SOUTH AFRICAN BROADCASTING SABC SOC LIMITED
("the SABC")

REQUEST FOR PROPOSAL (RFP)

RFP NUMBER: RFP/HEN/2020/29
RFP TITLE: GENERATOR & MV ELETRICAL INSTALLATION AT SABC AUCKLND PARK

EXPECTED TIMEFRAME

BID PROCESS	**1 September 2020**
Bid **Advertisement Date**	
Bid Documents Available From	**National Treasury's tender portal (http://www.etenders.gov.za) SABC Website (http://www.sabc.co.za/sabc/tenders/)**
Briefing Session Date & Time ***The Bid Specification Committee (BSC) to make use of virtual Briefing sessions were Briefing Session is deemed necessary and cannot be avoided.*** ***See Annexure B (Guideline for Briefing Session) that the bidder needs to take note of***	**Virtual Briefing Session on Microsoft Teams** **8 September 2020 @ 10am**
Venue / Link for virtual Briefing Session	
Bid **Closing Date** and Time	**21 September 2020 @ 12pm**
Contact details	**tenderqueries@sabc.co.za**

The SABC retains the right to change the timeframe whenever necessary and for whatever reason it deems fit.

BIDS DELIVERY

SABC's Tender Box
SABC Office
Radio Park
Henley Road; Auckland
Johannesburg

During the COVID-19 pandemic, bidders may submit bids in the tender box or electronically until further notice. Refer to Document A for Conditions to be observed when bidding.

Late Bid submissions will not be accepted for consideration by the SABC.

1. PRE-QUALIFICATION CRITERIA

- All bidders must submit evidence of commitment to sub-contract a minimum of 30% of the value of the contract to certain designated groups as prescribed in the PPPFA guidelines 2017 (as amended) see section 14 (sub-section 14.14) of this RFP document. (Bidders to complete **Document G** of this RFP document) Bidders to include the agreement between the sub-contractor and the main bidder.

2. MANDATORY REQUIREMENTS

- All bid respondents must submit documents that comply with all mandatory requirements. Bids that do not fully comply with the mandatory requirements will be disqualified and will not be considered for further evaluation.

- **Proof of registration in National Treasury Central Supplier Database (CSD)**
- **The supplier must have a CIDB grading as follow:**
  - **CIDB Grading -7EP/EB or higher**
  - **CIDB grading - 6EP/PE (Potential Emerging)**

NONSUBMISSION OF THE PRE-QUALIFICATION DOCUMENTS AND MANDATORY DOCUMENTS WILL RESULT IN AUTOMATIC DISQUALIFICATION

3. REQUIRED DOCUMENTS

3.1 SARS "Pin" to validate supplier's tax matters

3.2 Original or Certified copy of Valid BBBEE Certificate (from SANAS accredited Verification Agency)

3.3 All EME's and 51% black Owned QSE's are only required to obtain a sworn affidavit on an annual basis, confirming the following;

3.3.1. Annual Total Revenue of R10 Million or less (EME) or Revenue between R10 Million and R50 Million for QSE

3.3.2. Level of Black Ownership

Note 1:

Verification Agencies and Auditors who are accredited by the IRBA (Independent Regulatory Board for Auditors) are no longer the 'approved regulatory bodies' for B-BBEE verification and therefore IRBA auditors are not allowed to issue B-BBEE certificates after 30 September 2016.

Note 2:

Any misrepresentation in terms of the above constitutes a criminal offence as set out in the B-BBEE act as amended.

3.4 Proof of Valid TV License Statement (Company's, Shareholders and all Directors'), or affidavit proving that company and/or officials are not in possession of TV licence. Verification will also be done by the SABC internally.

3.5 Certified copy of Company Registration Document that reflect Company Name, Registration number, date of registration and active Directors or Members.

3.6 Certified copy of Shareholders' certificates.

3.7 Certified copy of ID documents of the Directors or Members.

3.8 Last three years audited/reviewed financial statements OR the Companies Management Accounts.

NB: NO CONTRACT WILL BE AWARDED TO ANY BIDDERS WHOM THEIR TAX AND TV LICENCE MATTERS ARE NOT IN ORDER.

C O N T E N T S

DOCUMENT A

CONDITIONS TO BE OBSERVED WHEN BIDDING

1. LODGING OF PROPOSALS

1.1 Bidders are required to complete and sign the RFP Document and initial all pages (including proposal and brochures).

1.2 Bids must be submitted in one (1) original, two (2) copies of the original and 1 (one) electronic copy (CD) or memory stick, by hand and be enclosed in a sealed envelope marked distinctly with the RFP number. All electronic copies should be in PDF format and must contain proposal, all completed forms, and attachments. This envelope must indicate the Bid number and the name and delivery address of the Bidder.

