adequate for loads and forces involved.

Cutting or welding to structure for support shall be permitted only as and where specified or approved by Engineer for each specified condition or location.

Supporting piping or equipment by attachments directly to metal decking shall not be permitted.

Steel items shall be hot-dip galvanised or painted in accordance with the specification for protective treatment of metalwork in Section TS 24 of the Technical Specification.

Continuous Supports:

Continuous supports shall be of the manufacturer's standard prefabricated type of C-Channel and shall be roll-formed from steel strip thickness not less than 2.5 mm and in standard length units requiring a minimum number of splices.

Continuous supports shall be complete with matching splices covers, insert devices suitable for hanger rods, etc. required to be supported.

They shall be secured to overhead concrete using unit anchors set through pre-punched holes in C-Channel webs.

Unit Anchors:

Unit anchors shall be manufacturer's standard type of steel insert bolts designed for use in hardened concrete, with pre-tested and predetermined load values; and in various types and sizes suitable for varying installation requirements.

Each unit selected shall be in accordance with manufacturer's certified load carrying capacity tables, as approved.

Each unit shall be selected to safely support works required and when under full load conditions; and as appropriate to which attachment is being made.

Selection of anchors shall be made using Factor of Safety not less than 5 times the loads to be supported

In any and all cases, bolt shank diameter shall be not less than 15 mm

Other Consideration:

Heavy Items in Steel Framing shall be attached using machine bolts, nuts and washers set through drilled holes.

Light Items to Steel Framing shall be attached using machine screws set into drilled and tapped holes or set through drilled holes and with nuts and washers.

Light Items in Sheet Metal shall be attached with self tapping screws.

Wood, fibre, plastic or lead type inserts shall not be used.

25.1.36 Protective Coating

General

Protective coatings are required for materials and equipment not otherwise pre-finished, protected or included for field painting.

Painting work and materials required herein and not otherwise specified shall be in accordance with applicable requirements specified under clause TS 24.1.16.

Includes all locations, whether exposed or concealed in completed work.

Painting

Unless otherwise specified, all raceways, conduits, cable trays, boxes, supporting devices and other materials and equipment seen visibly from outside shall be painted in accordance with the Engineer's instructions.

Metalwork which is normally painted in the factory before dispatch, shall be prepared by filing or wire brushing and rubbed down or similarly prepared to a smooth and rust-free finish and then given one prime coat, one or more undercoats and one more top coats of approved paints. The second top coat shall be of a different shade of colour. Metalwork installed to outdoor shall be painted with epoxy to avoid sea air corrosion.

Metalwork which is normally painted on Site shall be prepared as aforesaid and given one coat of approved preservative paint before leaving the factory.

Metalwork which will be erected in the open shall be given top coats of bitumen based paint with appropriate approved primer and undercoat.

Where aluminium paint is specified the paint used for the undercoat shall be of the same quality as the top coat but slightly coloured by the addition of washing blue.

The inside of control cubicles, cabinets, etc. where condensation is liable to occur shall be coated with approved anti-condensation composition.

All bright metal parts shall be covered before shipment with an approved protective compound and protected adequately during shipment to Site. The protective coatings will not be removed until necessary.

25.1.37 Safety Equipment and Notices

Copies of all statutory safety notices, regulations and instructions for resuscitation and treatment after electrical work shall be prominently displayed. Such notices shall be treated with clear varnish and mounted in a suitable frame.

Danger signs on the motor centres/control panels shall be provided.

The Contractor shall provide a varnished and mounted (on suitable hard backing) and framed (in glass panel) copy of the main single line diagrams showing clearly the full details of the electrical and mechanical system as supplied and installed.

25.2 POWER INTAKE CABLE WORKS

25.2.1 Description of Works

This clause covers the technical requirements for the materials, workmanship, fabrication and installation of power intake cable works, to include but not limited to, all cabling works between the secondary connection terminal of PLN's distribution transformer and [kWh Meter &

Distribution Panel] installed in the pump control building, and grounding rods.

25.2.2 Materials

Materials shall conform to the respective specifications and standards and to the specifications herein. Electrical rating shall be as indicated.

Cable

Cable shall be 600 V Class XLPE (Cross-linked Polyethylene insulated and PVC sheathed) cable.

Conduit

Conduit shall be PVC (Polyvinyl Chloride) conduit for electrical cable installation.

25.2.3 Installation

Conduit

Underground conduit shall be installed to 600 mm in depth and excavation and back filling shall conform to the requirements of Section TS 2.1 Earth Works of the Technical Specification.

Bends of conduit shall be so made that conduit will not be injured and that internal diameter of conduit will not be effectively reduced.

Field bends shall be made only using bending equipment intended for the purpose and with radius of curve of inner edge of bends not less than 6 times nominal diameter of conduit.

All joints between lengths of conduit, and between conduit and couplings, fittings and panel shall be made by a method approved for the purpose.

Where the conduit passes through the building walls and floors, holes shall be completely filled using suitable non-flammable and waterproof sealing materials.

Cable

Cable shall be full-length cable and continuous from origin to the panel termination without splices in intermediate.

All termination of the cable shall be protected from accidental contact, deterioration of coverings and moisture by the use of terminating device and materials.

Grounding

The neutral line of the service cable shall be grounded.

Grounding elect rods shall be copper bars of 15 mm diameter and 1500 mm length.

Grounding conductor shall be bare soft-drawn copper wire and sectional area of wire shall be not less than 70 mm^2.

25.3 MAIN CONTROL PANEL

25.3.1 Description of Works

The works comprises the supply, installation, testing and commissioning of indoor use metallic panels in accordance with the drawings, the specifications and the instruction of the Engineer.

25.3.2 Main Control Panel

25.3.2.1 Composition

The Main Control Panel shall consist of the following sections.

- kWh METER & DISTRIBUTION PANELS
- MOTOR CONTROL PANEL
- WATER LEVEL INDICATION AND ALARM PANEL
- BATTERY AND CHARGER PANEL

The panels shall be fabricated as one unit with modules having similar dimensions, finish and configuration.

All panels shall be provided with both of front and rear access doors.

25.3.2.2 Enclosure

The enclosure shall be made of sheet steel of minimum thickness as follows.

- For enclosure: 2.0 mm
- For interior partitions: 1.6 mm
- Index of Protection of all enclosures shall be IP 52.

All enclosures shall be strongly built, specifically designed to enclose equipment scheduled or shown, and able to withstand vibration or shock caused by operation of such equipment.

