



PT PLN (PERSERO)

**ADDENDUM NO.2
DOKUMEN PELELANGAN**

Nomor : 016.ADP/PBJ/UIP VII/2015

Tanggal: 24 Maret 2015

UNTUK PEKERJAAN :

**PENGADAAN DAN PEMASANGAN MATERIAL PENGGANTI
GITET 500 KV KESUGIHAN**

**PT PLN (PERSERO) UNIT INDUK PEMBANGUNAN VII
TAHUN 2015**



PT PLN (PERSERO)
UNIT INDUK PEMBANGUNAN VII
JL. Ketintang Baru I No 1 - 3 Surabaya

LEMBAR PENGESAHAN

Nama Dokumen : Addendum No. 2 Dokumen Pelelangan
Nomor Dokumen : 016.ADP/PBJ/UIP VII/2015
Perihal Pekerjaan : Pengadaan dan Pemasangan Material Pengganti GITET 500 kV Kesugihan
Sumber Anggaran : APLN

Demikian Addendum Dokumen Pelelangan ini disusun, ditetapkan dan disahkan untuk dapat digunakan dalam proses pelaksanaan pelelangan pekerjaan tersebut diatas.

Surabaya, 24 Maret 2015

Disusun oleh:
PEJABAT PERENCANA PENGADAAN,

JOHN Y.S. REMBET

Ditetapkan dan disahkan oleh:
GENERAL MANAGER,

ROBERTON MANURUNG

ADDENDUM NO. 2 DOKUMEN PELELANGAN
PENGADAAN DAN PEMASANGAN MATERIAL PENGGANTI
GITET 500 kV KESUGIHAN
Nomor : 016.ADP/PBJ/UIP VII/2015
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BAB IV KETENTUAN UMUM PEKERJAAN

IV.1 : GENERAL PARTICULARS OF CONTRACT

1.0 BRIEF DESCRIPTION OF THE PROJECT

This document and specification calls for the supply and erection, including civil work of

1. 500/150 kV Diameter I
2. 150 kV Outlet Bay IBT 1
3. Transportation, Insurance and erection Single Phase Inter Bus Transformer
(Including supervision from IBT manufacture) From :
 - a. 500 kV Grati Substation (1 bank) to Kesugihan Substation
 - b. 500 kV Ujung Berung Substation (1 bank) to Kesugihan Substation
 - c. 500 kV Tasikmalaya Substation (1 bank) to Kesugihan Substation

2.0 FORMAT OF SPECIFICATION AND SUBDIVISION OF CONTRACT LOTS

The following sections of this document describe equipment required including erection works in the Project, in groups which can be most conveniently specified together.

Itemized lists of Equipment including erection works, together with schedules of technical particulars and other schedules for completion by the Bidders are specified in Bid Document.

3.0 SCOPE OF WORK

3.1. General

The contract includes the design, manufacture, inspection and testing at maker's works and at Site, finishing, galvanizing, painting, packing for export shipment, insuring, shipping and delivery to the Site, unloading, civil constructions supply, erection, commissioning, test certificates, drawings, operating and maintenance instructions, and guaranteed replacement of defective materials for a period of 12 months from the date on which the equipment described herein has been put into operation of 500 kV and 150 kV Switchgear, Protection, accessories and ancillary equipment including Civil Works, and necessary equipment/materials to complete the Works of the project package as specified in clause 3.2 (Scope Works).

The Works covered by this contract form part of a comprehensive project and the Contractor is to co-operate with other contractors as may be necessary.

This Contract also provides for all parts of the work to be completed in every respect for Commercial operation to the requirements of the Employer/Engineer.

Notwithstanding that any details, accessories etc, required for the complete installation and satisfactory operation of the Plant are not specifically mentioned in this specification, such details are to be considered as included in the Contract Price.

3.2. Scope of Works

The scope of supply and erection also includes all equipment like control cables, grounding network, outdoor switchyard lighting, which is necessary for the proper function of the switchgear, packing, erection, transportation and insurance of 500 MVA IBT. The detail Description and Quantities required please refer to Price Schedules in Book C.

4.0 CONTRACT TERMINAL POINTS

4.1. The contract shall include and not limited to:

- a. Steel structures, insulators, conductors, connectors and clamps.
- b. 500 kV and 150 kV switchgears
- c. Protection and Control of Diameter IBT
- d. Integration and modification of SAS, Buspro, etc
- e. LV power and control cables
- f. Civil Work
- g. Test and Commissioning (include Line Current Differential Relay at Rawalo S/S)

The contract terminal points are as shown in the bid drawings.

The following shall be the contract terminal points:

1. Connection to 500 kV and 150 kV lines

Conductors and overhead ground wires of the slack span between 500 kV and 150 kV terminal towers of transmission lines and steel gantry of switchyard will be supplied and erected by transmission line Contractors, but jumper connections, connectors and clamps from the equipment to the slack span conductors, and to overhead ground wires shall be provided under this Contract.

The Contractor shall liaise directly with the nominated transmission line Contractor and shall be responsible for ensuring that transmission lines are terminated in a satisfactory manner.

2. Remote Substations



Loose equipment supplied for remote substations shall be installed, connected and commissioned in accordance with the relevant sections of the Contract.

The Contract includes the removal and reinstall of any necessary equipment, returning to Employer stores, cutting and wiring of relay panels. Test and Commissioning including protection inter trip between two substations.

- 4.2. The Contractor shall liaise with other Contractors engaged on the project and shall to this purpose produce such diagrams and schedules as are necessary both to coordinate the Works with equipment in the supply of other Contractors and to enable them to design and manufacture accordingly.

The procedure for effecting this shall be as follows:

- a). The Contractor shall send to the Employer and to the Engineer simultaneously some copies of all communications, program, drawings and records of all meetings between himself and the other Contractor for the associated works.
- b). Should occasion arise that the Contractor considers that another Contractor has by action or inaction prejudiced his contractual operations, he shall advise the Employer and Engineer.
- c). In the event of any disagreement with another Contractor which cannot be resolved mutually and subject to the rights of the Employer under the Contract, the decision of the Employer shall be final.
- d). When submitting drawings, information, program of the like which affect other Contractors for approval to the Employer and Engineer, the Contractor shall indicate whether or not the other Contractor's approval has been obtained.
- e). When the Contractor has reached agreement with another Contractor as to any action, approval must be obtained from the Employer and Engineer.
- f). In the event that two Contractors cannot resolve the matter, the Employer and Engineer shall decide which decision shall be final and binding upon the Contractor.

5.0 CIVIL WORKS

All civil engineering and civil works necessary for the proper completion of the project in every respect shall form part of this Contract.

The civil engineering and civil works to be executed by the Contractor are to cover the collection of site data, detailed design, preparation of construction drawings for the approval of the Engineer, supply of materials, construction and maintenance of the works required for the establishment of the substation as outlined in this Specification.

The Bidder will be deemed to have visited the sites before preparing his bid to ascertain the local conditions under which the civil works will be carried out and also to satisfy himself as to the availability of all labour, plant and materials required.

After the award of the contract, the Contractor must take his own site survey before commencing detailed design and working drawings necessary for the execution of the civil works.

The Bidder shall submit with his bid an outline civil works program showing how works are to be completed in the time available.

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After acceptance of his bid and before the Engineer authorizes work to commence on site, the Contractor is to prepare and submit to the Engineer for approval a detailed civil works program.

Once approved, the program shall not be departed from without the approval of the Engineer.

Full design calculations, construction drawings, etc., for each particular construction shall be submitted to the Engineer for approval at least six weeks before being required at site.

The Contractor shall supply all holding down bolts, nuts, washers, templates and packing required for the proper installation of plant supplied under this Contract.

The civil works shall include all grouting and concrete work required for the erection of structures and Plant upon foundations at site.

All items requiring to be embedded or built into concrete work such as foundation bolt assemblies together with templates shall be delivered to site in good time.

The Contractor shall level and adjust all the Plant on the foundations. Not until each item is set up to the approval of the Engineer shall grouting commence.

The Contractor is responsible for ensuring that levels and adjustments made by him as aforesaid are not disturbed by routing operations and that such work is to the satisfaction of the Engineer.

6.0 TOOLS AND APPLIANCES (OPTIONAL)

The Item Price Schedules list items which are required under this Contract. The Bidder must add to this list and price any special items in sufficient number, as may be required for maintenance of equipment supplied under this Contract.

Each tool or appliance is to be clearly marked with its size and/or purpose and unless otherwise stated is not to be used for erection purposes.

The tools and appliances with the appropriate boxes are to be handed to the Employer as soon as they arrive on site.

7.0 SPARES (OPTIONAL)

In the Schedule of Recommended Spare Parts, the Bidder shall state the spares which he recommends, bearing in mind the remote location of the sites.

The Employer may order all or any of the spares so recommended. Those ordered are to be delivered to the specified port of destination not later than the date of receipt of the last shipment of the associated item of plant.

The price of spares shall be subject to the same price conditions as the associated item of plant. The price of spares ordered after the date of Taking Over Certificate shall be negotiated between the Employer and the Contractor.

All spares are to be interchangeable with the original parts. They are to be treated and packed for long term storage under the climatic conditions at site.

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Each spare is to be clearly and permanently labeled on the outside of its container with its description and purpose. When several spares are packed in one case, a general description of the contents is to be given on the outside of the case.

All cases, containers, or other packages are liable to be opened for inspection and checking on site.

8.0 DESIGN AND CONSTRUCTION

In complying with the requirements of the Specification, both with respect to arrangement and detail, design is to conform to the best current engineering practice. Each of the several parts of the plant shall be of the maker's standard design provided that this design is in general accordance with the Specification.

The essence of design should be simplicity and reliability in order to give long continuous service with high economy and low maintenance cost. Particular attention should be paid to internal and external access in order to facilitate inspection, cleaning and maintenance.

The design, dimensions and materials of all parts shall be such that they will not suffer damage as a result of stresses under the most severe service conditions.

Fully detailed specifications of the several parts of the plant shall be submitted describing particularly the materials to be used.

The materials used in the construction of the plant shall be of the highest quality and selected particularly to meet the duties required of them. Mechanism shall be constructed to avoid sticking due to rust or corrosion.

Workmanship and general finish shall be of the highest class throughout.

All similar parts of the plant shall be interchangeable.

All equipment is to operate without undue vibration and with the least possible amount of noise and is not to cause a nuisance.

All equipment shall be designed to minimize the risk of fire and any damage which may be caused in the event of fire.

The equipment is also to be designed to prevent entry of all vermin and to minimize the ingress of dust and dirt.

The use of materials which may be liable to attack by termites or other insects shall be avoided.

The equipment shall be designed to prevent accidental contact with live parts.

9.0 UNITS OF MEASUREMENT

In all correspondence, in all technical schedules and on all drawings metric Systems International d'Unites (SI) units shall be used. On drawings where Imperial or other units have been used it will be in order if the equivalent SI units are suitably marked in addition.

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10.0 CONTRACTOR'S RESPONSIBILITIES

The Contractor is to familiarize himself fully with Bidding Document, particularly in regard to the Conditions of Contract.

The following clauses are intended to supplement but not supersede the information contained in Bidding Document.

The execution of all contract work is to be adequately supervised by qualified representatives of the Contractor to the approval of the Employer and Engineer, who can demand removal of any of the Contractor's staff without assigning any reason.

The Contractor shall replace staff at his own expense.

Full facilities are to be provided by the Contractor to allow the Employer/Engineer to check and test the works.

The Contractor is to seek advice from the Employer/Engineer regarding the parts of the plant which will be subject to inspection; such inspection shall not relieve the Contractor from his obligations under the Contract.

The Employer/Engineer may require the opening up on site of equipment which has been delivered to site partly assembled.

10.1. Transport to Site

The Contractor is to bear all expenses in connection with the importation and transport to the Site of all Plant, material and things needed for the purpose of the Contract including warehouse rent, handling and other charges.

The Contractor is to observe any regulations which limit loads on roads and bridges over which material may be conveyed.

The handling and storage of any Plant at the Site shall be at the risk of the Contractor and without responsibility to the Employer.

The Contractor is to arrange for the protection, to the satisfaction of the Engineer, of all material against corrosion and mechanical damage during storage and erection at Site.

10.2. Design

Unless stated specifically to the contrary in the Bid with full supporting explanations, the Contractor will be deemed to have concurred as a practical manufacturer the design and layout of the Works as being sufficient to ensure reliability and safety in operation, freedom from undue stresses and satisfactory performance in all other essentials as a working plant.

The Contractor is to include the whole of the Works which are described in or implied by the Contract Document. All matters omitted from the Contract Documents, which may be inferred to be obviously necessary for the efficiency, stability and completion of the Works, shall be deemed to be included in the Contract Price.

Anything shown on the drawings, but not mentioned in the Specification or mentioned in the Specification and not shown on the drawings shall be deemed to be included in the Contract Price.

Unless explicitly excluded in this specification, the contractor shall perform all work and supply all items and materials for achieving completion of the work. This shall include all work, items, and materials, whether they were explicitly specified or not, provided they can be reasonably inferred from this specification as being required for achieving completion of the work, just as if they were expressly specified.

The Contractor will be deemed to have visited site before preparing his tender to ascertain the local conditions under which the works will be carried out and obtain by own information on all factors which might affect the supply, construction and completion of the contract works.

10.3. Importation

All expenses concerned with importation of all plant, materials or any other items required for the purpose of the Contract are the Contractor's responsibility.

10.4. Compliance with Specification

Notwithstanding any descriptive literature, drawings or illustrations which may have been submitted with the Bid, all details other than those shown on the Schedule of Departures will be deemed to be in accordance with the Specification and the Standard Specifications and Codes referred to in the Specification.

No departure from the Specification, except those shown in the Schedule of Departures and approved by Employer/Engineer shall be made without the written approval of the Employer/Engineer.

10.5. Drawings

All drawings associated with the Contract are to have the following particulars in the lower right hand corner:

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and in addition, the title of the drawings, the Contractor's name, the date and the scale are to be shown.

Before manufacture commences, dimensioned comprehensive drawings and diagrams giving full details of the Equipment are to be submitted to the Employer/Engineer for approval. Two prints of each drawing are to be provided to the Engineer and four prints submitted to the Employer for approval. The drawings are to be submitted in time to allow revisions or modifications as required by the Employer/Engineer.

After approval six copies of the approved drawings shall be submitted to the Employer with two copies to the Engineer.

Approval of the drawings does not relieve the Contractor from any responsibility in connection with the Works. At the completion of the Contract all drawings are to be marked up with any alterations made on site and two soft copy, and one white print of each drawing are to be provided.

10.6. Safety of Personnel

The maximum safety, consistent with good erection practice in the case of work above or underground, must be afforded to personnel directly engaged on this Contract, or to persons who, in the normal course of their occupation, find it necessary to utilize temporary works erected and to frequent the working area.

Once any section of the plant has been made alive the Contractor, the Engineer and the Employer shall establish and agree to a system for ensuring the safety of personnel and equipment. While the plant is under the control of the Contractor, the Contractor shall be primarily responsible for the safety precautions. While the plant is under the control of the Employer, the Employer shall be primarily responsible for these precautions.

10.7. Contractor's Employees

The Contractor is to fulfill all his obligations in respect of accommodation, feeding and medical facilities for all personnel in his employ, in accordance with the responsibilities imposed on him in The General Particular of Contract or as necessary to ensure satisfactory execution of the Contract. He is also to comply with the requirements of all relevant Labour Laws of Indonesia.

The Contractor is to be responsible for the behaviour on site of all personnel employed by him.

10.8. Instruction of Local Staff

The Contract price will be deemed to include for the instruction of the Employer's employees who will later operate and maintain the equipment.

10.9. Program of Work

Within one month of acceptance of the Bid the Contractor is to forward to the Employer/Engineer four copies of a network chart detailing the program for the complete Contract work for approval. Copies of the approved chart, as required by the Employer/Engineer are to be provided by the Contractor. The chart is to indicate the various phases of work for all items of the Contract from the taking over of materials to its final completion.

If at any time during the execution of the Contract it is found necessary to modify the approved chart, the Contractor is to inform the Employer/Engineer and submit a modified chart for approval. Such approval is not to be deemed to be consent to any amendment of the completion date stated in the Schedule.

10.10. Progress Reports

At monthly intervals, after approval of the program network chart referred to in Clause 1.6.10, the Contractor is to submit to the Engineer written detailed progress reports (in triplicate) in an approved form indicating the stage reached in the design, ordering of material, manufacture, delivery and erection of all components of plant. These reports are to be forwarded promptly so that, on receipt by the Employer/Engineer, the information contained therein is not more than seven days out of date. Copies are also to be forwarded to the Engineer's representative on Site.

If during the execution of the Contract the Engineer considers the progress position of any section of the work to be unsatisfactory, he will be at liberty to call such meetings, at the Contractor's works, as he deems to be necessary.

These meetings may be held at the Contractor's Works, the Engineer's head Office, or in other location as determined the Engineer in Consultation with the Employer. If required by the Engineer, a responsible representative from the Contractor's Works is to attend such meetings.

Access to the Contractor's and SubContractor's works shall be granted to the Engineer and Employer at all reasonable times for the purpose of ascertaining progress.

10.11. Erection and Checking at Site

All work at Site shall be carried out in such a manner as not to obstruct the operations of any other Contractor on the Site or the operation of the existing Power Stations or Substations.

The carrying out of all work included in the Contract shall be supervised by a sufficient number of qualified representatives of the Contractor and full facilities and assistance shall be afforded by the Contractor for the Engineer to check the works.

The Contractor is to obtain from the Engineer details of the parts which he wishes to inspect, but such inspection shall in no way exonerate the Contractor from any of his obligations. The Contractor, if requested by the Engineer, is to open up for inspection before re-erection any equipment which has been delivered to the Site partly assembled.

The Contractor is to keep the Site, on which he erects or stores Plant, reasonably clean, removing all waste material resulting from the work as it accumulates and as reasonably directed. On completion of the Works the Site shall be left clean and tidy to the satisfaction of the Engineer. Any damage done to buildings, structures and plant or property belonging to the Purchaser shall be made good at the Contractor's expense.

The Contractor shall be responsible for satisfying himself as to the correctness of the electrical and mechanical connections to all Plant supplied under the Contract before such Plant is brought into commission.

During erection and commissioning the Contractor is to provide all temporary scaffolding, ladders, platforms with the boards and handrails essential for proper access or workmen and inspectors, cover or rail off all dangerous openings or holes in floors and afford adequate protection against materials falling from a high level on to personnel below.

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The operation of any items of Plant once made alive shall be subject to a "Permit to Work" system in a form agreed between the Engineer's representative and the Employer in accordance with the Employer's standard safety regulations for such work.

While the Plant is still under the control of the Contractor the permit to work shall be endorsed by the Contractor's authorized representative. Permits to work on Plant which is handed over shall be under the control of the Employer.

10.12. Maintenance

The Contractor is to guarantee the efficient and good working of the Plant supplied under the Contract for a period of six (6) calendar months from the date on which the Employer takes over the Plant in accordance with the General Conditions of Contract.

10.13. Installation, Operating and Maintenance Instructions

The Contract Price will be deemed to include illustrated installation, operating and maintenance instructions written in English or Indonesian language.

When the general arrangements and details of the Plant have been finalized and not later than three (3) months before delivery commences, the Contractor is to submit to the Engineer for approval four (4) sets of fully detailed installation, operating and maintenance instructions for each substation including two (2) copies of readable all drawings on soft file.

The details are to cover the main Plant and all associated ancillary equipment as supplied under the Contract. It will not be sufficient to incorporate manufacturers standard brochures as part of the text unless they refer particularly to the equipment supplied and are free of extraneous matter.

The information provided should include essential circuit diagrams, general arrangement and detailed drawings of the installation, make mention of special materials where used and include schedules of lubricants and all ball and roller races employed on the Plant. The drawings and diagrams, which may be approved existing drawings reduced to a convenient size, should be bound into the volume and not inserted into cover pockets.

If the complete text is unduly bulky, then the manual shall be appropriately sub-divided and produced in multi-volume form. When approved, four copies of the complete text, diagrams and drawings as made up in draft form shall be handed to the Engineer for distribution at Site and these shall be provided not later than the date delivery commences.

A further six (6) copies for each substation shall be reproduced as a book or books of approximately A4 size and bound into strong durable imitation leather covers inscribed with black letters upon the front generally in permanent form upon the front generally in the form of the title page to this document except that the references to Specification, Conditions of Contract, Drawings, etc., will be replaced by "Operating and Maintenance Instructions".

The name of the main Contractor but not that of any SubContractor may also be inscribed upon the cover after the description of the Plant.



The name of the Employer and substation or other identification followed by a classification of the Plant (eg: 150 kV Switchgear), shall be inscribed upon the spine of the cover and, if the instructions are contained in several books, these shall be marked with the appropriate volume number.

~~The finished books are to be handed to the Employer/Engineer not later than one (1) month before taking over the plant.~~

11.0 SEGREGATED OR OPTIONAL PRICES

Bidders are requested to price the optional extra items of work as specified herein and listed in the Bid Price Schedule "Optional Prices".

These optional price items are not part of the Lump Sum bid price and will only become part of the Contract on the issue of the Employer's written order for specific items.

12.0 COMPLETION OF WORK

The completion of work shall be 9 months from contract signing.

13.0 SITE CONDITIONS

13.1. General

The substations equipment covered in this Specification are located in Kesugihan

13.2. Site Services

i). Living accommodation

The Contractor is to make his own arrangements in regard to accommodation for his expatriate or locally recruitment staff during the erection and completion of work.

ii). Office Accommodation

The Contractor is to provide such temporary buildings as may be necessary for office accommodation for his Site staff during the erection of the Works and the cost of these shall be deemed to be included in the Contract Price.

iii). Medical Facilities

These will not be provided by the Employer and the Contractor will be required to make his own arrangements where these services may be required for his staff.

iv). Labour, Work permits, Accommodation and Insurance

It will be the responsibility of the Contractor to ensure that all grades of expatriate labour have valid work permits and/or visas, and to comply in every way with the immigration and/or emigration regulations. He shall also ensure that he complies

with labour employment laws of the country and the requirements for leave, accommodation and insurance of all his employees and the employees of his sub-contractors.

The Contractor in all dealings with labour in his employ shall have due regard to all recognized festival days of rest and religious or other customs.

13.3. Layout of Plant and Buildings

The Bid Drawings show the preferred layouts of all plant, equipment and buildings and these shall not be changed without the written approval of the Engineer. Dimensions in these Drawings have been based on typical sizes of plant and equipment.

The Contractor should ascertain for himself during the bid stage that the plant he proposes to supply will be suitable for the arrangements shown on the Bid Drawings; should alternative arrangements be necessary he shall state this in the Schedule of Deviations.

If such a statement is not made and during the Contract it is found that major alterations are necessary, the Contractor may be required to meet the cost of such modifications.

Failure of the Engineer or Employer to comment on drawings submitted by the Contractor during the bid stage Design Principles shall not be accepted as approving such arrangements; any modifications proposed should be clearly stated in the Schedule of Deviations.

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UIP VII

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TSS.1 : 150 kV STEEL STRUCTURES AND OUTDOOR LIGHTING

1. GENERAL

Steel structures shall be provided under this Contract for supporting the insulators, switchgear, overhead conductors, busbars, earthwires, and other equipment and fittings generally as shown on the drawings, and have to be designed and erected according to the relevant international recognized standards.

Existing substations to be extended have gantry steel structures of lattice tower (column) and girder (beam) construction. Extensions with similar steel work are preferred. A price shall be included for a design closely resembling the existing arrangement of the Bidder's manufacture. Drawings of the Bidder's design are to be submitted with the bid.

The structures shall include all necessary access ladders to give access to the various levels of the high-level equipment and shall incorporate all necessary screens to comply with the requirements of insulation levels and minimum clearances.

Step, ladders, handrails, guards and other facilities shall be provided on the inside of the columns near the junction of the beam and column, to facilitate safe inspection and maintenance for the structures. Step bolts are not acceptable for the steel structures.

If necessary, the gantry structures of the existing substations subject to uprating shall be checked by the Contractor and replaced or reinforced in order to correspond to the new short circuit conditions.

The design and arrangement of supporting structures shall be subject to approval by the Owner/Engineer. The structures shall be rigid and self bracing against all dead, wind, pull-off and other applied loads. Wherever such an arrangement can be adopted, structures shall be braced by horizontal beams at intermediate or high level to provide an integrated framework. At or near ground level, all uprights shall be provided with holding down bolts provided under this Contract.

The rigidity of the structures shall be such that the alignment of the apparatus which they carry shall not be disturbed by the loads to which the structures are subjected.

Busbar dead end structures shall be designed so as to be suitable for future busbar extention.

2. DESIGN

All structures shall be designed so that no failure or permanent distortion shall occur when tested with applied forces equal to 2.5 times the maximum simultaneous working loads.

The maximum allowable stresses in tensile members shall be such as to give a factor of safety of not less than 2.5 on the elastic limit strength.

Major design condition

The following table gives the required maximum tensile strength of the materials to the used, the span lengths, angles of loading, etc.

BAB IV. SYARAT – SYARAT TEKNIK DAN GAMBAR
 BAB IV.3 : TECHNICAL SPECIFICATION

Structures	Maximum design tensile strength per support *1)	Conductor used	Angle of loading *2)	Maximum Span length (Slack Span)
For transmission line first span	$\frac{1}{4}$ xMWT/Cond..... (kg)	ACSR/ACSR-ASmm ²	10 – 15 deg	100 m
Aerial groundwire first span	$\frac{1}{4}$ xMWT/Cond..... (kg) mm ² x 1		100 m
Aerial groundwire between columns	$\frac{1}{4}$ xMWT/Cond..... (kg) mm ² x 1		According to substation layout

*1) According to conductor type and size.

*2) "Angle of loading" is the angle between the direction between the direction of external force and the line perpendicular to the arm of beam.

The earthquake loadings shall be simulated by horizontal force equal to total vertical force, multiply by the seismic ground acceleration in accordance to SNI 2833:2008 acting in any direction upon the center of gravity of the structure.

The following criteria shall be used for detailed design of the new respectively checking of the existing structures.

a. Vertical loading :

The dead weight of all conductors, earthwires, insulator strings and apparatus supported by the structures and the structures themselves shall be considered.

b. Wind loading :

Wind loading on the projected area of the steel members, conductors, insulators and fittings as specified. The steelwork shall be designed to withstand simultaneously wind loads as follows :

	Wind pressure (kg/m ²)	Wind pressure coefficient	Resulting for design (kg/m ²)
Lattice steel structure (towers, gantries)	70	2.8	196
Flat Surfaces	70	1.6	112
Conductors	53	1.0	53
Insulators	53	1.5	80

c. Horizontal loading :

The pulls of phase conductors and earthwires, taking into account the expected dynamic loads dictated by the specified short circuit current.

Details and fastenings shall be designed to have factor of safety against failure not less than the main members of the structure.

d. Short circuit loading (Initial symmetrical short-circuit current)

Stress diagrams and calculations shall be submitted as required by the Engineer and the dispositions and sections of all members and the design of joints and fittings shall be subjected to approval.

Contractor should design the steel structure considering the applied conductor tension and sag for the condition, that at the highest operating temperature of conductor (i.e 90°C for ACSR and AAC) the maximum sag of conductor is 3 percent.

Bolts and nuts shall be fitted with spring washers. Taper washers are to be added where necessary. Threads of bolts shall be spun galvanized and the threads of nuts shall be greased. The diameter of bolts and nuts which are mechanically stressed shall not be less than 12 mm and shall have metric screw threads. Nuts and heads of all bolts shall be of the hexagonal type. Minimum quality of bolt shall be in accordance to the respective standards (5.6 of DIN 267).

Bolt holes are not to be more than 1.5 mm larger in diameter than the corresponding bolt diameter. The design is to be such as to keep the number of different parts as small as possible and is to facilitate transport, erection and inspection.

3. DEFORMATION – DEFLECTION CONDITIONS

Under permanent loads and with normal wind but with no short-circuit and no earthquake, deformations are never higher than the following values :

- Beam : vertically : 1/200 of the span
horizontally : 1/200 of the span
- Column : 1/150 of the height in both directions measured at the level of the horizontal axis of the beam.

4. MATERIAL

Material for steel members and plates of towers shall be of the type and grade most suitable for the application intended and shall conform to the latest applicable standard, specifications and recommended practices of the industry. The quality of steel to be used for the fabrication on the towers shall at least correspond to SS400 and SS540 according to JIS G 3101. The steel to be used shall be of a quality that will not have its physical properties changed or become embrittled by hot dip galvanizing.

All material shall be tested at the steel mill in accordance with applicable specification and standards under which they are manufactured. The contractor shall apply all certified mill tests. Test shall be conducted in accordance with ASTM A 370. The test to be conducted shall include, but are not limited to uniformity of galvanizing coating, mechanical and chemical properties of all steel and additional embitterment testing on high strength steel.

High tensile steel, when stores in the fabricators stockyard prior to fabrication and galvanizing, shall be marked continuously throughout its length with a light blue water paint line. In addition the grade number of the steel shall be painted on and ringed round with paint.

The steel shall be free from blisters, scale and other defects.

Main members and bracings of lattice structures shall be not less than 6 mm and 5 mm thick respectively.

5. CONSTRUCTION

The compression members of steel structures shall consists of rolled steel sections and

the tension members of rolled steel sections or flats.

All members shall be stamped or marked for erection purposes as specified.

All members shall be stamped or marked in an approved manner with numbers and/or letters corresponding to number and/or letter on the drawings or material lists. Drawings and material lists shall be submitted to the Engineer for approval. The erection marks if stamped, shall be stamped before galvanizing and shall be clearly visible after galvanizing.

Pockets and depressions likely to hold water shall be avoided and all parts of the structures shall be properly drained.

Where overhead transmission lines are terminated at the substation structures, landing plates welded to the structures shall be provided for reception of the transmission line insulator fittings and earthwire clamps which will be supplied and fitted under other Contracts.

Special care shall be taken not to injure the skin on galvanized or special treated surface during erection. Care shall be taken to prevent or remove any white rust, streaks or foreign matter deposited on galvanized surfaces during storing or transport or after erection.

Approved means shall be provided for fixing and bonding copper conductors to the steel work at sufficient points to obtain efficient earthing. Earth connection shall be made to a vertical face, clear of the ground. Foundation bolts shall not be used for their attachment.

To facilitates inspection and maintenance the structures shall be provided with steps, ladders, handrails, screens, guards and other facilities. Step bolts are not acceptable for substations structures

6. WORKMANSHIP

All members shall be cut to jig and holes shall be drilled or punched to jig. All parts shall be carefully cut and holes accurately located so that when the members are in position the holes can be accurately aligned before being bolted up. Drifting or reaming of holes will not be permitted. All burrs shall be removed before galvanizing.

The drilling, punching, cutting, bending and welding of all fabricated steelwork shall be carried out before galvanizing and shall be such as to prevent possibility of irregularity occurring which might cause any difficulties in the erection of steel structures on the site.

Except where specified to the contrary, all iron and steel used in the construction of the work shall be galvanized.

Galvanizing shall be applied by the hot dip process for all parts according with ASTM A-123, A-143 and A-153 shall be applied by the hot dip process and shall consist of a suitable thickness of zinc coating of not less than 610 grams of a zinc per square meter of surface.

The zinc coating shall be smooth, clean and of uniform thickness and free from defects. The preparation for galvanizing itself shall not adversely affect the mechanical properties of the coated materials.

Built members shall, when finished, be true and free from all kinks, twists and open joints, and the material shall not be defective or strained in any way.

Steel gauges of the stud type shall be provided to enable the Engineer to carry out such checking of members as he may consider necessary.

7. OTHER MATERIALS

(1) General

All construction materials such as conduit, steel angles, steel channels, steel plate, bolts, nuts and other related items required for operation shall be provided without extra charge and shall comply with the highest grade requirements of relevant standards.

(2) Lighting fixtures

- (a) High pressure mercury vapour Lamp 230 V, 300 W, 50 Hz, Single phase to be mounted on the Steel structure with adequate fittings .
- (b) Daylight switch (photoelectric automatic switching) 230 V, 6 A, 50 Hz, single phase.
- (c) Magnet switch, 230 V, 50 A, 3-phase
- (d) Emergency lighting, 230 V, 20 W x 2, fluorescent lamp, to be connected to inverter circuit
- (e) Power distribution box.

Outdoor use for housing of (b) (c) and required number of switches/wiring, to be fixed on a steel structure column.

The Contractor shall submit to the Employer design drawing of item (e) for approval.

Road and fence outside perimeter lighting fittings amounted on suitable columns shall be supplied and erected to give a general level of illumination of 5 lux.

Special attention shall be given to access and building gates.

8. TESTS

The following tests shall be carried out before shipment according to ASTM A370

- (a) Mechanical strength of materials
- (b) Galvanizing test
- (c) Shop assembly

REN SIP
UIP VII

PT PLN (Persero)
 TECHNICAL PARTICULAR GUARANTEE
 CIRCUIT BREAKER 500 kV
 FOR DIAMETER 1BT

NO	DESCRIPTION	UNIT	PLN REQUIRED	PROPOSED & GUARANTEE
Manufacturer			to be mentioned	
Type			to be mentioned	
1 Standard			IEC 62271-100 and IEC 62271-1	
2 Service condition			Outdoor; Tropical area	
3 Type of Circuit breaker			Live Tank	
4 Type of arc quenching medium			SF6	
5 Number of Phases	phase		3	
6 Rated voltage (Ur)	kV _{ms}		550	
7 Rated frequency (Fr)	Hz		50	
8 Rated normal current (In)	A _{ms}		≥ 3150	
9 Rated short-time withstand current (I _{th})	kA _{ms}		50	
10 Rated peak withstand current (I _p)	kA _{peak}		≥ 2.5 × I _{th}	
11 Rated duration of short circuit	s		≥ 1	
12 RATED INSULATION LEVEL :				
Power frequency withstand voltage, dry for 1 minute	kV _{ms}		≥ 620	
- Phase to earth, between the phases	kV _{peak}		≥ (1550 or 1800)	
Impulse withstand voltage (at 1.2/50 microsecond)	kV _{peak}		≥ 1175	
- Phase to earth, between the phases	kV _{peak}		≥ 1760	
Switching withstand voltage (at 250/2500 microsecond)	mm/kV		31	
- Phase to earth and across the open breaker gap				
- Between the phases				
13 Minimum Creepage distance				
14 OPERATING SEQUENCE AND OPERATING DUTY				
- Nominal Sequence	O - 0.3s - CO - 180s - CO		O - CO	
(rapid auto-reclosing/dead time)				
- Out of phase				
15 Rated making and breaking current to Normal/Reclose:				
- Making current	kA _{peak}		≥ 2.5 × I _{th}	
- Breaking current (symmetrical)	kA _{ms}		50	
- % dc component	% dc		> 20	
16 Breaking current under out of phase condition			≥ 25 % × I _{th}	
17 Rated capacitive switching currents	kA _{ms}		refer to IEC 62271-100 table 9	
18 Radio influence voltage level, measured at 1.1 Ur/√3 at 1 MHz	μV		To be Mentioned	
- circuit closed to ground	μV		To be Mentioned	
- circuit breaker open, grounded terminal				
19 Classes				
- Electrical endurance	E1		refer to IEC 62271-100 table 26	
- Transient Recovery Voltage				
- Mechanical endurance	M2			
- Restrike performance	C2			
20 Temperature rise at :	K		≤ 65	
- Contacts in SF6	K		≤ 75	
- Connection, bolted or equivalent in SF6	K		≤ 65	
- Terminal				

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UIP VII

Name of bidder :
 Signed of bidder :

Name of manufacturer :
 Signed of manufacturer :

PT PLN (Persero)
 TECHNICAL PARTICULAR GUARANTEE
 CIRCUIT BREAKER 500 KV
 FOR DIAMETER IBT

NO	DESCRIPTION	UNIT	PLN REQUIRED	PROPOSED & GUARANTEE
MECHANISM				
	Manufacture			
Type				
21	Number of interrupters in series per phase	pcs	2	
22	Number of tripping coils per phase	pcs	2	
23	Number of closing coils per phase	pcs	1	
24	Operating mechanism :			
	- Type			
	- Number of stored energy operation		3 (one per phase)	
25	Protection level of control cubicle		min. IP54	
26	Supply voltage :			
	- Control voltage	Volt DC	110	
	- Tripping and closing Coils	Volt DC	110	
	- Motor voltage	Volt AC	230/400	
	- Heater	Volt AC	230	
27	Tolerance range for auxiliary supply voltage			
	- tripping coil	%	85 to 110	
	- closing coil	%	85 to 110	
	- motor	%	85 to 110	
28	Mechanical performance			
	1. Total break time (trip initiation to final arc extinction)	ms	≤ 40	
	2. Opening time (trip initiation to contact separation) without current	ms	≤ 30	
	3. Time interval between opening of interrupters of first and last phase	ms	≤ 4	
	4. Time interval between opening of interrupters of one phase	ms	2.5	
	5. Closing time without current	ms	≤ 110	
	6. Time interval between closure of interrupters of the first and last pole	ms	≤ 10	
	7. Time interval between closure of interrupters of one phase	ms	3	
	8. Time from extinction of main arc to contact make during auto-reclose duty	ms	≤ 300	
29	Number of auxiliary contacts (NO/NC) per pole	pcs	> 8	
OTHERS				
30	Discrepancy device		Yes	Yes
31	Antivumping device		To be mentioned	To be mentioned
32	Method of controlling voltage distribution between break unit		N/A	N/A
33	Method of Closing control	Ohm	N/A	N/A
	Value of closing resistor	ms		
	Pre insertion time of closing resistor	pcs	1	
34	SF6 Pressure Indicator per pole	pcs	3	
35	Counter to record the frequency of fault operation and normal operation	q	0.3	
36	Seismic acceleration constant consideration	%	≤ 0.5	
37	Leakage rate of SF6 gas per annum	μ ohm	< 80	
38	Contact resistance across main contacts per interrupters at rated current			
39	Number of switch operations between two inspections for changing the main-contacts		to be mentioned	to be mentioned
	- with rated continuous current		to be mentioned	to be mentioned
	- with rated breaking current			
40	Material of insulator		Porcelain	
41	Minimum clearance in air :			
	- between phase	mm	2350	
	- phase to earth	mm	2200	
	- live conductor to ground level	mm	5100	
	- live insulator to ground level	mm	2900	

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UIP VII

Name of manufacturer :

Signed of bidder :

Name of manufacturer :

Signed of bidder :

PT PLN (PERSERO)
TECHNICAL PARTICULAR GUARANTEE
LIGHTNING ARRESTER 500 KV

NO	DESCRIPTION	UNIT	PLN REQUIRED	PROPOSED AND GUARANTEE
1	Standard			IEC 60099-4; IEC 60099-5
2	Service condition			Outdoor, Tropical area
3	Type of Designation			Post type, metal oxide, gapless
4	Type of housing			Porcelain
5	Frequency (Fr)		50	
6	Highest system voltage	kV	550	
7	System neutral connection			Solid (effective)
8	Rated voltage (Ur)	kV	444	
9	Maximum Continuous Operating Voltage/MCOV (Uc)	kV	350 up to 360	
10	Class of Arrestor		min 4 20	
11	Rated nominal discharge current (8/20 us) (In)	kA rms	≥ 50	
12	Short circuit capability (for Arrestor Housing)			< 2.8 * Ur
13	Maximum Residual Voltage			< 3.1 * Ur
	- lightning impulse (wave 8/20 us)			< 2.3 * Ur
	- steep current impulse (front time 1 us)			
	- switching impulse (front time 30 us)			
14	Electric strength of housing (at sea level)	kV _p	min 1550	
	- impulse withstand voltage (wave 1.2/50 us)	kV _p	1175	
	- switching withstand voltage	mm/kV	31	
15	Creebage distance phase to earth according to IEC 60815			
GENERAL				
16	Mechanical characteristics :	N	to be mentioned	
	a) Average mechanical breaking load			
	b) Minimum falling loads	N	to be mentioned	
	- tensile loads	Nm	to be mentioned	
	- torsional loads	N	to be mentioned	
	- cantilever loads	N	to be mentioned	
	- compressive loads	N	to be mentioned	
	c) Max. permissible static and dynamic pull	mm kg	to be mentioned to be mentioned	
17	Total height	mm		
18	Total weight	kg		

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UIP VII

PT PLN (PERSERO)
 TECHNICAL PARTICULAR GUARANTEE
 LIGHTNING ARRESTER 150 kV

TPG : 150 KV SURGE ARRESTER

NO	DESCRIPTION	UNIT	PLN REQUIRED	PROPOSED AND GUARANTEE
Manufacturer			IEC 60099-4; IEC 60099-5	
Type			Outdoor, Tropical area	
1	Standard		IEC 60099-4; IEC 60099-5	
2	Service condition		Post type, metal oxide, gapless	Outdoor, Tropical area
3	Type of Designation			
4	Type of housing			
5	Rated Frequency (Fr)	Hz	50	
6	Highest system voltage	kV	170	
7	System neutral connection		Solid (effective)	
8	Rated voltage (Ur)	kV	132 / 138	
9	Maximum Continuous Operating Voltage/MCOV (UC)	kV	104 up to 112	
10	Class of Arrestor		3	
11	Rated nominal discharge current (8/20 us) (In)	kA	20	
12	Short circuit capability (for Arrestor Housing)	kA rms	≥ 50	
13	Maximum Residual Voltage			
	- lightning impulse (wave 8/20 us)		< 3.3 * Ur	
	- steep current impulse (front time 1 us)		< 3.7 * Ur	
	- switching impulse (30/60 us)		< 2.6 * Ur	
14	Electric strength of housing (at sea level)			
	- impulse withstand voltage (wave 1.2/50 us)	kV _p	750	
	- switching withstand voltage	kV _p	NA	
15	Creepage distance phase to earth according to IEC 60815	mm/kV	31	

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 UIP VII

Name of Bidder :

Signed of Bidder :

Name of manufacture :

Signed of manufacture :

