Request for Proposals (RFP)

Request for Proposal for the electrical installation, standby generator installation, and switchgear replacement situated at building 44, at the CSR Pretoria Campus.

RFP No. 3467/16/07/2021

Date of Issue	Wednesday, 23 June 2021
Last day for submission of Intent to Bid Form (Annexure M)	Monday, 28 June 2021
Compulsory briefing session and site inspection	**Virtual Briefing Session** Date: Wednesday, 30 June 2021 Time: 10H00 Access Link: **Join on your computer or mobile app** Click here to join the meeting Learn More | Meeting options **Site Inspection** Date: Friday, 02 July 2021 Venue: CSIR, Meiring Naude Street, Pretoria, building 44 Time: 10H00
Last date for submission of queries / clarifications	Date: Friday, 09 July 2021 at 16H30
Closing Date	Date: Friday 16 July 2021 Time: 16H30
Tender submission	tender@csir.co.za

Enquiries	Strategic Procurement Unit	E-mail: tender@csir.co.za
CSIR business hours	08h00 – 16h30	
Category	Electrical Construction	

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SECTION A – TECHNICAL INFORMATION

1 INTRODUCTION

The Council for Scientific and Industrial Research (CSIR) is one of the leading scientific research and technology development organisations in Africa. In partnership with national and international research and technology institutions, CSIR undertakes directed and multidisciplinary research and technology innovation that contributes to the improvement of the quality of life of South Africans. The CSIR's main site is in Pretoria while it is represented in other provinces of South Africa through regional offices.

2 BACKGROUND

The CSIR Pretoria Campus building 44 has old electrical infrastructure that needs upgrading and replacement to comply with current regulations and is in need of a standby power supply.

3 INVITATION FOR PROPOSAL

Proposals are hereby invited from CIDB registered contractors for the supply, procurement, delivery, erection, testing, commissioning, and successful handover of a complete electrical installation for the CSIR at the Pretoria Campus.

4 PROPOSAL SPECIFICATION

All proposals are to be submitted in a format specified in this enquiry (if applicable). However, tenderers are welcome to submit additional / alternative proposals over and above the originally specified format.

Bidders are to submit responses in the following format prescribed below. Failure to adhere to this may result in disqualification and the tender may be deemed as non-responsive.

4.1 Technical Proposal

The following must be submitted as part of the **technical** proposal:

- Covering letter.
- Company profile clearly stipulating the number of years including a list of completed projects/sites of similar projects rendering similar services between 2015 and 2021. Bidders

may complete schedule of Bidders Experience, item 31.

- Submit detailed CV, qualification and registration/affiliations of Lead Installer.
    - Must submit proof of Wireman' license.
    - Must submit proof of Electrical Trade Test (heavy current).
    - Must have a minimum of 5 years work experience in the installation of MLV boards and MV switchgear.
- Provide a minimum of three (3) contactable reference letters (or referee to complete Annexure A) from previous clients for similar work done between 2015 and 2021 and must be accessible for vetting purposes.
- Provide a valid CIDB registration certificate, Grade 5EB or 5EP or higher grading designation.
- Provide a valid letter of good standing relevant to the scope of work from the Department of Labour (COIDA) and or an approved Insurance Firm
- Provide proof of valid public liability cover to the minimum value of R10 Million or valid Letter of Intent.
- Completed and signed Local Content Annexure C and production declaration form SBD 6.2, where applicable.
- Original completed Bills of Quantities (BOQ) (Annexure I).
- Schedules of equipment offered (Annexure K).
- Detailed brochures of all equipment offered shall be presented together with the tender documents.

4.2 **Financial Proposal:**

The following must be submitted as part of the **financial** proposal:

- Cover letter
- Proposed cost/ commercial offer as per attached BOQ (Annexure I).
- Provide a valid original or certified copy of B-BBEE certificate or valid sworn affidavit; and registration report (RSA suppliers).

Additional Requirements:

- The supplier must also submit a signed quotation on their official company letterhead.
- The pricing must be firm and inclusive of all costs required to render the required

services to the CSIR. Anything outside the scope of this RFP must be quoted separately.

- Pricing information must be provided separately from the technical requirements.

4.3 Annexures Enclosed in the RFP documents

4.3.1 Annexure A – Reference Form
4.3.2 Annexure B – Project Specification
4.3.3 Annexure C – Local Content
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4.3.10 Annexure J – SBD 1 Form
4.3.11 Annexure K – Schedule of Equipment Offered
4.3.12 Annexure L – Schedule of Tender Drawings (Drawings to be shared with only bidders who attend the compulsory briefing and site inspection)
4.3.13 Annexure M – Intent to Bid
4.3.14 Local Content Guidelines
4.3.15 National Treasury Instruction Note 5 of 2016/2017, Electrical Cable Products
4.3.16 National Treasury Instruction Note 15 of 2016/2017, Steel Products and Component

5 THE SCOPE OF WORK

The Scope of work is stated in the attached Bill of Quantities (BOQ). This includes, but is not limited to, the following:

See ANNEXURE B Item 1.1.2 – Schedule of technical information for full SCOPE OF WORK

General

Intent of Document

The specification is intended to cover the complete installation of the switchgear replacement project. The minimum equipment requirements are outlined, but do not cover all the details of design and construction. Such details are recognised as being the exclusive responsibility of the contractor.

In all cases where a device or part of the equipment is referred to in the singular, it is intended that such reference shall apply to as many devices as are required to complete the installation.

Standards and Codes

All work and equipment shall be in accordance with the requirements of BS5514 and shall comply with the Occupational Health and Safety Act, No 85 of 1993 and current regulations of all other codes applicable to this work.

Scope of Supply

Supply, delivery, installation and commissioning of the complete switchgear replacement specified in this document.

The scope of the work will be carried out while the premises, buildings and workshops are fully occupied and in a live and operational condition. The sequence in which the work must be carried out must be established in consultation with the CSIR Representative.

All interruptions of the electrical supply that may be necessary for the execution of the work will be subject to prior arrangements between the Contractor, the end user, and the CSIR Representative.

Co-ordination

Due to the nature of the installation, a fixed sequence of operation is required to properly install the complete switchgear replacement project. The work shall be closely scheduled and monitored, in order not to delay the entire project.

The contractor shall familiarise himself with the requirements of the other trades and shall examine the plant and specification covering each of these sections.

The space requirements shall be carefully checked with the other trades to ensure that his equipment can be installed in the proper sequence in the space allocated.

Test Certificates and Inspections

The following tests are to be carried out:

(a) At the supplier's premises, before the generator set will be delivered to site, Representatives of the CSIR may be present during the test to satisfy them that the generating set complies with the specification and delivers the specified output. The test must be carried out in accordance with BSS 5514, Part 2 and 3. The CSIR must be timeously advised of the date for the test.

(b) After completion of the works and before first delivery is taken, a full test will be carried out on the installation for a period of sufficient duration to determine the satisfactory working thereof. During this period the installation will be inspected and the contractor shall make good, to the satisfaction of the Representative, any defects which may arise.

(c) The Contractor shall provide all instruments and equipment required for testing and any water, power and fuel required for the commissioning and testing of the installation at completion.

(d) Test reports of both tests as specified under (a) and (b) are to be submitted to the CSIR.

Guarantee and Maintenance.

The Contractor shall guarantee the complete plant for a period of twelve (12) months after the first delivery has taken place.

If during this period the plant is not in working order, or not working satisfactorily owing to faulty material, design or workmanship, the Contractor will be notified and immediate steps shall be taken by him to rectify the defects and/or replace the affected parts on site at his own expense.

The Contractor shall maintain the plant in good working condition for the full twelve-month period to the final delivery of the installation. However, should the Contractor fail to hand over the plant in good working order on the expiry of the specified twelve months, the Contractor shall be responsible for further monthly maintenance until final delivery is taken.

During this period the contractor will undertake to arrange that the plant be inspected at least once per month by a qualified member of his staff who shall: -

(a) Report to the Officer-in-charge, keeping the maintenance records, and enter into a logbook the date of the visit, the tests carried out, and the adjustments made, and any further details that may be required.
(b) Grease and oil moving parts, where necessary.

(c) Check the air filter and, when necessary, clean the filter and replace filter oil.

(d) Check the lubricating oil and top-up when necessary.

(e) Drain the sump and refill with fresh lubricating oil and change the filter as per the interval stipulated by the manufacturers. The reading of the hour meter on the switchboard will be taken to establish the number of hours run by the plant.

Under this heading only the cost of the actual oil used, shall be charged as an extra on the monthly account.

(f) Clean the lubricating oil filter and/or replace the filter element at intervals recommended by the engine manufacturer, the cost of a new filter element to be charged as an extra on the monthly account.

(g) Check and when necessary, adjust the valve settings and the fuel injection equipment.

(h) Check the battery and top-up the electrolyte when necessary.

(i) Test-run the plant for 0,5 hour and check the automatic starting with simulated faults on the mains, the proper working of all parts, including the electrical gear the protective devices with fault indicators, the changeover equipment, and the battery charger. Make the necessary adjustments as required.

(j) Report to the Department and to the Contractor on any parts that become unserviceable through fair wear and tear or damaged by causes beyond the control of the Contractor.

The Contractor on receiving the report shall immediately submit a detailed quotation for the repair or replacement of such parts to the CISR.

(k) Advise the CSIR when it has become necessary to de-carbonise the engine and submit a quotation for this service.

(l) Top up the water of the radiator, if applicable.

(m) Clean the plant and its components.

Materials and Workmanship

(a) The work throughout shall be executed to the highest standards and to the entire satisfaction of the Representative who shall interpret the meaning of the Contract Document and shall have the authority to reject any work and materials, which, in his judgement, are not in full accordance therewith. All condemned material and workmanship shall be replaced or rectified as directed and approved by the Engineer.

(b) All work shall be executed in a first-class manner by qualified tradesman.

(c) The Contractor shall warrant that the materials and workmanship shall be of the highest grade, that the equipment shall be installed in a practical and first-class manner in accordance with the best practices and ready and complete for full operation. It is specifically intended that all material or labour which is usually provided as part of such equipment as is called for and which is necessary for its proper completion and operation shall be provided without additional cost whether shown or described in the Contract Document.

(d) The Contractor shall thoroughly acquaint himself with the work involved and shall verify on site all measurements necessary for proper installation work. The Contractor shall also be prepared to promptly furnish any information relating to his own work as may be necessary for the proper installation work and shall co-operate with and co-ordinate the work of others as may be applicable.

(e) All components and their respective adjustment, which do not form part of the equipment installation work but influence the optimum and safe operation of the equipment shall be considered to form part of and shall be included in the Contractor's scope of works.

(f) All control equipment and serviceable items shall be installed and positioned such that they will be accessible and maintainable.

(g) The Contractor shall make sure that all safety regulations and measures are applied and enforced during the installation and guarantee periods to ensure the safety of the public and the User Client.

(h) The Contractor is to include for all scaffolding required to complete the work required.

Brochures

Detailed brochures of all equipment offered shall be presented together with the tender documents.

6 FUNCTIONAL EVALUATION CRITERIA

6.1 The evaluation of the functional / technical detail of the proposal will be based on the following criteria:

#	Evaluation criteria	Criteria Description	Weighted score
1	**Company experience**	▪ The service provider must submit a list of projects which they have completed between 2015 and 2021. A minimum of 5 projects on similar scope of work must be submitted.	30
2	**Client references**	▪ Bidders to submit a minimum of three (3) contactable references from previous clients for similar work done between 2015 and 2021. ▪ Completed projects/sites of similar projects must be accessible for vetting purposes.	40
3	**Staff capability**	▪ Detailed CV of the lead person who does installation. ▪ Must have a minimum of 5 years work experience	30
		TOTAL	**100**

6.2 Proposals with functionality / technical points of less than the pre-determined minimum overall percentage of **70%** and sub section of **60%** will be eliminated from further evaluation.

6.3 Refer to ***Annexure G*** for the scoring sheet that will be used to evaluate functionality**.**

7 ELIMINATION CRITERIA

7.1 **Proposals will be eliminated under the following conditions:**

- Submission after the deadline.
- Proposals submitted at incorrect e-mail address.
- Failure to attend the compulsory briefing session / site inspection.

- Failure to provide a valid and active CIDB Grade 5EB or Grade 5EP or higher grading certificate.
- Failure to submit a letter of good standing issued by the Department of Labour (COIDA) or approved Private Insurer (*If the letter of good standing is not relevant, bidder would have to do an affidavit to Department of Labour (DoL) or their private assurer to include the relevant "Nature of business" into the letter, therefore Bidder would need submit proof the affidavit and acceptance by DoL, however no appointment done without a letter of good standing relevant to the scope of work)*.
- Failure to submit proof of Wireman' license.
- Failure to submit proof of Electrical Trade Test (heavy current).
- If the supplier fails to meet the Local Production and Content requirements and does not submit local content Annexure C and SBD 6.2 declaration certificate for Local Production and Content.
- Failure to submit completed Schedule of Equipment offered, Annexure K.
- Failure to submit Bidders Declaration Form, Annexure F

8 NATIONAL TREASURY CENTRAL SUPPLIER DATABASE REGISTRATION

Before any negotiations will start with the winning bidder it will be required from the winning bidder to:

- be registered on National Treasury's Central Supplier Database (CSD). Registrations can be completed online at: www.csd.gov.za;
- provide the CSIR of their CSD registration number; and
- provide the CSIR with a certified copy of their B-BBEE certificate. If no certificate can be provided, no points will be scored during the evaluation process. (RSA suppliers only).

SECTION B – TERMS AND CONDITIONS

9 INTENT TO BID

Prospective bidders are requested to complete the intent to bid form (Appendix M) published with this RFP and confirm their intention to submit a bid. All interested bidders MUST submit the completed intent to bid form by not later than Monday, 28 June 2021 at 16:30 to tender@csir.co.za. The RFP Number must be used on the email subject.

10 BRIEFING SESSION PROTOCOL

Please take note of the following Safety Protocols to follow when visiting the CSIR site for the briefing session/site inspection:

a. Prior to site visit

i) *Only a maximum of two delegates from each company/bidder will be allowed on site.*

ii) *All bidders/contractors must prior to visiting the CSIR site complete the online COVID-19 symptom screening questionnaire via the following link* - https://screen.csir.co.za/

- All bidders attending the compulsory briefing session must prior to the visit watch the CSIR Safety and Health video via the following link - http://streaming.csir.co.za/View.aspx?id=9264~4v~6hmMEM7b (Please view this video prior to visiting any of the CSIR sites).
- All bidders must watch the COVID-19 Visitors' induction video https://www.youtube.com/watch?v=XD4NDvtO8ck (Please view this video prior to visiting any of the CSIR sites).
- *Any special requests for Personal Protective Equipment relating to the area to be inspected must be stated upfront.*

b. *Entrance to a CSIR site*

i) *All bidders/delegates must wear a cloth face mask on entrance and at all times during the site inspection.*

ii) *The Covid-19 self-screening questionnaire must be completed on the morning of entry to the site and a screenshot of the result must be shown to Security.*

iii) *All delegates will subject to temperature screening at the gates using a non-contact temperature scanner and any person with a temperature of 38 C and above will not be allowed entry.*

c. *Conduct during site visit*

i) *All Covid-19 precautionary measures as explained in the videos and induction must be obeyed.*

ii) *Masks must be worn for the duration of the visit.*

iii) *Hand-sanitizer will be made available at the entry points to buildings and at the meeting venue.*

iv) *No pens, paper or other stationary will be distributed. Bidders need to bring their own pens, notepads, etc to avoid sharing or passing of items.*

v) *Social distancing of at least 2m must be maintained at all times.*

vi) *Where items for inspection need to handled, sanitzer must be used by the delegate prior to and after handling/touching the item.*

vii) *Depending on the available space at the inspection site, the number of delegates allowed at a specific may be limited to allow for social distancing.*

viii) *No refreshments will be served during the site inspection.*

ix) *Should a delegate not feel well during an inspection they need to immediately alert the host and the Medical Assistance will be contacted for assistance.*

11 PROCEDURE FOR SUBMISSION OF PROPOSALS

11.1 All proposals must be submitted electronically to **tender@csir.co.za**

11.2 Respondents must use the RFP number as the subject reference number when submitting their bids.

11.3 The e-mail and file sizes should not exceed a total of 30MB per e-mail.

11.4 The naming/labeling syntax of files or documents must be short and simple.

11.5 All documents submitted electronically via e-mail must be clear and visible.

11.6 All proposals, documents, and late submissions after the due date and time will not be evaluated.

NB: NO HARD COPIES OR PHYSICAL SUBMISSIONS WILL BE ACCEPTED

12 TENDER PROGRAMME

The tender program, as currently envisaged, incorporates the following key dates:

- Issue of tender documents: Wed, 23 June 2021
- Submission of Intent to bid form: Mon, 28 June 2021
- Compulsory briefing session: Wed, 30 June 2021
- Compulsory site inspection: Fri, 02 July 2021
- Last date for submission of queries: Fri, 09 July 2021
- Closing / submission Date: Fri, 16 July 2021

13 SUBMISSION OF PROPOSALS

13.1 All proposals are to be submitted electronically to tender@csir.co.za. No late proposals will be accepted.

13.2 Responses submitted by companies must be signed by a person or persons duly authorised.

13.3 All e-mailed proposal submissions are to be clearly **subject - referenced with the RFP number.** Proposals must consist of two parts, each of which must be sent in two separate e-mails with the following subject:

PART 1: Technical Proposal RFP No.: 3467/16/07/2021

PART 2: Pricing Proposal RFP No.: 3467/16/07/2021

13.4 The CSIR will award the contract to qualified tenderer(s)' whose proposal is determined to be the most advantageous to the CSIR, taking into consideration the technical (functional) solution, price, and B-BBEE.

13.5 Proposals submitted must be in the following file formats:

- PDF

14 DEADLINE FOR SUBMISSION

Proposals shall be submitted at the address mentioned above no later than the closing date of **Friday, 16 July 2021 at 16H30.**

Where a proposal is not received by the CSIR by the due date and stipulated place, it will be regarded as a late tender. Late tenders will not be considered.

15 AWARDING OF TENDERS

Awarding of tenders will be published on the National Treasury e-tender portal or the CSIR's tender website. No regret letters will be sent out.

16 EVALUATION PROCESS

16.1 Evaluation of proposals

All proposals will be evaluated by an evaluation team for functionality, price and B-BBEE. Based on the results of the evaluation process and upon successful negotiations, the CSIR will approve the awarding of the contract to successful bidders.

A two-phase evaluation process will be followed.

- The first phase includes evaluation of **elimination, local content and production** & **functionality criteria.**
- The second phase includes the evaluation of **price** and **B-BBEE** status.

Pricing Proposals will only be considered after functionality phase has been adjudicated and accepted. Only proposals that achieved the specified minimum qualification scores for functionality will be evaluated further using the preference points system.

16.2 Preference points system

The 80/20 preference point system will be used where 80 points will be dedicated to price and 20 points to B-BBEE status.

17 PRICING PROPOSAL

17.1 The Pricing Proposal must be cross-referenced to the sections in the Technical Proposal. Any options offered must be clearly labelled. Separate pricing must be provided for each option offered to ensure that pricing comparisons are clear and unambiguous.

17.2 The price needs to be provided in South African Rand (excl. VAT). Note that this is a fixed price contract and not subject to escalation.

17.3 Only firm prices* will be accepted during the tender validity period. Non–firm prices** (including prices subject to rates of exchange variations) will not be considered.

**Firm price is the price that is only subject to adjustments in accordance with the actual increase or decrease resulting from the change, imposition, or abolition of customs or excise*

duty and any other duty, levy, or tax which, in terms of a law or regulation is binding on the contractor and demonstrably has an influence on the price of any supplies, or the rendering costs of any service, for the execution of the contract.

***Non-firm prices are all prices other than "firm" prices.*

17.4 Payment will be according to the CSIR Payment Terms and Conditions.

18 VALIDITY PERIOD OF PROPOSAL

Each **proposal** shall be valid for a minimum period of three (3) months calculated from the RFP closing date.

19 APPOINTMENT OF SERVICE PROVIDER

19.1 The contract will be awarded to the bidder who scores the highest total number of points during the evaluation process, except where the law permits otherwise.

19.2 Appointment as a successful service provider shall be subject to the parties agreeing to mutually acceptable contractual terms and conditions. In the event of the parties failing to reach such agreement, CSIR reserves the right to appoint an alternative supplier.

20 ENQUIRIES AND CONTACT WITH THE CSIR

Any enquiry regarding this RFP shall be submitted in writing to CSIR at tender@csir.co.za with ***"RFP No: 3467/16/07/2021 – Request for proposal for the electrical installation, standby generator installation, and switchgear replacement situated at building 44, at the CSR Pretoria Campus"*** as the subject.

Any other contact with CSIR personnel involved in this tender is not permitted during the RFP process other than as required through existing service arrangements or as requested by the CSIR as part of the RFP process.

21 MEDIUM OF COMMUNICATION

All documentation submitted in response to this RFP must be in English.

22 COST OF PROPOSAL

Bidders are expected to fully acquaint themselves with the conditions, requirements and specifications of this RFP before submitting proposals. Each bidder assumes all risks for

resource commitment and expenses, direct or indirect, of proposal preparation and participation throughout the RFP process. The CSIR is not responsible directly or indirectly for any costs incurred by bidders.

23 CORRECTNESS OF RESPONSES

23.1 The bidder must confirm satisfaction regarding the correctness and validity of their proposal and that all prices and rates quoted cover all the work/items specified in the RFP. The prices and rates quoted must cover all obligations under any resulting contract.

23.2 The bidder accepts that any mistakes regarding prices and calculations will be at their own risk.

24 VERIFICATION OF DOCUMENTS

24.1 Tenderers should check the numbers of the pages to satisfy themselves that none are missing or duplicated. The CSIR will accept no liability concerning anything arising from the fact that pages are missing or duplicated.

24.2 Only one electronic copy of the proposal (Technical and Financial) must be submitted via e-mail to tender@csir.co.za. If the bidder sends more than one proposal, the first submission shall take precedence should it not have been recalled/withdrawn in writing by the bidder.

Pricing schedule and B-BBEE credentials should be submitted with the proposal, but as a separate e-mail and no such information should be available in the technical proposal.

25 SUB-CONTRACTING

25.1 A bidder will not be awarded points for B-BBEE status level if it is indicated in the tender documents that such a bidder intends sub-contracting more than **25%** of the value of the contract to any other enterprise that does not qualify for at least the points that such a bidder qualifies for, unless the intended sub-contractor is an exempted micro enterprise that has the capability and ability to execute the sub-contract.

25.2 A bidder awarded a contract may not sub-contract more than **25%** of the value of the contract to any other enterprise that does not have an equal or higher B-BBEE status level than the person concerned, unless the contract is sub-contracted to an exempted micro enterprise that has the capability and ability to execute the sub-contract.

26 LOCAL CONTENT

26.1 Only locally manufactured designated goods and/or services from local raw material or input will be considered.

26.2 If the raw material or input to be used for a specific item is not available locally, bidders should obtain written authorisation from the DTI should there be a need to import such raw material or input.

26.3 A copy of the authorisation letter must be submitted together with the bid document at the closing date and time of the RFP. For further information, bidders may contact the DTI at telephone 012 394 3717/1390.

26.4 The guidelines and declarations that should be used by tenderers when preparing a tender are available on the DTI website. Guidance on the calculation of local content and manufacturing can be assessed on the DTI's official website – http://www.thedtic.gov.za/sectors-and-services-2/industrial-development/industrial-procurement/

26.5 Tenderers must complete Declarations D and E, and consolidate the information on Declaration C. Annexures C, D and E must be submitted with the tender by the closing date and time as determined by the CSIR. If the tender is successful, the tenderer must continuously update Declarations C, D and E with actual values for the duration of the contract.

26.6 The Declaration Certificate for Local Production and Content (SBD 6.2) in addition to the above declarations must also be completed, duly signed and submitted by the bidder at the closing date and time of the tender; and

26.7 The rates of exchange quoted by the bidder in paragraph 6.8 below of the declaration certificate will be verified for accuracy.

26.8 The exchange rate to be used for the calculation of local production and content must be the exchange rate published by the South African Reserve Bank (SARB) AT 12:00 on the date of advertisement of bid.

26.9 Only the South African Bureau of Standards (SABS) approved technical specification number SATS 1286:2011 must be used to calculate local content.

26.10 Bidders must clearly indicate in their bids, the quantities of products to be supplied, and the level of local content for each product.

26.11 Applicable local production and content minimum thresholds for this tender are as per the table below:

Sector	Local Content	Minimum Local Content Threshold
1. National Treasury Instruction Note 5 of 2016/2017, Electrical Cable Products	Applicable	90%
2. National Treasury Instruction Note 15 of 2016/2017 - Steel Products & Components	Applicable	100%

27 ADDITIONAL TERMS AND CONDITIONS

27.1 A bidder shall not assume that information and/or documents supplied to CSIR, at any time prior to this request, are still available to CSIR, and shall consequently not make any reference to such information document in its response to this request.

27.2 Copies of any affiliations, memberships and/or accreditations that support your submission must be included in the tender.

27.3 In case of proposal from a joint venture, the following must be submitted together with the proposal:

- Joint venture Agreement including split of work signed by both parties.
- The original or certified copy of the B-BBEE certificate of the joint venture.
- The Tax Clearance Certificate of each joint venture member.
- Proof of ownership/shareholder certificates/copies.
- Company registration certificates.

27.4 An omission to disclose material information, a factual inaccuracy, and/or a misrepresentation of fact may result in the disqualification of a tender, or cancellation of any subsequent contract.

27.5 Failure to comply with any of the terms and conditions as set out in this document will invalidate the Proposal.

27.6 SANS 1200 will be referred to for any assessment of contractor's claims.

28 CSIR RESERVES THE RIGHT TO

28.1 Not to appoint the lowest tenderer.

28.2 Extend the closing date.

28.3 Verify any information contained in a proposal.

28.4 Request documentary proof regarding any tendering issue.

28.5 Give preference to locally manufactured goods.

28.6 Appoint one or more service providers, separately or jointly (whether or not they submitted a joint proposal).

28.7 Award this RFP as a whole or in part.

28.8 Cancel or withdraw this RFP as a whole or in part.

29 DISCLAIMER

This RFP is a request for proposals only and not an offer document. Answers to this RFP must not be construed as acceptance of an offer or imply the existence of a contract between the parties. By submission of its proposal, bidders shall be deemed to have satisfied themselves with and to have accepted all Terms & Conditions of this RFP. The CSIR makes no representation, warranty, assurance, guarantee or endorsements to bidder concerning the RFP, whether about its accuracy, completeness or otherwise and the CSIR shall have no liability towards the bidder or any other party in connection therewith.

30 RETURNABLE DOCUMENTS

NOTE: *The bidder is required to complete each schedule listed below to the best of his ability as the evaluation of tenders and the eventual contract will be based on the information provided by the bidder. Failure of a bidder to complete the schedules and forms to the satisfaction of the CSIR will inevitably prejudice the tender and may lead to rejection on the grounds that the tender is not responsive.*

The bidder must complete and or submit the following returnable documents:

RETURNABLE DOCUMENTS			
PART A: TECHNICAL RETURNABLE **Returnable Schedules required only for Tender Evaluation Purposes.**			
Description		Submitted (please tick) Yes	No
1	Cover letter		
2	Company profile		
3	Curriculum Vitae ▪ Must submit proof of Wireman' license. ▪ Must submit Electrical Trade Test ▪ Must have a minimum of 5 years work experience		
4	Three (3) contactable references		
5	Completed sites / projects		
6	Valid and active CIDB certificate		
7	Valid COIDA certificate		
8	Public Liability Cover		
9	Local Production and Content • Annexure C and • SBD 6.2 declaration certificate for Local Production and Content		
10	Schedule of equipment offered (Annexure H)		
11	Brochures with product specifications		
PART B: PRICING PROPOSAL **Returnable Schedules that will be incorporated into the Contract.**			
12	Cover letter		
13	Proposed cost / commercial offer		
14	Proposed cost / commercial offer on company letterhead		
15	Valid B-BBEE certificate or sworn affidavit		
16	CSD Registration		

31 SCHEDULE OF THE BIDDER'S EXPERIENCE

The bidder must list relevant projects completed between 2015 and 2021. Duplications of this schedule may be completed and attached to this document.

Client	Contact Person	Telephone Number and E-Mail Address	Scope of Work	Value of Work (Inclusive of Vat)	Date Completed

Signed…….. Position …… Date……..

32 PRICING PROPOSAL FORM

THE BIDDER IS TO COMPLETE AND SIGN THE TENDER FORM

The Bidder, identified in the Offer signature block below, has examined the documents listed in the Tender Data as listed in the Tender Schedules, and by submitting this Offer has accepted the Conditions of Tender.

By the representative of the Bidder, deemed to be duly authorised, signing this part of this Form of Offer, the Bidder offers to perform all of the obligations and liabilities of the Contractor under the Contract including compliance with all its terms and conditions according to their true intent and meaning for an amount to be determined in accordance with the conditions of contract identified in the Contract Data.

THE OFFERED TOTAL OF THE PRICES INCLUSIVE OF VALUE ADDED TAX IS

.....

.....

..... Rand (in words); R ..... (in figures),

This offer may be accepted by the CSIR by signing the Acceptance part of this Form of Offer and Acceptance and returning one copy of this document to the Bidder before the end of the period of validity stated in the Tender Data, whereupon the Bidder becomes the party named as the Contractor in the Conditions of Contract identified in the Contract Data.

Signature(s) .....

Name(s) .....

Capacity .....

For the Bidder .....

Name and signature of witness .....

Date .....

33 ANNEXURE A REFERENCE FORM: TO BE COMPLETED FOR EACH REFERENCE SUBMITTED (FORM TO BE COMPLETED BY REFERENCE AND NOT BIDDER)

It is critical for the referee to complete the form fully. CSIR will not give scores for incomplete forms

Referee Company legal Name: ……

Bid Description (reference provided for): ……

Describe the service/work done: ……

……

……

Project Start Date: …… **Project End Date:** ……

Contract Amount: ……

Rate Service Provider (Put a mark to the relevant score)

Indicator	Excellent	Very good	Good	Poor	Unacceptable
Score	5	4	3	2	1

Would you use the service provider again: Yes / No

Referee Contact Person: ……

Referee Designation: ……

Referee Contact number: ……

Referee Email: ……

I hereby declare that to the best of my knowledge, information completed above is true and correct.

Bidder's referee signature: …… **Date:** ……

34 ANNEXURE B – PROJECT SPECIFICATION

ANNEXURE B

PROJECT SPECIFICATION

FOR THE

ELECTRICAL INSTALLATION

FOR THE

SWITCHGEAR REPLACEMENT

FOR

THE CSIR

ANNEXURE B

PROJECT SPECIFICATION FOR THE ELECTRICAL INSTALLATION FOR CSIR B44 SWITCHGEAR REPLACEMENT

CONTENT OVERVIEW

PAGE

1. GENERAL

The Client, CSIR is in process of replacing old electrical equipment that is nearing their end of life. This specific project encompasses the removal of such medium- and low voltage equipment currently installed at Building 44 on the CSIR's Pretoria campus.

The scope of works is described in detail under paragraph 1.1.2 below. Any possible ambiguity as to which specification will be applicable to a particular component of the project, will be clarified in writing with the Engineer prior to tendering day.

1.1 NOTES

1.1.1 The project specification together with all other documentation such as the conditions of tender and contract, the standard specifications, and all schedules and drawings as described in this tender document, constitute the specification and will be the basis of the contract.

The electrical reticulation system within the boundaries of the campus consists of a fully underground electrical reticulation system. The new 1 MVA miniature substation will replace existing 11 kV switchgear and three transformers. This miniature substation will be cut into the existing 11 kV ring that loops in and out of building 44. The existing switchgear must be removed from the plantroom and disposed by the contractor as part of this contract. The transformers must also be removed and safely transported to a storage facility on campus by the contractor.

A new 700 kVA standby generator must be supplied, installed, and commissioned as indicated on the site plan drawings.

Both the miniature substation and generator shall be installed to the north of building 44, as per the general arrangement drawing. This area must be cleared, and a permanent Clearview fence shall be erected around this equipment as part of this contract.

The existing main LV distribution board located in building 44 must be properly surveyed against the SLD drawings, stripped and removed after existing cables have been properly marked. The new main LV distribution board will then be installed in the same location by connecting all existing cables. As part of this contract the appointed contractor will have to trace and mark each fuse link, circuit breaker and cable to ensure all feeders are accounted for before the distribution board can be ordered.

1.1.2 SCOPE OF WORK

The Work to be performed under this contract includes the supply, procurement, delivery, erection, testing, commissioning, and successful handover of a complete electrical installation for the CSIR, operational to the Employer and the guarantee and comprehensive maintenance thereof for a further period of 12 months.

The work involves the following:

- The supply and installation of the complete electrical reticulation, wiring, and trunking for the existing building which includes the following:

LOW VOLTAGE:

- Supply and installation of low voltage cables;
- Supply and installation of low voltage distribution boards;
- Supply and installation of all conduits and wiring;

MEDIUM VOLTAGE:

- Supply and installation of complete 1 MVA miniature substation;
- Supply and installation of medium voltage cables, joints and terminations;

EMERGENCY POWER GENERATOR:

- Design, manufacture, assemble all components as well as testing of the complete enclosed Standby Diesel Generator Units (SDGU) and bulk diesel tank.
- SDGU's to be supplied with a fully **type tested AMF panel**.
- Design and supply of a base diesel tank for **12 hours** of standby fuel supply for the generator. The design will include all arrangements and approvals with the fire department, if required.
- Provide and install suitable exhaust piping to exhaust the engine gas to outside the canopy. Exhaust piping will be lagged and cladded.
- Provide and install suitable ducting to duct hot engine air out of the generator canopy.
- Provide and install suitable attenuation louvers for the cold air inlet as well as the hot air outlet.
- Submit dimensioned drawings for the complete Standby Diesel Generator Unit to enable the Structural Engineer to design the concrete plinth for this unit.
- Package, marking, insurance for shipping, deliver to site, including all taxes and fees to the final position on site.
- Off-loading, rigging and positioning onto the plinth designated for this unit.
- Return to site to connect all control and power cables once is installed by the electrical contractor.
- All duties involved with council fire approval, if required.
- Return to site to perform the specified commissioning tests.
- Provide the following
  - Operation and maintenance training to the Employer's personnel.
  - Operating and maintenance manuals as specified.
  - All required warning signs.
  - A critical spares list to be kept on site.
  - Fuel for testing and commissioning
  - A full tank of fuel on date of handover
  - 12 months maintenance from date of handover

1.2 SPECIFICATIONS

This project specification is specifically applicable to this installation and will have preference over the Standard Specifications.

The latest revision of the following Standard Specification will also apply to this contract:

A-SPES-00-01	-	General Requirements and Procedures
A-SPES-07-01	-	General Electrical Distribution in Buildings
A-SPES-04-02	-	Standard Specification for Miniature Substations
A-SPES-11-01	-	Standard Specification for Standby Diesel Alternator sets

All the specifications and regulations as stipulated in A-SPES-07-01 clause 1.2, will be applicable as well as any specification attached in Annexure B - Standard Specification.

The latest revisions of the following standards shall also be applicable to this contract. Should there be conflict between standards or between any standard or any part of this Tender Document, such conflict must be referred to the Employer's Representative for a resolution.