Metal components shall be factory pre-treated, primed and baked enamel finished.

Colour will be selected from manufacturers standard colours available.

All devices installed on the front face or doors such as meters, meter switches, circuit breakers, indication panels and alarm buzzer shall be arranged in an orderly, systematic fashion so as to be legible and readily readable.

All doors shall be fully openable for ease of installing or removing equipment or devices.

Ventilation openings shall be provided to required panels.

All enclosures shall be connected to the grounding rod by PVC-insulated wire of 25 mm^2.

25.3.2.3 Circuit Breakers

The circuit breakers installed to the Main Control Panel shall be 600 V Class MCCB (Moulded Case Circuit Breaker) rated as shown on the drawings.

25.3.2.4 Batteries Charger

Batteries charger to be used shall re-charge the diesel engine start batteries within 5 hours.

25.3.2.5 Water Level Detector

The type and requirements for water level detector shall be as follows:

a. Type: float switch
b. Water level of measurements: 4-Points or -3.00 m, -2.50 m, -1.50 m and –1.00m
c. Trash and wave protector: Shall be required

d. Cable connection box with connection terminal block: Shall be required

25.3.3 Installation

The bank of Main Control Panels shall be erected with adjacent components accurately aligned and all components shall be set square, plumb and level and full bearing on supporting base frame and floor.

25.4 GENERATOR SYSTEM

25.4.1 Description of Works

The work comprises the supply, installation, testing and commissioning of an indoor use, metallic cubicle-type generator system in accordance with the drawings, the specifications and the instructions of the Engineer.

25.4.2 Qualifications of Manufacturer / Subcontractor

The manufacturer of the generator system and the subcontractor responsible for its installation shall have had the had the levels of experience stated in clause TS 25.1.7.

25.4.3 Shop Drawings and Calculations

The Contractor shall submit the following in accordance with the procedures in clauses 1.4 and 1.5 of the General Specification:

- Certified outline, drawings arrangement (setting plan), and anchor bolt details. Drawings shall show the total weight and centre of gravity of the assembled equipment on the mounting skid.
- General requirement drawings showing location of all auxiliary equipment in relation to the diesel generating unit.
- Piping schematics for fuel oil, lubricating oil, integral with diesel engines
- Critical speed calculations.
- Electrical elements, schematics and wiring diagrams, including details of the safety shutdown systems and main generator circuit breaker trip system.

25.4.4 Certified Test Reports

The following tests shall be carried. Certified test reports shall be prepared and submitted to the Engineer for approval.

- Diesel engine shop tests
- Generator shop tests.
- Diesel engine driven electric generator set shop tests.

25.4.5 Products

The generator system shall, as a minimum, be in accordance with the requirements of this Specification and shall be the manufacturer's standard commercial product with any added features needed to comply with the requirements. Additional or better features which are not specifically prohibited by this Specification, but those which are a part of the manufacturer's standard commercial product shall be included in the generator set being furnished. "Standard commercial product" is defined as a product which has been or will be sold on the commercial market through

advertisements or manufacturer's catalogues, or brochures, and represents the latest production model.

The Contractor shall furnish new materials of high quality which will give long life and reliable operation. Equipment shall not have been in prior service except as required by factory tests. Workmanship shall be of highest quality in every detail.

25.4.6 Diesel Generator Set and Auxiliary Equipment

The generator set shall consist of a diesel engine connected to an alternating current generator with brushless excitation system mounted on a steel sub base and provided with all necessary accessories, auxiliaries, and control equipment resulting in a complete self-contained unit capable of operation.

The generator set shall be arranged for manual starting. The generator set must be capable of providing full rated power within 30 seconds after starting.

Equipment Rating and Capability

Diesel - engine generating set shall have a continuous rating as indicated at 0.8 power factor for 3 - phase unit. Both the engine and generator set shall be capable of satisfactorily carrying a load 10 percent in excess of the continuous hours out of any 24 consecutive hours.

Gross kW rating of the diesel generating set shall be not more than the figure obtained by multiplying the delivered shaft horse power rating of the engine by 0.746 and by the overall efficiency of the generator shall allow for power to operate the exciter, including power consumed in losses and in windage and friction for generator and rotating exciter.

Rated net capacity of the generating set is defined as gross electrical power requirements of "engine assemble", as defined in NEMA publication "Standard Practices for Stationary Diesel and Gas Engine". All auxiliary equipment furnished shall be designed for continuous duty at 110 percent of rated net capacity of generating set.

The generating set shall be rated for the kW indicated at 0.8 power factor 3 phase 380 volt.

Critical Speeds

The complete diesel generating set shall be free of critical speeds of either a major or minor order that will endanger satisfactory operation of the set. Satisfactory operation will be considered to be endangered if torsional vibration stresses exceed 350 kg/cm^2 within 10 percent above or below rated engine speed. The Contractor shall submit three (3) copies of a summary of computations of critical speeds to the Engineer.

25.4.7 Design and Construction

Rotating or reciprocating parts, or other parts that may present a hazard to operating personnel shall be isolated or shielded to minimise danger. Design characteristics shall limit operating temperatures at critical points of maximum wear at full-load operating conditions.

25.4.8 Generator Diesel Engine and Accessories

25.4.8.1 Type and Requirements

The generator diesel engine to be furnished shall drive the A/C generator and shall be base mounted.

The diesel engine shall be a vertical, single-acting; solid injection, 4-stroke cycle, cold starting, air cooled with radiator diesel engine.

Main parts shall posses excellent properties against heat, pressure, erosion and wear. All parts shall be manufactured to ensure the highest accuracy and precision by means of limit gages, special jigs, fixtures, etc.

Materials used, manufacturing and performance shall be in accordance with JIS specification or equivalent.

The design conditions for the main engine shall be as follows:

ITEM	TYPE AND REQUIREMENTS
Rating	3-Phase, 380 V, 50 Hz, 30 kVA
1 Hour rating output	Not less than 110% of Rating Capacity
Continuous operating speed: (rpm)	3,000
Bore of Cylinders: (mm)	
Number of Cylinders:	
Specific fuel Consumption	
Starting System:	Battery, 100 Ah, DC 12V
Location of Operation:	Asin Pump House
Engine cooling system:	Radiator
Engine Lubrication System:	Forced lubrication by use of gear pump mounted on engine
Fuel Oil Recommended:	Diesel heavy oil

Note: Blank items shall be in accordance with the completed, approved, data sheets submitted by the Contractor with his bid.