PT PLN (PERSERO)
 TECHNICAL PARTICULAR GUARANTEE
 LIGHTNING ARRESTER 150 kV

TPG : 150 KV SURGE ARRESTER

NO	DESCRIPTION	UNIT	PLN REQUIRED	PROPOSED AND GUARANTEE
GENERAL				
16	Mechanical characteristics :			
a)	Average mechanical breaking load	N	to be mentioned	
b)	Minimum falling loads			
	- tensile loads	N	to be mentioned	
	- torsional loads	Nm	to be mentioned	
	- cantilever loads	N	to be mentioned	
	- compressive loads	N	to be mentioned	
c)	Max. permissible static and dynamic pull	N	to be mentioned	
17	Total height	mm	to be mentioned	
18	Total weight	kg	to be mentioned	
OTHER				
19	Counter arrester (required per phase)	-	provided with counter, time & magnitude surge current recording	
20	Leakage current monitor	-	Digital	
21	Maximum Leakage current	mA	to be mentioned	
22	Seismic condition	g	0.3	
23	Corona Ring		to be mentioned	
24	Grading Ring		to be mentioned	
25	Low Voltage Insulator base support		Yes	

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 UIP VII

Name of Bidder :

Name of manufacture :

Signed of Bidder :

Signed of manufacture :

PT PLN (PERSERO)
TECHNICAL PARTICULAR GUARANTEE
LIGHTNING ARRESTER 500 KV WITH SILICON RUBBER INSULATOR

NO	DESCRIPTION	UNIT	PLN REQUIRED	PROPOSED AND GUARANTEE
	Manufacturer			to be mentioned
Type				to be mentioned
1	Standard			IEC 60099-4; IEC 60099-5
2	Service condition			Outdoor, Tropical area
3	Type of Designation			Post type, metal oxide, gapless
4	Type of housing	Hz	50	Silicon Rubber
5	Frequency (Fr)	kV	550	
6	Highest system voltage			
7	System neutral connection			Solid (effective)
8	Rated voltage (Ur)	kV	444	
9	Maximum Continuous Operating Voltage/MCOV (Uc)	kV	350 up to 380	
10	Class of Arrester	kA rms	5	
11	Rated nominal discharge current (8/20 us) (In)	kA rms	20	
12	Short circuit capability (for Arrester Housing)		≥ 50	
13	Maximum Residual Voltage			
	- lightning impulse (wave 8/20 us)			$< 2.8 * Ur$
	- steep current impulse (front time 1 us)			$< 3.1 * Ur$
	- switching impulse (front time 30 us)			$< 2.1 * Ur$
14	Electric strength of housing (at sea level)	kV _p	1800	
	- impulse withstand voltage (wave 1.2/50 us)			
	- switching withstand voltage	kV _p	1775	
15	Crepage distance phase to earth according to IEC 60815	mm/kV	31	
16	GENERAL	N	to be mentioned	
	Mechanical characteristics :			
a)	Average mechanical breaking load	N	to be mentioned	
b)	Minimum falling loads	N	to be mentioned	
	- tensile loads	Nm	to be mentioned	
	- torsional loads	N	to be mentioned	
	- cantilever loads	N	to be mentioned	
	- compressive loads	N	to be mentioned	
c)	Max. permissible static and dynamic pull	N	to be mentioned	
17	Total height	mm	to be mentioned	
18	Total weight	kg	to be mentioned	
19	Counter arrester (required per phase)	-		provided with counter, time & magnitude surge current recording
20	Leakage current monitor (required per phase)	-		Digital
21	Maximum Leakage current	mA	to be mentioned	0.3
22	Seismic condition	g	to be mentioned	Yes
23	Corona Ring			Yes
24	Grading Ring			Yes
25	Low Voltage insulator base support			Yes

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PT PLN (PERSERO)
TECHNICAL PARTICULAR GUARANTEE
LIGHTNING ARRESTER 600 KV PORCELAINE INSULATOR

NO	DESCRIPTION	UNIT	PLN REQUIRED	PROPOSED AND GUARANTEE
1	Manufacturer			to be mentioned
	Type			to be mentioned
2	Standard			IEC 60099-4, IEC 60099-5
3	Service condition			Outdoor, Tropical area
4	Type of Designation			Post type, metal oxide, gapless
5	Frequency (f _r)	Hz		Porcelain
6	Highest system voltage	kV		50
7	System neutral connection			550
8	Rated voltage (U _r)	kV		Solid (effective)
9	Maximum Continuous Operating Voltage/MCOV (U _c)	kV	350 up to 360	444
10	Class of Arrester	kV	5	
11	Rated nominal discharge current (8/20 us) (In)	kA	20	
12	Short circuit capability (for Arrester Housing)	kA rms	≥ 50	
13	Maximum Residual Voltage			
	- lightning impulse (wave 8/20 us)		< 2.8 * U _r	
	- steep current impulse (front time 1 us)		< 3.1 * U _r	
	- switching impulse (front time 30 us)		< 2.3 * U _r	
14	Electric strength of housing (at sea level)			1800
	- impulse withstand voltage (wave 1.2/50 us)	kV _p	1175	
	- switching withstand voltage	mm/kV	31	
15	Creebage distance phase to earth according to IEC 60815			
16	GENERAL			
	Mechanical characteristics :			
	a) Average mechanical breaking load	N	to be mentioned	
	b) Minimum failing loads	N	to be mentioned	
	- tensile loads	N	to be mentioned	
	- torsional loads	Nm	to be mentioned	
	- cantilever loads	N	to be mentioned	
	- compressive loads	N	to be mentioned	
	c) Max. permissible static and dynamic pull	N	to be mentioned	
17	Total height	mm	to be mentioned	
18	Total weight	kg	to be mentioned	
19	OTHER			
20	Counter arrester (required per phase)	-	provided with counter, time & magnitude surge current recording	
21	Leakage current monitor (required per phase)	-	Digital	
22	Maximum Leakage current	mA	to be mentioned	
23	Seismic condition	g	0.3	
24	Corona Ring		Yes	
25	Grading Ring		Yes	
	Low Voltage insulator base support		Yes	

REN EM
 UJP VII

PT. PLN (Persero)
TECHNICAL PARTICULAR AND GUARANTEE
DISCONNECTOR 500 KV

NO.	DESCRIPTION	UNIT	PLN REQUIRED	PROPOSED AND GUARANTEE
Manufacturer			to be mentioned	
Type			to be mentioned	
1 Standard			IEC 62271-102 and IEC 62271-1	
2 Type of Designation			Horizontal break or vertical break or Knee or Panthograph	
3 Service Condition	-		Outdoor; Tropical area	
4 Rated Frequency (F _r)	Hz			
5 Rated Voltage (U _r)	kV _{rms}		50	
6 Rated Normal Current (I _r)	A		550	
7 Rated short time withstand current (I _{sk})	kA _{rms}		≥ 3150	
8 Rated duration of short circuit	s		50	
9 Rated peak withstand current (I _{pk})	kA _{peak}		≥ 1	
10 Rated static mechanical loading	N		≥ 2.5 × I _r	
a. Straight load	N			
b. Cross load	N			
11 Rated values of bus transfer current Switching capability of disconnectors	A		refer to IEC 62271-102 table 3	
a. Rated Bus Transfer Current	V _{rms}		0.8 × I _r or max. 2520 A	
b. Rated Bus Transfer Voltage	V _{rms}		100	
12 Rated values of mechanical endurance for disconnector	class		min M0 (1000 operating cycle(s)	
13 Number of pole	pole		3	
14 Radio Interface Voltage	UV		to be mentioned	
INSULATION				
15 Rated lightning withstand voltage (BL) - at 1.2 or 50 microsecond	kV _p		≥ 1550 or ≥ 1800	
- Phase to earth & between phase	kV _p		≥ 1550 (+315) or ≥ 1800	
- Across Open Switching Device and or isolating distance	kV _p			
16 Rated switching impulse withstand voltage	kV _p			
- phase to earth and across open Switching device	kV _p		≥ 1175	
- between phases	kV _p		≥ 1760	
- across isolating distance	kV _p		≥ 900 (-450)	
17 Power frequency withstand voltage (1 min) :	kV _{rms}		≥ 620 or ≥ 710	
- phase to earth and between phases	kV _{rms}			
- Across Open Switching Device and or isolating distance	mm or kV			
18 Creepage distances	mm or kV			
19 Minimum clearance in air :	mm		31	
- phase to phase	mm		3100	
- to earth	mm		2900	

REN EM
UIP VII

Name of Bidder:

Name of Manufacture :

PT. PLN (Persero)
TECHNICAL PARTICULAR AND GUARANTEE
DISCONNECTOR 500 kV

NO.	DESCRIPTION	UNIT	PLN REQUIRED	PROPOSED AND GUARANTEE
GENERAL				
20	Type of operating mechanism	-		motor drive and manual
	- Main Blade			manual
	- Earthing Blade			230 / 400
21	Motor operating voltage (Ua)	VAC		85 - 110 x Ua
	- Tolerance range for auxiliary supply voltage	%		
22	Total time from initiation of opening operation to isolator in fully open position	s		to be mentioned
23	Motor Torque	N		to be mentioned
24	Contact Resistance at rated current	$\mu\Omega$		≤ 100
25	Degrees of Protection for Driving Mechanism Box (IP)	IP		min. 54
26	Material of enclosure (Mechanism Box)			Aluminum / Stainless Steel
27	Poles arrangements:			parallel
OTHERS				
28	Seismic acceleration constant consideration	g		0.3
29	Earthing Switch equipped with mechanical interlock system		YES (line, IBT, pembangkit) or NO (diameter, Reaktor)	
30	Measures to prevent building of bird's nests in the drive housing		YES	

REN EM
UIP VII

Name of Bidder :
 Signed of Bidder :

Name of Manufacture :
 Signed of Manufacture :

PT PLN (Persero)
TECHNICAL PARTICULARS AND GUARANTEE
70 KV OUTDOOR CAPACITOR VOLTAGE TRANSFORMER

NO.	DESCRIPTION	UNIT	PLN REQUIRED	PROPOSED AND GUARANTEE
Manufacturer				to be mentioned
Type				to be mentioned
1. Standard				IEC 61869-5
2. Service Condition				Outdoor, Tropical area
3. Nominal voltage		kV	70	
4. Highest Voltage for equipment (Um)		kV	72.5	
5. Rated frequency (Fr)		Hz	50	
6. Rated primary voltage (Upr)		kV	70/ $\sqrt{3}$	
7. Rated secondary voltage (Usr)		V	100/ $\sqrt{3}$ and 100/3	
RATED INSULATION LEVEL				
8. Insulation Class :		kVrms	140	
	Power frequency withstand voltage	kVp	325	
	Lightning impulse withstand voltage	kVp	N.A.	
	Switching impulse withstand voltage		25	
9. Creepage distance phase to earth		mm/kV		
GENERAL				
10. Rated voltage factor and corresponding rated time, continuous			1.2	
11. Rated voltage factor and corresponding rated time, 30 sec.			1.9	
12. Dissipation factor of capacitor (tan δ)	%		≤0.5	
13. Accuracy class :			3P	
- for protection			0.2	
- for instrument and metering				
14. Rated burden :				
- for protection	VA		30	
- for instrument and metering	VA		30	
- total simultaneous burden	VA		60	
15. Rated capacitance	pF		4000 up to 10000	
16. Capacitance tolerance			- 5 % to + 10 %	
17. Ferro resonance :				
- Duration of ferro resonance oscillation	s		≤0.5	
- Maximum instantaneous error after ferro resonance oscillation	%		≤10	
18. Suitable for use as coupling capacitor	Yes		Yes	
OTHERS :				

REN EM
UIP VII

Name of manufacture :

Signed of manufacture :

Name of bidder :

Signed of bidder :

PT PLN (Persero)
TECHNICAL PARTICULARS AND GUARANTEE
70 KV OUTDOOR CAPACITOR VOLTAGE TRANSFORMER

NO	DESCRIPTION	UNIT	PLN REQUIRED	PROPOSED AND GUARANTEE
19.	Insulator material			
20.	Oil compensation			porcelain
21.	Mechanical characteristics :			corrosion-proof metallic bellow with pressure relief device
	a) Average mechanical breaking load	N		to be mentioned
	b) Minimum failing loads :			to be mentioned
	- tensile loads	N		to be mentioned
	- torsional loads	Nm		to be mentioned
	- cantilever loads	N		to be mentioned
	- compressive loads	N		to be mentioned
	c) Max. electromechanical failing load	N		to be mentioned
	d) Max. operating load	N		to be mentioned
22.	Oil level indicator		Direct type	
23.	Secondary terminal box		Made from corrosion resistant die cast aluminum, IP54, removable, undrilled, terminal flange with drainage	
24.	Earthing terminal	q	One earth terminal	
25.	Sesmic Condition (Earthquake Factor)		q	≥ 0.3

REN EM
UIP VII

Name of bidder :

Signed of bidder :

Name of manufacture :

Signed of manufacture :

TECHNICAL PARTICULAR AND GUARANTEE

TPG EARTH WIRE (GSW)

No.	DESCRIPTION	UNIT	PROPOSED AND GUARANTEE	
			PLN REQUIRED	GSW 55
A. Stranded Earthwires				
1	For Earthwires			
1	Manufacturer's name			
2	Number and diameter of aluminum wire	number/mm	-	
3	Number and diameter of steel wire	mm	73.2	
4	Overall diameter approximately	mm	9.6	
5	Sectional area of aluminium	mm ²	-	
6	Sectional area of steel wire	mm ²	54.5	
7	Weight per 1,000 meters	kg	444	
8	Nominal breaking load calculated	kg	7,230	
9	Maximum resistance at 20°C	ohm/km	1,350	
10	Modules of elasticity	kg/mm ²		
11	Coefficient of linear expansion	per °C		
12	Length of one drum	m	≤ 2000	
13	Minimum conductivity at 20°C	%		
14	Approximate gross weight of one drum	kg		
15	Approximate net weight of one drum	kg		
16	Dimension of drum (diameter x weight)	mm x mm		
17	Direction of stranding of outermost layer	Z-type		

REN EM
UIP VII

Name of Bidder :

Name of manufacturer :

Signed of Bidder :

Signed of manufacturer :

TECHNICAL PARTICULAR AND GUARANTEE

TPG EARTH WIRE (GSW)

NO.	DESCRIPTION	UNIT	PLN REQUIRED GSW 55	PROPOSED AND GUARANTEE GSW 55
B.	Individual Wires <u>For Earthwires</u>			
1	Material	AL		
2	Diameter	mm	3.2	
3	Tolerance of diameter	mm	± 0.064	
4	Minimum tensile strength	kg/mm	129	
5	Minimum elongation in 250 mm	%	4	
6	Minimum conductivity on 1,000 mm x dia	%		
7	Minimum number of twisting on length of 100 times	g/mm ²		
8	Minimum weight of zinc coating	mm		
9	Minimum thickness of aluminium			
10	Minimum number of immersions in uniformity test of galvanizing	times		
11	Minimum weight of grease	kg/mm		
12	Lowest dropping point of grease	deg.C		

REN EM
UP VII

Name of Bidder :

Name of manufacturer :

Signed of Bidder :

Signed of manufacturer :

TECHNICAL PARTICULARS AND GUARANTEES

TPG : 150 KV STRING INSULATOR

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
1	Manufacturer	-	submitted	
2	Type of designation	-	submitted	
3	Standard	-	IEC 60120, 60272, 60383, 60437, 60305, 60471, 60506, 60507, 60575, 60815	
4	Material	-	porcelain / toughened glass	
5	Diameter of disc (maximum)	mm	280	
6	Unit spacing nominal	mm	146	
7	Creepage distance (minimum)	mm	440	
8	Ball and socket	mm	16	
9	Electro mechanical failing load	kN	120	
10	Power frequency withstand voltages	kV	-	
	- dry	kV	85	
	- wet	kV	50	
11	Impulse withstand voltages	kV	125	
	- positive	kV	125	
	- negative	kV	130	
12	Puncture voltage	pcs	12	
13	Number of disc per string set	-	yes	
14	Provide with zinc sleeve	kg	submitted	
15	Weight per unit	-	required	
16	Catalog drawing or other references	-		

**REN EM
UIP VII**

Name of Bidder :

Signed of Bidder :

Name of Manufacture :

Signed of Manufacture :

DAFTAR ISIAN 3 : TECHNICAL PARTICULARS AND GUARANTEES

TPG - LV POWER CABLES AND CONTROL CABLES

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
1.	Manufacturer	-	To be mentioned	
2.	Cable type	-	NYCY	
3.	Rated voltage	kV	0.6 / 1.0	
4.	Nominal size of conductor	sqmm	2.5, 4, 6, 10	
5.	No. of cores	-	2, 4, 6, 10, 12	
6.	Maximum permissible temperature of the cores	°C	70	
7.	Material of conductor	-	Copper	
8.	No. of conductor and stranding (no/diameter)	mm	To be mentioned	
9.	Type of insulating material	-	PVC	
10.	Thickness of insulation	mm	To be mentioned	
11.	Type of screen material	-	Copper tape	
12.	Thickness of screen material	0.2	0.2	
13.	Maximum current rating	A	To be mentioned	
14.	Outside cable diameter	mm	To be mentioned	
15.	Resistance of conductors maximum	ohm/km	To be mentioned	
16.	Impedance of conductors	ohm/km	To be mentioned	
17.	Maximum short circuit rating :	KA	To be mentioned	
	t= 0.1 seconds	KA	To be mentioned	
	t= 0.2 seconds	KA	To be mentioned	
	t= 0.3 seconds	KA	To be mentioned	
	t= 1.0 seconds	KA	To be mentioned	

REN EM
UIP VII

BIDDER'S SIGNATURE
(.....)

MANUFACTURER'S SIGNATURE
(.....)

DAFTAR ISIAN 3 : TECHNICAL PARTICULARS AND GUARANTEES

TPG - LV POWER CABLES AND CONTROL CABLES

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
18.	Cable weight	kg/km	To be mentioned	
19.	Minimum drum wound lengths	m	To be mentioned	
20.	Drum diameter maximum	mm	To be mentioned	
21.	Drum width maximum	mm	To be mentioned	
22.	Full drum weight maximum	kg	To be mentioned	
23.	Test Certificates :	-	To be submitted	
	- Issued by			
	- Reference no.			
	- Date of Test Report			

REN EM
UIP VII

BIDDER'S SIGNATURE

(.....)

MANUFACTURER'S SIGNATURE

(.....)

TPG : OUTDOOR MARSHALLING KIOSK

TECHNICAL PARTICULARS AND GUARANTEES

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
1	Manufacturer	-	submitted	
2	Type	-	Outdoor	
3	Protection class	-	IP41	
4	Mounting position	-	On frame	
5	Material of cubicle	-	Aluminium or Hot dip galvanized sheet steel	
6	Minimum thickness of sheet steel	mm	2	
7	Front cover : door with glass window	-	No	
8	Provided with swingable cover for mimic and control	-	No	
9	Dimension	mm		
	- depth	mm	400	
	- width	mm	800	
	- height	mm	1120	
10	roof : shallow pitched	-	Yes	

REN EM
UIP VII

Name of Bidder :

Signed of Bidder :

Name of Manufacture :

Signed of Manufacture :

TECHNICAL PARTICULARS AND GUARANTEES

TPG : OUTDOOR MARSHALLING KIOSK

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
11	Heating resistor : manual control	-	No	
12	Mimic diagram provided	-	No	
13	Position indicator provided for :			
	- busbar isolators	-	No	
	- circuit breaker	-	No	
	- line isolator	-	No	
	- earthing switch	-	No	
14	Control push-buttons for all motor operated isolators	-	No	
15	Build-in sockets :			
	- 2 pole AC 220 V 16 A	-	Yes	
	- 3 pole AC 380 25 A	-	Yes	
	protected by MCBs			
16	Built-in lighting	-	Yes	
17	Built-in terminal blocks	-	Yes	
18	Built-in switches	-	No	
19	Built-in fuses	-	No	
20	Total weight	kg		

REN EM
UIP VII

Name of Bidder :

Signed of Bidder :

Name of Manufacture :

Signed of Manufacture :

TECHNICAL PARTICULARS AND GUARANTEES

TPG : 150 KV POST INSULATOR

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
1	Manufacturer	-	submitted	
2	Type of designation	-	submitted	
3	Standard	-	IEC 60168, 60273, 60383, 60437	
4	Nominal voltage	kV	150	
5	Height system voltage	kV	170	
6	Impulse withstand voltages	kVp	750	
7	Power frequency withstand voltages	kV	submitted	
	- 1 min. dry	kV	410	
	- 1 min wet	kV	325	
8	Puncture voltage	kV	-	
9	Total Creepage distance phase to earth	mm	5270	
10	Material	-	porcelain	
11	Color	-	submitted	
12	Post Insulator design	-	cylindrical	
13	Strength class	-	4	

REN EM
UIP VII

Name of Bidder : _____
Signed of Bidder : _____

Name of Manufacture : _____
Signed of Manufacture : _____

TPG : STRING SET

	Insulator sets for AAC Lephine		Double Suspension set	Single Tension set	Double Tension set	PROPOSED AND GUARANTEE
1	Name of Manufacture : Number of strings and discs per string : - For Heavy Pollution (U 120 BP)					
2	Length of string when stretched	unit mm	2 x 12 Required	1 x 12 Required	2 x 12 Required	
3	Overall creepage distance	mm	Required	Required	Required	
4	Net weight of one set	kg	Required	Required	Required	
5	Ultimate breaking strength of string	kN	2 x 120	1 x 120	2 x 120	
6	Withstand voltage without arcing horn : - Wet power-frequency withstand voltage test	kV	Required	Required	Required	
7	- Lightning impulse withstand voltage test (1.2 x 50 us) Withstand voltage with arcing horn : - Wet power-frequency withstand voltage test	kV	Required	Required	Required	
	- Lightning impulse withstand voltage test (1.2 x 50 us)	kV	Required	Required	Required	

REN EM
UIP VII

Name of Bidder :

Signed of Bidder :

Signed of Manufacture :

TECHNICAL PARTICULAR AND GUARANTEE

TPG : 500 KV AND 150 KV SWITCHYARD CONNECTORS

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
1	Manufacturer	-	<u>500 KV</u>	<u>500 KV</u>
2	Nominal voltage	kV	500	150
3	Highest system voltage	kV	525	170
4	System short circuit level	kA	50	50
5	Type of connector	-	compressed, bolted	compressed, bolted
6	Type of corresponding conductor	-	AAC Lupine	AAC Lupine
7	Conductor cross section	mm ²	1267	1267
8	Overall diameter of conductor	mm	-	-
9	Minimum current carrying capacity (ambient temp. 35°deg C, max. temp. 115 deg C)	A	-	-
10	Tensile breaking strength	kg/m ²	Required	Required
11	Test Certificates	-	-	-
12	Catalog, drawing and other reference	-	-	-

REN EM
UIP VII

Name of Bidder :
Signed of Bidder :

Name of Manufacture :
Signed of Manufacture :

TPG : 110V DC SWITCHBOARD

TECHNICAL PARTICULAR AND GUARANTEE

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
1	Manufacturer	-		
2	Type of construction	-		
3	Material of casing	-		Steel
4	Front door / cover with glass window	-		
5	Protection degree	-		Yes
6	Busbars :			
	- Material of Busbar			Copper
	- dimensions			
	- Max. current rating	mm A	200	
7	Boost charge contactor's:			
	- Manufacturer	-		A
	- Max. current rating			W
	- Coil rating			
	- Method of interlocking			-
8	Alarm relays :			
	- Manufacturer	-		mA
	- Type and reference			A
	- Power consumption :			
	a. quiescent			
	b. operated			

REN EM
UIP VII

Name of Bidder :

Name of Manufacture :

Signed of Bidder :

Signed of Manufacture :

TPG 10A : 110V DC SWITCHBOARD

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
9	DC Voltmeter	-	Yes	
10	DC Ammeter	-	Yes	
11	Provided with alarm signal in case of undervoltage and DC supply failure ?	-	Yes	
12	Automatic tripping of CB in case of overcurrent and overvoltage.	-	Yes	
13	Earthfault monitoring device	-	Yes	
14	Incoming cables entry from below	-	Yes	
15	Outgoing cables entry from below	-	Yes	
16	Suitable to feed control building's emergency lighting, MV switchgear and min 15 bays of HV equipment.	-	Yes	
17	Number and rating of distribution circuits	-		
18	Overall dimension : - Length - width - height	mm mm mm		
19	Total weight	kg		

REN EM
UIP VII

Name of Bidder :

Name of Manufacture :

Signed of Bidder :

Signed of Manufacture :

TPG 10B : 110V BATTERY SET

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
1	Manufacturer	-		
2	Type	-	NiCd	
3	Capacity at 8 hours rate	Ah	Minimum 300	
4	Number of Cell	-	90	
5	Voltage per Cell :	-		
	- maximum	V	1.65	
	- floating	V	1.40	
	- final, after discharge	V	1.14	
6	Total Nominal voltage	V	110	
7	Discharge current (8 hours)	A		
8	Case of cells	-		Translucent plastic
9	Rack	-		1 Step
10	Bidder's type designation	-		
11	Total weight	kg		
12	Total dimension : length x width x height	mm		

REN EM
UIP VII

Name of Bidder :

Name of Manufacture :

Signed of Bidder :

Signed of Manufacture :

TPG 10C : 110V BATTERY CHARGER

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
1	Manufacturer			
2	Type of designation		Automatic rectifier	
3	Input voltage 3 phase AC	V ac	230 / 400	
4	Frequency	Hz	50	
5	Output voltage DC	Vdc	110	
6	Range of adjustment of constant voltage setting	Vdc	100 - 130	
7	Output voltage variation from no load / full load	%		
8	Admissible variation of input power supply voltage	%	85 - 110	
9	Automatic / manual operation	-	Yes	
10	Maximum current rating	A		Subject to calculation
11	Continuous capacity at ambient temp. of 35 deg. C (min 6 min.)	A		
12	Time required to recharge battery from minimum to 80% min.			

REN EM
UIP VII

Name of Bidder :

Name of Manufacture :

Signed of Bidder :

Signed of Manufacture :

TPG 10C : 110V BATTERY CHARGER

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
13	Characteristic IU	-	Required	
14	Mounting position	-	Free standing	
15	AC Voltmeter (Input)	-	Yes	
16	AC Ammeter (Input)	-	Yes	
17	DC Voltmeter (Output)	-	Yes	
18	DC Ammeter (Output)	-	Yes	
19	Suitability for NiCd Battery specified	-	Yes	
20	Power output by temperature range + 20 deg C to + 40 deg C 100 % Humidity	-	Yes	
21	Dimension : - length - width - height	mm mm mm kg		
22	Weight of the Charger	kg	Yes	
23	Catalogue, drawing or other references			

REN EM
UIP VII

Name of Bidder :

Name of Manufacture :

Signed of Bidder :

Signed of Manufacture :

TPG 10D : 48V DC SWITCHBOARD (NOT APPLICABLE)

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
1	Manufacturer	-		
2	Type of construction	-		
3	Material of casing	-		Steel
4	Front door / cover with glass window	-		Yes
5	Protection degree	-		IP 41
6	Busbars :			
	- Material of Busbar	-		Copper
	- dimensions	mm		
	- Max. current rating	A		100
7	Boost charge contactor's:			
	- Manufacturer	-		
	- Max. current rating	A		
	- Coil rating	W		
	- Method of interlocking	-		
8	Alarm relays :			
	- Manufacturer	-		
	- Type and reference	-		
	- Power consumption :			
	a. quiescent			
	b. operated			
		mA		
		A		

REN EM
UIP VII

Name of Bidder :

Name of Manufacture :

Signed of Bidder :

Signed of Manufacture :

TPG 10D : 48V DC SWITCHBOARD (NOT APPLICABLE)

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
9	DC Voltmeter	-	Yes	
10	DC Ammeter	-	Yes	
11	Provided with alarm signal in case of undervoltage and DC supply failure ?	-	Yes	
12	Automatic tripping of CB in case of overcurrent and overvoltage.	-	Yes	
13	Earthfault monitoring device	-	Yes	
14	Incoming cables entry from below	-	Yes	
15	Outgoing cables entry from below	-	Yes	
16	Number and rating of distribution circuits	-		
17	Overall dimension : - Length - width - height	mm mm mm		
18	Total weight	Kg		

REN EM
UIP VII

Name of Bidder :

Name of Manufacture :

Signed of Bidder :

Signed of Manufacture :

TPG 10E : 48V BATTERY SET (NOT APPLICABLE)

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
1	Manufacturer	-		
2	Type	-		
3	Capacity at 8 hours rate	Ah		NiCd Minimum 240
4	Number of Cell	-		40
5	Voltage per Cell :	-		
	- maximum	v		1.65
	- floating	v		1.40
	- final, after discharge	v		1.14
6	Total Nominal voltage	V		
7	Discharge current (8 hours)	A		
8	Case of cells	-		Translucent plastic
9	Rack	-		1 Step
10	Bidder's type designation	-		
11	Total weight	kg		
12	Total dimension : length x width x height	mm		

REN EM
UIP VII

Name of Bidder :

Name of Manufacture :

Signed of Bidder :

Signed of Manufacture :

TPG 10E : 48V BATTERY SET (NOT APPLICABLE)

NO.	DESCRIPTION	UNIT	PROPOSED AND GUARANTEE
1	Manufacturer		
2	Type of designation		
3	Input voltage 3 phase AC	V ac	Automatic rectifier 230 / 400
4	Frequency	Hz	50
5	Output voltage DC	Vdc	48
6	Range of adjustment of constant voltage setting	Vdc	48 - 58
7	Output voltage ripple (0 - 100 MHZ) - with Battery - without Battery	%	< 0.1 % < 1 % 5
8	Output voltage variation from no load / full load	%	
9	Admissible variation of input power supply voltage	%	15
10	Automatic / manual operation	-	Yes
11	Maximum current rating	A	
12	Continuous capacity at ambient temp. of 35 deg. C (min @	A	Subject to calculation
13	Time required to recharge battery from minimum to 80% min.		

REN EM
UIP VII

Name of Bidder :

Name of Manufacture :

Signed of Bidder :

Signed of Manufacture :

TPG 10F : 48V BATTERY CHARGER (NOT APPLICABLE)

NO.	DESCRIPTION	UNIT	PROPOSED AND GUARANTEE
14	Characteristic IU	-	Required
15	Mounting position	-	Free standing
16	AC Voltmeter (Input)	-	Yes
17	AC Ammeter (Input)	-	Yes
18	DC Voltmeter (Output)	-	Yes
19	DC Ammeter (Output)	-	Yes
20	Suitability for NiCd Battery specified	-	Guaranteed
21	Power output by temperature range + 20 deg C to + 40 deg C 100 % Humidity	-	
22	Dimension : - length - width - height	mm mm mm kg	
23	Weight of the Charger	kg	Required
24	Catalogue, drawing or other references		

REN EM
UIP VII

Name of Bidder :

Name of Manufacture :

Signed of Bidder :

Signed of Manufacture :

TPG : 72.5 KV POWER CABLE

TECHNICAL PARTICULAR AND GUARANTEE

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
A. 72.5 KV SINGLE CORE XLPE POWER CABLES				
1	Number of core		1	
2	Insulation		XLPE	
3	Manufacturer			
4	Conductor		Copper of 99.5% purity	
5	Nominal size of cores	mm ²		
6	Number and diameter of strands	mm		
7	Thickness of insulation	mm		
8	Thickness of conductor shield	mm		
9	Thickness of sheath (minimum)	mm		
10	Outside cable diameter (Approx)	mm		
11	Maximum temperature rating of conductor	°C		
12	Maximum current rating at 20° (in ground)	A		
13	Conductor resistance	ohm/km		

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TECHNICAL PARTICULAR AND GUARANTEE

TPG : 72.5 KV POWER CABLE

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
14	Conductor impedance			
15	Inductance			
16	Cable capacitance			
17	Short circuit rating t = 0.1 seconds t = 0.2 seconds t = 0.5 seconds t = 1.0 seconds			
18	Cable weight (Approx)	kg/km		
19	Minimum bending radius	mm		
20	Maximum drum wound lengths	m		
21	Drum diameter maximum	mm		
22	Drum width maximum	mm		
23	Full drum weight maximum	kg		
24	Test certificate - Issued by - Reference no. - Date of Test Report	Required		

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TPG : 72.5 KV POWER CABLES ACCESSORIES

TECHNICAL PARTICULAR AND GUARANTEE

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
A. OUTDOOR TERMINATION				
1	Manufacturer			
2	Number of cores	-		
3	Nominal size of cables	mm ²		
4	Type			
5	Type of connector			
6	Method of voltage stress relief			
7	Material of outer insulation	minutes		
8	Non tracking per ASTM D 2303/ESI 09-13			
9	Type of heat recoverable			
10	Overall dimension	mm		
11	Weight	kg		

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TPG : 72.5 KV POWER CABLES ACCESSORIES

TECHNICAL PARTICULAR AND GUARANTEE

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
B.	72.5 KV STRAIGHT THROUGH JOINT KIT			
1	Nominal size of cable	mm ²		
2	Number of cores			
3	Manufacturer			
4	Type			
5	Method of Insulation			
6	Method of voltage Stress Relief			
7	Material of Outer Sheath			
8	Material of Outer Jacket			
9	Type of Connector	mm		
10	Overall Length	kg		
11	Weight			

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TPG : 72.5 KV POWER CABLES ACCESSORIES

TECHNICAL PARTICULAR AND GUARANTEE

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
C.	72.5 KV TERMINATION KITS			
1	Nominal size of cable	mm2		
2	Number of cores			
3	Manufacturer			
4	Type			
5	Type of connector			
6	Material of Inner Voltage Stress Relief			
7	Material of Outer Insulation	minutes		
8	Non Tracking per ASTM D2302/ESI 09-13			
9	Type of Heat Recoverable Polymeric material			
10	Overall Dimensions	mm		
11	Weight	kg		

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TECHNICAL PARTICULAR AND GUARANTEE

Spesifikasi Umum IED I/O

NO	Description	Requirement	Proposed and Guarantee
1	Rack Standard	19"	
2	Tampilan	Embedded LCD / LED (kecuali IED I/O)	
3	Key-Pad	Enable to change setting by key-pad	
4	Indikasi/Annunciator	LED (kecuali IED I/O)	
5	Technology	Numerical IED	
6	Power Supply	110 VDC (-15% s.d +10%)	
7	Frequency	50 Hz ±5%	
8	Licensed Software for setting & analysis	Included	
9	Connection between relay to computer	Included	
10	Default Setting & Programmable Logic Controller	Enable	
11	Communication Port to PC	built in	
12	Test Plug	Included	
13	Test Block	Included	

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**TECHNICAL PARTICULAR GUARANTEE
AUTOMATIC VOLTAGE REGULATOR (AVR)**

TPG AVR

No	Description	Requirement	Proposed and Guarantee
1	Name		
2	Manufacture/Type	Automatic Voltage Regulator/.....	
3	Rating	<ul style="list-style-type: none"> - Nominal Current (I_n) - Voltage Input (V_n) - Frequency - Auxiliary DC Voltage (V_x) - Digital Input 	<ul style="list-style-type: none"> 1A and 5 A 100 V or 110 V 50 Hz $\pm 5\%$ 110 V DC (-15% ; +10%) 8
4	Burden	<ul style="list-style-type: none"> Kapasitas Rated voltage range 110 VDC 	<ul style="list-style-type: none"> $\leq 0.2 \text{ VA} (1 \text{ A})$ $\leq 1.0 \text{ VA} (5 \text{ A})$ 100 V or 110 V $\leq 50\text{W}$
5	Control function setting ranges		

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Name of Bidder : _____
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Name of Manufacture : _____
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**TECHNICAL PARTICULAR GUARANTEE
AUTOMATIC VOLTAGE REGULATOR (AVR)**

TPG AVR

NO	Description	Requirement	Proposed and Guarantee
-	Regulated Voltage	V _s	90% - 120% of V _n ±0,5% to ±5,0% of V _n
-	Deadband	dV _s	0,1 %
-	Resistive line drop compensation	V _r	1,0 V
-	Resistive line drop compensation	V _{xl}	1,0 V
-	Circulating current compensation	V _c	1,0 V
-	Load shedding/boosting		
-	Total taps available TapsAvail	Taps Avail	0 - ±10% of V _s 1 - 40 or 1 - 30
-	Maximum total tap position	TP>	1 - 40 or 1 - 30
-	Minimum total tap position	TP<	-30 or 1 - 30
-	Total number of tap changes	TotalOps>	1 - 10000
-	Tap Changers Operations	Ops/tP>	1 - 100
-	Time Period	tP	1 - 24 hrs
-	Intertap Delay	tINTER	0 - 120 seconds
-	Tap Change indication time	tPULSE	0,5 - 5 seconds
-	Tap Change indication time	tTapChange	1 - 3 seconds
6 Time delay setting ranges			

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**TECHNICAL PARTICULAR GUARANTEE
AUTOMATIC VOLTAGE REGULATOR (AVR)**

TPG AVR

NO	Description	Requirement	Proposed and Guarantee
	Inverse time delay	$t = k + [(initial\ time\ delay\ setting) \times (1/N)]^*$ or Short time inverse	
	Time curve :		
-	Definite time delay	Setting Range	Step size
	Initial time (definite)	tINIT	0 - 20 secs 20 - 300 secs
			10 secs
7	Supervision function settings		
	Setting	Setting Range	Step size
	Under voltage blocking	V<<	1,0 V
	Under voltage detection	V<	1,0 V
	Over voltage detection	V>	1,0 V
	Circulating current	Ic	0.02-0.5A (In = 1A) 0.1-2.5A(In = 5A) 0.05-2.0A (In = 1A) 2.5-10A (In = 5A)
	Load current	IL>	0.01 A 0.05 A 0,05 A
	Load current	IL<	0 - 1A (In = 1A) 0 - 5A (In = 5A) 0 - 5A (In = 5A)

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**TECHNICAL PARTICULAR GUARANTEE
AUTOMATIC VOLTAGE REGULATOR (AVR)**

TPG AVR

NO	Description	Requirement	Proposed and Guarantee
8	Excessive circulating current time delay Power factor angle	tIC Angle	'0 - 180 seconds 0 - 90 degrees 10 secs 1 deg
9	Transformers Ratios CT ratios VT ratios		9999 : 1 9999 : 1 Default = 1:1 Default = 1:1
10	Measurement Local Configuration	Enable	
11	Terminal Interface Database configuration Protocol	RJ45/RS 485/RS 232 Upload dan download IEC 61850	



Name of Bidder : _____
Name of Manufacture : _____
Signed of Bidder _____
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TECHNICAL PARTICULAR AND GUARANTEE

TPG : BAY CONTROL UNIT

No.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEED
1	Manufacture	-		
2	Type	-		
3	DC voltage working range	Volt	110 V DC (-15% s.d +10%) -5° C to +55° C < 90 % (no condensation)	
4	Service condition (Temperature and RH)			
5	System bus interface/speed		IEC 61850 (FO) LAN/100 MBps	
6	Protocol		IEC 61850	
7	Provision of two redundant interface to LANs		Yes	
8	Method of loading/extending data base		via LAN	
9	Logic function & sequences		Yes	
10	Clock			IRIG-B
	a. Type			Potocoi
	b. Method of synchronisation to master clock			acc to IEC 61850
11	Method of data exchange with station computer (e.g Pier to Pier)			Yes
12	Provision of logic functions and sequences			
13	Voltage / Current			
	a. AC Voltage (secondary)		min (100 - 120 V rms) phase to phase 3 Phase 4 Wire	
	b. Primary Nominal Voltage		min (20 - 500 kV rms) phase to phase selectable VT matching	
	c. AC Current (secondary)		1 A dan 5 A 3 Phase 4 Wire	
	d. Primary Nominal Current		min (50 - 4000 A rms) selectable CT matching taps	
	e. Frequency		50 Hz	
14	Analog Input (AC)		7 Input (3 Current, 4 Voltage)	
	a. Capacity		1 and 5 A	
	b. Nominal Current		100 / 120 V	
	c. Nominal Voltage		at 1 A < 0.1 VA	
	d. Power Consumption		at 5 A < 0.5 VA	
	e. Measurement range current		± 20 %	
	f. Accuracy		± 0.5%	
	g. Sampling period		100 ms	
15	AC Burden			
	a. In = 1 A		≤ 0.2 VA	
	b. In = 5 A		≤ 1.0 VA	
16	DC Burden (Trip Condition)		≤ 50 VA	
17	Direct ac input from CT/VT for analouge values		Yes	
	a. Maximum No. of inputs per card		3x I ; 4x V	
	b. Outputs available per unit		NO	
	c. Input CT/VT			

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TECHNICAL PARTICULAR AND GUARANTEE

TPG : BAY CONTROL UNIT

No.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEED
18	Conventional dc analuge inputs a. Maximum No. of inputs per card b. Current input value supported		2 0 ... 20 mA	
19	Digital inputs a. Number of inputs per module b. Isolation withstand c. Range voltage d. Minimum voltage threshold e. Max permitted voltage f. Power Consumption		≥ 32 2.5 kV 24 to 220 V dc -20% +20% - 0.2 Watt/ input	
20	Digital outputs a. Number of inputs per module b. Isolation withstand c. Contacts		≥ 16 2.5 kV Min 125 V dc Min 5 A Continuous Min 30 A make and carry Min 30 A, 250 V dc for 0.2 s Min 0.2 A, 110 V dc break	
21	Synchro Check a. Voltage Difference b. Phase Difference c. Frequency slip or timer d. LL/DB and DL/LB		5 - 20 % of rating in 1 % steps 5 - 30 deg in 2.5 deg steps 0 - 1 sec enable	
22	Electrical test		IEC 60255, ANSI/IEEE C37, UL 508, DIN 57435 Part 303	
23	Insulation test		IEC 60255-5, IEC 60870-2-1	
24	EMC type test		IEC 60255-6, IEC 60255-22, EN 50082-2, DIN 57 435 Part 303	
25	Mechanical dynamic test		IEC 60255-21 and IEC 60068-2	
26	High precise measurements for voltage, current and calculated values P and Q		$\pm 0.5 \%$	
27	LED display can be configured		Yes	
28	Local Configuration a. Database configuration b. Terminal interface		upload and download RS 232/RS 485/RJ 45	
29	Communication port		ST/SC/MTRJ/LC	
30	Display operational measured values		V, I, P, Q, f, cos phi	
31	Mulyprocessor and firmware principal		Yes	
32	On-line parameterizable		Yes	
33	Limit values for measured values		Yes	
34	Connection to engineering service lap top		Yes	
35	Configured easily by CFC		Yes	
36	Key switches (Turn switch local/remote)		Yes	
37	Integrated synchrocheck for synchronized closing Circuit Breaker		Yes	
38	Assignable Function keys to speed up frequently recurring operator actions		Yes	
39	External clock sync-inputs		Yes	
40	Switchgear interlocks		Yes	
41	Interbay communications		Yes	
42	Autoclosure, synchrocheck and protection		Yes	
43	Volume of signals for high voltage		Yes	
44	Engineering tools		Yes	
45	Switchgear interlocking		Yes	
46	Service interface for parameterization (modem)		Yes	