Standard Reference	Title of Standard
SANS 8528	Reciprocating internal combustion engine driven alternating current generating sets
1. B'S/2. BS. (BEVARE SEEMAN) 5514-5	Reciprocating internal combustion engines: Performance Part 5: Torsional Vibrations
ISO 3046-4	Reciprocating Internal Combustion Engines: Performance – Part 4: Speed Governing
SABS IEC 60034-16	Rotating Electrical Machines – Part 16: Excitation System for Synchronous Machines
SABS 0103	The Measurement and Rating of Environmental Noise with respect to Annoyance and Speech Communications – Amendment No 2: Nov. 1992
IEEE 112	Test procedures for Polyphone Induction Motors and Generators
IEE 446	Recommended Practice for Emergency and Standby Power
SABS 1652	Battery chargers: Industrial Type
SABS 1091	National Colour Standards for Paint
SABS 1186	Symbolic Safety Signs
IEC 60529	Degrees of Protection Provided by Enclosures
IEC 947 (Parts 4-1, 6-1, 7-1)	Low Voltage Switchgear and Control gear
SABS 0131	The Storage and Handling of Liquid Fuel
SABS 342	Automotive Diesel Fuel
OHSA 85	Occupation Health and Safety Act
ISO 9001	Model to Quality Assurance in Design Development, Production, Installation and Services.

1.3 RESPONSIBILITY OF THE CONTRACTOR

Refer to A-SPES-07-01 clause 1.3.

1.4 ARRANGEMENTS WITH THE SUPPLY AUTHORITY

1.4.1 PERMANENT BULK SUPPLY COST

Not applicable to this contract.

1.4.2 BUILDER'S SUPPLY

The Client shall be responsible for construction power requirements.

1.4.3 REGISTER, INSTALLATION AND INSPECTION FEES

Refer to A-SPES-07-01 clause 1.4.3

The Electrical Contractor shall submit all inspection certificates of the Supply Authority to the Engineer.

1.5 PRELIMINARIES AND GENERAL

Refer to A-SPES-07-01 clause 1.5

1.6 CONTRACT

The contract will be a selected contract.

1.7 QUALITY

Refer to A-SPES-07-01 clause 1.7

The Electrical Contractor will be required to ensure that work is at all times executed under supervision of a competent, qualified and experienced site foreman who is able to receive instructions on behalf of the Contractor and is approved by the Engineer.

Hold Points:

To assist the Contractor in order that corrective action can be taken in good time, Plantech has indicated several hold points in A-SPES-07-01, which shall be adhered to at all times.

	HOLD POINT REQUIRED
Approval of all major equipment prior to order placement.	YES
Approval of samples	Switchgear, miniature substation, Generator, Earth mat connections and testing
Shop/For Construction drawings of DB's & Generator	YES

1.8 SITE, SITE CONDITIONS & SITE FACILITIES

Refer to A-SPES-07-01 clause 1.8

1.8.1 SITE LOCATION

This site is located on CSIR, Building 44, Meiring Naude Road, Lynnwood Manor, Pretoria, 0081, Gauteng.

1.8.2 SITE CONDITIONS

Description	**Parameter**
Altitude above sea level	1350m
Maximum ambient temperature	42°C
Average daily maximum temperature	28.7°C
Average daily minimum temperature	6.9°C

Maximum Relative humidity	65%
Degree of pollution	Moderate
Wind speed: Steady condition	5m/s
Lightning conditions	Severe

The Contractor shall acquaint himself fully to the prevailing site conditions, access to the site, storage and other facilities prior to submitting a tender since no claim in this regard will be considered.

A dedicated site office for the electrical contractors must be provided under this contract.

Tenderers shall acquaint themselves of the security and other site procedures to be adhered to.

1.8.3 SITE VISIT

A compulsory/formal site visit is planned on the date specified on the cover page of this RFP document.

1.9 PROJECT MANAGEMENT AND PLANNING

Refer to A-SPES-07-01 clause 1.9

The successful tenderer shall liaise with the Principal Agent concerning the compilation of a construction programme.

1.10 DRAWINGS

Refer to A-SPES-07-01 clause 1.10

Three (3) sets of paper prints forming part of the approved O & M manual shall be supplied to the Engineer.

1.11 RESPONSIBILITY OF OTHER PARTIES

1.11.1 The Electrical Contractor shall co-ordinate his activities with the Principal Agent.

1.12 OPERATING AND MAINTENANCE MANUALS

Refer to A-SPES-07-01 clause 1.12

Two complete sets of O&M manuals with "As Installed" drawings must be supplied to the Engineer.

One set of electronic copy of the O&M manual shall be supplied on flash disk or CD, the contractor will submit the O&M manual for review and approval, 3 weeks before practical completion.

1.13 INSPECTION, TESTING, COMMISSIONING AND HANDOVER

Refer to A-SPES-07-01 clause 1.13

The Electrical Contractor is primarily responsible for his quality and shall compile the necessary butt lists. He shall also arrange for the necessary inspections and tests with the

Consulting Engineer and the Supply Authority and shall supply all test equipment. The Contractor's attention is drawn to the relevant clauses in the attached Standard Specification for General Requirements and Procedures - A-SPES-00-01.

1.14 TRAINING OF EMPLOYERS PERSONNEL

Refer to A-SPES-07-01 clause 1.14

1.15 TOOLS, EQUIPMENT, TEST INSTRUMENTS AND MAINTENANCE TOOLS

Refer to A-SPES-07-01 clause 1.15

1.16 CODING, LABELING, NOTICES AND NAME BOARDS

Refer to A-SPES-07-01 clause 1.16, 3.8 and 3.15

1.17 FIRE EXTINGUISHER

No fire extinguishers are required as part of this contract.

1.18 FIRST AID KITS

No first aid kit is required to be installed as part of this subcontract.

1.19 GUARANTEE PERIOD

The Electrical Contractor will be responsible to guarantee the installation for a period of 12 months after the Form of Acceptance, Form C, has been issued.

1.20 MAINTENANCE PERIOD

The Electrical Contractor shall maintain the electrical installation for a period of 3 months after issuing the Form of Acceptance.

The Contractor shall **maintain the complete SDGU installation for a period of 12 months**.

All filters shall be replaced at 250 hours of running of the SDGU or one year, whichever is reached first.

All filters and spares required for this service must be supplied and installed as part of this contract.

The Contractor shall inspect the SDGU at least every three months during this maintenance period to do a thorough inspection of all equipment and do all minor adjustments to ensure that the unit performs at the specified levels.

All defects and/or work done shall be reported to the Employer.

Each visit shall be recorded in a logbook that must be supplied by the Contractor and be kept in a pocket in the enclosure.

1.21 CERTIFICATE OF COMPLIANCE

The Engineer will not issue a Final Completion Certificate - Form D until he is in receipt of

such a Certificate of Compliance, as referred to in A-SPES-07-01 clause 1.21

2. MEDIUM VOLTAGE DISTRIBUTION (11kV)

2.1 GENERAL

In summary, the medium voltage system consists of the following:

- 1 x 800 kVA miniature substation complete with DIDI configuration RM6 and adjustable 1200 A 400V circuit breaker,
- 70mm² x 3 core, 11kV, PILC cable

2.2 11KV RETICULATION SYSTEM

The 11kV reticulation system throughout the campus, preliminary consist of 5 underground 11kV ring distribution systems by means of 70mm^2, 3-core, Cu PILC type cables as specified below. All 11kV medium voltage reticulation cables to be supplied and installed as part of this project, shall fully comply with the requirements of SANS 97. These cables shall be of the PILC, SWA type, in accordance with Table 17 of SANS, and fully complying with the Standard Specification for Medium Voltage Paper Insulated Cables.

These 11kV cable ring systems originates at the local CSIR satellite substation and services all the miniature substations throughout the campus. The existing 11kV ring feeder system within the campus is depicted on drawing A-2090-07-00-001.

All the 11kV cable to be installed as part of this Contract, shall be installed in properly riddled bedding soil, with a maximum thermal conductivity of 1.2°K.m/W, at a minimum depth of 1,0 meter. A minimum bedding thickness of 70mm, shall be maintained both below as well as above the 11kV feeders, prior to any backfilling being commenced in full compliance with the requirements of A-SPES-04-04 clause 6.1. All 11kV cable to be installed as part of this Contract, shall be of the new unused material, and shall bare the SANS mark.

All joints and terminations for the 11kV cable, shall be provided and installed in strict accordance with the requirements detailed in A-SPES-04-04 clause 6. It is an explicit requirement of this enquiry, that the number of cable joints shall be limited to the absolute minimum. The Contractors therefore require to carefully study the layout plan and to carefully co-ordinate the cable installation to comply with the above requirement.

2.3 MINIATURE SUBSTATION

A single miniature substation of the 800 kVA, 11,000/400-volt outdoor type is required. It is however a requirement that this miniature substation be provided with a transformer with a higher impedance of 10%, to ensure a fault rating equal or lower than 15kA. Because of this increased impedance, preference will also be given to designs where the tap change range of the off-load tap changers could be altered to ± 3% and ± 6%.

The miniature substation shall be fitted with an Arc Proof Explosion vent and Arc Proof doors and shall fully comply with SANS 62271 – 21kA 1 Second AFLR. A Schneider VIP400 self-powered relay with 60A:1A CT's matched for the VIP400 or closest standard shall be supplied as part of this project.

In addition to the standard voltmeter, selector switch, maximum demand ammeters, as well as the necessary test block, the low voltage compartment of the miniature substation shall

each be fitted with Schneider outgoing circuit breakers. The quantity of the required outgoing circuit breaker ratings for the miniature substations are indicated on the single line diagrams included on the schedule of drawings of this document. All these circuit breakers shall have a minimum fault rating of 25kA.

The miniature substation shall be mounted on the colour impregnated pre-cast double bunted concrete foundations, with the exposed aggregate, as detailed more clearly in A-SPES-04-02 clause 3.3.

The installed miniature substation shall likewise be fully earthed and bonded, in accordance with the requirements for earthing and bonding detailed in paragraph 2.5 below.

The test will include, but are not limited to:

- Oil moisture test.
- Over voltage pressure testing.
- Transformer paper insulation integrity testing, partial discharge testing.
- General cleaning of the miniature substation.

Contractors shall ensure that the sufficient allowance for the above requirements to ensure that the miniature substation is operating and fully functional.

The miniature substation required for the internal reticulation within the campus shall be painted to an approved avocado green colour, which exactly matches the colour of the currently installed miniature substations installed.

2.4 PRECAST PLINTHS AND FOUNDATIONS

All outdoor type miniature substations shall be installed on precast double bunted concrete plinths.

A single miniature substation foundation will be required. These quantities have all been indicated in the Schedule of Prices of this document.

The concrete used for the construction of these concrete foundations, shall have a minimum concrete strength of 25MPa, and shall have suitable dimensions for the safe mounting of all the above equipment.

These foundations shall all be installed to be perfectly level, as well as stable during the associated trench excavations in the approaches to these foundations, as detailed more clearly in A-SPES-04-02 clause 3.3.

2.5 EARTHING

It is an essential component of this project that all electrical equipment supplied and installed as part of this Contract, shall be fully earthed, and bonded to comply with the requirements of SANS, as well as the Occupational Health and Safety Act.

The single miniature substation required as part of the internal reticulation system shall be equipped with a ring earthing system. The mini-sub shall be provided with an approved

earth mat system, connected to the earth bar of the miniature substation. This earth mat installation shall fully comply with the requirements detailed below.

A 70mm^2, bare earth conductor shall be installed in the cable trench with the 11kV cable, 50m (re-measurable) to both sides from the respective miniature substation and connected to the earth bar within the unit. In addition to the earth type ring earth the minimum of 4 earth spikes with a length of 1,2m shall be provided and installed on the 4 corners of the ring earth system. The ring earth shall be tied to the earth bar of the miniature substation to the full approval of the Engineer, by means of a minimum of 2 separate earth conductors with a minimum cross section area of 70mm^2 to the opposite sides of the ring system connected to the earth bar of the miniature substation.

In addition, a bare earth conductor with a minimum cross section of graded from 16mm^2 to 70mm^2 depending on the cross-section area of the associated low voltage cable, will be installed over the full length with the primary low voltage cables, from the earth bar in the miniature substation to the earth bar in the Main LV distribution board. This bare earth conductor shall be installed in the ground together with the primary low voltage cables in riddled soil, in a depth of 700mm.

All equipment with exposed metal surfaces such miniature substations shall all be properly earthed and bonded in full accordance with the requirements detailed in A-SPES-04-02 clause 8.3.10. The electrical Contractor on completion of the project shall prove this earthing and bonding system to the full approval of the Engineer.

All buried type earth mat systems detailed in this specification, shall be inspected, and tested by the Engineer or his representative, prior to any backfilling taking place. The necessary signed off inspection certificate shall be kept in the records of the electrical Contractor for inspection by the Engineer.

2.6 TRENCHING, WORK COORDINATION AND INSTALLATION PROCEDURE

The electrical Contractor will be required to trench for small sections as indicated on drawing A-2090-04-00-002. All trenching by the electrical Contractor will only be done by hand/jack-hammer due to the trenching being in areas where existing cables are installed, TLB will only be allowed with written approval by the engineer.

The electrical Contractor will fill the trenches with the correct bedding soil as described in S-SPES-04-04 whereafter the cables will be installed. The 11kV cables will be installed at a depth of 1m and the low voltage cables at a depth of 800mm below final ground level.

After the installation of the cables and the required bedding material the electrical Contractor will fill the trench up to a level of 300mm above the installed cables and compact the soil every 150mm. This soil will be screened local bedding material to ensure that no rocks larger than 10mm dia. is in contact with the cables. On top of the 300mm cover the electrical Contractor will install danger tape over all trenches.

3. LOW VOLTAGE DISTRIBUTION BOARDS

3.1 GENERAL

- Refer to A-SPES-07-01 clause 3.1
- The distribution boards shall be manufactured in strict accordance with the applicable and relevant schematic diagrams and shall be in accordance with Specification A-SPES-07-01, Clause 3.
- Please see special requirements regarding submetering.
- Provisional rates for DB boards are supplied, as the required information is not yet available for costing.
    - Distribution boards will be supplied by a supplier approved by the Engineer (ex. Isazi Power / Molefe Sisonke Electrical / EBM / Protection Switchboards).
    - The proposed DB manufacturer must be disclosed in section 6 in the equipment schedule. The responsibility falls on the tenderer to ensure that these suppliers are carrying the SABS or equivalent mark.

For distribution boards with a Fault level higher than 10 kA, an approved and certified type tested manufacturer must be used. Proof of this certification shall be supplied to the Engineer at the start of the contract. These distribution boards shall be type tested in accordance with SANS 1973-1:2007 and SANS 10142-1:2020.

Additional space for future extensions must be allowed for in the distribution boards as specified on the schematic diagrams.

The electrical contractor shall confirm the maximum dimensions and confirm as built space with on-site measurements, in particular the width of the distribution boards as indicated on the schematic diagrams prior to the order placement of the board and shall obtain the engineer's full agreement and approval.

3.2 CONSTRUCTION OF FLOOR STANDING BOARDS

Refer to A-SPES-07-01 Clause 3.2.

3.3 CONSTRUCTION OF SURFACE MOUNTED BOARDS

Refer to A-SPES-07-01 Clause 3.3.

3.4 CONSTRUCTION OF FLUSH MOUNTED SWITCHBOARDS

Refer to A-Spes-07-01 Clause 3.4

3.5 METALWORK FINISH AND PAINTING

The colour of the distribution boards shall be:

- Distribution Boards as indicated on the schematic drawings.

3.6 BUSBARS

Refer to A-SPES-07-01 clause 3.6

All busbar ratings will be as specified on the relevant schematic diagrams.

3.7 CONDUCTORS

Refer to A-SPES-07-01 clause 3.7

3.8 IDENTIFICATION OF CONDUCTORS

Refer to A-SPES-07-01 clause 3.8

3.9 CABLES

Refer to A-SPES-07-01 clause 3.9

3.10 ESSENTIAL AND NON-ESSENTIAL SUPPLIES

3.11 EQUIPMENT SPECIFICATION

3.11.1 METAL CLAD AIR CIRCUIT BREAKER, WITHDRAWABLE TYPE

SCHNEIDER type circuit breakers shall be offered as part of this contract.

3.11.2 MOULDED CASE CIRCUIT BREAKER

Refer to A-SPES-07-01 clause 3.11.2.

SCHNEIDER type circuit breakers shall be offered as part of this contract.

The supply voltage and rupturing capacity of the circuit breakers are specified on the relevant schematic diagrams.

3.11.3 EARTH LEAKAGE RELAYS

Refer to A-SPES-07-01 clause 3.11.3

3.11.4 FULL LOAD, FAULT -MAKING ISOLATORS

Refer to A-SPES-07-01 clause 3.11.4

3.11.5 COMBINATION FUSE SWITCH UNITS

Not applicable to this contract.

3.11.6 POWER FUSES AND FUSE HOLDERS

Refer to A-SPES-07-01 clause 3.11.6

3.11.7 CONTACTORS

Refer to A-SPES-07-01 clause 3.11.7

3.11.8 CONTROL RELAYS AND TIMER

Refer to A-SPES-07-01 clause 3.11.8

3.11.9 INDOOR LIGHTNING ARRESTORS

Refer to A-SPES-07-01 clause 3.11.9

All the distribution boards shall be equipped with suitably rated lightning arrestors/Surge Protection Devices approved by the Lightning Protection and Earthing Design and Supply contractor.

3.12 INSTRUMENTS

3.12.1 VOLTMETERS

Refer to A-SPES-07-01 clause 3.12.1
If a voltmeter is required on the schematic diagram, the voltmeters shall be calibrated 0-500V.

3.12.2 AMMETERS

Ammeters are required in the distribution boards.

3.12.3 MAXIMUM DEMAND AMMETERS

Refer to A-SPES-07-01 clause 3.12.3

Maximum demand ammeters will be installed on all DB board incomers. .

3.12.4 BULK KILOWATT-HOUR METER

Refer to A-SPES-07-01 clause 3.12.4

Three phase Kilowatt-hour meters will be supplied and installed in the main distribution boards as shown and specified on the schematic diagrams for the various boards to serve as an overall check metering facility.

All metering CTs shall be rated at 15VA, Class 0,5 and shall be clamped to the relevant busbars.

3.12.5 SUB-METERING

Not applicable to this contract

3.13 SWITCHES

Refer to A-SPES-07-01 clause 3.13

No switches required in the distribution boards.

3.14 TIME SWITCHES

Refer to A-SPES-07-01 clause 3.14

3.15 LABELS

3.15.1 GENERAL

Refer to A-SPES-07-01 clause 3.15.1

3.15.2 NOTICES AND WARNING SIGNS

Refer to A-SPES-07-01 clause 3.15.2 and clause 1.16 of this Specification.

Provide labels in boards as indicated on schematic diagrams.

3.15.3 IDENTIFICATION OF CONDUCTORS

Refer to clause 3.8 of this specification.

3.15.4 IDENTIFICATION OF EQUIPMENT

Refer to A-SPES-07-01 clause 3.15.4

3.15.5 IDENTIFICATION OF SWITCHBOARDS

Refer to A-SPES-07-01 clause 3.15.5

3.16 TERMINAL BLOCKS

Refer to A-SPES-07-01 clause 3.16

3.17 EARTHING

Refer to A-SPES-07-01 clause 3.17

3.18 BOLTS AND NUTS

Refer to A-SPES-07-01 clause 3.18

3.19 DRAWINGS AND APPROVAL

Refer to A-SPES-07-01 clause 3.19

A set of three for construction shop drawings for the manufacture of the distribution boards must be submitted to the Engineer for approval at least four weeks before manufacturing commences.

4. LOW VOLTAGE CABLES

4.1 GENERAL

The cables shall be installed in strict accordance with the attached Specification A-SPES-07-01 clause 4.

All cables will be specified in the Cable Schedule. (Clause 4.5)

4.2 PAPER INSULATED CABLES

Refer to A-SPES-07-01 clause 4.2

4.3 PVC INSULATED ARMOURED CABLES

All cables supplied and installed for this project will be 600/1000V, PVC/SWA/PVC insulated Flame Retardant (FR) armored cables in accordance with specification A-SPES-07-01 clause 4.3.

4.4 XLPE CABLES

The type of cable to be used shall be XLPE insulated PVC bedded, steel wire armoured, copper conductor cable complying with all the requirements of SANS 1339 2006 Edition 3.02.

- Voltage rating 11kV
- Cable size 70mm² 3-core
- Material Copper

- Impulse withstand ability 95kV

4.5 SCHEDULE OF CABLES

All low voltage cables are indicated on distribution board single line diagrams.

All cables shall be PVC/SWA/PVC/PVC type with copper conductors, manufactured in compliance with SABS 1507:2007.

ECC Cables to be supplied as specified in the BOQ.

5. CABLE TRENCHES AND SLEEVES

Refer to A-SPES-07-01 Clause 5.

Where the Electrical Contractor must install cables and/or sleeves through walkways and existing paving, the paving bricks shall be removed as carefully as possible, where after the Main Contractor will be responsible for the relaying of the paving bricks.

6. WIRING, CONDUITS AND ACCESSORIES

6.1 WIRING

All wiring will be in accordance to A-SPES-07-01 clause 6.1

The following conductor sizes are applicable:

Circuit	Power Conductor	Earth Conductor
Lighting Power	2,5mm^2 4,0mm^2	2,5mm^2 2,5mm^2

All earth conductors will be insulated.

6.2 WIRING ACCESSORIES

6.2.1 MOUNTING HEIGHT

Not applicable to this contract

6.2.2 SOCKET OUTLETS

Not applicable to this contract

6.2.3 LIGHT SWITCHES AND DIMMERS

Not applicable to this contract

6.2.4 OCCUPANCY SENSORS

Not applicable to this contract

6.2.5 WATERTIGHT LIGHT SWITCHES

Not applicable to this contract

6.2.6 FLAME PROOF LIGHT SWITCHES

Not applicable to this contract

6.2.7 ON LOAD ISOLATORS

Not applicable to this contract

6.2.8 PHOTOCELLS

Not applicable to this contract

6.2.9 EMERGENCY STOP STATIONS

Not applicable to this contract

6.2.10 FIREMAN'S ISOLATOR

Not applicable to this contract

6.2.11 POWER SOCKETS

Not applicable to this contract

6.2.12 MOTOR PROTECTION UNITS

Not applicable to this contract

6.3 CONDUITS

6.3.1 SCREWED STEEL CONDUITS

Bosal black enameled conduit will be allowed for this contract.

6.3.2 PLAIN-END GALVANIZED STEEL CONDUITS

Plain-end galvanized steel conduits will be allowed for this project.

6.3.3 GALVANIZED CONDUITS (SCREWED ONLY)

Refer to A-SPES-07-01 clause 6.3.3

6.3.4 RIGID NON-METALLIC CONDUITS

Refer to A-Spes-07-01 clause 6.3.4. uPVC conduits will be allowed on this project.

6.3.5 FLEXIBLE CONDUIT

Refer to A-Spes-07-01 clause 6.3.5

6.3.6 ALUMINUM SHEATHED CONDUCTORS ("SURFIX")

Refer to A-SPES-07-01 Clause 6.3.6.

6.3.7 CONDUIT ACCESSORIES

Refer to A-SPES-07-01 clause 6.3.7

6.3.8 INSTALLATION

Refer to A-SPES-07-01 clause 6.3.8

6.3.9 TERMINATION OF CONDUITS

Refer to A-SPES-07-01 clause 6.3.9

7. TRUNKING, POWER SKIRTING AND FLOOR DUCTS

Not applicable to this contract.

8. CABLE SUPPORTS

8.1 CABLE TRAYS AND LADDERS

Refer to A-Spes-07-01 clause 8.

Only hot dipped galvanized cable ladders and supports is allowed.

The dimensions of the cable ladders are indicated on the drawings and BOQ.

9. LIGHT FITTINGS

Not applicable to this contract.

10. STANDBY DIESEL GENERATOR UNIT (SDGU)

10.1 RATINGS

10.1.1 EMERGENCY POWER GENERATOR

The complete Standby Diesel Generator Unit shall be rated for a minimum Prime Power of 700kVA.
The power factor may be 0,8 at any load between no-load and maximum load.

The unit shall further be rated for an overload of 10% during any 12-hour period.

After the de-rating factors for the engine and generator, due to site conditions, have been considered, each set must have a site output and voltage as follows:

- No load voltage : 400/230 Volt
- Rating : 700 kVA
- Frequency : 50 Hz
- Fault Level : 36 kA
- Emissions Rating : Tier II (Certified)

10.2 LOAD ACCEPTANCE

The SDGU shall be able to accept 60% of the full load capacity in one step after start-up.

10.3 ENGINE FUEL SYSTEM

An intercooler must be installed in the return fuel line from the fuel injectors to ensure that

the return fuel temperature does not exceed 60°C.

10.4 ENGINE COOLING SYSTEM

Refer to Paragraph 4.9 of A-SPES-11-01.

The cooling system shall be heated to a minimum temperature of 50°C.

10.5 CONTROLLER

The latest model “Deep Sea” Controller shall be supplied and installed as part of this contract. No break return/sync to mains is required. Supplier to include a Deep Sea 8620 controller for this contract.

All alarms as described in A-SPES-11-01 shall also be controlled and reported by means of this controller.

10.6 LOW VOLTAGE DISTRIBUTION BOARDS/AUTOMATIC MAINS FAILURE

Additional to Paragraph 3.1 the AMF panel shall be supplied with motorized circuit breakers.

10.7 FUEL TANK

Each SDGU shall be supplied with a double-skin fuel tank with adequate capacity to allow the SDGU to operate at full load for a period of 12 hours (base mounted day tank, with low fuel level switch and alarm, electric pump, filtration system (Water separation) and drain).

A breather and filter shall be supplied and installed on the fuel tank.

Full details of the unit offered shall be submitted with the tender.

10.8 ENCLOSURE/PLANT ROOM REQUIREMENTS

GENERATOR

The SDGU shall be placed on a purpose-built concrete plinth located at the north side of building 44, and an external canopy/enclosure is required.

- Adequately sized inlet and outlet sound attenuated louvres shall be fitted to the external canopy to allow for the required cooling and hot air flow. The louvres shall be installed in such a manner to prevent rain and water from the irrigation system entering the plant room.
- The contractor shall ensure that adequate noise attenuation measures are implemented in the plant room to comply with the noise pressure level requirements described below.
- The exhaust pipe shall penetrate the external canopy and be extended from the external canopy in such a way to allow for vertical flow with a cover to prevent the ingress of rainwater and shall allow for expansions. The contractor is to determine the diameter of the required exhaust piping to ensure that no restrictions or backpressure is created.
- The exhaust piping will be adequately lagged and cladded from the engine to the exhaust.
- All statutory, as well as unit identification signs and notices shall be installed in the canopy. The signage shall consist of durable material and shall be approved by the Engineer prior to manufacture.
- The SGDU Supplier will be responsible for sealing around all cable entries.

- A red flashing light as well as a siren shall be mounted on the equipment to warn personnel prior to startup as well as to signal an alarm in the event of any of the alarms being triggered by the controller.

10.9 NOISE PRESSURE LEVEL

The sound pressure level emitted from the SDGU when operation at full load shall be:

- 65 dB(A) at a distance of 7m in all directions from the plant room.
- 105 dB(A) inside the SDGU plant room.

Two sets of hearing protectors shall be installed on the inside next to the door for the protection of personnel.

10.10 CABLE ENTRY

The control cables as well as the power cables shall enter SDGU and associated panels from the bottom.

10.11 CONCRETE PLINTH

The Contractor for this installation shall submit the drawings for the concrete plinth within one weeks after receipt of the letter of appointment showing the following details to enable the structural engineer for the overall building project to design the plinth:

- Overall dimensions for the plinth.
- Positions of penetrations through the plinth for the installation of all the necessary cables.
- Total mass of the complete unit, including the enclosure.
- Separation wall

10.12 ENGINE EMISSION REQUIREMENTS

The Contractor shall confirm in writing that the SDGU's on offer comply with the following emission requirements.

SDGU	Minimum Engine Emission Rating
Emergency Power Generator	Tier II (Certified)

11. MISCELLANEOUS ITEMS

Not applicable to this contract.

12. SPECIALIZED SYSTEMS AND PROVISIONAL SUMS

12.1 LIGHTNING PROTECTION SYSTEM

Excluded from this Contract.

12.2 TELEPHONE, DATA, ACCESS CONTROL, CCTV AND SMOKE DETECTION CABLING SYSTEMS

Not applicable to this contract.

12.3 UPS SYSTEM

Not applicable to this contract.

12.4 FIRE DETECTION SYSTEM

Not applicable to this contract.

12.5 CLEARVIEW FENCE

The appointed contractor shall erect a Clearview fence around the installation area as per drawing A-2090-07-002. This fence colour shall be confirmed at a later stage.

ANNEXURE B (Continued)

STANDARD SPECIFICATIONS

FOR THE

ELECTRICAL INSTALLATION

FOR THE

SWITCHGEAR REPLACEMENT

FOR

THE CSIR

STANDARD SPECIFICATIONS

The Standard Specifications of Plantech Consulting Engineers which have been marked as applicable to this Installation shall form part of this Specification and will apply.

Standard Specifications which have been referred to or specified in the Specification, but which have not been included can be obtained from the Engineer.

SPECIFICATION NO.	DESCRIPTION	APPLICABLE
A-SPES-00-01-W13	STANDARD SPECIFICATION FOR GENERAL REQUIREMENTS OF PROCEDURES (NO 21)	YES
A-SPES-07-01-W06	STANDARD SPECIFICATION FOR GENERAL ELECTRICAL DISTRIBUTION	YES
A-SPES-04-02-W01	BUILDINGS	YES
A-SPES-04-04-W01	STANDARD SPECIFICATION FOR MINIATURE SUBSTATIONS	YES
A-SPES-11-01-W01	STANDARD SPECIFICATION FOR EXCAVATION WORK	YES
	STANDARD SPECIFICATION FOR STANDBY DIESEL ALTERNATOR SETS	

STANDARD SPECIFICATION

FOR

GENERAL REQUIREMENTS

AND

PROCEDURES

STANDARD SPECIFICATION FOR GENERAL REQUIREMENTS AND PROCEDURES

CONTENTS OVERVIEW

PAGE

STANDARD SPECIFICATION FOR GENERAL REQUIREMENTS AND PROCEDURES

1. GENERAL

1.1 Documentation

The specification for this installation consists of all written documents such as Conditions of Tender and Contract, Standard Specifications, Project or Detail Specifications, Bills of Quantities and Schedules together with applicable Drawings.

1.2 Discrepancies, Conflicts And Ambiguities

Any discrepancy or contradiction between the Tender/Contract documents and drawings, shall be brought to the notice of the Engineer in writing for a ruling, prior to submitting a Tender.

1.3 Contractor / Subcontractor

Where the Installation referred to in this Tender is a subcontract of the Principal contract, the word “Contractor” refers to the Subcontractor responsible for the Installation.

2. SCOPE OF WORK

2.1 The installation and scope of works is fully described in the Project Specification.

2.2 Unless otherwise specified the specification includes the design, supply, delivery, erection, testing, commissioning and handing over in complete working order as well as the maintenance and guarantee for a period of 12 months after acceptance by the Engineer.

2.3 The installation shall be complete and shall include all material and equipment necessary for the proper functioning thereof.

3. SPECIFICATIONS

3.1 The Project Specification will specifically apply to this installation and will have precedence over the Standard Specifications.

3.2 The Standard Specifications of the Engineer which apply to this Contract are listed in the Project Specification.

3.2 Reference Specifications

The latest revisions of any Specification or Code issued by the SABS/ISO or other Standards referred to in this Specification, will be applicable.

4. STATUTORY AND REGULATORY REQUIREMENTS

4.1 The Contractor shall ensure that the Installation, including all equipment used, is designed, installed and maintained in compliance with the following regulations:

(a) SANS 10142: Code of Practice for Wiring of Premises.
(b) Occupational Health and Safety Act - Act 85: 1993 as amended by the Occupational Health and Safety Amended Act No. 181 of 1993 and the labour Relations Act, No. 66 of 1995.
(c) National Building Regulations - Act 103 of 1977 a.a. as deemed to be satisfactory in terms of SANS 10400-2010 a.a.
(d) Applicable regulations of Telkom S.A.
(e) Municipal, Local or where applicable other authorities by laws and regulations with regard to building, electrical, fire, gas, water, traffic and health requirements.
(f) The Montreal Protocol for refrigerants.
(g) Regulations, requirements and licensing as laid down by SATRA for radio installations.
(h) General Machinery Regulations GNR 1521 of 5 August 1988.
(i) General Safety Regulations GNR 1031 of 30 May 1986.
(j) General Administrative Regulations GNR 929 of 25 June 2003.

4.2 The latest revisions amendments or additions to the above mentioned regulations will apply.

4.3 The Contractor shall exempt the Employer from any claims, losses or expenditure which may arise as a result of the Contractor's negligence or failure to comply with the above mentioned regulations.

4.4 The Contractor shall be responsible for all notifications and payments required by any Authority for inspections, tests and supply of any service required for this Installation. The Tenderers are therefore required to fully acquaint themselves with these requirements prior to Tendering.

4.5 The Contractor shall supply and install all notices and warning signs that are required by relevant laws or regulations, to the full approval of the Engineer and the applicable authorities. All uncertainties of any such requirements shall be clarified prior to tendering. The cost of all such notices shall be allowed for in the tender.

4.6 Refer to Clause 21 specifically with regard to the OHSA requirements.

5. CONTRACT

Refer to the Conditions of Contract in this regard.

6. QUALITY OF MATERIALS AND WORKMANSHIP

6.1 All material and equipment for this Installation shall be new and undamaged, unless otherwise stated in the Project Specification.

6.2 All equipment and material shall be of the highest quality as specified and shall be suitable for the application and prevailing conditions on site.

6.3 A comprehensive CV of the person responsible for site supervision shall be submitted to the Engineer. The Engineer may require an interview with the proposed supervisor and may request replacement of the supervisor, which shall in no way alter the contract tender amount.

6.4 The labour used by the Contractor on this Installation shall at all times be adequately qualified and experienced for the particular task and shall execute the work in a professional manner to the full satisfaction of the Engineer.

6.5 The Contractor is responsible to ensure that the Installation meets all the requirements of this Specification.

6.6 Refer to the specific requirements for this Contract regarding Quality Assurance procedures.

6.7 Under no circumstances may any material or equipment be ordered or installed other than the equipment offered in the respective schedules of Information, without obtaining written approval from the Engineer.

6.8 Approval Of Equipment Selections

The Contractor shall obtain written approval from the Engineers in writing before major equipment is ordered.

6.9 Samples

The Contractor shall, if requested to do so, provide samples of any material, equipment or test section of a fabrication process.

7. SITE LOCATION, SITE CONDITIONS & SITE FACILITIES

7.1 The location of the site is described in the Project Specification.

7.2 Site Visit

Tenderers are advised to visit the site and acquaint themselves fully of all local conditions pertaining to the execution of the contract before the tender closing date, since no claims arising from insufficient knowledge of site or related conditions will be considered.

7.3 Storage of Material

The Contractor shall provide the necessary storage facilities to ensure that all material and equipment is safely stored and protected against any possible loss or damage.

Unless otherwise agreed in writing payment will only be made for materials delivered and stored on site.

7.4 Site Office

The Contractor shall provide the site office and all other necessary facilities required by his personnel for the proper execution of this Contract.

8. PROJECT MANAGEMENT AND PROGRAMMING

The Contractor shall at all times ensure that he has the necessary experience and expertise for the successful internal project management, programming and reporting of the total project.

The programme to carry out the Work shall be submitted in detail covering all significant operations and shall be presented as a bar chart to the Engineer within 2 weeks from date of appointment.

The Contractor's programme shall cover each item of equipment in the Contract and indicate periods for:

(a) Preparation, approval and finalization of manufacturing drawings.
(b) Ordering and procurement

(c) Manufacturing
(d) Inspection and testing during manufacture
(e) Delivery
(f) Installation on Site
(g) Testing
(h) Commissioning.
(i) Take-over
(j) Maintenance visits

The programme shall furthermore clearly indicate the required cashflow, as well as the full details of the planned manpower requirements throughout the project.