25.4.8.2 Manufacturing and Materials

Cylinder Block, Head and Crankcase

The cylinder block, head and crankcase shall be made of cast iron. Replaceable wet-type cylinder liners shall be made of high grade cast iron.

Crankshaft

The crankshaft shall be of the forged, one piece type made of carbon steel. Bearing surfaces shall be of sufficient size to safely sustain all bearing loads imposed, and shall be heat-treated to provide resistance against shocks and wear.

Camshaft

The camshaft shall be made of carbon steel, driven by gears from the crankshaft. The hard-wearing surfaces shall be treated by high frequency shall be treated by high frequency induction hardening.

Piston and Piston-Pin

Pistons shall be trunk and made of special cast iron or high grade heat treated light alloy, and shall have sufficient resistance against heat and pressure. Piston rings shall consist of two or three compression rings and one or two oil scraping rings. The piston-pins shall be of full floating type and completely carbonised.

Connecting Rods

Connecting rods shall be made of forged steel and designed for using replaceable and precision insert type crank pin bearings. A drilled passage for piston - pin lubrication shall be incorporated.

Bearings

The bearings for both main and crank pin journals shall be precision insert bearings and readily replaceable. The piston-pin metals shall be of the special phosphorous bronze.

Fuel Injection Nozzle

Each one set of fuel pump with plunger, for adjusting injection volume and timing, shall be provided for each cylinder.

The injection nozzle shall be pin hole type and designed to adjust the needed injection pressure automatically and to meet with the any load conditions immediately.

Governor

The governor is of mechanical and/or hydraulic type and so sensitive in operation that it is able to adjust of loads automatically and immediately. Engine speed variation is calculated not more than 100 % (instantaneous) and 5 % (steady).

Exhaust System

The diesel engine exhaust gas shall be released to atmosphere outside the house through exhaust pipe works and silencers. All exhaust pipe work inside the house shall be lagged by an approved thermal insulation materials as shown on the Drawings and shall be a standard accessories of the diesel engine.

The silencer shall be positioned as shown on the Drawings. The exhaust system shall be complete with expansion bellows, support structures and brackets where necessary.

25.4.8.3 Accessories

The diesel engine shall be complete with the following accessories:

Gauges

Tachometer, lubrication oil pressure, , etc.

Thermometer

Lubrication oil, cooling water, etc.

Auxiliary Priming Pump

Wing type lubrication oil pump.

Strainer and Cooler

Fuel oil strainer, lubrication oil strainer, lubrication oil cooler, suction air cooler, etc.

Safety Devices

Lubrication oil pressure relay, cooling water high temperature relay, over speed relay, cooling water flow - sight glass, etc.

Miscellaneous

Exhaust system shall have a turbo-supercharger, pressure indicator cock for each cylinder, flywheel and dual air reservoir tanks, flexible pipe joints, installation bolts, etc.

25.4.9 Diesel Generator and Excitation Systems

Generator

The generator shall be 380 V, 50 hertz, 0.8 power factor, 3 - phase, alternating-current type with revolving field. The speed of the generator shall be that of the diesel engine. The generator shall be capable of carrying continuously a 0.8 power factor load equal to the gross kilowatt rating of the diesel generating unit, and to carry a 0.8 power factor load 10 percent in excess of the gross kilowatt rating of the diesel generating unit for 1 continuous hour out of any period of 24 consecutive hours at normal voltage and with a temperature rise of not more than 80 °C as measured by resistance based on 40 °C ambient temperature. Enclosures shall be the general-purpose open type with ventilating openings covered with removable screens a mesh not larger than ½ inch.

The generator shall conform to ANSI C50.10, and NEMA MG -1. The generator shall have form-wound coils and Class H insulation. The generator and flywheel shall have sufficient flywheel effect to meet the requirements of regulation and operation as specified. The rotor shall be continuous or interconnected armature windings. The generator rotor shall be mounted on an extended shaft which shall be coupled rigidly to the engine crankshaft. Impellers shall be mounted on the rotor for cooling the generator. The rotor shall be capable of safe operation at a speed 25 percent in excess of its rated synchronous speed. The generator armature, field, and ground leads shall have clamp-or crimp-type lugs or connectors for electrical connections. Terminal markings shall conform to NEMA MG -1.

Excitation and Voltage Regulation System

The excitation system shall be the integral brushless type consisting of a rotating AC exciter and rectifier diode assembly together with a static-type voltage regulating system and including surge protection and the required accessories. The system shall serve as an individual excitation and regulation system for the generator specified herein, and there is no requirement for parallel operation with other exciters.

The excitation system shall have a continuous current rating of not less than the generator excitation current required when the generator operates at 105 percent rated voltage under the condition of continuous rating requiring maximum field current. The voltage rating of the system shall be as required to match the generator field requirements. The excitation system response ratio shall not be less than 0.5 and the ceiling voltage shall not be less than 120 percent of rated voltage.

Exciter

The exciter shall be a rotating AC generator having a rotating armature on the rotor spider and a stationary field on the stator frame. The exciter insulation shall be Class B and the temperature rise shall not exceed 70 °C when measured by resistance based on a 40 °C ambient temperature.

Rectifier

Rectifiers shall be full-wave silicon diode type, with each diode protected by individual fuses. The rectifiers shall be mounted on the rotating part of the exciter to convert AC exciter output to DC for the main generator excitation. Connections shall be provided between the exciter, rectifiers, and generator field without use of brushes or slip rings.

Voltage Regulator

The voltage regulator shall be a completely solid-state type to control the generator voltage by controlling of the exciter field. The regulator shall be

suitable for mounting in the generator control panel. The regulator shall control the generator exciter field as required to maintain a constant and stable generator output voltage within plus or minus ¼ of one percent of nominal for all steady - state loads from no load to full load, including a 5 percent variation in frequency and the effects of field heating. The regulator shall be designed for single - phase voltage sensing. Electromagnetic interference suppression shall be integral part of the regulator. Thermal protection for power semi-conductors, inherent over-voltage, and fuse protection shall be provided internally in the regulator. No electrolytic capacitors, vacuum tubes, or electromechanical relays shall be used in the voltage regulator. The regulator shall have provisions for switching to manual control to allow the generator voltage to be controlled either manually or automatically. The following regular components shall be mounted en the front of the generator control panel.

Voltage adjusting rheostat

Manual voltage control with adjusting rheostat

Engine - Generator Instruments and Controls

NEMA ICS 1, 2, 3, 4 and 6 shall be applied to engine - generator instruments and controls.