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TECHNICAL PARTICULAR AND GUARANTEE

TPG : CIRCUIT BREAKER FAILURE

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
1	Manufacturer	-	to be mentioned	
2	Type of designation	-	Numeric	
3	Frequency	Hz	50	
4	Nominal Current	A	1	
5	- Primary Nominal Current Wiring Type	A	Min. (50-4000), selectable CT matching Taps 3 Phase - 4 wire	
6	AC Burden	VA	≤ 0.2	
7	In = 1 A DC Burden	VA	≤ 50	
8	DC Supply	Vdc	110 (-15 % -- + 10 %)	
9	Circuit Breaker Failure Protection	-	Min 10% – 100% x rated current, step 1%	
10	Setting Range	-	Min 10 ms – 10 second, step 10 ms	
11	CB Failure Time	-	Min 10% – 100% x rated current, step 1%	
12	Short Zone/Dead Zone Protection Range setting	-	Min 10 ms – 10 second, step 10 ms $\leq 7.5 \%$	
13	Dead Zone Time	-	$\geq 5 A$ 110 VDC continuously	
14	Accuracy at set value Contact Rating	-	$\geq 9 A$ make and carry, 1 sec ≥ 192 event records in ring buffer FIFO ≥ 4 analog signal ≥ 8 digital signal	
	Event records Internal disturbance recorder	-	≥ 8 oscilloscope for each ≥ 2.0 second	
	Format File		COMTRADE IEC 60255-24	

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TECHNICAL PARTICULAR AND GUARANTEE

TPG : CIRCUIT BREAKER FAILURE

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
15	High voltage withstand Dielectric withstand	-	Minimum complied with IEC 60255-5-1977 / ANSI C37.90 - 1989 2 kV rms for 1 minute between all case terminals connected together and the case earth 2 kV rms for 1 minute between all terminals of independent units with terminals on each independent circuit connected	
	High voltage impulse	-	IEC 60255-5-1977 positive and three negative impulse of 5 kV peak, 1.2/50 μ s between all terminals and all terminals and case earth	
16	Electrical environment strength DC supply interruption	-	Minimum complied with IEC 60255 - 11 : 1979 Unit will withstand a 20 ms interruption in the auxiliary supply quiescent state, without deenergising	
	AC ripple on DC supply	-	IEC 60255-11-1979 The unit will withstand a 12 % ac ripple on the dc supply	
	Fast transient withstand	-	IEC 60255-22-4-1992 / ANSI C37.90.1 - 4 kV, 2.5 kHz applied directly to auxiliary supply	
	Radio interference withstand	-	- 4 kV, 2.5 kHz applied directly to all inputs IEC 60255-22-3-1992 / ANSI C37.90.2	
15	Communication Standard Protocol Interface Communication port Communication media	-	IEC 61850 RJ 45, RS-232, RS-485 or USB In front or rear, or both Shielded or Fibre Optic	

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Name of Manufacturer : _____
Signed of Manufacturer : _____

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TECHNICAL PARTICULAR AND GUARANTEE

TPG : CIRCUIT BREAKER FAILURE

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
16	Performance test	-	Submitted	
	Type test	-	Submitted	
	Routine test	-	Tested by user	
	Acceptance test	-		
	Others :			
	- RTDS test (only for first installation in PLN)	-	Witness by user	
	Licensed Software for setting and analysis	-	Included	
	Connection between relay to computer	-	Included	
	Training	-	Included (class room and site)	
17	Default setting and Programmable Logic Control	-	Enable	
18	Guarantee	-	Min 3 years free of charge (maintenance)	
19		-	Min 5 years (supply of spareparts)	
20	Manual book (original hard and soft copy) and enclosed with original certificate of routine test	-	Submitted	
21		-		
22		-		
23	Minimum Feature	-	enable	
	- Watch dog	-	enable	
	- Block for relay Failure	-	enable	
	- Default logic and setting	-	enable	
	- MMI (man Machine Interface)	-	enable	

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UIP VII

Name of Bidder :
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TPG : THREE PHASE OVER VOLTAGE RELAY

TECHNICAL PARTICULAR AND GUARANTEE

NO	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
1	Manufacturer	-	-	to be mentioned
2	Type	-	-	Numeric
3	Models	-	-	Three phase over voltage
4	Nominal voltage (Un)	Vac	100 V	
5	Frequency	Hz	50	
6	Auxiliary dc voltage (Vx)	Vdc	110 (-15% +10%)	
7	Setting range	-	-	Min range UVR 10% - 90% * Un Min range OVR 100% - 150% * Un
	- UVR			
	- OVR			
8	Accuracy	-	-	< 5% of setting voltage < 5% of the time setting $\geq 0,00 - 9,9$ sec, time step 0,01
	- Operating Voltage			
	- Operating Time			
9	Time delay setting range	-	-	
	Drop off to pick-up ratio	%	%	
	- overvoltage	%	≥ 95	
	- undervoltage	%	≤ 105	
10	Out put contact rating	Vdc	110	
	- Rated voltage	A	≥ 5	
	- Continuous	A	≥ 9	
	- Make and carry	A		

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Name of Bidder :

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TPG : THREE PHASE OVER VOLTAGE RELAY

TECHNICAL PARTICULAR AND GUARANTEE

NO	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
11	Continuous Withstand Voltage	-	> 200% * Un	
12	Event records	-	≥ 192 event in ring buffer FIFO ≥ 4 analog signal ≥ 8 digital signal	
13	Internal disturbance recorder	-	≥ 8 oscilloscope each ≥ 2 second ≥ 16 Sample /cycle	
14	Format file MMI (Man Machine Interface)	-	COMTRADE IEC 60255-24 Switch or keypad and can communicate with PC or Laptop Minimum complied with IEC 60255-5:1977 / ANSI / IEC C37.90-1989	
15	High voltage withstand Dielectric withstand	-	- 2 kV common mode - 1 kV differential mode IEC 60255-5:1977 - 5 kV common mode - 1 kV differential mode Minimum complied with IEC 61000-4-4	
16	Impulse voltage withstand Fast transient withstand Electrical environment strength	-	4 kV auxiliary voltage, class 4 ANSI C37.90.1 2 kV others, class 4 IEC 61000-4-1 - 2.5 kV common mode, class 3 - 1 kV differential mode, class 3 ANSI C37.90.2 35 V/m IEC 61000-4-2 8 kV, class 4	
	High frequency disturbance	-		
	Radio Frequency	-		
	Electrostatic discharge	-		

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TECHNICAL PARTICULAR AND GUARANTEE

TPG : THREE PHASE OVER VOLTAGE RELAY

NO	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
	Impulse	-	IEC 61000-4-3 10 kV/m	
	AC ripple on DC supply	-	IEC 60255-11:1979	The unit will withstand a 12% ac ripple on the dc supply
	DC supply interruption	-	IEC 60255-11:1979	The unit will withstand a 20 ms interruption in the auxiliary supply, in its quiescent state, without deenergising
17	EMC compliance	-	must	Minimum complied with IEC 60255-6 Storage -25°C to +70°C Operation -25°C to +55°C IEC 60068-2-3 56 days at 93% RH and 40°C IEC 60529:1989 IP 52, IK 07
	Atmospheric environment	-		
	Temperature	-		
	Humidity	-		
	Enclosure protection	-		
18	Mechanical Environment	-	Minimum complied with IEC 60255-21-1:1996 Response and endurance, class 2	
	Vibration	-	IEC 60255-21-2:1995 Response and withstand, class 1	
	Shock and bump	-	IEC 60255-21-3:1995 Class 2	
	Seismic	-		

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TECHNICAL PARTICULAR AND GUARANTEE

TPG : THREE PHASE OVER VOLTAGE RELAY

NO	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
19	Communication Protocol Interface	-	-	IEC 61850
	Communication port	-	-	RJ-45, RS - 232, RS - 485 or USB In front or rear, both
	Communication media	-	-	Shielded or Fibre Optic
20	Licensed Software for setting and analysis	-	-	Included
21	Connection between relay to computer	-	-	Included
22	Training	-	-	Included (class room and site)
23	Default setting and Programmable Logic Controller	-	-	Enable
24	Guarantee	-	-	Min 3 years free of charge (maintenance) Min 5 years (supply of spareparts)
25	Manual book (original hard and soft copy) and enclosed with original certificate of routine test	-	-	Submitted
26	Measurement	-	-	enable
27	Minimum Feature	-	-	enable
28	- Watch dog - Block for relay Failure - Default logic and setting - MMI (man Machine Interface)	-	-	enable enable enable enable

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Name of Bidder :
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TECHNICAL PARTICULAR AND GUARANTEE

TPG : ETHERNET SWITCH

No.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEED
1	Manufacture	-	submitted	
2	Type	-	submitted	
3	Technology		Fully Managable	
4	Approval / Certificate		IEC 61850 from KEMA	
5	Management Interface		Web base HTML, Command line Interface, Telnet	
6	Ethernet Port Type Port	Port	100 base Min. 8 Ethernet	
7	Port Type	-	ST / SC/ MTRJ / LC RJ - 45	
8	Switch capacity per port		ST / SC/ MTRJ / LC 110 (-15% +10%)	
9	Switch - IED Switch - Server Switch - Switch	Vdc	Yes	
	Power supply			
	Rack mountable			

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TECHNICAL PARTICULAR AND GUARANTEE

TPG : OVER CURRENT RELAY

NO	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
1	Manufacturer	-		
2	Type	-		to be mentioned
3	Models	-		Numeric
4	Nominal current (In)	A		Three phase over current and One Earth fault
5	Frequency	Hz	1 and 5	
6	Auxiliary dc voltage (Vx)	Vdc	50	
7	Setting range	-	110 (-15% -+ 10%)	
8	Characteristic	-		
9	Time setting range	s	Min 0.4 - 2 * In (In 0.05 steps)	
	- Inverse (TMS)	ms	Mn 0.05 - 1 * In (In 0.05 steps)	
	- Definite Independent Time	Vdc	Min 0.05 - 1 with 0.05 steps for IEC Standard	
		A	Min 0.5 - 15 with 0.5 steps for ANSI Standard	
		A	Min 0.04 - 30 sec in 0.1 steps	
10	Out put contact rating	Vdc	Min 0.04 - 500 millisecond in 0.01 steps	
	- High set delay	A	110	
	- Rated voltage	A	≥ 5	
	- Continuous	A	≥ 9	
	- Make and carry	A		

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TECHNICAL PARTICULAR AND GUARANTEE

TPG : OVER CURRENT RELAY

TECHNICAL PARTICULAR AND GUARANTEE

NO	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
11	Drop off to pick up ratio	%	≥ 95	≥ 192 event in ring buffer FIFO
12	Event records	-	≥ 4 analog signal	≥ 16 digital signal
13	Internal disturbance recorder	-	≥ 8 oscillograph each ≥ 2 second	> 16 Sample /cycle
14	Format File MMI (Man Machine Interface)	-	COMTRADE IEC 60255-24 Switch or Keypad and can communicate with PC or Laptop	Minimum complied with IEC 60255-5: 1977 / ANSI / IEEE C37.90-1989
15	High voltage withstand Dielectric withstand	-	-	- 2 kV common mode - 1 kV differential mode
16	Impulse voltage withstand	-	-	IEC 60255-5:1977 - 5 kV common mode - 1 kV differential mode
	Electrical environment strength	-	-	Minimum complied with IEC 61000-4-4
	Fast transient withstand	-	-	4 kV auxiliary voltage, class 4 ANSI C37.90.1 2 kV others, class 4
	High frequency disturbance	-	-	IEC 61000-4-1 - 2.5 kV common mode, class 3 - 1 kV differential mode, class 3
	Radio Frequency	-	-	ANSI C37..90.2 35 V/m
	Electrostatic discharge	-	-	IEC 61000-4-2 8 kV, class 4

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Name of Manufacture :

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TPG : OVER CURRENT RELAY

TECHNICAL PARTICULAR AND GUARANTEE

NO	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
	Impulse	-	IEC 61000-4-3 10 kV/m	
	AC ripple on DC supply	-	IEC 60255-11:1979	The unit will withstand a 12% ac ripple on the dc supply
	DC supply interruption	-	IEC 60255-11:1979	The unit will withstand a 20 ms interruption in the auxiliary supply, in its quiescent state, without deenergising
17	EMC compliance	-	IEC 60255-6 Storage -25°C to +70°C Operation -25°C to +55°C IEC 60068-2-3 56 days at 93% RH and 40°C IEC 60529:1989 IP 52, IK 07	Minimum complied with must
	Atmospheric environment	-		
	Temperature	-		
	Humidity	-		
	Enclosure protection	-		
18	Mechanical Environment	-	IEC 60255-21-1:1996 Response and endurance, class 2	Minimum complied with
	Vibration	-	IEC 60255-21-2:1995	
	Shock and bump	-	IEC 60255-21-3:1995 Class 2	
	Seismic	-		

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TECHNICAL PARTICULAR AND GUARANTEE

TPG : OVER CURRENT RELAY

NO	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
19	Communication Protocol	-	IEC 61850	
	Communication port	-	RS-45, RS - 232, RS - 485 or USB	
	Communication media	-	In front or rear, both Shielded or Fibre Optic	
20	Licensed Software for setting and analysis	-		
21	Connection between relay to computer	-		
22	Training	-		
23	Default setting and Programmable Logic Controller	-		
24	Guarantee	-		
25	Manual book (original hard and soft copy) and enclosed with original certificate of routine test	-		
26	Measurement	-	enable	
27	Minimum Feature	-	enable	
28	- Watch dog - Block for relay Failure - Default logic and setting - MMI (man Machine Interface)	-	enable enable enable enable	

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Signed of Manufacture :

TECHNICAL PARTICULAR AND GUARANTEE

TPG : DIFFERENTIAL RELAY AND RESTRICTED EARTH FAULT

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
1	Manufacturer	-	to be mentioned	
2	Type of designation	-	-	
3	Frequency	Hz	50	
4	Nominal Current	A	1 and 5	
4	- High Voltage	A	1	
4	- Low Voltage	A	1	
5	- Primary Nominal Current	A	Min. (50-4000), selectable CT matching Taps	
5	Wiring Type	-	3 phase - 4 wire + 1 phase, 2 wire	
5	- High Voltage	-	3 phase - 4 wire + 1 phase, 2 wire	
5	- Low Voltage	-	3 phase - 4 wire	
5	- Terinary Voltage	-	3 phase - 4 wire	
6	AC Burden	VA	≤ 0.2	
6	- In = 1 A	VA	≤ 1.0	
6	- In = 5 A	VA	≤ 50	
7	DC Burden	Vdc	110 (-15 % --+ 10 %)	
8	DC Supply	-	Low Set 15 - 40%, step 5%	
9	Setting Range	-	High Set 50 - 90%, step 5%	
10	Accuracy at set value	-	≤ 7.5 %	
11	Operating time	ms	≤ 20	
11	- Low Set	ms	≥ 20 (according to RTDS)	
11	- High Set	-	≥ 5 A 110 VDC continuously	
12	Contact Rating	-	≥ 9 A make and carry, 1 sec	
13	Additional Requirement	-	Range of setting must be suitable for existing equipment	
	a. Transformer	MVA MVA	
		Voltage KV	
	b. CT ratio	-	
	High Voltage	A A	
	Low Voltage	A A	

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TECHNICAL PARTICULAR AND GUARANTEE

TRG : DIFFERENTIAL RELAY AND RESTRICTED EARTH FAULT

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
14	Internal ACT	-	Yes	
15	Applicable for all vector group	-	Yes	
16	Harmonic restraint function to block inrush current	-	A must	
17	Event records	-	≥ 192 event records in ring buffer FIFO	
18	Internal disturbance recorder	-	<ul style="list-style-type: none"> ≥ 11 analog signal ≥ 16 digital signal 	
19	Format file	-	<ul style="list-style-type: none"> ≥ 8 oscillograph for each ≥ 2.0 second 	
20	High voltage withstand Dielectric withstand	-	<ul style="list-style-type: none"> COMTRADE IEC 60255-24 Minimum compiled with IEC 60255-5:1977 / ANSI C37.90 - 1989 - 2 kV rms for 1 minute between all case terminals connected together and the case earth - 2 kV rms for 1 minute between all terminals of independent circuits with terminals on each independent circuit connected together and the case earth - 1 kV rms for 1 minute between all terminals and case earth - 1 kV rms for 1 minute between all terminals and case earth 	
21	High voltage impulse	-	<ul style="list-style-type: none"> IEC 60255-5:1977 - positive and three negative impulse of 5 kV peak, $1.2/50 \mu\text{s}$, between all terminals and all terminals and case earth - Minimum compiled with IEC 60255 - 11 : 1979 - unit will withstand a 20 ms interruption in the auxiliary supply, in quiescent state, without deenergising - IEC 60255-11:1979 	
	Electrical environment strength	-	<ul style="list-style-type: none"> The unit will withstand a 12 % ac ripple on the dc supply 	
	DC supply interruption	-	<ul style="list-style-type: none"> IEC 60255-22-4:1992 / ANSI C37.90.1 - $4 \text{ kV}, 2.5 \text{ kHz}$ applied directly to auxiliary supply - $4 \text{ kV}, 2.5 \text{ kHz}$ applied directly to all inputs - IEC 60255-22-3:1992 / ANSI C37.90.2 	
	AC ripple on DC supply	-		
	Fast transient withstand	-		
	Radio interference withstand	-		

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TECHNICAL PARTICULAR AND GUARANTEE

TPG : DIFFERENTIAL RELAY AND RESTRICTED EARTH FAULT

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
	Radiated immunity	-	ANSI C37.90.2	
	Surge withstand	-	- 25 MHz to 1000 MHz, zero and 100% square wave modulated - Field strength of 35 V/m IEC 60255-22-1 / ANSI C37.90.1 : 1989	
	Electromagnetic compatibility Isolation Voltage (High-Potential)	-	- last transient and 2.5 kV oscillatory applied directly across each contact, optically isolated input and power supply circuit Compliance ANSI C37.90	
22	Atmospheric environment Operation temperature Humidity Enclosure protection	-	Minimum complied with ○ 10° - 50° C (IEC 60255-6 : 1988 90 (IEC 60068-2-3 : 1969 56 days at 93% RH and +40° C) % IEC 60529:1989	
	Mechanical strength Vibration	-	- 52 Protection (front panel) against dust and dripping water at 1 to the vertical Minimum complied with IEC 60255-21-1:1996	
	Shock and bump	-	- Response class 2 - Endurance class 2 IEC 60255-21-2:1995	
23	Seismic	-	- Shock Response class 2 - Shock Withstand class 1 IEC 60255-21-3:1995	

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Name of Manufacture :
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TECHNICAL PARTICULAR AND GUARANTEE

TRG : DIFFERENTIAL RELAY AND RESTRICTED EARTH FAULT

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
24	Communication Standard Protocol Interface	-	IEC 61850	RJ 45, RS-232, RS-485 or USB In front or rear, or both Shielded or Fibre Optic
25	Communication port Communication media Performance test Type test Routine test Acceptance test Others : - RTDS test (only for first installation in PLN system) - Operational performance (existing relay)	-	Submitted Submitted Submitted by user	Witness by user Have been installed in PLN system for 1 (one) year with good performance
26	Licensed Software for setting and analysis	-	Included	Included
27	Connection between relay to computer	-	Included (class room and site)	Included (class room and site)
28	Training	-	Enable	Enable
29	Default setting and Programmable Logic Controller	-	Min 3 years free of charge (maintenance)	Min 3 years free of charge (maintenance)
30	Guarantee	-	Min 5 years (supply of spares/parts)	Min 5 years (supply of spares/parts)
31	Manual book (original hard and soft copy) and enclosed with original certificate of routine test	-	Submitted	Submitted
32	Minimum Feature - Watch dog - Block for relay Failure - Default logic and setting - MMI (man Machine Interface)	-	enable enable enable enable	enable enable enable enable



TECHNICAL PARTICULARS AND GUARANTEES

TPG : CONTROL AND PROTECTION CUBICLE

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
1	Manufacturer	-		
2	Type	-		Indoor
3	Protection class	-		IP41
4	Mounting position	-		Free standing
5	Material of cubicle	-		Steel
6	Thickness of the steel sheet for :			
	- front and rear panel	mm	2	
	- other steel sheet (min)	mm	1.5	
7	Roof panel	-	Yes	
8	Side panel each cubicle unit	-	Yes	
9	Front panel built as door	-	Yes	
10	Cut-outs for flush mounted instrument, control devices, relays, test sockets, test switches and signalling panels	-		
11	Dimension of cubicles :			
	- length	mm	800	
	- width	mm	800	
	- height	mm	2200	
12	Cable inlet from bottom	-	Yes	
13	Internal wiring in plastic cable canals with plastic cover	-	Yes	
14	Surface treatment of all steel components :			
	- primer	-	2 x	
	- varnish coat	-	1 x	
15	Mimic diagram for Control Panel provided	-	Yes	
16	Earthing connection provided	-	Yes	
17	Test block provided	-	Yes	

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UIP VII

BIDDER'S SIGNATURE

MANUFACTURER'S SIGNATURE

(.....)

TECHNICAL PARTICULAR AND GUARANTEE

TPG : CIRCULATING CURRENT PROTECTION FAULT

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
1	Manufacturer	-	to be mentioned	
2	Type of designation	-	Numeric	
3	Frequency	Hz	50	
4	Nominal Current	A	1	
5	- Primary Nominal Current Wiring Type	A	Min. (50-4000), selectable CT matching Taps 3 x (3 Phase - 4 wire)	
6	AC Burden	Va	≤ 0.2	
7	- In = 1 A DC Burden	Va	≤ 50	
8	DC Supply	Vdc	110 (-15 % - + 10 %)	
9	Setting Range	-	0.1 - 0.5 In	
10	Accuracy at set value	-	$\leq 7.5\%$	
11	Operating time	-	≤ 20 (according to RTDS)	
12	Contact Rating	-	≥ 5 A 110 VDC continuously ≥ 9 A make and carry, 1 sec	
13	Event records	-	≥ 192 event records in ring buffer FIFO ≥ 9 analog signal ≥ 16 digital signal	
14	Internal disturbance recorder	-	≥ 8 oscillograph for each ≥ 2.0 second	
15	Format File Communication Standard Protocol Interface Communication port Communication media	-	COMTRADE IEC 60255-24 IEC 61850 RJ 45, RS-232, RS-485 or USB In front or rear, or both Shielded or Fibre Optic	

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TECHNICAL PARTICULAR AND GUARANTEE

TPG : CIRCULATING CURRENT PROTECTION FAULT

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
16	Performance test Type test Routine test Acceptance test Others : - RTDS test (only for first installation in PLN - Operational performance (existing relay)	-	Submitted Submitted Tested by user	Witness by user Have been installed in PLN system for 1 (one) year with good performance
17	Licensed Software for setting and analysis	-	Included	Included
18	Connection between relay to computer	-	Included	Included (class room and site)
19	Training	-	Enable	Min 3 years free of charge (maintenance)
20	Default setting and Programmable Logic Control Guarantee	-	Min 5 years (supply of spareparts)	Submitted
21		-		
22	Manual book (original hard and soft copy) air enclosed with original certificate of routine test	-		
23	Minimum Feature - Watch dog - Block for relay Failure - Default logic and setting - MMI (man Machine Interface)	-	enable enable enable enable	

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DAFTAR ISIAN 2 : TECHNICAL PARTICULARS AND GUARANTEES

TPG XIII.2.1 : STEEL STRUCTURES

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
1.	Nominal voltage	kV	150	
2.	Highest system voltage	kV	170	
3.	Manufacturer	-	To be mentioned	
4.	Length, height and width of structures	mm	As seen on the attached drawing in Book B	
5.	Standard of material	-	SS 400 and SS 540 according to JIS G3101	
6.	Minimum tensile strength of material	kg/mm ²	To be mentioned	
7.	Minimum yield strength of material	kg/mm ²	To be mentioned	
8.	Minimum thickness :			
	- main members	mm	6	
	- bracing of lattice structure	mm	5	
9.	Galvanizing, minimum quantity of zinc coating	g/m ²	610	
	- thickness of the galvanizing	μm	85	

BIDDER'S SIGNATURE

(.....)

MANUFACTURER'S SIGNATURE

(.....)



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TECHNICAL PARTICULAR AND GUARANTEE

TPG : Disturbance Fault Recorder

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
1	Name	-	DFR (Disturbance Fault Recorder)	
2	Manufacturer/Type	- /	
3	Input	-		
	Analog AC Input	-		Min. 16 (perlu memperhatikan spek khusus)
	Channel	-		
	Voltage	V		100/ $\sqrt{3}$ volt or according to existing secondary voltage
	Current	A	1	
	Burden	VA	48 - 250 VDC , 100 - 250 VAC / 50 Hz	
	Operating Voltage and frequency Power Supply		$\pm 0.5\%$	
	Error	-		min. 64 channels
	Digital input	-		
				Wet & Dry Contact, Normally Open or Close Input, Trigger on Active & return to normal
4	Recording Time	Sec	min 10 Sec (Adjustable)	
	- Pre Fault	Sec	min 0.1 Sec (Adjustable)	
	- Fault Recorder Indication	-	Adjustable	
	- Post Fault	Sec	min 0.1 Sec (Adjustable)	
5	Recording	-		
	- Analog	-	Enable	
	- Voltage Element	-	Enable	
	- Current Element	-	Enable	
	- Digital Element	-	Enable	

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TECHNICAL PARTICULAR AND GUARANTEE

TPG : Disturbance Fault Recorder

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE	
6	Triger - RMS Level Triger - Related of change - Sub Cycle (For Power Quality)	-	V, I, P, Q, freq V, I, freq Yes	- Contact Input Debounce ≤ 20 - Contact Rating relay 24 - 250 VDC or existing Min 128 samples per cycle (Selectable) - 150 kV	
7	Contact	msec			
8	Sampling rate	-			
9	Power Quality Record:	-			
10	Harmonic Recording. - Voltage Quality 1. Range High 2. Range Low 3. Accuracy - Current Quality 1. Range High 2. Range Low 3. Accuracy - Sag and Swells. - Flicker. - Frequensi. 1. Range	-	Ability to measure harmonic and THD current and voltage (up to 40 105-125% Vn Step 0.1% 50-95 % Vn Step 0.1 % ≤ 0.5 % of reading Min 15 x ln Step 0.1% Min 0.01 x ln Step 0.1 % ≤ 0.5 % of reading Yes (IEC 61000-4-30) Yes (IEC 61000-4-15) -10%fn up to 5%fn.		

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TECHNICAL PARTICULAR AND GUARANTEE

TPG : Disturbance Fault Recorder

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
	2. Accuracy	-	$\leq 0.5\%$	
	- Voltage unbalance	-		
	1. Range	-	1-5 %	
	2. Accuracy	-	$\leq 1\%$	
	- P&Q Accuracy	-	$\leq 0.5\%$	
11	Synchrophasor Compatibility	-		Available (Based on IEEE C37.118 protocol)
12	Memory Capacity (internal/external) (including Power Quality Data Loger).	-	$\geq 16\text{ MB}$ - With Battery Backed RAM (for max. 32 channels Analog, 64 events & min storage for 10 days Power Quality Data)	
13	Hard Disk (External disk/host PC)	-	$\geq 1\text{ TB}$	
14	Resolution Power Of A/D Conversion	-	$\geq 16\text{ Bit}$	
15	Internal Clock	Crystal Oscillator	Yes	
16	Base clock	Date/time (year,month,day, hour, Minute, Second)	$\leq 0.1\text{ sec/day}$	
17	Stability up to 40°C		available	
18	Starting Unit		available	
19	Fault Recorder Indication	-	available	
20	Free Contacts (for alarm/watchdog)	-	GPS, IRIG-B port (include GPS & accessory)	
21	External Time Sync. Facilities	-	Accuracy $\leq 10\mu\text{s}$.	

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TECHNICAL PARTICULAR AND GUARANTEE

TPG : Disturbance Fault Recorder

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
19	Front Panel Key Pad And Display (Meter and status Indication)		Available	
20	Automatic & Multitasking For Recording Printing, Transmit & Diagnostic	o	Yes	
21	Cross Trigger & Time Sync For More Than One Fault Recorder	%	Yes	
22	Self Test Mode	-		Ethernet port, TCP/IP
23	Communication for Remote DownLoad			
24	Power Consumption		≤ 150 VA	
	Standby		≤ 300 VA	
	Operating	-	≥ 10 MW	
25	Insulating Resistance At 500 VDC		≥ 2000 V rms	
26	Dielectric Test For 50 Hz, 1 Min		According to IEC 255-5-5	
27	Voltage Withstand Surge	-	According to IEC 60255-22-2	
28	Electro Static Discharge		According to IEC 60255-21-1-2	
29	Vibration and Shock Test			

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Name of Manufacture :
 Signed of Manufacture :

TECHNICAL PARTICULAR AND GUARANTEE

TPG : Disturbance Fault Recorder

NO.	DESCRIPTION	UNIT	REQUIRED	PROPOSED AND GUARANTEE
30	Environment - Operating Temperature. - Humidity Others	-	10 - 50°C 0.9	
31	Mounting Current probe and R Shunt Software (For Operation and Maintenance)	-	\$ 19 Rack Mountable or moveable High Class Accuracy Original CD software of DFR & PQ (For Operational and Maintenance (Calibrating)).	
			- Minimum 3 years free upgrade firmware - Enable For Window XP. Coexist with another software (no crash/conflict)	
			- Have ability to remote download, include automatic download, remote setting - Have help function. - Have ability to Analyze Fault.	
			- Have ability to Analyze Power Quality. Have ability to analyze distance to fault - Have ability to save file in comtrade available (Automatic send by email / sms)	
	Tools for automatic Record Analysis		Enable	
32	Printer		Original Manual Book (hard and soft copy)	
33	Manual Book Guarantee		Min 3 years free of charge (maintenance) Min 5 years (supply of spareparts)	
34	Password		Device & User Interface Password (min 2 Levels of User)	

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Name of Bidder : _____
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Name of Manufacture : _____
Signed of Manufacture : _____

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TSS.20 : CIVIL WORKS

BUILDINGS AND RELATED STRUCTURES

1. GENERAL REQUIREMENTS

1.1 Scope of Works

The works shall consist of the Civil and Structure Works for the construction of Substations as mentioned at Bidding Document Book B IV.1 : GENERAL PARTICULARS OF CONTRACT – Clause 3, consist of but not limited to site clearance, demolition and dismantling, earthworks and excavation, drainage, road works, fencing, concrete works, pilings, mortar, cable ducts and trenches, structural steel work, masonry work, floor construction and finishes, building finishings, joinery, water supply, painting and glazing, electrical work, fire protection, air conditioning and ventilating service.

This Specification is intended for general use on the construction of substation. The Contractor should therefore refer to the Section or Sub-sections of this Specification relative to the work contained in the substation.

1.2 Documents Complementary

The Conditions of Contract and the Drawings shall be read in conjunction with this Specification and matters referred to in any of these documents are not necessarily repeated in any other.

1.3 Definition

The words "approved", "approval", "specified", "condemned" and the like used in this specification shall mean approved, approval, specified, condemned or the like by the Owner.

The word "Owner" used in this specification shall also mean the "Owner's representative" in respect of the duties stated in the condition of contract.

1.4 Measurement for Payment

The unit of measurement shall be metric on the international system of unit (S.I.) and the works will be paid for at the appropriate rates given in the price schedule. The contractor should make the breakdown of the unit price for each of the item of the works.

1.5 Material and Workmanship

1.5.1 Standards.

Indonesian Standards and/or Codes of Practice have been used as reference throughout this specification. Other National Standard in common use in Indonesia for

particular section of a work shall normally be acceptable but should be approved by the Owner.

1.5.2 Materials

All material used in the works shall be new and of best quality of their respective kinds. They shall comply with the requirements of the latest edition of the relevant Standard and or Code of Practice refer to in Subsection 1.5.1. above.

1.5.3 Workmanship

All workmanship shall be of the highest standard and shall be executed by component men skilled in their respective trades.

1.5.4 Samples

In addition to the special provisions made in this Specification for sampling and testing of materials by particular methods, samples of any material and workmanship proposed to be used in the Works may be called for at any time during the Contract by the Owner and shall be furnished by the Contractor without delay and at the expense of the Contractor. Samples when approved, shall be regarded as the acceptable standard, any material or workmanship subsequently not complying with standard shall be rejected and replaced by those of acceptable standard at the expense of the Contractor. Sample storage boxes shall be provided by the Contractor free of cost if requested by the Owner.

1.5.5 Tests

- (a) Whenever considered desirable by the Owner, Inspectors may be sent to manufacturer's or sub-contractor's premises to test materials or supervise their manufacture.
- (b) Where specified or requested the Contractor shall obtain from the manufacturer and send to the Owner certificates of test, proof sheets, mill sheets, etc., showing that materials have been tested in accordance with this Specification.
- (c) Not notwithstanding any tests which may be directed to be carried out at manufacturer's and/or sub-contractor's works, the Owner may carry out any tests or further tests he considers necessary or desirable after delivery of materials to the site.

1.6 Site Condition

1.6.1 Access to Site

Unless otherwise directed, the access to site from public roadways shall be by existing site access roads where these exist and elsewhere along the routes of access roads to be constructed under this Contract. The site shall not be entered until the written permission of the Owner has been given. The Contractor shall make his own arrangements for providing and maintaining any temporary access he may require.

1.6.2 Prevention of Damage

The Contractor shall take all necessary and reasonable precaution during the period of the Works to prevent damage to land, walls, fences channels roads, buildings, services and the like on or adjacent to the Site and site access. When such items are to be removed or modified under the Contract the method of removal or modification shall be agreed.

1.6.3 Safety Precautions

Wherever works are to be constructed in the vicinity of any existing electrical substation, overhead power line, power cable or any other electrical equipment, the Contractor shall be responsible for ascertaining from the Authority responsible for the equipment the precautions and safety measures to be observed, any for strictly complying with these precautions and safety measures.

1.6.4 Cleanliness of Site

The Contractor shall at all times maintain the site in a clean condition, and all rubbish, debris and the like shall be collected as it accumulates and be disposed of by burning or other suitable means. All trades shall maintain their plant, materials, stores and equipment in an efficient and workmanlike manner at all times.

1.7 Contractor's Area

1.7.1 Offices, Stores etc.

The area or areas to be used by the Contractor for erection of offices, stores, messing accommodation shall be agreed with the Owner.

1.7.2 Lavatory Accommodation

The Contractor shall be responsible for providing suitable and adequate lavatory accommodation for his site staff, in a position agreed with the Owner, and shall meet all statutory requirements of the States and Local Authorities.

1.7.3 Health

The Contractor shall take such health measures as may be required by the statutory provisions of the State and Local Health Authorities.

1.8 Accommodation for the Owner

The Contractor shall provide at site for the exclusive use of the Owner and his staff, suitable office (24 m^2) and lavatory accommodation including a sufficient supply of clean and sterile drinking water.

The accommodation shall be kept clean, maintained in good condition by the Contractor, and shall meet all statutory requirements of the State and Local Authorities.

1.9 Water, Electricity and Other Power

The Contractor shall be responsible for supplying all water, electricity and other power required for the works and for any other purpose in connection with the works.

He should give notice and pay all fees as required by the respective water, electricity and other authorities concerned with such supplies and services.

1.10 Program

1.10.1 Outline and Detailed Programs

The Contractor shall construct the works in compliance with the outline program and shall submit for approval a detailed program in accordance with the Conditions of Contract.

1.10.2 Labor, Plant and Materials

The Contractor shall provide on the site, and elsewhere as required, sufficient labor, plant, materials and all other things necessary to construct the works in accordance with the agreed program.

1.10.3 Inclement Weather

No payment will be made to the Contractor in respect of loss of output of plant or labor due to inclement weather.

1.11 Setting Out

1.11.1 Dimension and Levels

All dimension and level shown on the drawings shall be verified on site by the Contractor.

1.11.2 Datum

A datum to which all levels are to be related will be defined or established at a convenient point by the Owner. The Contractor shall then establish a minimum of four temporary bench marks, approximately equally spaced round the site, which shall be related to the datum. Each temporary bench mark shall be securely set in concrete, and shall be protected from damage or disturbance.

1.11.3 Surveying Instruments

The Contractor shall keep on site such surveying instruments as are necessary for the complete and accurate setting out and construction of the works. These instruments shall be modern, shall be maintained in excellent condition, and shall be accurate in all respects. They shall be kept available for use by the Owner if so required, and their accuracy and adjustment shall be regularly checked in an approved manner.

1.11.4 Setting Out Lines

The Owner will establish two lines mutually at right angles from which the Contractor shall set out the works. Each of these main lines shall be defined by not less than four steel pins set in concrete at points indicated by the Owner. The Contractor shall supply all necessary labour and materials for this purpose.

1.12 Record Survey

After the clearance of bush and other vegetation and before any earthworks or demolitions are commenced, the Contractor shall make a record survey of the site in conjunction with and in a manner approved by the Owner.

1.13 Soil Investigation

1.13.1 Scope of Work

The contractor shall perform the soil investigation work for the project, the minimum of the scope of work for this soil investigation are as follow :

- a. Core drilling at minimum 2 points mainly in the, switchyard, and transformer area, each drilling to a depth of 20 meters where substation area located in the swampy or shore area the depth of the core drilling will be adjusted by Owner.
- b. SPT Shall be carried out for sample per drilling starting at a depth of 2 meter with steps at 2 meter.
- c. Dutch Cone Penetration Test shall apply at 2 points and located in building, switchyard and transformer area.
- d. Testing for clean water shall be carried out in the substation area.

The test procedure to be carried out shall be in accordance to ASTM Standard.

Laboratory work include:

- Soil investigation test shall be made on all 10 samples
- Water chemical analysis 2 samples

The report of soil investigation shall be made and included the recommendation for foundation type, minimum report 5 (five) set.

1.13.2 Field Work

1. Core drilling.

The kind of performed drilling during investigation is core drilling and to be done in accordance to ASTM D 2113. Core drilling comprises continues core sampling by single tube barrel, taking undisturbed and disturbed sample and standard penetration test.

The final core diameter should not be less than 54 mm. The use of double tube core barrels for core 76 mm is required. Core box shall be made of good and durable material such a hamper or equal.

The box must show of the following indications:

- Project name, job site, number of bore hole, date of finishing the bore hole, depth interval, etc.

Water level in each hole shall be recorded daily during the days of drilling that hole.

Observation of ground water level shall be made every morning before starting the days drilling work. The water level shall be recorded in term of depth from the top of the bore hole.

This measurement shall be continued for each bore hole during the period when the hole is being drilled.

The contractor shall describe lithologi of soil/rock condition, such as :

1. Name of soil / rock (clay, silt, sand, etc)
2. Strength (strong, weak, stiff, etc)
2. Standard Penetration Test (SPT)

The test shall be made in according to ASTM designation D 1586.

With the sample resting on the bottom of the hole, drive the sample with blows of 140 pound hammer falling 75 cm until either 45 cm have been penetrated. The number of blows required to penetrate each 15 cm depth shall be recorded.

3. Dutch Cone Penetration Test (DCPT)

The Dutch Cone Penetration test to be performed in accordance to ASTM D 3441.

Observation to be taken every 20 cm penetration and the aim of test is to get the cone resistance (qc) , local friction (fc) and total friction (tf).

The reading indicated of cone resistance (qc) and local friction (fc) shall be carried out until the total reading indicated as the maximum capacity of the equipment/qc =200 kg/cm².

1.13.3 Laboratory Work

Soil laboratory testing for soil classification test (index and properties) from soil samples comprised as follows:

- a. Sieve analysis mechanical grain size and hydrometer (ASTM D.422).
- b. Moisture content (ASTM D.2216)
- c. Specific Gravity (ASTM D.854)
- d. Unconfined compression strength test (ASTM D.2166)
- e. Consolidation Test (ASTM D.2435)
- f. Triaxial Compression Test (ASTM D 2850).
- g. Liquid, Plastic limit & plasticity Index (ASTM D 423 & ASTM D 424)

1.14 Topographical Survey

A topographical survey at scale 1 : 200 shall be performed by the contractor and shall be submitted to the Owner for approval before starting of design and works on site.

This topographical survey shall be defined the actual level and the designated 0.00 level. The network of point will be sufficiently clear to determine exactly the moving of earth for backfill or earthwork.

The contractor shall have to provide and maintain the monument for the Bench Mark (Reference Point) during construction.

2. SITE CLEARANCE, DEMOLITION AND DISMANTLING

2.1 Scope

Site clearance and demolition consists of the removal and disposal of trees, bushes

and other obstructions on site and backfilling with approved materials any existing or resulting pits, trenches and the like.

2.2 General

The Contractor is requested, before submitting his Tender, to visit the site for the purposes of inspecting and examining the extent and nature of the various items of work which are included in this section.

2.3 Construction

2.3.1 Clearing and Grubbing

Clearing and Grubbing shall consists of clearing all trees, brush other vegetation and rubbish over the site area generally as directed by the Owner. It shall include grubbing stumps and roots and disposing of all resulting spoil material either by burning or removing to a tip provided by the Contractor. Where the Owner direct that any items are to remain undisturbed, the Contractor shall take all necessary precautions to prevent damage to them.