1.3 Bidders should ensure that bids are delivered timeously to the correct address**.** Bids not received in a specified manner, and by the specified time and date as set out in this RFP document will be rejected. The bid box is generally opened 24 hours a day, 7 days a week.

2. COMPLIANCE WITH CONDITIONS OF PROPOSAL

2.1 No alteration, amendment or variation of the submitted proposal by the closing date of this bid shall be permitted, unless otherwise agreed in writing by both the SABC and the bidder. Should the bidder desire to make any amendments to the conditions of their proposal document, they shall stipulate upfront in their proposal document. The SABC reserves the right to reject such bid document.

3. COMPLIANCE WITH TECHNICAL SPECIFICATIONS

3.1 All bidders are required to submit bids in accordance with stipulated technical specification as indicated on this bid document. Failure to comply with the required technical specification will result in disqualification.

4. SCHEDULE OF QUANTITIES

4.1 Bidders are required to submit a detailed Schedule of Quantities indicating how the bid amount is composed. This schedule shall contain itemised descriptions, quantities and unit prices.

5. BID PRICES

5.1 No change in the submitted bid prices shall be accepted and/or approved by the SABC after receipt and before award of this bid.

5.2 All prices are to be quoted in the Republic of South African Rand with **VAT** as a separate item.

5.3 All local suppliers quoting in foreign currency must convert the currency to Rands and indicate the (exchange rate) if applicable.

5.4 The prices quoted should be inclusive of all costs needed to perform the specified services, not limited to, all kinds of local guarantee bonds, taxes and duties, customs, customs clearance, inland transportation, storage, unpacking, positioning, installation, integration and testing. The prices quoted should be inclusive of all costs for the duration of the project.

5.5 This bid document is not an offer to purchase, order or contract.

5.6 Prices must be fixed for the first year and shall, where applicable, be subject to an increase (to be negotiated).

5.7 Bid prices for supplies in respect of which installation/erection/assembly is a requirement, shall include ALL costs on a basis of delivery on site as specified.

5.8 Bid prices shall, where necessary, include packaging. If desired, packaging material may be returned to the bidder provided the amount of credit that will be allowed for the returnable packaging is shown against each item concerned.

5.9 Any response submitted by a Bidder is subject to negotiation and review by the SABC.

6. SOURCE OF SERVICE AND MATERIAL

6.1 In the case of equipment/goods, which are partially or completely designed and/or manufactured in the Republic of South Africa, Bidders shall state the local content percentage.

6.2 Documentation certifying the local content percentage shall be submitted.

7. ACCEPTANCE OF PROPOSALS

7.1 The SABC does not bind itself to accept the lowest or any bid/proposal, nor shall it be responsible for or pay any expenses or losses which may be incurred by the Bidders in the preparation and delivery of its/his/her bid/proposal. The SABC reserves the right to accept a separate bid/proposal or separate bids/proposals for any one or more of the sections of a specification. The SABC also reserves the right to withdraw the bid at any stage.

7.2 No bid shall be deemed to have been accepted unless and until a formal contract/ letter of award is prepared and signed.

7.3 The SABC reserves the right, should it deem it necessary, to monitor every stage of the contract to ensure:

- that the directors who were awarded the bid are in control of the company and/or that changes in directors does not affect delivery of the goods/services/work adversely;
- that, if there are changes in the control of the company, these should be brought to the attention of the SABC;
- that in the event that the bid or any part thereof is to be subcontracted to another company or organisation after the bid was awarded, the Bidders must immediately advise the SABC and the SABC shall approve same as it deems fit;
- successful delivery of the goods/services/works in terms of the contract, or timeous termination of the contract should such action be in the best interest of the SABC;
- audit the successful Bidder's contract from time to time.

7.4 This bid will remain valid **180** (one hundred and eighty) days from the date of bid closing.

8. DEFAULT BY BIDDERS

8.1 If Bidders purport to withdraw their bid(s)/proposals within the period for which they have agreed that their bid/proposal shall remain open for acceptance, or fails to enter into a written contract when called upon to do so, or fails to accept an order in terms of the bid, the SABC may, without prejudice to any other legal remedy which it may have, accept their bid(s)notwithstanding the purported withdrawal, or proceed to accept any other less favourable bid or call for bids afresh and may recover from the defaulting Bidders any additional expense it has incurred for the calling for new bids or the acceptance of any less favourable bid.

9. AMPLIFICATION OF PROPOSALS

9.1 The SABC may, after the opening of bids; call on the Bidder to amplify in writing any matter, which is not clear in the Bidder's submission, and such amplification shall form part of the original bid.

9.2 In the event of the Bidders failing to supply such information within the specified timeframe, the bid will be liable to rejection.