The programme shall be updated regularly and the required copies shall be supplied to the Engineer at each meeting.

A written progress report, clearly indicating the latest progress as well as any deviations from the approved programme, complete with proposals for corrective action, shall be submitted at each site meeting.

All procedures to be followed during the execution of the Contract will be determined at a Briefing Meeting to be attended by all concerned parties shortly after the awarding of the Contract.

9. CLAIMS

All claims which may result in additional cost or extension of time shall be submitted to the Engineer as set out in the Conditions of Contract, but the following shall apply at all times irrespective of that which is stated elsewhere:

- The Engineer shall be notified of any possible claim within 7 days of the occurrence.
- The cost of the claim shall be submitted within a further 14 days.
- Should an event/instruction cause a possible disruptive influence on the progress of the Contractor, it shall immediately be brought under the attention of the Engineer in writing, in order that the necessary arrangements and possible reprogramming can be done to eliminate or minimize the disruption or delay.

10. DRAWINGS

10.1 Available Drawings

The Contractor shall acquaint himself fully with the available information on the following drawings:

- Architect's drawings
- Structural Engineer's drawings
- Drawings available of all other services such as electrical, mechanical, plumbing and other specialised services.

The Contractor shall be responsible for all site co-ordination of his Installation with the other Contractors and Subcontractors.

10.2 Standard of Drawings

All drawings shall be of sufficient quality to ensure - clear and legible copies at all times.

10.3 Builder's Work Drawings

The Contractor shall provide Builder's Work Drawings in accordance with the construction programme but not later than 4 weeks after acceptance of his tender which shall indicate all openings in concrete slabs, brick walls or building structure, walls or structure to be temporary left out for access to install equipment, the mass and dimensions of all heavy equipment, wooden frames and any other builder's work such as plinths, bases etc. including services to be provided i.e. electrical, water and drainage.

10.4 Detail Design Drawings (Shop Drawings)

The Contractor shall submit to the Engineer, in accordance with the construction programme, 2 copies of each shop drawing for approval. A marked-up copy with the Engineer's and if applicable Architect's comments will be returned to the Contractor who will update the original accordingly after which the original shall be submitted to the Engineer for his signature.

The Engineer's approval shall not relieve the Contractor of his responsibility for erection or installation or of errors or omissions in the shop drawings.

Five (5) copies of each certified drawing or revision shall be issued to the Engineer for distribution during construction. The Contractor will be required to produce the following Project Design Drawings:

(a) Electrical Systems
General Arrangement Drawings
Schematic and Circuit Diagrams

Basic Logic Diagrams
Interconnection Diagrams
Cable Schedules
Cable Route Lay-out Drawings, complete with supporting details

(b) Mechanical Systems
General Arrangement Drawings
Process Flow Diagrams

(c) Instrumentation System
Control Diagrams
Sequence Diagrams
Logic Diagrams

The drawings shall be sufficiently detailed to enable the Employer's staff to maintain, dismantle, reassemble and adjust all parts of the works. The layouts shall indicate the location of all manual and automatic control devices, control panels, sensors, thermostats, etc. The wiring diagrams shall indicate all motor kilowatt ratings and circuit breaker and contactor ratings and protection settings.

A copy of the wiring diagram shall be mounted in the plant room in a glass fronted frame. The diagrams shall be printed by a non-fading process.

10.5 "As Installed" Drawings

Drawings shall be updated as work progresses in order that the "As-Installed" Drawings on completion reflect the final Installation.

One set of hard copy and soft copy drawings shall form part of each O&M manual.

Soft copy drawings shall be compatible with AUTOCAD software.

11. OPERATING AND MAINTENANCE MANUAL

The Contractor shall prepare and supply O & M manuals for the successful operation and maintenance of the Installation.

The manual shall include:

(a) A system description of the Installation

(b) Step-by-step operating instructions with start-up and shut-down procedures

(c) Full information of the Contractor including emergency telephone and fax numbers and contact persons.

(d) A list of equipment (and spares) giving the following information for each item:

Description	:	
Make	:	
Model No	:	
Manufacturer/Agent	:	(Name, address, tel & fax no)
Comment	:	(Indicate spares to be held if of a critical nature)

(e) Data sheets, characteristic curves and calculations

(f) Catalogues and brochures

(g) List of recommended lubricants

(h) Set of "As-Installed" drawings

(i) All commissioning data and settings

(j) Test certificates

(k) Completed Certificate of Compliance

A draft copy shall be submitted to the Engineer prior to commencement of commissioning. Prior to Taking-over the Installation by the Employer, the Contractor shall supply 3 complete manuals which have been updated and which include all commissioning data and "As-Installed" drawings called for in Clause 9. The Engineer will not issue "Form C" until all the approved O & M manuals and drawings have been received.

12. INSPECTIONS, TESTING, COMMISSIONING AND TAKING OVER

12.1 Progress Inspections

The Engineer will hold inspections at his discretion during the contract to ensure that the Contractor meets the

requirements of the Specification and that the Contractor is fulfilling his responsibility regarding quality control.

Should remedial action be required the Engineer will notify the Contractor, and the Contractor shall rectify this work within 7 days.

12.2 "Hold Point" Inspections And Tests

"Hold Point" inspections and Tests are identified in the Project specification and the Contractor requires written approval to proceed.

The Engineer is required to inspect and test certain equipment listed in the specification under "Hold Points" at their place of manufacture and such equipment may not be delivered to the Contract site, nor may the Contractor proceed with the manufacture and/or installation of such equipment without prior written consent from the Engineer.

The Contractor must give the Engineer at least 7 days advance notice of the date at which such tests and inspection are to be carried out unless otherwise agreed by both parties.

12.3 Completion And Take-Over Procedures

In terms of the Conditions of Contract the following procedure will apply to the "take-over" of the Installation, or if required by the Employer to the sectional completion of a portion thereof.

12.3.1 Form A: Application for Practical Completion Inspection (Completion Test Inspection – FIDIC)

After the physical completion of manufacturing and upon completion of the installation, the Contractor shall carry out his own internal quality control checks on all the various items of the installation, where after such "Contractor's Inspection List" shall be signed off by the Contractor and be submitted to the Engineer together with a "Form A" to apply to the Engineer within one week for the Practical Completion Inspection List.

Subject to the discretion of the Engineer detailed in writing, the Installation may be divided into different sections for the application of the above inspection procedure.

Any inspection carried out by the Engineer on the request of the Contractor without the above documentation will be regarded as unofficial, and the cost may be recovered from the Contractor.

12.3.2 Form B: Practical Completion Inspection Certificate (Completion Test Certificate – FIDIC)

Once the Engineer has received a "Form A" from the Contractor he will officially inspect the Installation, listing all minor outstanding items still to be rectified on a Practical Completion List - Form B1.

Commissioning:

All site testing and all commissioning activities as specified shall be carried out in close co-operation with the Engineer.

It is a requirement of this Contract that the Contractor shall submit a complete testing and commissioning procedure to the Engineer for approval, at least two weeks prior to the commencing of the actual testing and commissioning activities on Site.

All testing and commissioning shall be carried out in the presence of the Engineer or his duly authorised representative and shall at all times be thorough and in strict accordance with the specified requirements and approved procedures. All tests carried out without the Engineer been duly notified, will be regarded as unofficial and may at the discretion of the Engineer have to be repeated at the cost of the Contractor.

12.3.3 Form C: Works Completion Certificate (Take-Over Certificate – FIDIC)

The Engineer will issue Form C, after the items listed on Form B1 have been completed to his satisfaction, together with his Final Completion List containing all outstanding and unacceptable work (except undetected patent and latent defects). The Contractor shall complete all items listed within 20 working days.

The Engineer will only issue Form C if all O&M manuals, and "As-Installed" drawings have been received and training of personnel has taken place.

12.3.4 Form D: Final Completion Certificate (Performance Certificate – FIDIC)

The Engineer will issue, on request by the Contractor, a Final Completion Certificate at the end of the Defects Liability (Retention) Period.

12.4 Cost Of Re-inspections

Should the Engineer, after an inspection or test, find that the number of outstanding defects is of such a nature that he is unable to issue a meaningful list or certificate, or that due to the Contractor not attending to previous lists or reports, re-inspections are required, such re-inspections will be charged to the Contractor and deducted from the balance of his account by means of a variation order. The Engineer will be compensated accordingly by the Employer.

13. TRAINING OF EMPLOYER'S PERSONNEL

13.1 Once the Contractor has completed and commissioned the Installation and issued the O & M manuals to the satisfaction of the Engineer, he shall train the Employer's personnel the proper operation and maintenance of the plant.

13.2 The Contractor shall prepare and submit a recommended training program to the Engineer for approval.

13.3 The Contractor shall give the Engineer sufficient time to make the necessary arrangements.

13.4 The Contractor will remain responsible to operate the Installation on a daily basis until he has adequately trained such personnel.

14. TOOLS, EQUIPMENT AND TEST INSTRUMENTS

14.1 The Contractor shall provide all tools and equipment necessary for the proper and efficient execution of the work.

14.2 The Contractor shall provide all test instruments necessary for the proper testing of equipment or systems to ensure that the specified requirements are met.

14.3 The Contractor shall provide valid calibration certificates for all instruments.

14.4 If necessary the Engineer will arrange for test instruments and the cost will be recovered from the Contractor, as set out in clause 12.4.

15. MAINTENANCE TOOLS

15.1 The Contractor shall provide one complete set of all special tools, such as gland keys, lockshield valve keys, air cock keys, etc., required for testing, dismantling or operating all items of equipment.

15.2 Duplicate keys shall be provided for all control panels, instrument locks, safety valve locks etc.

16. CODING, LABELLING AND NOTICES

16.1 The language shall be English, or as specified by the Engineer.

To reduce the possibility of incorrect wording the Contractor shall submit a proposed "Schedule of Labels and Notices" to the Engineer for approval prior to manufacture and at least 4 (four) weeks in advance thereof.

16.2 For painting/colour coding refer to the Standard Specification for Painting and Coatings A-SPES-30-01.

16.3 **Manufacturer's Nameplate**

All equipment shall be provided with a manufacturer's nameplate, which shall be a copper, anodised aluminium or stainless steel tag, welded or riveted to the equipment. (No "glue-on" plates will be accepted.) The lettering thereon shall be suitable to withstand the climatic or other conditions under which the equipment is to operate.

The nameplates shall display the information required by the relevant SANS specifications. At least the following shall be shown:

Manufacturer’s name
Model number
Volume where applicable
Size, Speed, Power input, Power output, FLA,
All letters shall be hard stamped and at least 4 mm.
Supply Voltage, etc whichever may be applicable.

16.4 **Identification Tag**

The Contractor shall provide an identification tag or label with the equipment identification code, in approved format, screwed or riveted next to each piece of equipment (no 'glue on' attachment will be accepted).

Labelling shall be CRITCHLEY UNILABEL Cable Marker or engraved "IVORENE" or "TRAFOLITE" labels.

Black letters on a white background shall be used.

The minimum height of letters shall be as follows:
Equipment identification = 10 mm

16.5 **Notices**

The Contractor shall install all notices required in terms of Statutory Regulations and shall amongst others include the following:

16.5.1 Prohibiting unauthorised persons from entering.

16.5.2 Prohibiting unauthorised persons from handling or interfering with electrical apparatus.

16.5.3 Directions and procedures to be followed in case of fire or emergency.

16.5.4 Directions as to resuscitation of persons suffering from the effects of electrical shock.

17. FIRE EXTINGUISHERS

The Contractor shall install the fire extinguishers specified in the Project Specification which meet the requirements of SANS 1910 / 1151 as applicable and to the approval of the Local Authorities in all locations where installation work is done as part of this Contract.

18. EMERGENCY EQUIPMENT, MEDICINE AND FIRST AID

The Contractor shall provide a first aid box or boxes as specified in the Project Specification in the plant room(s) which meets the requirements of Machinery and Occupational Safety Act (Act no. 6 of 1983) a.a.

19. GUARANTEE PERIOD

The Contractor is required to guarantee the complete installation against defective material and workmanship for a minimum period of 12 months after the Final Completion Certificate - Form D has been issued by the Engineer. During this period the Contractor will be required to rectify or replace all defective items at his cost.

The Contractor shall cede all manufacturers' warranties to the Employer.

20. MAINTENANCE PERIOD

The Contractor shall comprehensively maintain the installation as part of this Contract for a minimum period of 12 months after the Final Completion Certificate - Form C has been issued by the Engineer.

The Contractor shall submit a maintenance programme to the Engineer for approval and shall allow for a monthly maintenance visit during this period.

The Employer shall not be expected to do any maintenance work during this period and only consumable items such as water, electricity etc. and items specifically mentioned in the Project Specification will be paid for by the Employer, while all other costs will be for the account of the Contractor.

In addition to regular maintenance visits, the Contractor shall attend and react promptly to all complaints by the Employer, regarding failure of any item of equipment.

The Contractor shall report to the Employer's nominated representative on site both his arrival and departure times and shall make the necessary entries in the "Maintenance Log Book" of all visits to the Installation.

The Contractor shall timeously, prior to the expiry of the 12 month maintenance period, submit a quotation to the Employer for a further maintenance contract.

21. OCCUPATIONAL HEALTH AND SAFETY ACT REQUIREMENTS

21.1 The Contractor shall ensure that all requirements of the Act are adhered to and shall point out any shortcomings in this regard.

21.2 Certificate of Compliance for Electrical Installations

The Contractor shall issue a Certificate of Compliance for all electrical work which forms part of the installation under his control. The Engineer will not certify the installation as complete until he is in possession of this certificate.

21.3 Safety

The safety specification of Plantech (Pty) Ltd is as follows and the Contractor shall adhere to, but not limited, to the following:

21.3.1 All requirements of the latest OHS Act and Regulations will apply.

21.3.2 The Contractor shall take note of the potential hazards related to a construction site, such as:

(a) Explosive materials will not be allowed.

(b) Work in confirmed spaces and fumes – adequate ventilation shall be provided.

(c) Excessive dust – Take measures to reduce dust and issue dust masks to workers.

(d) Work above 2 m – Provide workers with harnesses and ensure that scaffolding is inspected for safety.

(e) Excavations deeper than 1 m – Provide anti-subsidence measures.

(f) Falling materials – Ensure that all workers wear hand hats and safety shoes.

(g) Electrical equipment – Check cords and connections daily and ensure that earth leakage relays and circuit breakers operate correctly

(h) Welding – Ensure adequate ventilation and take measures against potential fire hazards.

(i) Ensure that flammable and combustible materials are safely stored.

(j) Ensure that firefighting equipment is functioning and clearly identified with approved notice signage.

21.3.3 Safety plan – The Contractor shall compile a safety plan prior to the commencement of work on site.

21.3.4 Safety training – The Contractor shall train all workers on site regarding safety and provide induction courses for all persons who enter the site.

21.3.5 Safety audits – The Contractor shall appoint a safety officer. The Contractor shall prepare regular safety reports and appoint a safety consultant if he does not have the necessary safety skills.

21.4 Pressure Vessels

All pressure vessels shall be manufactured and tested as required by the Act.

21.5 Lifts and Escalators

All lifts and escalators shall be manufactured, erected and tested by a registered Contractor in terms of the Act.

APPENDIX TO STANDARD SPECIFICATION A-SPES-00-01

FORM A : Application for Practical Completion Inspection

The forms below are not necessarily included in the Tender Document but are available:

FORM B : **B:** Practical Completion Certificate (Completion Test Certificate – JBCC)

B1: Practical Completion List

FORM C : Works Completion Certificate (Take-Over Certificate - JBCC)

FORM D : Final Completion Certificate (Performance Certificate – JBCC)

FORM A

APPLICATION FOR PRACTICAL COMPLETION INSPECTION (COMPLETION TEST INSPECTION - JBCC)

PROJECT : .....

INSTALLATION : .....

PORTION : .....

CONTRACTOR : .....

REFERENCE NO. : .....

As Contractor responsible for the erection of the abovementioned Installation, I hereby certify that the Installation has been completed in full accordance with the Specification and the Engineer's instructions, and that initial commissioning has been completed.

As responsible person of the Contractor I hereby certify that I have inspected the installation and that all the items as listed on my "Contractor's Inspection List", a copy of which is attached, have been completed to my satisfaction.

I therefore officially request that the "Practical Completion Inspection" in terms of the contract be performed by the Engineer. I accept that should the inspection prove fruitless due to false declarations in the above paragraphs, I will be liable for the Engineer's cost in performing additional inspections.

I herewith hand over draft copies of the Operation and Maintenance Manual, "As Installed Drawings" and Commissioning Procedures for the Engineer's comments.

SIGNED : _____ _____
For Contractor Print Name

DATE : ...../...../.....

COPIES:

1. _____
Engineer

2. _____
Principal Agent

3. _____
Principal Contractor

FORM B

PRACTICAL COMPLETION CERTIFICATE (COMPLETION TEST CERTIFICATE - JBCC)

PROJECT : .....

INSTALLATION : .....

PORTION : .....

CONTRACTOR : .....

REFERENCE NO. : .....

NOTE: A Practical Completion Certificate will be issued for each portion for sectional completion.

The installation is substantially completed and can be used for the purposes intended and has passed the initial tests.

ENGINEER'S REPORT

Contractor's Final Inspection List received?	NO/YES	DATE : ...../..../.....
Draft O & M Manual received?	NO/YES	DATE : ...../..../.....
Draft "As Installed Drawings" received?	NO/YES	DATE : ...../..../.....
Commissioning Data received?	NO/YES	DATE : ...../..../.....

The items listed on the attached Practical Completion List (Form B1) shall be rectified before the Contractor requests a Works Completion Inspection.

The Principal Agent shall ensure that the items marked as the responsibility of other parties be attended to by such parties.

SIGNED:

_____ _____

Engineer Date

COPIES:

1. _____
   Employer
2. _____
   Principal Agent
3. _____
   Principal Contractor
4. _____
   Contractor

FORM B1

QUALITY REPORT / PRACTICAL COMPLETION LIST (Delete if not applicable)

PROJECT : .....

INSTALLATION : .....

PORTION : .....

CONTRACTOR : .....

REFERENCE NO. : .....

NOTE: This Quality Report gives a "running" record of quality and other matters which require attention and rectification and the outstanding items at date of the issue of the Practical Completion Certificate, becomes the Practical Completion List.

ITEM	DESCRIPTION	RESPONSIBLE PARTY	DATE OF INSPECTION	DATE ACCEPTED

SIGNED:

_____ _____

Engineer Date

FORM C

WORKS COMPLETION CERTIFICATE (TAKE-OVER CERTIFICATE - JBCC)

PROJECT : .....

INSTALLATION : .....

PORTION : .....

CONTRACTOR : .....

REFERENCE NO. : .....

1. The items marked for the responsibility of the Contractor on the Practical Completion List (Form B1) have been rectified and completed.
2. The defects liability period will commence on the date of this Certificate.
3. Three hard & soft copies of the Operation and Maintenance Manual were received and that two copies have been handed to the Employer ..... NO/YES DATE: .....
4. Three hard and soft copies of the "As-Installed" drawings have been received and two sets has been handed over to the Employer ..... NO/YES DATE: .....
5. The Employer's personnel have been trained by the Contractor to operate the Installation. NO/YES DATE: .....
6. The Contractor has satisfactorily completed all his contractual commitments in terms of the Contract with the exception of his responsibilities during the maintenance and guarantee period, which he undertakes to do punctually.
7. All rights of equipment guarantees and warranties are hereby ceded by the Contractor to the Employer.
8. All parties accept the final contract sum to be R..... including VAT, as the full and final payment regarding the Contract signed, and declares that no further claims will be submitted. Refer to the attached Final Contract Sum Summary.
9. The Employer shall take cognisance of the expiry date of the one year maintenance and guarantee period by the Contractor and will be responsible for all maintenance of the Installation from .....
10. The Employer shall take cognisance that from the date of this Certificate he is fully responsible for the Installation and the safe operation thereof in terms of the Occupational Health and Safety Act (Act 85 of 1993).
11. Admission to the installation for retention and maintenance work shall be under the full control and authority of the Employer and the Contractor shall approach the Employer in order to make arrangements for admission for such work during the Guarantee and Maintenance period.
12. The Employer shall record all complaints regarding the operation of the Installation in the “Maintenance Log Book” and notify the Contractor thereof.
13. Dates of all visits and reports on written complaints recorded by the Employer or User shall be signed by both the Contractor and the representative or the Employer in the "Maintenance Log Book" held on site.
14. Final Completion List: The following additional remedial items shall be attended to by the Contractor within 20 days.

ITEM	DESCRIPTION	DATE ACCEPTED

SIGNED:

1. _____ _____
   Engineer Date

2. _____
   Employer

3. _____
   Principal Agent

4. _____
   Principal Contractor

5. _____
   Contractor

Copies: Issued to all above

FORM D

FINAL COMPLETION CERTIFICATE (PERFORMANCE CERTIFICATE – JBCC)

PROJECT : .....

INSTALLATION : .....

CONTRACTOR : .....

REFERENCE NO. : .....

It is hereby certified that the Contractor has completed his obligations during the Defects Liability Period (Defects Notification Period – FIDIC) and will be relieved of further responsibilities upon acceptance by the Engineer of the following defects identified during the said period.

ITEM	DESCRIPTION	DATE OF ACCEPTANCE
For JBCC contracts	The Contractor shall complete all his responsibilities in respect of the 12 month maintenance and guarantee period for the remaining 9 months.	As per Contract

Liability for Latest Defects will be in accordance with the Contract.

SIGNED:

_____ _____

Engineer Date

COPIES:

1. _____
   Employer
2. _____
   Principal Agent
3. _____
   Principal Contractor
4. _____
   Contractor

STANDARD SPECIFICATION

FOR

GENERAL ELECTRICAL

DISTRIBUTION IN BUILDINGS

STANDARD SPECIFICATION FOR GENERAL ELECTRICAL DISTRIBUTION IN BUILDINGS

CONTENT OVERVIEW

Page

STANDARD SPECIFICATION FOR GENERAL ELECTRICAL DISTRIBUTION IN BUILDINGS

1. GENERAL

1.1 Scope of Work

The installation and scope of works is fully described in the Project Specification.

1.2 Specifications

The following specifications and regulations will apply:

1.2.1 Standard Specifications:

1.2.1.1 A-SPES-00-01: General Requirements and Procedures, including the specifications and regulations.

1.2.1.2 A-SPES-02-03: Medium Voltage Switchgear

1.2.1.3 A-SPES-03-02: Distribution Transformers and Associated Equipment

1.2.1.4 A-SPES-04-02: Miniature Substations

1.2.2 SABS 0142-1987 a."Code of Practice for the Wiring of Premises" will apply to this Installation.

Over and above the requirements of SABS 0142-1987, the conditions of this Standard Specification and those laid down in the Detail Specification will also apply.

1.2.3 Refer to Standard Specification A-SPES-00-01 Clause 4 regarding standards and regulations.

1.3 Responsibility of the Contractor

1.3.1 The Contractor (Electrical Contractor) shall only use qualified and experienced personnel for this project.

1.3.2 A licensed electrician shall not be responsible for a team of more than four wireman each with two labourers.

1.4 Arrangements with the supply Authority

1.4.1 Permanent Bulk Supply Cost

The Engineer will make the necessary arrangements with the Supply Authority for the permanent bulk supply. The connection fees and bulk supply service charge will be paid by the Employer and if a provisional sum has been budgeted for in the tender price, this cost will be omitted in full without any compensation whatsoever to the Contractor and will be paid directly by the Employer to the Supply Authority.

1.4.2 Builder's supply

Unless otherwise specified, it is the responsibility of the Principal Building Contractor to arrange and pay for the temporary electrical builder's supply.

1.4.3 Register Installation and Inspection Fees

The Contractor shall be registered as a Class 1 Electrical Contractor in terms of the Machinery and Occupational Safety Act No. 6: 1983 a.a.

The Contractor shall register the project at, give all notices required by and pay all necessary fees, including any inspection fees as required by the Supply Authority. The Contractor shall make the necessary arrangements with the Supply Authority at his own cost and shall supply the labour, equipment and means to inspect, test and commission the installation to the satisfaction of the Supply Authority.

The Contractor shall submit all inspection certificates of the Supply Authority to the Engineer. Hold point

1.5 Preliminary and General

The Contractor shall allow in his tender price for all preliminary and general costs such as site establishment, overhead, management, administration insurance and all other costs of a general nature including breakage and wastage.

The cost for preliminary and general items shall be divided into the following categories:

- Fixed costs
- Time related costs

1.6 Contract

Refer to the Conditions of Contract in this regard. D/Spec

1.7 Quality

1.7.1 Refer to Clause 6 of Standard Specification A-SPES-00-01

1.7.2 Refer to the Detail Specification regarding the requirements for this Contract for Quality Assurance procedures. D/Spec

1.7.3 Only proved equipment readily available in the Republic of South Africa and conforming to the applicable standard of code of SABS and where no such standard exists, to that of IEC, DIN or BS will be accepted.

1.8 Site, Site Conditions & Site Facilities

Refer to clause 7 of Standard Specification A-SPES-00-01 and to the relevant clauses in the Detail Specification. D/Spec

1.9 Project Management and Programming

Refer to clause 8 of Standard Specification A-SPES-00-01 and to the relevant clauses in the Detail Specification. D/Spec

1.10 Drawings

Refer to clause 10 of Standard Specification A-SPES-00-01 and to the relevant clauses in the Detail Specification. D/Spec

The Contractor shall retain a full set of drawings on site and shall mark up all changes and additional information on an ongoing basis in order that the Engineer can produce "as installed" drawings on completion of the project.

1.11 Responsibility of other Parties

Refer to the relevant clauses in the Detail Specification. D/Spec

1.12 Operating and Maintenance Manuals

Refer to clause 11 of Standard Specification A-SPES-00-01 and to the relevant clauses in the Detail Specification. D/Spec

1.13 Inspection, Testing, Commissioning and Handing Over

Refer to clause 12 of Standard Specification A-SPES-00-01 and to the relevant clauses in the Detail Specification. D/Spec

1.14 Training of Employer's Personnel

Refer to clause 14 of Standard Specification A-SPES-00-01 and to the relevant clauses in the Detail Specification. D/Spec

1.15 Tools, Equipment, Test Instruments and Maintenance Tools

Refer to clauses 14 and 15 of Standard Specification A-SPES-00-01 and the relevant clauses in the Detail Specification. D/Spec

1.16 Coding, Labelling, Notices and Name Boards

Refer to clause 16 of Standard Specification A-SPES-00-01 and the relevant clauses in the Detail Specification. D/Spec

Also refer to Clauses 3.8 and 3.15 of this Standard Specification.

1.17 Fire Extinguishers

Refer to the relevant clauses in the Detail Specification. D/Spec

1.18 First Aid Kits

Refer to the relevant clauses in the Detail Specification. D/Spec

1.19 Guarantee Period

Refer to the relevant clauses in the Detail Specification. D/Spec

1.20 Maintenance Period

Refer to the relevant clauses in the Detail Specification. D/Spec

1.21 Certificate of Compliance

The Contractor shall, in terms of the Electrical Installation Regulations, of the Machinery and Occupational Safety Act, Act 8 of 1983 a.a. issue a Certificate of Compliance to the Employer with a copy to the Engineer after the Installation has been completed, inspected and tested.

The Engineer will not issue a Final Completion Certificate - Form D until he is in receipt of such a Certificate of Compliance.

2. MEDIUM VOLTAGE DISTRIBUTION

The requirements of Medium Voltage Distribution Equipment for this Installation are specified in the Detail Specification. D/Spec

2.1 Medium Voltage Switchgear

Medium voltage switchgear, in the range of 6,6 kV to 11 kV to be supplied and installed as part of this Contract shall conform to the requirements of the latest revision of Standard Specification A-SPES-02-03: Medium Voltage Switchgear.

2.2 Transformers

Distribution transformers to be supplied and installed as part of this Contract shall be in accordance with the latest revision of Standard Specification A-SPES-03-02: Distribution Transformers and Associated Equipment.

2.3 Miniature Substations

Miniature substations shall conform to the requirements of the latest revision of Standard Specification A-SPES-04-02: Miniature Substations.

2.4 Medium Voltage Cables

Refer to Detail Specification.

3. LOW VOLTAGE DISTRIBUTION BOARDS

3.1 General

3.1.1 The Contractor shall determine the positions and dimensions of all distribution boards timeously and ensure that ample provision has been made in the structure to accommodate all boards and for sleeves, access holes, etc.

3.1.2 All distribution boards shall be totally enclosed, vermin and insect proof, drip- and dustproof to at least class IP 42 of IEC 144.

3.1.3 The type of distribution board shall be as indicated on the schematic diagrams which form Part of the Detail Specification. D/Spec

3.1.4 The name of the switchboard manufacturer shall appear on each distribution board.

3.1.5 The Contractor shall, during commissioning, balance single phase loads as evenly as possible over the phases and shall amend the "as installed" drawings (Clause 1.10). If required by the Engineer the Contractor shall rebalance the system 3 months after the Installation has been completed/accepted (Form D) should the occupancy have changed significantly.

3.2 Construction of Floor Standing Distribution Boards

Floor standing distribution boards shall be of the multi-tiered, fixed pattern, sectional construction type, allowing for the logical grouping of equipment behind individual hinged doors or panels to the full approval of the Engineer. The distribution board shall mainly consist of the following:

3.2.1 A rigid channel base frame of at least 2 mm thickness and of sufficient strength to prevent any distortion.

3.2.2 The top, side and rear panels of the distribution board shall be of minimum 1,6 mm folded steel. Front panels shall be fixed by means of two locating pins at the bottom and two square key operated panel locks similar to Series 3100 manufactured by Messrs Insulator Industries on top.

3.2.3 All joints shall be welded and shall be completed to a smooth finish.

3.2.4 Dome nuts of self-tapping screws to secure front panels will not be accepted.

3.2.5 If doors are specified in the "Detail Specification" or on the schematic diagrams, the width of the doors shall not exceed 800 mm and it shall be manufactured from minimum 1,6 mm sheet steel, folded in a 20 mm deep rigid pan section with a 10 mm return edge towards the inside, parallel to the closing face of the board. D/Spec

3.2.6 A neoprene type seal of 3 mm thickness shall be applied to the 10 mm return edge of the door.

3.2.7 The doors for weather proof boards for outdoor applications shall be arranged to close over a 10 mm return edge on the board frame, projecting into the door pan, to the full approval of the Engineer.

3.2.8 Machine punched slots or holes shall be provided in the front panels to allow for the operating handles of circuit breakers and switches, without excessive gaps.

3.2.9 Only hinges similar to "fixed type flush mounted "PERANO"/Howarth Technical Components for doors and panels with instruments or equipment mounted thereon and "lift-out" type for doors and panels without equipment mounted thereon shall be used.

3.2.10 Galvanised gland plate/s with minimum thickness of 3 mm for glanding off of all required cables shall be provided at the base or in the top of the board as specified in the Detail Specification or on the relevant schematic diagrams. D/Spec

3.2.11 "Deleron" or "Tuffnol" gland plates, at least 8 mm thick, shall be provided where single core cables are specified.

3.2.12 Front panels shall have machine punched slots for housing the specified and future flush mounted switchgear. The distance between the inside of the closed doors and the panel shall not be less than 20 mm. No equipment may be mounted on the panel unless the panel is permanently hinged to the switchboard frame.

3.2.13 Switchboard doors shall be equipped with padlockable "PERANO" Howarth Technical Components lever locks.

3.3 Construction of Surface Mounted Boards

Surface mounted boards not larger than 1500 x 15000 shall be totally enclosed and shall consist of:

3.3.1 A minimum of 2,0 mm sheet metal enclosure, of approved design suitably braced and with the necessary reinforced fixings for wall mounting.

3.3.2 All applicable requirements for "floor standing boards" in Clause 3.2 will also apply to surface mounted boards.

3.4 Construction of Flush Mounted Switchboards

3.4.1 Flush mounted switchboards shall comply fully with SABS 1180, Part 1.

3.4.2 Where switchboards are to be built into 115 mm thick walls, expanded metal shall be spot welded to the rear of the bonding trays. The expanded metal shall protrude at least 75 mm on each tray side to prevent plaster from cracking.

3.4.3 Knock-outs shall be provided in the top and bottom ends of each galvanised switchboard tray to allow for the installation of conduits for the specified and future circuits. Knock-outs shall be provided for an equal number of 20 mm and 25 mm dia. conduits.

Alternatively provision shall be made for vertical trunking from the floor to the ceiling.

3.4.4 Switchboard doors shall be equipped with lockable push button handles.

3.4.5 All applicable requirements for "floor standing boards" in Clause 3.2 will also apply to flush mounted boards.

3.5 Metalwork Finish and Painting

3.5.1 All metalwork shall be smooth, free from rust, scale or grease and shall be cleaned in strict accordance with SABS 780 of 1996 (as amended), and finished with either baked enamel or electrostatically applied powder coating in the case of interior applications, in the case of all outdoor applications the final paint layer shall consist of an ultra-violet resistant epoxy type paint to the approval of the Engineer. The paint finish shall generally comply with:

- ❖ Dry ground-layer paint thickness - minimum 0,03 mm of approved rust inhibiting paint.
- ❖ Total dry-paint thickness for indoor applications - minimum 0,06 mm.
- ❖ Total dry-paint thickness for outdoor applications - minimum 0,09 mm.
- ❖ Shock resistance on 0,9 mild steel plate - 25 Kg.

- ❖ Scratch resistance 2000 grams.

3.5.2 Where the electrostatic powder coating method is used, the paint shall be baked to harden within 10 minutes at a constant temperature of 190NC.

3.5.3 The internal surfaces of all boards shall have a final coat in the same colour as that for the outside. All equipment mounting frames shall similarly be painted white.

The compartment for "Essential Supply" of all boards shall be painted signal red.

3.5.4 Special attention shall be given to achieving the required paint thickness to all edges and corners, as well as the inside of slots and channels formed by folding of the metal.

3.5.5 It is a requirement of this Specification that the fully painted metal cubicle be subject to inspection and approval by the Engineer prior to any wiring or equipment being fitted. Hold point

3.5.6 Any damage to paintwork incurred during transport and erection shall be made good to the full approval of the Engineer, by thoroughly cleaning the damaged portion to the original metal surface and applying the full number of coats that had previously existed.

3.6 Bus bars

3.6.1 General

All busbars shall be of solid drawn, high conductivity copper and shall comply with SABS 784, BS 159 and BS 1433. Completed busbar installations shall withstand the full test voltage specified in the relevant BS specification.

3.6.2 Application

Busbars shall be provided for the following applications:

(a) Distribution of supply voltage (main busbars).

(b) Connection to all equipment with current ratings exceeding 200 Amps.

(c) Connection of outgoing circuits with current ratings in excess of 200 Amps.

(d) Collection bars for parallel circuits.

(e) Connection bars for neutral conductors.

(f) Earth busbars

(g) Connections to miniature circuit-breakers

3.6.3 Rating

Busbars for system voltages up to 600 V shall be designed to withstand a test voltage of 2,5 kV for 1 minute.

The maximum allowable temperature of busbars carrying full load current in an ambient temperature of 35 NC shall not exceed 80 NC. All busbar designs shall be submitted to the Engineer for approval prior to manufacturing.

Busbar installations shall comply with SABS 0142 and shall be designed to a maximum current rating of 2,1 Amp per sq. mm for all applications where the current is less than 1000 Amp and 2,2 Amp per sq. mm for applications where the current is in excess of 2000 Amp. Manufacturers shall where requested prove that the busbar design and enclosure comply with the temperature rise as specified above.

In addition to the current rating, busbars shall comply with the fault level rating as specified in the relevant BS specification.

3.6.4 Mounting of Busbars

The copper surfaces of busbars at joints shall be tin coated.