2.3.2 Demolition of Structures

Buildings or other structures to be removed shall be demolished by methods approved by the Owner and all builders rubbish resulting there from shall be removed to a tip provided by the Contractor or otherwise disposed of as directed by the Owner.

All necessary precautions shall be taken to ensure that no damage is caused to any structures which are to remain.

Care shall be taken to salvage as much material as possible this remaining the property of the Employer. It must be stored on site for re-use when appropriate. Material unsuitable for further use, such as debris, waste and rubbish shall be removed directly to the tip provided by the Contractor and with the consent of the Owner.

2.3.3 Site Leveling

Where the existing ground surface is under or above the finished level which indicated on the drawing and directed on site, so site leveling shall be carried out.

The work means over ground surface shall be excavated and shall be spread on the another part below, up to properly level.

If insufficient over ground surface is available on site for subsequent soil spreading, suitable material shall be imported by the contractor and brought to site. It shall be free of stone, lump of clay or others, which prevent the growth is issued by the Owner.

The work shall include hauling, dumping, spreading and compacting.

Spreading and compacting shall be carried out every 20 cm thickness of compacted layer.

2.3.4 Use of Explosives

Explosives shall not be brought on the site or used without the prior written approval of the Owner. Such approval shall not relieve the Contractor of his responsibility to comply

with the relevant Statutory Regulations on the storage and use of explosives.

The Contractor shall be wholly responsible for the proper and secure storage of explosive and such storage places shall be accessible only to authorized personnel. The handling and use of explosives shall be entrusted only to men experienced in their use and shall in all respects be to the satisfaction of the Owner.

Contractor shall be wholly responsible for any loss or damage to persons or property which may occur through the use of explosives.

When the need for explosives has passed, they shall be removed from the site without delay.

The Owner may prohibit the use of explosives during excavation or demolition work if, in his opinion, such use constitutes a danger to persons or adjacent structures or the work is being carried out in a reckless manner.

2.3.5 Filling of Wells and Existing Excavations

Any wells or other existing excavations on the Site shall be completely filled with approved material in layers not exceeding twenty (20) cm, well rammed and compacted or by puddling with water. When these wells or excavations occur under, or within, three meters of new load bearing construction one they shall be filled with cement stabilized soil consisting of one (1) part cement and fifteen (15) parts sieved soil, thoroughly mixed and with a minimum quantity of water added to make a workable mix.

2.3.6 Dismantling

For the uprating switchgear work, the Contractor shall dismantle the steel work (including gantries, Conductor, Fitting, Insulator and Accessories) and stored in the PLN's storage.

The Contractor should sort and packed it based on type of gantries and completed with handed over certificate.

Also for the materials/goods i.e. conductor, fitting, insulator and accessories.

All the cost caused by activity above had to be included in the Bill of Quantity.

2.4 Measurement For Payment

2.4.1 Clearing and Grubbing

Measure clearing and grubbing to the nearest square meter.

2.4.2 Site Leveling

Measurement for payment of Site Leveling specified herein shall be base on a survey made prior to any excavation phase and the lines and grades.

Payment will be made on the number of cubic meters of excavated materials and filling in accordance with the approval in situ measurement.

Unit prices for the site leveling shall include but not limited to the cost of all labor, equipment and materials, temporary sporting loading unloading and disposal of excavated materials, hauling of previously excavated material from the stockpile of borrow area, compacting the fill and all testing in accordance with the specification.

2.4.3 Filling of wells and existing excavation

Measurement for payment for filling of wells and existing excavation will be made on the number of cubic meter of fill.

The unit price of fill shall include excavation and hauling of previously excavated material from the stockpile or borrow area, compacted the fill, and all testing in accordance in specification. Payment for fill will be paid at the contract unit price per cubic meter.

3. EARTHWORKS AND EXCAVATION

3.1 Scope

This section covers all the necessary work for the excavating, importing, transporting, placing and disposal of earth, rock or other such material as required by the drawings for the proper execution of the Works.

3.2 General

3.2.1 Character of Ground

The Contractor is requested, before submitting his Bid, to visit the site and satisfy himself as to the ground conditions on the site, the nature of the strata to be excavated, obstructions which may be encountered within the limits of the excavation, the possibility of flooding and the like, and he shall use excavation techniques and equipment best suited to the site conditions.

No claims for a revision of rates because of site conditions will be considered subsequent to the award of the Contract.

3.2.2 Removal of Water

The rates for all classes of excavation shall include for the cost of control or removal of water during or after excavation. The Contractor shall provide all facilities and take whatever action is necessary, whether by pumping, well pointing or other approved means, to keep the excavation clear of water at all times for the execution and protection of the work.

3.2.3 Earthworks and Excavation Generally

Unless otherwise stated in the Contract, the rates for earthworks and excavation shall be held to include for excavation in any material except rock.

3.2.4 Rock Excavation

The term "rock" shall mean a material which in the opinion of the Owner cannot be excavated except by means of explosive or compressed air drilling equipment. Boulders over one quarter (1.25) cubic meter in volume will be classed as rock and those of lesser volume as normal excavation.

The use of explosive for rock excavation shall comply with the requirements of Sub-section 2.3.4. of this Specification.

3.3 Construction

3.3.1 Topsoil

(a) Removal

The first earthworks operation shall be the removal of topsoil to a depth of twenty (20) cm or other such depth of the top layer of soil as agreed with the Owner over the area of the site designated by the Owner. The topsoil shall be kept separate from other material and stock-piled for re-use on slopes and beams or elsewhere on the site or site access as indicated on the drawings or as directed by the Owner.

(b) Spreading

Where indicated on the drawings or directed on site, topsoil shall be spread on a properly leveled or graded surface to thickness of not less than twenty (20) cm and raked smooth. Variation from level or gradient of the raked surface shall not exceed three (3) cm in any length of three (3) meters.

If insufficient topsoil is available on site for subsequent soil spreading, suitable material shall be found by the Contractor and brought to site. It shall be free of stones. Lumps of clays or other matter which would prevent the growth is issued by the Owner.

3.3.2 Excavation to Reduce Level (Bulk Excavation)

Excavation over site to reduce levels shall be carried out to the lines and levels shown on the drawings. Any excavation beyond or below these lines and levels shall be made good by the Contractor at his own expense and to the satisfaction of the Owner. Slopes shall be formed and trimmed to the lines and gradients shown on the drawings.

3.3.3 Use and Disposal of Excavated Material

All suitable excavated material approved by the Owner shall be used for bulk filling.

Any material surplus to these requirement or adjudged by the Owner to be unsuitable shall be removed from site to a tip provided by the Contractor or spread and leveled in thin layers not exceeding twenty (20) cm over general areas of the site within the site boundary as directed by the Owner. The Contractor shall not delay in disposing of surplus material after receipt of instructions from the Owner.

3.3.4 Bulk Filling

(a) Materials

The material for filling shall be approved material obtained from excavations on the site, but if this should prove insufficient, the deficiency shall be made good with imported material as specified below.

No material containing organic soil, vegetable or other unsuitable matter shall be used.

Imported filling material shall consist of naturally occurring material free from mud, silt, vegetable or other soft or injurious matter. The Contractor shall inform the Owner of the source of borrow pit from which he proposes to obtain the material and no material shall be brought to site until the source has been approved.

(b) Placing and Compacting

Bulk filling shall be placed to the lines and level **shown on the drawings**. The filling shall be placed in layers not exceeding twenty (20) cm in depth and the surface of each layer shall be given a slight fall to assist drainage.

Each layer shall be compacted at optimum moisture content by eight (8) tonne self propelled type with smooth drum roller, or equivalent vibrating roller, or other approved means, until the following degrees of compaction have been achieved.

(1). Non-cohesive soils : Until no further settlement occurs

(2). Cohesive soils : Until dry density is nowhere less than 95% of modified factor.

Subsequent layers shall not be placed and compacted until the previous layer has been compacted as specified and accepted by the Owner. Filling material that does not contain sufficient moisture to achieve the required degree of compaction shall be sprayed with water from approved sprinklers until compaction can proceed at optimum moisture content.

Material with a higher moisture content than necessary shall not be used in the works until it has dried out sufficient to achieve the degree of compaction specified.

Slopes shall be formed and trimmed to the lines and gradients shown on the drawings and shall be thoroughly compacted with smooth uniform surfaces. Variation from specified gradient shall not exceed three (3) cm in any length of three (3) meters.

3.3.5 Excavation in Pit and Trench for Foundations, Drainage, etc.

(a) Excavation

Excavation shall be taken out to the minimum sizes necessary for the proper construction of the works, and excavation shall not be kept open for periods longer than that reasonably required to construct the works.

The Contractor shall take all precaution necessary to ensure that the bottoms of excavation are protected from deterioration and that the excavation are carried out in such a manner that adjacent foundations, pipes or such like are not undermined, damaged or weakened in any way. Any excavation taken out below the proper level without approval shall be made good at the expense of the Contractor using concrete or other material as directed.

(b) Support of Excavations

The Contractor shall be responsible for the stability of the sides of the excavations, and shall provide and install all timbering and shoring necessary to ensure stability.

If any slips occur, they shall, as soon as practicable, be made good in an approved manner at the expense of the contractor. Shoring shall not be removed until the possibility on damaging the works by earth pressure has passed.

(c) Inspection and Trimming

The bottoms of all excavations shall be properly trimmed and leveled, inspected and approved by the Owner before placing the blinding concrete layer of foundation concrete.

(d) Backfilling

As soon as possible after the permanent works are sufficient hard and have been inspected and approved, backfill shall be placed where necessary and thoroughly compacted layers not exceeding twenty (20) cm in depth.

(e) Use and Disposal of Excavated Material

All suitable excavated material shall be used for filling or backfilling or otherwise disposed of as specified in Clause 3.3.3.

3.3.6 Slope Stability and Bench Cut

Where part of the finishing level is lower than the existing ground surface of surrounding area, contractor shall perform slope excavation and shall form slope stability.

If the high of cut slope more than 1,5 meter, bench cut shall be performed.

On the cut slope shall be performed sod facing and the sodded face shall be tamped with the suitable tool to form a smooth surface.

The contractor shall be responsible for all completed sodding for a period of 30 days and shall spray water on the sod whenever necessary to ensure rooting.

3.4 Protection of Underground Existing Construction

The Contractor shall locate, protect , shore, brace, support and maintain all existing underground pipes, conduits, drains and other underground construction which may be uncovered or otherwise be affected by the work.

3.5 Site Finishing

3.5.1 Weed killer

Weed killer of an approved type suitable for local conditions shall be spread over areas to be covered by site surfacing before such surfacing is laid. The weed killer shall be of type which does not cause corrosion of metals and shall be used strictly in accordance with the manufacturer's instructions.

3.5.2 Site surfacing

Site surfacing shall consist of clean, hard, natural, gravel or crushed stone all to pass a thirty (30) millimeters sieves but all retained on a ten (10) millimeters sieves. It shall be spread after installation or service and cables earth strip, electrical equipment and such like.

The surfacing shall be spread where indicated on the drawings on a properly leveled or graded surface, free from weeds, to a compacted thickness of fifteen (15) cm and lightly rolled.

3.6 Measurement for Payment

3.6.1 Excavation

Measurement for payment of excavation specified herein made in cubic meters and shall be based on survey made prior to any excavation phase and the lines and the grades shown on the approved drawings or established on the sites by the Owner. Unit prices for the excavation shall include the cost of all labor, equipment and materials, temporary supporting diversion ditches and drainage structures, loading unloading and

disposal of excavated materials.

3.6.2 Fill work

Measurement for payment for filling and backfilling will be made on the number of cubic meter of fill.

The rates for filling or backfilling, consolidation and trimming shall include for setting aside temporary excavated material on site, for complying with specification and for trimming surface to specified level, slope and profile.

The unit price for fill shall include excavation and hauling of previously excavated materials from the stockpile area and compacting the fill in accordance with the Specification.

3.6.3 Dewatering

All cost for the design, furnishing and maintenance of the dewatering system will be paid at the lump sum price on an agreed upon schedule of payment. The lump sum price shall include excavation for sumps, pumps, any over excavation required for the installation of the dewatering system and the discharge piping.

4. DRAINAGE

4.1 Scope

The work covered by this section of the Specification consist of:

- (a) Water drainage system for the drainage of the Switchyard area generally, roads and paved areas, cables trough and roofs of buildings.
- (b) Sub drainage system for the connection and discharge of water closets (W.C.'s) wash basins, shower, sinks, urinals and other similar appliances.

4.2 General

4.2.1 Water Drainage System

- (a) The water drainage system shall consist of pipes under drains backfilled with brooked stone or gravel (French drains) manholes and catch pits, rodding eyes and lined or unlined drainage ditches and channels.
- (b) The outfalls of the system shall discharge into existing watercourses or to constructed soakaways as shown on the drawings or otherwise as directed by the Owner.

4.2.2 Sub Drainage System

- (a) The sub drainage system shall consist of a system of pipes, manholes and inspection chambers and shall discharge into a septic tank unless otherwise shown on the drawings.
- (b) If a septic tank is required by the drawings the effluent shall discharge to a filter bed or soakaway.

4.3 Materials

4.3.1 Pipes for Water Drainage

(a) Concrete Pipes and Fittings

These shall be obtained from an approved local manufacturer and shall be subject to tests and inspection by the Owner.

(b) Porous and Perforated Concrete Pipes

These shall be of approved local manufacture and shall be tested and inspected by the Owner.

(c) PVC Pipes and Fitting

These shall be obtained from an approved local manufacturer and shall be tested and inspected by the Owner.

4.3.2 Stone or Gravel Backfilling on the Switchyard Area

The backfilling to French drains shall be clean, free from lumps of clay or other objectionable matter and be graded with the limit twenty (20) cm minimum.

4.3.3 Pipes for Sub Drainage System

The pipes shall used AW 6" P.V.C. (Japan Industrial Standard).

4.3.4 Bends, Gullies and Fittings

All bends, gullies and fittings used in the drainage systems shall be of the same materials and of equally high quality as the adjacent pipe work.

4.3.5 Materials in Manholes, Catch pits, Septic Tank etc.

(a) Concrete, Formwork and Reinforcement

As described on the drawings and in accordance with the relevant sub-section of concrete work.

(b) Walls

Walls shall be built in concrete or common brick and rendered, both faces with Grade "A" mortar to which an approved waterproofing agent has been added.

(c) Covers

Covers shall be of precast concrete with mild steel angle iron framing. The top surface of the covers shall have a class "B1" finish.

(d) Step Iron and Lifting Irons

These shall be fabricated from mild steel and shall be galvanized or coated with best quality bitumastic composition.

Step irons shall be provided where the depth of chamber exceeds one (1) meter.

4.4 Construction

4.4.1 General

(a) **Regulations**

The regulation and recommendation of any relevant drainage or sanitary authority shall be fully observed and the Contractor shall be responsible for acquainting himself with any such regulations.

(b) **Existing and Temporary Drainage during Construction**

The Contractor shall maintain at his own cost all existing drainage channels in good order during the period of the works, and also cut any additional temporary channels which may be necessary to prevent flooding of the site until the permanent drains have been laid.

4.4.2 Excavation and Backfill to Pipe Drains

(a) **Excavation**

Excavation shall be carried out in accordance with Clause 3.3.5. of this Specification. Trench excavation for drains shall be carried out with the minimum disturbance to adjacent ground and in such a way that existing or new work shall not be undermined.

Where trenches are to be filled with hardcore gravel or the like, or where open channels are to be constructed, excavated material shall be removed immediately after excavation.

(b) **Backfill**

No Backfill shall be placed until pipes, etc. have been inspected, tested and approved. Backfill shall be carefully placed by hand tools round pipes, etc. and rammed in layers not exceeding ten (10) cm thick in a manner which will not cause damage.

When a minimum thickness of thirty (30) cm above the pipes has been so placed, normal methods of backfilling and ramming may be adopted.

4.4.3 Laying and Jointing of Pipes (Generally)

(a) **Laying**

Pipes and fitting shall be of the types qualities and sizes specified and shown on the drawings. They shall be laid to the lines and level shown, and the barrel of each pipe shall bear firmly and uniformly on the trench bottom or prepared foundation bed, any projection in the trench bottom which could cause damage to pipes being first removed. Pipes shall be kept clean during and after laying, and open ends shall be provided with temporary plugs to prevent entry of foreign matter.

Each pipe shall be accurately boned to gradient between sight rails and drain laying shall commence at the lowest end and proceed uphill. Pipes shall be laid with the sockets leading uphill.

(b) **Jointing Generally**

The jointing of pipes shall be carried out as specified below. The pipes to be jointed shall be accurately centered and butted together, and joints shall be made only by the particular type of joint. Joints shall generally be of a flexible type.

(c) **Flexible and Proprietary Joints**

The joints in concrete, asbestos cement and unplasticised P.V.C. pipes designed

for flexible jointing shall be made in accordance with the manufacturer's instructions and relevant British Standard. Unless otherwise directed or agreed, the joints in concrete and asbestos cement pipes shall be of the compressed rubber ring type, and when loose collars are used, these shall be accurately located over the center of the joints.

(d) Rigid Jointing of Spigot and Socket Pipes

Concrete and asbestos cement spigot and socket pipes for rigid jointing shall be used only where specified or directed. They shall be jointed by inserting and caulking one complete ring of tarred gaskin which shall center the pipes and prevent mortar from entering the pipes. The joint shall be complete by filling with Grade "A" mortar. The mortar shall be well rammed into the joint and finished with 45° level. Joint shall be undisturbed and kept covered with wet sacking for seven days.

(e) Porous Concrete Pipe Joints

Joint in porous pipes shall be made by butting the pipes tightly together so that no soil or the like can enter the pipes. If, due to minor changes of line or gradient, a joint cannot be completely closed, it shall be wrapped with bituminous felt and surrounded with weak concereted.

4.4.4 Concrete Surround and Haunching to Pipes

Concrete surrounds, bedding and haunching to pipes shall be at the locations and to the dimensions shown on the drawings. Concrete Grade 15/40 (k-150) as specified under section 7 of this specification shall be used.

4.4.5 Pipes under Buildings

Unplasticized or Rigid P.V.C. soil pipes and fittings shall be used under buildings, laid and bedded on concrete and jointed in accordance with the manufacturer's instructions and surrounded with concrete after testing as specified below. The concrete bed to pipes shall not be less than ten (10) cm thick, and finished smooth and true to line and levels with pockets at all positions for pipe sockets to facilitate bedding of the barrel of the pipes throughout.

4.4.6 Drainage Ditches

(a) Unlined Ditches

These shall be constructed as shown on the drawings and the Contracted shall be responsible for their maintenance through the works and to the completion of the maintenance period.

(b) Lined Ditches

Lined ditches shall be provided where shown on the drawings or as directed by the Owner.

The lining shall consist of stone pitching to the lines, gradients and dimension indicated on the drawings bedded in Grade "A" mortar. The stone shall be clean, hard and durable with a thickness of not less than twenty five (25) cm and with length and widths of approximately one and a half (1 1/2) times the thickness. It shall be of good shape and free of projections and depressions to ensure proper

bedding and uniform slopes and the finished ditch should not vary from true line by more than fifty (50) millimeters.

4.4.7 Lined Drainage Channel

Lined channels shall be of concrete Grade 175/20 or solid block work if approved by the Owner and shall be constructed to the dimensions, lines, gradients and levels shown on the drawings. Weep holes thirty (30) millimeters diameter shall be positioned at half the internal depth of the channels or as otherwise shown on the drawings, and at intervals of one (1) meter along both sides of the channels. Expansion joints of two (2) cm wide and filled with an approved resilient filler, shall be proved at interval of not more than twenty (20) meters.

4.4.8 Manholes, Catch pits, Septic Tank etc.

Excavation to manholes, catch pits and the like shall be in accordance with Clause 4.4.2. above.

Detail and sizes of bases, benching, covers and manholes generally shall be obtained from typical manhole details shown on the drawings. Unless otherwise directed manhole walls shall be built with common bricks and rendered on both faces with Grade "A" mortar to which an approved waterproofing agent has been added. All joints in brickwork shall be well filled with mortar.

Manholes deeper than one (1) meter shall be provided with step irons. Precast concrete relieving blocks manufactured with Grade 225/20 concrete shall be provided and set in the brickwork walls over each pipe.

4.5 Testing

All drains, other than open channel, stone filled and porous drains, shall be of watertight construction and all soil drains shall be subjected to a water test before backfilling of trenches is commenced. Drains may be tested in section and manholes may be tested separately. The Contractor shall submit to the Owner for approval his proposals for testing. The drains shall withstand, without leakage, a water pressure of not less than one and half (1.5) meters at any point for a period of twenty (20) minutes or such other time as the Owner may direct. All necessary plugs, temporary connections and other equipment and all labor required for the tests shall be provided by the Contractor.

For testing of pieces in areas where an adequate supply of water is not readily available, the Owner will accept an air (smoke) test. Further testing may be called for after backfilling of trenches to ensure that pipes have not been damaged during that operation.

4.6 Measurement for Payment

4.6.1 Excavation

Excavation is measured by the cubic meter of material excavated.

4.6.2 Embankment, backfill

Embankment and backfill is measured by the cubic meter of material hauled, placed and compacted.

4.6.3 Pipes / Concrete drainage

Pipes / concrete drainages are measured by linear meter of pipes / concrete drainage.

4.6.4 Manholes, Catch pits and Septic tank

Manholes, catch pits and septic tank will be paid on lump sum price. The contractor shall make the breakdown of this works.

5. ROAD WORKS

5.1 Scope

This section of the Specification consists of the requirements for the construction of the different categories of roads and vehicle standings which provide access to and maintenance of the substation areas. The various stages of road construction are included, together with concrete kerbing (precast and cast in situ) and cable ducts laid under roads.

5.2 References

American standards in common used in Indonesia for road construction bituminous binders, Macadam and the live will be acceptable alternatives unless otherwise directed.

5.3 General

5.3.1 Services to be completed and protected

Culverts, pipe drains, ducks and other services shall be completed under and alongside roads, paths and hard standings to the approval of the Owner before road works are started.

The contractor shall take all necessary precautions to prevent damage to completed or partially completed services until the road, paths or hard standings have been completed. The precautions shall be adequate to allow passage of plan of vehicles of other contractors having legitimate access to the site.

Ditches, drainage channels, outfalls and the live shall be in a suitable working conditions to ensure effective drainage of service water to avoid damage to the road foundation.

5.3.2 Approval of Road Construction

Each state of road construction shall be inspected; any defects rectified, and the state approved by the Owner before the next state is commenced.

5.4 Earthworks

Earthworks shall be carried out in accordance with section 3. of this Specification, but the surface shall be formed seventy-five (75) mm higher than the levels shown on the drawings. These seventy-five (75) mm shall be removed when the subgrade preparation and laying of the sub-base is about to commence.

5.5 Subgrade

5.5.1 Description

The subgrade is the part of the road on which the sub-base is laid, or if a sub-base is not specified for a particular road categories, than the part on which the base is laid. It shall extend the full width of the road, and include hard shoulders and the like where these are shown on the drawings.

5.5.2 Preparation of subgrade

When road works are about to commence the earthworks shall be graded to the lines and levels shown on the drawings, and any soft or weak areas shall be dug out and replace by approved material. The subgrade shall than be compacted by ten (10) tons self propelled type with smooth drum roller and the moisture content of the soil shall be controlled to give the specified compaction.

5.5.3 Degree of Compaction

Rolling of the subgrade shall continue until the dry density of the top thirty (30) cm is nowhere less than 95 percent of the dry density at optimum moisture content obtained by application of the American Standard compaction test. Any irregularities which may develop in level during compaction shall be corrected by adding or removing material as required and re-compacting. The top level of subgrade shall have a CBR value of six (6) percent, after compaction.

5.5.4 Protection of Subgrade

The Contractor shall take adequate precautions to ensure the protection of the subgrade from weather effects or from damage due to negligence. Areas of the subgrade which in the opinion of the Owner, require repair due to the Contractors failure to take such precaution shall be made good to the Owner satisfaction at the Contractors expense.

5.6 Sub-Base Coarse

5.6.1 Description

The sub-base is that portion of the road which lies between the sub-grade and the underside of the base.
It shall extend the full width of the road and include hard shoulders unless otherwise shown on the drawings.

5.6.2 Material

(a) Testing and Approval

Before commencement of sub-base construction the Contractor shall provided the Owner with full particular of the origin and composition of the material he proposes to use in the sub-base course.

Representative samples shall be taken by the contractor in the presence of the Owner and sent to an approved testing laboratory to ascertain the properties of the material as directed and required by the Owner. Taking of samples and testing at an approved laboratory shall be carried out at the contractors expense.

Test certificates shall be submitted for the Owner approval prior to starting quarry or borrow excavations.

(b) Type of material

Type of material shall be well graded consisting of crushed stone or crushed or natural gravel graded from seventy five (75) to (5) millimeters down with sufficient fine material to bind readily to produce a dense, firm and stable sub-base. It shall be previous, free from mud, dirt, organic matter, shale or other deleterious matter, with not more with not more than fifteen (15) percent by weight passing the no. 200 sieve and fulfilling the following requirements :

- liquid limit	0 - 25 %
- plasticity index	0 - 6 %

(c) Degree of Compaction

The final level of sub-base coarse shall have a CBR value of not less than twenty five (25) percent

5.6.3 Construction

(a) Spreading and compacting

The sub-base shall be constructed to the final thickness shown on the drawings or as directed otherwise by the Owner, but shall not be less than fifteen (15) cm when fully compacted.

The material shall be laid by box spreader or other approved means in layers not exceeding twenty (20) cm in thickness and compacted by ten (10) tons self propelled type with smooth drum roller or other approved compaction equipment, working parallel to the center line of the road.

In areas not accessible to power rollers the material shall be compacted with approved tempers or compactors.

Rolling shall continue until all the surface has been compacted and no further consolidation takes place or the maximum dry density is nowhere less than ninety five (95) percent as determine in accordance with the American Standard compaction test. Should any irregularities or depressions developed in the sub-base during compaction, these areas shall be rectified by loosening the sub-base material and adding or removing material as the case may be until the surface after compaction is smooth and uniform.

(b) Surface of sub-base

The sub-base shall be finished to the lines and levels shown on the drawings or as otherwise direct, and the finished surface shall not show any departure from true surface greater than twelve and a half (12.5) millimeters in any directions when checking with a straight edge or chamber board three (3) meters long.

5.7 Base Course

5.7.1 Description

The road base lies between the top of the sub base and the underside of the bituminous surface course.

5.7.2 Materials

(a) Testing and Approval

Before commencement of base construction the Contractor shall provide the Owner with full particulars of the origin and composition of the material he proposes to use. Representative samples shall be taken at the quarry site in the presence of the Owner and sent to an approved testing laboratory to determine the properties of the material as directed and require by the Owner. Taking of samples and testing at an approved laboratory shall be carried out at the Contractors expense. Test certificates shall be submitted for the Owner's approval prior to removal or delivery of material from the quarry.

(b) Crushed Stone

Crushed Stone aggregate shall be clean, hard durable, sharp angled fragments of stone with a minimum of elongated partials and free from dirt, soft or decomposing rock fragment or other deleterious matter.

(c) Fine (or blending) material

This material shall be used in conjunction with crushed stone aggregate. It shall be dry crushed rock well graded from five (5) millimeters to dust, preferably non-plastic but in no case should the Plasticity index of the finest exceed six (6) per cent.

(d) All - in aggregate

The use of all - in crushed stone aggregate or crushed gravel, or alternative method of mixing and blending the base material may be use with the Owner's approval.

Grading limits for all-in crushed stone base shall be as follows.

SIEVE SIZE	% AGE BY WEIGHT PASSING
50 mm.	100
37.5 mm	95 - 100
20 mm	60 - 80
10 mm	40 - 60
5 mm	25 - 40
No. 7	13 - 30
No. 25	8 - 20
No. 200	5 - 10

(e) Degree of Compaction

The final level of Base Coarse shall have a CBR value of not less than sixty (60) percent.

5.7.3 Construction

(a) Spreading and compacting

The crushed stone base shall be constructed to the final thickness shown on the drawings or as otherwise directed by the Owner, but shall not be less than fifteen (15) cm after compaction.

The stone shall be laid by box spreader or other approved means in layers not exceeding ten (10) cm thick and compacted by an eight to ten (8 - 10) tons of self propelled with smooth drum roller working parallel to the center line of the roads.

In areas not accessible to power roller the base shall be consolidated with approved tempers or compactors. Compaction by rolling shall continue until no further consolidation takes places.

After preliminary shaping, the crushed stone base shall be covered by a twenty five (25) millimeters thick layer of fine or blinding material which is vibrated into the interstices of the base course aggregate by means of a vibrating roller or other approved equipment. Should patches deficient in fines developed during compaction, additional fine material shall be applied and the process continued until no more fines can be taken in. Final compaction shall be by an 8 - 10 tons roller until consolidation is complete.

(b) Surface of Sub-base

Spreading and compacting and layer as above shall continue until the Specified thickness has been achieved. In addition the final layer of stone shall be shape and compacted to provided a smooth and even surface free from irregularities or loose material and true to cross section, line and level. When tested with a straight edge or camber board, the permitted tolerance shall not exceed six (6) millimeters in three (3) meters length.

5.8 Bituminous Prime Coat

5.8.1 Description

The prime coat is the application bituminous material to the surface of the previously prepared base course prior to laying a bituminous surface dressing or penetration Macadam surface course.

Its purpose is to bind the surface of the base course together and provide good adhesion for the surface dressing or penetration Macadam course.

5.8.2 Materials

(a) Bitumen

The bituminous material shall be medium curing cut-back asphalt Grade "MC-0", with a temperature of application within the range 21°C - 60°C, or Grade "MC-1" with a temperature of application within the range 43°C - 85°C.

(b) Blinding (or blotter) Material

Blinding material shall be river sand or hard grit graded from five (5) millimeters down with not more than ten (10) percent by weight passing a No. 200 sieve.

5.8.3 Construction

(a) Precautions

The prime coat shall not be applied in wet weather or when the surface to be treated is, in the opinion of the Owner too wet.

The surfaces of structures, manhole covers, road kerbs and the like shall be protected in such a manner to prevent their being spattered or marred. No bituminous material shall be discharged into borrow pitch, gutters or drainage channels.

(b) Preparation

The surface of the base shall be swept clear of all dust, dirt, mud or loose material with a power broom or other approved equipment.

If considered necessary by the Owner the surface of the base may be slightly dampened before application of the bitumen to assist penetration.

(c) Application

The bitumen shall be heated to a temperature within the range specified for the particular grade used and sprayed using a distributor at the rate directed by Owner, normally in the range 0.5 - 1.0 liters per square meter depending on the absorbency of the base and designed to give a penetration of three (3) to six (6) millimeters and a drying time of twenty four (24) to forty eight (48) hours.

To check the rate of bitumen actually applied sheets of building paper fifty (50) by fifty (50) centimeters shall be weighed and laid on the surface to be treated, and then weighed again after application of the prime coat. The difference in the weight divided by the area of sheets shall give the actual spraying rate which may then be converted to a volumetric measure.

Within three hours of applying the bitumen the blending or blotting material shall be distributed evenly over the surface in such a manner that the wet bitumen does not "Pick up" during the spreading operation.

The prime surface shall be maintained for seven days, during which time no traffic shall be allowed to pass over the surface without authorization of the Owner.

Before commencing the next surface treatment, any areas found to be division in priming material shall be rectified to the Owner's satisfaction.

5.9 Surface Dressing

5.9.1 Description

Surface dressing consists of one or more applications of stone chippings bonded to the primed coat surface a continuous film of bituminous binder. Areas of road to receive surface dressing shall be designed on the drawings as either "Single surface dressing" or "Double surface dressing".

Where double surface dressing is specified the second dressing will normally be applied at least three months after the road has been opened to traffic.

5.9.2 Materials

(a) Chippings

Stone chipping shall be clean, tough, durable and free from dirt, dust, clay or other objectionable material which would impair adhesion to the bituminous binder. They shall be tested for wear soundness and grading as directed by the Owner.

For single surface dressings, the chippings shall be single size ten (10) millimeters crushed stone approximately cubical in shape with a ten (10) percent fines value of eight (8) or more, or an aggregate impact value of to thirty (30) percent.

For double surface dressings, the first dressing shall be as above followed by a second dressing using stone aggregate with a similar specification but with a nominal size of six (6) millimeters.

(b) Binder

The bituminous binder shall normally be cut-back bitumen Grades "MC1-MC4", the Grade to be decided in consultation with the Owner having regard to the prevailing ambient temperature and the equipment available for heating and spraying the binder.

5.9.3 Construction

(a) Precaution

These shall be as indicated under Sub-section.

(b) Preparation

Immediately before application of the bituminous binder the surface shall be swept clear of all loose and objectionable material which would impair adhesion, using a power broom or other approved equipment.

(c) Application

The bituminous binder shall be heated to within the temperature range recommended by the manufacturer for a particular grade use and spread on evenly using a distributor at rate site by the Owner to suit prevailing conditions, normally in the range of 0.5 - 1.0 liters per square meter. The actual rate of spraying shall be checked as specified in Clause 5.8.3(c).

Chipping shall be evenly spread over the surface by approved method at a rate of twelve (12) kilograms per square meter and rolled with a ten (10) tones self propelled type with smooth drum roller to produce close, uniform surface. The finish surface shall be closed to traffic for twenty-four (24) hours on completion, or such longer period as the Owner may direct, and for a further seven days traffic shall be restricted to a speed of thirty (30) kilometers/hours.

Where double surfacing dressing is indicated on the drawings, the surface of the first dressing shall be thoroughly bushed and cleaned of all loose material before the next application of the binder. The rate of application of the binder and chippings shall be as specified for the first dressing but may be varied at the direction of the Owner to suit prevailing conditions.

5.10 Penetration Macadam Surface Course

5.10.1 Description

Penetration Macadam surfacing shall consists of the construction on the previously primed base course, of a pavement surface of clean crushed rock penetrated with hot application of bituminous binder. The thickness of the pavement shall be as shown on the drawings or otherwise as directed by the Owner.

5.10.2 Materials

(a) Material Generally

Material generally shall conform to the requirements of the Ministry of Works (Bina Marga) general specification for this type of work, which should be used to supplement and amplify the information contained herein.

(b) Aggregate

Aggregate shall be crushed stone of uniform quality approved by the Owner and within the following grading limits :

SIEVE SIZE	BY WEIGHT PASSING 1st Application (Coarse Aggregate)
37.5 mm	100
25 mm	55 - 75
20 mm	35 - 55
12.5 mm	10 - 30
10 mm	0 - 15

SIEVE SIZE	BY WEIGHT PASSING 2nd Application (Intermediate Size)
20 mm	100
10 mm	40 - 75
5 mm	5 - 25
2.36 mm	0 - 10

SIEVE SIZE	BY WEIGHT PASSING 3rd Application (Fine aggregate for surface treatment)
10 mm	100
5 mm	85 - 100
2.36 mm	10 - 40
1.18 mm	0 - 10

(c) Asphalt Binder

The binder shall be asphalt penetration 60 - 70 (150°C - 210°C).

5.10.3 Construction

(a) Precautions

These shall be as indicated under Clause 5.8.3. (a).

(b) Preparation

The existing surface shall be dry and brushed clean of all loose material, dust, clay or other objectionable matter.

(c) Laying

The first application of aggregate (course aggregate) shall be spread evenly over the surface using spreaders or other approved means at a rate of eighty (80) kilograms per square meter or at such other rate as determined by the Owner in relation to specific gravity of the material used.

The stone shall be laid in such a manner to provide an even surface free from irregularities and true to cross section and level. Not more than sufficient aggregate for the binder. After spreading, the aggregate layer shall be shaped and ~~rolled parallel to the center line of the road using a ten (10) tons three point power roller until a firm, even surface is achieved, free from irregularities and in the opinion of the Owner suitable to allow proper penetration of the asphalt binder.~~ Should irregularities appear during rolling they adding shall be rectified by loosening the surface and removing or adding aggregate as the case may be and compacting as before. Areas not accessible to power rollers shall be thoroughly consolidated by tampers or compactors to the satisfaction of the Owner.

Asphaltic binder shall be heated to a temperature within the range specified above and applied to the first layer of aggregate using pressure distributing trucks or other approved methods, at a rate of four (4) liters per square meter or at such other rate directed by the Owner. The rate of spreading shall be checker as specified in Clause 5.8.3. (c).

Immediately after application of the binder intermediate size aggregate shall be laid as specified for the coarse aggregate layer at a rate of fourteen (14) kilograms per square meter and rolled as before until the aggregate is thoroughly embedded in the asphaltic binder.

If necessary, additional aggregate shall be added in small quantities and lightly brushed into the surface during rolling of the layer shall continue until the surface is firm and even and shows no movement under the roller.

A second application of binder shall then be distributed as before at a rate of four point five (4.5) liters per square meter or such other rate as directed by the Owner.

Finally the third layer of aggregate (fine aggregate for surface treatment) shall be evenly spread over the surface and rolled as before, except that pneumatic tired roller shall be used. The finished surface shall be firm and protected and closed to traffic for a period of twenty four (24) hours on completion.

5.11 Kerbs And Channels

5.11.1 Description

Kerbs and channels shall be used where shown on the drawings to delineate the running surfaces of roads with flexible pavements.

5.11.2 Materials

Precast concrete Grade 22.5/20 (k-225) conforming with the requirements of Section 7 of this Specification shall be used for kerbs and channels. They shall be manufactured to the size shown on the drawings and radius kerbs shall be used on all curves of twelve (12) meters radius or less.

5.11.3 Construction

Kerbs shall be laid prior to the construction of the road base on a continuous foundation of concrete Grade 100/40 fifteen (15) cm thick and of width ten (10) cm greater than the kerbs. They should be bedded and jointed on the foundation in Grade "A" mortar and haunched up the back of the kerbs with Grade 100/40 concrete.

At completion, the kerbs shall be true to line and radius and any work showing marked aberration from true line and level shall be rejected.

5.12 In-situ Concrete Road Edging

5.12.1 Description

Roads with a bituminous surface course may where shown on the drawings, have a cast in-situ concrete edging in lieu of precast concrete kerbs.

5.12.2 Materials

(a) Concrete

Concrete shall be Grade 22.5/20 (K-225) for the in-situ edging and Grade 100/40 (B-100) for the foundation, all as specified in Section 7.

(b) Formwork

Formwork shall be wrote and comply with this Specification.

5.12.3 Construction

The edging shall be constructed to the dimensions shown on the drawings or as directed by the Owner but shall not be less than thirty (30) cm wide by thirty (30) cm deep.

The top surface shall be set flush with or not more than fifteen (15) millimeters below the finished surface of the carriageway and trowelled to a class B1 finish.

The edging shall be constructed prior to laying the road sub-base on a foundation of concrete Grade 150/40 (K-150) to the dimensions shown on the drawings. The foundation shall be laid on the prepared subgrade but where this is low relative to the dimensions shown on the drawings the foundation concrete shall be proportionally increased.

Drainage of the road base shall be by P.V.C. pipes one hundred (100) millimeters diameter inserted at four (4) meter intervals and passing through the full width of the edging at subgrade level.

Care shall be exercised in erection of form-work to ensure that opposite faces are everywhere truly parallel and curves merge into straight at tangent points smoothly and without angled junction.

5.13 Cable Road Crossing

5.13.1 Description

Pipe ducts for cable and other service under roads shall be indicated on the drawings.

5.13.2 Materials

- (a) Concrete or Poly Vinyl Chloride (PVC) Pipes.
Pipes shall be of approved by Owner.
- (b) Concrete
Concrete surround to ducts shall be Grade 10/20 (B-100).

5.13.3 Construction

Ducts for cables and other services shall be constructed under roads in advance of road construction all as shown and specified in the drawings.

The inside surface of ducts shall be smooth and free from sharp edges or projections which could cause damage to the sheathing of cables.

Each duct shall be thoroughly cleaned on completion and closed at both ends with a timber plug driven in and sealed with bitumen. A light galvanized steel or non-ferrous wire shall be drawn through each duct and left in before plugging.

5.14 Measurement For Payment

5.14.1 Excavation

Excavation is measured by the cubic meter of material excavated.

5.14.2 Embankment, Backfill

Embankment and backfill is measured by the cubic meter of material hauled, placed and compacted.

5.14.3 Pavement

The pavement, including subbase, base and surface course is measured by the square meter of pavement completed.

6. FENCING

6.1 Scope

This section of the Section consists of the requirements for the security of the high voltage switchyard area and the site area generally.

6.2 References

Reference is based on the typical fencing drawing of tender document.

6.3 General

~~Electricity substation contain high voltage equipment and access is restricted to authorized personnel only.~~

The location of the fencing required for security purpose shall be as shown on the drawings.

The Contractor shall ensure that the outside faces of fences and gates have no projections or footholds which would be a climbing aid to unauthorized personnel and reduce security characteristics.

6.4 Security And Anti - Intruder Fence

6.4.1 Materials

a. Fence Fabric

Fence fabric shall be hot dipped galvanized with 7 mm diameter of steel wire . Galvanizing shall have a nominal thickness of 80 microns.

b. Post, Frame, Gates, and Appurtenance.

- Steel tube and frame Steel Profile; hot deep galvanized material conforming to ASTM A.120-79.
- Galvanizing : Hot dip galvanize steel tube (inside and outside) and frame steel profile section (all surfaces) and other ferrous parts, with a weight of zinc coating not less than 0.6 kg/m² of surface.
- Sizes of material for post , rails , braces and gate frame shall conform to the following dimension and weight as shown on the approved drawings.

c. Barbed wire and attachments.

- Three lines of two strand 2.5 mm diameter steel wire with 2.11 mm diameter four point barbs spaced approximately 125 mm on center.

All wire shall be hot dip galvanized, with the weight of zinc coating per square meter of surface area shall not less than 0.24 kg/m² for 2.5 mm diameter wire and not less than 0.198 kg per square meter for 2.11 mm diameter wire or plain wire.

- Barbed wire shall be fastened to extension arms with heavy galvanized steel pins, and to post extension with galvanized steel bands.
- The contractor shall provide barbed wire across the top of gates, as well as continuously along the entire top of the fence.