Generator Controls and Instruments

NEMA ICS 1, 2, 3, and 4 shall apply to the components listed below. Instruments shall comply with ANSI C39.1.

- Voltmeter and Ammeter: Semi-flush mounted direct indicating type, not less than 110 mm nominal round or square, 180 °C arc, with accuracy of 2 percent of full scale.
- Frequency Meter: Dial type.
- Control Switches: Voltage and ampere ratings suitable for the intended use. Contacts shall be rated in accordance with NEMA Standards ICS 2 -125.
- Generator Output Circuit Breaker: Moulded case type, trip-free, and shall be mounted to allow operation from outside the control panel. Frame size shall be adequate for generator amperage when operating at standby rating, and adjustable trip shall be provided. Lugs shall be provided for electrical connections.
- Voltage adjustment rheostat.
- Panel lights and control switch.
- Alarm indicating panel.

25.4.10 Base Assembly and Enclosure

Engine-Generator: Engine-Generator shall be mounted on a fabricated steel skid base suitable for supporting, transportation, and skidding engine and generator without damage to equipment or alignment.

Vibration Isolators: Vibration isolators shall be provided to isolate the engine-generator set from the building floor. At least four isolators, as recommended by the isolator manufacturer, are required. The isolators shall be manufactured by a firm specialising in this product, and the unit shall be specifically listed for this application and have a maximum deflection of 25 mm.

25.4.11 Treatment and Painting

All parts, including engine subject to high temperature, shall be painted in accordance with manufacturer's standards. The generator and all associated electrical equipment shall be thoroughly cleaned and treated prior to painting. Colour shall be manufacturer's standard.

25.4.12 Execution

25.4.12.1 Installation

Installation shall conform to the requirements of PEC and NFPA 70.

25.4.12.2 Diesel Engine Generator

Diesel engine generator shall be installed on a concrete foundation as indicated. Vibration isolators shall be provided to isolate vibrations from the diesel engine generator set to the foundation.

25.4.12.3 Testing

The following tests shall be performed on the generator set system provided. The Contractor shall provide all test equipment and personnel and submit three (3) copies of all test results.

Factory Tests

The engine-generator shall be subjected to the manufacturer's standard run-in and conditioning tests.

Following the run-in tests, the engine-generator set shall be tested at rated speed and voltage for 8 hours of continuous operation with 2 hours each at 50, 75, 100 and 110 percent of rated load, consecutively, 0.8 power factor. The Contractor shall confirm generator frequency, phase, current, and voltage and record at 15 - minute intervals. The Contractor shall tests run on the voltage regulator to determine the variation in terminal voltage under conditions of constant load, and under conditions of abrupt load changes to determine the maximum voltage change during the surging period and the time required.

Speed Governing Test

Engine speed governing system shall be tested in accordance with ASME PTC26.

Field Tests and Inspections

The Contractor shall perform all field tests and trial operations, and conduct all field inspections. The Contractor shall provide all labour, equipment, and requirements, including water, fuel, and lubricants required for tests. The Contractor shall give sample notice of the dates and times scheduled for tests, trial operations, and inspections which require the presence of the Engineer. All deficiencies found shall be rectified and work affected by such deficiencies shall be completely re-tested at the Contractor's expense. Fields tests shall include the following:

- Demonstrate proper operation of all system
- Conduct 3 - hour load run utilising Contractor - furnished portable load banks as follows:
- ½ load - one hour
- Full load - two hours

25.5 POWER SUPPLY WORKS TO EQUIPMENT

25.5.1 Description of works

This clause covers the technical requirements for the equipment, materials, workmanship, fabrication and installation of power supply works to include but not limited to, all cabling works between the distribution panel installed in the pump building and each control panel of the equipment listed hereinafter, and control panels.

The following power feeders and branch cables are included in the scope of work described in this clause:

- Feeder to Auxiliary drainage Pumps
- Feeder to Gate Lifts
- Branch Cable to Grease Pump 1
- Branch Cable to Grease Pump 2
- Brand Cable to Grease Pump 3
- Branch Cable to Fuel Transfer Pump
- Branch Cable to Gate Lift Motor

25.5.2 Equipment and Materials

Equipment and materials shall conform to the respective specifications and standards and to the specifications herein. Electrical rating shall be as indicated.

25.5.2.1 Cable

Cable shall be 600 V Class XLPE (Cross-linked Polyethylene insulated and PVC sheathed) cable.

All cables shall be installed into conduit run as specified below.

25.5.2.2 Conduit

Conduit shall be ridged steel conduit for electrical cable installation.

Both internal and external surface of the conduit shall be either galvanized or painted.

Conduit shall be practically straight and uniform in cross-section.

25.5.2.3 Pull boxes

The pull boxes shall be made of sheet steel thickness not less than 1.6 mm and galvanized or painted.

The pull boxes installed in outdoor area shall be of waterproof type.

25.5.3 Installation

25.5.3.1 Conduits

The conduit runs for the branch cables to the grease pumps shall be embed into the floor slab of the building and all other conduit runs shall be installed to the exposed location.

All conduits installed to exposed location shall be installed and supported in a rigid and satisfactory manner.

Conduit runs between pull boxes or between box and panel shall not contain more than equivalent of 4 quarter bends or 360 degrees in total.

All cut ends of conduit shall be reamed to remove rough edges.

Conduits shall be firmly fastened within 0.5 m of each pull box or panel and intermediately supported interval of less than 1.5 m.

All supports, bolts, straps, etc. shall be corrosive-resistant metal, galvanized or painted.

Joining parts of conduits, conduit and pull box that may become energised shall be bonded for electrical continuity.

Bend of conduit shall be so made that conduit will not be injured and that internal diameter of conduit will not be effectively reduced.

Field bends shall be made only using bending equipment intended for the purpose and with radius of curve of inner edge of bends not less than 6 times nominal diameter of conduit.

Where the conduit passes through the building walls, holes shall be completely filled using suitable non-flammable and waterproof sealing materials.

25.5.3.2 Cable

Cable shall be full-length cable and continuous from origin to the end termination without splices in intermediate.

All termination of the cable shall be protected from accidental contact, deterioration of coverings and moisture by the use of terminating device and materials.

25.5.3.3 Grounding

All panels for the equipment shall be grounded to the grounding rod installed near the panels.

Grounding elect rods shall be copper bars of 15 mm diameter and 1500 mm length.