All busbars shall be installed horizontally or vertically with the longer side of the cross section in the vertical plane. Main busbars shall be supported on "DELARON" or "THIOLITE" resin bound panels or similar insulating material to the approval of the Engineer. These panels shall be firmly bolted to the switchboard frame and shall fit tightly and neatly around the busbars. Busbars may also be mounted on resin insulators. Porcelain insulators are not acceptable.

The busbars shall be fixed and supported at sufficient intervals to withstand the mechanical forces encountered during the maximum fault current that can occur. The maximum allowable spacing of busbars supports for fault levels of 20 kA and more is 500 mm.

Where a busbar consists of 2 or more busbars laminations per phase the laminations shall be separated by a minimum distance equal to the thickness of one lamination. The laminations shall be clamped together with copper spacers at intervals not exceeding 450 mm in order to equalise the current distribution in the laminations.

The busbars shall withstand a fault current test under the conditions of the specified fault level for 1 sec. If a fault level is not specified, the busbars shall be tested at 20 times rated current for 1 second. The fault current during tests shall be:

(a) between all three phases,
(b) any two phases,
(c) neutral and the adjacent phase, and
(d) earth conductor and the nearest phase conductor.

- Busbars shall be at least 150 mm from the nearest equipment. Where busbars protrude through a switchboard panel for incoming or outgoing circuits, the busbars shall be properly insulated and rigidly supported on the inside of the switchboard. This shall be achieved by means of resin bound synthetic material or similar insulating material with cut-outs which fit tightly around the busbars. The insulating panel shall be firmly bolted to the frame. Busbars or "droppers" that pass through internal partitions in the switchboard shall be similarly insulated and supported.

The minimum clearances between current carrying parts and other metal parts for system voltages up to 600 V is in accordance with SABS 784 and BS 159 but shall not be less than 25mm. The side panels shall be provided with an insulated pad with an area of at least double the area of the cross section of the busbars at both ends to prevent the busbar from touching the side panel during expansion of the busbar.

3.6.5 Insulation

All busbars shall be covered with coloured heat-shrinkable material equal to "RAYCHEM" or "SIGMAFORM" products. The colour shall correspond to the colour of the supply phase.

Alternatively busbars may be covered with two coats of coloured insulation paint if approved by the Engineer. The tape shall be applied in such a way that at least 50% overlapping occur. Busbars shall be radius edged where they change direction.

Joints shall be insulated on site after installation on site and after the Engineer has checked the bolts. High tensile steel bolts with washers and spring washers shall be used at joints.

3.6.6 Connections to Busbars

All conductors and cables shall be bolted to busbars using crimped lugs of the correct size to suite the conductor. Cadmium plated steel bolts and nuts, washers and lockwashers shall be used. Only hexagon type crimping tools and lugs shall be used where the conductor sizes exceed 10 sq. mm.

3.6.7 Neutral Busbars

Neutral busbars in 3 phase, 4 wire supplies shall have a cross-section of at least 60 % of the cross-section of the phase busbars. Where single phase circuits (e.g. lighting and general power circuits) are protected by single phase circuit breakers or fuses, all neutral conductors shall be connected to a separate neutral busbar mounted in a suitable position. The cross-section of the busbar shall be at least 6 mm x 25 mm and the busbar shall be long enough for the lug of each conductor to be bolted separately to the busbar. Only one neutral conductor is allowed per nut and bolt combination.

A separate neutral bar shall be provided for each earth leakage unit provided on the switchboard.

3.6.8 Earth Busbar

An earth busbar shall be installed in a convenient position along the entire length of the switchboard. All earth connections shall be bolted separately to the busbar. The cross-sectional area of earth busbars shall be calculated according to the relevant formula in IEC 439 with a minimum cross-section of 6 mm x 25 mm.

In addition, the longer side of the earth busbar shall be at least twice the diameter of the largest bolt that will be fitted to the busbar. The earth bar shall be bolted to the frame of the switchboard. Brass earth strips with tapped holes and screws are not acceptable. Busbars with clamp type terminals that fit over the bar, are acceptable as an alternative to bolted connections. The earth busbar shall be clearly marked with green paint or green heatshrink cords in suitable positions.

3.7 Conductors

3.7.1 Power Conductors

Connections between busbars and all equipment in the switchboard shall consist of heavy duty coloured PVC insulated stranded annealed copper conductors manufactured to SABS 1507 and/or solid high conductivity copper bars of ample cross-section covered with heat shrinkable material. The colours to be used in all instances shall be red, white and blue for phase connections and black for neutral connections. All circuits with a rating of 200 A and more and all connections to cables larger than 70 sq. mm shall consist of busbars only.

3.7.2 Current Rating

The current rating of all conductors used for the internal wiring of switchboards shall be equal to the capacity of the circuit breaker or fuse which protects the circuit and shall be selected to comply with SABS 0142, Table B, column 4.

3.7.3 Internal Wiring

(a) Standard 600/1000 V grade PVC-insulated stranded annealed copper conductors to SABS 1507 shall be employed for the internal power wiring of switchboards. The smallest conductor size to be used for power wiring in switchboards shall be 2,5 mm². Flexible cord of minimum size 1 sq. mm may be used for control wiring, having a minimum of 20 strands.

(b) Where heat generating equipment is present and the internal temperature of the board is likely to exceed 50 °C, silicon-rubber insulated stranded conductors shall be used.

(c) Wiring shall be neatly arranged in horizontal and vertical rows and shall be installed in PVC wiring channels or bound with plastic straps where channels are not practical. Under no circumstances may PVC adhesive tape be used for the bunching of conductors or for the colour identification of conductors.

(d) Conductors to hinged panels and doors shall be secured on both the door and the frame and shall be looped to allow sufficient movement. "Glue on" type clamping methods will not be acceptable. A flexible protection sleeve shall be installed over the conductors.

(e) Where wiring channels are used, they shall be installed horizontally and vertically. The wiring used for all control wiring shall be 600 V grade.

(f) All wiring between different panels within the same switchboard shall be installed in wiring channels.

(g) Grommets shall be installed in each hole in the metalwork through which conductors pass. Such holes shall be of adequate size to prevent heating due to Eddy currents in the metal work.

(h) All wiring shall be installed away from terminals, clamps or other current carrying parts. Wiring shall also be kept away from exposed metal edges or shall be protected where they cross metal edges.

(i) A maximum of 2 conductors per terminal may be joined at equipment terminals or numbered terminal strips only. No other connections are allowed.

(j) Where conductors change direction, smooth bends shall be formed with a radius of at least 5 times the outside diameter of the conductor or harness.

(k) For the installation of screened cables refer to Standard Specification A-SPES-01-01: Control Boards and Small Wiring.

(l) Where neutral or earth connections are looped between the terminals of instruments or other equipment, it is essential that the two conductor ends be inserted into a common lug and are crimped or soldered together in order that the neutral connection is not broken when the conductors are removed from one of the instruments.

(m) Conductors terminating on meters, fuse holders and other equipment with screw terminals shall be fitted with crimped wire end ferrules.

(n) Wiring should be confined to the front portions of switchboards as far as possible for ease of access. This requirement is important for wiring between circuit breakers with a rating of less than 60 A and the associated main circuit breaker as well as the wiring from circuit breakers to lighting and socket circuits.

(o) A maximum of two conductors will be allowed per equipment terminal. Where more conductors must be connected to the same equipment terminal (e.g. a main circuit breaker feeding other circuit breakers), stub busbars shall be provided for the various conductors.

(p) Cables bundled together shall be de-rated according to the applicable SABS specifications.

All instrument fuses shall be accessible from the front, located behind the front panels. Where equipment is fed by busbars, the fuse holders shall be bolted directly onto the busbars. In other cases, conductors from the incoming circuit to the fuse shall be as short as possible. Each fuse shall be separately labelled stating instrument circuit, phase and rating.

3.8 Identification of Conductors

The colour of all conductors for 400V or 230 V AC circuits shall comply with the colour requirements specified in SABS 0142. Conductors for DC circuits and earth connections shall be grey and green respectively in compliance with BS 158 but the conductors for control, alarm, interlocking and measuring circuits, shall preferably have different colours which are installed according to a consistent colour code. Each conductor including conductors at terminals shall be marked at both ends by means of durable ferrule type plastic wiring/cable markers of Critchley manufacture. Cable markers specially manufactured for this purpose shall be used. Hand-punched PVC or other type is not acceptable. The numbers of all conductors shall appear on and correspond to the switchboard drawings.

3.9 Cables

All cables for incoming or outgoing circuits shall terminate on a gland plate supplied for this purpose and be supported to take the force off the gland.

All outgoing power cables shall terminate within 500 mm of the gland plate to avoid long leads. Where this is not possible, each lead must be separately braced to the approval of the Engineer.

3.10 Essential and Non-Essential Supplies

3.10.1 "Essential supply" means that in case of a power interruption, standby power is either automatically or manually switched to these circuits from a standby power source. Special care shall be taken to prevent any feedback from the "Essential" to the "Non-essential" supply or vice versa and that motor starting currents do not exceed the capability of the standby power source. If necessary, special precautions must be taken to limit the motor starting currents.

3.10.2 The switchboard shall be divided into electrically separate sections with sheet metal barriers to isolate the "Essential" and "Non-essential" compartments.

3.10.3 A main switch shall be provided in both the "Essential" and "Non-essential" supply sections of the switchboard. Each main switch must be interlocked with the access door or panel in that section to ensure that the door can be opened only when the main switch is in the OFF position.

3.11 Equipment Specification

3.11.1 Metal Clad Air Circuit Breaker, Withdrawable Type

(a) The metal clad circuit breaker shall comply with the requirements laid down in BS 4752.

(b) The circuit breaker shall be horizontally withdrawable and shall be a self contained unit of the dead front type, allowing maintenance and tests to be carried out without having to remove the circuit breaker from the withdrawal mechanism. The unit shall contain the necessary mechanical interlocks to prevent:

- Access to "Live" terminals when the breaker is withdrawn.
- The withdrawal or insertion of the unit, when breaker is in the closed position.
- Closing of the circuit breaker following an automatic trip condition without resetting the mechanism.

(c) Adjustable thermal overload releases shall be provided to suit the required current range. In addition, instantaneous magnetic short circuit trips which are adjustable shall be fitted. The tripping devices shall be direct acting. This delay adjustment shall be bypassed with an instantaneous making current release when the circuit breaker is closed to prevent the delay timer from operating when the circuit breaker is closed on a fault.

(d) The tripping time characteristics of the circuit breaker shall be such that good grading can be obtained between the main incoming circuit breaker and the switchgear on the outgoing circuits, under overload and short circuit conditions.

(e) The air circuit breaker shall be of the quick-make, quick-break type with a stored-energy spring assisted operating mechanism provided with:

- A trip free mechanical hand operated closing mechanism.
- A manually operated mechanical trip mechanism suitably protected to prevent inadvertent tripping.
- A positively driven mechanical device to provide ON/OFF/TRIP indication. This indication shall be clearly visible with the circuit breaker in position.

(f) Provision shall exist for the addition, if specified, of a source-side under voltage lock-out.

(g) Circuit breakers shall have electrically separate auxiliary contacts as specified. Where none are specified two N/O and two N/C auxiliary contacts shall be provided. Shunt trips and electrical stored energy breakers shall be interlocked to prevent repeated operation of the trips or winding mechanisms when the breaker is in the tripped or closed position.

(h) All non-current carrying metal parts of the circuit breaker shall be solidly interconnected and connected to an earth contact which shall engage with a mating contact or copper plate which is connected to the earth busbar of the switchboard. The arrangement shall be such that the circuit breaker frame is earthed in the test position and before the breaker contacts engage the live fixed contacts.

(i) The fixed cradle shall be of high mechanical strength.

(j) The circuit breaker shall have RACKED-OUT, TEST and ENGAGED positions which shall be clearly marked.

(k) The circuit breaker shall bear a clearly legible rating plate indicating the current rating, breaking capacity and voltage rating.

(l) Extension type operating handles shall be fixed to the circuit breaker on completion of the installation.

(m) The circuit breaker shall be designed to allow the incoming terminals to be at the top or bottom without affecting the operation of the unit.

(n) The circuit breakers shall be derated as necessary to compensate for the following environmental factors:

- Maximum ambient air temperature in excess of 40 deg. C or the daily average ambient air temperature in excess of 30 ° C. This is especially important with regard to the type of enclosure in which the circuit breaker is to be installed.
- Height above sea level.
- Operational duty cycle and estimated loading.

(o) The complete circuit breaker and its electrical and mechanical constituents and accessories must be a standard product of a single original manufacturer.

3.11.2 Moulded Case Circuit Breaker

(a) MCB's shall be either Merlin Gerin or CBI but shall be of the same manufacture for the specific project.

(b) The circuit breaker shall be of the single pole or multipole free handle, air break type, housed in a moulded phenolic or glass polyester case and suitable for panel mounting.

(c) The circuit breaker shall comply with the requirements of SABS 156.

(d) Circuit breakers shall be suitable for operation on supply voltages of 380/220 V to 440/250 V, 50 Hz and the rupturing capacity at these voltages, when the circuit breakers are tested in accordance with Clause 7.10 of SABS 156, shall be as specified in the Detailed Technical Specification. D/Spec

(e) The overload and short circuit trips of the circuit breaker may be of the following type to suit the application:

- Combined thermal/magnetic trips with interchangeable trip units, the magnetic trip setting being adjustable.
- Combined thermal magnetic trips with fixed and sealed trip units, the magnetic trip setting being adjustable.
- Combined thermal/magnetic trips with fixed and non-adjustable trip units.
- Hydraulic/magnetic trips with fixed and non-adjustable trip units.
- Solid state controlled trips with interchangeable fixed rating plugs for overload tripping and adjustable magnetic trip settings incorporating a short time delay..
- Solid state controlled trips with interchangeable adjustable rating plugs for overload tripping and adjustable magnetic trip settings incorporating a short time delay.

(f) The tripping times of the circuit breakers shall be in accordance with Clause 4.5 of SABS 156.

(g) The circuit breaker contacts shall be of silver alloy, and arc chutes or magnetic blow-outs shall be provided. The contacts shall close with a high pressure wiping action.

(h) The incoming terminals of single pole miniature circuit breakers shall be suitable for connection to a common busbar. Ganged toggles for circuit breakers will be acceptable, provided that the trip mechanisms are internally linked.

(i) Where specified, the circuit breaker shall be capable of accommodating factory fitted shunt trip or auxiliary contact units or similar equipment.

(j) The operating handle shall provide clear indication on ON, OFF and TRIP positions.

(k) The mechanism shall be of the TRIP-FREE type preventing the unit from being held in the ON position under overload conditions.

(l) Circuit breakers used on any one particular service shall be supplied by a single manufacturer.

(m) The continuous current rating, voltage rating and rupturing capacity of the circuit breaker shall be as required by the equipment and the circuit breaker shall have a rating plate indicating the current rating, voltage rating and rupturing capacity.

(n) Extension type operating handles shall be provided for units of 600 A rating and above.

3.11.3 Earth Leakage Relays

(a) Single phase or three phase earth leakage relays with associated double or triple pole circuit breakers shall be supplied and installed on all circuits feeding socket outlets and other general power circuits in compliance with the Code of Practice for the Wiring of Premises, SABS 0142 and shall conform to SABS 767.

(b) The relays shall operate on the core balance (current balance) principle. The operation shall be independent of mains voltage and shall function with any of the supply conductors (and neutral) disconnected or broken.

(c) The sensitivity and operating response of the relay must be such that instantaneous tripping will occur at a total earth leakage current of 30 mA or more. The unit shall have compensation for ambient temperature variations and the sensitivity and operating response time must be maintained over the range of normal frequency variations. Stability of operation, long life and retention of characteristics are essential.

(d) The unit shall be provided with integral test facilities by means of which the correct functioning of the unit may be tested.

(e) The unit shall withstand fault currents of at least 5 kA or as specified, either between phase and earth, or between phase and neutral, without any damage being caused thereby.

(f) The circuit breaker associated with the earth leakage unit shall be of the double pole (for single phase circuits) and triple pole (for three phase circuits), free handle type, having a rupturing capacity of not less than 5kA. The circuit breaker shall be fitted with a release tripping mechanism and must match with the earth leakage unit.

(g) The circuit breaker and earth leakage relay shall be suitable for operation on a 220/250 V, 50 Hz supply on single phase circuits and 380/440 V, 50 Hz supply on three phase circuits.

(h) The earth leakage unit shall comply fully with SABS 767.

(i) Where specified for wall mounting, the circuit breaker and earth leakage relay shall be mounted in a sheet metal case with anti-corrosion treatment and baked enamel finish.

(j) The earth leakage unit shall be so designed that the case do not saturate and sender unit inoperative when the total harmonic component of the voltage exceeds 2,5%.

3.11.4 Full-load, Fault-making Isolators

(a) Full load, fault-making isolators shall be of the triple pole, hand operated, panel mounting, air break type suitable for operation on 380/440 V,50 Hz systems.

(b) The contacts shall be of silver alloy and the switch mechanism shall be of the quick-make, quick-break type..

(c) The switches shall be capable of opening and closing the full current rating of the switch. The current rating of the switch shall be at least 20% in excess of the full load current of the circuit which the switch will be required to open. In the case of motor circuits the switch shall be capable of breaking the "locked rotor current" of the motor.

(d) The switches shall further be capable of being closed on to a fault. The switches shall be adequately rated to withstand the maximum fault current that can occur at that point in the circuit for a sufficient time to allow the back-up protection (circuit breakers or fuses) to open the circuit.

(e) The switches shall be suitable for mounting behind switchboard panels.

(f) To distinguish the switches from circuit breakers, the operating handle shall have a distinctive colour or other clear indelible indication and shall be clearly labelled "ISOLATOR".

3.11.5 Combination Fuse Switch Units

(a) The fuse switch shall be of the triple pole type in accordance with BS 2510 or BS 3185 as applicable.

(b) The fuse cartridges shall comply with BS 88, Category of Duty AC 16, 33, 46 or 80, suitable for a 415 V 50 Hz system. Category of duty shall be matched to the fault level at the point where the fuses are to be installed.

(c) The fuse switch shall have a hand operated lever and the "ON" and "OFF" positions shall be clearly marked.

(d) Fuse switch units shall be of the double air-break, quick-make, quick-break type and shall have a spring

mechanism smoothly driven by springs on both sides of the mechanism. Fuse gear comprising HRC fuse cartridges carried on the cover, the cover also forming the operating lever, is regarded as a fuse isolator and is not acceptable.

(e) The fuse links must be fully isolated when the switch is in the "OFF" position and interlocks must be provided to prevent the cover or door being opened when the switch is closed and to prevent the switch being operated with the cover open.

3.11.6 Power Fuses and Fuse Holders

(a) High rupturing capacity (HRC) fuses shall comply with the requirements of SABS 172 or BS 88 with a fusing factor of 1,5.

(b) Fuses which are not mounted integrally with switches, shall be mounted on insulated draw-out carriers (holders) which hold the fuses positively after withdrawal. Fuse holders shall comply with SABS 173.

(c) Each fuse link and holder shall incorporate a visual inspection eye for fault location.

(d) Should live terminals become exposed after the withdrawal of fuses, rigid barriers shall be provided between adjacent sets of terminals to prevent accidental contact during withdrawal or insertion of the fuses.

(e) Control circuits shall be protected by suitably rated fuses. Instrument fuses shall be mounted in close proximity to the relevant instrument. These fuses shall be clearly labelled with engraved "IVORENE" or similar strips indicating use, rating and duty.

(f) Striker pin fuses shall be equipped with an alarm contact so arranged that the contact closes and remains closed when the striker pin operates.

(g) Fuses shall be so connected that the live terminal is at the top.

(h) Fuse ratings shall be accurate to within 5% of the published value for unused fuses and shall not vary significantly after long periods of service.

(i) Fuses shall be de-rated for ambient temperatures above 25 °C in accordance with the manufacturer's recommendation. If no such recommendation exists, a de-rating factor of 1 % per deg. C above 25 °C shall be applied.

(j) Fuses shall be de-rated for altitudes of more than 1000 above sea level in accordance with the manufacturer's recommendation. If no such recommendation exists, a de-rating factor of 1 % per 300 m above 1000 m above sea level shall be applied.

(k) Time/current characteristics shall be chosen to suit the application.

- Cable protection: The fusing factor shall not exceed 1,5.
- Motor circuits: Time-lag characteristic shall be such that the starting currents will not cause deterioration of the fuse.
- Capacitor circuits: Fuses shall be chosen to withstand a higher than normal full-load current (1,5 times rated capacitor current) to allow for harmonics and shall not deteriorate due to the high transients at switch-on.
- Distribution systems: The total operating IE2t let through by secondary (minor) fuses shall be less than that of primary (major) fuses in any specific branch.

(l) It shall be ensured that the rupturing capacity of a fuse chosen for a specific application shall be adequate both as far as short circuit current and applied voltage are concerned.

3.11.7 Contactors

(a) Contactors shall be either Telemecanique or Klockner Moeller or an equivalent contactor of another manufacturer approved by the engineer, suitably rated for the application.

All contactors on a specific project shall be of a single manufacturer.

(b) Contactors shall be of the totally enclosed, double or triple pole, electromechanically operated air-break type suitable for 220/250 V or 380/440 V supplies and shall comply with SABS 1092.

(c) The current rating of the contactor shall be as specified for the circuit with a switching duty in accordance with the IEC 158-1, utilisation category AC1 for lighting and power circuits and utilisation category AC3 for motor starting.

(d) The mechanical duty of the contactor shall comply with the specified requirements for Class IV of Clause 5.6 of BS 775.

(e) Contactors shall be suitable to accept clip on auxiliary contact modules and sufficient space shall be allowed on the board layout.

(f) Contactors for motor starters shall be fitted with adjustable thermal overload protection modules with single-phasing sensitivity to IEC 292 - 1C.

(g) Contactors for normal/standby change-over circuits shall be electrically and mechanically interlocked. Contactors shall also be electrically and mechanically interlocked in star-delta starters.

(h) Contactors or motor starters not located in a switchboard shall be housed in a purpose made enclosure of the same manufacture as the contactors to at least IP55.

3.11.8 Control Relays and Timers

(a) All relays and timers shall be either Telemechnique or Klockner Moeller or equivalent of another manufacture approved by the Engineer.

All control devices on a specific project shall be of the same manufacturer as the contactors.

(b) Relays shall be rail mounted and shall be to IEC 159-1, 337 and 255.

3.11.9 Indoor Lightning Arresters

(a) Lightning arresters shall be of the single pole indoor type suitable for mounting in the switchboard and suitable for the protection of domestic electrical appliances.

(b) The arrestors shall conform to SABS 171 and shall be provided when specified in the Detail Specification. D/Spec

(c) They shall be suitable for installation at altitudes of up to 1800 m above sea level.

(d) The arresters shall be suitable for systems with grounded neutral and voltages up to 250 V to earth, and shall comply with the requirements of SABS 171 or VDE 0675.

3.12 Instruments

All instruments specified in the "Detail Specification" shall be provided and installed on switchboards. All such instruments shall be of the following types and shall comply with the specific requirements.

3.12.1 Voltmeters

(a) Voltmeters shall be PCI type Fv voltmeters.

(b) Voltmeters shall be of the moving iron type with Class 1,5% accuracy as specified in IEC 51 and shall be suitable for flush mounting on vertical switchboard panels.

(c) Voltmeters shall be 72 mm square pattern unless specified to the contrary. Voltmeters, ammeters, frequency meters, etc. shall all have the same dimensions for any particular application.

(d) Voltmeters shall be manufactured in accordance with the requirements of BS 89 for industrial grade accuracy. The voltmeters shall be calibrated as specified in the Detail Specification and shall withstand an insulation test voltage of 2 kV AC for 1 minute. D/Spec

(e) Voltmeters shall be fitted with zero adjustment screws.

(f) Voltmeters shall be screened to prevent magnetic interference and shall be fitted with anti-static glass.

(g) Voltmeters shall be protected by suitable 2 Amp fuse to BS88.

(h) Where voltmeters are connected to potential transformers, the ratio of the potential transformer shall be marked on the voltmeter faceplate.

(i) Under certain conditions voltmeters to be supplied shall be of the suppressed zero type and shall be scaled in accordance with the requirement of the switchgear.

(j) Where only one voltmeter is specified, a voltage selector switch shall be provided having four positions marked "Off", "R-B" "R-Y" and "Y-B".

3.12.2 Ammeters

(a) Ammeters shall be PCI type Fa ammeters.

(b) Ammeters shall be of the moving iron type suitable for flush mounting on vertical board panels.

(c) Ammeters shall be manufactured to the requirements of BS 89 with an accuracy which need not exceed 1,5%. Direct reading ammeters up to a maximum of 60 Amp may be used. Current transformer operated ammeters of 5A full scale shall be used to measure large currents. The current transformer ratio shall be indicated on the scale. Full load ratings shall be indicated by a red line. Ammeters shall withstand a test voltage of 2 kV AC for 1 minute.

(d) In the case of ammeters connected into protection circuits, such meters shall be fitted with saturation current transformers in order to protect the meter and associated circuiting. For normal load applications these current transformers shall saturate at 200% of their full load and at 700% on motor load applications.

(e) The applicable requirements set out in Clause 3.12.1 will also apply to ammeters.

3.12.3 Maximum Demand Ammeters

(a) Unless otherwise specified in the Detail Specification ammeters provided on the main incoming cables to switchboards shall be of the maximum demand type with a manual resettable residual pointer to indicate the 15 minute mean maximum current reached during the period between resetting. D/Spec

(b) Maximum demand ammeters shall be PCI type FBIA ammeters.

(c) The requirements of Clause 3.12.2 will also apply to maximum demand ammeters.

3.12.4 Kilowatt-hour Meters

(a) kWh meters shall be provided if specified in the Detail Specification. D/Spec

(b) kWh meters shall be of the LP type Enermax-type with data logging facilities as specified in the Detail Specification. D/Spec

(c) The meter shall be manufactured in accordance with the requirements of BS 37. The meter shall be suitable for operation on a three phase, 50 Hz AC system with Class 2 accuracy.

(d) Up to 80A meters shall provide a direct reading in kWh without the use of multiplication factors.

(e) Over 80A, 5A meters shall be provided with the correct ratio Class 0,2 metering current transformers for the application. An engraved label shall be installed below the meter indicating the factor by which the meter reading shall be multiplied to obtain the correct Kwh value.

(f) Combined kVA/kWh meters shall be provided when specified in the Detail Specification. D/Spec

(g) If required in the Detail Specification the meter shall in addition be equipped with a 30 minute integrated kVA maximum demand indication which shall be ambient temperature compensated and shall have an accuracy of 3%. D/Spec

(h) The Contractor shall provide the Engineer with a Certificate from an approved specialist test authority, who has tested and certified the meter after installation on site including the meter reading at hand over.

3.13 Switches

All switches, selector switches, push button controls, pressure switches, vacuum switches, float switches, limit switches, proximity switches, key switches and lock-out stops shall be either Telemacanique or Klockner Moller or an equivalent manufacture approved by the Engineer, correctly sealed for the application.

All switches for a specific project shall be of the same manufacture.

3.14 Time Switches

Time switches shall be "Theben" or "Merlin Gerin" programmable time switches.

Unless otherwise specified the unit shall be 7 day units with battery back-up. D/Spec

3.15 Labels

3.15.1 General

Labels shall be of the engraved "Trefolite" type.

All indication and descriptive labels shall have black letters on a white background, while danger labels will have white letters on a red background.

Safety warning notices shall appear in both official languages.

All labels shall be mounted in an approved manner by means of screws or rivets. Under no circumstances shall the

labels be glued to the metalwork.

3.15.2 Notices and Warning Signs

All notices and warning signs as prescribed by SABS 0142 and the "Occupational and Safety Act" shall be installed to the satisfaction of the Engineer.

Refer to Clause 1.2.3 and 1.16 of this Specification.

3.15.3 Identification of Conductors

Refer to Clause 3.8.

3.15.4 Identification of Equipment

All equipment on the inside and on the outside of the switchboard shall be identified by means of a label.

The identification number of a contactor etc. shall correspond with the number on the single line diagram or other drawing.

All fuses and fuse switches shall clearly indicate the rating.

The minimum letter size shall be 6 mm.

All remote equipment and motors shall similarly be labelled.

MCCB's shall be labelled with the circuit number on an engraved label and corresponding legend card fully describing the area served.

3.15.5 Identification of Switchboards

All switchboards shall be externally identified by means of labels with the following minimum letter sizes:

Main switchboard	=	32 mm
Sub-switchboards	=	20 mm
Notices and descriptions	=	4 - 6 mm

3.16 Terminal Blocks

Terminal blocks shall be of the "Klippon" type.

All incoming and outgoing wiring shall be terminated on separate terminal blocks.

Terminals and conductors on either side shall be suitably marked.

Terminations of "live" conductors shall be covered to prevent accidental contact and shall be provided with a warning label.

3.17 Earthing

Each switchboard shall be provided with a copper earth bar with minimum dimensions of 25 mm x 6 mm.

The earthbar shall be pre-drilled over its full length at 15 mm centres with holes with a minimum diameter of 5 mm. The above earthbar shall be earthed to the main substation earth.

All exposed instruments shall be effectively earthed to the earthbar by means of copper conductors with a minimum cross-sectional area of 2,5 mm^2, which shall be insulated by means of green PVC insulation. Care shall be taken that the gland plate and screens of all incoming cables be connected to the above earthbar to the approval of the Engineer.

3.18 Bolts and Nuts

Unless otherwise approved all bolts and nuts shall be metric sizes complying with an approved international standard. Terminal bolts or studs used for carrying current of more than 100 Amps shall not be less than 12 mm in diameter. All terminal bolts and studs used for electrical connections with diameter less than 4 mm shall be made from either stainless steel or phosphor bronze. Brass shall not be used.

Self-tapping screws are not acceptable. All bolts, nuts and washers exposed to atmospheric conditions shall be suitably treated to prevent corrosion by means of cadmium plating to the approval of the Engineer.

Bolts and Nuts shall project a maximum of 4 - 8 threads and a minimum of 1 thread through their respective nuts.

3.19 Drawings for Approval

A set of three prints of shop drawings for the manufacturing of the switch board shall be submitted to the Engineer for

approval at least four weeks before manufacturing starts. The following information shall in particular be included:

- A detail general arrangement of the arrangement of the switchboard indicating all equipment dimensions and the construction of the board. The positions and method of fixing and sizes of wiring shall be shown.
- All labelling information in the required languages shall be provided on a separate sheet.
- The make, catalogue number and capacity of all equipment such as isolators, circuit breakers, fuses etc.

The approval of drawings shall not relieve the Contractor of his responsibility to supply the switchboards according to the requirements of this specification and limitations of the building.

4. LOW VOLTAGE CABLES

4.1 General

4.1.1 The following cables shall be used:

(a) 3,3 kV grade paper or PVC insulated, lead sheathed and galvanised steel wire armoured cables (PILCSWA) galvanised to SABS 150 for all supply voltages between 1000V and 3,3 kV.

(b) 600/1000V PVC insulated cables for all supply voltages between 50 V and 600 V.

Only armoured cables shall be used for underground cable runs, whether installed in pipes or laid in the ground. Unarmoured cables may only be used when installed in conduit or enclosed metal ducts along the entire cable route.

All cables installed on the cable trays, in floor trenches, in vertical riser ducts and all cable runs that are partially installed in conduits, underground pipes or metal ducts, shall be fully armoured.

4.1.2 All cables shall comply with the relevant SABS, EDC or NEMA specifications and shall be installed, fixed, protected and terminated in a proper fashion according to approved methods and in accordance with the manufacturer's specifications and the Code of Practice for the Wiring of Premises, SABS 0142. The Contractor shall employ competent staff for the installation of the various cable types.

4.1.3 Cables with conductor sizes of less than 1,5 m^2 shall not be used except for communication or control systems where the supply voltage is less than 50 V. Only cables with copper conductors shall be used unless approved otherwise.

4.1.4 Cable sizes shall be determined strictly in accordance with the relevant tables of the Code of Practice of the Wiring Premises, SABS 0142. Special attention shall be paid to group de-rating factors and cables sized for equipment requiring low voltage drops (especially in the case of motors starting high inertia loads.) Cables spaced apart by a minimum of 2 cable diameters need not be de-rated.

4.1.5 Through joints will not be allowed in cables without the written permission of the Engineer's Representative.

4.1.6 Unless clearly specified to the contrary, each cable run which forms part of the low tension distribution system, and each cable feeding equipment, shall be provided with an earth continuity conductor. The earth conductor size shall be selected in accordance with Table 3 and Appendix H of the Code of Practice for the Wiring of Premises, SABS 0142. No earth continuity conductor shall be less than 2,5 mm^2.

The earth continuity conductor shall consist of:

(a) A separate un-insulated stranded copper conductor installed along the same route as the associated cable, or

(b) one of the cable conductors, or

4.1.7 The armouring of an armoured cable shall be connected to the earth continuity conductor at both cable ends and at all joints. The cross sectional area of the armouring at joints shall not be reduced and shall be made continuous across joints.

4.2 Paper Insulated Cables

4.2.1 Paper insulated cables shall comply with SABS 97 and shall be of the (PILCSWA) mass-impregnated or pre-impregnated non-draining belted type. The conductors shall be of copper.

4.2.2 All joints and terminations shall be made either by means of compound filled boxes or by means of epoxy resin materials. Epoxy resin joints and terminations shall be made entirely in accordance with the manufacturer's instructions and with the materials stipulated.

4.2.3 If a cable is cut and will be exposed to the atmosphere for more than 2 hours, the cable ends shall be sealed and wiped to prevent the ingress of moisture.

4.3 PVC Insulated Armoured Cables

4.3.1 All PVC/SWA/PVC cable shall comply with SABS 150/1970 and shall consist of PVC insulated copper conductors, PVC bedding, galvanised steel wire armouring and an extruded PVC outer sheath.

4.3.2 Cable ends shall be terminated in approved cable glands to ensure a moisture proof connection between the outer sheath, gland and equipment.

In cases where copper earth conductors are included in the armouring (ECC/SWA cables), special glands in accordance with SABS 150 par. 5.8.3 (c) shall be used.

4.3.3 Cable glands shall be of the type in which the armouring is clamped between tapered cones, tightened down and fitted to a cable gland plate or equipment housing by means of locknuts.

4.3.4 A neoprene shroud shall cover the gland externally and form an effective seal with the outer sheath of the cable.

4.4 XLPE Cables

4.4.1 XPLE cables will only be allowed with the prior written approval of the Engineer's Representative.

4.4.2 Joints and terminations shall be made entirely in accordance with the manufacturer's instructions and with the materials stipulated in such instructions.

4.5 Installation of Cables

4.5.1 Lugs shall be crimped to cable core ends using mechanical or hydraulic tools designed for this purpose. Evidence may be requested that the crimping method used complies with the performance requirements of BS 4579, Part 1: "COMPRESSION JOINTS IN COPPER" Cables that are connected to clamp type terminals where the clamping screws are not in direct contact with the conductor, need not be lugged but the correct terminal size shall be used. Contact surfaces shall be thoroughly cleaned and smoothed and fixing bolts shall match the hole size of the lug.

4.5.2 Medium tension cables (voltages in excess of 600V phase to earth) shall be installed away from other cables in separate sleeves or ladders.

4.5.3 Single core cables for 3 phase supplies shall be installed in trefoil formation, with cables being in physical contact and tied together at 0,5 m intervals with 10 layers of 3M fibre glass tape.

4.5.4 Cables in floor trenches shall not be bunched in random fashion but shall be installed parallel to each other. All floor trenches shall be covered with chequer plate.

4.5.5 The internal radius of a bend of a cable shall not be less tan 12 times the overall diameter in the case of a paper insulated or XLPE cable and not less than 10 times the overall diameter in the case of a PVC insulated cable.