6.4.2 Fencing Details

- a. Post Setting : The Contractor shall provide posts of sufficient length for depths.
- b. Post Tops and Extension Arms : Malleable iron or pressed steel, with post tops for round posts designated to exclude moisture from inside the posts, and with integral extension arms for barbed wire, as follows :

- For Intermediate Posts : Extension arm or arms extending at 45° angles and slotted to carry three evenly spaced strands of barbed wire with the top strand or strands located approximately 300 mm above the top of the fence fabric.
- For End and Corner Posts : Same construction as for intermediate posts, with the post top and extension securely riveted to posts : or, extend posts up to the

full height required and provide a post top.

- Gate Post : Extend posts up to the full height required and provide post top.
- c. Top Rail Details : Provide with 17.5 cm long outside sleeve type couplings every 6 m on center. The top rail shall pass through the base of the intermediate post tops and form a continuous brace from end to end of each stretch of fence. Securely fasten the top rail to terminal posts with heavy pressed steel connections.
- d. Cross Stiffener : Provide at both sides of corner posts, and between terminal posts or gate posts and first adjacent intermediate posts. The compression cross stiffener be wire or steel bar installed midway between the top rail and ground. Securely fasten the compression cross stiffener to post with heavy pressed steel connections.

6.4.3 Fence Construction

- a. The installed fence shall conform to the alignment and finish grade indicated on the Contractor's drawings. Unless otherwise indicated or specifies, all posts shall be plumb and spaced 3 m apart. Where necessary, the fence grade shall be adjusted to fit the ground contour by slipping the fence fabric links. On steep grades, the posts may be set normal to the slope, provided transition sections are constructed. Ground surface irregularities shall be machine graded as required to eliminate frequent changes in vertical alignment and to provide a smooth profile for the fence.
- b. It is the intent of these specifications that the plan and profile of each reach of fence between corner posts, or between corner posts and gate posts shall be straight. The Contractor shall grade ground surfaces as required to achieve the straight profiles before each reach of fence is installed.
- c. Where posts are set in earth, concrete foundations 60 cm deep shall be provided. Concrete foundations shall be square in plan, not less than 40 x 40 cm. Foundations shall extend above the ground surface and shall be crowned approximately 10 cm. Concrete for foundations shall conform to the cast-in-place concrete section. Each foundation shall be cured for at least 72 hours before further work is done on the post.
- d. Concrete block shall be provided in between the two posts as detailed on the drawings.

6.4.4 Temporary Gaps In Fencing

Any gaps left in fences for constructional purposes shall be in agreed positions. They shall be provided with straining posts and struts as required and shall be closed when directed. Gaps requested by the contractor for his own use shall be formed, maintained and closed at the expenses of the contractor.

6.4.5 Gates

- a. Gate shall be sliding type, complete with frames, latches, stopper, keepers, bottom rollers & rail, fabric, braces. Gate leaves shall have intermediate members and diagonal truss rods as requires for rigid construction and shall be free from sag or twist. Gates shall be fitted with vertical extensions arms. Joints between frame members shall be made by welding or by means of heavy fittings, and shall be rigid and watertight. Gate fabric shall be the same as fence fabric and shall be attached to the frame ends by stretcher bars, bolt hooks or other mechanical means.

- b. Bottom rollers shall be of a heavy pattern with large bearing surfaces and shall not twist or turn under the action of the gate. Latches shall be the plunger bar type, at middle gate height, and arranged to engage the gate stop except that single gates less than 3 m wide may be provided with a forked latch. Latches shall be arranged for padlocking with a padlock accessible from both sides of the gate. Stopper shall consist of a plate which is welded to rail, with an anchor set in concrete and to arrange the movement of a gate in its position. Rails shall be of steel angle, embedded to concrete base (grade 17.5/40), by using rod anchor.
- c. Gates shall be installed so that they cannot be removed without disassembly of the hardware. Hardware attachment bolts shall be pinned so that removal will be difficult.
- d. Gates and it's accessories shall be as detailed on the drawings and constructed in accordance with the details and within the limit shown on the drawings.

7. CONCRETE WORKS

7.1 Scope

This section of the Specification consists of the requirements for the composition, manufacture and placing of concrete, reinforced concrete and mortar throughout the works in accordance with and to the dimensions shown on the construction drawings, or as indicated in other sections of this Specification.

7.2 Reference

The Contractor shall comply with the following codes and standards:

- Peraturan Beton Bertulang Indonesia - 1971 (NI-2)
- Peraturan Umum untuk Bahan Bangunan Indonesia (NI-3)
- Peraturan Cement Portland Indonesia (NI-8)
- SKSNI - 1991. T.15 - 91 - 03
- American Concrete Institute (ACI)

7.3 Materials

7.3.1 General

- (a) All material used in the Work shall be new and of the best quality of their respective kinds from approved sources and shall comply with the requirements of the latest edition of the approved standards or codes of Practice.
- (b) The Contractor shall be deemed to have satisfied himself that suitable materials for concrete and mortar can be obtained in sufficient quantities to carry out the works.
- (c) As soon as possible after the contract has been placed the contractor shall submit a list giving details of the sources from which he proposes to obtain concrete and mortar materials. Only materials from approved sources shall be brought to site. Approval of sources shall no imply acceptance of material found not conform to this Specification.

7.3.2 Cement

The cement used throughout the works shall be in accordance with NI - 8 or similarly.

All cement shall be delivered to the site under cover in strong, sealed waterproof bags in such quantities and at times suitable for the amount of work in hand. All cement shall be effectively protected against deterioration during storage on the site. Only sufficient cement shall be stored at site to ensure continuity of the works, and to allow testing of any consignment before it is required for use.

Cement shall be stored in unopened bags on a dry raised platform in a well ventilated but weatherproof storage shed which is used for no other purpose. Each consignment and brand shall be clearly numbered and separated from order in which it is delivered. Only one brand of cement shall be used to complete any individual structure or foundation unless otherwise instructed by the Owner.

Cement stored on site for a period longer than two months shall be laboratory tested at the contractor's expense before use. Any cement which has hardened or become contaminated shall be rejected.

Cement manufacturer's test certificates shall be made available to the Owner on request.

7.3.3 Additives Generally

Air entraining, water reducing, set accelerating, set retarding, or other additives shall not be used except with the written approval of the Owner, following comparative concrete durability and compression strength tests carried out on concrete made with and without additives.

Test with additives shall give durability and compressive strength at least equal to those without additives except that water reducing agents shall increase the compressive strength by ten (10) per cent. The use of all additives shall be strictly supervised.

7.3.4. Aggregates

(a) Coarse Aggregates

Coarse aggregates shall be crushed stone with well graded and show general compliance with the requirements of the appropriate standards. It shall be clean, hard, strong, fine grained, non friable, non-porous and durable stone of approved quality and shall be obtained from an approved source. It shall be roughly cubical in shape and be free from dust.

The granulometric curve of the coarse aggregate shall be within the following tolerances, which shall be achieved by means of sifting and screening of the material.

Should the loss by weight, when the aggregate is subjected to abrasion test by the use of the Los Angeles Machine (ASTM (31) exceed 10 % at 100 revolutions or 40 % at 500 revolution, the coarse aggregate shall be rejected.

SCREEN SIZE	% AGE WEIGHT PASSING	NOMINAL MAXIMUM SIZE
40 mm	20 mm	10 mm

37.5 mm	95 - 100	100	
19.0 mm	30 - 70	95 - 100	100
9.5 mm	10 - 25	25 - 55	85 - 100
4.75 mm	0 - 5	0 - 10	0 - 20

(d) Fine Aggregate (Sand)

The fine aggregate for concrete and mortar shall comply with the appropriate standard. The fine aggregate for concrete shall be clean, sharp, fresh-water or pit sand, or other suitable and approved material, and shall be free from all impurities.

The clay, silt and fine dust in, or adhering to, the aggregate shall not exceed five (5) percent by volume. The fine aggregate shall be well graded within the limits of four and three-quarters (4.75) mm to six hundred (600) micrometers in size.

The fine aggregate for mortar shall, unless otherwise specified, be rounded sand or other suitable and approved material and shall be free from all impurities. The clay, silt or fine dust shall not exceed five (5) per cent by volume. The sand shall consist of particles between two point three six (2.36) mm and six hundred (600) micrometers in size.

(c) Storage of Aggregates

The coarse and fine aggregates shall be stored on site in bins or on clean, dry, hard surfaces, and be kept free from all sources of contamination. Aggregates of different grading shall be stored separately, and no new aggregate shall be mixed with existing stocks until tested and approved.

7.3.5 Water

Water used for mixing concrete and mortar shall be clean, fresh water obtained from an approved source and free from harmful chemicals, oils, organic matter and all other impurities, conforming with the requirement of the applicable standard.

7.3.6 Steel Bar Reinforcement

The reinforcement shall comply with the requirement of the appropriate Standards. The bars shall be round and free from corrosion, cracks, surface flaws, laminations, rough, jagged and shall not exceed two and one half (2.5) per cent. All bars shall be clean, new and of the diameters described on the drawings, and shall be transported and stored on site so that they remain straight, clean, undamaged and free from corrosion, rust or scale.

Bars of different diameters shall be separately bundled and bars from different sources shall be separately stored, free from direct contact with wet ground.

Deformed bar shall be used for diameter more than 13 mm and other sized plain bar may be used.

7.3.7 Threaded Inserts

Threaded insert for casting into concrete shall be of the diameters and dimensions shown on the drawings and shall be electro-galvanized and of malleable iron or mild steel.

7.3.8 Lime Putty

Lime putty used for mortar shall be well slaked and kept in the lime pool for a minimum of four days. It shall be prevented from drying while in the lime pool.

7.3.9 Waterproofing Admixture

Waterproof concrete and mortar shall be used where shown on the drawings. Waterproofing shall be by the use of a reliable and approved brand of admixture. The admixture shall be used strictly in accordance with the manufacturer's instructions.

7.4 Concrete Construction

7.4.1 Concrete Grades

The grades of concrete to be used in the works shall be as shown in Table 1 below:

Table 1

GRADE REFERENCE S.I	GRADING OF COARSE AGGREGATE NI - 2	NOMINAL 28 DAY COMPRESSIVE STRENGTH (Cube Specimen)
22.5/20	20 - 4.75 mm	225 kg/cm ²
22.5/40	40 - 4.75 mm	225 kg/cm ²
17.5/20	20 - 4.75 mm	175 kg/cm ²
17.5/40	40 - 4.75 mm	175 kg/cm ²
10.0/20	20 - 4.75 mm	100 kg/cm ²
10.0/40	40 - 4.75 mm	100 kg/cm ²

7.4.2 Concrete Strengths

The contractor shall ensure that the crushing strengths of the various grades of concrete are not less than the values given in Table 2 below :

Table 2

GRADE REFERENCE S.I, NI - 2	MINIMUM RESISTANCE TO CRUSHING (CUBE STRENGTH)			
	28 DAYS		7 DAYS	
	N/MN ²	Kg/cm ²	N/MN ²	Kg/cm ²
22.5/20	22.5	225	15.0	150
22.5/40	22.5	225	15.0	150
17.5/20	17.5	175	11.5	115
17.5/40	17.5	175	11.5	115
10.0/20	10	100	6.5	65
10.0/40	10	100	6.5	65

The cube strengths relate to a standard one hundred and fifty (150) mm cube, and when standard cylinders of three hundred (300) millimeters in height with base of one

hundred and fifty (150) millimeters in diameter are used and tested the crushing values of such cylinder tests shall be multiplied by a factor of one and one quarter (1.25) to obtain equivalent values for comparison with cube strengths specified in Table 2.

7.4.3 Mix Proportions for concrete grades

It shall be the contractors responsibility to design the concrete mixes, using the constituent materials specified, to comply with the requirements of the various grades of concrete.

The contractor shall, as soon as possible after the contract has been placed, obtain representative samples of water and fine and coarse aggregates in sufficient quantities for testing as directed by the Owner. Tests so designated by the Owner shall be in accordance with the provisions of the appropriate standards by the Owner. Materials which do not comply with those specified under Clause 7.3. shall be rejected.

In determining the mix proportions, the contractor shall use trial mixes in accordance with the recommendations of NI-2 to establish the most suitable combination that will give concrete of the maximum water/cement ratios consistent with the strengths specified for the different concrete grades. Water cement ratios will normally be not greater than 0.55 by weight otherwise specified, approved or instructed for each grade of concrete.

7.4.4 Approval of Mix Proportions

The contractor shall submit to the Owner for approval the proportions of ingredients he proposes to use for each grade of concrete, and the basis on which he has designed the mix.

Under the supervision of the Owner the contractor shall make six (6) test cylinder or cubes of each grade of concrete, using his proposed proportions. The making, curing and testing of cubes shall be in accordance with B.S. 1881 and NI-2 BAB.4. unless otherwise specified.

Three (3) cubes of each set shall be tested at seven (7) days by an independent authority approved by the Owner, the remainder tested at twenty-eight (28) days.

All test cubes shall be given a reference number and the contractor shall supply the Owner with a record, in duplicate showing the reference number, date made, concrete grade, proportions of mix, water cement ratio and the concrete slump.

The minimum designed strengths obtained from the trial mix tests shall be one and one third (1 1/3) times the minimum crushing strengths specified in Table 4 for each grade of concrete.

When the mix proportions of each grade of concrete have been finalized and approved by the Owner, the Contractor shall not vary these proportions without a good and valid reason for doing so and only with the Owner's approval. Any such change of proportions, arising from any cause whatsoever shall not be considered as a basis for a claim to an increase in unit rated for concrete.

7.4.5 Use of Concrete Grades

The grades for concrete to be used in the works shall be as follows unless otherwise specified on the drawings:

Support Equipment	22.5/20
Precast Members, slabs (< 12 cm in thickness)	22.5/20
Beams, columns and slabs	22.5/40
Plant and structure plinths pads and	
Foundation slabs	22.5/40
General foundation work, roads, linings etc.,	
Reinforced or unreinforced	17.5/20 and 17.5/40
Pipe Surrounds and making up to	
Level foundation	10.0/40
Blinding, protective layer for tiling	10.0/20 or 10.0/40

7.4.6 Blinding

Under all foundation elsewhere as indicated on the drawings, a layer of concrete grade 10.0/40 or 10.0/20 shall be laid immediately the excavation is carried down to foundation level. The blinding surface shall be thoroughly clean before foundation concrete is deposit thereon.

Sumps shall be provided where necessary to facilitate the control of drained water. The two grades shall be applied as follows:

	Grade of Concrete	Thickness
Foundation bases	10.0/40	100 mm
Floors of ducts, troughs or		
Reinforced slabs not exceeding 100 mm	10.0/20	50 mm

7.4.7 Measurement of Materials

(a) General

All equipment used for measurement of concrete ingredients shall be maintained in good and clean condition and the Contractor shall ensure that men engaged on concreting work are fully instructed and competent in the use of such equipment.

(b) Cement

The quantity of cement shall be determined by weight the cement is supplied in bags the concrete shall be mixed in batches using one or more complete bags of cement.

(c) Aggregate

The quantities of fine coarse aggregate should preferably be determined by weight but where written approval has been obtained from the Owner, may be determined by volume.

The conversion of "weight" to "volume" or vice versa shall be based on the weight per cubic meter of the preliminary tests on aggregates. Where batching by volume

is approved, suitable batch boxes for measurement of the aggregate shall be made and use.

Allowance shall be made in gauging fine aggregate for increase in volume due to bulking because of moisture content.

(d) Water

Water for each batch of concrete shall be accurately gauged by measurement of volume in a calibrated tank or by weighing. One liter of water shall be equivalent to one kilogram weight.

If the fine and coarse aggregates contain water, adjustment shall be made to the quantity water to be added to the mix by carrying out moisture content test on the aggregate and by slump test on the freshly mixed concrete.

7.4.8 Batching and Mixing

Batching and mixing shall be carried out in plant approved by the Owner and generally complying with the requirements of NI-2 BAB 6, 6.2. and 6.3.

The concrete shall be mixed in mechanical mixer of approved type unless as specified below or otherwise approved. The time allowed for mixing after all ingredients are in the machine shall be not less than two minutes.

Mixing shall continue until the mass is uniform in color and consistency and the complete batch shall be discharged before the introduction of more materials.

Small quantities of concrete less than half (0,5) cubic meter may be hand mixed on a clean watertight platform. The fine and coarse aggregate shall be thoroughly mixed together, cement then added, and the whole turned over three times dry. The material shall be turned over whilst adding water, then finally turned twice and worked to produce a mixture of uniform color and consistency

For hand mixing the specified quantities of cement shall be increased by 10 (ten) per cent without alteration in price.

All equipment shall be thoroughly clean before use or reuse for other grades of concrete.

7.4.9 Control tests and Workability

The concrete shall be a dense, homogenous nature produced with the minimum quantity of water necessary to ensure a compact mass sufficiently workable to enable proper placing and consolidation in corners and around reinforcement, and to give the specified finish, strength, density or other required qualities. The water/cement ratio for each grade of concrete shall be agreed with the Owner.

Quality control of the concrete used throughout the works shall be maintained in accordance with NI-2 or similarly. Test cubes shall be made as directed during the period of the works and not less frequently than six (6) per week or per five (5) cubic meters of concrete whichever is more frequent. All test cubes shall be referenced and recorded as required by sub-section .7.4.4. of this Specification, including a record of the position in the works from which the concrete was taken. Three of the specimens shall be tested at seven (7) days and the other three at twenty eight (28) days.

Concrete may be assumed satisfactory if the cube strengths at 7 days are in accordance with TABLE 2. Should the 7 days values be below the specified figures the concrete may still be assumed satisfactory if the 28 days test results conforms with the

TABLE. If the results of both the 7 days and 28 day work cube tests show crushing strengths less than those specified, the Owner may suspend all concreting work and order further tests to ascertain if the concrete place in the works is acceptable.

If the results of strength tests indicate that concrete does not meet specified requirements the concrete production shall be stopped until corrective action is implemented to guarantee conformance with specification.

The Contractor may be directed to take concrete cores and/or make load tests, at his own expense, of any work that he has installed with concrete not meeting specified strength requirements. If cores and/or load tests establish that such work in place does not meet requirements, the concrete shall be broken out and replace, or otherwise rectified as requested by the Owner without cost to the Owner.

The contractor shall be responsible for keeping a record of Slump Tests, and the slump of the standard cone shall be within the following limits whilst conforming to the specified crushing strengths:

GRADE OF CONCRETE	SLUMP OF 300 MM CONE	
	VIBRATED	HAND COMPACTION
22.5/20, 22.5/40 and 17.5/20, 17.5/40	25 - 50 MM	
10.0/20, 10.0/40	24 - 75 MM	25 - 100 MM

Checking and testing the concrete quality shall be prerogative of the Owner who may increase the number of tests to be made or order such other tests as he may deem necessary to ensure that the concrete is of the specified strength and workability required for the works.

All remedial measures including cutting-out, reinating, mix adjustments, further testing and the like which, in the opinion of the Owner, are required shall be at the expense of the contractor.

7.4.10 Transporting

Concrete shall be distributed from the mixers to final position in the works as rapidly as possible and by approved methods which prevent segregation or loss of ingredients. All equipment shall be thoroughly clean before use or re-use for other grades of concrete.

7.4.11 Placing

(a) Preparation for Placing

Surplus water or any flow of water shall be removed or diverted from the excavation in accordance with sub-section 3.2.2. of this Specification and the layer of blinding concrete as specified under sub-section 7.4.6. thoroughly cleaned and washed.

Formwork shall be checked for line, level, shape and rigidity and shall be cleaned of all debris or other foreign matter which would adhere to or impair the finished concrete. The forms shall be treated with an approved mould oil before fixing the reinforcement.

Reinforcement shall be free from pitting, mud, oil, paint, loose rust or scale or other adherents harmful to the bond or strength of the reinforcement. Bars shall be fixed rigidly and accurately in position and in accordance with the working drawings, unless otherwise approved by the Owner.

Reinforcement at all intersection shall be accurately tied together with soft annealed tying wire. No insertion of bars in previous placed concrete shall be permitted. Projecting bars shall be adequately protected from displacement.

Spot or tack welding for positioning bars in heavily reinforced areas will only be allowed with the express permission of the Owner. Extension of lengths of reinforcement by welding will not be permitted.

Welding will be approved only in low stress members, and lap welding will not be approved in any circumstances.

(b) Inspection and Approval before Placing

All formwork moulds and fixing of reinforcement shall be subject to inspection and approval by the Owner immediately prior to the placing of concrete.

(c) Placing

Placing of concrete will not be permitted when the weather conditions or the limitation of facilities or equipment for concreting provided by the Contractor are such, in the opinion of the Owner, as to prevent construction procedure, finishing and curing of the concrete.

Not more than thirty (30) minutes after water is first added to the mix and before initial set has occurred the final placing of the concrete shall be completed. On no account shall water be added after the initial mixing.

Concrete shall be introduced into the forms between predetermined construction joints, as near as practicable to its final position in a manner which will not cause segregation of the mix or displacement of the reinforcement of forms. Placing shall be in approximately horizontal layers of uniform thickness not exceeding 30 cm.

Concrete shall not be dropped from a height greater than one a half (1.5) meter and placing and consolidation shall be done in a manner which will not disturb previously placed concrete.

If greater drops are unavoidable, a tremie or other approved means shall be used so that the concrete may be effectively placed and compacted in horizontal layers as before and segregation or disturbance of previously placed concrete does not occur.

Conduits and pipes shall not be embedded in concrete unless specially indicated on the drawings or instructed by the Owner.

Formworks and reinforcement with concrete and mortar droppings shall be cleaned in advanced of placing subsequent lifts.

Concrete finished shall be as specified in sub-section 7.6.

7.4.12 Compacting of Concrete

Concrete shall be consolidated by immersion type vibrators operating at an approved frequency, and supplemented by hand spading, rodding, ramming and tamping to ensure adequate and proper compaction.

The concrete shall be carefully worked around reinforcement and embedded fixtures, into corners and against the forms to produce a dense uniform mass free from defectors, care shall be exercised to ensure that the duration of vibration is sufficient to produce satisfactory consolidation without segregation and that the whole depth is thoroughly compacted without disturbance without to other parts of the work already placed. Excessive vibration shall be avoided.

The number and type of vibrators shall be approved prior to placing the concrete and sufficient spare units must be on hand in case of breakdown.

Operators of vibrating tools shall demonstrate that they have received adequate instruction and training in their use. Every care shall be taken to avoid contact of vibrators with reinforcement or previously placed concrete.

External formwork vibrators will not be permitted unless specifically approved by the Owner on agreed sections of the works.

7.4.13 Construction Joints

Concreting shall be carried out continuously up to approved construction joints with moulded bounding chases. Unless otherwise approved or instructed concrete shall be placed to the full depth of slabs, beams and the like and shall be placed in horizontal layers not exceeding one and one half (1.5) meters deep in walls, column and similar members.

Construction joints shall be formed in the horizontal vertical planes by means of stop boards which allow the reinforcement to run through. Where practicable, laitance shall be removed whilst the concrete is still soft so as to expose the coarse aggregate. Where concrete already deposited has set but not set hard the laitance shall be removed and the coarse aggregate expose by wire brushing and washing.

At joints where the placed concrete has set hard any or laitance shall be removed by hacking, care being taken to avoid damage to the aggregate.

Immediately before concreting proceeds the roughened joint surface shall be thoroughly cleaned and loose matter removed, then treated with a layer, 12 mm thick, of cement mortar 1:1 mix. The concrete shall be immediately deposited and punned into the cement mortar.

Where construction joints will be permanently visible, the cement mortar shall be kept back from the exposed face of the concrete.

7.4.14 Expansion Joints

Expansion joints shall be formed in positions and to the details shown in the drawing or as directed.

Joints shall be straight and vertical except where otherwise approved and concrete surface faces shall be flush on both sides of the joint.

The joints shall be filled with "Flex cell" non extruding wood fiber bitumen impregnated boarding, and sealed with Plt "Plastic" opical grade rubber bitumen compound, or other approved products of equal properties and quality.

7.4.15 Contraction Joints

Contraction joints in concrete shall be formed in positions and to details shown on the drawings or as directed by the Owner.

The joints shall be straight and vertical except where otherwise approved and concrete surface levels on both sides of the joint shall be flush. Alternatively they may be formed by cutting with an approved cutting/sawing machine after the concrete has set.

The surface of the concrete shall be flush on both sides of the joint and the joint shall be sealed with bituminous polyurethane foam strip or with "Plastic" tropical grade rubber bitumen compound, poured into the joint, or with other approved products of equal properties and quality.

7.4.16 Protection and Curing

Proper protection shall be provided to prevent cement from being taken or washed away and the concrete from being diluted during the process of storing, handling, transporting, apportioning and mixing the materials, and transporting, placing compacting and curing the concrete.

Care should be taken to ensure that concrete during hardening is not disturbing by direct or indirect loading, movement of projecting reinforcement, vibrating or other similar effects. All concrete shall be protected from the harmful effects of sunshine, wind and rain and foundation concrete shall also be protected from damage by storm or subsoil water.

After placing and during early stages of hardening, concrete shall be protected from moisture loss, harmful effects of sunshine, wind, rain, running surface water and shocks.

Curing activities shall be started as soon as any free water has disappeared from the surface of the concrete after placing and finishing. Surfaces shall be kept covered and wet for at least fourteen (14) days after placing, or for such other period as may be approved.

Covers shall be Hessian, sacking or other absorbent material and shall be kept wet continuously for the agreed curing period. Alternative proposed methods of covering the concrete or sealing-in the moisture should require approval.

Where formwork is removed before the end of the fourteen days curing period, curing as specified above shall continue on all exposed surfaces until the end of the curing period.

7.5 Formwork Construction

7.5.1 General

Formwork shall be constructed from timber, metal, plastic or concrete, lined as necessary for special finished and designed with the quality and strength required to ensure rigidity throughout placing, ramming, vibration and setting of the concrete, without detrimental effect.

7.5.2 Erection

Formwork shall be erected true to line, level and shapes required using a minimum of approved internal ties. Faces in contact with the concrete shall be true and free from defect, jointed to prevent loss of water or fines, in panels or units which permit easy handling, and designed to permit side forms to be struck independently of soffit shuttering. Ties or spacers remaining embedded shall have the minimum cover

specified for reinforcement.

Forms for exposed concrete beams, girder casings and columns shall provide for a twenty five (25) millimeter chamfer on external corners.

7.5.3 Classes of Formwork

(a) Wrot Formwork

Wrot formwork shall be planed timber "Meranti" or better, plywood, smooth steel or other material with a similar smooth surface. Samples of the quality of the concrete finish using wrot formwork shall be required by the Owner. It shall be used for all permanently exposed concrete surfaces where a "class A1" finish is required.

(b) Sawn or rough Formwork

Sawn or rough formwork shall be timber as left from the saw or other approved material.

It shall be used for non-exposed concrete surfaces where a "class A2" finish is required, and shall include surfaces to be covered by backfill, plaster or the like.

(c) Formwork at Construction Joints

Construction joints in the works shall be so arranged to provide a "starter" to which the forms for the next lift may be clamped.

Wedges and clamps shall be kept tight during vibrating operations. Before commencement or resumptions of concreting, the interior of forms shall be cleaned and freed of sawdust, shavings, dust, mud or other debris and openings shall be formed to facilitate this cleaning and inspection.

7.5.4 Removal of Formwork

Formwork shall be kept in position, fully supported, until the concrete has hardened and gained sufficient strength to carry itself and any loads likely to be imposed upon it. Stripping must be effected in such a manner and at such a time that no shock or other injury is caused to the concrete. Results from control test specimens referred to in subsection 7.4.9. shall be used as a guide in the removal of formwork where appropriate. However, the responsibility for safe removal rests with the Contractor but the Owner may delay the time of striking if he deems it necessary.

Removal of Formwork	
Position in Works	Minimum Period before Striking Formwork
Removal of shuttering to sides of rafts, walls, beams and columns	2 days 7 days
Removal of shuttering to slabs, beams and arches (Props left under)	7 days
Removal of props to slabs, beams and arches	14 days

7.6 Finish Of Concrete Surfaces

7.6.1 Concrete Cast against Formwork

The following finishes to concrete surfaces unless otherwise specified or shown on the drawings, shall be as follows:

Class A1 : All permanently exposed surfaces, including exposed sides of foundations.

Class A2 : Surfaces to be covered by backfill, plasters or the like.

Class A1 surfaces shall be dense, fair, smooth, even, free from honeycombing, water and air holes and other blemishes, true to line and surface and free from board or panel marking. They shall be of uniform color. Rendering of defective surfaces shall not be permitted, and, if, ordered by the Owner the Contractor shall at his own expense cut out to expose reinforcement and make good any unsatisfactory work. All areas so treated shall be rubbed down and kept moist for several days.

Application of plaster or rendering to permanently exposed concrete with a class A1 finish will on no account be accepted.

Class A2 surfaces shall be dense, even, free, from honeycombing and true to line and surface.

Any special finished will be to details or instructions given by the Owner.

7.6.2 Concrete not cast against formwork

The following finished shall be provided unless otherwise specified or shown on the drawings :

Class B1 : All permanently exposed surfaces, including tops of equipment foundations, wall copings, windowsills, recast items (except paving flags).

Class B2 : Paving flags and paths. Floors and slabs to be surfaced with blocks, tiles or water proofing materials.

Class B3 : Roads, buried concrete and floors or slabs to be covered by screen.

Class B1 surfaces shall first be leveled and screeded to produce a true surface. After the moisture film has disappeared, and the concrete has hardened sufficiently, the surface shall be finished with a steel trowel under firm pressure to give a smooth, dense, even and hard surface free from all marks and defects.

Class B2 surfaces shall be leveled and screeded to produce a true surface, and be finished with wooden or steel float to give a level surface free from screed marks. Excessive floating shall be avoided.

Class B3 surface shall be leveled and screeded to produce a true and uniform surface.

7.7 Precast Concrete Members

Precast concrete members shall be used in the works only where specified on the drawings or approved by the Owner.

All the requirements for concrete, formwork and reinforcement shall apply equally to the molds for precast members and concreting shall be carried out in one continuous operation.

Precast members shall not be disturbed or lifted until the minimum periods specified for formwork removal have elapsed.

7.8 Damaged Concrete

In the event of any portion of the concrete work being damaged so that in the opinion of the Owner it does not fulfill the requirements of the contract, the replacement or reinstatement shall be carried out at the expense of the Contractor to the directions of the Owner.

7.9 Fixings In Concrete

7.9.1. Holes, Pockets, Inserts etc.

Holes, cavities and fixings shall be provided in the works only at the positions indicated on the drawings or as directed and they shall be incorporated as necessary during the work of concreting. Unless otherwise agreed a tolerance in position of plus or minus five (5) millimeters shall be allowed.

Insert and bolts shall be fixed square in the works by means of temporary bolts or nuts, and then concrete cast around them. The projecting portions of such fixings, and concrete within fifty (50) millimeters of them, shall be bitumastic painted and all threads well greased on completion of the works. Holes and pockets shall be stepped down clean on completion.

7.9.2. Ties to Brickwork and Block work

- (a) Brickwork shall be tied to structural concrete columns by galvanized wire ties.
- (b) Ties to block work at columns shall be galvanized steel dowels and be bedded for half their length in the nets. Ties shall be fixed at their correct positions to meet block work joints at a maximum of 500 mm centers.
- (c) Positions of ties will not normally be shown on the drawings but unit rates for concrete will be understood to include for building-in ties for brickwork and block work.

7.10 Tremie Concrete

7.10.1 Concrete

Conform to the requirements specified for Grades 22.5/40 concrete unless otherwise indicated, except use 10% additional cement in mix and limit slump to 140 mm maximum.

7.10.2 Tremie Equipment

Pipe or tube having minimum diameter of 250 mm, constructed in sections with flanged couplings fitted with gaskets, and with hopper at top

Support tremie so as to permit free movement of discharge end over entire top surface of work and so as to permit tremie to be rapidly lowered, when necessary, to choke off or retard flow of concrete.

7.10.3 Placing

7.10.3.1 Deposit concrete underwater by carefully placing concrete in its final position by means

of tremie. Do not disturb concrete after it is deposited.

7.10.3.2 Use special care to maintain still water at point of deposit. Do not place tremie concrete in running water.

7.10.3.3 Carefully regulate consistency of concrete and use special care to prevent segregation of materials.

7.10.3.4 Place concrete in continuous horizontal layers, with thickness of each layer generally not exceeding 300 mm. Carefully regulate method of depositing concrete so as to produce approximately horizontal surfaces on each layer.

7.10.3.5 Have tremie and tremie hopper completely full of concrete during entire placing operation in order to maintain sufficient head.

Keep flow continuous, and in no case interrupt, until placing of concrete is completed.

7.11 Quality Assurance/Quality Control (Qa/QC)

Quality Assurance/quality control shall conform to the requirements as specified in this contract.

7.12 Measurement And Payment

7.12.1 Concrete

The quantities of concrete shall be the calculated volumes in cubic meters for each wach grade of the concrete actually placed (Insitu) in accordance with the approved drawings.

The rates for concrete shall include all materials (expect for reinforcing steel), all labor, formwork, mixing, placing, vibrating, finishing, curing, and repair of surface defects.

No deduction shall be made in the measurement of concrete for openings in slabs and walls of 1 square meter or less, chamfers, nosing, bolts, holes, reinforcement, structural steel sections and the like.

The rates for concrete shall include for all formwork, including struts and supports required to support concrete below ground level, subject to external pressure and forces. The rates for concrete shall include preparation of construction joints, cleaning and complying with all the requirements of this Specification.

The rates for concrete shall include for the costs of tests on material and concrete in accordance with the requirements of the Specification.

All reinforcement and is measured separately.

7.12.2 Reinforcement

The unit rate for the reinforcing steel in tons shall include all materials, detailing fabrication, labor, cleaning an specified, necessary wires, temporary supports, spaces blocks or other material required for fabrication and installation of the reinforcement and for all other work in providing, fixing and maintaining the shown on the drawings or specified.

No allowance shall be made in the weight of the reinforcement for rolling margin. No

allowance shall be made for waste materials cut from stock length; only the calculated weight of the reinforcing steel shown on the approval drawing shall be submitted for payment, the rates for fabric reinforcement shall include for all extra material at laps, for all cutting, bending, binding and waste and supporting in position where required. For fabric reinforcement laps shall be 150 millimetre side and end unless otherwise described.

7.12.3 Precast Concrete

The quantities of concrete shall be the calculated volume of the concrete in cubic meter actually placed in accordance with the approved drawing.

The rates for precast concrete shall include for all necessary dowels, plugs and cramps, mortises, all moulds, hoisting, slightly rounded edges if required, setting and pointing in mortar, treating all surfaces to form key for plaster or finishing fair or exposed faces as necessary, protection, cleaning down and leaving perfect on completion.

The unit price for precast concrete shall include all formwork and erections of precast units to the position.

7.12.4 Expansion Joints

Measurement for payment of expansion joints will be made on number of meters of joint material-furnished and installed at site as shown on the approved drawings or as approved by the Owner.

The unit price shall include all material, labor and equipment for completion of the work.

8. PILINGS

8.1 Scope

This section of specification consists of the requirement for manufacturing, supplying driving of piles, mobilization of equipment, erection and the like in accordance with and to the dimensions shown on the construction drawing.

8.2 General

The buildings and switchyard foundation may be constructed on load-bearing bored piles/driven piles. Setting out of the bored driven piles position shall be carried out by the Contractor in the presence of the Supervisor. A proper record must be taken and the Contractor is solely responsible for their correct position.

Boring works shall be carried out mechanically and by a specialist enterprise, to whom prior approval must be obtained from the Employer.

The length of each bored/driven piles will be in accordance with geotechnical survey. However, the actual length of each pile must conform to the depth of the bearing stratum and be determined on site by the Supervisor. Where the bored hole need to be prevented from soft earth or influx of water and where casings.

Contractor shall furnish all labor, material and equipment, necessary design, to fabricate, deliver, install and test the piles, complete as specified herein and shown on the approved drawing.

8.3 Codes And Standards

The following codes and standards are specifically applicable to the design, manufacture and testing of the work included in the Specification :

- ASTM : American Society for Testing and Maintenance.
ACI : American Concrete Institute.
JIS : Japan International Standard

8.4 Pile Type

PROPOSAL

A proposal shall submit for the Driven Piles or Bored Piles. The Contactor shall submit with the Bid proposal details or the proposed pile including the outside dimension.

Contractor shall be fully responsible for furnishing the dimension required for driving sound piles or bored piles. Concrete strength shall also be sufficient to withstand ground pressure from driving adjacent piles.

8.5 Materials

- (a) The Driven Piles or Bored Piles shall conform to requirements of ACI 313-1983 and ACI 543-1974 or JIS A 5335-1987 and JIS B 3536-1983 (or latest). All pile shall be new and shall be made locally.
- (b) Piles shall be supplied free from harmful defects and of good commercial finish with regard to smoothness and freedom from loose scale and rust.
- (c) The certificate of test performed on material to be used for piles shall be submitted to the Owner prior to pile acceptance and manufacturing.
- (d) When requested by the Owner the Contractor shall accompany the Owner to the place of manufacture to witness test and inspections carried out on the piles.
- (e) For each consignment of piles delivered to the site, the Contactor shall submit to the Owner, copies of the manufacture's certificate.

8.6 Submittal

Before commencing the work, the contractor shall prepare and submit to the Employer approval, the following:

- a) Construction and shop drawings
- b) Quality Assurance procedure

No more than three (3) weeks after completing the works, the Bidder shall submit a Quality Control (QC) report in accordance with this specification and specification, concrete works.

8.7 Driven Piles

8.7.1 Design Criteria

- a) The Driven Piles shall indicate in the Contractor's detail drawing that have been designed for an allowable of load with a safety factor 2.0
- b) If prestressed is used, concrete compressive strength up to minimum design 500 kg/cm²and for conventional concrete pile shall be 225 kg/cm²
- c) Prestressing reinforcement shall be steel stand conforming to JIS G 5335 and the prestress steel breaking's strength is 160 kg/mm².
- d) All other non prestressing reinforcing shall be deformed steel bars conforming to JIS G 3112 grade 40 or ASTM A 615 M Grade 400.

8.7.2 Jointing

Splicing of piles performed by "piles Manufacture Procedure" or approved by the Owner.

8.7.3 Soil Data

Soil investigations to obtain the necessary soil data will be performed by the Contractor.

8.7.4 Concrete Pile Manufacturing and Transport

- a) Length of concrete piles shall be determined as to allow proper handling of concrete piles, transport and driving and subject to Owner's approval.
- b) Transport of completed piles shall be such as not damage to piles.

8.7.5 Lines and Grade

- a) The Contractor shall lay out lines and grades and be fully responsible for correctness of such lines and grades and for proper execution of the work to such lines and grades.
- b) All surveying shall be in accordance with the specification.

8.7.6 Piling Equipments, Installation

a. Driving equipment

The Contractor shall submit with the Bid proposal full details of the proposed pile driving equipment and the method of carrying out the work. Such information shall include : a full description of frame, hammer and packing, the method of handling and pitching piles and supporting them during driving and proposed driving procedure to obtain the penetration and accuracy required. The piling equipment shall be capable of driving the piles to the ultimate resistance of 2 times nominal compression capacity / design load capacity.

b. Length of piles

The length of piles shall be as necessary to develop the required pile capacity. The contractor shall determine length of piles based on geotechnical data and shall be proven by pile load test.

c. Setting out

The main setting out for the piles is to be completed prior to commencement of piling. Secondary or individual pile setting out is to be completed and agreed upon not less than 8 hours prior to commencing work on the piles concerned. All main setting out points, lines stations and the like are to be maintained safe and

undisturbed.

8.7.7 Driving on Piles

- a) All piles shall satisfy the tolerance for position and inclination as stated herein. The deviation in position of the as driven centerline of a pile or the projection of its centerline from the pile center point as shown on the setting out drawings shall not exceed 75 mm when measured in a horizontal direction at the defined level. Deviation from vertical piles and batter piles shall not deviate by more than 2 in 100 from the specified batter.
- b) If piles are installed out of plan position or line beyond allowable tolerance, the piles shall be extracted or additional piles shall be driven, as requested by the Owner, to properly provide for load conditions and to avoid overstressing of piles. Manipulation of piles to force them into proper position or line will not be permitted. The Contractor shall be responsible to extract and / or drive additional piles as noted above at no cost to the Owner.
- c) Any damaged pile shall be abandoned, replaced or repaired as approved by the Owner at Contractor expense. Abandoned piles shall be driven as requested, to provide for load conditions and to avoid overstressing of piles. The Contractor shall be responsible to drive additional at no cost to the Owner.
- d) Piles shall be driven until the required final set is achieved. If piles do not achieve the required final set at the specified depth, pile shall be driven deeper until specification in met and upper portion shall be extended by welding.
- e) Driving of production piles shall not begin until the evaluation of preliminary pile load tests for tension load, lateral load and compression load to failure has been completed.

8.7.8 Pile Cut-Off

On completion of the driving of the piles to the levels approved by the Owner, the heads of all piles shall be cut off the level indicated of the drawing. Cut-off piles at elevations indicate only after there is no danger from upheaval. All cut-offs by him from the Project site.

8.7.9 Extraction of Piles

When extraction of piles is required, it shall be carried out using efficient extraction equipment or adequate capacity. The extraction equipment shall be correctly positioned over the pile to minimise damage to the pile head and to prevent any major disturbance of the supporting ground. Pile head damage during extraction and pile toes found to have been damaged during initial driving are to be trimmed with a clean cut perpendicular to the pile axis prior to redriving . Extension pieces shall be added as necessary to restore the pile to its original length.

8.7.10 The Piles Connection with Pile Caps

Adequate structural connection between the piles and the pile caps shall be provided to suit design taking into account the seismic requirements.