25.5.3.4 Control Panels

All Control Panels shall be erected with adjacent components accurately aligned and all components shall be set square, plumb and level and full bearing on supporting base frame and floor.

25.6 LOCAL SWITCH FOR FUEL TRANSFER PUMP

The switch shall consist of one Moulded Case Circuit Breaker, voltage indication lamp, magnetic switch and manual operation (ON/OFF) switch.

These components shall be installed in a metallic enclosure of protection grade IP 65.

25.7 LOCAL CONTROL PANELS

25.7.1 Scope

This clause covers the requirements for local control panels for the auxiliary pump system and for the local control panel for the gate.

25.7.2 Enclosures

The enclosures of panels shall be made of sheet steel of minimum thicknesses as follows:

- For enclosure: 2.0 mm
- For interior partitions: 1.6 mm
- The Index of Protection of each control panel shall be as follows:
- For auxiliary pump control panel: IP 65
- For gate control panel: IP 52
- All enclosures shall be strongly built specifically designed to enclose equipment scheduled or shown on the Drawings and shall be capable of withstanding vibration or shock caused by the operation of such equipment.
- Metal components shall be factory pre-treated, primed and baked enamel finished.
- The Contractor shall submit samples of the manufacturer's standard colours available for the Engineer's review and selection.
- All devices shall be installed inside the enclosure and no device shall be installed on the door or outer surface of any panel.
- Devices such as meters, meter switches, circuit breakers, indication lamps, relays, alarm buzzer etc. shall be arranged in an orderly, systematic manner so as to easily read.
- Doors shall be fully openable for ease of installation or removal of devices.
- The grounding terminal of enclosures shall be connected to the nearest reinforcing bar of the concrete structure on which the panels are mounted. PVC insulated wire of 25 mm2 or larger shall be used for grounding.

25.7.3 Circuit Breakers

Circuit breakers shall be 600 V Class MCCB (Moulded Case Circuit Breakers) rated as shown on the Drawings.

25.8 INSPECTION AND TESTING

The Contractor shall prepare a comprehensive testing programme for inspection and testing of the electrical works. The programme for inspection, testing and commissioning of electrical works shall be part of the comprehensive manual for all mechanical and electrical works described in clause TS 24.2.14.1. Procedures for submission and approval shall be in accordance with clauses 1.4 and 1.5 of the General Specification.

The inspection and testing programme shall include all items to be inspected, schedule, parties to witness such tests and inspections, acceptance criteria and pertinent information relating to each event.

Inspection sheets for the recording of all tests and inspections shall be completed for each test and inspection and shall be submitted to the Engineer for approval on completion.

25.9 MEASUREMENT AND PAYMENT

25.9.1 Main Control Panel

This clause covers the method of payment for the main control panel as shown on the Drawings and specified in clause TS 25.5

Payment shall be made at the lump sum price entered in the priced Bill of Quantities following completion of testing of the entire mechanical and electrical systems to the approval of the Engineer.

Payment shall constitute full compensation for manufacturing, delivering, installing, commissioning, supervising, testing, training of local staff and all other associated costs.

The item to be paid under this clause is as follows:

Pay Item No.	Description	Unit of Measurement
D.4.1	Main Control Panel	L.S.

25.9.2 Local Switch

This clause covers the method of payment for the local switch for the auxiliary drainage pump system as shown on the Drawings and specified in clause TS 25.6

Payment shall be made at the lump sum price entered in the priced Bill of Quantities following completion of testing of the entire mechanical and electrical systems to the approval of the Engineer.

Payment shall constitute full compensation for manufacturing, delivering, installing, commissioning, supervising, testing and all other associated costs.

The item to be paid under this clause is as follows:

Pay Item No.	Description	Unit of Measurement
D.4.2	Local Switch	L.S.

25.9.3 Inspection and Test

This clause covers the method of payment for the inspection and testing of the electrical works specified in clause TS 25.8.

Payment shall be made at the lump sum price entered in the priced Bill of Quantities following completion of all inspection and testing to the approval of the Engineer.

Payment shall constitute full compensation for supplying the tools, specialised equipment, specialised personnel, the cost of expenses for the Engineer or his Representative to attend specified workshop test and any associated costs.

The item to be paid under this clause is as follows:

Pay Item No.	Description	Unit of Measurement
D.4.3	Inspection and Test	L.S.

25.9.4 Spare Parts

This clause covers the method of payment for the spare parts for electrical plant specified in clause TS 25.1.5

Payment shall be made at the lump sum price as entered in the priced Bill of Quantities following delivery to the Site of complete sets of spare parts in

accordance with the schedule of spare parts for each system, as entered in the data sheets appended to the Contractor's bid.

Payment shall constitute full compensation for supplying the spare parts as specified, and any associated costs.

The item to be paid under this clause is as follows:

Pay Item No.	Description	Unit of Measurement
D.4.4	Spare Parts	L.S.

25.9.5 Maintenance Tools

This clause covers the method of payment for the provision of maintenance tools specified in clause TS 25.1.6

Payment shall be made at the lump sum price as entered in the priced Bill of Quantities following delivery to the Site of complete sets of maintenance tools (complete with tool boxes for each set of tools) in accordance with the schedule of maintenance tools for each system, as entered in the data sheets appended to the Contractor's bid.

Payment shall constitute full compensation for supplying the tools as specified, and any associated costs.

The item to be paid under this clause is as follows:

Pay Item No.	Description	Unit of Measurement
D.4.5	Maintenance Tools	L.S.

25.9.6 Control Panel for Auxiliary Drainage Pump

This clause covers the method of payment for the control panel for the auxiliary drainage pump system as shown on the Drawings and as specified in clause TS 25.7

Payment shall be made at the lump sum price entered in the priced Bill of Quantities following completion of testing of the entire mechanical and electrical systems to the approval of the Engineer.

Payment shall constitute full compensation for manufacturing, delivering, installing, commissioning, supervising, testing, training of local staff and all other associated costs.

The item to be paid under this clause is as follows:

Pay Item No.	Description	Unit of Measurement
D.4.6	Control Panel for Auxiliary Drainage Pump	L.S.

25.9.7 Generator System

This clause covers the method of payment for the generator system as shown on the Drawings and as specified in clause TS 25.4.

Payment shall be made at the lump sum price entered in the priced Bill of Quantities following completion of testing of the entire mechanical and electrical systems to the approval of the Engineer.