9.3 The SABC reserves the right to:

9.3.1 not evaluate and award bids that do not comply strictly with this bid document.
9.3.2 make a selection solely on the information received in the bids and
9.3.3 enter into negotiations with any one or more of preferred Bidder(s) based on the criteria specified in the evaluation of this bid.
9.3.4 contact any Bidder during the evaluation process, in order to clarify any information, without informing any other Bidders. During the evaluation process, no change in the content of the bid shall be sought, offered or permitted.
9.3.5 award a contract to one or more Bidder(s).
9.3.6 accept any bid in part or full at its own discretion.
9.3.7 cancel this bid or any part thereof at any time.

Should Bidder(s) be selected for further negotiations, they will be chosen on the basis of the greatest benefit to the SABC and not necessarily on the basis of the lowest costs.

10. IMPORT/EXPORT PERMITS

10.1 Bidders are required to include complete information on equipment and/or components requiring export/import permits.

11. COST OF BIDDING

11.1 The Bidder shall bear all costs and expenses associated with preparation and submission of its bid/proposal, and the SABC shall under no circumstances be responsible or liable for any such costs, regardless of, without limitation, the conduct or outcome of the bidding, evaluation, and selection process.

12. COMMUNICATION

12.1 The SABC has provided a single point of entry for any questions or queries that the Bidder may have. All queries must be submitted in writing and directed to authorised contact person. **Unauthorised communication with any other personnel or member of staff of the SABC, with regard to this bid is strongly discouraged and will result in disqualification of the respective Bidder's bid/proposal submission**.

12.2 Should there be a difference of interpretation between the Bidder and SABC; SABC reserves the right to make a final ruling on such interpretation.

12.3 The closing time for clarification of queries is **3 (three) days** before the deadline for bid/proposal submission.The Bidders should take note that questions together with responses will be sent to all Bidders who attended compulsory Briefing Session.

13. AUTHORISED CONTACT PERSONS

13.1 All enquiries in respect of this bid must be addressed to:
tenderqueries@sabc.co.za

14. BROAD-BASED ECONOMIC EMPOWERMENT

14.1 Bidders other than EMEs must submit their original and valid B-BBEE status level verification certificate or a certified copy thereof, substantiating their B-BBEE rating issued by a Verification Agency accredited by SANAS.

14.2 Only South African Accreditation Systems (SANAS) is the authorised body to issue B-BBEE certificates

14.3 IRBA and Accounting Officers are **not** allowed to issue B-BBEE affidavit or certificates to EMEs and QSEs as it was under 2007 Codes

14.4 100% black-owned EMEs and QSEs are now Level 1

14.5 **An affidavit (DTI Affidavit) confirming that the entity's turnover is below R10 million and percentage of black ownership will be accepted for EMEs**

14.6 QSEs have to comply with all elements

14.7 Start-up enterprises are verified similar to EMEs, but can opt to be rated using the QSE and Generic Scorecard

14.8 QSE with at least 51% black ownership or above are only required to obtain a sworn affidavit on an annual basis with a confirmation of turnover and black ownership

14.9 A trust, consortium or joint venture, will qualify for points for their B-BBEE status level as a legal entity, provided that the entity submits their B-BBEE status level certificate.

14.10 A trust, consortium or joint venture will qualify for points for their B-BBEE status level as an unincorporated entity, provided that the entity submits their consolidated B-BBEE scorecard as if they were a group structure and that such a consolidated B-BBEE scorecard is prepared for every separate bid.

14.11 Tertiary institutions and public entities will be required to submit their B-BBEE status level certificates in terms of the specialized scorecard contained in the B-BBEE Codes of Good Practice.

14.12 A bidder will not be awarded points for B-BBEE status level if it is indicated in the bid 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 EME that has the capability and ability to execute the sub-contract.

14.13 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 EME that has the capability and ability to execute the sub-contract.

14.14 **This tender has a pre-qualification tendering condition that the successful bidder must subcontract a minimum of 30% (as prescribed in the PREFERENTIAL PROCUREMENT POLICY FRAMEWORK ACT, 2000: PREFERENTIAL PROCUREMENT REGULATIONS, 2017) of the value of contract.**

Pre-qualification criteria for preferential procurement
4.(1) If an organ of state decides to apply pre-qualifying criteria to advance certain designated groups, that organ of state must advertise the tender with a specific tendering
condition that only one or more of the following tenderers may respond-
(a) a tenderer having a stipulated minimum B-BBEE status level of contributor;
(b) an EME or QSE;
(c) a tenderer subcontracting a minimum of 30% to-

(i) an EME or QSE which is at least 51% owned by black people;
(ii) an EME or QSE which is at least 51% owned by black people who are youth;
(iii) an EME or QSE which is at least 51% owned by black people who are women;
(iv) an EME or QSE which is at least 51% owned by black people with disabilities;
(v) an EME or QSE which is 51% owned by black people living in rural or underdeveloped areas or townships;
(vi) a cooperative which is at least 51% owned by black people;
(vii) an EME or QSE which is at least 51% owned by black people who are military veterans;
(viii) an EME or QSE.