4.5.6 Parallel cable runs on cable trays, etc. shall be separated by a minimum of 2 cable diameters unless otherwise specified.

4.5.7 Where cable clamps are used, they shall be of non-combustible material and shall be of the correct size for the cable.

4.5.8 All cables shall be marked at both ends and at all joints by means of non-corroding metal bands with punched or raised numbers. The numbers shall appear on the "as installed" drawings.

5. CABLE TRENCHES AND SLEEVES

5.1 Cable Trenches

5.1.1 Excavations, cable trenches, bedding backfilling, compaction and reinstatement of surface shall be in accordance with Standard Specification A-SPEC-04-04: Excavation Works.

5.1.2 The requirements can be summarised as follows:

- LT cables buried in ground shall be installed in a cable trench at a depth of 800 mm below final ground level which has been excavated, back filled and compacted in accordance with this specification by the electrical contractor.
- Trenches for single cables shall be 350 mm wide.
- Where more than one cable is installed in a trench, the cables shall be at least 100 mm apart.
- Cable warning tape shall be installed 300 mm above the cables.
- A bedding layer of sifted topsoil 75 mm deep shall be placed underneath and on top of the cables in all excavated trenches.
- All trenches shall be inspected and approved by the engineer before laying of cables with bottom bedding in place as well as after the cables have been installed with the top bedding in place. No trench shall be backfilled

unless the above inspections were carried out and the trenches approved by the engineer.

Hold/p

- Backfilling of the trenches shall be in layers of 200 mm and compacted to 95% in accordance with AASHTO/SABS 1200D. The classification for "SOFT GROUND" will be accepted to apply, unless witnessed and certified by the Engineer to the contrary.

- Sufficient cable markers shall be provided to identify the cable route.

5.2 Manholes

Unless otherwise specified manholes for low tension cables shall be in accordance with "Concrete Manhole Installation Manual" of the Concrete Society of South Africa and shall be of the pre-cast type with a diameter of 1 m for a maximum depth of 2 m.

5.3 Sleeves

Cable sleeves shall be either PVC or KABELFLEX sleeves, as specified in the Detail Specification. D/Spec

5.3.1 PVC Sleeves

PVC cable sleeves shall be 110 mm uPVC pressure pipes to SABS 966 Class 4 similar to DUROFLO with LYNG type smooth joints.

Only slow bends with a bending radius/sleeve diameter of 10 will be acceptable.

5.3.2 Kabelflex (Nex Tube (Pty) Ltd)

When specified in the Detail Specification for compression resistance such as under road ways or other reasons KABELFLEX to DIN 16961 shall be installed for sleeves

D/Spec

6. WIRING, CONDUITS AND ACCESSORIES

6.1 Wiring

6.1.1 All wiring used shall be 600/1000 V PVC insulated, single core multi stranded copper conductors and green PVC insulated copper conductors for earth continuity (no bare stranded copper) and shall be compounded and stabilised to comply with SABS 175.

6.1.2 All conductors shall be installed in wire ways, cable channels or power skirting of metal unless otherwise approved. Exposed conductors at any point will not be allowed.

6.1.3 Conductors from different switchboards may not be installed in the same wire way or cable channels. The number of conductors in a conduit shall comply with the requirements of SABS 0142.

6.1.4 The combined total cross-sectional area (including insulation) of conductors installed in enclosed cable channels may not exceed 40% of the cross- sectional area of the channel.

6.1.5 Conductors for power, control DC supply, telephone and other services shall be installed in separate conduits for each separate service or system. Conductors for power and control of motor circuits only may be run in the same conduit, provided the insulation of the control wiring is of the same voltage grade as that of the power wiring.

6.1.6 Conductor sizes shall be determined strictly in accordance with the relevant tables for current ratings and voltage drops as listed in SABS 0142.

Generally the following will apply unless otherwise specified:

Circuit	Power Conductor	Earth Conductor
Lighting	2,5 mm²	2,5 mm²
Power	4,0 mm²	2,5 mm²

6.1.7 Only insulated earth wires will be accepted unless bare earth conductors have been approved by the Engineer in writing.

6.1.8 A loop-in system of wiring shall be followed for outlets or equipment on the same circuit. Joints in conductors will not be allowed.

Not more than 2 ends will be allocated at any outlet point.

6.1.9 Where the conductors of more than one circuit are present in wire ways, cable channels or power skirting, the conductors of each circuit (including earth conductors) shall be taped together at intervals of 1m. The conductors of the various

circuits shall, however, be separate in order that any circuit can be withdrawn.

Circuits are to be marked at 3 m intervals when installed in trunking and/or power skirting.

6.1.10 Circuits of different phases may not be present in the same outlet box, switch box or connection point except where three phase equipment is installed.

6.1.11 The colour of conductors shall be as follows:

Normal power:

3-phase	=	Red/White/Blue
Single-phase	=	Red
Neutral	=	Black
Earth	=	Green
Emergency power	=	Purple
UPS Power	=	Brown
Return circuit from lights	=	White

6.1.12 Conductors installed in vertical conduit or cable duct runs shall be clamped at intervals not exceeding 3 m. The clamps shall be installed in suitable accessible draw-boxes.

Clamps are to be of durable insulating material that cannot damage insulation of conductors.

6.1.13 Terminations of conductors

Where earth conductors are installed according to a loop system, all looped connections shall be ferruled to avoid breaking earth continuity when the conductors are removed from any such terminals. Termination to be on body of outlet box with tail piece to accessory.

The conductor insulation shall only be removed sufficiently for full insertion into the terminal. Bare conductors shall not be visible. (No insulation tape will be allowed).

Conductor strands may not be cut away under any circumstances.

Crimped lugs shall be used for terminations to equipment such as motors and terminal blocks.

Wire end ferrules are to be used at all screwed connections.

6.1.14 Wiring conductors shall not be installed until the entire conduit or wire way for the circuit has been completed and cleaned.

6.2 Wiring Accessories

6.2.1 Mounting Height

Except where otherwise specified, mounting heights shall be as indicated below.

The dimension given is the measurement from the centre of the fitting or outlet box above the finished floor level.

Light switch	=	1400 mm
Socket outlet	=	300 mm
Telephone outlet	=	300 mm
Socket outlets in kitchens	=	1250 mm

6.2.2 All outlets shall be of the flush mounted type unless otherwise specified. All wall and floor outlet boxes shall be galvanised. Unless otherwise specified the colour of cover plates shall be standard "ivory".

6.2.3 Fittings shall be mounted square without openings under cover plates.

6.2.4 Fittings shall have protected terminals for safe wiring.

6.2.5 Approved manufacturers are: "CRABTREE", "LUMEX"

6.2.6 Socket Outlets

SABS 164-2 shall apply.

The Contractor shall obtain a directive from the Engineer as to whether IEC 906-1 (European Type) socket outlets shall be used for the project.
D/Spec

6.2.7 Light Switches

(a) Switches shall generally be mounted adjacent to entrance doors inside the room served 150 mm from the door frame on the side containing the lock.

(b) Switches shall be mounted in 100 x 50 x 50 mm outlet boxes.

(c) Switches shall be of the rocker operated micro-gap type rated for 16A, 250 V with yoke strap and earth terminal to SABS 163 and SABS 1085.

(d) One switch per circuit with a maximum of three switches per outlet box shall be installed.

6.2.8 Watertight light switches

Watertight switches shall be of heavy duty totally enclosed construction with threaded connection for direct conduit entry.

6.2.9 Flame Proof Light Switches

Refer to Detail Specification D/Spec

6.2.10 On Load Isolators

Isolators shall be of the on load type, panel or box mounted and shall have silver alloy contacts with quick make/break mechanism.

The rating shall be at least 20% in excess of the full load current of the circuit that is to be switched.

In the case of motor circuits, the isolator shall be capable of breaking the locked rotor current of the motor.

Isolators must be clearly distinguished from circuit breakers by distinctive colour of handle and clearly labelled "Isolator" and must conform with SABS 0142.

6.2.11 Photo Cells

The photo cells shall be of the Royce Thompson type, with a current rating of 16A. The units shall be supplied and installed complete with base.

6.2.12 Emergency Stop Stations

The emergency stop station shall be of the push button type with twist release.

All emergency stop stations shall be either Telemecanique or Klockner Moeller or equivalent, approved by the Engineer.

6.2.13 Fireman's Isolator

The fireman's isolator will be a red, double pole isolator with a 20A current rating.

The isolator will be to the approval of the Engineer.

6.2.14 Power Sockets

The power sockets will be preferably of the AMPCO type or as specified in the Detail Specification D/Spec

6.2.15 Motor Protection Units

All motor protection units shall be of the Telemecanique or Klockner Moeller type. Refer to Detail Specification D/Spec

6.3 CONDUITS

6.3.1 Screwed steel conduits

Unless otherwise specified all conduits shall be welded seam thick wall screwed steel conduits with baked enamel or powder coated factory finish and shall comply with SABS 1065 (Type A).

All visible threads to be treated with approved coating to prevent rust.

6.3.2 Plain-end steel conduits

The uses of these alternative systems are subject to the following conditions:

(a) Only if permitted in the Detail Specification or with the written approval of the Engineer. D/Spec

(b) Conduits shall be manufactured out of mild steel with a minimum thickness of 0,9 mm and shall be in accordance with SABS 1065 (Type B).

(c) Bending and setting shall only be special bending apparatus approved by the manufacturer of the conduit.

(d) The same approved unscrewed conduit system shall be used throughout.

(e) All joints shall be strictly in accordance with the Manufacturer's Specifications.

6.3.3 Galvanised Conduits

(a) Galvanised conduits and fittings shall be used under the following circumstances:

- In areas exposed to the weather
- For surface mounted conduits installations in kitchens, boiler rooms, air conditioning plenum chambers, basements or damp areas.
- Where steel conduits are required for installations within 50 km from the coast.

(b) Conduit and accessories for the above applications shall comply with SABS 1065 and shall be hot-dip galvanised to SABS 763.

6.3.4 Rigid Non-Metallic Conduits

(a) UPVC conduits may only be installed under the following circumstances.

- When specified in the Detail Specification or with the written approval of the Engineer. D/Spec
- For surface mounted electronic systems such as smoke detection etc.
- Conduits and fittings shall be to SABS 950.

(b) UPVC conduit systems shall be used for all installations within 50 km from the coast unless galvanised conduits have specifically been specified. D/Spec

(c) UPVC conduits may not be used under the following conditions:

- When exposed to direct sun.
- In case of mechanical load bearing.
- When subject to temperature below -10NC or above 70NC.
- Where conduits may be subject to mechanical damage such as in concrete slabs and columns.

(d) Joints and couplings shall be glued and only moulded screw fittings may be used.

(e) An earth conductor shall be provided for earth continuity.

6.3.5 Flexible conduits

(a) In substations where equipment is moved during normal operation, or in the case of connection to motors or other vibrating equipment, or connections to stoves and other kitchen equipment or where otherwise specified, flexible conduit shall be used for the final connection to the equipment.

(b) Only "COPEX" or "REYROLLE ADAPTAFLEX" flexible conduits with taper screwed connectors will be acceptable.

6.3.6 Aluminium Sheated Conductors: ("Surfix")

(a) Surfix conductors may be used under the following conditions:

- When specified and with the written approval of the Engineer. D/Spec
- For connections to small equipment with sufficient loops to allow for vibration or movement.
- Provided that all fittings are of the same approved manufacturer.

6.3.7 Conduit Accessories

(a) Where galvanised conduits are used all conduit accessories shall also be galvanised.

(b) All accessories shall be compatible with the conduit and wiring system used.

(c) All outlet boxes and draw boxes shall be of the inspection type. Inspection type bends and T-pieces will not

be allowed without the Engineer's approval.

6.3.8 Installation

(a) Position of outlets

It is the responsibility of the Contractor to ensure that all outlet boxes are correctly positioned for the specified purpose.

(b) Continuity

Mechanical and electrical continuity shall be maintained throughout the conduit installation, but under no circumstances shall the conduit be relied on for earth continuity.

(c) Draw wires

Galvanised steel wire (0,9 mm dia) shall be installed in all unwired conduits.

(d) Bends

Only two 90N bends or equivalents angular displacement will be allowed between draw boxes and/or outlets. All bends shall be made cold without flattening the conduit. The inner radius of a bend shall be at least three times the outside diameter of the conduit.

(e) Prior to and during installation conducts shall be kept clean and dry. Open ends shall be plugged with stoppers (Paper, PVC etc. not allowed).

(f) Prior to wiring conduits shall be cleaned.

(g) All conduit ends shall be reamed and free of burrs.

(h) Exposed threads, damaged painting and damaged galvanising shall be repaired immediately with an appropriate protective coating to the Engineer's approval.

(i) The Contractor shall allow for the installation of sufficient draw boxes and these shall be placed in positions where access will remain possible after completion of the building.

(j) Conduits cast into concrete

- The Contractor shall ensure that all conduits and accessories are placed into position timeously not to delay the main contractor.
    - Deep type conduit boxes in slabs and rear entry concrete boxes in hollow block construction shall be used.
    - Elbows for conduits of 32 mm and smaller and sharp bends will not be allowed.
    - Conduit shall be installed as close to the neutral axis of the beam, slab or column as possible.
    - Conduit shall be fixed to the reinforcing steel or shuttering to prevent movement during the casting of concrete.
    - All outlet and draw boxes shall be firmly fixed to the shuttering. Wire fixings will not be accepted in the off-shutter concrete finishes. All boxes shall be tightly packed with wet paper before fixing to the shuttering.
    - Steel conduits may not be installed in floor slabs of boiler rooms, laundries and other damp areas.
    - Within two days of removal of the shuttering, all draw boxes shall be inspected and cleaned and draw wires shall be installed. Should there be draw boxes or conduits that are blocked or have been omitted, alternative arrangements shall immediately be made by the Contractor, subject to these alternative methods routes being to the approval of the Engineer's representative.
    - Steel conduits cast in surface beds shall be installed on top of the plastic damp coarse or above reinforcing steel. Conduits to be spaced in concrete to allow aggregate to easily pass through.

(k) Conduits in Screeds

- The upper surface of conduits installed in screeds shall be at least 20 mm below the final surface. A minimum distance of twice the outside diameter of the conduit shall be allowed between adjacent conduits in screeds. Conduits shall be fixed to the slab at intervals not exceeding 2m before the slab is screeded.

(l) Expansion Joints

Where a conduit crosses an expansion joint, an approved type of expansion draw box shall be provided.

The expansion draw box shall be installed adjacent to the expansion joint. A conduit sleeve, one size larger than that specified for the circuit, shall be provided on the side of the draw box nearest to the joint. One end of the sleeve shall terminate at the edge of the joint and the other shall be secured to the draw box by means of locknuts.

The circuit conduit passing through the sleeve shall terminate 40 mm inside the draw box and the conduit ends shall be fitted with a brass bush. The gap be sealed with silicon sealer to prevent the ingress of wet cement.

(m) An earth connection which shall be bonded to the box by means of 2,5 mm² bare copper earth wire and a brass bolt and nut.

Expansion draw boxes shall be provided with sheet metal covers and screws.

Where the number of conduits run in parallel they shall transverse the expansion joint via a single expansion draw box, or by means of separate boxes placed not closer than 700 mm to each other.

(n) Conduits built into walls

The Sub Contractor shall co-ordinate such activities with the Principal Contractor since no cutting of plastered walls will be allowed.

(o) Chasing walls for conduits

The chasing of walls for the installation of conduits will only be allowed under the following conditions:

- Face brick walls may not be chased.
- Brickwork already plastered may only be chased with the written approval of the Engineer.
- The Contractor shall be responsible for all chasing and fixing of conduits and outlet boxes.
- The minimum plaster cover over conduits shall be 20 mm.

(p) Surface installations

Offsets
Where crossovers of conduits are unavoidable, offsets shall be made in one of the conduits only and shall be symmetrical and as short as possible and secured on either side of the cross-over.

Steel conduits shall be installed in accordance with Clause 5.4.2 of SABS 0142 and secured with steel saddles (not plastic clip fasteners) at least at 2 m spacings and at least 150 mm from a bend or outlet/draw box and at 3 m spacings in ceilings.

Saddles for galvanised conduits shall also be galvanised.

Rigid Non-Metallic conduits shall be installed in accordance with Clause 5.4.3 of SABS 0142 and secured with PVC saddles at 1 m spacings and 1,5 m in ceilings (Poly clips not allowed).

Aluminium sheathed conductors (surfix) shall be fixed at 500 mm spacings with P-saddles (not PVC polysaddles).

6.3.9 Termination of Conduits

(a) Steel conduits shall be terminated by means of either two lock nuts and a brass female bush or by means of a conduit coupling external to the outlet box, trunking etc. and a brass male bush.

(b) Holes shall be the correct size to accommodate bushes and conduit ends without excessive tolerance.

(c) PVC conduits and surfix conductors shall be terminated by means of fittings approved by the manufacturer with the necessary glands, lock-nuts etc.

7. TRUNKING, POWERSKIRTING AND FLOOR DUCTS

7.1 Wiring Channels (Trunking)

7.1.1 Wiring channels shall be performed galvanised sheet metal channels and all fittings such as bends and junctions shall be factory made with radius corners by the same manufacturer. Covers shall be performed galvanised sheet metal.

7.1.2 Wiring channels shall be "O-line Series O-L" or equal with the following minimum thickness:

1mm for unribbed channels with a maximum width of 42mm
1,2 mm for unribbed channels with a maximum width in excess of 42 mm

1,6 mm for ribbed channels with a maximum width of 42 mm cast into concrete
2,5 mm for unribbed channels with a maximum width in excess of 42 mm cast into concrete.

7.1.3 Exposed wiring channels shall be powder coated in the colour specified in the Detail Specification. D/Spec

7.1.4 Adjoining lengths shall be correctly aligned and securely joined by means of fishplates fixed by mushroom bolts, washers and nuts or connection pieces that are pop-riveted to both adjoining sections. All adjoining sections shall be rectangular and butt tightly. Covers shall fit tightly across the joint. All bolts and rivets shall be of the correct length and thickness without sharp internal protrusions to prevent damage to conductors.

Where channels cross expansions in the concrete, suitable expansion joints shall be provided in the channels by means of fishplates pop-riveted or screwed to the channel on one side of the expansion joint and floating freely in the channel on the other side of the expansion joint. (Bonding across joint).

7.1.5 All channels up to 125 mm wide shall have snap-in cover plates of metal or PVC. Cover plates for wider channels shall be of metal and shall be fixed by means of screws spaced at suitable intervals to prevent warping. The finish of the covers shall match the finish of the channel.

7.1.6 All conductors in inverted cable channels shall be retained by means of metal clips or metal spacer bars at not less than 1 m centres.

7.1.7 All wiring channels shall be sealed and vermin proof after installation.

7.1.8 Electrical and mechanical continuity shall be maintained throughout the channel installation. A copper bonding strip shall be placed across each expansion joint and secured to both adjoining channels by means of brass bolts and nuts. The channel shall be bonded to the earth bar of the associated switchboard.

7.1.9 The inside edges of all joints shall be smooth with no sharp protrusions inside which can damage the conductor insulation.

7.1.10 Separate channels for different services shall be provided.

7.1.11 Where vertical channel lengths exceed 5 m, conductors shall have intermediate fixings.

7.1.12 Channels shall be large enough to ensure that the combined total cross-sectional area (including insulation) of all conductors does not exceed 40% of the cross-sectional area of the channel.

7.1.13 The Contractor shall supply and install all hangers, supports or fixings for the channels. Channels up to 76 x 76 mm shall be supported at maximum intervals of 2 m and larger channels at maximum intervals of 2,4 m provided that there are at least two supports between joints.

7.1.14 Where channels are cast into the concrete, reinforced types (ribbed) shall be used. Additional spacer blocks shall be used where necessary to prevent channels from being bent when the concrete is cast. Channels shall be filled with polystyrene or other suitable fillers to prevent the ingress of cement and shall be securely fixed in position to the shuttering.

7.1.15 Where channels pass through walls a cover not more than 500 mm shall be built in and the wall shall be sealed around the channel as a fire barrier.

7.1.16 All conduit connections shall be terminated by means of two locknuts and a brass female bush. All holes through which conductors pass shall be equipped with grommets.

7.1.17 Punch-outs

The Contractor shall study the drawings to ensure that, where required, more than the standard number of pre-punched openings for sockets outlets to light fittings is provided by the manufacturer. (Additional surface mounted outlets shall only be as approved by the Engineer.)

7.2 Power Skirting

7.2.1 Until the Engineer has issued a Form C for power skirting the Electrical Contractor remains fully responsible for the power skirting and any other sub-contractor shall only work inside the power skirting under his supervision.

7.2.2 Type

The type of power skirting and number of compartments shall be as specified in the Detail Specification.
D/Spec

7.2.3 Finish

Unless a specific colour has been specified in the Detail Specification the colour of the cover plates and visible sections of duct shall be one of the standard PLASCON powder coating range of colours and shall be confirmed with the Engineer prior to orders being placed. D/Spec: Hold point

A sample of the finished power skirting shall be submitted to the Engineer for approval prior to manufacture. Hold point

7.2.4 Expansion Joints

Appropriate provision shall be made in the power skirting installation for movement of the structure at expansion joints. No single section shall be fixed to the wall over such a joint. Proposals as to the method for compensating for expansion shall be submitted to the Engineer. Hold point

7.2.5 Covers

The covers shall be manufactured in modular lengths, as specified in the Detail Specification or otherwise in 1 m lengths and shall be secured to the wall channel by means of toggle or swivel nuts. Snap-in covers are also acceptable.

D/Spec

At the building module lines, covers of specified length or otherwise in 250 to 500 mm lengths shall be installed, against which partition walls may be installed, thereby trapping these covers. The removable modular covers shall be installed between these "fixed" covers.

7.2.6 Conduit connection to power skirting

Conduits of 32 mm dia shall be used for connections to power skirting.

All conduit couplings to power skirting shall be done by means of the Plantech design

Draw boxes or conduit connections behind the power skirting is not acceptable.

7.3.7 Installation

Each section of power skirting shall be earthed and bonded with a 2,5 mm² earth conductor. No cutting by hand of any power skirting on site shall be accepted.

All conductors shall be installed in power skirting with a loop allowing sufficient slack for additional outlets. Power skirting shall be mounted 10 mm above the finished floor to allow for floor finishes at a later date.

Factory made end covers shall be installed at the ends of all runs of power skirting. All internal and external bends or offsets shall be factory made.

Power skirting and covers shall be supplied to site with a protective plastic covering which shall remain in position till completion to protect the finish.

7.3.8 Services

Unless otherwise specified the top compartment shall be wired for power outlets, the central compartment/division for low tension/data and the bottom compartment for telephone.

Standard 13A or 16A, 3 pin flush switched socket outlets (100 x 50 nominal size) shall be installed in positions indicated on the drawings.

The switched socket outlets shall be secured to the channel by means of brackets.

7.3 Floor Ducts

7.3.1 General

Until the Engineer has issued a Form C for floor ducting the Contractor remains fully responsible for the floor ducting and any other contractor or Telkom shall only work inside the power skirting under his supervision.

Type

The type of floor ducting and number of compartments shall be as specified in the Detail Specification.

Floor Service Boxes and Outlet Pedestals

Unless otherwise specified the cast aluminium pedestals of ELECTRODUCT type shall be installed in the positions indicated on the drawings. D/Spec

Each outlet box shall be fitted with the number of 15A S/Sockets as specified and cover plates shall be installed for telephone and data outlets. D/Spec

Samples of complete pedestals and flush mounted service outlet boxes shall be submitted to the Engineer prior to orders being placed. Hold point

Flush covers for future extensions are to be installed on all spare outlet positions.

Unless otherwise specified cut-outs for outlets shall be provided at 1,5m intervals.
D/Spec

7.3.2 Installation

Conduit connections to floor ducts shall only be made at purpose made draw boxes with access panels.

Connections between floor ducts and power skirting shall be done by means of "Mod-U-Duct" connection boxes of ELECTRODUCT.

Floor ducts shall be installed on a bedding layer provided by the Builder of at least 20 mm to level all ducts. After the ducts have been fixed in position the builder shall lay the screed up to the floor duct in one operation with a strength of at least 20 mPA/28d. The Contractor shall seal all openings during the building process and shall clean all ducts with a vacuum cleaner prior to wiring.

8. CABLE SUPPORTS

8.1 Cable Trays and Ladders

8.1.1 The Contractor shall supply and install all cable trays or ladders as specified or as required by the cable routes including the necessary supports, clamps, hangers, fixing materials, bends, angles, junctions, reducers, T-pieces etc.

8.1.2 Metal cable trays shall be manufactured from perforated rolled galvanised steel unless otherwise specified. Only factory manufactured accessories such as bends, reducers, droppers, tees, etc. of the same make as the cable trays may be used. Metal trays manufactured to the following standards shall be used:

(a) Less than 150 mm wide - 1,0 mm minimum thickness with 12 mm minimum return

(b) 150 mm to 457 mm - 1,2 mm minimum thickness with 19 mm minimum return

(c) 460 mm to 610 mm - 2,5 mm minimum thickness with 76 mm return

The upstands or trays listed in (a) and (b) shall not be perforated and the top of the upstand shall be smooth. The same cable tray type shall be used in long parallel tray runs.

8.1.3 Metal cable ladders shall consist of a 76 mm high side rail of 2 mm minimum thickness similar to O-Line medium duty. Cross pieces channel section shall be spaced at maximum intervals of 375 mm. Where cables of 10 mm² or smaller are installed on cable ladders, the spacing of the cross pieces shall be 125 mm. Cables shall be clamped in position by means of purpose made cable clamps that fit into the cross pieces. Cross pieces consisting of slotted metal rails which accommodate plastic or metal cable binding bands, may be used in vertical cable runs against walls etc. where the prior approval from the Engineer has been obtained. These cross pieces are not acceptable in horizontal cable runs.

Purpose-made hot dipped galvanised and bolted cable trays consisting of 6 mm angle iron and 6 x 40 mm minimum cross pieces are acceptable in industrial applications. Cross pieces shall be welded in pairs at 250 mm maximum centre-to-centre intervals. The pairs shall be spaced approximately 10 mm apart to allow cable clamps or metallic binding bands to affix the cables to the tray along the full length.

8.1.4 Rigid unplasticised PVC cable trays are acceptable. Only the following tray types may be used:

(a) Less than 250 mm wide - 3 mm minimum thickness and 40 mm minimum return

(b) 250 mm and wider - 4 mm minimum thickness and 60 mm minimum return.

8.1.5 Metal cable trays and ladders shall be finished as follows:

(a) In coastal areas

Hot-dip galvanised to SABS 763 or epoxy powder coated.

(b) False ceiling voids

Electro galvanised or epoxy powder coated.

(c) Vertical Building ducts
Hot-dip galvanised to SABS 763 or epoxy powder coated.

(d) Plant rooms, substations, service tunnels, basements
Electro galvanised or epoxy powder coated.

(e) Damp areas, exposed to weather
Hot-dip galvanised to SABS 763 or epoxy powder coated.

(f) Undercover industrial applications
Hot-dip galvanised to SABS 763 or epoxy powder.

The above mentioned finishes shall apply unless specified to the contrary in the Detailed Technical Specification. Hot-dip galvanised or electro-galvanised trays and ladders shall be cold galvanised at all joints, as well as sections that have been cut and at places where the galvanising has been damaged. Powder coated trays and ladders shall likewise be touched up at joints, cuts and damaged portions using spray canister recommended by the manufacturer of the trays and ladders.

8.1.6 Trays shall be supported at the following maximum intervals

(a)	1,2 mm to 1,6 mm thick metal trays with 12 to 19 mm return	1 m maximum spacing
(b)	2,5 mm thick metal trays with 76 mm return	1,5 m spacing
(c)	O-Line cable ladder with 76 mm side rail of 2 mm thickness	1,5 m spacing
(d)	Metal cable ladders other than (c) above including site manufactured angle iron types	1 m spacing
(e)	3 mm thick PVC trays with 40 mm return	1 m maximum spacing
(f)	4 mm thick PVC trays with 60 mm return	1,5 m maximum spacing

In addition to the above spacing on the longitudinal run, trays and ladders shall be supported at each bend, offset and T-junction.

8.1.7 Joints shall be smooth and without projections or rough edges that may damage the cables. The Contractor will be required to cover joints with rubber cement or other non-hardening rubberised or plastic compounds if in the opinion of the Representative joints may damage cables. Joints shall as far as possible be arranged to fall on supports. Where joints do not coincide with supports, joints shall in the case of trays with single returns (items (a) to (c) of Clause 5.1.2) be made by means of wrap around splices of the same thickness as the tray and at least 450 mm long. The two cable tray ends shall butt tightly at the centre of the splice and the splice shall be bolted to each cable tray by means of at least 8 round head bolts, nuts and washers.

Splices shall have the same finish as the rest of the tray.

8.1.8 Trays shall be bolted to supports by at least two round head bolts per support. Bolts shall be securely tightened to avoid cables being damaged during installation.

8.1.9 The supports for cable trays and ladders shall in all cases be securely fixed to the structure by means of heavy duty, expansion type anchor bolts. It is the responsibility of the Contractor to ensure that adequate fixing is provided since cable trays and ladders that work loose shall be rectified at his expense.

8.1.10 Horizontal and vertical bends, T-junctions and cross sections shall be supplied by the Contractor. The dimensions of these connections shall correspond to the dimensions of the linear sections to which they are connected. The radius of all bends shall be 1 m minimum. The inside dimensions of all horizontal angles or connections shall be large enough to ensure that the allowable bending radius of the cables is not exceeded. Sharp angles shall have 45N cornices.

8.1.11 Cables shall be installed adjacent and parallel to each other on the trays with spacings as determined by the current ratings. Horizontal trays and ladders shall in general be installed 450 mm below slabs, ceilings etc., to facilitate access during installation.

8.1.12 All metal trays and ladders shall be bonded to the earth bar of the switchboard to which the cables are connected. Additional bare copper stranded conductors or copper tape shall be bolted to the tray or ladder where the electrical continuity cannot be guaranteed.

8.2 Shafts

8.2.1 The shafts as shown on the layout drawings will be provided for vertical cable routes.

8.2.2 Cables shall be supported and clamped at maximum spacings of 1 m.

8.2.3 Fire Seal

The Contractor shall seal all openings of sleeves and shafts between floors with FYRO LASTIC (Fultons Tel.: 011-976-3063) as follows:

Cut to size and fit 50 mm thick 160 density minimal wood board and fit into the electrical duct around cables.

Coat the minimal wood board on both sides with FYRO LASTIC to a dry film thickness of ±3 mm.

Coat cables and surround of opening for 500 mm from seal.

9. LIGHT FITTINGS

9.1 General

9.1.1 Luminaires, associated equipment and control gear shall be new and unused and shall be supplied complete with lamps, control gear, diffusers, mounting brackets, etc. as applicable and shall be delivered to site in a protective covering.

9.1.2 Lamps shall be delivered separately.

9.1.3 Tenders shall be accompanied by full descriptive information of the luminaires offered. Photometric data, i.e. polar curves and co-efficient of utilization certified by the SABS shall be submitted with tenders for all luminaires offered.

9.1.4 Only makes and model numbers specified in the Detail Specification will be acceptable. Other makes may only be offered as an alternative after approval by the Engineer of a sample. D/Spec

9.1.5 The mounting positions of luminaires shall be verified on site. All luminaires shall be placed symmetrically with respect to architectural features.

9.1.6 Lamps and luminaires shall be standardized as far as possible regarding manufacturer and type.

9.2 Fluorescent Luminaires

9.2.1 General

9.2.1.1 Tubular fluorescent lamp luminaires shall comply fully with SABS 1119 as well as the additional requirements of this specification and shall bear the SABS mark.

9.2.1.2 The Engineer reserves the right to have samples of luminaires offered tested by the SABS for compliance with SABS 1119 at the cost of the Contractor.

9.2.2 Construction

9.2.2.1 The luminaire shall consist of a ventilated body manufactured of cold rolled sheet steel not less than 0,8 mm thick, suitably braced or stiffened to prevent distortion.

9.2.2.2 The luminaire body shall be designed to accommodate the control gear, wiring, lamp holders and, where applicable, the diffuser. It shall be possible to reach the control gear without disconnecting wiring or removing the luminaire.

9.2.2.3 Suitable knockouts shall be provided in the rear of the luminaire body for wire entry.

9.2.2.4 All components, including screws, bolts and nuts utilised in the construction of the luminaire or fixing of its components, shall be corrosion proof.

9.2.3 Internal Wiring

9.2.3.1 Luminaires shall be completely wired internally. Conductors shall be protected with grommets where they pass through holes in the body.

9.2.3.2 The wiring shall be totally enclosed to prevent any possible contact with live components while changing lamps.

9.2.3.3 The Conductor insulation shall be rated to withstand the temperature inside the luminaire body without deterioration.

9.2.3.4 The wiring shall terminate on a suitable terminal block. There shall be no joints in the internal wiring.

9.2.3.5 An earth terminal, welded to the luminaire body, shall be provided. To ensure good earth continuity the earth terminal shall not be spray painted. The earth conductor shall be connected to this terminal by means of a crimped lug.

9.2.4 Lamp Holders

9.2.4.1 Lamp holders shall preferably be of the telescopic spring loaded type. Where twist lock type lamp holders are provided, the mounting of the holders shall be able to accommodate the tolerances experienced in the length of lamps and in the manufacture of luminaires.

9.2.5 Control Gear

9.2.5.1 The control gear, ballasts, capacitors and starters shall be designed and manufactured to suit the control circuitry adopted.

9.2.5.2 Ballasts shall comply with SABS 890 and 891, suitable for operation on 220/250 V, 50 Hz supplies.

9.2.5.3 Ballasts shall further be suitable for the particular luminaire to ensure that the thermal limits specified in par. 3.5 of SABS 1119 are not exceeded.

9.2.5.4 Noisy ballasts will not be accepted and shall be replaced at the cost of the Contractor.

9.2.5.5 Starters shall comply with BS 3772. Starters with metal cans shall contain integral earthing facilities to earth the can upon insertion.

9.2.5.6 Starters shall be accessible from the outside of the luminaire, and the replacement of the starter shall not necessitate the removal of lamps.

9.2.6 Capacitors

Capacitors shall comply with SABS 1250. The power factor of each complete fitting shall be corrected to at least 0,85.

9.2.7 Lamps

9.2.7.1 Fluorescent lamps shall be suitable for the control circuitry used. Lamps shall comply with SABS 1041.

9.2.7.2 If no colour is specified in the Detail Specification, the light colour shall correspond to colour 2 (4300K) of SABS 1041.
D/Spec

9.2.7.3 Lamps of the same colour shall be provided for an entire installation unless specified to the contrary.

9.2.7.4 There shall be no visible flicker in the lamps and lamps shall readily strike when switched on. Faulty lamps or ballasts shall be replaced at the cost of the Contractor.

9.2.8 Decorative Luminaires

9.2.8.1 Decorative luminaires shall incorporate an injection moulded prismatic acrylic diffuser or a high grade optical reflector type diffuser as specified in the Detail Specification.
D/Spec

9.2.8.2 The diffuser shall be hinged for maintenance and lamp replacement.

9.2.8.3 Highly polished reflectors shall be protected and carefully handled to prevent fingerprints showing on the surface.

9.2.9 Recessed Luminaires

9.2.9.1 Recessed luminaires shall be suitable for mounting in the ceiling structure specified.

9.2.9.2 Filler plates shall be provided as part of the luminaire to accommodate the luminaire in the specified ceiling tile size.

9.2.9.3 The diffuser or reflector shall fit flush with the ceiling.

9.3 Down Lighters

Down lighter types of luminaires shall be fitted with miniature fluorescent lamps as specified in the Detail Specification.
D/Spec

9.4 High Luminaires

9.4.1 High bay luminaires shall be securely suspended from the roof structure.

9.4.2 The luminaires may be fixed to suspended wiring channels containing the wiring on condition that:

(a) Rigid channels with a maximum width of 42mm be used.