Payment shall constitute full compensation for manufacturing, delivering, installing, commissioning, supervising, testing, training of local staff and all other associated costs.

The item to be paid under this clause is as follows:

Pay Item No.	Description	Unit of Measurement
D.4.7	Generator System	L.S.

25.9.8 Power Supply Cabling

Measurement will not be made for power supply cables and associated works as described in clauses TS 25.2 and TS25.5 and the costs of such shall be deemed to be included in other payment items included in the priced Bill of Quantities.

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SECTION TS 26. MAINTENANCE EQUIPMENT

SECTION TS 26. MAINTENANCE EQUIPMENT

26.1 GENERAL

This section of the Technical Specification covers the requirements of maintenance equipment to be supplied by the Contractor.

All equipment shall be complete, new, of first class quality and suitable for the intended applications and shall comply with all regulatory requirements in Indonesia.

All equipment shall be delivered to the Site or to other location in the City of Semarang as directed by the Engineer.

All equipment shall be from well-known suppliers with established histories of sales and service and shall have full-time representatives in Indonesia for the purposes of after-sales service.

Documentation to be supplied with each item of equipment shall include, but not be limited to, ownership documentation, warranties and guarantees, log books, operation and maintenance manuals, coupons for routine after-sale service (if applicable) and other documents normally supplied with such equipment.

All equipment supplied shall be complete with special tools and spare parts as recommended by the manufacturers for a minimum of two years of normal operation.

26.2 SUBMITTALS

The Contractor shall supply with his bid completed data sheets (M-12 to M-15) complete with technical specifications of each of the various items of equipment to be supplied.

26.3 WARRANTIES

Warranties for the back hoe, truck and truck crane shall have a minimum duration of 2 years from the Completion Date and shall be made out in favour of the Employer.

26.4 REQUIREMENTS

Equipment to be supplied by the Contractor shall meet the following minimum technical requirements.

26.4.1 Backhoe

The backhoe shall be a hydraulically-operated, crawler-mounted back-acting excavator. The bucket volume shall be not less than 0.35 cubic metres. The swing radius shall be not less than 2.1 metres.

26.4.2 Truck

The truck shall be a dump truck with a load capacity of at least 8 tonne. The tipping mechanism shall be hydraulic and operable from the cabin or externally. The truck shall be suitable for transporting spoil excavated from the river and transporting it over public roads.

26.4.3 Truck Crane

The truck crane shall comprise a tray truck with a hydraulically-operated crane mounted between the truck cabin and the tray and shall be fitted with hydraulically operated outriggers.

The crane shall have a lifting capacity of 2.2 tonne and a working radius of not less than 1.8 m and a maximum lift of not less than 7.5 m

The truck tray shall be fitted with drop sides.

26.4.4 Garbage Container

The garbage container shall be a steel framed and timber construction garbage skip capable of being lifted and handled by the City of Semarang's normal garbage disposal service. It shall have a capacity of 6 m^3 and shall fully conform to the requirements of the Kotamadya Semarang, Dinas Kebersihan dan Pertamanan with regard to design, construction, quality, painting and marking.

26.5 MEASUREMENT AND PAYMENT

The following pay items shall be measured and paid for under this clause:

Payment for each of the items of equipment shall be made in accordance with the prices entered in the priced Bill of Quantities which shall include full payment for supplying the respective items of equipment including the spare parts and warranties. (Warranty is not applicable to Garbage Container)

Payment shall be made following delivery, testing, inspection and approval of respective items which shall be complete and in compliance with the requirements of this specification and the approved proposal for each item of equipment submitted by the Contractor with his bid.

Pay Item No.	Description	Unit of Measurement
I.1.1	Supply of Backhoe, 0.35 m^3	No.
I.1.2	Supply of Dump Truck 8t	No.
I.1.3	Supply of Truck Crane, 2.2 t	No.
I.1.4	Supply of Garbage Container, 6 m^3	No.

DIVISION D

TECHNICAL SPECIFICATION
BUILDING WORKS

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SECTION TS 27. BUILDING WORKS

SECTION TS 27. BUILDING WORKS

27.1 GENERAL

This section of the Technical Specifications covers the requirements for all building works to be completed under the Contract.

27.2 SCOPE

The scope of the building works comprises all the work necessary for the construction, completion and rectification of defects for the construction of buildings and external works, commissioning of all mechanical, electrical and plumbing systems, in accordance with the Drawings for Building Works and as specified herein.

The Building Works consists of the following:

- Asin Pumping Station Complex:
  - Pump Control Building
  - Management Office
  - Garage
  - Staff House
  - External Works
- Specific Elements for the Asin Pumping Station Gate Control House comprising:
  - Window
  - Door
  - Roof Sealing

27.3 SPECIFICATIONS FOR BUILDING WORKS

The following specifications shall be applicable to Building Works.

- The General Specification contained in Division A
- The following specifications contained in Division B
  - TS 1 Preparatory Works
  - TS 2 Earthworks
  - TS 3 Concrete Work
  - TS 4 Precast Concrete
  - TS 5 Prestressed Concrete
  - TS 8 Handling and Erection of Prestressed Concrete Units
  - TS 9 Concrete Repairs
  - TS 10 Falsework and Scaffolding
  - TS 12 Epoxy Resins
  - TS 17 Stone Masonry
  - TS 19 Weep Holes

- The whole of Division D including all of the technical specifications appended to this section TS 27.

Note:

In the event of a conflict between the requirements of the technical specifications appended hereto and those in Division B, the former shall govern.

27.4 PAYMENT

Building Works in the Asin Pumping Station Complex

a) Pump Control Building, Management Office, Garage and Staff House

Payment for the above building works shall be made in accordance with the various lump sums entered in the priced Bill of Quantities which shall include the entire cost of completing the work including excavation, filling, grading, foundation, reinforced concrete, roofing, concrete block, brick, plastering, door & windows, glazing, miscellaneous metal, interior finishing, tile, sanitary, electrical and painting works and the supply of all materials, labour, equipment, transportation and any other associated costs.

Interim payments for work-in-progress shall be made in proportion to the completion of sub-sections of the work based on the lump sum breakdowns provided by the Contractor with his bid.

b) External Works

Payment for the external works shall be made in accordance with the lump sum entered in the priced Bill of Quantities which shall include the entire cost of completing the work including excavation, filling, grading, roadworks, paving, landscaping, lighting, sanitary, electrical and painting works.