8.7.11 Records of Pile Construction

During the course of the work, the contractor shall maintain a complete record of pile construction and the Contractor shall submit to the Owner, in approved format, a record

of each pile. Each pile record shall be submitted immediately after completion of each pile and shall include the followings:

- Type pile
- Pile number and all principal characteristics of the pile including dimensions
- The depth and rate of penetration, in relation to site datum, for the length of the pile
- Details of driving and installation sequence progress, including dates, times, equipment used and personal (operator, Owner, etc).
- The equipment hammer model number, weight and rated energy
- Number of hammer blows for each 300 mm of driving / penetration
- Actual location of piles as driven, with variations from plan locations indicated
- Variations in plumpness or batter
- Set on completion of the initial drive and final set on completion of the final redrive
- Any unusual phenomena encountered in driving piles
- Depth and type of soil strata
- Observation of ground water level and ground water inflow
- Name of Inspector for each pile
- Cushion material identification when changed, when material added
- Tip elevation when driving if completed
- Cut-off Elevation
- Depth and size of auger (if required).

8.8 Bored Piles

8.8.1 Design Criteria

- a) The safety factor F against pile failure shall be $F = P_{\text{failure}} / P_{\text{effective}} = 2.0$ the allowable concrete stress be limited to 75 kg/cm^2 .
- b) All detail with respect to the pile dimensions, length, reinforcement, cover plates etc. Shall be shown on the Bidder's shop drawings, and shall be subject to approval by the Employer.
- c) Concrete compressive strength up to a design minimum 225 kg/cm^2 .
- d) All reinforcing shall be deformed steel bars confirming to Grade 400 after ASTM A 615 M.

8.8.2. Piling Equipment, Installation and Workmanship

8.8.2.1 Boring Equipment

- a) The Bidder shall submit with the Bid Proposal full details of the proposed pile boring equipment and the method of carrying out the work, such information shall include, a full description of the frames, lifting devices and other equipment needed for the installation.
- b) The equipment shall be capable of boring through bearing strata, boulders, shales, staff clays, gravels, sand and limestone, and shall be capable of shunking bore holes in diameters within the range of 400 mm to 600 mm and down to depths of 40 meters.
- c) The diameters of both augers and clearing bucket shall be least equal to the

diameters of pile to be installed. Where inclined rock surfaces are encountered, a coring bucket shall be used to level the rock surface before commencing with chiselling or coring. The Bidder shall allow in the unit rate of the pile costs for consequent enlargement of the pile arising from over boring, including additional concrete resulting from such enlargement.

8.8.2.2 Length of Piles

The length of the piles shall be as necessary to develop the required pile capacity. The Bidder shall determine length of piles based on geotechnical data and shall be proven by pile load tests.

8.8.2.3 Setting Out

The Bidder shall provide all pegs, rods, survey instrument, concrete pasts ect. Needed for setting out the works. The Bidder is to ensure that boundary marks defining the limits of Owners property are in their correct positions. The Bidder shall be responsible for setting out the piles from the approved drawings and boundary marks, and for date ~~guarding the position and level of all reference pegs, boundary and bench marks used for setting out the piles.~~

8.8.2.4 Boring on Piles

- a) All piles shall satisfy the tolerances for position and inclinations as stated herein. The deviation in position of centre of pile or the projection of its centre line from the pile center point as shown on the setting out drawing shall not exceed 75 mm in any direction from the true position of the same pile, provide also that the true centre of pile shall not deviate laterally from the true centre of the same pile by more than 40 mm.
- b) If any pile has been installed out of plan or line beyond allowable tolerance the Bidder shall be responsible to remedy as noted above as no cost to the Employer.
- c) Piles shall not be bored so close to adjacent piles which have been recently cast and containing workable, unset or fresh concrete such that a flow of concrete may be induced from or otherwise causing damage to those adjacent piles.
- d) No pile shall be bored or pile casing be driven nearer than five times its diameter (measured centre to centre) from an unfilled pile borehole or from uncased concrete pile where the concrete had been placed less than 24 hours previously.
- e) On completion of boring and immediately prior to casting, all loose, disturbed or remoulded soil or rock shall be removed from the base of the pile. Unless otherwise agreed, cleaning of the pile base shall be carried out by means of a flat bottom cleaning bucket. In case of deep piles with lengths in excess of 50 meters or where debris at the bottom of the bore cannot be broken down sufficiently to facilitate extraction by cleaning bucket method, the air lift (grab bucket) method may be employed in combination with the flat bottom cleaning bucket to clean the base of pile. In such cases, a final round of cleaning by the flat bottom bucket should always be carried out before casting can proceed.
- f) In the event of rapid loss of drilling fluid from the pile excavation, the excavation shall be backfilled without delay with available material up to a level where no further loss of drilling fluid is observed. The Bidder shall investigate and determine the cause of fluid loss while the pile excavation is left to stabilise under the action of the drilling fluid. Based on the outcome of his investigation, the Bidder shall submit

- for agreement his proposed method of construction before resuming pile construction.
- g) All reasonable steps shall be taken to prevent the spillage of drilling fluid on the site in areas outside the immediate vicinity of the bore. In particular, discarded bentonite shall be removed from the site without delay. Any disposal of bentonite shall comply with the regulations of the local controlling authority.
 - h) Any damage pile shall be abandoned, replaced or repaired as approved of the Employer at the Bidder's expense. Abandoned piles shall be filled with soil and no cost to the Employer. Additional piles shall be installed as requested, to provide for load conditions and to avoid overstressing of piles. The bidder shall be responsible to install additional piles as no cost to the Employer.

8.8.2.5 Concreting

- a) The requirements of the Concrete Specification shall apply to the construction of bored piles.
- c) The concrete for each pile shall be from the same source. The Bidder is to ensure that the supply from what ever source (whether site-mixed or ready mixed) is of sufficient quantity so that concrete for each pile shall be placed without such interruption as would allow the workability of the previously placed batch to have deteriorated significantly.
- c) All bored holes shall be concreted within the same day. In the event of rain, the Bidder is to provide adequate shelter to keep the hole dry and to concrete under cover.
- d) The method of placing and the workability of concrete shall be such that a continuous monolithic concrete shaft of the full cross-section is formed. The method of placing shall be approved by the Employer. The Bidder shall take all precautions in the design of the mix and the placement of concrete to avoid arching of the concrete in the pile shaft. No spoil, liquid or other deleterious matter shall be allowed to contaminate the concrete.

8.8.2.6 Pile Cut-Off

Concrete shall be finished not less than 500 mm above the cut-off level ("overcast") to ensure that all concrete at and below cut-off level is homogeneous and free of laitance and deleterious matter. A thicker overcast may be required by the PT. PLN depending on site conditions, and this shall be carried out without extra cost. The overcast shall be chipped off level later by the Contractor.

8.8.2.7 Connection Between Piles and Pile Caps

Adequate structural connection between the piles and the caps shall be provided to suit the design requirement to accommodate the seismic force.

8.8.2.8 Records of Pile Construction

During the course of the work, the Bidder shall maintain a complete record of pile construction and the Bidder shall submit to PT. PLN, in an approved format, a record to reach pile. Each pile record shall be submitted immediately after completion of each pile and shall include:

- a) Type, location and site of pile.
- b) Pile number and all principle characteristics of pile including dimensions.

- c) Details of boring and concreting sequence progress, including dates, times, equipment used and personnel (operator, Employer, etc).
- d) Actual location of piles, with variation from plan location and inclination as indicated.
- e) Date and time of Boring.
- f) Weather Condition.
- g) Ground level before commencement of pile installations.
- h) Pile cut-off level.
- i) Length Temporary casting.
- j) Any unusual phenomena encountered
- k) Depth and type of soil strata.
- l) Observation of ground water level and ground water in flow.
- m) Name of inspector for each pile.

8.9 Pile Load Testing

8.9.1 Scope of work

- a) Work specified under this section includes furnishing all labor, materials and equipment for compression, tension and lateral load testing of the piles.
- b) Drive test pile to indicate depth and / or indicate resistance.
- c) Keep a penetration record of test piles and anchor piles in accordance with requirements set forth in clause 8.7.11 above.
- d) The pile load testing shall be carried out to the satisfaction of the Owner.
- e) Upon completion of the preliminary pile load testing, the Contractor shall cut-off the preliminary test piles, as directed by the Owner and dispose of the cut-off portion.

8.9.2 Method of test

8.9.2.1 General test provisions

- 1) Perform tests to the test load indicated on the approved drawings or as specified herein. Test equipment for the compressive load test shall be capable of applying the required test load. Test equipment for the lateral and tensile load test shall be capable of applying a test load equal to 300 % of the test design load shown on the approved drawings.
- 2) Care shall be taken to ensure that the load applied by the hydraulic jack is coaxial with the pile.
- 3) Maintain continuously during test period. If a test is stopped before completion, and the load is wholly or partially removed from the test pile due to improper or insufficient loading, yield of supports or connections, malfunctioning of measuring and testing equipment or after mechanical reasons or for reasons which the test abandoned and replaced by a new test on another pile at and adjacent location at on additional cost.
- 4) Prior to driving each preliminary test pile, the Contractor shall drill a borehole located between 1 and 2 meters from each test pile. The boring shall consist of continuous sampling with Standard Penetration Test (SPT) being performed at 2.0 m intervals in the soil continuous sampling. A Dutch cone penetration test shall also be performed at each boring location.

- 5) Before commencing any test, the Contractor shall submit for approval full detail of his proposals including the datum beam arrangement and location of supports. Working piles shall not be used as tension reaction piles.
- 6) Sufficient number of anchor piles shall be driven to prevent excessive movement of anchor piles. All devices for measuring the settlement of piles shall be sheltered and rigidly attached to firm and independent support driven not less than 2,5 m from the nearest point of the test pile or anchor piles.
- 7) The calibrated load cell shall be used for the load measurements.

8.9.2.2 Compressive load test

- 1) Perform compressive load test on individual piles in accordance with applicable requirements of ASTM D 1143.
- 2) Hydraulic jack and anchored reaction member method shall be used to apply the test load. Jacking against production piles acting in tension shall not be permitted.
- 3) Prior to the start of production pile driving, compressive test to failure shall be performed on individual test piles driven for testing purpose. The location of the test piles shall be as indicated on the approved drawings.
- 4) Compressive test shall be performed on individual production piles selected by the Owner. The approximate location and number of test shall be as indicated on the approved drawings.
- 5) Test load for preliminary loading test, and in excess of standard load test for production piles shall be applied in accordance with the loading procedure as specified in ASTM D 1143. The cyclical load test as specified in ASTM D 1143 shall be included in the preliminary pile loading test. Cyclical load tests for production pile load tests only if indicated on the approved drawings.
- 6) For the preliminary compression tests, loading shall be increased as specified in ASTM D 1143 until failure or when 200 % of the test design load is reached. Loading for the production piling test shall be increased as specified in ASTM D 1143.
- 7) Monitor pile head deflection using a minimum of 3 dial gages, mounted to an independent frame and located radially about the pile.
- 8) Failure shall be defined as the load at which vertical deflection or the pile head exceeds 50 mm.

8.9.2.3 Test equipment and materials

- 1) Provide all equipment and materials required for the tests and remove all such equipment and materials at conclusion of tests.
- 2) Submit drawing of the test arrangement, including full data, for equipment and materials, for review and Owner's approval.
- 3) Test Results: Submit test results complete with tabulation of all test data to the Owner immediately after conclusion of test. Data shall include, as minimum, calibration results of all test loading equipment, all dial gauge readings at each increment and decrement of load, time duration of test with time started and time completed and any unusual occurrences during testing.

8.9.3 Number of Test

1. Before piling work commences, preliminary pile tests shall be carried out.
2. The preliminary load tests shall be carried out on 1 pile. The location of the piles will be designated by Owner.

8.9.4 Measurement for Payment

Pre-production piles furnished for testing only will be measured by the meter and shall include furnishing and driving the pile as required by Specification for Fabrication and Installation of Steel piles (or Reinforced Concrete and Prestressed Concrete piles) for the complete pile. Piles furnished for testing only are the reaction piles and pre-production piles selected for compression testing.

Testing piles will be measured by the number of pile type test (Vertical compression to failure)

The unit price for each load test shall include the frame, auxiliary piles, drilling of bore hole, labor, instrumentation, measurement of settlement, reports and all other work and material necessary to satisfactorily complete the pile load tests. No payment will be made for improperly conducted load tests which must be repeated.

8.10 Pile Quality Assurance/Quality Control (Qa/Qc)

1. QA /QC shall conform to the requirements of Section "quality Assurance & Quality Control".
2. The QA /QC procedure shall include the requirements defined in this specification, in particular in Subsection 5.6 and aspect such as:
 - Definition of design requirements.
 - Compliance with the requirements.
 - Material testing.
 - Shop tests and inspection procedures.
 - Transportation.
 - Tests prior to start of works.
 - Tests during execution of works.
 - Control procedure for materials fabricated at site
 - Construction control procedures.
 - Tolerance.
 - Inspections of Erection and Installation.
 - Erection tests (e.g. load tests).
 - Commissioning and testing.

8.11 Measurement For Payment

This item will be measured in meters (with two fraction of decimals) as the number of meter of vertical or batter pile satisfactorily installed and as measured from the tip elevation to the design cut-off elevation along the centerline of each pile accepted. This item includes furnishing, storing, handling, supporting, driving, cut-off and all other work necessary to complete the pile.

9. MORTAR

9.1 Lemi shall be pressure hydrated and commercially available material. Total unhydrated calcium oxide (CaO) and magnesium oxide (MgO) shall not exceed 8 percent.

9.2 Mixing

Mixing of mortar shall be generally as specified in Sub-section 7.4.8. The ingredients shall be accurately measured and thoroughly mixed before water is added. The amount of water shall be the minimum necessary to produce a workable and compact mass of the correct consistency. An approved admixture to improve workability may be used if the Contract wishes to do so provided it used in accordance with the manufacturer's instructions.

Small quantities of mortar shall be mixing in one time and shall be used within thirty (30) minutes of preparation. Any mortar not than used shall be discarded. Retempering of mortar will not be permitted.

9.3 Mortar Grades

The mortar mixes to be used in the works shall be referenced and proportioned as follows:

Grade A : One (1) volume cement and three (3) volumes fine aggregate.

Grade B : One (1) volume cement and one (1) volume lime putty and six (6) volumes aggregate.

9.4 Uses Of Mortar Grades

Unless otherwise specified, ordered or shown on the drawing, the various mortar grades shall be used in the works as fallows:

Grade A : Grouting of foundation and other steelwork, screeds to falls in cable troughs, floor screeds pointing of walls and bedding and jointing generally below damp proof course level or ground level.

Grade B : Walls generally above ground level or damp proof course level.

9.5 Additives Generally

Air entraining, water reducing, set accelerating, set retarding, or other additives shall not be used except with the written of the Owner, following comparative concrete durability and compression strength tests carried out on concrete made with and without additives.

Test with additives shall give durability and compressive strength at least equal to those without additives except that water reducing agents shall increase the compressive strength by ten (10) percent. The use of all additives shall be strictly supervised.

10. CABLE DUCTS AND TRENCHES

10.1 General

The Contractor is responsible for all civil works required for the cable runs between switchgear and buildings, whether cables are buried, in ducts, or in cable trenches. Cable entries into buildings shall be through ducts or in cable trenches.

Trench covers outside buildings shall be of reinforced concrete, designed for the maximum likely imposed loads appropriate to their location. All buried cables must be protected by means of approved cable tiles, or similar.

10.2 Construction

All cable ducts are to be constructed in concrete following Clause 7. and drawings. Where indicated drain holes and a general fall for drainage must be provided. The openings and pipe positions at the trench shall be accurately located.

The corbels or rebates at the trench walls must be horizontally formed so that the cover plates would be seated flush.

11. STRUCTURAL STEELWORK

11.1 SCOPE

This section consists of the requirement for the structural steelworks in skeleton of buildings.

11.2 References

The Contractor shall have full effort to apply Indonesian Code. Other recognized standard may be used.

11.3 General

Checked shop drawings and calculations shall be submitted to the Owner for approval before any material is fabricated. Drawings shall show all connection details, erection plans, temporary bracing, cutting lists, etc.

Approval by the Owner based on the checking of general design and arrangement only, shall not relieve the Contractor of his responsibility for the correctness of all measurements, detailing, fabrication, alignment and erection of the work.

Should amendments or revisions be required by the Owner further drawings and calculations shall be submitted until the Owner's approval is obtained. The Contractor shall supply additional copies of the approved drawings as required by the Owner.

Once approved, no changes or modifications shall be made without the Owner's consent in writing.

Unless otherwise indicated ; the surface of structural steelwork should be sand blasting cleaned, before proceed structural steelwork painting.

11.4 Protection Of Steel And Ironwork Generally

11.4.1 Galvanizing

All steel and ironwork is to be galvanized or painted and shall be fabricated before galvanizing or painting.

Site drilling or cutting of steel will generally not be permitted, but any agreed to be necessary shall be carried out in an approved fashion, and the exposed bare metal treated immediately with zinc-rich or other approved metallic primer as approved or directed by the Owner.

11.4.2 Shop Painting

With the exception of steelwork which is to be encased in concrete galvanized, all surfaces of steelwork shall be shot blasted to a commercial gray finish using chilled iron shot of an approved type and grade to a profile height of 40 microns mini.

All surfaces of steelwork shall then be painted with one Epoxy metallic zinc holding primer of an approved type and make within one hour of shot-blasting, to be applied by airless spray.

All surfaces of steelwork which will be in accessible after fabrication of the steelwork, such as back to back angles etc., shall then be painted two coats of red lead and two coats of Micaceous Iron Oxide paint.

Contact surfaces of steelwork shall be painted two coats of red lead, other than those included above.

All areas of painted surfaces shall be made good of any damage incurred during stockpiling and delivery to Site prior to erection.

11.4.3 Site painting

All materials shall be the best of their respective and shall be supplied from an approved Manufacturer and suitable for the climatic conditions of site.

The contractor shall undertake to arrange with the Paint Manufacturer who supplies the paints and materials for this contract for technical supervision by the Paint Manufacturer at intervals of not less than once per week on the Site during the carrying out of this contract at no extra cost to the Employer.

All materials shall be applied in strict accordance with the Manufacturer's instructions and shall not be diluted in any way unless specifically stated and agreed by the Manufacturer and the primings and under coatings shall be those recommended by the Manufacturer for their respective finishing paints.

All materials shall be delivered direct from the Manufacturer on to the Site in sealed containers on which maker's name and brand are clearly displayed, and shall be stored to comply with all requirements for the preservation of the paints.

The whole of the work shall be executed to give a uniform finish and is in all cases to be equivalent in appearance to the existing newly painted work.

If any of the painting work deteriorates from any cause other than by mechanical damage by others the contractor shall thoroughly scrape and remove the damaged paint work and repaint the area affected in accordance with the Specification and to the satisfaction of the Owner.

A color schedule for all painting works will be made available to the contractor prior to commencement of the works.

The contractor is to carry out at the Owner direction the painting of sample panels.

Sample panels shall be of a size directed by the Owner and shall be preserved as examples and removed or obscured when directed by the Owner.

All finishes shall be such as to completely cover and obscure the base construction and priming coats such that additional coats of paint will not effect a significant improvement.

All finishes shall be consistent in color and free from brush marks and all irregularities and defects in the paint surface.

Drying times shall be such that dust contamination of the finished surface is kept to a minimum consistent with a good hard gloss finish.

No painters' materials shall be emptied down gullies or wastes to sanitary fittings.

All rubbish is to be cleared from time to time as it accumulates, and the premises on completion are to be left clean and fit for occupation.

11.5 Materials

11.5.1 Structural steel

The whole of the steel used in the works except steel rods and fabric for concrete reinforcement shall conform in every respect to the requirements of approved standards.

11.5.2 Electrodes

Electrodes shall be suitable for the type of weld, the duties imposed on the weld and the properties of the parent metal.

11.5.3 Bolts and washers

All bolts shall be fitted with one flat steel washer under the nut appropriate to the grade of bolt used.

High strength friction grip bolts (HSFG) are permitted.

11.6 Workmanship

11.6.1 Testing and inspection

The contractor shall supply to the Owner copies of the manufacturer's certificates certifying that the steel as used in the works is of a quality fully complying with the Specification.

When so instructed by the Owner the contractor shall provide samples of the steel to be used in the works for tests to be carried out at an independent laboratory approved by the Owner.

The whole of the steelwork manufactured, fabricated and erected under this contract shall be subject to inspection by the Owner, who shall have access to the fabrication shop off site for the purpose of inspection at all reasonable times, and the contractor shall provide all necessary facilities, including transport for the Owner to carry out such inspection.

Should the works, or any part thereof, fail to pass any test, or in the opinion of the

Owner fail to comply with the Specification, then the contractor shall immediately take such action as is necessary to ensure that the works are made to comply with this specification. All defective materials and workmanship will be rejected and the same shall be replaced and reconstructed at the contractor's expense.

11.6.2 Fabrication

Fabrication of structural steelwork, cutting, drilling, welding, assembly preparation and protection of surfaces shall as far as practicable be carried out before steelwork is delivered to site.

All bars, plates, tubes to rolled sections shall be straightened, freed from twist or otherwise trued before any work is done on them.

All holes shall be drilled in the solid to sizes indicated on drawings.

All rough edges and burrs, due to drillings, shall be removed.

All notches and re-entrant cuts shall have their corners rounded to a minimum of 12 mm radius.

Ends of universal beams, joints, channels, angles, tees and tubes shall be cold sawn to exact lengths, true and square.

The ends of all columns shall be machined to butt at column bases, caps and splices. All members when finished shall be free from any distortion or twist.

All such work of fabrication as is reasonably practicable shall be completed in the shop and as possible the bolt head shall be on the upper side of the connection.

All girders that bed or fix against other members shall have their ends finished true and square and be of the strict length shown on the approved drawings. In all cases holes used for connections shall be in their true position.

11.6.3 Erection

All steelwork shall be effectively stayed as necessary during the carrying out of the works.

All stanchions shall be placed in true position and shall be strictly vertical and all necessary packing shall be provided for setting the stanchions to correct levels prior to grouting.

End clearance for beams shall be kept to a workable minimum but should allow the structure to be erected without any straining. Reasonable springing and rocking of stanchions shall be permitted to an extent approved by the Owner.

The finished structures shall be plump, level and true to linear dimensions, within the following tolerances:

(a) Stanchions bases:

Level to within 4 mm of levels shown on contractor's approved drawings and horizontal alignment to be within 4 mm of both true grid lines.

(b) Stanchions :

Not more than 4 mm in 4 meters out of plumb in any direction and not more than 7 mm out of plumb in the total height of stanchions of two or more stores.

(c) Beams :

Top surfaces to be level within 4 mm of levels shown on the contractor's approved drawings.

11.6.4 Tests after erection

All lifting beams shall be tested after erection. On successful completion of these tests the contractor for the beam and supply to the Owner in triplicate completed test certificates.

11.7 Handling And Storage

All material shall be properly protected to prevent damage during transportation. Bolts, nuts, washers and other small loose items shall be packed in boxes. Plates and section edges prepared for field welding shall be protected. Floor plate shall be bundled.

In all cases where finished steelwork is exposed, in addition to care being exercised to ensure sound work, regard shall be made to finish.

Before leaving the marks, all steelwork shall be clearly marked to conform with the key plans.

The contractor shall define all centerlines of girder bearings with all the care necessary to ensure the whole work coming together in proper position.

All bearing levels must be determined or checked by the contractor relative to a datum previously agreed with the Owner.

The contractor shall define all centerlines of girder bearings with all the care necessary to ensure the whole work coming together in proper position.

All bearing levels must be determined or checked by the contractor relative to a datum previously agreed with the Owner.

The contractor shall furnish templates of the bolt spacing for all stanchions and wall bearings.

Holding down bolts, assemblies, templates, tubes and washers shall be delivered to the site in sufficient time to position and build them into the foundations. No boxing out shall be permitted.

These bolts are to be screwed sufficiently to allow for them to project above the finished foundation levels.

The method of welding shall be subject to the approval of the Owner and the contractor shall accept full responsibility for all such welding work being executed.

All welding shall be carried out by certified welders and the contractor shall produce such evidence of competency as the Owner may require before any welding is commenced at the works.

Intermittent welds shall not be used without the prior approval of the Owner. The contractor shall carry out the nondestructive testing of all butt welds subject to tensile stresses, those made in the fabrication shop shall be tested in the fabrication shop and those made on Site shall be tested on the site.

The results of such tests shall be submitted to the Owner and the contractor shall provide all facilities to the Owner to enable him to be present at such tests.

The contractor shall unload and store all fabricated steel at the site. If any structural steel and accessories arrive at the site in bent or distorted conditions, the connections

to the members at his own expense and with the that has been damaged in the course of shipment to the extent of seriously effecting the properties of the Owners and cannot be replaced by a new member at the contractor's expenses.

Proper care shall be taken in storing and handling of fabricated materials at site to avoid damage to painting.

Stacking shall be done clear of the ground and in order of erection as far as possible to reduce multiple handling.

12. MASONRY WORK

12.1 General

Block work shown on the approved drawings shall be built using calcium silicate (sand-lime) blocks of approved local manufacture complying generally with the standards regarding constituent materials, classification and compressive strength.

12.2 Materials

Brick units shall be sound, well burned, free from defects that would impair its strength or effect its service- ability.

The contractor should submit locally manufactured sample of six pieces for approval.

12.3 Mortar Materials

Lime shall be pressure hydrated and commercially available material. Total unhydrated calcium oxide (CaO) and magnesium oxide (MgO) shall not exceed 8 per cent.

Cement shall be of grade S - 325 as specified in NI - 8, chapter 3.2.

Sand shall be clean, fine, sharp granules, free from foreign or deleterious matter.

Water shall be clean and free from acid, alkalis, oil or organic matter.

The contractor should submit samples of cement, sand and lime for supervisor's approval.

12.4 Mortar Mixtures

There shall be two types of mortar mixtures for brick masonry :

- i. One (1) part PC : two (2) parts sand as type - C
- ii. One (1) part PC : four (4) parts sand as type – D

Type C shall be used on all brick masonry from the first layer of brick up to 30 cm above finish floor and in bathrooms, toilets and other wet areas up to 160 cm above finish floor.

Type D shall be used on the rest of the brick masonry.

12.5 Bricks Masonry Laying

Lay brick masonry in accurately spaced courses, level, plumb and true to line.

Soak brick units in clean water for one hour before laying. Units shall be damped when laid. Lay brick in running bond with joints approximately fifteen (15) mm wide.

Where brick masonry walls cross the recessed floor cable trenches provide and install

precast concrete lintels of sufficient size and strength to support and carry masonry walls across the trench spans.

Reinforced all masonry walls with cast-in place reinforced concrete pilasters, formed flush with the masonry surfaces for cement plaster finish.

Provide concrete pilasters for every 9 square meters of masonry wall surface, plus at all corners and door jambs.

12.6 Provisions for Other Works

Provide chases, recesses, openings, anchors, etc., necessary for installation of later work. Build in wood buck, nailing blocks, anchors, boxes, piping, sleeves, fixtures, flashings and various accessories as needed by own work or supplied or set by other works.

Install items furnished under other sections, including built-in miscellaneous metal items, built-in carpentry specialties.

12.7 Preparation For Plaster Finish

Masonry to receive plaster finish shall have joints raked to provide proper keying for plaster bond.

12.8 Curing

Spray masonry surfaces with water twice daily for a period of 3 days, or until the surface receives a plaster finish.

12.9 Protection

Where exposed to weather, protect top of masonry with water tied material in such a way that it will protect the completed work. Masonry wall shall set for 48 hours before any load is applied on the completed work.

13. FLOOR CONSTRUCTION AND FINISHES

13.1 Sub Grade

The sub grade shall be thoroughly compacted by hand or mechanical ramming.

If filling is required, it shall comply with the Specification for Bulk Filling and shall be spread and compacted in layers not exceeding fifteen (15) cm. deep.

13.2 Hardcore

Hardcore, as described in the Earthworks and Excavation section of this Specification, shall be spread on the sub grade and thoroughly rammed and compacted to give a total compacted thickness of fifteen (15) cm. It shall be finished true to level and thoroughly blinded with small gravel and sand or similar granular material, spread and compacted to a smooth even surface. During compaction, water shall be sprayed in such manner to get a dense of hardcore layer.

13.3 Impervious Membrane

An impervious membrane shall be laid under ground floor slabs. The membrane shall be laid flat with the minimum number of joints on the sand/gravel blinding layer in a manner that reduces the risk of damage to a minimum.

The siliconised protective paper shall be placed in contact with the sand layer, and joints sealed in accordance with the recommendations of the membrane manufacturer and the whole inspected and approved by the Owner prior to laying a 10 cm thick protective layer of concrete grade 10.0/20.

13.4 Concrete Floor Slabs

Concrete floor slabs shall have a minimum structural thickness of one hundred and fifty (150) millimeters or such greater thickness of concrete grade 22.5/40 as required by the design to safely carry the combination of dead, live loads ; imposed and wind loads or seismic condition, which produces the worst effects in the structure under consideration.

Slabs to be surfaced with screed, terrazzo, ceramic tiles or such like shall be given a class B3 finish.

Slabs to be unsurfaced, or painted, or surfaced with PVC (vinyl) asbestos tiles shall be given a class B1 finish.

The bay layout of floor slabs should be agreed with the Owner before construction commences.

13.5 Floor Slab Finishes

13.5.1 Cast-in-place terrazzo

(a) Requirements.

- (1) This work shall be carried out by men thoroughly experienced in terrazzo laying. The surfacing shall be laid in two layers. The first or base layer shall be forty (40) millimeter thick and shall consist of four hundred (400) kilograms of Portland cement per cubic meter of fine aggregate. The second or top layer shall be ten (10) millimeters thick and consist of five hundred and fifty (550) kilograms of white or colored cement per cubic meter of marble chips shall be subject to the approval of the Owner.
- (2) The terrazzo shall have a dense even surface showing not less than seventy (70) per cent marble chips and the Contractor shall offer a sample of finished surface for inspection and approval before carrying out the floor surfacing.
- (3) The top layer shall be curved by keeping it damp for six (6) days after laying and before initial grinding. The initial and final grinding shall be performed using abrasive grit stones of the proper grade to obtain the approved finish and grinding shall be by electrically driven machine. Hand rubbing shall only be used for areas inaccessible to the machine.

After the initial grinding and rubbing, the surface shall be grouted with neat cement paste of creamy consistency to fill all voids, the cement being colored as necessary to match the final surfacing. The grout shall then be left

for a period of not less than two (2) days before final grinding. The final grinding shall be smooth and free from all imperfections and shall not show a wave exceeding two and a half (2.5) millimeters between dividing strips when tested from splashing or damage of any kind during the grinding process.

- (4) Cast-in-place terrazzo surfacing shall be laid in one (1) meter squares, with ebonite dividing strips between squares. All wall, floors and other work shall be protected from splashing or damage of any kind during the grinding process. After completion all work shall be thoroughly washed and left in perfect condition. Acids shall not be used for cleaning.

13.5.2 Precast terrazzo tiles

(a) Requirements:

- (1) Terrazzo tiles shall have a size of 400 x 400 millimeter square by thirty (30) millimeter thick and consist of a base layer and a surface layer as specified below. They shall be manufactured by the hydraulic pressure method, be of high quality and be properly cured.
- (2) The base layer, approximately twenty (20) millimeters thick, shall consist of four hundred (400) kilograms of Portland cement per cubic meter of fine aggregate. The surface layer, approximately ten (10) millimeters thick, shall consist of five hundred and fifty (550) kilograms of white or colored cement per cubic meter of marble chips of various colors. Both the cement and the chips shall be subject to the approval of the Owner, and the Contractor shall also submit sample tiles for inspection and approval. ~~The final surface of the terrazzo tiles shall not be inferior to that specified for cast-in-place terrazzo.~~
- (3) The tiles shall be accurately laid to level or to gradient as indicated on a Grade A mortar bed twenty (20) millimeters thick, with continuous straight joints. Joints shall not be wider than three (3) millimeters and shall be neatly pointed with grouted colored cement.

(c) Uses :

- (1) Hallway, office, manager room and kitchen at first floor.
(2) Other area or as indicated in the drawings.

13.5.3 PVC (Vinyl) asbestos tiles

(a) Requirements:

- (1) The vinyl tiles have a minimum thickness of three (3) millimeters. The adhesive to be used shall be of a type recommended by the tile manufacturer. Skirting and nosing shall be of approved profile and color.
- (2) The tiles shall be laid on a screeded bed of Grade A mortar as specified below, twenty five (25) millimeters thick well compacted, leveled and trowelled with a steel trowel.
- (3) The tiles shall be laid to an approved design using the specified adhesive in accordance with the manufacture's instruction and all tiles shall be firmly bedded of the edges and base to give a smooth and even surface. Tiles which are cracked or broken or otherwise damaged shall be rejected.

13.5.4 Cement/sand screed

(a) Requirements:

- (1) A screed of 1:3 cement/sand with twenty five (25) millimeters thick shall be applied on all concrete floor slabs whose surfaces will not normally receive any further treatment.
- (2) The surface of the structural concrete shall be thoroughly cleaned from all rubbish, concrete and mortar droppings. Oil and grease patched shall be cleaned with approved agents. The surface of the floor should be roughened to the satisfaction of the Owner, wire brushed and thoroughly cleaned by washing with clean water. Surplus water shall be brushed off and a 1:1 sand/cement slurry brushed over the surface immediately before the laying of the screed.
- (3) The mix shall be one part Portland cement to three parts sand with water/cement ratio as low as possible compatible with workability.
- (4) The finished surface shall be laid in panels of approved size and trowelled smooth to produce a hard, dense and flat surface.

(e) Uses :

- (1) Battery, DC room and storage.
- (2) Auxiliary building.

13.5.5 Granolithic surfacing

Concrete floors subject to heavy wear shall be finished with granolithic surfaces, monolithic with the structural concrete.

The laying of granolithic surfacing shall be carried out by men experienced in this work.

The water/cement ratio shall be as low as possible compatible with workability. The thickness shall be nowhere not less than fifty (50) millimeters and after laying and flat. Surface grouting shall not be allowed and companion and trowelling shall be controlled so that fines are not brought to the surface. The finished surface shall be smooth, hard, dense and flat. Curing shall be as for concrete and the work shall be protected from traffic until hard. ~~Granolithic surface shall be laid in panels not exceeding fourteen (14) square meters.~~

13.5.6 Floor hardness and paint

All concrete floor surface (including granolithic screeds) which are not to be covered with tiles or other covering shall be treated with an approved proprietary hardening liquid applied in strict accordance with the manufacturer's instructions.

Where a colored finish is required an approved floor hardening decorative epoxy paint shall be applied to the surface of the new concrete or granolithic secreted after curing and hardening. The paint shall be an approved proprietary product and applied strictly in accordance with the manufacturers instructions and the work shall be carried out during the maintenance period.

13.5.7 Ceramic Tiles

(a) Requirements

- (1) Ceramic tiles shall be grade No. 1 quality and tile color, size and pattern shall be approved by the Owner.
- (2) The tiles shall be soaked and bedded on a prepared screed, in 1 : 3 by volume cement/sand, with thickness of 5 cm.

The tiles shall be laid square and true with 4 mm wide joints grouted in

matching cement mortar.

- (2) Provide bonding adhesive for separate concrete floor finish up through 10 cm thick.
- (4) The Contractor shall include all cutting and fitting tiles to abutments and protecting ceramic tiles after laying.

The tiles shall be washed and left clean on completion.

(b) Uses:

- (1) Hallway, stair landing, prayer room and locker at ground floor
- (2) Other area unless otherwise indicated.

13.5.8 Clinker tiles

(a) Requirements

- (1) Clinker tiles shall be grade No. 1 quality and the tile size (150 mm x 150 mm x 12 mm) or other approved size and pattern shall also be approved by the Owner.
- (2) The tile shall be soaked and bedded on a prepared screed, in 1 : 3 by volume cement sand mortar with thickness of 5 cm over the based area. The tile shall be laid square and true with 4 mm wide joints grouted.
- (3) The tile shall be installed to meet the Clause 13.5.7.

(b) Uses

- (1) Gallery/patio.
- (2) Other area unless otherwise indicated.

13.5.9 Glazed tiles

(a) Requirements

- (1) Glazed tiles shall be grade No. 1 quality and the tile color, size and pattern shall be approved by the Owner.
- (2) The tiles shall be installed to meet the Clause 13.5.7.

(b) Use

- (1) Toilet
- (2) Other area unless otherwise indicated.

13.5.10 Free access floor (Raised Floor)

(a) Requirements

- (1) Free access floor (false floor), made with vinyl tile over aluminum glazed frame and supporting legs shall be provided on the dustproof painted floor finished as monolithic finish, to ensure the free way of cabling and alternate layout of equipments.
- (2) The height of free access floor shall be 150 mm above the base floor elevation.
- (3) The Contractor shall submit detailed drawing and sample of the free access floor he intend to provide including explanation of setting method to the Owner for approval.

- (b) Uses
 - (1) Telecommunication Room
 - (2) Control & Relay Room

14. BUILDING FINISHINGS

14.1 Plastering/ Rendering and Tiling

14.1.1 Materials

Cement, mortar, sand and water shall be as specified in Clause 9.2 of this Specification and other materials shall be as follows :

Wall Tiles : shall be glazed ceramic.

Mosaic : mosaic for walls shall be glazed ceramic of approved colors and shall be delivered to site mounted to pattern on paper in reverse or on open texture Hessian backing.

14.1.2 Cement/sand mix

Rendering for internal and external work shall comprise of grade C mortar mixed dry in a mechanical mixer until uniform distribution of the material and color are obtained. Sufficient water, and the plaster shall be used as soon as possible after mixing. Plaster shall not be used after commencement of initial set, no setting batch shall be mixed with another.

14.1.3 Internal rendering

Internal rendering shall be applied in one coat, with thickness of sixteen (16) millimeters. The walls shall be wetted before the application of the coat, which shall be finished flat and vertical by straightedge and scored to form a key. The second coat shall not be applied until the first coat has dried out completely

Immediately before application of the second coat, the surface of the first coat shall be wetted and the second coat shall be applied and finished to a smooth, hard and dense surface which is truly flat and vertical. An approved plasticiser may be used in second coat.

14.1.4 External rendering

External rendering where required shall be applied in two coats the first being nowhere less than twelve (12) millimeters thick. An approved waterproofing agent shall be added to the mix. The walls shall be wetted before the application of the first coat, which shall be finished flat and vertical by straightedge. The first coat shall be allowed to dry before a second coat is applied. The second coat shall be applied by machine, to give a 'Tyrolean' finish of uniform thickness and texture. The contractor shall produce samples of the Tyrolean finish for approval before any second coat work is commenced. All external rendering shall be protected from rain and direct sunlight for a period of seven (7) days. The external rendering shall be colored, as directed by the Owner.

14.1.5 Mosaic and Tiling

Walls which are to be finish with mosaic or tiling shall be rendered as specified above

with a single coat to a thickness of twelve (12) millimeters.

For mosaic panels, the rendering shall be finished smooth and the panels fixed an approved adhesive.

Where glazed ceramic tiles are to be applied these shall be fixed using an approved adhesive, or a cement mortar consisting of one part Portland cement to one part sand, as directed by the Owner.

Where a special adhesive is used the rendered surface shall be finished smooth, but where the cement mortar is directed, the rendering shall be finished with a true but slightly rough surface to provide a key for the fixing mortar.

Approved grouting cement shall be applied to flush up all joints and the entire surface wiped clean before the grout has hardened. The joints in tiling shall be drawn with a round pointed key before the grout has set.

14.1.6 Beads and Plaster

Metal angle beads and plaster stops shall be galvanized expanded metal obtained from an approved manufacturer.

Reinforcement shall consist of approved galvanized wire mesh or galvanized expanded metal.

Expansion joints shall be formed of two plaster stops and an approved extruded aluminum cover strip.

The bonding agent shall be polyvinyl acetate (8 per cent concentration) in suspension and used in accordance with the manufacture's instructions.

14.1.7 Preparation

All surface to be rendered shall be clean free from dust, grease, loose mortar and all traces of salts. They shall then be thoroughly wetted, and excess moisture allowed to evaporate before rendering is applied. Before rendering all junctions of dissimilar materials covered by the rendering shall be reinforced.

This shall be apply where walls about columns concrete lintels and similar situation where cracks are likely to develop, and where directed by the Owner. The reinforcing mesh shall be fixed at the edges by stapling, plugging or nailing at intervals of 500 mm or less and as required, and shall be completely embedded in the first coat.

14.1.8 Application and Curing

After preparation of the surfaces to be rendered, the first coat shall be applied to the required thickness between screeds, laid ruled and plumbed as necessary. If a second coat is to be applied, the first coat shall be scratched when nearly set to form a key for the second coat.

The first coat shall be allowed to set completely before the second coat is applied. All plastering or rendering shall be executed in a neat workmanlike manner. All faces except circular work shall be true and flat and angles shall be straight and level or plumb.

Plastering shall be neatly finished up to metal or wood frame or skirting and around pipes or fittings. All metal frame to doors or windows adjacent plasterwork shall be protected by wide adhesive tape from plastering operations the tape being removed after the plasterwork has cured.

Surface described as trowelled smooth shall be finished with a steel or plastic trowel to a smooth flat surface free from trowel marks. Surface described as floated shall be finished with a wood float to a flat surface free from trowel or float marks.

All plastering or rendering shall be cured and protected against too rapid drying by, where practicable draping with Hessian sprayed constantly with water.

14.2 Suspended Ceiling Generally

The type of suspended ceiling shall be as shown on the construction drawings.

Unless otherwise specified or directed, the Contractor shall submit shop drawings showing hid proposed constructional details and layout of the ceiling panels. Materials for framing joints, wall plates, plugs, hangers and the like shall be specified.

Fabrication and erection work shall not commence until shop be finished wrought and so arranged to suit panel sizes.

The underside of all framing joints and wall plates shall be finished wrought and so arranged to suit panel sizes.

Where asbestos ceiling are specified the sheets or tiles shall be screwed to the timber framing as recommended by the manufacturer and approved by the Owner. Damage sheets or tiles shall be rejected.

Plywood ceilings shall be made up from carefully selected sheets or modules with approved edges and secretly nailed to the timber framing at one hundred (100) mm centers and carefully aligned so that joints are within the permitted tolerances.