(b) The channels are supported at intervals that will prevent sag or warp

and

(c) The channels are large enough to accommodate the wiring.

9.4.3 Luminaires may be suspended from metal roof trusses with the aid of "CADDY" or similar fasteners.

9.4.4 A safety chain shall be provided.

9.5 Flood Lights

Refer to requirements of Detail Specification. D/Spec

9.6 Bulkhead Luminaires

Refer to requirements of Detail Specification. D/Spec

9.7 Decorative Luminaires

Refer to requirements of Detail Specification. D/Spec

9.8 Low Voltage Luminaires

9.8.1 A maximum of four low voltage lights (24 Volts) shall be supplied from a single transformer.

9.8.2 Each light shall be connected to the transformer by means of a separate 1,5 mm² CABTYRE conductor of equal length.

9.8.3 A terminal strip with screw connections shall be provided at each light.

9.8.4 Fuse protection shall be provided on both the primary and secondary windings of the transformer.

9.8.5 The transformers shall be mounted to the concrete slab or against a wall above the ceiling and not on the ceiling tiles.

9.9 Installation

9.9.1 Cover Plates

9.9.1.1 Cover plates shall be fitted over all outlet boxes intended for luminaires that are not covered by the luminaire.

9.9.2 Fixing to Draw boxes

9.9.2.1 Where an outlet box provides the necessary support for a luminaire, all luminaires with the exception of fluorescent luminaires mounted against ceilings, shall be fixed directly to the box.

9.9.2.2 Fluorescent luminaires and luminaires with a mass in excess of 10 kg shall be suspended independently of the outlet box.

9.9.3 Hangers and Supports

9.9.3.1 Where provision has not been made for the fixing of luminaires, the Contractor shall supply the necessary supports, hangers, conduit extensions, angle brackets or any other fixing method approved by the Engineer.

9.9.4 Suspended Luminaires

9.9.4.1 The necessary hangers shall be provided where luminaires which are of the non-suspension type have to be fixed below false ceilings or roof structure.

9.9.4.2 Provision shall be made for adjustments to enable the levelling of luminaires.

9.9.4.3 Suspended conduit for fixing to the ceiling by means of ball-and-spigot type dome lids shall be used where conduit lengths exceed 600 mm.

9.9.4.4 Wiring shall be installed in the conduit hangers.

9.9.5 Suspended Wiring Channels

9.9.5.1 Luminaires (especially fluorescent luminaires) may also be suspended from ceilings by means of suspended metal channels. The metal channel may be supported by conduits or threaded rods.

9.9.5.2 Wiring shall be installed in the metal channels.

9.9.6 Fluorescent Luminaires Fixed to Concrete Slabs

9.9.6.1 Fluorescent luminaires to be installed directly against concrete slabs or walls shall be securely fixed to the outlet box and at two additional points.

9.9.6.2 Shot-fired fixings are not acceptable.

9.9.6.3 Where approved, fluorescent luminaires may be installed against metal wiring channels in which the wiring is housed. The channel fixing may in this case be shot fired.

9.9.7 Fluorescent luminaires fixed to ceiling

9.9.7.1 In all cases where luminaires are fixed to false ceilings the Contractor shall ensure that the ceiling is capable of carrying the weight of the luminaires before commencing installations. Should any doubt exist in this regard, the matter shall be referred to the Engineer.

9.9.7.2 In cases where the weight of the luminaire is not carried by the ceiling but by a support or other suspension method, provision shall be made to prevent relative movement between the ceiling and luminaire, ceiling rose or connection

point.

9.9.7.3 In the case of ceilings surface mounted luminaires shall be fixed only to the ceiling tiles by means of butterfly screws.

9.9.7.4 Drilling of holes in ceiling tees to support luminaires will not be allowed.

9.9.7.5 Luminaires shall be fixed in neat relation to the ceiling layout.

9.9.8 Recessed Luminaires

9.9.8.1 Where recessed luminaires are specified, the Contractor shall maintain close liaison with the ceiling Contractor. In the case of tiled ceilings, the luminaires shall preferably be installed while the metal supports are being installed and before the tiles are placed in position. The Electrical Contractor shall be responsible for the co-ordination of the curring of ceiling tiles with the other contractors concerned.

9.9.8.2 All mounting rings and other accessories shall fit closely into cut-outs to ensure a proper finish.

9.9.8.3 In all false ceiling where wiring channels are used, recessed luminaires shall be connected to the wiring channels by means of unswitched 5 A socket-outlets.

9.9.8.4 The following requirements shall be adhered to:

(a) Socket outlets used shall comply with Clause 6.2.6 of this specification and shall be of 5 A minimum rating and moulded type plugs shall be used.

(b) The connector cord attached to the luminaire may not exceed 3 m in length and shall consist of 1,5 mm² minimum, 3 core, PVC-insulated flexible cord.

(c) The 5 A socket outlets shall be positioned such that they are not more than 600 mm above the false ceiling.

9.9.9 Special Ceilings

In cases where special ceilings e.g. aluminium strips, decorative glass, metal leaves, etc. are to be installed, the Contractor and the Manufacturer of the ceiling shall agree upon the method of fixing of luminaires in the ceiling.

9.9.10 Type of Conductor

PVC-insulated conductors, unless protected by an approved heat-resistant sheathing, shall not be used where the temperature of the insulation is likely to exceed 70NC.

In unventilated luminaires or luminaires capable of housing incandescent lamps over 60W, the interconnecting wiring from the lamp holder to the circuit wiring shall consist of silicon rubber insulated conductors.

Silicon rubber insulated conductors shall be used exclusively in the case of high bay fittings. Refer also to the provisions of SABS 0142, par. 6.5.1 (f).

10. SITE LIGHTING

10.1 Street Lighting

Refer to Detail Specification

10.2 Flood Lighting

Refer to Detail Specification

11. MISCELLANEOUS ITEMS

11.1 Municipal Connection

The Contractor shall confirm the type, size and date of the municipal supply with the Supply Authority within one month after being appointed. Refer to Clause 1.4.1

11.2 Metering

Refer to the Detail Specification and Clause 3.12.4. D/Spec

12. SPECIALIZED SYSTEMS AND PROVISIONAL SUMS

12.1 Provisional Sums

Although Provisional Sums which have been allowed for systems and equipment to be supplied and installed by specialist contractors for systems such as lightning protection, power factor correction emergency power and UPS, these contractors shall be assisted by the Electrical Contractor.

D/Spec

All specialist equipment shall be installed in accordance with the Conditions of contract applicable to this Installation.

The Contractor shall make due provision for profit and attendance for assistance to any of the specialist contractors in his tender price as no extra claims in this regard shall be considered.

Should provisional sums be omitted the total cost including profit and attendance will be omitted without any compensation to the Contractor.

12.2 Earthing and Bonding

The earthing and bonding of the electrical installation shall in general comply with the requirements of SABS 0142.

Additional requirements such as earth mats, spikes and separate earth systems for clean earth systems are specified in the Detail Specification.

12.3 Lightning Protection System

Unless specified otherwise in the Detail Specification a specialist contractor shall be appointed by the Contractor.

D/Spec

The lighting protection system shall fully comply with SABS 03.

SABS drawings shall be submitted to the Engineer for approval by the Contractor prior to installation of the system.

The test links shall be installed in such a manner that it will always be accessible.

A certified test report shall be submitted to the Engineer after completion of:

- the installation of the ground earth system with the earth resistance shown for each earthing point.
- the complete lightning protection system with all test links in position.

STANDARD SPECIFICATION

FOR

MINIATURE SUBSTATIONS

STANDARD SPECIFICATION FOR MINIATURE SUBSTATIONS

INDEX

PAGE

STANDARD SPECIFICATION FOR MINIATURE SUBSTATIONS

1. GENERAL

1.1 This specification covers the manufacture and supply of miniature substations suitable for use on the system as specified in A-SHED-04-02-B.

1.2 The substation shall comply with the requirements of SABS 1029 and SABS 1030 unless otherwise specified.

2. CONSTRUCTIONAL REQUIREMENTS

2.1 Fibreglass Housings

Where specified and for all substations to be installed within 50 km of the coast and in all corrosive industrial atmospheres, the roof, walls, and doors shall be manufactured of fibreglass in accordance with the following minimum requirements:

2.1.1 The laminate shall be constructed to SABS 141.

2.1.2 The fibreglass shall comply with the minimum strength requirements of clause 3.4 of SABS 1029.

2.1.3 An outer isopthalic resin gel coat with a minimum thickness of 0,4 mm and ultra-violet absorption properties to prevent degradation of the surface from exposure to the sun shall be provided.

2.1.4 The gel coat shall be backed by multiple layers of chopped strand mat glass rendering not less than 1,2 kg/m². The strength shall be increased to 1,35 kg/m² on all panels larger than 500 x 500 mm.

2.1.5 The fibreglass shall be thoroughly impregnated with polyester resin. The resin should preferably be clear.

2.1.6 The resin to fibreglass ratio shall not be less than 2,5 : 1 and not more than 3,0:1.

2.1.7 Air entrapped between the glass mat layers shall be thoroughly worked out. The laminate must be free of air bubbles and voids

2.1.8 All edges shall be reinforced with an additional 700 g/m² of fibreglass.

2.1.9 All large surfaces, wider than 300 mm, shall be reinforced or panelled to improve stiffness and rigidity.

2.1.10 A resin coat shall be applied to the inside of the panels to cover the fibre pattern.

2.1.11 Brass or steel backing plates shall be laminated into the fibreglass at hinge points, locking mechanism catch support areas, door restraint fixing points and all other points which will be subjected to mechanical stress.

2.1.12 Doors shall be adequately braced, reinforced, ribbed or double laminated with an air gap between the two layers of laminate to ensure rigidity.

2.2 Finish and Colour of Fibreglass Miniature Substations

2.2.1 The outside surface of the fibreglass shall have a glossy, smooth finish to ensure good weathering. To obtain this the manufacturer shall ensure that the moulds are smooth, free of voids, hair-line crack's, pores or other defects.

2.2.2 Compound rubbing or sanding of the outside surface will not be permitted.

2.2.3 Pigments shall be added to the outer gel coat to obtain a matching colour as specified in A-SHED-04-02.

2.2.4 Fibreglass panels shall not be painted.

2.3 Sheet Steel Housings

2.3.1 Where specified, the roof, walls and doors shall be manufactured of steel.
2.3.2 The sheet steel construction shall comply with the minimum strength requirements of clause 3.4 SABS 1029.

2.3.3 All welds shall be ground smooth and the joints wiped with plumber's metal in order to provide a smooth finish.

2.3.4 All panels, the roof and doors shall be suitably braced and stiffened to ensure rigidity and to prevent warping.

2.3.5 The colour of the outer coat of paint on the outer surface of the substation shall be as specified in A-SHED-04-02. A tin of matching touch-up paint (not smaller than 500 ml) shall be provided with each mini-substation.

3. CONCRETE PLINTH

3.1 The mini-substation shall be mounted on a concrete plinth. Plinths shall be cast on site, or precast plinths may be used, to the approval of the Engineer.

3.2 The Contractor shall issue to the Engineer a detailed plinth drawing suitable for each type of mini-substation supplied.

3.3 The top of the plinth shall protrude at least 200 mm above the final surrounding ground level. The concrete plinth shall protrude approximately 100 mm beyond the edges of the mini-substation to form an apron.

3.4 The concrete apron and plinth shall be wood float finished and shall slope from the base to ensure rain water run off. A 3 mm thick gasket of approved malthoid shall be inserted between the mini-substation and the concrete surface. The gasket shall be as wide as the base.

3.5 Cable ducts shall be provided in the plinth to the approval of the Engineer to accommodate all the incoming and outgoing cables. The cable ducts shall be sealed to prevent entry of rodents. The sealing shall be easily removable in the event of future cable work and may consist of a layer of 10:1 sand and cement mix, approximately 10 mm thick, and finished flush with the top of the concrete plinth.

4. BASE

Steel bases shall be supplied for the mini substations. Bases shall be hot dip galvanised and then epoxy tar coated before being painted.

5. DOORS

5.1 Long pedestal type hinges with at least two fixing bolts per hinge or similar hinges to approval shall be used to hang the doors. The pedestal hinges shall be arranged in opposed fashion so that doors cannot be lifted off. Piano hinges are not acceptable. The hinges shall be of brass or other corrosion resistant materials. Nylon or aluminium hinges or hinges of similar materials are not acceptable.

5.2 At least three hinges shall be provided on doors higher than 1,2 m.

5.3 Door restraints shall be provided. Cloth or canvas straps are not acceptable. The fixing points of the restraints at both the door and the door frame shall be reinforced.

5.4 Doors shall be fitted with brass or stainless steel lever locks equal or similar to the "BARKER & NELSON" type with a 180 degree movement. The locking mechanism shall have a catch on the rear which catches behind the frame or door entry surround. The locking mechanism as well as the catch support area shall be backed by brass or galvanised steel plates. The locking mechanism shall be padlockable. Padlocks will be provided by Contracts to the specification of the Client.

Preference will be given to designs where only one lever lock system is fitted per compartment and where the other doors are bolted from the inside, with bolts and nuts in fully accessible position.

5.5 Brass bolts and nuts shall be used to fix the hinges.

6. HIGH VOLTAGE COMPARTMENT

6.1 The high voltage compartment shall be equipped with a non-extensible bulk oil filled ring main unit with a fused tee-off unless otherwise specified.

6.2 All ring main units or other HV switchgear installed in miniature substations must be fitted with integral testing facilities. Testing by means of a separate test harness is not acceptable.

6.3 The minimum clearances between connecting cables and jumpers and any sharp metal edges or protrusions shall be at least 75 mm.

6.4 "DELARON" or "THIOLITE" resin bound synthetic wood or other suitable dielectric material shall be used to maintain the phase-to-phase and phase-to-earth spacing of the cables and jumpers. The surfaces of these spacers shall be treated to prevent surface tracking.

6.5 Stranded annealed copper conductors only shall be used for jumper cables.

6.6 All terminals shall be shrouded with "RAYCHEM", "OZOCORITE" or similar heat-shrinkable shrouds. Taping is not acceptable.

6.7 The high tension connections between the fused switch unit and the transformer shall be suitably blanked off so that they cannot be touched.

7. TRANSFORMER COMPARTMENT

7.1 The transformer compartment shall be equipped with a transformer as specified and in accordance with the latest

revision of the Standard Specification for Distribution Transformers SABS 780 and the requirements of SABS 1029.

7.2 An off-circuit tap switch shall be provided, with the tapping range as specified by SABS 1029.

7.3 The transformer shall be of he sealed type and shall not contain any silica-gel breather.

8. LOW VOLTAGE COMPARTMENT

8.1 Equipment

8.1.1 The specified equipment detailed in Schedule A-SHED-04-02 shall be installed in the low voltage compartment.

8.1.2 The equipment shall comply with the Specification for Low Voltage Switchboard.

8.1.3 The low voltage compartment shall be of ample size to accommodate the specified equipment and provide space for future requirements as specified.

8.2 Equipment Support Frame

8.2.1 A rigid angle iron or folded metal support framework shall be provided.

8.2.2 The frame shall be bolted down on the base by at least four M16 high tensile steel bolts.

8.2.3 A cable gland plate shall be provided at the bottom of the frame across the full width of the compartment. The gland plate shall be at least 100 mm above the plinth height. A minimum distance as required by the bending radius of the cores of the outgoing cables shall be provided between the lowest terminals of major equipment and the gland plate.

8.2.4 The gland plate shall be suitably punched to accept the number and size of cables specified.

8.2.5 All steelwork shall be hot-dip galvanised in accordance with SABS 763.

8.2.6 A "DELARON" or "THIOLITE" resin bound synthetic wood or other suitable dielectric material panel shall be provided for the mounting of all equipment and busbars. Impregnated hardboard or other treated or untreated wood products are not acceptable.

8.2.7 Alternatively, all equipment and busbars shall be flush mounted within a purpose-made sheet metal frame enclosed by a machine punched removable front panel through which the operating handles of the equipment protrude. Care shall be exercised that the rear studs of circuit-breakers are properly insulated from the steel chassis. Miniature circuit-breakers may be installed in clip-in trays mounted on the frame.

8.3 Busbars

8.3.1 Application

(a) Busbars shall be manufactured of solid drawn high conductivity copper with a rectangular cross-section in accordance with SABS 1195 and BS 159 and BS 1433, where applicable.

(b) Busbars in miniature substations shall comply with applicable sections of this specification-, especially as far as insulation and clearance values, creepage distance, joints, insulation resistance, dielectric strength, deflection test, absorption resistance and rated short time withstand current are concerned.

(c) Busbars shall be supplied for the following applications:

(i) Distribution of supply voltage.

(ii) Connection of equipment with ratings exceeding the current rating of 70 sq. mm conductors.

(iii) Connection of outgoing circuits with current ratings in excess of that allowed for 70 sq. mm conductors (par. 8.4.1).

(iv) Collector bars for parallel cables.

(v) Connection bars for neutral conductors (par. 8.3.8)

(vi) Earth busbars (par. 8.3.9)

(vii) Connections to miniature circuit-breakers.

8.3.2 Voltage rating

Busbars for system voltages up to 600 V shall be designed to withstand a test voltage of 2,5 kV for one minute.

8.3.3 Rating

(a) The maximum allowable temperature of busbars (including joints) carrying full load current in an ambient temperature as specified shall not exceed 80 degree C. Unless different ambient temperatures are specified, an ambient temperature of 35 degree C shall be assumed with a maximum temperature increase of 45 degree C.

(b) The distance between the phase busbars is at least the distance of the longer side of the cross section with a minimum spacing of 50 mm and at least 150 mm from the sheet metal enclosure. It is however essential that the manufacturer shall make due allowance for the "proximity and skin" effects, the effect of ferrous enclosures, ventilation, etc. for the arrangement used in his switchboard design. Manufacturers shall, where requested, prove that the busbar rating and enclosure design comply with the temperature rise specified above. The busbars can also be rated to DIN 43671 unpainted busbars.

(c) Neutral busbars in three phase, four wire supplies shall have a cross-section of at least 60% of the cross-section of the phase busbars.

(d) Busbars may not be tapered. The rating of the bars shall be equal to the incoming current rating. In cases where the main switch is an isolator, the isolator rating may not be taken as the incoming current rating.

(e) In addition to the current rating, busbars shall comply with the following fault level rating:

A	=	8,2 x I x □t
Where A	=	minimum cross-section (sq. mm)
I	=	prospective fault current (kA)
t	=	maximum time in seconds required for protection to clear the fault. (Minimum allowable value for t = 0,2 s.).

(f) Where a busbar consists of two or more busbars per phase (laminations), the limitations shall be separated by a minimum distance of the thickness of one lamination. The laminations shall be clamped together with copper spacers at intervals not exceeding 450 mm in order to equalize the current distribution in the laminations.

8.3.4 Mounting

(a) All active phase busbars shall be installed horizontally along the top of the LV compartment with the longer side of the section in the vertical plane. Main busbars shall be supported by "DELARON" or "THIOLITE" resin bound synthetic wood panels or other suitable dielectric material. The surface of these supports shall be treated to prevent surface tracking. The supports shall be bolted securely to the framework and busbars shall fit tightly in the supports. Alternatively, busbars may be supported on resin insulators. Porcelain insulators will not be allowed.

(b) The rating and fixing of busbars shall be designed to withstand mechanical and temperature-stresses during fault conditions. The busbars shall withstand a fault current under test conditions of the specified fault level. If a fault level is not specified, the busbars shall be tested at 20 times rated current for one second. The fault current shall be applied:

(i) between all phases,

(ii) any two phases,

(iii) neutral and adjacent phase, and

(iv) earth conductor and the nearest phase conductor.

(c) The minimum clearance for system voltages up to 600 V is 10 mm in accordance with SABS 784 and BS 159 and shall be strictly maintained.

(d) The maximum allowable spacing of busbar supports for fault levels of 15 kA and more is 600 mm.

(e) All secondary and "dropper" busbars shall be mounted on suitable insulators or directly on circuit-breaker terminals, where practical.

(f) Busbars shall be mounted at least 100 mm away from the nearest equipment. Special attention should be given to spacing between fuse-switches and busbars.

(g) Busbars shall be properly insulated and sufficiently supported to withstand the maximum fault current at the points where they pass through panels or partitions. This shall preferably be achieved by means of resin- bound synthetic wood or similar material with cut-outs which fit tightly around the busbars. The insulating panel shall be firmly bolted to the frame. Busbars or "droppers" that pass through internal partitions in the LV compartment shall be similarly insulated and supported.

8.3.5 Covering & Shrouding

All busbars shall be covered with coloured heat- shrinkable material equal to "RAYCHEM" or "SIGMAFORM" products. The colour shall correspond to the colour of the supply phase. Busbars may not be covered with coloured insulation paint. Busbar joints shall be covered with a suitable non-hardening compound and then taped with coloured PVC tape. Busbars shall be radius-edged where they change direction.

Suitable approved shrouding plates shall be provided to prevent accidental contact with any busbar.

8.3.6 Connections

Conductor ends shall be fitted with crimped or solid sweated lugs which are bolted to the busbar. Busbar clamps with bolted connections are acceptable for smaller circuit conductors.

Where lugs are crimped only hexagon crimping techniques may be used with the correct lug sizes for the associated conductors and evidence shall be submitted that the crimping technique used will comply with the performance requirements of BS 4579, Part I: "COMPRESSION JOINTS IN COPPER".

8.3.7 Outgoing Circuits

Conductors up to a maximum of 70 sq. mm may be used for connections from equipment to external cables. The terminations shall comply with par. 8.4.1. Busbars shall be provided and shall extend to approximately 900 mm above the cable gland plate for circuits with currents larger than 200 Amp. These busbars shall be insulated over their entire length to 8.3.5.

8.3.8 Neutral Busbars

(a) Neutral conductors for circuits protected by a single-pole circuit breaker or fuse-switch shall be connected to a neutral busbar mounted in a suitable position adjacent to the earth busbar in the bottom of the LV component.

(b) A separate neutral bar shall be provided for each earth leakage unit provided. These neutral bars shall have a cross-section of at least 6,3 x 25 mm and shall be long enough for the lugs of all neutral conductors to be bolted separately to the busbar without over- lapping the lugs.

(c) The requirements of par. 8.3.6 and 8.3.11 are applicable.

(d) The rating of neutral busbars for three-phase circuits is specified in par. 8.3.3 (c)

8.3.9 Earth Busbar

An earth busbar shall be installed in a convenient position along the entire length of the LV compartment. The requirements of 8.3.4, 8.3.6 and 8.3.7 are applicable to earth busbars with the exception that earth busbars may be bolted directly to the framework. The cross-sectional area of earth busbars shall be calculated in accordance with the following formula in IEC 439 with a minimum cross section of 6,3 x 20 mm.

S = (I/X) x (t/dT)
where S = cross-section (sq. mm)

I = the r.m.s. value of the current (A)

X = 13 for Copper

t = operating time of protection equipment (s). (Minimum value = 0,2 s.)

dT = temperature rise (degree C)

= 120 degree C for insulated conductors

= 180 degree C for uninsulated conductors

If it is between 2 s and 5 s then dT may be increased in the same formula to:

dT = 145 degree C for insulated conductors

= 215 degree C for uninsulated conductors

In addition the longer side of the earth busbar shall be at least twice the diameter of the largest bolt that will be fitted to the busbar.

8.3.10 Earthing of Metal Parts

All non-current carrying metal parts of the mini- substation, e.g. framework, panels, base, steel housing, transformer, ring main unit, etc. shall be bonded to the earth busbar.

8.3.11 Bolts and Nuts

Only cadmium-plated high tensile steel bolts and hexagonal nuts may be employed at busbar joints and connection points. All nuts shall be provided with spring washers or be of the "NYLOCK" type with washers. The largest possible size bolt that will fit into holes in lugs and fixing holes of equipment shall be used in every instance. Bolts shall be of sufficient length that at least two but not more than five threads protrude beyond the nut.

8.4 Wiring

8.4.1 Cabling

Incoming and outgoing cables shall be terminated on the gland plate. Cable tails with sizes up to 70 mm² may terminate on clamp type terminals where the clamping screws are not in direct contact with the conductor. All cables larger than 70 sq. mm shall terminate on busbar stubs which are connected directly to the equipment. Parallel connected cables shall be connected to a collector busbar or busbar stub without crossing the conductors.

8.4.2 Current Ratings

The current rating of conductors for the internal wiring shall be sufficient to carry the maximum continuous current that can occur in the circuit. This value shall be determined from the circuit breaker or fuse protection of the circuit. The smallest conductor size to be used for power wiring shall be 2,5 mm² with a minimum of seven strands.

8.4.3 Internal Wiring

(a) Standard 600/1000 V grade PVC-insulated stranded annealed copper conductors to SABS 150 shall be used for the internal wiring.

(b) Wiring shall be installed away from terminals, clamps or other current carrying parts. Wiring shall also be kept away from exposed metal edges or shall be protected where they cross metal edges.

(c) Joints in the wiring are not acceptable.

(d) Where conductors change direction, smooth bends shall be formed with a radius of at least five times the outside diameter of the conductor.

8.4.4 End Connections

The supply end connections to equipment shall be at the top and the load end connections at the bottom.

8.4.5 Conductor termination

Conductor connected to terminals shall comply with the Standard Specification for Control Boards and Small Wiring - A-SPES-01-01.

All conductors terminating on equipment with screwed terminals shall be fitted with lugs. The lugs shall be soldered or crimped to the end of the conductor with the correct amount of insulation removed from the end to fit into the lug. Strands may not be cut from the end of the conductor.

Connections to circuit-breakers, isolators or contractors shall be installed by one of the following methods:

(a) A ferrule of the correct size,

(b) soldering the end of the conductor, or

(c) winding a conductor strand tightly around the end to totally cover the end.

8.4.6 Identification

The colour of the conductors for all 220/250 V circuits shall correspond to the colour of the supply phase for that circuit. Neutral conductors shall be black. All other conductors for control circuits, etc. shall be coded in colours other than those specified above. The devised colour codes shall be shown on a wiring diagram. Coloured PVC or other tape will not be acceptable for colour coding.

8.5 Mounting of Equipment

8.5.1 The mounting of equipment shall comply with SABS 1180 where applicable. Equipment shall be fixed to the support

panel with bolts, nuts, washers and spring washers. Self-tapping screws will not be accepted.

8.5.2 Equipment shall be arranged and grouped in a logical fashion.

8.5.3 All equipment shall be flush mounted behind panels with only circuit-breaker and isolator toggles and meter faces protruding. The front panels shall be secured in position by 6 mm studs and hexagonal chromed brass dome nuts and washers or hank nuts or "DZUS" or "CAMLOC" fasteners. Self-tapping or similar screws are not acceptable.

8.5.4 Blanking plates shall be fitted over slots intended for future equipment. These plates shall be fixed so that fixing holes do not need to be drilled through the front panel.

8.6 Access

All equipment, busbars and wiring shall be completely accessible with the front cover panel removed.

8.7 Labelling

8.7.1 All equipment shall be fully labelled and accurate descriptions and safety warning notices shall be given in both official languages.

8.7.2 Engraved plastic or ivory sandwiched strips shall be used for labels. The labels shall bear white lettering on a black background, painted or printed labels are not acceptable.

8.7.3 The following labels shall be supplied as a minimum requirement:

(a) Designation of mini-substation

e.g. KERKSTR. MINI-SUB
CHURCH ST. MINI-SUB

(Lettering: At least 40 mm high. Label on the outside in a prominent position on both the front and back of the substation).

(b) Designation of circuit i.e. circuit-breaker, isolator, meter, etc.

e.g. HOUSE 473
HUIS 473
POMPTOEVOER
PUMP SUPPLY

(Lettering: At least 5 mm high. One label installed directly below each item of equipment pertaining to the particular circuit shall be provided).

(c) The main switch shall be labelled in accordance with the regulations.

(d) The function and circuit of all other equipment shall be clearly identified. Flush mounted equipment within the front panel shall be identified by labels fixed to the front panel. The labels for all equipment installed behind panels shall be fixed to the support panel close to the equipment.

(e) The labels shall be secured by means of brass nuts and bolts, self-tapping screws, pop-rivets or slotted label holders. Engraved labels shall be secured to facilitate a neat alteration of the designation of the labels. Labels shall not be glued to their mounting positions. Sufficient fixing points shall be provided to prevent labels from wrapping.

(f) All label designations shall be confirmed with the Engineer before manufacture.

9. NOTICES

The notices in terms of clause C52 of the Factories, Machinery and Occupational Safety Act and labels as required on the outside of the mini-substation, shall be riveted to the steel door or panelling so that they cannot easily be removed. Brass rivets shall be used. In the case of fibreglass housings, the notices shall be laminated into the fibreglass except for the designation label.

10. INSPECTION

The Engineer shall be notified at least two weeks in advance of the completion of the mini-substation in order that an inspection may be carried out before delivery.

11. DRAWINGS

11.1 Drawings for Approval

11.1.1 A set of three prints of the microfilm standard shop drawings of the mini-substations shall be submitted to the Engineer for approval.

(a) Schematic and wiring diagrams.

(b) A complete layout of the internal arrangement of the mini-substations showing all equipment dimensions and constructional details. The positions and method of fixing of busbars shall be shown.

(c) All labelling information in both the official languages on a separate sheet.

(d) The makes, catalogue numbers and capacities of all equipment scheduled on a separate sheet.

(e) A detail drawing of the concrete plinth showing concrete mixes, dimensions, opening sizes, steel reinforcing details and holding down bolts fixing details.

11.1.2 The approval of drawings shall not relieve the Contractor of his responsibility to the Engineer to supply the mini-substations according to the requirements of this Specification.

11.2 Final Drawings

A complete set of "as built" transparent drawings of the mini-substations shall be submitted to the Engineer within two weeks after delivery. The information called for in par. 11.1.1 (a) to (e) above shall be provided.

11.3 Completion

The supply contract shall be regarded as incomplete until all drawings have been handed to the Engineer.

STANDARD SPECIFICATION

FOR

EXCAVATION WORK

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STANDARD SPECIFICATION FOR EXCAVATION WORK

1. EXCAVATIONS

1.1 General

1.1.1 The term "excavations" means all excavations that may be necessary for the proper execution of the contract and includes the excavation of trenches, pole holes, manholes, joint pits, drain trenches and any other excavations required in the contract.

1.1.2 The Contractor must comply with all the relative regulations as set out in the Act on Machinery and Occupational Safety of 1983.

Attention is specifically drawn to the requirements of struts and shoring of walls when excavations are deeper than 1,5 m.

1.1.3 The Contractor must advise private owners timeously and in writing when a cable trench has to be excavated through such non-municipal property. The format of the notice must be submitted to the Engineer for approval.

1.1.4 The Contractor must obtain written approval from the Engineer for the use of mechanical excavators.

1.1.5 The Contractor must take all possible precautions for the protection of trees, plants, flowers and shrubs during the execution of the contract and must ensure that no excavated material is deposited thereon.

1.1.6 The Contractor must immediately notify the Engineer when the cable trench passes through chemically active soil which may have a harmful effect on the cable. The responsibility will then rest on the Engineer to have the soil analysed in a suitable laboratory and to prescribe such precautionary measures as he may deem fit to ensure the safety of the cable and the Contractor shall give his full co-operation.

1.1.7 The Contractor will be held responsible for any damage to the installation should he fail to advise the Engineer regarding the presence of any possible chemically active soil. The Contractor will then be responsible for replacing, at his own cost, all materials thus damaged and carry all consequential expenditure himself.

1.1.8 If during the duration of the contract any hindrance or obstruction is encountered which necessitates an alteration to the trench or route or construction procedure, then such alteration must first be approved by the Engineer in writing. The deviation must be clearly shown on the plans.

1.1.9 The Contractor must carry out tunnel excavations for a minimum of 500mm on each side of stays, telephone, electrical or traffic light poles when the excavation is within one meter of such services. The tunnel excavations must be done to protect the surface services. The width of the tunnel will depend on the number of cables to be installed and the height must be such to ensure the maximum amount of supporting soil in situ.

1.2 New Cable Trenches

1.2.1 The cable trench as indicated on the electrical reticulation drawing must be excavated in accordance with the standard and procedure as shown on the services drawing and placed exactly on the cable route or as otherwise determined by the Engineer. The services drawings will be handed to the Contractor when the contract is awarded.
In townships where precast walls and brick walls have already been erected, the Engineer will determine where the cables will be laid and the Contractor must take the necessary precautions to ensure that the walls will not collapse or yield.

1.2.2 The trench must be excavated absolutely straight and in accordance with the required dimensions. The length of open trench shall normally not exceed 600m. Thereafter a length of cable must be laid and the trench backfilled before further excavations are done.

1.2.3 The trench must be wide enough to enable the number of cables set out in the schedule of technical details to be laid with ease.

1.2.4 The trench will be excavated up to a depth of 1.0 m (with a tolerance of 50 mm) measured from the final pavement level or at least 500 mm below the final tarred street level.

If, due to circumstances conflicting with the standard, the trench has to be excavated at the lower slope of the road then the bottom of the excavation must be at least 500 mm below the ground level of the nearest stand boundary.

The Contractor must provide a dumpy level and the required set-rods for checking the trench depth if required by the Engineer.

N.B. Any additional excavation that may be necessary to meet these requirements will be considered as inclusive in the unit tariff for normal excavations.

1.2.5 Where the roads and streets have not yet been constructed and the carriageway must be crossed, the cables must be laid in sleeve pipes 1,5 m below the street level to ensure the safety of the cables during road construction work at a

later date.

1.2.6 The bottom of the trench must be level and must follow the contour of the final surfaced street level. All excessive depths must be filled with suitable soft soil well consolidated to the required depth.

1.2.7 Where the trench passes through rock formations the Contractor must examine the excavation for sharp projections and sides which may damage the cables during and after laying and remove same. All loose pieces, splinters, stones and boulders must be removed from the trench.

1.2.8 All natural obstructions must be removed or tunnelled through. Where other services are encountered the shortest possible route must be followed round same with due regard to the prescribed clearances.

1.3 Excavations Adjacent to Existing Routes

When excavations are carried out adjacent to existing routes the following procedures must be carefully followed:

1.3.1 Crosscuts must be made in positions to be indicated by the Engineer so that the position of existing cables and other services can be accurately identified.

1.3.2 The Engineer will then decide where the new cable(s) must be laid.

1.3.3 The new cable must be laid in straight routes along an absolutely straight line and parallel to the stand boundary. This may result in situations where the existing cables must be slightly moved under the supervision of the local Electricity Department.

1.3.4 No cable joints may be moved without written approval of the Engineer and without the supervision of a representative of the local Electricity Department and they must be adequately protected to the satisfaction of the Engineer.

1.3.5 All possible precautions must be taken to prevent damage to the existing cable(s). If this should happen repairs will be carried out by the local Electricity Department for the account of the Contractor.

1.3.6 No mechanical excavator may be used in the vicinity of existing cables or services.

If the Contractor considers the use of jack hammers or mechanical excavations as imperative, he must obtain the written permission of the Engineer.

Where such permission has been obtained the Contractor shall take all possible precautions to ensure the protection of existing cables and throughout the Contractor will carry the full responsibility for the damage to any cable or service.