Interim payments for work-in-progress shall be made in proportion to the completion of sub-sections of the work based on the lump sum breakdown provided by the Contractor with his bid.

Building Works for the Asin Pumping Station Gate Control House

a) Windows

Payment for windows shall be made in accordance with the lump sum entered in the priced Bill of Quantities which shall include the entire cost of completing all of the windows in the Asin Pumping Station Gate Control House in accordance with the Drawings and the Specification for Windows contained in the Appendix to Section TS 27 and shall include the cost of all materials, labour, equipment, transportation and any other associated costs.

b) Door

Payment for door shall be made in accordance with the lump sum entered in the priced Bill of Quantities which shall include the entire cost of completing the door in the Asin Pumping Station Gate Control House in accordance with the Drawings and the Specification for Doors contained in the Appendix to Section TS 27 and shall include the cost of all materials, labour, equipment, transportation and any other associated costs.

c) Roof Sealing

This item refers to the sealing system applied between the precast concrete slabs comprising the roof of the Asin Pumping Station Gate Control House

including rubber filler, asphalt mix and steel cover strips all as shown on the Drawings.

Payment for roof sealing shall be made in accordance with the lump sum entered in the priced Bill of Quantities which shall include the entire cost of completing the roof sealing in accordance with the Drawings and the Specification Caulking and Sealing contained in the Appendix to Section TS 27 and shall include the cost of all materials, labour, equipment, transportation and any other associated costs.

The following pay items shall be measured and paid for under this clause:

Pay Item No.	Description	Unit of Measurement
F.1.1	Pump Control Building	L.S.
F.1.2	Management Office	L.S.
F.1.3	Garage	L.S.
F.1.4	Staff House	L.S.
F.1.5	External Works	L.S.
E.1.14	Windows	L.S.
E.1.15	Door	L.S.
E.1.16	Roof Sealing	L.S.

APPENDICES TO TS 27. BUILDING WORKS

The standard building specifications listed below and appended hereto shall form part of the specification for the Works:

TS – 02280 – TERMITE CONTROL

TS – 0215 – UNIT PAVEMENT

MP – 2616 – SEPTIC TANK AND ABSORPTION

TS – 02900 – LANDSCAPE WORK

AR – 0401 – UNIT MASONRY

CS – 0402 – STONE MASONRY

AR – 0404 – CEMENT MORTAR

CS – 0501 – STRUCTURAL STEEL FABRICATION

CS – 0502 – STRUCTURAL STEEL ERECTION

AR – 0509 – ORNAMENTAL METALS

AR – 0602 – CARPENTRY

AR – 0705 – WATERPROOFING

AR – 0714 – CAULKING AND SEALING

AR – 0722 – RAIN GUTTER AND LADDER

TS – 07321 – ROOF MATERIALS

AR – 0821 – FINISH HARDWARE

TS – 08110 – STEEL DOOR AND FRAME

AR – 0824 – ALUMINIUM DOORS AND WINDOWS

AR – 0825 – GLASS AND GLAZING

AR – 0903 – CEILINGS

AR – 0914 – PAINTING

TS – 09250 – GYPSUM PANEL

TS – 09300 – TILE WORK

TS – 09545 – METAL PANEL

TS – 09930 – TRANSPARENT COATING

AR – 1011 – WASHROOM ACCESSORIES

MP – 1504 – PLUMBING SYSTEM

EL – 1601 – ELECTRICAL WORKS

EL – 1652 – LIGHTNING PROTECTION AND GROUNDING SYSTEM

CS – 0304 – PRECAST CONCRETE

TS – 02280 – TERMITE CONTROL

1.0 DESCRIPTION OF WORK

The work shall cover the following :

- Underground termite control
- Termite control for wooden material.

2.0 REFERENCE STANDARDS

a. Technical Specification AR 0602 –Carpentry

b. Perform the work within the requirements and restrictions of all application codes

c. The contractor is responsible for being familiar with the applicable regulations

3.0 GENERAL PROCEDURES

3.1 Submittals

Submit 3 copies of manufacturer's detailed product data and application instruction.

Upon completion of the work, submit applicator's certification stating that the work has been done in compliance with the manufacturer's instructions and the specification requirements.

3.2 Quality Assurance

The work of this section shall be carried out by an approved contractor having specialised in this work as performed satisfactorily work of this type and magnitude.

Employ only craftsmen who are thoroughly skilled in the various crafts, and who are completely familiar with the specified requirements. Provide the services of competent foreman or supervisor who shall be available at all times during the progress of the work of this section.

Company's data and qualification shall be as follows :

a. A legal and valid company's data.

b. A valid government license of the termite control operations.

c. A valid reference of termicides application issued by Department of Labour Force.

d. A valid permit of the use of restricted termicides issued by the Department of Health and the Pesticide Commission.

e. References of capability/learning of termite control operations and the field experiences.

f. A reference of a back-up of an authorised consultant of termite control.

g. Company's tax number.

h. Selected Termite Control Company shall be approved by the Engineer.

i. The company shall be able to exhibit a design following the submittance of a proposal of the application and cost of the termite control to the building.

j. Appropriate drawing for this purpose may be acquired.

k. The building ground into which termicides will be dispersed, shall be at least 8 metres from the water source to be drilled.

l. The building area shall be furnished with an adequate drainage system.

3.3 Environmental Conditions

Do not apply soil poison when surface water is present.

If soil is disturbed after treatment, retreat the disturbed area.

Take adequate precautions to protect all persons at the site from the danger of toxic materials.

4.0 MATERIALS

4.1 Product

Out of the so many, there are three groups of termicides permitted by the GOI to be applied, such as :

- Chlorinated hydrocarbon (status : restricted).
- Organophosphates (status : general).
- Pyrethroids (status : general).

Each termicide has its own rating and characteristics, toxicity, class and price value.

So far, skilfully applied, there has not been any report recorder of the occurrence of a negative side effect to the environment. The selected termicides for the job shall be in the original packing available for inspection.

4.2 Equipment

The minimum requirement foe an adequate termite control equipment consist of :

- A power sprayer set, included water containers and accessories.
- Spray and injection guns.
- A compressor set, included containers and accessories.
- A set of labour safety equipment for each operator.
- A first aid box.