Joints between panels shall not exceed three (3) millimeters in width and adjacent panels shall not be out of true alignment by more than two (2) millimeters.

Priming and painting of the ceiling panels shall be as specified in this Specification.

14.3 Protection Of Work

All work liable to damage shall be covered up and properly protected and any such damage which may occur shall be reinstated at the expense of the Contractor.

14.4 Moisture Protection

14.4.1 Caulking and Sealing

Caulking and joint sealants are for use in interior and exterior joints, window wall work, glazing and other works if necessary.

14.4.2 Waterproofing

The waterproofing shall be self-adhesive bitumen/ polyethylene membrane of thickness about 1.5 - 2.00 capable of bridging any shrinkage cracks in concrete.

The are to be applied must be dry and swept free form dust.

Prime all surfaces with primer and apply the membrane when the primer is tacky. All lap joints must have an overlap of 75 mm rolled firmly against each other. The membrane has to turn up to the roof parapet, center flashed by a metal sheet all in accordance to drawings and manufacture's instructions.

The type and made of the membrane must first be submitted for approval by the

Employer.

15. JOINERY

15.1 Architectural Metal Works

15.1.1 General

Except as specifically specified in other section of these specifications, all nonferrous metal and stainless steel (corrosion resting steel) metal items shall be provided under this section of the specification. Carefully examine all drawings for architectural metal neither items nor specifically note but normally included in this trade.

Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be provided; include all bolts, anchors, supports, braces and connections necessary for the completion of the work.

Miscellaneous metals, metal window. Metal doors, miscellaneous doors, structural steel and miscellaneous building specialist are specified in other sections of these specifications.

All items to view shall have welds ground and finished to match adjoining surfaces. Welds in internal corners shall be square root welds ; concave welds are not permitted. Butt welds between adjacent surfaces shall be ground smooth and finished flush with the adjacent surfaces.

Architectural metal items concealed from view shall not require grinding of welds. Mechanical fastenings shall be concealed where practicable ; where concealed fastenings cannot be used, use exposed fastenings.

Exposed fastenings shall be compatible materials, shall match in color and finishing and shall harmonize with the material to which fastenings are applied. Necessary in a neat and substantial manner. Edges of flanged items shall be turned to from plaster keys where plaster occurs. Holes for bolts and screws shall be drilled or punched. Poor matching of holes shall because for rejection.

Thickness of metal and details of assembly and supports shall give sample strength and stiffness. Joints exposed to the weather shall be formed to include water.

15.1.2 Materials

Shall conform to the approved specifications.

15.1.3 Construction

(i) Shop Drawings

Shop drawing together with erection and installation details shall be submitted for all architectural metal items.

Submittal shall be completed in detail and shall indicate thickness, type, grade and class of metal and shall completely show construction details, reinforcement , anchorage, dimension and installation with relationship to other items of building construction. Verify all measurements and take all field measurements necessary before fabrication.

(ii) Protection Contact Surface

a. Dissimilar metals

Where aluminum components are in contact with, or fastened to dissimilar metals, except stainless steel or zinc, the dissimilar metals shall be given a coat of zinc chromate primer and a heavy brush coat of alkali-resistant bituminous paint. In permanently dry locations, the metals may be separated by non-absorptive plastic tapes or gaskets.

b. Masonry, concrete or plaster

Aluminum in contact with, or built into masonry, concrete or plaster shall be given a brush coat of alkali-resistant bituminous paint, or clear methacrylate lacquer.

c. Wood

Where aluminum is in contact with wood or other absorptive material repeatedly wet, the wood or other material shall be given a coat of aluminum pigment bituminous paint. Joints shall be sealed with caulking compound at points of contact with aluminum.

15.1.4 Protection Finish

After fabrication and finishing, all aluminum and bronze, except surfaces in contact and with sealants, shall be given two sprayed-on clear, water white non-yellowing methacrylic lacquer to a total minimum thickness of 0.01 mm and a total maximum thickness of 0.015 mm.

Prior to shipment from the factory, finished surfaces of aluminium, stainless steel and bronze shall receive a protective coating in addition to the coat of lacquer specified. Coating shall not chip, peel or flake due to temperature or weather and shall protect against discoloration and surface damage from transportation, storage and construction activities. Coating shall be readily removable without affecting the finish. Protection may be adhesive paper, waterproof tape or strippable plastic. Surface in contact with sealants after installation shall not be coated with any type of protective materials. Such surfaces shall be thoroughly cleaned with lacquer solvent before sealant are applied.

Upon completion of installation, protective coating, except methacrylic lacquer, shall be removed and surface washed with water and detergent or any cleaning agent which will not affect the metal finish or adjacent surfaces.

Carbon steel wood, pads, brushes, or other steel tools shall not be used. Cleaning shall be done in the direction of polishing.

15.1.5 Architectural Finishes

For all items architectural metal shall be as follows :

Aluminum for use on exterior shall have a bronze integral color anodic coating.

Aluminum for use in interior shall have a clear (natural) anodic coating.

Workmanship

Items shall be shop fabricated so far as practicable. Joints shall be flush riveted to conceal reinforcement, or welded where thickness of a section permits.

Contact surfaces of connected members shall be ground true. Parts shall be so assembled that joints will be tight and practically unnoticeable, without use of filling compound.

Sheet metal 1.9 mm or less, to which hardware of the rivet or screw in each direction,

or to nearest break in plane whichever is less.

Electrodes or filler rods for arc and gas welding shall be as recommended by the electrode manufacturer for the metals. Welds shall be sound and free from defects. Fluxes, welding oxides and discoloration shall be removed by pickling or grinding. Exposed weld beads shall be ground and polished to match adjacent metal.

Soldering shall be used only for filling or sealing joints and for mechanical strength. Soldered work shall be washed with a solution of washing soda, or other neutralizer, followed by a clear water rinse. Solder for stainless steel shall have a minimum of 75 per cent tin. Silver solder with a flow point not in excess of 718,50 C shall be used for Nickel-copper alloy. Brazing may be finished to conceal brazing metal.

Casting shall have fine. Even texture and shall be unwrapped and sound. Lines and miters shall be sharp, arise unbroken profiles accurate and ornament true to pattern. Plan surfaces shall be smooth,. Ornament shall have excess metal or in perfections that obscure design, undercut to restore detail. Filed or cut areas shall have texture restored.

Wrought work shall be leveled or straightened. Members shall have sharp lines and angles and smooth surfaces. Extruded members shall be free from extrusion marks. Square turns and corners shall be sharp. Curves shall be true, rings and loops without visible joints. Wider members shall be drilled or punch for smaller members secured by pins or welding. Similar members assign shall be halved and weld or tenoned and riveted.

Punched work shall be clean and true, without fins or burrs, with pattern of uniform shape and size.

Holes for bolts and screw shall be drilled. Fastening shall be concealed where possible. Exposed ends and edges shall be milled smooth, with corners slightly rounded. Joints exposed to weather shall be formed to exclude water.

Hardware shall match metal to which applied, in color and finish. Hardware supplied from other sources shall be prefitted in the shop. Parts to receive hardware shall be countersunk. Plates for mounting hardware shall be riveted or welded in place.

Bolts for securing metal items to concrete or masonry shall have machine screw threaded metal shields.

Accessories and fastening shall be of same material and finish as metal to which attached. Wall anchors for aluminium shall be of stainless steel. Rivets for aluminium shall be of aluminium.

15.1.6 Samples

Samples shall be submitted in duplicate. Samples of manufacturers stock shelf items shall be full size; samples of custom fabricated items shall be submitted in adequate size and detail to indicate compliance with standards of work specified. Samples shall show the quality of welding and grinding of all architectural metal items and shall serve as a standard of all work after approval by the Supervisor.

15.2 Miscellaneous Metal

15.2.1 General

Except as specifically specified in other sections of these specifications, all ferrous metal items except stainless steel (Corrosion resisting steel) shall be provided under

this section of the specifications. Carefully examine all drawings for miscellaneous metal items not specifically noted, but normally included in this trade.

Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be provided, include all bolts, anchors, supports, braces and connections necessary for the completion to the work, fitting for cable support, metal nosing, cable trench cover, rails, rain-water drain pipe, built in ladder, hand drilling support etc.

Architectural metals, metal windows, miscellaneous doors; welds in internal corners shall be concave; butt welds between adjacent surfaces shall be ground smooth and finished flush with the adjacent surfaces. Miscellaneous metal items concealed from view shall not require grinding of welds. Mechanical fastenings cannot be used, use exposed fastenings.

Exposed fastenings shall be compatible materials, shall match in color and finish, and shall harmonize with the material to which fastenings are applied. Necessary rebates, lug as and brackets shall be provided so that the work can be assembled in a neat substantial manner. Edges of flanged items shall be turned to form plaster keys where plaster occurs. Holes for bolts and screws shall be drilled or punched. Poor matching of holes shall be cause for rejection.

Thickness of metal and details of assembly and supports shall give ample strength and stiffness. Joint exposed to the weather shall be formed to exclude water.

15.2.2 Materials

Shall conform to the approved specifications.

15.2.3 Construction

(i) Shop drawings

Shop drawings together with catalog cuts plus erection and installation details shall be submitted for all miscellaneous metal items. Submittal shall be completed in detail and shall indicate thickness, type, grade and class of metal and shall completely show construction details, reinforcement, anchorage, dimension and installations with relationship to other items of building construction.

Verify all measurements and take all field measurements necessary before fabrication.

(ii) Workmanship

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines angles and true curves. Drilling and punching shall produce clean true lines and surfaces.

Connection shall be welded, riveted or threaded.

Permanent connections shall be welded.

Welding shall be continues along the entry area of contact except where tack welding is permitted.

Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish and exposed riveting shall be flush. Corner joints shall be coped or mitered well formed and in true alignment. Work shall be accurately set to establish lines and elevations and securely fastened in place. Work shall be executed and

finished in accordance with approval drawings, cuts, details and samples.

15.2.4 Protection Finish and Other Works

Metalwork specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip processed after fabrication.

Unless otherwise specified, surfaces of all ferrous metals shall be shop primed in accordance with the requirements specified in SECTION: PAINTING.

Surfaces of items embedded in concrete shall not be painted.

Where dissimilar metals are in contact, or where aluminium is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting the surfaces shall be protected with a coat of bituminous paint.

Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage shall include slotted inserts, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts for masonry; machine and carriage bolts for steel; through bolting for masonry and woods; and bolts and screws for wood.

Slotted inserts shall be of types required to engage with the anchors and shall be approved. Anchorage shall be provided as indicated and specified herein for attachment of miscellaneous items.

Miscellaneous plate and shape for items that do not form a part of the structural steel framework, such as lintels, sill angles, curb angles, equipment mountings and frame, shall be provided to complete the work.

15.2.5 Samples

Samples shall be submitted in duplicate. Samples of manufacturers stock shelf items shall be full size; samples of custom fabricated items shall be submitted in adequate size and detail to indicate compliance with standards of work specified.

Samples shall show quality of welding and grinding of all miscellaneous metal items and shall serve as a standard for all work after approval by the Supervisor.

15.3 Wooden Doors

15.3.1 General

Doors specific as wood doors shall include these following doors:

- **Teak Plywood Door**

Teak plywood Door will have teak plywood on both sides of the door, which are to have transparent finish.

- **Plain Plywood Door**

Plain Plywood Door will have plain plywood on both sides of the door, which are to be painted.

15.3.2 Installation

Doors shall be installed so they hang plumb and true.

At completion, doors shall be free from warp, joints shall be undamaged, and all surfaces shall be in satisfactory condition for further finishing required.

Top and bottom edges of doors shall be given two coats varnish, or other approved water resistant sealer.

Doors shall be fabricated with approved water-resistant adhesive. The adhesive for interior door shall be nonstaining when doors are scheduled to receive natural finish.

15.4 Hardware

15.4.1 Scope

This section includes all the hardware for all doors expect metal doors/windows.

15.4.2 Materials

Hardware shall be supplied in the material for the approved type.

Base metals for finishes shall be as follows:

Finish	Base metal
Statuary bronze	Bronze or Brass
Satin Aluminium	Aluminium

15.4.3 Packing, Marking and Libeling

Hardware shall be delivered to the project site in the manufacturer's original packages.

Each article of hardware shall be neatly wrapped and individually packed in a substantial carton or other container, properly identifiable with the permanent hardware schedule.

15.4.4 Installation

Hinges

Top hinges shall be installed with the center of hinges not more than 28 centimeters below the top of the door.

Bottom hinge shall be installed with the centerline of hinge not more than 33 centimeters above the finish floor.

Intermediate hinges shall be installed equal distant between the top and bottom hinges.

Door pulls, sectional

Pull shall be centered 100 cm above finish floor.

Locks, latched and strikes

The location of locks and latches shall be determine by:

Centering the strike of mortise dead-locks 150 centimeters above the finish floor.

Centering the strike of knob locks and knob latches 100 centimeters above finish floor.

Centering the strike of rollers latches 100 centimeters above the finish floor.

Hardware sets

(i) Main entrance, glass with teak plywood finish.

- Double door (double swing)
- Lockset
- Spring hinge

- Flush bolt
- (ii) Entrance door, aluminium frame or internal door.
 - Lockset
 - Butts as require
 - Stopper
 - Holder

15.5 Metal Doors

15.5.1 Scope

This section includes all the metal doors, including their frames.

15.5.2 Reference

All work shall conform to NI - 3 (1970) or similar.

15.5.3 Material

- Galvanized Steel

Steel to be used for doors and frames shall be lighter than 16 pages steel.

15.5.4 Construction

(i) Shop drawings

Shop drawings shall be submitted for approval before delivery.

Shop drawings shall show construction thickness of metal, provisions for receiving hardware, method of reinforcing, type and location of anchors and hardware locations.

(ii) Frame construction

Frame shall be either.

Welded - type frame, with face joints continually welded or secured with spot - or protection-welded splice plates.

Welds on exposed surfaces shall be dressed plush and smooth and shall present a neat appearance.

Knock-down-type frame, with concealed reinforcing at the corners, field assembly of head to jams members shall be inter-locking joints to produce a square and rigid corner.

15.6 MISCELLANEOUS DOORS

15.6.1 Scope

This section includes all other doors.

15.6.2 Reference

All work shall conform to NI - 3 (1970) or similarly.

15.6.3 Material

Glass doors

Glass doors to be used in glass door with wood framing.

15.7 Other Works

15.7.1 Anchors

Three adjustable anchors, shall be provided on each jamb. The bottom wall anchors on doors frames shall be installed 60 cm above the floor.

A metal clip angle shall be securely fastened to the bottom of each jamb member for anchoring to floor construction where floor fill occurs, the level shown and supported by an adjustable or extended clip angle.

15.7.2 Finishing

Steel doors and doors frames shall receive 2 coats of painting as specified in Sub-section 5.16 - PAINT.

First coating shall be applied by door manufacturer, second coating shall be done on the field.

15.7.3 Delivery and Handling

Doors and door frames shall be delivered stored handled, and installed so as not to be damaged or deformed.

Abraded, scarped or rusty areas as steel shall be cleaned and corrective painting shall immediately be done upon detection.

15.8 Aluminium Windows

15.8.1 General

This section covers the supplying and the laying of the aluminium windows and screens and their associated frames and accessories.

15.8.2 Materials

Section shall be extruded form aluminium alloy.

Section shall have a minimum well thickness of 3 mm.

Fasteners shall be stainless steel of a type selected to prevent galvanic action with the components fastened.

Gaskets shall be vinyl glazing channel gasket to commercial standard.

Hardware shall be manufacturers standard hardware. Flush to match window finish.

Weathering and glazing splines shall be neoprene or similar.

Screen frames shall be fabricated of extruded aluminium, be removable and filled with 14 x 18 mesh wire.

Screen frames shall be anodized to match window frames.

All exposed aluminium shall be anodized to a color to be selected by the Owner.

The anodic finish coating shall be a minimum of 0.7 mm thick a density of at least 5 mg per square meter.

15.8.3 Construction

Temporary protection shall be achieved by applying water-soluble protective coating capable of withstanding the action of lime mortar. Apply coating in the manufacturer's plant to the exposed surfaces of all components. Before application of coating, remove all gaveication compounds, moisture and dirt accumulations.

The aluminium windows shall be installed in strict accordance with the manufacturer's printed instructions.

The window manufacturer shall furnish his standard written guarantee against leakage of rain, excessive infiltration of sand and air and all defects in material workmanship covering all work under this Section.

However, such guarantees shall be in addition to and not in lieu of all other liabilities which manufacturers and Contractor may have by law or by other provisions of the Contract Documents.

16. WATER SUPPLY

16.1 SCOPE

This Section of Specification covers the work involved in selecting a suitable source of water (in consultation with the Owner), providing a supply to any buildings constructed under the Contract which require a permanent supply of water for domestic or other purposes and the requirements for the internal plumbing of the buildings.

16.2 References

Approved Standards currently in use in INDONESIA.

16.3 Materials

16.3.1 General

All pipes and fittings used for the permanent water supply shall be in accordance with the standard practice and regulations of the local Water Authority as regards type, class and weight unless otherwise specified or shown on the drawings. Other locally accepted Standards/Codes of Practice may be used providing these conform to Water Authority regulation.

16.3.2 Pipes

All types of pipes such as asbestos-cement pressure, rigid P.V.C., copper, galvanized steel or iron, unplasticised P.V.C. pipes shall be used with the Owner's permission.

16.3.3 Valve and Hydrant Boxes

Sluice valves, air valves, hydrants and such like shall be located inside suitable block work or concrete boxes, built up to ground level and provided with cast iron covers inscribed with the initial letter or letters of the type of valve or fittings.

16.3.4 Elevated Storage Tanks

Elevated water storage tanks , if necessary, shall be of fiber plastic, steel or concrete and shall comply with the relevant parts of this Specification for these materials. It also be completely with installation of jet pump 250 watt

The capacity of the tank will be decided by the Owner. Steel tanks shall be painted with three (3) coats of non-toxic paint.

16.4 Construction

16.4.1 Excavation and Backfill

The trench excavations for pipe work shall be as narrow as practicable to allow the laying and jointing of pipes. Trenches in hard or rocky ground shall excavated one hundred (100) millimeters over depth and this depth shall be filled with selected granular soil free from stones and thoroughly rammed.

The thickness of the layers of soil shall be increased as necessary at joint positions to give a minimum thickness below the joint of fifty (50) millimeters. Backfill up to three hundred (300) millimeters above the pipe shall be of selected granular stone free material and shall be laid and well compacted by hand tools in layers not exceeding one hundred (100) millimeters thick.

Where unplasticised P.V.C. pipes are used extra care shall be taken in ramming at the sides and above so that no deformation of the pipes occurs. The remainder of the backfilling of the trench may be carried out by normal methods using any approved excavated material, but only in sandy soil may water be used to assist compaction.

16.4.2 Laying and Jointing of Pipes

(i) Laying

Pipes shall be laid so that they bear firmly and uniformly on the prepared trench bottom.

The minimum cover Over non-metallic pipes shall be :

- (a) Under roads and hard standing 900 millimeters
- (b) Under ground not subject to 750 millimeters vehicle loads or such other depths as may be directed.

Where the specified cover cannot be given to pipes laid under roads or hard standings, or when indicated on the drawings, water pipes shall be laid inside asbestos cement ducts of sufficient diameter to allow clearance to joints in the water pipe.

These ducts shall extend one (1) meter beyond the edges of roads or hard standings and shall be encased in concrete Grade 15/40 (K-150) of minimum thickness one hundred and fifty (150) millimeters.

At crossing with foul drainage pipes the water pipe shall, unless otherwise agreed, be laid at a higher level than the fault drain, with a separating distance of not less than two hundred (200) millimeters.

The foul drain shall always be encased in concrete Grade 15/40 (K-150) not less than one hundred and fifty (150) millimeters thick for a distance of three (3) meters on either sides of the crossing.

(ii) Prevention of Air Locks

Pipe work shall be laid so that air locks cannot occur. If a summit in a water main is agreed by the Owner to be unavoidable, a suitable air valve shall be provided.

(iii) Joints in Underground Pipe work

Joints in underground pipe work shall be of a type approved by the Owner, and joints shall be made only by men experienced in such work and using the proper tools and methods in accordance with the manufacturer's instructions. Where it is necessary to joint pipe work to valves and other special fittings with cast iron bodies, the correct adaptor pieces shall be used.

(iv) Pipe Anchorages

At all chances of direction, branches and other points in a pipeline where there will be unbalanced hydraulic pressure, the pipe work shall be secured by means of anchor blocks of concrete Grade 15/40 (K-150). The dimension of the blocks shall guarantee firmness taking account of the working stress of the soil and the stresses due to static pressure testing of the water pipeline.

16.4.3 Exposed Pipe work

Pipe work installed above ground level shall, unless otherwise approved in writing, be surface mounted and shall be of galvanized steel or copper tubing. It shall be adequately supported at intervals not exceeding two (2) meters and shall be suitable for water pressure heads of up to seventy-five (75) meters. The joints shall be threaded unions of material compatible with the pipes.

16.5 Source Of Water

16.5.1 General

The source of water for the permanent supply system to be constructed under the Contract will be selected by the Owner and the Contractor shall assist, if so directed, by taking samples, arranging for analyses, carrying out pumping tests and such like. The cost to the Contractor of giving this assistance to the Owner shall be recoverable. It is probable that the source of water for the permanent system will be from a suitable nearby piped supply, if such exists, or from a borehole or well to be sunk on or near the site; but the Owner may deem it necessary to select or develop any other sources.

16.5.2 Borehole

(i) Sinking and Lining

Where it has been directed that the source of supply will be a borehole, the Contractor shall be required to satisfy the Owner that he is experienced in the sinking and lining of water supply boreholes or he is to employ a sub-contractor who is so experienced.

The Contractor shall drill and the borehole using equipment and tools suitable for the depth and diameter of the well, and the subsoil's through which the drilling will be made.

The drilling shall not deviate from true vertical by more than one hundred (100) millimeters in depth of thirty (30) meters and the diameter shall be sufficient to permit proper installation of the lining tubes and gravel prefilter.

The lining tubes shall be steel with helical welding, not less than eight (8) millimeters thick and shall have screwed flush but joints with square form parallel thread screwing and coated on the internal surface with two coats of heavy duty

bituminous compound after removal of all mill scale and rust.

The tubing shall be of sufficient diameter to allow installation of the pump and pipe work. The annular space between the tubing and the soil above the water bearing strata of aquifer shall be filled with cement grout to prevent the entry of surface or shallow subsoil water to the well.

(ii) Well Screen

The Contractor shall provide and fit at the bottom of the borehole a stainless steel Johnson type non clogging tubular well screen of diameter suitable for the pump installation, secured to the bottom of the lining tubes by a purpose made heavy duty adaptor fitting.

The annular space between the well screen and the borehole side shall be packed with filter material consisting of siliceous gravel, the grading of which has been determined from studies and tests of the stratum material and structure of the aquifer derived from samples taken from the borehole or pilot borehole.

The performance of the filter shall be such that no sediment is drawn from the aquifer or overlying strata and its performance will be deemed satisfactory when pumped water is clear and free from sediment five (5) minutes after the pump has reached maximum output rate.

This packing shall be commenced at a level five hundred (500) millimeters above the top of the stainless steel screen and be continued down for the whole depth of the screen.

The whole diameter of the bore below the screen shall be packed solid to the bottom of the borehole at the depth not less than five hundred (500) millimeters below the bottom of the screen.

A plug of grout five hundred (500) millimeters deep will be placed in the annular space above the filter material and allowed to harden for a minimum period of twenty four (24) hours before the grouting of the lining tubes.

(iii) Cleaning Out and Test Pumping

On completion of drilling and lining of the boreholes they shall be "swabbed out" using a method to be approved by the Owner, each section of the borehole receiving at least twenty five (25) passes. Prior to test pumping the Contractor is to "shell out" the borehole to ensure that they are free from obstruction over the whole depth. Following this the Contractor shall cleaned out and tests pump the boreholes in the presence of the Owner for a period of not less than seventy-two (72) hours continuously to establish that the required yield is being obtained.

(iv) Borehole Pumps

- (a) The contractor shall submit to the Owner for approval details of the pumping and control equipment proposed.
- (b) Borehole pumps shall be of the underwater type and all pumps shall be in every respect suitable for the application. They shall be of a reliable make obtained from an control gear. The operation of the pumps shall be automatic controlled by float switches, or equivalent, situated in the borehole and primary storage tank.

Suitable housings shall be provided to give adequate shelter and protection to motors, control gear, etc. from weather and interference from unauthorized

persons. A supply of electricity will be provided at the heads of boreholes under another contract.

16.6 TREATMENT PLANT

Treatment of water will normally comprise filtration and/or chlorination depending on the quality of the source. Any treatment plant required shall be of proprietary design and manufacture, capable of reliable service with the minimum of routine attention and maintenance.

The plant shall be obtained from a reliable and approved manufacturer of such plant and the contractor shall submit details of the equipment proposed for approval.

16.7 Testing

The completed water system shall be tested by application of hydraulic pressure equal to a head of seventy five (75) meters.

The test shall be carried out twice. The first test shall be made twenty-four (24) hours after the system has been filled with water and before backfilling has commenced. The second test shall be carried out after placing and compacting the first three hundred (300) millimeters of backfill above the top of the pipe. The system may be tested in sections. As may be approved by the Owner. And the tests shall be considered satisfactory if the system is free from leaks.

16.8 Construction Of Plumbing

16.8.1 Supervision

The plumbing work shall be carried out by or under the direct supervision of fully qualified and skilled plumbers.

16.8.2 Flashings

The materials for flashing shall be sheet lead or copper.

Lead and copper flashings shall be dressed by the use of proper tools and shall be adequately fixed so they can expand and contract without injury. Joints shall be watertight and evenly spaced and laps shall be at least one hundred and fifty (150) millimeters. Contact surfaces with mortar or concrete shall be coated with bitumen.

16.8.3 Soil, Waste and Ventilating Pipes

Soil, waste and ventilating pipes shall be as specified in section 4-Drainage. They shall be fixed to walls with holder bats and the minimum distance between the pipes and the wall should be forty (40) millimeters. Pipes shall be jointed as previously specified herein or in the relevant standard number pipes shall be built in until tested and approved inspection covers shall be provided where necessary on bends and branches to allow rodding of all pipes.

Rainwater pipes gutters and fittings shall be of asbestos cement of unplasticised P.V.C. They shall be fixed to walls and edges of roofs etc with approved holder bats brackets etc and shall be jointed as previously in the relevant standard.

16.8.4 Water Pipes

Water pipes within buildings will generally be of copper or galvanized steel but

unplasticised P.V.C. pipes may be used for cold water lines only. Subject to approval of the Owner unplasticised P.V.C. pipes shall conform to approved class and manufacture and shall be jointed and fixed to walls using the correct fittings and fixings as supplied or specified by the manufacturer.

16.8.5 Taps

The taps and stop valves for water services unless otherwise specified or described shall be screw down pattern. Chromium plated and shall be to the Owner's approval.

16.8.6 Water Storage Cisterns

Cold water storage cisterns shall be of mild steel sheet galvanized after fabrication and shall be supplied with covers ball valves and floats for ball valves shall comply with the relevant standards for the materials used.

Glass fiber cisterns may be used subject to the Owner's approval.

16.8.7 Pipes etc. Generally

The pipes and fittings for water supply shall be of a type and class or weight suitable for the local cold water authority.

16.8.8 Lavatory Basins

Lavatory basins shall be white ceramic unless otherwise specified and shall be approved by the Owner before purchase or fixing in the works.

16.8.9 W.C."S. Seats and Cisterns

Unless otherwise agreed or directed, water closet pans shall be white ceramic and seats shall be plastic. Flushing cisterns be white ceramic All materials .shall be approved by the Owner before fixing in the works.

16.8.10 Urinals

Urinals shall provided with white ceramic automatic flushing cisterns to approval.

16.8.11 Battery Room Sinks

Unless otherwise specified battery room sinks shall be six hundred (600) millimeters by four hundred and fifty (450) millimeters by two hundred and fifty (250) millimeters deep acid resisting white glazed fireclay with overflow. All plugs, traps and waste pipes shall be acid resisting.

16.8.12 Sanitary Ware Generally

All basins, pans, urinals, sinks, etc., Shall be obtained from an approved manufacturer and the Owner will in the company of the contractor, select these various items.

16.9 Testing

All pipe work and joints in soil and waste pipes obtained from an approved by air (smoke) pressure test to the satisfaction and approval of the Owner.

17. PAINTING AND GLAZING

17.1 Painting

17.1.1 Materials

(i) Paints

The contractor shall submit for approval the name of the manufacturer whose point he proposes to use and no orders shall be placed until such approval is given. Only paints suitable for the climatic conditions of the site shall be used.

All materials shall be delivered to site in sealed containers on which the maker's name, and brand specification number and date of manufacture are clearly displayed and shall be stored to comply with all requirements for the preservation of the paints.

Only colors and undercoats approved by the Owner shall be used.

(ii) Stopper (for timber)

This shall be approved water repellent putty or plastic compound.

(iii) Knotting

An approved by the Owner.

(iv) Silicon

This shall be applied to exterior brickwork as directed as a growth and water repellent. The type used shall be as approved by the Owner.

17.1.2 Construction

(i) Preparation

All rubbish and debris shall be removed and floors swept and dampened before painting commences. Door, furniture, light switch covers and the like shall be removed and surrounding surfaces covered with canvas or other approved and tested. Masking tape should be used on non-removable fittings.

The painter shall examine the surfaces on which he is to work and satisfy himself regarding their suitability for the specified treatment. All rust, dust, or any other removed by washing, wire brushing or any other means necessary before painting is commenced. Surfaces shall be dry before and during application of paint and shall be suitably-primed.

(ii) Application

Application of paint shall by brush or roller as approved or directed by the Owner. The treatment to be given to the different surfaces shall be described. All progressive coats of paint shall be of different shades, such variations in shade being agreed with the Owner before commencement of the work.

All paint shall be applied in strict accordance with the manufacturer's instructions and shall not be diluted in any way unless specifically stated or agreed by the manufacturer. The priming and undercoating shall be those recommended by the manufacturer for the respective finishing paints. Any dilution of paint, unless otherwise directed, shall be carried out by the manufacturer prior to delivery to site. No external paintwork shall be carried out during high winds or other unfavorable weather conditions.

Painting shall be carried out at temperatures suitable for the type of paint being applied.

Plastered surfaces should be allowed to dry out for four weeks before painting and be primed with an alkali resistant primer. On external work two priming coats should be applied. Finishing coats shall be as described in the Bill of quantities or on the drawings. Bituminous paint shall be used as directed below damp proof course of face brickwork level.

Brickwork to be sealed should be allowed to dry out for four weeks and brushed at regular intervals to remove efflorescence. Cracked or chipped mortar should be repaired and the surface painted liberally with approved silicate of soda solution.

Steelwork should be wire brushed to remove all loose rust, scale and dirt or grease and primed with two coats of red lead primer before delivery to site. After fixing in the works the primer shall be touched up where necessary before application of the finishing coats.

All timber shall be knotted, stopped and primed with approved with an alkali resistant primer before applying the specified finishing coats.

(iii) Surface Finishes

All finishes shall cover completely and obscure the base construction and priming coats and be such that any additional coats of paint will not effect any significant improvement.

All finishes shall be consistent in color and free from brush marks and irregularities. Newly painted surfaces shall be protected from contamination by dust or other causes.

The Owner may require additional coats if the finish of any part of the work does not conform to the Specification. Any additional coats so required shall be at the expense of the contractor.

(iv) Surfaces to be polished

Internal hardwood surfaces which are not to be painted shall be thoroughly cleaned and rubbed down to a smooth finish, grain filled and wax polished to a fine satin finish.

(v) Lacquered Finishes

External hardwood surfaces which are not to be painted shall be thoroughly cleaned and rubbed down to a smooth finish, grain filled and painted two coats of approved hardwood lacquer.

17.2 Glass And Glazing

17.2.1 Materials

(i) Glass

Glass for glazing shall conform to the appropriate Standards and unless otherwise recommended by the manufacturer shall be best quality clear sheet glass at least three (3) millimeters thick.

Blades for louvers shall be at least six (6) millimeters thick.

(ii) Putty

Timber putty shall be an approved, local product complying generally with approved standards.

(iii) Neoprene

To be used for glazing to aluminium windows as recommended by the manufacturer.

(iv) Opaque Glass

This shall be of local manufacturer and approved by the Owner.

17.2.2 Construction

(i) Delivery and Storage

Glass shall be delivered to site in shockproof containers supplied by the manufacturer and marked with the manufacturer's name, type, quality and thickness of glass. Glass shall be stored on site in properly constructed racks.

(ii) Cutting and Fixing

Glazing shall be carried out by skilled tradesmen in accordance with good trade practice. Aluminium windows shall be glazed by the aluminium sub-contractor. Cutting shall be to measurements checked on site with clearances to normal trade practice and approved by the Owner.

Glass in windows and doors, unless of special fixing, shall be bedded and back puttied, sprigged or clipped in and front puttied. All putties shall be full to the sight lines of glazing bars and neatly trimmed off. Where surrounding work is not to be painted, the putty shall be colored to match the sight lines of glazing bars and neatly trimmed off. Where surrounding work is not to be painted, the putty shall be colored to match the general finishes.

Glass in louvers, etc, provided with special or proprietary fixings shall be fixed in accordance with the manufacturer's instructions.

(iv) Cleaning

On completions of the works, all glass shall be cleaned inside and outside and all broken or cracked glass be replaced.

17.3 Attendance On Other Trades

Each trade shall attend upon, cut away for, and make good after, the electrical Owners and all other trades as described or directed.

17.4 Cleaning Up At Completion

On completion of the works, all floors shall be scrubbed, all glass cleaned on both sides, all work touched up after all trades and the whole left clean and ready for use. All rubbish and debris shall be removed from site.

18. ELECTRICAL WORK

18.1 Scope

This Specification covers the Lighting, Socket Outlet and small Power Installations in Substation (Control building and outdoor installations.)

18.2 Standards

Except where otherwise specified or implied, the works shall comply the latest applicable Specifications in Indonesia or the International may submit for approval equipment of materials conforming to technically equivalent National Standards of the country of origin. In the latter case, copies of the relevant standards or part thereof in the English language shall be submitted with the Tender. Requirements of this Specification other than IEC requirements must be met.

18.3 General

18.3.1 Particulars of System

The installations will be fed from 400-230 volts boards situated in the substation plant buildings by means of cables which will be supplied under another contract.

The voltage will be 400-230 volts. The phases will be designated and the standard phase sequence will be red, yellow, black, rising anticlockwise.

18.3.2 Extent of Work

The contract works to be supplied shall include all work incidental thereto whether specified in detail or not and in general is to be carried out by the contractor in accordance with the conditions of contract.

18.3.3 Compliance with Specification

Any departures from the requirements of this Specification which are agreed between the Owner and the Contractor shall be as stated. All apparatus shall comply with this Specification except as provided for therein. No other departures will be permitted.

18.3.4 Testing and Inspection

Whenever considered desirable by the Owner, Inspectors may be sent to manufacturer's or sub-contractors' premises to test materials or supervise their manufacture.

Where specified or requested the contractor shall obtain from the manufacturer and send to the Owner certificates of tests, proof sheets, etc. Showing that materials have been tested in accordance with this Specification.

Notwithstanding any tests which may be directficated to be carried out at a manufacturer's and/or sub-contractor's works, the Owner may carry out any tests or further tests he considers necessary or desirable after delivery of materials to the site.

The contractor shall provide all labor, equipment and facilities necessary for the carrying out of tests both in work and on site.

The manufacturers and the places of manufacture, testing and inspection for the portions of the contract works shall be as stated.

The cost of tests shall be borne by the contractor.

The contractor shall carry out insulation and earth continuity tests on all wiring and apparatuses and such additional tests as in the opinion of the Owner are necessary to determine that the works comply with the conditions of the specification either under test conditions (in the manufacturers' works on the site, or elsewhere), or in ordinary working. Type tests may be omitted at the discretion of the Owner if satisfactory

evidence is given of such tests already made on identical equipment.

The insulation, metal continuity and earth connection tests, shall be carried out as prescribed by the local regulations, or the Recommendations of the Institution of Electrical Owners and also any other tests required by the Owner.

The test of insulation shall be carried out with a megohmeter at no less than 500 v. To verify the earth insulation of each conductor, all switches must be switched off.

When testing insulation between conductors, appliances and devices are to be disconnected, likewise all switches shall be switched off. Accepted value of insulation resistance to ground and between conductors at all moisture conditions shall be 1000 ohm for each volt of service tension.

All material used shall also be subjected to, and shall withstand satisfactorily, such routine tests as are customary in the manufacture of the types of plant included in the works.

All tests shall be carried out to satisfaction of the Owner, and if required, in his presence at such reasonable time as he may require. Not less than seven days notice of all tests shall be given to the Owner, in order that he may be present if he so wishes. As many tests as in the opinion of the Owner are possible, shall be arranged together. Six copies the contractor's records of all tests be supplied to the Owner.

Measuring apparatus shall be approved by the Owner and if required, shall be calibrated at the expense of the contractor at an approved laboratory.

The contractor shall be responsible for the proper testing of work completed or plant and materials supplied by a sub-contractor.

All apparatus, instruments and connections required for the above tests shall be provided by the contractor but the Employer will permit the contractor to use for the tests on site any instruments and apparatus which may be provided permanently on the site, subject to the operation of the system and the carrying out of other contracts and conditional upon the contractor accepting liability for any damages which may be sustained by the Employer's equipment during the tests.

The Employer will also provide free of charge on site, electrical energy, if available, for the purpose of approved preliminary tests and for the official tests. If tests are required due to the contract works not complying with upon the contractor to pay the costs of providing the additional electrical energy supplied.

The contractor shall supply suitable test pieces of any materials as required by the Owner. If so required, tests specimens shall be prepared for check testing and forwarded at the expense of the contractor to an independent testing authority selected by the Owner.

The cost of all test and/or analyses shall be borne by the contractor but the cost of such tests and or analyses affected elsewhere than at the manufacturer's works or on site and the results of which are approved, will be refunded.

No inspection or passing by the Owner of work plan or materials, whether carried out or applied by the contractor or sub-contractor, shall relieve the contractor from his liability to complete the contract works or exonerate him from any of his guarantees.

18.3.5 Drawings, Modes and Samples

A list of drawings relative to the Specification is appended to the Tender.

The contractor shall submit copies of drawings of the components and fittings he

proposes to use as and when requested to do so by the Owner.

The contractor shall submit all drawings or samples of materials for approval in sufficient time to be permitted without causing delay in the initial deliveries or completion of the contract works.

Two copies of all drawings shall be submitted for approval and two copies of any subsequent revision. Following approval, a minimum of five further copies will be required for distribution.

After completion of work on site all drawings shall be revised where necessary to show the equipment as installed and two copies submitted for approval. Reproducible the Owner and shall be of sufficient detail to enable all parts to be identified.

All dimensions marked on the drawings shall be considered correct although measurement by scale may differ there from. Detailed drawings shall be worked to where they differ from general arrangement drawings.

All detail drawings submitted for approval shall be to scale not less than 1:30. All important dimensions shall be given and the material of which each part is to be constructed shall be indicated.

Drawings, samples and models already submitted by the contractor and approved by the Owner (and such drawings samples and models as shall be thereafter submitted by the contractor and approved by the Owner) shall not be departed from without the instruction in writing of the Owner.

The contractor shall be responsible for any discrepancies or errors in or omissions from the drawings, whether such drawings have been approved or not by the Owner, and no approval given by the Owner to any drawing or sample shall relieve the contractor from this specification and conditions of contract or exonerate him from any of his guarantees.

If the contractor shall require approval of any drawing within fourteen days of its submission in order to avoid delay in the completion of the contract works he shall advise the Owner to such effect when submitting the drawing.

All drawing, samples and models shall be submitted in accordance with the provision of this specification and shall become the property of the Employer.

18.3.6 Safety Precautions

Wherever works are to be constructed in the vicinity of an existing electrical substation, overhead power contractor shall be responsible for ascertaining from the authority responsible for the equipment, the precautions and safety measures to be observed and for strictly complying with these precautions and safety measures.

18.3.7 Spares

All spare apparatus all comply with the requirement of this specification. Spares shall be available at the time of the works.

All spares, apparatus or materials containing electrical insulation shall be delivered in approved containers suitable for storing such parts or materials over a period of years without deterioration. The containers will remain the property of the Employer. Each container shall have fixed to the underside of the lid a list detailing its contents.

18.3.8 Names of Suppliers and Copies Orders All Material

If so required and before ordering of any description, the contractor shall submit for

orders will also be submitted if so required. The Owner may at any time withdraw his previously given sanction to obtaining materials from any maker or supplier should such maker or supplier fail to supply materials of the specified quality or quantity in the requisite time.

18.3.9 Compliance With Regulations

All apparatus and materials supplied and all work carried out shall comply in all respects with such of the requirements of the Regulations and Acts in force in the country of the Employer as are applicable to the contract works and with any other applicable regulations to which the Employer is subject.

18.3.10 Bedding and Grouting

All bedding and grouting of plant and apparatus of foundations and floors and cementing into walls as is necessary for the erection of plant and apparatus shall be carried out by the contractor.

18.3.11 Cutting Away and Making Good

Cutting of holes, chases, etc, in brickwork, walls or reinforced concrete or ceilings shall be carried out by the contractor and the cost of all such cutting away shall be included in his tender.

All cutting of holes and chases must be approved before such work is put in hand.

18.3.12 Fire Precautions

All apparatus, connections and cabling shall be designed and arranged to minimize the risk of fire and any damage which might be caused in the event of fire when cabling responsible for sealing in an approved manner all holes in floors, walls, etc. Through which the cabling may pass and for protecting the cable in an approved manner against mechanical damaged by fire where exposed.

18.3.13 Erection Marks

Before leaving the contractor's works all apparatus and fittings shall be painted or stamped in two places with a distinguishing number and/or letter on an approved drawing and material list.