1.4 Excavation of Joint Pits

1.4.1 Joint pits must be at least 1,2 m deep, rectangular and large enough to enable the cable jointers to carry out their work conveniently and efficiently. Where more than one joint must be made in the same position the joint pits must be large and long enough to enable the joints to be made in staggered positions. The minimum size of joint pits will be as follows:

(a)	Single cable joint	2.5m long x 1.2m wide
(b)	Two staggered joints	3.0m long x 1.4m wide
(c)	Three staggered joints	3.0m long x 1.6m wide (triangular pattern)
(d)	For staggered joints	3.5m long x 1.8m wide

1.4.2 The precise positions of joint pits will at all times be subject to the approval of the Engineer.

1.5 Safety Measures During Excavation Work

1.5.1 Every vehicle or road crossing over a trench, whether a private entrance or a public road, must be protected on both sides by means of a sturdy barricade to the satisfaction of the Engineer.

1.5.2 Where boarding is used as bridges the former must be bolted to cross beams below the deck so that they cannot shift or tip.

Such a crossing must be able to support a point-load of 6 metric tonne without failure or such a load as may be necessary at a specific instance as required by the Engineer.

1.5.3 For pedestrian access over open trenches in front of residential houses or otherwise a bridge one metre wide with sturdy railings must be provided. The deck boards must be at least 38 mm thick and the railings sturdy and bolted to the deck so that there will be no failure if a person leans or falls against the sides.

The railings must be at least one metre high.

1.5.4 Alternatively structures of steel or other materials may be used but the general requirements must comply with that as specified above for timber.

1.5.5 The ends of all open trenches must be barricaded by means of white lime-washed 2001. oil drums or other means approved by the Engineer and placed at least 3m ahead of the actual excavation.

1.5.6 Effective warning signs must be provided where roads, walkways or pavements, vehicle entrances or road crossings open trenches.

All barricades must be effectively lighted as below:

1.5.6.1 Over the ends of open trenches two red lights must be placed 2m apart with reflectors in between.

1.5.6.2 Along open trenches red lights and reflectors alternating must be placed 10m apart on the traffic side and 5m apart on the pedestrian side.

1.5.6.3 At least 2 red lights at pedestrian bridges and at least 4 red lights at vehicle bridges must be placed in suitably dispersed positions.

1.5.7 All lights must be placed at sunset and maintained in position and burning until sunrise. At least one watchman must be on duty after normal working hours to patrol the lights and ensure that they are operational.

1.6 Inspection and Measuring of the Excavations

1.6.1 As soon as the excavations for cable trenches and joint pits have been fully completed and all distribution boxes, switch boxes and meter cubicles have been erected, the Contractor must notify the Engineer with 24 hours notice accordingly so that he can carry out the inspections and be present when the excavations are measured. Inspections are not done on Saturdays, Sundays or Public holidays.

1.7 Maintenance of Excavations

1.7.1 The Contractor must maintain the excavations in a good condition, free of storm or rainwater, seepage water, mud, loose ground, boulders, stones, gravel or any foreign material which may come into them until the cables have been laid, backfilled and consolidated.

1.7.2 The Contractor must ensure that loose stones and soil are not deposited on the tarmac surface or into other services after heavy rain and if this should happen steps must immediately be taken to remove same and rectify the situation.

2. DEPOSITING OF EXCAVATED MATERIAL

2.1 No excavated material may be deposited on stand pegs or left nearer than 300mm from the side of the excavation. The material which the Engineer considers suitable for use as bedding soil must be deposited near the excavation from where it can be retrieved for use when required.

The excavated material must be stacked as compact as possible with due regard to the safety of the works and the workmen so that unnecessary space is not taken up and the pulling in of the cables obstructed.

2.2 All excavated material must be so stacked that pedestrians and traffic are not unnecessarily inconvenienced.

The Contractor must move all excavated material immediately after excavation to a place on the project site mutually agreed upon until later required, if the Engineer considers this necessary for the purpose of speeding up the traffic or any other reason.

The cost involved in the handling of the excavated material must be included in the unit price for excavations.

2.3 No excavated material may be stacked on the tarmac surface.

3. PLACING OF SLEEVES

3.1 In the case of road and/or street crossings where insufficient cable sleeves have been provided the Contractor must install the necessary sleeves as indicated on the drawing.

3.2 The sleeves must comply with specification S022-83-1 or the latest edition thereof.

3.3 The sleeves must be placed 1.5m below the surface level in new townships or other places where the street or roads have not yet been tarred so that they will not be damaged during road construction.

3.4 Where the roads have been constructed or are under construction and the curbing placed in position the top of the upper layer of the sleeves shall not be less tan 900 mm below the curbing. Where the cable sleeve openings are less than one meter from other services and the cables cannot cross such services with the required minimum clearance, the sleeves must be placed deeper to enable the cables to cross underneath the other services with the required clearance.

3.5 Unless otherwise specified at least two additional sleeves for future use must be provided adjacent to the route for the high voltage cable and at least one additional sleeve in the case of all low voltage cables.

3.6 Where more than five sleeves have to be provided they may be placed in two layers in staggered formation with the external walls spaced at least 50 mm apart. Sleeves placed in layers must be indicated as such on the "as built" plans. In such cases of multiple layers each level must be laid separately, backfilled with soil and properly consolidated before the next layer is installed.

3.7 The lower layer of sleeves must always be utilised first and the upper layer left as spare pipes.

3.8 The sleeves used in crossings must be straight and undamaged. No bends or turns will be permitted in crossings.

3.9 Cable sleeves under road crossings, tarred streets etc. must be carefully surrounded by soil so that there are no air pockets. The trench must be backfilled in layers of 300mm and consolidated with mechanical compactors to a figure of 95% amended ASSHTO.

3.10 The Contractor must lay and joint the sleeves and consolidate the backfill to the satisfaction of the Engineer. After laying and cleansing the sleeves a close fitting plug must be drawn through the sleeves.

A galvanised steel draw-wire must be left in each sleeve, the ends of which must be sealed off with a polythene cover until the cables are drawn in. Thereafter the sleeves must be sealed off in an approved manner to the satisfaction of the Engineer.

3.11 Road crossings must be carried out in two stages so that traffic will not be unduly delayed.

4. INSTALLATION OF CONCRETE SLABS AND CABLE MARKERS

4.1 Electric cables crossing over other services such as water pipes, sewer pipes, other electric cables, pilot cables or telephone cables or where there is a danger that the cable may be damaged by excavations by others, must be protected by reinforced concrete slabs. The concrete service crossing.

4.2 Electric cables crossing under another service such as a water pipe, sewer pipe, Post Office cables etc. must be protected by means of a concrete slab placed axially to the service involved. If the clearance between the two services is less than 300mm (oil or gas pipe lines and Rand Water Board pipes excluded) an additional concrete slab must be placed axially to the electric cable between the two services.

4.3 Two cable markers must be installed where an oil or gas pipeline or Rand Water Board pipe is crossed. One marker on each side of the servitude and to the entire satisfaction of the Engineer.

5. CROSSING OF OTHER SERVICES

5.1 General

5.1.1 A cable laid over another service shall be not less than 800mm below the ground level otherwise it must be placed below the other service and protected with slabs as prescribed. This deeper or shallower position of the cable applies only for a distance of 1.0m on each side of the crossing.

5.1.2 If under circumstances it is not possible to cross below other services the case must be referred to the Engineer for a written decision.

5.2 Clearances

The following minimum clearances must be maintained between electric cables and other services:-

	Vertical	Horizontal
Post Office cables	0.3m	0.3m
Gas or Oil pipe lines and		
Rand Water Board pipes	1.0m	1.0m
Other water pipes	0.3m	0.3m
Sewer pipes	0.3m	0.3m
Storm water pipes	0.3m	0.3m
Other electrical cables up to 11kV	150mm	150mm
33kV to 132kV cables	0.3m	2.0m
All types of manholes and catch pits	100mm	

5.3 Post Office Cables

5.3.1 Special conditions prescribed by the Postmaster-General for crossing telephone cables must be strictly observed.

5.4 Rand Water Board, Gas and Oil Pipeline Crossings

5.4.1 The Contractor must be in possession of an authorising permit from the above mentioned authorities and obtained from the Engineer when the cable route crosses these services.

5.4.2 These pipes operate under high-pressure and excavation work may only be undertaken under supervision of an employee of the respective authority and in accordance with the prescribed conditions and authorisation. The Contractor must arrange well in advance for the required supervision.

5.4.3 In all cases sleeves must be provided to project on both sides for at least 1.5m beyond the pipe. Concrete slabs must be placed on the sleeves for the full length of the sleeves.

5.5 National and Provincial Road Crossings

5.5.1 The Contractor must be in possession of an authorising permit from the above mentioned authorities and obtained from the Engineer when the cable route crosses these roads.

5.5.2 The road crossing must be carried out under supervision of employees of these authorities and the Contractor must make his own arrangements for supervision. The work must be carried out strictly in terms of the permit.

5.5.3 The crossings must be done without obstructing the traffic.

5.6 Railway Crossings

5.6.1 Where the cable route crosses railway lines such crossing shall be made with 150mm I.D. asbestos-cement or concrete pipes. The pipes must reach from the railway boundaries on both sides of the railway servitude. The top of the pipes must be at least 1,5m below the sleepers.

5.6.2 The Contractor will be required to comply with all the conditions specified by the Railway Administration and he must obtain written permission from the Administration before starting with excavations on railway property. All excavations and work on railway property must be arranged by the Contractor and be under the supervision of the administration.

5.7 Stormwater Crossings

5.7.1 Rivulets, streams, canals or irrigation furrows must be crossed with asbestos-cement pipes of at least 100mm ID except where the Engineer directs or approves otherwise. Five spare sleeves must be placed unless otherwise requested. The length of the system must be such that the pipes extend for at least 2m beyond the banks of the river or stream. Unless otherwise directed or approved by the Engineer the sleeves laid in the bed of the stream must be encased in concrete of 6 stone, 3 sand and 1 cement mix with at least 100mm cover round the pipes and the top of the concrete must be at least 300mm below the bed of the stream.

5.7.2 The Contractor must excavate the necessary coffer dams and build the retaining walls to divert the stream while excavating the trench and these costs must be included in the unit price for stream crossings.

5.8 Tunnel and Bridge Crossings

5.8.1 The Contractor must do the excavations up to the mouth of the tunnel, remove the sealing wall (usually a brick wall) draw the cables through and reseal the tunnel to the complete satisfaction of the Engineer.

5.8.2 In the case of bridge crossings the channel must be opened and reinstated after laying of the cables. If no channel is available over the bridge 150mm diameter galvanised water pipes to carry the cables must be bolted to the bridge to the complete satisfaction of the Engineer.

5.8.3 The cables must be laid on building sand in the channels.

5.9 Installation of Cable Racks and Cable Clamps

5.9.1 The Contractor shall submit proposals and plans of clamps and racks to the Engineer for approval where these may be necessary before he proceeds with the provision and installation of same.

6. INSTALLATION OF CABLES

6.1 Bedding layer for cables

6.1.1 Soft and properly sifted soil must under all circumstances be backfilled into the trench and levelled with a minimum thickness of 50mm before a trench inspection is requested.

6.1.2 Suitable soil must be imported if the excavated soil is not suitable for the bedding layer. The cost of this must be included in the unit price for normal excavation. (Under no circumstances may the top soil of the neighbourhood or any unlawful site be used for this purpose.)

6.1.3 A sufficient quantity of soft soil, similar to the bedding layer, must be available adjacent to the trench when a trench inspection is requested and to be used as cover layer to cover all the cables to a minimum depth of 80mm. Directly after the cable inspection all cables must be covered with this material.

6.1.4 The screen to be used for sifting the soil for the bedding or cover layers must have a mesh of not more than 10mm. This material must be prepared and ready for backfilling before an inspection of the cable installation is requested.

6.2 Planning

6.2.1 Before the laying of cables is commended the Contractor must thoroughly plan the job to ensure that pieces of cable left over can be re-used in the network and thus minimise wastage. The cost of all unnecessary wasted cable will be recovered from the Contractor when the Client supplies the cable.

6.2.2 The high voltage cables must be laid so that the starting end of the cable on one drum can connect to the terminating end of the previous drum to ensure that the core rotation remains the same. Where connection jointed to existing cable, it will be necessary first to determine the core rotation of the existing cable so that the new cable can be laid accordingly. This information must be submitted to the Engineer for discussion before cable laying is started.

6.2.3 The Contractor must allow sufficient cable at the start and end of routes to permit the cable to be made off on the switchgear or other terminating points. Where necessary the Engineer will decide what lengths are to be allowed. The Contractor must take the necessary steps to protect the termination lengths until such time as the cables are made off or the Contract has been completed. Protection of the cable ends includes capping by means of a soldered cap. Each cable end inside the substation must be clearly marked.

6.2.4 Successive high voltage cable lengths must overlap one another in joint pits by not less than one meter but not more than 1.5m.

6.2.5 No cables may be laid before the foundations for mini-substations or high voltage distribution cubicles have been installed and approved.

6.2.6 The cables must be laid on the same horizontal plain with a central line spacing of 150mm. The consecutive order of the cables in the trench from the stand boundary side must be as follows:

1. All secondary low voltage connection cables to the stands behind the meter cubicle or low voltage distribution box.
2. All main low voltage cables.
3. All high voltage cables.
4. All street lighting cables.
5. All secondary low voltage cables serving stands on the opposite side of the street.
6. All other cables i.e. photocell cables.

N.B. The low voltage cables must always cross underneath the high voltage cables. The service cables and street light cables may touch

Pilot cables and earthing conductors may be laid without clearances between other cables.

If a house service cable or street lighting cable will have to cross the other cables twice in order to be laid on the outside then that section of cable may occupy the inside position.

6.2.7 Cables must be laid without delay

The cables must be laid with the minimum delay in order to ensure that the trench is closed up as soon as possible. The Contractor may, however, not backfill the trench before he has tested every cable and assured himself that the cable is in order and has been inspected and approved by the Engineer.

The type of tests to be carried out on the respective cables must be discussed and approved by the Engineer before the installation work commences. Complete test records must be kept available for the Engineer's inspection at all times.

Only one cable may be laid at any time and the Contractor must ensure that the cables already laid are not damaged by subsequent laying procedures.

6.2.8 All cables must enter the mini-substations from the back and the high voltage cables must be laid with a curve to ensure that there is at least one meter tolerance for use if the end is damaged in case of a fault.

6.3 Procedure

6.3.1 The procedures according to which the cables will be laid must be approved by the Engineer in advance.

6.3.2 Cable rollers must be provided and so placed that the cable will not touch the bottom or sides of the trench when drawn into the trench. The rollers must be of approved construction without any sharp edges that may damage the cable. After removal of the rollers all slack must be taken up and the cable straightened to the satisfaction of the Engineer.

6.3.3 If the Contractor contemplates using a winch to draw the cable into the trench he must provide all required cable socks to be soldered to the cable sin such a manner that the pull is exerted simultaneously on all the cores, the lead sheath and the steel armouring of the cable.

6.3.4 The maximum permissible pull that may be exerted on the cable with the sock soldered to all the cores, the lead sheath and the steel armouring is as below:

For 240mm5, 3 core cable ..... 20 kN.

For 185mm5, 3 core cable ..... 20 kN.

For 150mm5, 3 core cable ..... 13 kN.

For 120mm5 and 70mm5, 3 & 4 core cable ..... 6 kN.

N.B. The maximum speed at which the cable may be drawn in is 10m/minute.

6.3.5 The cost of providing, placing and operating of all installation equipment must be included in the unit price for the laying of cables.

6.3.6 If the Engineer is not satisfied with the procedures or manner in which the cable is being laid (although approval may have been obtained earlier) he may direct the Contractor to provide adequate labour to lay the cable by hand in accordance with the standard practice of the local Electricity Department, and this will be at no extra cost to the Client.

6.4 Other Requirements

6.4.1 Cables must not be curved or unduly bent when drawn into sleeves.

6.4.2 Sharp objects such as picks shovels etc. may not be used to move cables and must not be left near the trench where they may damage the cable.

6.4.3 The Contractor must keep an accurate record of each drum of cable laid. The following data are required:

Drum number

Cable sectional area

Starting pint to finishing point description

Length of cut-off

Date of laying

N.B. The Contractor will be responsible for the cost of repairing any factory faults in the cable if the above data is not recorded immediately after the cable is laid.

6.5 Inspections and Measuring of Cables

6.5.1 A fully completed **INSPECTION FORM - FORM 'A'"** must be handed to the Engineer when notice is given that a cable length has been laid and is ready for inspection before the trench is backfilled. The required data must already be entered on the plan kept on site so that the Engineer and the Client's representative can verify the data and lengths of a particular section during inspection.

6.5.2 All cables must be measured and certified by the Engineer or the Client's representative before backfilling is done. (As far as possible use must be made of the dimensions marked on the cable). This information must be entered on the cable schedules to the satisfaction of the Engineer.

6.6 Backfilling of Cable Trench

6.6.1 After the cable has been laid, straightened, inspected and approved and covered with the cover layer specified in clause 6.1.3, the trench must be refilled for the full width with soil containing not more than 40% stones or shale and which will pass through a 100mm screen and has been approved by the Engineer.

6.6.2 Should there be more than 40% but less than 70% stone in the soil the Engineer will determine the percentage stone for which the Contractor will be reimbursed for replacing the stone with suitable backfilling soil. It will be required from the Contractor to import all the backfilling soil at extra compensation should the stone content be in excess of 70%.

6.6.3 The Contractor may import stoneless soil instead of sifting the soil if he so desires but he will only be compensated for

the actual percentage stone present as determined by the Engineer. The volume of imported soil required will (for payment purposes) be determined according to the nominal trench width.

6.6.4 The soil must be backfilled in layers of 300mm with the warning tapes as indicated on the enclosed cross-sectional drawing of the cable trench and must be consolidated to 90% AASHTO as amended. The soil for backfilling must not contain more than 10% moisture. The Engineer may call for the use of mechanical compactors if he considers it necessary.

6.6.5 The completed (reinstated) portions of the cable trench must be maintained by the Contractor in a safe condition for the full period of the contract. If the soil in the trench should subside he must refill and consolidate same.

6.6.6 After completion of the work the payment adjacent to the cable route must, for its full width, be neatly finished off and cleaned.

6.7 Reinstatement of Road and Other Surface Cover

6.7.1 All road material such as tarmac, crushed stone and gravel removed where excavations are done in roads and streets must be placed separately so that it will be readily available if needed. The order of backfilling the various layers must be exactly the same as they were taken out to the satisfaction of the Engineer. If not required for re-use it must be removed and dumped at the dumping site.

6.7.2 A trench excavated across an existing road must be temporarily filled with soil so that the road can be opened to the traffic until it can be permanently repaired by the local authority or, if required, by the Contractor. The temporary filling must be well maintained so that the traffic is not disrupted. Any claims in respect of damage to vehicles because the road crossings were not adequately maintained will be fully recovered from the Contractor.

6.7.3 The removal of tiles, bricks or similar materials necessitated by the trenching must be carefully done without damaging same and carefully stacked on one side for re-use. The Contractor will be responsible for damage to the tiles, bricks etc. except for damage to those already broken before the start of the work and pointed out the Engineer and entered in the site instruction book prior to commencement of the work.

6.7.4 Where the excavations have to cross lawns or other cultivated ground the Contractor must first, before starting the general excavation, remove the top-soil to a depth of 300mm and carefully place it separately so that it can later be re-used as top soil. If the Contractor should fail to separate the top-soil he will be required to provide approved top-soil to refill the top 300 mm of the trench at his own costs.

STANDARD SPECIFICATION

FOR

STANDBY DIESEL ALTERNATOR SETS

INDEX

STANDARD SPECIFICATION FOR STANDBY DIESEL ALTERNATOR SET

PAGE

STANDARD SPECIFICATION FOR STANDBY DIESEL ALTERNATOR SETS

1. SCOPE

This specification provides for standby diesel alternator sets and including all associated equipment.

2. GENERAL

13. Each diesel alternator set called for in this Specification will be used as a standby unit for the continuity of electrical power supply to emergency services.

Unless stated to the contrary in the Schedule of Particulars - Schedule A-SHED-11-01 the unit shall be fully automatic, i.e. the unit shall start up automatically when the main power supply fails and shall automatically shut down after a preset time when the normal power supply is restored.

The unit shall be capable of delivering the specified output, continuously under all site and operating conditions that may occur as specified in the Schedule for Prevailing Site and System Conditions A-SHED-01-A, without any signs of overheating or malfunctioning.

3. RATING OF ALTERNATOR SET

14. The standby alternator set shall have a continuous standby power rating on site, as specified in the attached Schedule of Particulars and Guarantees A-SHED-11-01.

The output terminal voltage of the alternator set shall be three phase, at a frequency of 50 Hz and at a voltage as specified in the attached "Schedule of Particulars and Guarantees - A-SHED-11-01.

4. DIESEL ENGINE

4.1 Rating

15. The specified rating of the diesel engine shall be the nett available kW-output (or brake horsepower) when the engine is equipped with all the necessary operating accessories such as air cleaners, lubricating oil pump, jacket water pump, charging alternator, governor, etc.

The radiator fan shall also be included as a necessary operating accessory and is to be deducted from the gross rating of the machine.

The engine power output capacity shall be measured at the engine flywheel, with all the above accessories attached and in operation.

The engine shall be rated for all the applicable site and system conditions, as well as all load characteristics, prevailing on site.

If required in the Schedule of Particulars and Guarantees Schedule A-SHED-11-01 the engine shall further be rated for a 10% overload capability based on the design rating at the specified speed, for a minimum period of one hour during any 12 hour continuous operating period.

4.2 Type

16. The engine shall be a two or four stroke, full compression ignition, solid injection and of the readily available type industrial rated type diesel engines.

4.3 Flywheel

17. The engine shall have a flywheel of suitable inertia, to ensure that the cyclic variations of the engine are within the limits as specified in B.S. 649.

No visible flickering of fluorescent or any lighting connected to the alternator set shall be allowed or accepted.

The flywheel shall be protected by a suitable guard to the approval of the Engineer.

4.4 Engine Speed

18. The engine speed shall not exceed 1500 r.p.m. at normal full load operation without the written permission of the Engineer.

4.5 Governor

The speed of the engine shall be controlled by a governor capable of providing accurate speed regulation to B.S. 649 Class A1.

4.6 Fuel

The engine shall be capable of the guaranteed performance using diesel fuels normally available in Southern Africa.

4.7 Fuel System

An engine driven fuel transfer pump shall be provided for supplying fuel through the filters at a constant pressure to the injection pumps.

The fuel system shall be equipped with replaceable type fuel filter elements of adequate capacity for at least 500 hours of continues operation. These filters shall be easily removable without breaking any fuel line connections, disturbing fuel pumps or any other engine components.

A hand operated bleeding pump shall be provided to bleed the fuel system to the approval of the Engineer.

A fuel control solenoid shall be fitted in the fuel supply to the engine. When the engine is switched off, the solenoid shall be closed, blocking the fuel supply to the engine. This solenoid shall also be actuated by an alarm circuit. The solenoid shall be rated for continuous operation.

4.8 Lubricating System

A gear type lubricating oil pump will supply oil under high pressure to all main bearings, crank pin bearings, pistons, timing gear, camshaft bearings and valve rocker mechanism.

An oil filter system shall be provided and this filter system shall be equipped with a suitable spring loaded bypass valve as an assurance against stoppage of lubricating oil circulation, in the event of the filters becoming clogged.

A label with the recommended oil type shall be provided on the engine in a fully accessible and legible position.

4.9 Cooling System

The engine shall either be of the water- or air cooled type. The type of cooling system shall be stated in the Schedule of Particulars and Guarantees - Schedule A-SHED-11-01. If the engine is of the water cooled type, the radiator and water system shall be of the high pressure type.

All water cooled engines shall be equipped with a water temperature meter clearly indicating the correct engine temperature. The engine shall also be protected against high temperature, which shall measure the water temperature (to the full approval of the Engineer). Two separate sensors shall be provided for the water temperature and high temperature protection.

All water cooled engines shall be equipped with a centrifugal pump to circulate the water through the engine and radiators.

The radiator and engine cooling system shall be filled with a rust inhibitor solution.

An electric heater or heaters shall be fitted to the engine to maintain the cooling system at a suitable temperature for cold starting under the worst climatic condition prevailing on site. The electric heaters shall be supplied from the control panel and protected by a circuit breaker.

Where louvers and/or sound attenuators are required to be fitted into the outside walls of the plant room to accommodate the cooling system, such louvers and/or sound attenuators shall be sized according to the requirements of the manufacturer of the standby alternator set. The supply of all such louvers and/or attenuators to site forms part of this Contract.

The louvers and attenuators shall be delivered to site according to the building program in order to be installed by the Builder.

The final colour of all such louvers shall be in accordance with the requirements of the Architect and shall be provided after the appointment of the Contractor.

The Contractor appointed in terms of this Contract will be held responsible to obtain the building program from the Builder and to ensure that the louvers are correctly installed by the Builder, to the specification of the manufacturer of the alternator set.

Should any additional ventilation fans, louvers, air ducts or anything else, to ensure adequate ventilation of the plantroom, be required, the tenderer shall clearly state these in his tender offer.

4.10 Air Intake System

The engine shall be equipped with high performance dry type air filters of adequate capacity for at least 500 hours of continuous operation.

A differential pressure indicator shall be installed on the filter clearly indicating when the filters are due for replacement.

4.11 Exhaust System

The exhaust system shall be designed to at all times prevent exhaust gasses being circulated in the plantroom.

The diesel engine will be provided with a suitable exhaust pipe and exhaust silencer or silencers to meet the ratings of environment noise criteria as specified in SABS 0103-1983 a.a. and any such additional requirements specified by the appropriate Local Authority, for the applicable location, or the rating specified in the Schedule.

A flexible interconnector shall be provided between the engine and the silencer. To reduce tension on the exhaust manifold and the silencer, this flexible interconnector shall be mounted in a straight line section of the exhaust system.

The exhaust system inside the plantroom shall be covered with 20 mm dia asbestos-rope and cement.

The exhaust system shall be installed at an approved slope to ensure that all condensate be drained to the outside of the plantroom, or alternative drainage shall be provided to approval.

The successful tenderer shall finish off and seal off the walls where the exhaust pipe passes through the wall. A flashing shall be used on the outside of the wall, and a flexible cover plate on the inside to the approval of the Engineer.

4.12 Engine Protection

The engine shall be equipped with automatic safety control system which shall shut the engine down in the event of low lubricating oil pressure, high engine temperature or overspeed. This protection system shall be backed up with a clear and legible indication and alarm system, clearly indicating the cause of the stoppage to the full approval of the Engineer.

4.13 Instrumentation

The following instrumentation is required as the minimum to be provided:-

a) Jacket water thermometer
b) Fuel gauge
c) Fuel pressure gauge
d) Mechanical hour meter
e) Lubricating oil pressure gauge
f) Lubricating oil thermometer (only on air cooled engines)
g) Battery charging ammeter
h) Electrical or mechanical tachometer

All instruments shall indicate minimum, maximum and normal operating conditions.

4.14 Starting System

An electric starting motor must be fitted to the engine. Besides the automatic starting and stopping, provision must further be made on the control board for manual starting and stopping of the unit, by means of a key switch.

4.15 Charging System

The unit is to be provided with a charging alternator to keep the batteries in a fully charged condition while the engine is running.

A centre zero D C ammeter with a suitable and approved scale shall be connected to the starter battery circuit to clearly indicate the charge or discharge current.

A 220V mains operated automatic battery charger shall be provided according to the latest revised Specification for Battery Systems A-SPES-01-02 in order to keep the starting batteries fully charged in the non-running condition.

4.16 Batteries

The starting batteries shall be provided according to the latest revised Specification for Battery Systems A-SPES-01-02. The batteries shall be adequately rated to the approval of the Engineer. The batteries and battery charger shall be preferably mounted on the alternator unit, or as specified.

4.17 Fuel Tank

The fuel tank shall be mounted within the base of the unit or alternatively as a free standing. The tank shall have sufficient capacity to run the engine on full load for a minimum period of 8 hours or as specified in the Schedule. For filling the tank from 200 litre drums, a manually operated hand pump must be supplied.

The tanks shall be welded and constructed from sheet metal of minimum thickness of 1,6 mm. A drain plug shall be fitted in the bottom of the tank to drain off sludge and water. The bottom of the tank shall have an adequate slope towards the drain plug.

The tank shall be fitted with a fuel level indicator to the approval of the Engineer. A sump shall be provided beneath the tank on the floor of sufficient size to hold the full capacity in case of a fuel leak. This sump shall preferably be in concrete. It remains the responsibility of the contractor to ensure that the builder provides this required sump to his specification.

4.18 Coupling

The engine and alternator must be directly coupled by means of an approved shock absorbent flexible coupling. This coupling shall be removable with the engine and alternator in position.

5. BASE REQUIREMENTS

The base shall be of the duplex type consisting of two separate steel frames, with the one frame mounted inside the other.

Anti-vibration mountings shall be provided between the inner and outer frames at 45 degree angles. The anti- vibration mountings shall be rated to carry the fully equipped alternator set.

An approved method to lock the inner frame in position during transport shall be provided.
The outer frame shall be constructed as a skid, complete with lifting and pulling lugs for transportation purposes.

The engine and alternator shall be mounted on the inner frame.

The base construction shall be such that it will support and hold the complete unit in position during transportation and service conditions on site.

The outer frame shall be bolted to the concrete base, to the approval of the Engineer.

6. ALTERNATOR

6.1 Rating

19. Unless state to the contrary in the Schedule of Particulars and Guarantees - Schedule A-SHED-11-01, the alternator shall generate the specified voltages on three phase and at 50 Hz. The alternator shall be rated for the specified output and power factor as detailed in the 'Schedule of Particulars and Guarantees - Schedule A-SHED-11-01.

The alternator must be of the two bearing type equipped with ball or roller bearings. The bearings must be pre-lubricated to ensure long service periods without attention.

The alternator shall be of the self excited brushless type, with an enclosed and ventilated drip proof housing and must be capable of supplying the specified output continuously, with a temperature rise not exceeding the limits laid down in B.S. 2613, for rotor and stator windings with insulation of class F or better. Both windings must be fully impregnated for tropical climate and must have an oil resisting finishing varnish.

The alternator must be equipped with damper windings, enabling the unit to accommodate an unbalanced load of at least 25% of full load at any load and at the normal operating conditions without incurring any damage.

If stated in the Schedule of Particulars and Guarantees - A-SHED-11-1 the alternator shall be rated for 10% overload for a period of one hour, within a 12 hour operational period consecutively, without exceeding the prescribed temperature rise limits.

6.2 Construction

The rotor shall be dynamically balanced and all the windings and rotating components shall be suitable to withstand an overspeed of 25%.

6.3 Excitation

The excitation system shall be designed to promote rapid voltage recovery, following the sudden application of the full load. The voltage shall recover to within 2,5% of the steady state voltage within 0,3 seconds following the application of full load and the transient voltage dip shall not exceed 15%.

6.4 Wave Form

The voltage wave form of the alternator shall be such that the total voltage of the harmonic frequencies shall not exceed 5% of the voltage of the fundamental frequency over the range from no load to full load.

6.5 Regulation

The alternator must be self regulated and the inherent voltage regulation not exceeding 2,5% of the nominal voltage specified at all loads within the power factor limits between unity and 0,8 and within the driving speed variations of 4,5% between no load and full load.

6.6 Radio Interference

The alternator shall be suppressed to comply fully with the requirements of B.S. 800 as revised.

7. AUTOMATIC CONTROL CUBICLE

7.1 Construction

The automatic control cubicle shall be provided in accordance with the requirements detailed in the Specifications for Control Boards and Small Wiring A-SPES-01-01, attached.

7.2 Instrumentation

The following instrumentation shall be provided with each panel, as an absolute minimum:-

7.2.1 Three combined instantaneous and maximum demand ammeters.

7.2.2 One voltmeter with a voltmeter selector switch.

7.2.3 One frequency meter

7.2.4 One power factor meter

7.2.5 All instrumentation as specified for the diesel engine.

7.3 Selector and Control Switches

7.3.1 A control selector switch to give the following modes of operation of the alternator set.

OFF: All D.C. control circuits will be isolated
AUTO: The plant will start and stop automatically depending on whether the mains supply is available or not.
20. TEST: The automatic operation of the plant is tested without placing the plant on load.
MANUAL: The set may be started and stopped by means of approved push buttons.

7.3.2 Two separate manual start and stop push buttons.

7.3.3 Audible alarm cancel switch

7.3.4 Push button to test all indication lamps.

7.4 Monitoring Equipment and Alarms

7.4.1 Voltage and frequency monitoring equipment shall be installed in the control cubicle, to control the change over contactor and to provide the alternator with high and low speed protection. The three line voltages on both the alternator terminals and the terminals of the distribution network will be monitored by the voltage monitoring equipment.

7.4.2 The low voltage trip shall be adjustable between 90% and 94% of the nominal supply voltage. Initially this trip shall be set at 94% unless otherwise indicated in writing by the Engineer.

7.4.3 The high voltage trip shall be adjustable between 100% and 110% of nominal supply voltage. Initially this trip shall be set at 108% unless otherwise indicated in writing by the Engineer.

7.4.4 The voltage setting, actuating the change over operation shall be adjustable between 100% and 110% of nominal voltage and shall be set initially at 103% of the nominal voltage unless otherwise indicated in writing by the Engineer.

7.4.5 The frequency monitor shall trip the plant when exceeding the frequency limit's of -6% and + 6%.

7.4.6 All these monitor outputs shall activate the protection and alarm circuits accordingly.

7.4.7 All the monitors shall have a adjustable time delay between 1 and 5 seconds. No time delay shall be provided on the high frequency trip monitor.

7.4.8 The following protection and alarm circuits shall be provided and installed.

7.4.8.1 Low engine oil pressure

7.4.8.2 High engine temperature

7.4.8.3 High frequency

7.4.8.4 Low frequency

7.4.8.5 High Voltage

7.4.8.6 Low Voltage

7.4.8.7 Engine Start failure

7.4.8.8 Low fuel (Day tank)

7.4.8.9 Bulk fuel low

7.4.8.10 Low Battery Voltage

7.4.8.11 Over current (Actuated by the auxiliary contacts of the main circuit breaker)

7.4.9 All the above mentioned alarms shall be indicated by an approved lamp or flag on the control cubicle. The indicators shall be labelled as follows:

OLIEDRUK LAAG/OIL PRESSURE LOW
OORSNELHEID/OVER SPEED
ONDERSNELHEID/UNDER SPEED
LAE SPANNING/UNDER VOLTAGE
HO SPANNING/OVER VOLTAGE
AANSITFOUT/START FAILURE
BRANDSTOF MIN/FUEL LOW
MASSA BRANDSTOF MIN/BULK FUEL LOW
BATTERYSPANNING LAAG/LOW BATTERY VOLTAGE
OORSTROOM/OVER CURRENT

7.4.10 Any of the alarms mentioned in 7.4.8.1 to 7.4.8.7 shall interrupt the diesel supply to the engine to stop the engine and activate the audible alarm system immediately.

7.4.11 The low fuel alarm mentioned in 7.4.8.8 shall have two stages. An audible alarm must be activated when the fuel tank is 25% full and when the fuel level reached the 5% full mark the fuel supply to the engine shall be interrupted to stop the engine.

7.4.12 Any of the alarms mentioned in 7.4.8.8 to 7.4.8.10 shall not stop the engine,but will only be indicated on the control panel and shall activate the audible alarm system.

7.4.13 An alarm reset button shall be provided to cancel the alarm after the cause has been attended to.

7.4.14 An alarm master relay, with four auxiliary contacts rated at 3 Amps shall be installed to provide for an external alarm indicator. This master alarm shall not operate for a "Low Bulk Fuel Supply" alarm. The auxiliary contacts shall be wired to a terminal strip in the control cubicle. This alarm shall be reset by an alarm reset button.

7.4.15 A separate similar feature is required for the "Low Bulk Fuel Supply" alarm as mentioned above.

7.4.16 An indicator lamp test facility shall be provided by means of an approved test button.

8. OPERATIONAL REQUIREMENTS

8.1 An automatic change over contactor with electrical and mechanical interlocking shall be provided and installed in an approval position in the control cubicle. This change over contactor shall open when the normal "supply" voltage is interrupted, and will automatically close when the terminal voltage of the alternator reached its nominal voltage, thereby connecting the alternator on load.