5.0 CONSTRUCTION REQUIREMENTS

5.1 Government Regulations

In the applications process, regulations shall be pertinently followed, in compliance with the following :

a. The regulation for the safety of the labour, issued by the Department of Labour Force

b. The regulation of transport and the use of pesticides and pesticides empty container's disposal, issued by the Department of Agriculture

c. The regulation to safe guard the environment from pollution, issued by the state Minister of Life Environment

5.2 Soil Treatment

5.2.1 During preparation, step shall be taken to :

- Clean Soil from roots and other wood water.
- Non-horizontal soil-level must be treated differently so that no overflow of termicides solution fall into the soil.

5.2.2 And no application is permitted when :

- The soil is under running water.
- A rain burst is expected.
- If the soil area is closed to a planned water source hole or reservoir or water well of neighbouring buildings.
- The soil shall easily cracks during hot season.

5.2.3 Termicides preparation shall be as follows :

- The termicide solution container shall be ready and clean, after regular usage.
- Clear water will be filled into the container and mix with the needed termicides in correct ratio with the label instructions.

5.2.4 Chemical-Mechanical Method

This method is applied to buildings which are fitted reinforced beams and slabs over the foundation structure.

The treatment consists of the following :

a. Foundation Soil Treatment

After the cavity along both sides of the foundation has been filled with soil , the filler is injected with termicide solution on a rate of 5 litre / meter linear and 0.30 meter depth.

Places and spots susceptible to termites' penetration shall be treated with the same solution on a rate of 4 – 7.5 litre per square meter, depending on their intensity and the condition.

The same treatment shall be applied to the area of pipes and cables' entrances into the building.

b. Floor soil

Prior to the spread of the sand – layer upon which the tiles will be plastered into the floor, the floor soil shall be sprayed uniformly with termicides' solution on rate of 5 litre / m^2.

At the 1 meter distance from the outer wall around the building, the same treatment shall be conducted.

The time of application shall be prepared and prearranged and scheduled in conformity with the construction progress.

5.2.5 Landscaping Soil Treatment

Although landscaping soil is not included in the building's structure treatment, if the placement of the soil is adjacent to the building, the same treatment shall be conducted as in the floor soil treatment procedure.

The other part may not be treated with the non persistent termicides.

5.2.6 Wood Treatment

Wooden structure shall be chemically treated in accordance with the SKBI – 3.6.53 – 1987 standard.

An alternative method is the application by power spraying of termicide solution to wooden structure in conformity with the manufacturer's printed instructions before the wood is painted.

TS – 0215 – UNIT PAVEMENT

1.0 DESCRIPTION OF WORK

This work shall cover the delivery, materials, labour, equipment and installation of unit pavement, as indicated in the Drawings.

2.0 REFERENCE STANDARDS

a. Standar Industri Indonesia (SII)

b. British Standard (BS)

c. TS 1

d. TS 2

3.0 GENERAL PROCEDURES

3.1 Sample and Technical Data

The Contractor shall submit sample and technical data concerning this work to the Engineer for approval prior to delivery.

Technical data shall contain descriptions, characteristics and installation instructions.

Cost of samples and testing shall be Contractor's responsibility.

3.2 Shop Drawings

Contractor shall submit Shop Drawings to the Engineer prior to installation. The Shop Drawings shall be in close conformity with the shape, size, dimensions and class of concrete required in this Specification.

3.3 Inspection and Testing

All works in concrete block pavement shall be inspected and tested. Any unsatisfactory installation of concrete block pavement shall be removed and replaced with another concrete block pavement without additional expenses to the Owner.

Unit pavement not passing the laboratory test as required in this Specification shall be rejected and replaced with better quality product by the Contractor without any additional cost.

4.0 MATERIALS

4.1 Paving Blocks

Paving block made of concrete shall have compressive strength not less than 200 kg/cm^2, unless otherwise specified by the Engineer.

Unless otherwise specified, paving block shall be Trihex type in natural colour and in red colour, with thickness of 80 mm.

4.2 Grass Block

Grass block made of concrete shall have compressive strength not less than 200 kg/cm^2, having thickness of 60 mm with type or shape as indicated in the Drawings, and shall come from Cisangkan product or equal.

4.3 Curbing

Curbing shall be K-1 type from Cisangkan product or approved equal.

Precast concrete curbs shall consist of Class D concrete complying with the requirements specified in sections TS 3 and TS 4 of the Technical Specifications.

4.4 Sand

Sand for bedding and filler between concrete block pavement shall be hard, clean, free from clay and mud and shall be well graded and approved by the Engineer.

Gradation of aggregate shall be as follows :

Sieve	% By Weight Passing Sieve	
	Bedding	Filler
9.52 mm	100	-
4.75 mm	95 – 100	-
2.36 mm	80 – 100	100
1.18 mm	50 – 85	90 – 100
0.600 mm	25 – 60	60 – 90
0.300 mm	10 – 30	30 – 60
0.150 mm	5 – 15	15 – 30
0.075 mm	0 – 10	5 – 10
Water content (%)	< 10	< 5
Clay content (%)	< 3	< 10

5.0 CONSTRUCTION REQUIREMENTS

5.1 Sand Bedding Layer

Subgrade and sub-base shall have been prepared to the correct transverse and longitudinal profiles and having minimum cross fall of 2 %, or as indicated in the Drawings.

Subgrade preparation shall be in accordance with the requirements of Technical Specification TS2, and sub-base shall be in accordance with the requirements of Technical Specification TS2.

Sub-base shall be spread uniformly in thickness as specified in the Drawings.

The bedding sand is spread loose upon sub-base or base course in a uniform layer, thickness of which shall be determined on the basis of field trials to give a depth after compaction of 50 mm, or as indicated by the Drawings.

5.2 Laying Concrete Block Pavement

Concrete block pavement shall be laid manually on the uncompacted screeded sand bed in accordance with the pattern as specified.

Cutting block pavement at the edge shall be done by using mechanical saw in sizes precisely matched with the place to be filled.

After laying the concrete block pavement units, they were compacted to achieve consolidation of the sand bedding and brought to design levels and profiles by not less than 3 (three) passes, employing a suitable plate compactor.

The sand for joint filling shall be spread out over the pavement. The jointing sand shall be brushed to fill the joint.

Excess sand shall be removed from the pavement surface and the jointing shall be compacted by not less than two passes of the plate vibration.

5.3 Laying of Curbing

Concrete curbing shall be placed at the edge of concrete block pavement area as indicated in the Drawing.

Portion on excavation for foundation of concrete curbs shall be well compacted, cushioned with 30 mm thick concrete of K-125 or as indicated in the Drawings. It shall be worked out to the desired depth and dimensions.

Any unsuitable projections on the base shall be removed.