18.3.14 Supervision and Checking of Work on Site

The carrying out of all work on the site included in this contract shall be supervised throughout by a sufficient number of qualified representatives of the contractor who have had thorough experience of the erection and commissioning of similar contract works.

The contractor shall ascertain from time to time what portion of the work on site the Owner desires to check but such checking shall not relieve the contractor from his liability to complete the contract works in accordance with the contract or exonerate him from any of his guarantees.

If at any time it appears to the Owner that the contractor will be unable to complete any section of the contract works in the time stipulated, then the contractor shall increase the number of personnel or carry on such work outside normal working hours and shall not make any claim for any expense thereby incurred unless, in the opinion of the Owner, the delay is due to causes for which the contractor would be entitled to an extension of time under the conditions of contract.

The contractor shall satisfy himself as to the correctness of all connections made between apparatus supplied under the contract and apparatus supplied under any other contract before any of the former is put into operation.

If the Owner shall certify that defects have shown themselves in the works, the contractor shall for the purpose of the maintenance after the completion of the works provided for by the conditions of contract, keep on site a supervisory staff of such numbers and for such periods as the Owner may require.

18.3.15 Responsibility of Contractor

Until each section of the contract works has been taken over or deemed to have been taken under the conditions of contract, the contractor shall be responsible for such section on the contract works, whether under construction, during tests or in use for the Employer's service.

Any work which may be necessary for the contractor to carry out in pursuance of his obligations under the conditions of contract shall be carried out so as to interfere as little as practicable with the normal operation of the sub-station. Work on site shall be carried out at such time and during such hours as the Owner may require.

18.3.16 Additional Services of Contractor's Staff

If the Employer shall so require, the contractor shall lend to him the service of skilled workmen for the repair of any defect between the Employer commencing to use any section of the contract works (whether taken over or not) and the expiry of the period of maintenance. Wages for such services will be paid by the Employer to the contractor, except in respect of the contractor's obligations under the contract works.

The contractor shall continue to be responsible as the Employer for all the obligations to such workmen.

18.4 General Design Of Apparatus

18.4.1 Design and Standardization

The contract works shall be designed to facilitate inspection, cleaning and repairs, and for operation where continuity of supply is the first consideration. All apparatus shall also be designed to ensure satisfactory operation under the atmospheric conditions prevailing at the sites and under such variations of load and voltage as may be met with under working conditions of the system.

The design shall incorporate all reasonable precautions and provisions for the safety of all those concerned in the operation and maintenance of the works and of associated works supplied under other contracts.

All materials used in the works shall be new and of the best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperature and atmospheric conditions arising under working conditions without distortion or deterioration or the setting up of undue stresses in any part and also without affecting the strength and suitability of the various parts for the work which they have to perform. No repair of defective parts will be permitted without the sanction in writing of the Owner.

All electrical connections and contacts shall be of ample section and surface for carrying continuously the specified currents without undue heating. Fixed connections shall be secured by bolts or set screws of ample size, adequately locked.

All apparatus shall be designed to operate without undue vibration and with the least practicable amount of noise. All apparatus shall be designed so that water cannot collect at any point.

All metal jointing surfaces shall be machined or ground. Unmachined flat steel plate covers shall be used only where the corresponding joint flange is machined. The bolt spacing and packing material employed with such covers shall be approved.

All apparatus shall be designed to obviate the risk of accidental short circuit due to animals, birds and vermin.

Corresponding parts shall be interchangeable, when required by the Owner, the contractor shall demonstrate this quality.

18.4.2 Bolts and Nuts

All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate National standard for metric threads, or the technical equivalent. Washers shall be provided under all nut and bolt heads. Termian bolts or studs used for carrying current of more than 100 amps shall not be less than 16 mm diameter. Brass bolts or studs of less than 6 mm diameter shall not be used for electrical connection. Where a lesser size is necessary, stainless steel, phosphor bronze or high tensile brass may be used down to and including 4 mm diameter providing the current carrying capacity is adequate.

All nuts and pins shall be adequately locked.

Wherever possible, bolts shall be fitted in such a manner that in the event of failure locking resulting in the nuts working loose and falling off, the bolt will remain in position.

All bolts, nuts and washer in contract with nonferrous metallic part shall, unless otherwise approved, be of phosphor bronze.

Where bolts are used on external horizontal surfaces where water can collect, approved methods of preventing the ingress of moisture to the threads shall be provided.

Each bolt or stud shall project at least one thread but not more than 6 mm or three threads through its nut, except where otherwise approved for terminal board studs or relay items. If bolts and nuts are place so that they are inaccessible by means of ordinary spanners, special spanners shall be supplied by the contractor.

The length of the screwed portion or bolts shall be such that no screw thread may form part of a shear plane between members.

Taper washers shall be provided where necessary.

18.4.3 Galvanizing

Galvanizing shall be applied by the hot dip process and for all parts other than steel wires shall consist of a thickness of zinc coating equivalent to not less then 500 cm of zinc per sqm of surface.

The zinc coating shall smooth, clean and uniform thickness and free from defects. The preparation for galvanizing and itself shall not adversely affect the mechanical properties of the coated material.

All drilling, punching, cutting and bending of parts shall be completed and all burrs shall be removed before the galvanized process is applied.

Tests shall be carried out to the requirements of the Owner.

Alternative processes shall not be used without the approval of the Owner.

Surfaces which are in contact with oil shall not be galvanized or cadmium plated.

18.4.4 Aluminium and Aluminium Alloys

All aluminium alloys shall be of approved composition to the appropriate National Standard.

Aluminium alloy coatings shall be sound and free from porosity.

18.4.5 Labels and Plates

All apparatus, control gear and all panels and the apparatus contained therein shall be clearly labeled indicating, where necessary, their purpose and service positions. Each phase of alternating current and each pole of direct current switchgear and connections shall be colored in an approved manner to distinguish phase or polarity.

The material of all labels, the dimensions, legend and method or printing shall be to approval.

The surface of indoor labels shall have a matt or satin finish to avoid dazzle from reflected light.

Colors shall be permanent and free from fading. Labels mounted on black surfaces shall have white lettering. "Danger" plates shall have red lettering on a white background.

All labels and plates for outdoor use shall be of approved in corrodible material. Where the use of enameled iron plate is approved, the whole surface including the back and edges shall be properly covered and resistant to corrosion. Protective washers of suitable material shall be provided front and back on the securing screws.

18.4.6 Cleaning and Painting

Before painting, all ungalvanized parts shall be made completely clean and free from rust, scale or grease and all external rough surfaces shall be filled.

The internal surfaces of cubicles, kiosks and boxes containing wiring or other apparatus which are dispatched to site in an assembled condition shall be finish painted before inspection and testing. The internal finish for cubicles mounted indoors shall be a white enamel. The interior of marshaling kiosks and operating boxes for outdoor use shall be painted with three coats, of which the final coat shall be white or light gray anti-condensation finish.

All ungalvanized external surfaces of outdoor equipment other than nuts, bolts and washers which may have to be removed for maintenance purposes shall receive a minimum of four coats of paint at the works as follows :

- (i) A primary coat of rust inhibiting paint.
- (ii) Two coats of non-glossy, oil and weather resisting paint, the second of which shall be applied on completion of works tests.
- (iii) One final coat of glossy, oil and weather resisting non fading paint, the color of which shall be to the approval of the Owner.

Each coat of paint shall be of a different color and shall be applied to a surface which is clean and dry. With the agreement of the Owner, approved aluminium paints may be used as an alternative to (ii) and (iii) above.

Exposed ungalvanized nuts, bolts and washers which may have to be removed for maintenance purposes shall have aluminium of one coat of paint after erection.

18.4.7 Insulation

All insulating material shall be of an approved type and shall be capable of withstanding the variations in temperature and humidity likely to be met in service without impairing their insulating properties or mechanical strength.

18.4.8 Components

All Components, wherever applicable, shall be impregnated in an approved manner to prevent the ingress of moisture and shall be enclosed in hermetically sealed cases.

18.4.9 Distribution Boards

The distribution boards are to be of the completely enclosed metal clad type arranged for wall mounting. They are to be suitable for controlling either a 400/230 volt, 3 phase, four wire, 50 hertz supply, or a 110 volt 2 wire DC supply and shall be of substantial sheet steel or cast iron construction, dust excluding and drip-proof and are to have a rust resisting finish.

They shall be provided with hinged front covers with provision for padlocking or fitted with a built in lock. Where padlocks are used, a nonferrous padlock shall be provided for each box. All locks shall have differing change numbers.

Fuses or miniature circuit breakers are to be provided for all ways, including spare ways. They are to be of the indicating type and shall incorporate means of indicating when a fuse has blown or a circuit breaker has tripped.

Natural bars and terminals shall be readily accessible, connections to the neutral bar, shall be clearly identified with their respective fuse ways (ie IR,3Y,5B etc).by permanent marking or by ferrules on the wire terminations. The neutral bar of TP and N (three pole and neutral) boards shall include three terminations (ie R Y B) per way. The 110 volt DC distribution boards shall not have fuses or links in the negative connection.

The boards are to be complete with screwed conduit fittings or cable glands to suit the type of cables as specified below.

The enclosure shall allow ample room for wiring with particular reference to the development of wires from the point of entry.

All live terminals shall be adequately shielded suitable provision shall be made for the termination of all earthing connection inside or immediately outside the distribution board.

A separate connection shall be made from the earth bar to the main earth system. Each board is to provide with a stud type terminal not smaller than 6 mm diameter.

Each board shall have an identification label of engraved metal or laminated plastic material and colors shall be free from fading. The surface of the label shall be matt or satin finish to avoid dazzle from reflected light

Each phase of alternating current and each pole of direct current equipment shall be colored in an approved manner to distinguish phase or polarity.

Each board shall have a label mounted inside indicating the apparatus controlled by each fuse.

18.4.10 Underground Low Tension Cables

These cables shall be of polyvinylchloride sheathed type and shall be adequately protected against aggressive subsoil conditions.

Two, three or four core cables shall be used as specified, with conductors insulated for 1 KV.

Standards plus all others mentioned in them, shall be complied with.

Cable splicing shall not be allowed.

18.4.11 P.V.C. Wiring in Conduit

P.V.C. sheathed cables shall be enclosed in heavy gauge, welded steel, screwed galvanized conduit and the necessary conduit accessories.

All P.V.C. Wiring shall be carried out with 600 volt cable of not less than 2.5. Sqm copper section or equivalent.

No cable having a cross section area of less than 2.5 sqm shall be used for a final sub circuit, or less than 4.0 sqm for any other circuit. The cross sectional area of cables feeding distribution fuse boards shall be based on the number and rating of the fuse ways, including spare ways.

18.4.12 Conductors

If the installation is expanded or modified, the new dimensions shall be adjusted to meet the specification. When referring to cases not foreseen in the table shown in clause 18.4.16. The total area occupied by the conductors (including insulation and protection) must not exceed 35% of the interior section of the conduit.

Conductor sections between tees or between coupling units must be continuous couplings or conductor tees shall not be allowed inside conduits. Connection boxes shall be employed where tees and connections are used.

18.4.13 Terminals

Terminals for all apparatus shall be provided with suitable screws for clamping the conductors.

18.4.14 Conduit and Boxes

All conduit installations shall be of heavy gauge welded steel, screwed and galvanized conduit.

All couplings between sections of conduit shall be screwed in such a way that a perfect and mechanical continuity is obtained in the said conduit. All conduits in room with plaster finishes shall be embedded ; the uppermost portion shall be at least 5 mm from the plaster surface.

Joints shall not be allowed in any run of cable whether of the underground type or between the switches and heating or lighting points.

Conduits runs shall be vertical or approximately horizontal, ie allowing sufficient fall to minimize the accumulation of moisture. Provision shall be made for drainage at the lowest point or points of each run.

Where conduits are installed for the future installation of cables, the ends shall be sealed and draw wires left in every section.

Where conduits cross building expansion joints, flexible couplings shall be provided. Where runs are to be cast in concrete floors, care is to be taken that the installation is watertight. Joints under the concrete shall be avoided as far as possible.

18.4.15 Lighting Fittings

Lighting fittings shall be complete with lamp holders, auxiliary apparatus and wiring. The insulation of the internal wiring shall be such as to withstand without deterioration the highest temperatures likely to be experienced in service. Fluorescent fittings shall be provided with bi-pin lamp holders.

The mounting heights where specified on drawings and in schedules are provisional and are to be confirmed on site with the Owner.

The tender rates shall include for all brackets, supports and fixings which may be required.

All lighting fittings are to be complete with lamps.

Filament lamps shall be in accordance with the relevant standards.

Lamp holders shall be of the shrouded type and shall suit the screw type lamp caps.

Fluorescent lamp or Led lamp fittings shall be in accordance with the relevant standards and shall not cause objectionable noise. The control gear shall be effectively suppressed against radio interference and the circuit power shall not be less than 0.85.

Reflectors and lighting fittings shall be so arranged that all exposed metal parts are effectively earthed. They shall be seeing arranged as to facilitate cleaning. All lamps and fittings shall be cleaned before acceptance.

18.4.16 Lighting Switches

Tumbler switches shall be of 240 volt, 5 Amp capacity unless otherwise specified. They shall be mounted in galvanized iron boxes and for interior work shall be of the flush mounting type. Switches in general shall be mounted at a height of 1.5 from floor level.

All junction and other boxes, plus those destined for outlets and switches, shall comply with the respective Standards for heavy type boxes.

The coupling between tubes and boxes is to be carried out by means of a nut on the exterior of the box and a threaded stem on the inside so as to protect adequately the insulation of the conductor. The use of connections in any section of the installation is strictly forbidden .

When necessary, the installation of long curves between conduit sections shall be approved but the use of bellows shall not be permitted under any circumstances.

Passage and tee boxes are to be installed so as to be within reach at all times, bearing in mind that the appearance of the premises is a prime factor to be considered.

The system shall be watertight throughout except where drain or ventilation holes are required.

For outdoor mounting, boxes shall have gasketed covers and have external fixing lugs.

Cover fixing screws shall be of brass for outdoor mounted boxes and sherardised steel for indoor boxes.

All boxes and covers shall be malleable cast iron or heavy gauge pressed steel and shall be galvanized or stove enameled.

Conduits ends shall be reamed after screwing so as or remove all burrs. Conduit terminations on equipment not having screwed entries shall be made with smooth bore brass bushes. Locknuts shall be fitted where necessary.

Draw-in boxes shall be provided at intervals not exceeding 12 meters in straight through runs and inspection bends and boxes shall be located so as to facilitate access.

Size of conduits to be used in relation to the number and size of conductors shall conform with the following table:

Cross Sectional Area of PVC Insulated Conductor mm ²	Size of Conduit mm (Approx)					
	20	25	32.5	32.5	40	50
2.5	6	13	30	30	-	-
4.0	5	10	16	16	-	-
6.0	4	9	13	13	-	-
10.0	3	7	10	10	14	-
16.0	2	5	8	8	11	-
25.0	-	4	7	7	9	-
35.0	-	3	5	5	7	12
50.0	-	-	3	3	4	6
70.0	-	-	-	-	3	5

All exposed metal parts shall be so arranged that they are efficiently earthed to the rest of the system. Multi-gang switches shall be used where switches are grouped but assemblies controlling multi-phase outputs shall be efficiently screened between phases and shall be labeled so as to indicate the different phases.

Where switches are specified to be waterproof they shall be fitted with galvanized covers and mounted in galvanized boxes with gaskets as necessary.

Double pole quick-make quick-break switches shall be supplied for DC emergency lighting circuits. Switches used for fluorescent fitting circuits shall capable of interrupting a current of twice the normal load on the circuit.

18.4.17 Fuses (Mini Circuit Breaker = MCB)

All fuses (MCB) shall be of the high rupturing capacity cartridge type and of approved manufacture. The rating of the fuses to be installed in the various circuits shall be as specified by the Owner.

18.4.18 Connecting Boxes

All boxes and covers shall be of malleable cast iron or heavy gauge pressed steel and shall be galvanized or stove enameled .For outdoor use, boxes shall be watertight and fixing shall be by external lugs and shall be galvanized or rust resistant.

18.4.19 Socket Outlets

Socket outlets shall be two or three-pole as required, their nominal capacity will be equal the appliances maximum load or that immediately above it.

18.4.20 Connections to Semi Portable Apparatus

All apparatus of a semi-portable nature shall be connected up in a permanent manner. Where a flexible connection is required to such apparatus it shall consist of cables in a watertight flexible metallic conduit bonded across with a copper earthing conductor of the same size as the conductors enclosed in the conduit. Plug connection shall not be used for connections to semi-portable apparatus.

18.4.21 Portable Tool Transformers

The primary voltage shall be 230 volts. Single phase and the secondary voltage 110 volts, center tapped. The transformers will be of 500 VA capacity.

The secondary winding shall be connected to a socket outlet non-interchangeable with plug socket arrangements used for other purposes at 100 volts via cartridge fuses. The socket outlet shall be mounted on the transformer enclosure access to the fuse shall be by a drip-proof gasketed cover. The cover shall be labeled 110 volt fuses in an approved manner.

18.4.22 Earthing and Bonding

All metal sheathing, armoring, conduit and the metal casing of all apparatus shall be bonded together so as to be electrically continuous throughout the system and shall be connected to earth by a copper earth conductor.

The earth conductor shall cover the whole installation even if not detailed in the project drawings.

The purpose of the earth conductor is to protect the metal components of the installation against accidental electrical contact. Sections of conductor shall be those answering to the rupturing capacity of the automatic switch that feeds the circuit, according to the following synopsis:

Rupturing Capacity	Earth Connection Conductor Section MM ²	
up to 20 amps	1.5	1.5
up to 30 amps	2.5	2.5
up to 40 amps	4	4
up to 60 amps	6	6
up to 100amps	10	10

Normally earth connections for the main equipment in the plant buildings will be provided in other contracts for the main equipment to which the lighting contractor may take his earth connection. Where necessary the contractor will provide an earth electrode of approved design.

Connection to the station earth bar shall be by low temperature brazing or by riveting and soldering. Rivets shall not exceed 6.5 mm diameter. The earth conductor shall be neatly clipped into position throughout its length.

18.4.23 Flexible Connections

Where connections to apparatus are required to be flexible they shall be made in waterproof flexible metallic conduit and shall include a copper earth conductor not smaller than the line conduit shall be secured with approved glands.

Flexible conductors shall be composed of high conductivity tinned copper or aluminium wires insulated with two layers of vulcanized rubber and shall be of 250 volts grade. No flexible cable smaller than 30.25 mm section shall be of 250 volts grade. No flexible cable smaller than 30.25 mm section shall be used.

18.4.24 Emergency Lighting

Certain lighting points, or groups of points shall be arranged as emergency lighting circuits. These will not normally be energized but on the loss of the AC supply to the general lighting circuits, are to switch on automatically and will be fed from the DC supply from the station battery.

The changeover contractor and all necessary equipment including the DC wiring is to be included in the contract AC wiring is not to be run in the same conduit as AC wiring.

18.4.25 Lighting Columns and Towers

Road lighting columns whether of steel or concrete shall include all necessary mounting boards, uses, cable boxes, glands and wiring. Floodlight towers and gantries shall be of an approved design and construction. All columns and towers shall be accurately positioned and plumbed.

All metal parts, including the body of steel columns other than conductors shall be connected to the armoring of incoming cables in an approved manner, by a conductor of not less than 25 sqm sectional area. Foundations for road and site lighting columns and floodlighting towers shall be provided under the plant foundations section this contract.

18.4.26 External Floodlight

Where required, portable floodlights shall be supplied. Floodlights shall be of an approved type and capable of adjustment for direction of illumination and shall be weatherproof construction.

18.4.27 Scaffolding and Tools

All scaffolding, staging, ladders and tools and other plant required for the proper execution of the contract works shall be provided by the contractor. All such equipment shall be removed when the contract is finished or at other times when no longer required. During the execution of the work any scrap material or rubbish which is caused by such work shall be removed by the contractor.

19. FIRE PROTECTION

19.1 Fire Safety Facilities General

Fire safety facilities shall be designed for maximum reliability and ease of maintenance.

Equipment shall comply with the standards named in this specification but the contractor may propose equipment in accordance with other relevant published standards, as optional alternative.

The contractor shall submit copies of such alternatives standards with his proposal. All fire protection equipment shall be of types approved and listed by recognized approval authorities, or approved by the Owner.

19.2 Portable Fire Extinguishers

The portable apparatus to be provided under this contract is to be used for dealing with outbreak of fire in oil filled transformers and switchgear, not protected by a fixed installation and in electrical equipment in control and equipment rooms.

All apparatus shall be suitable for operation by one person alone and shall be easily recharged. The discharge shall be non corrosive and free of chemicals prone to give off toxic gases when heated.

Equipment for dealing with oil fires shall be foam generating and for other electrical fires, co₂ propelled dry powder type. The tenderer is at liberty to put forward alternative proposals for portable fire extinguishing equipment.

The contract shall include for the supply and installation of all wall brackets and fittings for small units and the provision of wheeled trolleys for units which cannot be carried easily.

19.2.1 Portable, Wall MOUNTED EXTINGUISHERS

Portable, wall mounted, hand head extinguishers shall be the 4 kg size charges with a multi purpose powder of ABC rating.

(i) Construction and Operator

The following requirements are made for construction :

The body of the extinguisher shall be seamless, welded or brazed as appropriate.

The body of the extinguisher shall have a minimum burst pressure of 5.0 MPa.

All extinguishers shall be provided with a hose and nozzle assembly which shall a length of not less than 80 of that of the extinguisher body.

The extinguishing shall be capable of being released by means of lever operated valve provided with a safety pin.

Extinguishers utilizing screw down valves are not acceptable.

Extinguishers which require to be inverted for normal operation are not acceptable.

Extinguishers shall be capable of controlled partial discharge.

(ii) Marking

All extinguishers shall be painted and marked in the English language with clear instructions use.

(iii) Housings for portable fire Extinguishers

Where extinguishers are provided in external positions or other areas where they may be subjected to the weather may shall be hung inside protective cabinets.

The protective cabinets shall be red in color and marked with the works FIRE EXTINGUISHER in the English language in white. The cabinet shall provide protection from rain and wind blown dust and have a pull off front cover allowing ease of access to the extinguisher.

(iv) Mounting

Where extinguishers are provided internally they shall be wall mounted and attached in a manner affording quick release from the supporting bracket. They shall be installed so that the top of the extinguisher is not more than 1.5. Meters above the floor.

In no case shall be the clearance between the bottom of the extinguisher and the floor be less than 0.1 meter. The extinguishers shall be positioned so that the instructions for operation face outwards.

19.2.2 Mobile Trolley Extinguishers

(i) Dry Powder Type

The extinguisher shall consist a powder container to which shall be attached a cylinder of compressed inert gas for use as the propellant of the extinguishing. The powder shall be red from the container to the discharge nozzle through a flexible

hose. This equipment shall be mounted on a metal frame with wheels and handle to make it mobile and maneuverable.

The dry powder container shall be of steel construction and shall have been pressure tested to at least twice its operating pressure. The container shall hold 45 kg of multi-purpose dry powder of ABC rating.

The pressurizing cylinder shall be externally attached to the powder container. The hose conducting the powder to the discharge nozzle shall be 10 meters long and made of braided synthetic flexible hose. The hose shall be permanently connected to the dry powder container. The hose shall be stored in a manner allowing easy removal for use.

The unit shall have at least two wheels which shall have rubber or synthetic tires and a minimum overall diameter of 300 mm. The overall width of the unit shall not exceed 800 mm.

A single easily accessible valve shall be used to release the pressuring gas into the powder container. The nozzle shall control the discharge of the dry powder and shall be designed for controlled partial delivery. The unit shall be capable of discharging all the dry powder in at most 60 seconds.

The extinguishers shall be painted and marked in the English language with clear instructions use which shall include the words *NOT FOR USE ON ELECTRICAL FIRES*.

(ii) Accommodation of mobile fire Extinguishers

Mobile fire extinguishers shall be protected from the prevailing climatic conditions, and shall be clearly visible and accessible.

20. AIR CONDITIONING AND VENTILATING SERVICES

20.1 Scope

This section of the works covers the supply, delivery, installation, commissioning and setting to work of the ventilating and the air conditioning system in control Buildings.

All air conditioning and ventilating system shall be fully automatic in operation and shall be capable of maintaining internal conditions within the bands of temperature and humidity specified hereafter.

20.2 Air Conditioning

The control building shall be air conditioned in the following rooms:

Control & Relay room

Offices

Telecommunication room

Air conditioning shall be provided in the form of split or multi split system units handling predominantly recirculated air with a controlled quantity of fresh air introduced at the units. Split system units shall incorporate direct expansion cooling coils served by externally mounted air cooled refrigeration condensing units. The number of plants that shall be provided for the building shall be dependent upon the cooling load characteristics of the various conditioned areas.

20.3 Mechanical Ventilation

Supply and extract ventilator shall be provided to serve the Diesel Room, Battery Room and 20 KV Metal clad Room.

Supply air handling plants shall consist of a fresh air intake Louver, insect screen, filter, fan and distribution ductwork.

Extract ventilation shall be provided by means of wall mounting fans, roof extract units or dusted system with louvered discharges to atmosphere. Individual extract fans shall be provided for the Toilet.

20.4 Basis For Design

20.4.1 External Design Conditions

The external conditions for the calculation of duties for the mechanical services plans shall be :

Summer 35°C DB/ 25°C WB

Rain 20°C/ 100% RH

All items of plant and equipment for all building services shall be designed to operate without mal function up to maximum ambient condition of 45°C D.B., with instances of 100% R.H.

All plant and equipment installed externally, or which can be affected by eternal conditions, shall be capable of withstanding without damage or deterioration the effects of solar radiation rain, wind, dust or other weather phenomena prevalent in the area in which the particular building is located.

20.4.2 Internal Design Conditions

Air conditioning system shall be capable of maintaining internal conditions in all air conditioned areas within the following bands :

25 - 22°C D.B. 50 - 60 % R.H.

Air conditioning system shall be arranged to introduce a fresh air quantity equivalent to 10% of the total air volume handled. Supply ventilation system shall handle 100% fresh air. In mechanically ventilated areas extract system shall extract 80% of the supply air volume to maintain a positive pressure internally.

All air conditioning system shall be designed for continuous operation. Plant shall be arranged to facilitate maintenance and future replacement of equipment.

The contractor shall calculate heat gains and losses under the specified conditions for each part of the building taking into account solar radiation, thermal transmittance through roofs, walls, floors and windows, fresh air requirements, heat emission from infiltration and any other sources. The contractor shall be responsible for determining the heat transfer coefficients for all materials, design or method of building construction, the contractor shall at all times be responsible for rechecking the design of all system to ensure that they are capable of meeting the specified design requirements.

20.5 Vibration

All vibration producing equipment shall be isolated from the building by means of

anti-vibration and noise isolators. The degree of isolation shall be such that noise criteria specified above are not exceeded and that no part of the building structure is subjected to vibration amplitudes in excess of the following values:

Frequency vibration Hertz)	2	5	10	25	50
Amplitude of vibration (mm) (Mean to Peak)	0.2	0.07	0.02	0.0008	0.02

20.6 Manufacturers

Wherever possible all air conditioning and ventilating plant shall be selected from a single manufacturer's product range and origin. Where this is not possible, because of practical or technical constraints, then the number of different sources of origin shall be kept to a minimum.

The Contractor shall provide, with his submission, illustrated technical literature covering all plant and equipment offered.

20.7 Standards

All air conditioning and ventilating equipment shall conform to Chartered Institution of Building Services of ASHRAE recommendations or other recognized International Standards.

20.8 Approvals

The contractor shall submit to the Owner for approval copies of all his calculations forming the basis for the selection of all air conditioning and ventilating plant, plant selection details and full working drawings. Such approval shall not, however, relieve the contractor of his contractual responsibilities.

20.9 Schedules And Tender Drawings

Drawings showing the proposals for air conditioning and ventilating installation shall be submitted with tenders. These drawings shall be listed in the appropriate schedule.

Schedules giving technical details and particulars of all air conditioning and ventilating plant must be completed and submitted with tenders.

20.10 Maintenance

The contractor shall be responsible for the maintenance of all installations covered by this section of this specification for the period stated.

20.11 Associated Civil And Builders Works

All civil works, builders works and attendance required associated with the air conditioning and ventilating installations shall be included within the appropriate building cost estimates.

20.12 Air Cooled Condensing Units

The cooling medium for the air conditioning shall be direct expansion refrigeration provided by air cooled condensing units located externally.

The condensing units shall be the fully packaged type requiring only site connection of refrigeration pipe work, isolated electrical supply and input from the control system.

The individual items of refrigerant equipment shall be matched such that the required performance or the evaporator is achieved concurrently with the satisfactory operation of the compressor and adequate heat rejection at the condenser.

Each system as a whole shall maintain the correct duty at the design ambient and operate at the maximum ambient conditions stated without exceeding the safe operational limits of any individual item of equipment and without causing any safety device to operate.

Air cooled condensing units and internal fan coil sections that are interconnected on site with refrigerant piping shall all be supplied by the same manufacturer.

The casing of the condensing units shall be weatherproof and shall incorporate access and inspection panels secured in place by rustproof fasteners.

The whole of the casing shall be treated for corrosion and weather resistance and ungalvanised mild steel shall not be used (even if painted).

The unit shall be finished in not less than two coats of weather resistant finish such as baked enamel of a light reflective color.

The access panels shall be adequately sized for the service and removal of all working parts of the unit.

All panels shall be stiffened and supported to prevent flexing and drumming. Electrical equipment shall be contained in a fully weatherproofed enclosure with internal division between the power connections and the equipment and the control connections and equipment.

20.13 Refrigeration Pipe Work Insulation

Liquid lines shall be insulated where they are in direct sunlight or where they pass through non air conditioned areas.

Suction lines shall be insulated over their entire length.

All insulation to refrigeration pipe work shall be flexible closed cell, foam phenolic rubber type with a temperature range of -40°C to - 150°C and having a thermal conductivity of 0.0375 w/m deg. C at 21°C and a wetter vapor transmission of less than 6.0 ng/Ns.

The thickness of insulation shall be in accordance with the following tables :

(i) Suction Lines Location	Insulation thickness for O.D. pipe sizes Range	
Exposed	6 mm to 10 mm 13 mm	12 mm to 22 mm 19 mm

In air conditioned spaces	9 mm	9 mm
In non-air conditioned spaces	9 mm	9 mm

- (ii) Liquid Lines
Exposed to weather
and in non air conditioned spaces 9 mm. 9 mm.

20.14 Charging Of Refrigeration System

The refrigerant used shall be non explosive, non combustible, non toxins and non irritating.

Packaged air conditioning plant items requiring interconnection with refrigeration piping on site shall be leak tested by the manufacturers and delivered to site with a holding charge of refrigerant.

20.15 Console Air Conditioning Units

Console model room air conditioners shall be of the slim-line pattern and complete with 4-way adjustable grilles, heavy gauge zinc coats stove enameled shed steel casing with single or two color decorative finish. Electrical re heaters shall not be fitted.

The casing and position shall be such so as to protrude not more than 250 mm into the conditioned space and no external projection beyond the building line will be permitted other than the fixing of the condenser cooling air grille.

The units shall be extremely quiet in operation, the noise level not being higher than 30 dB. All sections of the casing shall be acoustically and thermally insulated.

Compressors shall be of the fully hermetic type, fitted with resilient mountings and complete with thermal overload protection and starting relays.

Evaporators shall be manufactured of copper tube with copper or aluminium fins mechanically bonded. The evaporator fan shall be of double inlet double width type and complete with continuously rated totally enclosed electric motor.

Filters shall be of the washable type, suitably positioned for easy access for cleaning.

Automatic control by means of an integral thermostat shall be provided together with the safety controls to prevent excessive cooling.

Motors shall be air cooled and units shall be complete with internally mounted condenser cooling fans with totally enclosed motors.

Fresh air shall be introduced separately by means of a central fresh air plant, where these units are proposed to serve individual offices in a building.

Units shall be supplied as a whole and be suitable for easy removal and repositioning should this be desired by the building owner.

20.16 Ductwork

All sheet metal dusting shall be manufactured and installed in accordance with the International standards for sheet metal ductwork for low pressure air systems with air velocity of up to 10 m/s.

All ductwork and fittings serving hazardous areas such as battery rooms where corrosive fumes are expected shall be of rigid PVC material.

20.17 Dampers (Manually Operated)

All dampers shall be of rigid construction to prevent fluttering or the blades and mechanism. Airflow leakage past a damper when fully closed shall not exceed 5 % of the maximum design airflow at the maximum system static pressure difference.

All manually adjustable dampers shall be fitted with a quadrant type operator with a locking device and the position of the primary dampers as set after regulation shall be clearly and indelibly marked on the damper quadrant by means of a non-corrodible label approximately 25mm x 50mm stating the actual flow in that section of dusting in cubic meters second.

Blades of primary dampers shall be of aerodynamic cross section and manufactured from two sheets of the same materials as the duct to which it is connected. The blades shall be securely fixed to spindles which shall have both ends housed in nylon or soft metal sleeving bearings.

Damper shall have an opposed blade action.

20.18 Fire Dampers

Fire dampers shall be provided in the dusting systems where dusting passes through a wall or floor forming a fire zone or barrier.

Fire dampers shall be constructed with fire resistance measured in accordance with the approved standards and shall be tested and approved by the Owner.

Each damper shall be held open by means of a flexible link set to close the damper at duct temperature exceeding 72°C.

An access door shall be provided adjacent to each fire damper for service inspection and resetting of the fusible links.

Where the damper is fitted to a wall or floor the damper casing shall be fitted with building-in lugs.

20.19 Acoustic Attenuators

Sound attenuators and acoustic lining shall be supplied and installed in the air conditioning and ventilation systems to reduce noise levels in the rooms to those specified.

Purpose-made attenuators and sound absorbent material shall be so designed and installed in the ductwork that they offer low resistance to air flow, have adequate strength and cohesion to resist erosion by air flow and do not produce dust. They shall be free from odor and proof against rot, damp and vermin.

Adhesives shall be compatible with the sound absorbent material and shall be non-flammable.

Outer casings of rectangular silencers shall be contrasted in accordance with the previous specification for ductwork manufacture. Seams shall be lock-formed and mastic filled.

Filler material shall be of inorganic mineral or glass fiber of a density sufficient to obtain the specified acoustic performance and packed under not less than 5% compression to eliminate voids due to vibration and settling. Material shall be inert, vermin and

moisture-proof.

Airtight construction shall be provided by use of a duct sealing compound at the site, with material and structurally when subjected to a differential air pressure of 253 mm w.g. inside to outside casing.

20.20 Thermal Insulation

All thermal insulation works shall be carried out in accordance with international standards. Thermal insulation materials and finishes shall be proof against rotting, mould growth and vermin and shall be suitable for the ambient temperature and conditions prevailing.

Thermal insulation shall be applied to all supply and return air ductwork, fans and casings carrying conditioned air whether cooled, humidified or dehumidified. Thermal insulation shall be applied to fresh air intake dusting only where it passes through enclosed spaces where the duct surface temperature is equal to or lower than the air dew point temperature and where it is exposed to the weather.

Rectangular dusting shall be insulated with rigid glass fiber or mineral wool sheets secured to the dusting by means of non-flammable adhesive. Thermal insulation thickness and finishes shall be in accordance with the following table:

Insulated Service	Ductwork Inside Buildings	Ductwork Exposed to Weather
Supply air Ductwork	38 mm with vapor barrier finish	50 mm with weather proof vapor barrier finish
Return air Ductwork	25 mm with vapor barrier finish	50 mm with vapor barrier finish

All ductwork carrying air which is below the maximum dew point of the air in the space through which the duct passes shall have a vapor barrier finish comprising 1 coat PVC solution and 2 coats vinyl based vapor barrier.

Insulation shall be applied to access panels in the form of tightly slabs of rigid glass fiber of the appropriate thickness fixed into place by means of non-setting mastic compound and a galvanized mild steel sheet outer cover plate fixed into position by screwed studs and wing nuts.

Vapor barriers shall be continuous and unbroken over the surface of the dusting, fittings and equipment.

Thermal insulation exposed to weather and solar effect shall be additionally protected against the weather by means of an external coating of aluminium sheet at least 0.8 mm thick pop-riveted into position and sealed at the joints with non-setting sealing compound. This aluminium shall be applied over the vapor barrier where applicable. Where insulation ducts or pipes enter a building through a roof or wall the insulation and the flashing by means of non-setting sealing compound.

20.21 Fans

20.21.1 General

This Clause of the Specification deals with fans of all types as used in air conditioning and ventilation systems of the packaged or site assembled type.

The performance of fans shall be determined by the manufacturer and the test certificates shall be submitted to the Owner.

Fans shall be capable of the duties required to fulfill the specified design conditions. The contractor shall be responsible for ensuring that the installed fan is capable of the required duty without exceeding the specified noise levels or driving capacity of the motor and drive.

20.21.2 Centrifugal Fans

Forward curve centrifugal fans shall be used on low pressure systems only and shall not be run in excess of 25 rev/s.

Centrifugal fans scrolls shall be constructed of zinc coated or galvanized mild steel with angle stiffeners and base angles to ensure freedom from drumming. The construction shall be suitable for continuous operation at the maximum ratings published by the manufacturer.

Double inlet double width fans for use in fan coil sections shall have bearing on each side of the fan which shall be pedestal mounted on fans with impellers in excess of 250 mm diameter. Shaft bearings of all single inlet centrifugal fans shall be twin bearings mounted on a common pedestal. No more than three centrifugal fans shall be driven on a common shaft.

Centrifugal fan impellers shall be constructed with mild steel blades welded or riveted to spiders of robust cast aluminium alloy or welded steel. The impellers shall be centered in the fan casing by the manufacturer and fixed in position at each hub. After installation and before running, all fans shall be checked for misalignment and for the presence of foreign bodies or matter in the fan casings and any such fault shall be remedied.

Lubrication of bearings shall be in accordance with the manufacturers recommendations and bearings requiring regular lubrication service shall have lubrication nipples extended to a convenient location outside the fan casing and shall incorporate an oil reservoir where applicable. All bearings must be checked for satisfactory lubrication before any item of plant is put in operation.

20.21.3 Axial Flow Fans

Axial flow fans shall be of the single or multi-stage contra-rotating types.

Axial fan casings shall be of continuously welded mild steel construction hot dip galvanized after manufacture. The lengths of the casings shall be sufficient to allow removal of the fan without disturbing the connected ductwork. The motor/impeller assemblies shall be fixed to the casings by mild steel threaded rods which shall be directly fixed to motor casings for motors up to 25 kW.

Axial flow fan impeller blades shall be of aerofoil section constructed from cast aluminium. The hub shall incorporate a cast iron blade fixing plate with keyed slots for the blades.

The keyed slots shall permit the removal and readjustment of the blade pitch angle. The fan shall be clearly marked with the factory-set pitch angle and the maximum permissible pitch angle available with the motor fitted.

Axial fan casings of 150 mm diameter and above shall be fitted with an airtight inspection door. The fan casings shall be fitted with galvanized mild steel mating flanges, bolted mounting feet, coned inlets and upstream guide vanes as necessary.

Electrical connections to the fan motor shall be taken to a terminal block enclosed in a

terminal box welded to the fan casing. The terminal box lid shall be watertight.

20.22 Extract Ventilation Units

This clause covers fan powered extract ventilation units for mounting in walls and windows, on roofs and in plant rooms.

Extract units shall incorporate propeller, centrifugal or hybrid type fans shall be constructed in accordance with the relevant section of this Specification.

Roof units shall comprise a galvanized sheet steel base suitable for use as a weathering skirt, a mild steel fan motor mounting frame and a spun aluminium cowl. The sheet steel base shall be constructed to support the fan/motor without distortion and where the fan is belt driven shall incorporate a rigid sub frame for motor mounting. Fans shall be diaphragm mounted or fitted with a cylindrical casing designed for removal from or fitted with a cylindrical casing designed for removal from the unit from inside or outside the building without disturbing the weathering skirt or cowl fixings. The cowl shall be weatherproofed and shall be hinge mounted to provide complete access to the fan/motor.

Lubricating points shall be extended to a convenient access point.

Stainless steel nuts, bolts and washers shall be used for all fixings exposed to the weather.

20.23 Air Filters

20.23.1 General

All filter media shall be properly bonded and protected against filter fiber or particle migration. The direction of airflow shall be clearly marked on all filter panels and on installation frames.

Access to filter shall be through removable panels fitted with quick release fasteners and rubber sealing gaskets.

Each disposable panel filter system shall be provided with 4 complete spare sets for use during the commissioning period. These sets shall be in addition to any filter cells supplied as spares in accordance with the general clauses of this Specification.

Filter media of all types and sizes shall be supported in rigid peripheral frames with internal or external wire support of the media to ensure that the media shall not collapse under airflow. The holding frames shall incorporate accurately sized channel sections to provide a good sliding fit for the filters.

20.23.2 Washable Panel Filters

Washable panel filters shall be manufactured from two layers of differing grades of remembrance polyurethane foam bonded together to a total of 25 mm thickness. The medium shall be suitable for operation in air temperatures up to 90°C, shall contain a flame retardant and shall be unaffected by oils, solvents and grease at normal operating temperatures.

Filter panels shall have a face velocity not exceeding 1.6 m/s. Washable filters shall have an air pressure drop when clean not exceeding 33 N/m² when dirty and the dust holding capacity not be less than 7.0 kg per m² filter face area. The washable panel filters shall have a gravimetric efficiency of not less than 83%.

Each item of plant shall be provided with local isolation and/or emergency stop buttons to facilitate maintenance, inspection and emergency operation.

Where items of plant are monitored and controlled from a control panel or console, remote stop/start facilities shall be provided for each item.

20.27 Electrical Connections

All electrical power, control cable and wiring associated with the air conditioning and ventilation systems including all connections between control panels, valves, thermostats, sensing probes and other like items shall be supplied, installed and connected up as part of this Contract.

The cabling and wiring systems shall comply with the requirements of the relevant clauses of this Specification and be either surface or flush installation as appropriate.

Final connections to electric motor and all other items of plant subject to movement and vibration shall comprise flexible cable in flexible conduit.