8.2 Voltage- and frequency monitoring equipment shall be installed to monitor the normal "supply". When the voltage or frequency deviates from the normal operating conditions, a time relay, adjustable between 0 and 60 seconds shall initiate after the preset time delay the engine starting cycle.

8.3 The starting cycle shall consist of three time relays, with two relays which will be adjustable between 0 - 30 seconds. The two time relays shall perform the starting cycle. The starting cycle shall actuate the first time relay, which will energise the starter motor of the engine for the preset time. The second time relay shall perform the "wait period" before the second and third starting attempt is been actuated. After three unsuccessful starting cycles the third time relay shall be actuated to interrupt any further starting cycles and give an alarm "Start Failure". The third time relay shall have an adjustable time range of not less than 60 seconds.

8.4 When the alternator output voltage reaches the nominal value, the change-over contactor shall be activated to transfer load to the alternator.

Mechanical and/or electrical interlocking shall be provided in order to ensure that the change-over switching do not proceed under the following conditions:

(a) the engine fails to start
(b) interruption of the network supply voltage when the selector switch is in the "Manual", "Test" or "Off" positions.
(c) both above mentioned situations occur.

8.5 A timer relay shall be actuated when the supply network voltage is restored. This relay shall be adjustable between 0 - 10 minutes, and shall actuate the change over contactor to connect the load on back to the supply network.

8.6 After the load has been re-established to the supply network, the alternator set shall be switched off, by means of a time relay, which will be adjustable between 0 - 10 minutes, enabling the set to be "run down" for a preset time period.

8.7 Should any of the above mentioned control circuits or relays fail, the load shall be transferred automatically from the alternator to the supply network.

Each tenderer shall submit with this tender offer, a complete set of drawings and descriptive literature of the alternator control system offered. Any deviations of the specified alternator control system shall be clarified at tender stage. If no

clarification or qualification is submitted with the tender offer, it shall be accepted that the offer fully complies with all the requirements of this specification.

9. BYPASS SWITCH

A three position bypass switch shall be provided and installed in the control cubicle.
The bypass switch shall be screened off and mounted separately from all the other equipment in the cubicle.
The bypass switch shall provide the following switching:
BYSTAND/STANDBY - Normal working condition
OMLOOP/BYPASS - Incoming mains connected directly to the load with the alternator isolated for maintenance purposes.
AF/OFF - The incoming mains, alternator and load all isolated.

10. EARTHING

All non current carrying metal parts on the alternator set shall be bonded to the earthing system.

The neutral point of the alternator must be solidly earthed to the full approval of the Engineer.

If not stated elsewhere to the contrary, the Contractor shall provide an adequate earthing system, to the approval of the Engineer.

11. NOTICES

In the plantroom a clearly legible and indelible warning notice must be mounted in a conspicuous position.
The warning notice must read as follows:

"DANGER
This engine will start without notice. Turn selector switch on control board to "OFF" before working on the plant.

GEVAAR
Hierdie enjin sal sonder waarskuwing begin loop. Draai keuseskakelaar op beheerpaneel na "AF" voordat aan die masjienerie gewerk word."

Danger plates and notices shall be provided and installed on all the access doors of the plantroom.

Any notices shall be provided and installed as required in terms of The Machinery and Occupational Safety Act and Regulations - Act 6 of 1983 as amended to the full approval of the Engineer.

A complete, step-by-step fault finding procedure shall be provided and installed in a wooden frame, under a glass or perspex covered panel on the wall of the plantroom.

The following notice shall be provided on the outside of the door to the standby alternator set room, directly above the door lock:-

- Have the selector switch been turned back to the "automatic" position, prior to leaving?
- Was die keuseskakelaar na die "outomatiese"-posisie teruggedraai, voordat u die aanleg verlaat het?

12. GUARANTEE

The successful tenderer shall be required to guarantee the complete plant for a period of 12 months from the date it has been taken over by the Engineer in running order and been put into operational use (i.e. after issuing of Form "C").

If during this period the plant is not in working order or not working satisfactorily, owning to faulty material, design or workmanship, the contractor will be notified and, immediate steps shall be taken by him to rectify the defects and/or replace the affected parts on site, at his own expense.

13. MAINTENANCE

The successful tender will be required to maintain the plant in good running condition to the approval of the Engineer for a period of 12 months after the plant has been taken over by the Client (i.e. issuing of Form "C"). The cost of this maintenance must be included in the tender price of the Contractor.

14. INSTRUCTION OF OPERATOR

After completion of the installation and prior to the plant being put into full operation, the Contractor will be required to instruct an attendant, appointed by the Client, in the detailed operation of the plant, until he is fully conversant with the equipment, fault locating and the safe handling thereof to the approval of the Engineer.

Three copies of maintenance, fault-localising and operating manual are to be handed over to the Engineer on site, prior to the Engineer issuing Form "C".

15. TESTS

21. The following tests are to be carried out:

(a) At the supplier's premises, prior to the generating set being dispatched to site.

Representatives of the Consulting Engineers shall be present during the test to satisfy themselves that the generating set complies with the specification and delivers the specified output within the specified limitations. The test must be carried out in accordance with B.S.S. 649, clause 7.

The Engineer must be advised in time of the date of this test at least three days in advance.

(b) At site after completion of the installation all instruments which may be required for the tests have to be provided by the successful tenderer.
The highest possible load existing on the emergency supply network shall be connected to the standby set and shall be energized for a minimum period of 2 hours after which time the temperature rise shall be measured. In addition to the above, the noise levels shall be measured and recorded and all alarms and interlocks shall be proved to the Engineer.

Triplicate copies of the detailed test reports of both tests as specified under (a) and (b) are to be submitted to the Engineer, within 2 weeks of the plant being handed over.

16. DRAWINGS

22. The successful tenderer will submit for approval within four weeks after adjudication of the Tender, three paper copies of the following drawings:

(a) Complete detailed general layout drawing

(b) Working drawings of the cooling and exhaust systems

(c) Complete detailed and dimensional drawings of the alternator set with all auxiliary equipment.

(d) Wiring diagrams of the control protection and alarm circuitries.

(e) Detail layout of the equipment to be installed on the control panel.

23. The Contractor shall submit one complete set of transparent plastic "As Installed" drawings to the Engineer before an "Acceptance Certificate - Form C" will be issued.

All drawings shall be to microfilm standards and shall meet the requirements of SABS 0111-1980 as amended and SABS 0143-1980 as amended as applicable.

17. MANUALS

Four copies of the complete set of manuals shall be provided in a steel cabinet in the plantroom, to the full approval of the Engineer. A set of manual shall consist of the following:

(a) General description of the installation

(b) Manufacturer's Instruction

(c) Operating Instructions

(d) Maintenance Instructions

(e) Fault finding Instruments

The Contract shall be deemed as "Incomplete" until all manuals, drawings and descriptive literature are received and approved by the Engineer, and will result in a minimum of 10% of the Contract moneys being withheld.

35 ANNEXURE F - DECLARATION BY BIDDER

Only bidders who completed the declaration below will be considered for evaluation.

RFP No: ……..

I hereby undertake to render services described in the attached tendering documents to CSIR in accordance with the requirements and task directives / proposal specifications stipulated in **RFP No……..** at the price/s quoted. My offer/s remains binding upon me and open for acceptance by the CSIR during the validity period indicated and calculated from the closing date of the proposal.

I confirm that I am satisfied with regards to the correctness and validity of my proposal; that the price(s) and rate(s) quoted cover all the services specified in the proposal documents; that the price(s) and rate(s) cover all my obligations and I accept that any mistakes regarding price(s) and rate(s) and calculations will be at my own risk.

I accept full responsibility for the proper execution and fulfilment of all obligations and conditions devolving on me under this proposal as the principal liable for the due fulfilment of this proposal.

I declare that I have no participation in any collusive practices with any bidder or any other person regarding this or any other proposal.

I accept that the CSIR may take appropriate actions, deemed necessary, should there be a conflict of interest or if this declaration proves to be false.

I confirm that I am duly authorised to sign this proposal.

NAME (PRINT) …….

CAPACITY ……

SIGNATURE ……

NAME OF FIRM ……..….

DATE ……

WITNESSES
1 ……..……
2 ……..……
DATE……...

36 ANNEXURE G – SCORING SHEET

No.	Criteria	Proof required	Points allocation	Weight
1	**Company experience** ▪ The service provider must have experience on similar projects. ▪ The bidder must provide a clearly detailed company profile, stipulating the number of years rendering similar services.	▪ The bidder must provide a clearly detailed company profile, stipulating the number of years rendering similar services. ▪ The bidder must demonstrate the experience of the firm with respect to specific aspects of the project. Bidder must submit list of projects completed between 2015 and 2021.	No submission - 0 point 1- 4 projects - 4 points 5 – 7 projects – 6 points 8 – 10 projects – 8 points >10 projects – 10 points	**30%**
2	**Client references (only relevant references)** ▪ A minimum of three (3) contactable reference letters for similar work is required. ▪ Reference letters must be provided to substantiate such claims from different cliental. ▪ Completed projects/sites of similar projects must be accessible for vetting purposes.	▪ Contactable references for similar work/projects undertaken between 2015 and 2021. ▪ Completed reference form / letter for each reference.	No submission - 0 point 1- 2 references – 4 points 3 –5 references – 6 points 6 – 8 references – 8 points >10 references – 10 points	**40%**
3	**Staff capability** Detailed CV of Lead Installer, indicating the number of years and experience in similar projects	▪ Detailed CV of the Lead Installer. ▪ Must submit proof of Wireman' license. ▪ Must submit Electrical Trade Test. ▪ Must have minimum of 5 years work experience.	No submission - 0 point 1-4 years' experience – 4 points 5 – 7 years' experience – 6 points 8 – 10 years' experience – 8 points >10 years 'experience – 10 points	**30%**
			TOTAL	**100%**

37 ANNEXURE H - EQUIPMENT REQUIREMENTS

See Annexure B and Annexure K

ANNEXURE I

SCHEDULE OF PRICES

FOR THE

ELECTRICAL INSTALLATION

FOR THE

SWITCHGEAR REPLACEMENT

FOR

THE CSIR

GENERAL NOTES TO BILLS OF QUANTITIES FOR ELECTRICAL INSTALLATIONS

1. The attached Bills of Quantities form part of the Tender Document and shall be read in conjunction therewith.

2. Reference shall be made to the Specifications for the full meaning and description of work to be done and material/equipment to be used.

3. The Bills of Quantities shall be fully completed and returned to form part of a valid tender before the tender closing time.

4. No alterations, addition or erasure may be made to the text of the Bills. If such an alteration, addition or erasure is made it shall not be acknowledged and the original wording of the text shall apply.

5. All prices or rates shall be given against each item of the Bills of Quantities irrespective of any quantities given or not. The cost of items if not priced shall be taken as being included in other price or rates in the Bills of Quantities.

6. "Rates only" items, as all other rates and item prices will be used for costing variations.

7. Provisional Amounts and Contingency Sums are budgetary costs for use by the Engineer at his discretion and may be omitted in total without any compensation to the Contractor whatsoever.

8. Since the Specifications call for complete operational systems, the rates submitted shall cover the cost of associated items not specifically listed, but which are required for a complete operational installation in terms of the Specifications. Should the Tenderer wish to list such items separately, or if any requirements of the Specifications are not specifically covered by items in the Bills of Quantities, the Tenderer shall allow for these as additional items or in his Tender covering letter.

9. Unless otherwise measured all rates shall include for the detail design, engineering, procurement, supply, delivery, erection, waste, storage, commissioning, testing, maintenance and guarantee of material or equipment in terms of the Specifications.

10. Quantities in the Bills are net and Tenderers shall allow in their rates for wastage, off cuts, "slack" or over excavations.

11. The Engineer will use his discretion to correct conspicuous arithmetical errors when

adjudicating the tenders. The price entered against an item shall be accepted as being the correct price tendered for, for the completion of the work involved. Should any difference appear between the Rate times the quantity and the total item price, the Client shall have the right to adjust the individual unit rate as he may deem necessary in order that the Rate times quantity agrees with the total item price.

12. All unit rates entered in the Bills of Quantities shall exclude Value Added Tax. 14% Value Added Tax shall however be added to the Total Net Tender sum and this value including Value Added Tax shall be carried over to the Form of Tender as the TENDER SUM.

13. The Contractor shall allow in his costing for out of sequence work and re-programming due to unforeseen circumstances during construction.

14. No orders shall be placed on the basis of the quantities in the Bills, but shall be verified on site by the Contractor prior to placement of orders.

15. The final Contract price shall be measured to the actual installed net quantities of materials and work done and priced to the unit rates as stated in the Bills of Quantities, adjusted for escalation if applicable.

	BILL NO 1: PRELIMINARIES & GENERAL					
	CSIR B44 SWITCHGEAR REPLACEMENT					
	DESCRIPTION	**UNIT**	**QTY**	**MATERIAL RATE**	**LABOUR RATE**	**AMOUNT**
1.1	**CONTRACTUAL ITEMS**					
1.1.1	Fixed-charge and Value-related items.					
a	Contractual requirements	Sum	1			
b	Erection of facilities on site	Sum	1			
c	Removal of facilities from site	Sum	1			
1.1.2	Time-related Items					
a	Contractual requirements	Sum	1			
b	Usage and maintenance of facilities on site	Sum	1			
c	Supervision	Sum	1			
d	Company and Head Office overhead costs	Sum	1			
1.2	**NOTICE BOARD**					
a	Erection and removal of notice board.	Sum	1			
1.3	**OHS ACT REQUIREMENTS**					
	All conditions pertaining to the OHS Act, including but not limited to the items listed below:					
a	Provision of a SAFETY plan	Sum	1			
b	Provision of a medical aid kit on site	Sum	1			
c	Appointment of an ACCREDITED safety person on site	Sum	1			
d	Supply and provision of safety clothing to all workers on site	Sum	1			
e	Adherence to and Compliance with the OSH Act	Sum	1			
1.4	**WORKS ITEMS**					
1.4.1	Setting out of work	Sum	1			

1.4.2	Test and commission the installation and issue certificate of compliance	Sum	1			
1.4.3	Provide "As Built" drawings	Sum	1			
1.4.4	Additional items that the tenderer wishes to detail in order to complete the contract in good order:					
a						
b						
c						
d						
	NOTE:					
	THE INSTALLATION MUST COMPLY FULLY WITH SANS 10142					
	BILL 1 TOTAL TO SUMMARY					

	BILL NO 2: MEDIUM VOLTAGE EQUIPMENT					
	CSIR B44 SWITCHGEAR REPLACEMENT					
	DESCRIPTION	**UNIT**	**QTY**	**SUPPLY RATE**	**INSTALL RATE**	**AMOUNT**
2.1	**MEDIUM VOLTAGE CABLES**					
2.1.1	**11 kV, PILC Table 17 Cable:**					
a	70 mm², 3C, Cu Conductor	m	300			
b	95 mm², 3C, Cu Conductor	m				
c	185 mm², 3C, Cu Conductor	m				
2.1.2	**Cable Joints for above 11kV type cable.**					
a	70 mm², Cable Joints	each	5			
b	95 mm², Cable Joints	each				
c	185 mm², Cable Joints	each				
2.1.3	**Cable Terminations for above 11kV type cable.**					
a	70 mm², Cable Terminations	each	3			
b	95 mm², Cable Terminations	each				
c	185 mm², Cable Terminations	each				
2.1.4	**Bare Copper Earth Wire (BCEW) to be Installed with 11kV Cables**					
a	70 mm² BCEW	m	100			
b	Terminations for above BCEW	each	2			
c	Joints for above BCEW	each	2			
2.2	**11kV SWITCHGEAR**					
2.2.1	**Bulk Metering Kiosk (BMK)**					
a	Supply and install new BMK - 2SD & CB BMK, complete as per project specifications	each				
b	Supply and install BMK Pre-Cast Plinth	each				
c	Earthing System for BMK	each				
2.2.2	**Ring Main Unit (RMU)**					
a	Supply and install new Free Standing 11kV Metal Enclosed Ring Main Unit RMU - 3 SD	each				

	configuration, complete as per project specifications					
b	Supply and install RMU Pre-Cast Plinth	each				
c	Earthing System for RMU	each				
2.2.3	**Miniature Substations**					
	Miniature Substation, as per project specifications c/w circuit breakers and associated equipment					
a	315 kVA	each				
b	500 kVA	each				
c	630 kVA	each				
d	800 kVA	each	1			
e	1000kVA	each				
f	Supply and Install Pre-Cast double bunt concrete Plinth for above miniature substations - Included under PROVISIONAL SUMS	each				
g	Earthing System for Miniature substation	each	1			
h	VT's and CT's for Miniature substation feeder as per the drawing	each	1			
2.3	**SCANNING OF BURRIED SERVICES**					
2.3.1	Scanning and positively identifying of buried electrical cables	lot	1			
2.4	**TEST AND COMMISSIONING**					
2.4.1	Test and commissioning of the complete system, and issue the necessary test certificates	Sum	1			
	BILL 2 TOTAL TO SUMMARY					

	BILL NO 3:	**DISTRIBUTION BOARDS**				
	CSIR B44 SWITCHGEAR REPLACEMENT					
	DESCRIPTION	**UNIT**	**QTY**	**SUPPLY RATE**	**INSTALL RATE**	**TOTAL**
POWER DISTRIBUTION BOARDS						
	Low voltage distribution boards complete with all doors, sheet metal frames, subframes, chasis fixures, fittings, HDHC copper busbar, legend cards, complete with 30% spare space, and switchgear as per specification and drawings					
SHEET METAL						
3001	MAIN LV DB	LOT	1			
3002						
3003						
3004						
3005						
3006						
3007						
3008						
ADDITIONAL SUPPLY MOLDED CASE CIRCUIT BREAKERS						
	ADJUSTABLE SCHNEIDER MCCB - Installed in MAIN LV DB - Including all busbars and tails					
3009	**800A/25kA - RATES ONLY**	EACH				
3010	**630A/25kA - RATES ONLY**	EACH				
3011	**400A/25kA - RATES ONLY**	EACH				
3010	**250A/25kA - RATES ONLY**	EACH				
INFRARED SCAN AND REPORT FOR DB'S						
	Infrared & Photographic report of the following Distribution Boards at Project WC date					
3010	MAIN LV DB	LOT	1			
3011						
3012						
3013						
3014						
3015						
3016						
3017						
SURVEY REPORT FOR DB'S						

	Detail survey of existing Distribution Board to verify the actual circuit breaker and cable sizes with the SLD before placing of order.					
3018	MAIN LV DB	LOT	1			
3019						
3020						
TEST AND COMMISSIONING						
3021	Test and commissioning of the complete system, and issue of the necessary test certificates	Sum	1			
	BILL 3 TOTAL TO SUMMARY					

	BILL NO 4:	**LOW VOLTAGE CABLES**				
	CSIR B44 SWITCHGEAR REPLACEMENT					
	DESCRIPTION	**UNIT**	**QTY**	**SUPPLY RATE**	**INSTALL RATE**	**TOTAL**
	LOW VOLTAGE CABLE FEEDERS					
	600/1000V Grade PVC/PVC/SWA/PVC Red Stripe Fire Retardant (FR) stranded copper conductor cables (Terminations and earth conductor measured elsewhere)					
	Cable laid in a trench, pulled into sleeve, fixed to cable ladder or duct (including PVC cable ties or 'K' clamps) and as required in the specification.					
4001	4 sq mm x 4 core ECC - RATES ONLY	m				
4002	6 sq mm x 4 core ECC - RATES ONLY	m				
4003	10 sq mm x 4 core ECC - RATES ONLY	m				
4004	16 sq mm x 4 core ECC - RATES ONLY	m				
4005	25 sq mm x 4 core ECC - RATES ONLY	m				
4006	50 sq mm x 4 core ECC - RATES ONLY	m				
4007	95 sq mm x 4 core ECC - RATES ONLY	m				
4008	120 sq mm x 4 core ECC - RATES ONLY	m				
4009	185 sq mm x 4 core ECC	m	800			
	CABLE TERMINATIONS					
	Terminate 600/1000V grade PVC/PVC/SWA/PVC copper conductors ECC cables, including lugs, cable identification markers, drilling, bolting, waterproof shroud and gland					

4010	4 sq mm x 4 core ECC - RATES ONLY	EACH				
4011	10 sq mm x 4 core ECC - RATES ONLY	EACH				
4012	16 sq mm x 4 core ECC - RATES ONLY	EACH				
4013	25 sq mm x 4 core ECC - RATES ONLY	EACH				
4014	50 sq mm x 4 core ECC - RATES ONLY	EACH				
4015	95 sq mm x 4 core ECC - RATES ONLY	EACH				
4016	120 sq mm x 4 core ECC - RATES ONLY	EACH				
4017	185 sq mm x 4 core ECC	EACH	24			
	EARTH WIRE					
	Bare stranded copper earth wire installed in cable trench, pulled into sleeves, on cable ladder or duct, including fixings and terminations , including lugs, bolts, nuts, drilling, etc.					
4018	4 sq MM - *RATES ONLY*	m				
4019	16 sq MM - *RATES ONLY*	m				
4020	70 sq MM - *RATES ONLY*	m				
	TEST AND COMMISSIONING					
4021	Test and commissioning of the complete system, and issue of the necessary test certificates	Sum	1			
	BILL 4 TOTAL TO SUMMARY					

	BILL NO 5: CABLE TRENCHES AND SLEEVES					
	CSIR B44 SWITCHGEAR REPLACEMENT					
	DESCRIPTION	**UNIT**	**QTY**	**SUPPLY RATE**	**INSTALL RATE**	**TOTAL**
	CABLE TRENCHES					
	EXCAVATIONS					
	Refer to Standard Specifications					
	NATURE OF GROUND:					
	The following is the classification of the materials to be excavated:					
	SOFT GROUND					
	Shall mean all soil, earth gravel, clay and such other materials that can be excavated by hand or mechanical trenching equipment excluding jack hammers					
	"SOFT" ROCK (INTERMEDIATE):					
	Shall mean only such hard gravel or "soft" rock that can be excavated only by means of jack hammers					
	"HARD" ROCK:					
	Shall mean only such rock formation that can only be removed by means of explosives					
	EXCAVATIONS					
5001	"SOFT" GROUND	m^3	79			
5002	"SOFT" ROCK	m^3	23			
5003	"HARD"ROCK	m^3	11			
	BACKFILL AND COMPACTION					
5004	"SOFT" GROUND	m^3	79			
5005	"SOFT" ROCK	m^3	23			
5006	"HARD"ROCK	m^3	11			

5007	Clean, dry sifted through 10mm mesh, bedding soil, selected from the excavations, placed at bottom of cable trenches, and covering cables	m^3	23			
5008	Ditto but carted on (Only by Engineers Instruction)	m^3				
	CABLE SLABS					
5009	900mm Long x 300mm wide x 75mm thick concrete slabs laid in cable trench	EACH				
5010	2mm thick, interlocking type P.V.C. cable covers	EACH				
	DANGER TAPE					
5011	300mm Wide plastic, dangertape, laid in cable trench	m	250			
	CABLE SLEEVES					
5012	50mm PVC sleeve laid in cable trench	m	10			
5013	110mm PVC sleeve laid in cable trench	m	100			
5014	160mm PVC sleeve laid in cable trench	m	10			
5015	50mm PVC sleeve cast in concrete slab	m				
5016	110mm PVC sleeve cast in concrete slab	m				
5017	160mm PVC sleeve cast in concrete slab	m				
5018	Slow bend for 50mm PVC sleeve	EACH	2			
5019	Slow bend for 110mm PVC sleeve	EACH	2			
5020	Slow bend for 160mm PVC sleeve	EACH	2			
	DRAW WIRE					
5021	3mm diameter galvanized steel draw wire drawn into sleeves	m	250			
	MANHOLES					

5022	600x600x1000 complete with heavy duty double seal cover	EACH	1			
5023	400x400x600 complete with heavy duty double seal cover	EACH				
	BILL 5 TOTAL TO SUMMARY					

	BILL NO 11:	**MISCELLANEOUS ITEMS**				
	CSIR B44 SWITCHGEAR REPLACEMENT					
	DESCRIPTION	**UNIT**	**QTY**	**SUPPLY RATE**	**INSTALL RATE**	**TOTAL**
	REMOVAL OF EXISTING ELECTRICAL EQUIPMENT					
	All redundant MV and LV Equipment as per the project specification					
1102	Transformers	qty	**3**			
1103	MV Switchgear	lot	**1**			
1104	LV Distribution Board	qty	**1**			
1105	MV Cable	lot	**1**			
	BILL 11 TOTAL TO SUMMARY					

	BILL NO 12: STANDBY DIESEL GENERATOR UNIT					
	CSIR B44 SWITCHGEAR REPLACEMENT					
	DESCRIPTION	**UNIT**	**QTY**	**SUPPLY RATE**	**INSTALL RATE**	**TOTAL**
	SDGU					
1201	Supply, test, deliver to site, off-load and place in position on site of the SDGU unit as specified (Factory tests with dummy loads included)					
	SDGU (with double skin 12-hour day tank) & AMF Panel	EACH	**1**			
	Noise Attenuation Louvres & Ducting (Air) <65DBA	EACH	**1**			
	Exhaust system	EACH	**1**			
	Exhaust system lagging and cladding	EACH	**1**			
1202	Final connection of all power data and control cables, including traveling to site	EACH	**1**			
1203	First fill of day tank	EACH	**1**			
1204	Fire department approval	EACH	**1**			
1205	Supply and Install Pre-Cast double bunt concrete Plinth for above Generator - Included under PROVISIONAL SUMS	EACH				
	TEST AND COMMISSIONING					
1206	Test and commissioning of the complete system, and issue the necessary test certificates	SUM	**1**			
	BILL 12 TOTAL TO SUMMARY					

	BILL NO 13:	**RATES**				
	CSIR B44 SWITCHGEAR REPLACEMENT					
	The Contractor shall complete this Bill using rates and backup percentages which he applied throughout. This Bill will be used for adjustment to the scope of the work for items not measured elsewhere.					
	DESCRIPTION	**UNIT**	**QTY**	**SUPPLY RATE**	**INSTALL RATE**	**TOTAL**
	Time sheets specifying the time spent daily on the work (with the names of the workers) and the materials employed in dayworks shall be delivered to the Engineer weekly in accordance with the terms on the Conditions of Contract, in order to be considered.					
	Labour:					
	The rates for labour in dayworks (items not measured) are to be applied to the hours worked and they are to include for all cost of labour, overheads, profit levies, taxes, bonusses, leave pay etc.					
13001	Qualified electrician	hrs	1			
13002	Assistant electrician (Competent but not qualified)	hrs	1			
13003	Labourer	hrs	1			
	Materials:					
	The cost of materials in daywork shall be based on the nett cost and shall be substantiated with invoices					
13004	Provisional sum for materials in daywork					
13005	Allow percentage "markup" on item 4 to cover all overheads profit attendance etc.					
13006	Transport of material deliveries. (Transport of labour is regarded as an overhead cost)	km	1			

	BILL 13 TOTAL TO SUMMARY					

	BILL NO 14: PROVISIONAL SUMS				
	CSIR B44 SWITCHGEAR REPLACEMENT				
	PROVISIONAL SUMS CAN BE OMITTED AT THE DISCRETION OF THE CLIENT OR ENGINEER				
	DESCRIPTION	**UNIT**	**QTY**	**RATE**	**TOTAL**
	STRUCTURAL ITEMS				
14001	Allow PC Amount	SUM	1	R 80,000.00	
	- Miniature substation and Generator plinth				
	- Separation wall				
	- Structural Engineer				
14002	Profit and attendance	%			
	SECURITY / ACCESS CONTROL / DATA (SYSTEM CABLE ROUTING ONLY)				
14003	Allow PC Amount for conduit and sleeving installation only	SUM			
14004	Profit and attendance	%			
	FAÇADE/GARDEN & PARKING LIGHTING				
14005	Allow PC Amount	SUM			
14006	Profit and attendance	%			
	LIGHTNING PROTECTION				
14007	Allow PC Amount	SUM			
14008	Profit and attendance	%			
	CHANGES TO MAIN DB's				
14009	Allow PC Amount	SUM			
14010	Profit and attendance	%			
	BILL 14 TOTAL TO SUMMARY				

	SUMMARY OF BILLS	
	CSIR B44 SWITCHGEAR REPLACEMENT	
BILL NO	**DESCRIPTION**	**TOTAL**
1	PRELIMANARIES AND GENERAL	
2	MEDIUM VOLTAGE DISTRIBUTION	
3	DISTRIBUTION BOARDS	
4	LOW VOLTAGE CABLES	
5	CABLE TRENCHES AND SLEEVES	
6	WIRING, CONDUIT & ACCESSORIES	N/A
7	POWERSKIRTING AND TRUNKING	N/A
8	CABLE LADDER, TRAYS & SUPPORTS	N/A
9	LIGHT FITTINGS	N/A
10	SITE LIGHTING	N/A
11	MISCELLANEOUS ITEMS	
12	STANDBY DIESEL GENERATOR UNIT	
13	RATES	
14	PROVISIONAL SUMS	N/A
15	ALLOWANCE FOR PROJECT UNKNOWNS	R 150,000.00
	TOTAL EXCLUDING VAT	
	20% CONTINGENCY	
	SUB-TOTAL	
	VAT	
	TOTAL INCLUSIVE OF VAT	
	Date :……	
	TENDERER SIGNATURE: ……	
	Print Name : ……	

39 ANNEXURE J – SBD FORM 1

40 ANNEXURE K – SCHEDULE OF EQUIPMENT OFFERED

ANNEXURE K

SCHEDULE OF EQUIPMENT

FOR THE

ELECTRICAL INSTALLATION

FOR THE

SWITCHGEAR REPLACEMENT

FOR

THE CSIR

ANNEXURE K

ELECTRICAL INSTALLATION FOR THE SWITCHGEAR REPLACEMENT FOR THE CSIR SCHEDULE OF EQUIPMENT OFFERED

*The following schedules **MUST** be completed and returned as part of the tender submission.

EQUIPMENT		SUPPLIER/ MANUFACTURER	TYPE
1.	Low voltage distribution boards		
2.	Low voltage cables		
3.	Medium voltage cables		
4.	Miniature Substations		
5.	Generators		
6.	Other (Specify): A..... B..... C ..... D ..... E.....		

SIGNED BY TENDERER: .....

DATE: .....

SCHEDULE OF PARTICULARS AND GUARANTEES FOR MINIATURE SUBSTATIONS

*The following schedules **MUST** be completed and returned as part of the tender submission

SCHEDULE OF PARTICULARS & GUARANTEES FOR MINIATURE SUBSTATIONS				
ITEM	**DESCRIPTION**	**UNIT**	**SPECIFIED**	**GUARANTEED**
1	Primary Voltage	kV	11	
2	Secondary Voltage	V	400	
3	Number of phase		3	
4	System frequency	Hz	50	
5	Medium Voltage Switch Unit:			
5.1	Type		RM6 – NE-DIDI	
5.2	Rating	A	200	
6.1	Transformer rating	kVA	1000	
6.2	Transformer impedance	%	6	
6.3	Vector Group		Dyn 11	
6.4	Tap switch required ± 2,5 % and ± 5 %	-	Yes	
7	Basic insulation level for HV equipment	kV	125	
8	Fault rating	kA	13,2	
9	Constructional requirements:			
9.1	• Fiberglass housing	Yes/No	No	
9.2	• Sheet steel housing	Yes/No	Yes	
9.3	• Colour of housing		Avocado Green C12 SABS 1091	
10	Type of mini-sub	Type A Type B	No Yes	
11	Low voltage compartment:			
11.1	The following LV breakers shall be provided:			
	• Main CB	A	1500A	
	• Feeder CB1 with Enermax MD/kWh meter	A	1400A	
12	Metering:			
12.1	• Ammeters on incomer		3-MD-IND	
12.2	• Voltmeter with VSS on busbar		0-500V	
13	Street Light Compartment	-	None	

SCHEDULE OF PARTICULARS AND GUARANTEES FOR STANDBY DIESEL ALTERNATOR SETS

*The following schedules **MUST** be completed and returned as part of the tender submission

EMERGENCY POWER GENERATOR

ITEM	DESCRIPTION	UNIT	SPECIFIED	GUARANTEE
1	**ENGINE**			
1.1	Make			
1.2	Country of manufacture			
1.3	Model or Type No.			
1.4	Continuous rating at sea level, after allowing for ancillary equipment	kW		
1.5	Net output on Site	kW	560	
1.6	Nominal speed	rpm	1500	
1.7	Number of cylinders			
1.8	Bore and stroke	mm		
1.9	Replacement capacity	1		
1.10	Compression ratio			
1.11	Fuel consumption of complete set at the following alternator output 100% load			
1.11.1	100% load	1/h		
1.11.2	75% load	1/h		
1.11.3	50% load	1/h		
1.11.4	Make of fuel injection system			
1.12	Fuel tank capacity	l		
1.13	Fuel tank hour capacity	h	12	
1.13.1	Is electric pump for filling the fuel tank required?		Yes	
1.14	Starting method		Electric Starter	
1.15	Starting system voltage	V		
1.16	Method of cooling			
1.17	Type of radiator			
1.18	Method of protection against high temperature			
1.19	Method of protection against low oil pressure			
1.20	Minimum time required to accept full load	sec		
1.21	Are performance curves required?		Yes	
1.22	Type of exhaust system		Residential	
1.23	Engine Emission Rating		**Tier II (Certified)-** ***Compulsory***	

EMERGENCY POWER GENERATOR

ITEM	DESCRIPTION	UNIT	SPECIFIED	GUARANTEE
2	**ALTERNATOR**			
2.1	Make		Mecc Alte/Leroy Somers/Merelli	
2.2	Model or Type No.			
2.3	Country of manufacture			
2.4	Load Requirement			
2.5	60% of full load required	sec	Yes	
2.6	80% of full load required	sec	No	
2.7	Is 100% load acceptance required?	sec	No	
2.7.1	Type of enclosure		Open Set	
2.7.2	(a) Automatic or manual operation?		Auto	
2.7.3	(b) Whether 1 hour over rating of 10% is required		Yes	
2.8	Frequency	Hz	50	
2.9	Terminal voltage	V	230/400	
2.10	Continuous rating at 0,8 p.f.			
2.10.1	At sea level	kVA		
2.10.2	On site	kVA	700	
2.11	Single or Three phase		3	
2.12	Efficiency at 0,8 p.f.			
2.12.1	100% load			
2.12.2	75% load			
2.12.3	50% load			
2.13	Minimum Engine input required	kW		
2.14	Method of excitation			
2.15	Maximum voltage variation		< 5%	
2.16	Maximum frequency variation		<2,5%	
2.17	Transient voltage dip on application of full load		±2,5%	
2.18	Voltage recovery on application of full load	sec	< 3	
2.19	Maximum Harmonic Distribution		< 3%	
2.20	Is alternator brushless?		Yes	
2.21	Class or winding insulation		H	

DISTRIBUTION BOARDS

*The following schedule **MUST** be completed and returned as part of the tender submission

1. **Name of distribution board manufacturer**		
2. **Does the proposed manufacturer have an approved Type Test Certificate for his DB's as required by SANS 10142-1 and SANS 1973? (Include certificate in tender submission)**		
Tick one box (√)	YES	NO
3. **Name of switchgear manufacturer**		
4. **Contact details of distribution board manufacturer**		
Address		
Tel		
E-mail		

SIGNED BY TENDERER: _____

DATE: _____

41 ANNEXURE L – SCHEDULE OF TENDER DRAWINGS

(Drawings to be shared with only bidders who attend the compulsory briefing and site inspection)