(2) A tender that fails to meet any pre-qualifying criteria stipulated in the tender documents is an unacceptable tender.

15. MISREPRESENTATION AND FRONTING IS PROHIBITED

Fronting means a deliberate circumvention or attempted circumvention of the B-BBEE Act and the Codes. Fronting commonly involves reliance on data or claims of compliance based on misrepresentations of facts, whether made by the party claiming compliance or by any other person.

It is an offence to misrepresent or provide false information regarding a company's information or engaging in a fronting practice. If there is any contravention of some sought, the SABC may open a criminal and/or civil case/s against the bidder and its directors/members in terms of applicable legislation, and ban the bidder & its directors/members from doing business with the SABC for a pre-determined period.

It is important to note that any proposal that does not conform fully to the instructions and requirements in this RFP may be disqualified.

Suppliers might be required to demonstrate their proposed capabilities by means of a presentation, clear and easily verifiable reference documentation and/or a visit to an existing client site where their capabilities may be demonstrated.

Bids, which do not meet the technical requirements, will not be considered for further evaluation.

END OF DOCUMENT A

DOCUMENT B

GENERAL CONDITIONS OF PROPOSAL

1.0 COMPLIANCE WITH COMPLETION OF PROPOSAL

1.1 The bid forms should not be retyped or redrafted but photocopies may be prepared and used.

1.2 Bid forms must be signed in the original form; in ink and forms with photocopied signatures or other such reproduction of signature will be rejected.

1.3 Should bid forms not be filled in by means of mechanical devices, for example typewriters, ink, preferably black, must be used to fill in bid.

1.4 Bidders shall check the numbers of the pages and satisfy themselves that none are missing or duplicated. No liability shall be accepted in regard to claims arising from the fact that pages are missing or duplicated. Incomplete bids will result in disqualification**.**

2.0 COMPLIANCE WITH TECHNICAL SPECIFICATIONS

2.1 Unless a departure is clearly stated by the Bidder at the time of bidding, the works shall be taken as complying in detail with the Technical Specifications, and the Bidder shall be held liable on all the terms and conditions of the contract as if this bid contained no departures. Technical specifications contained in any brochures or any other descriptions submitted shall apply for acceptance test purposes.

3.0 WARRANTY

3.1 If there are any defects arising from failure of goods to meet the specifications within the period specified in the contract, the Bidder shall replace the defective items at his expense or shall refund the SABC such costs as the SABC may incur in replacing such defective item. The Bidder shall also bear the cost of transporting replaced/repaired items to the place of destination.

4.0 INSPECTION

4.1 The Bidder shall permit and assist the SABC's representatives in carrying out any inspections that are called for in the proposal or specifications.

5.0 PACKAGING

5.1 Goods purchased on this bid must be adequately protected and securely packaged during shipment and until delivery at the destination.

5.2 Goods must be clearly marked with the Bidder’s name, description of contents and the SABC's order number and delivery address.

6.0 RISK

6.1 The Bidder will be responsible for losses that SABC incurred due to Bidder’s negligence or intention and Bidder must provide Liability Insurance. This will be a condition of contract.

7.0 DELIVERY

7.1 Delivery will be to the Stores of the SABC Auckland Park, Johannesburg, Republic of South Africa. The contractual delivery date must be strictly complied with and each delivery must be preceded or accompanied by delivery note. If delivery does not take place within the period stipulated, the SABC may cancel the contract concluded with the bidder without further notice to the Bidder and with immediate effect without prejudice to any other course of action available to the SABC to recover any damages out of such delay. Receipt of the goods by the SABC will not be regarded as acceptance thereof until the goods have been acceptance tested in compliance with the Technical Specifications.

8.0 PAYMENT

8.1 Payment, in currency other than South African Rand, will be made by means of a telegraphic or wired bank transfer.

The Bidder must provide:

- Name and address of their bank.
- Company account number to be credited.
- Sort/swift code of bank.

8.2 The SABC's standard payment terms are **60-90 days** from date of invoice/statement.

9.0 ASSIGNMENT OF CONTRACT

9.1 The Bidder shall not have the right to cede any right or delegate any obligation in terms of this contract to any third party unless with the prior written approval of the SABC.

10.0 PROPOSALS ARE CONSIDERED TO BE BINDING ON THE BIDDERS

10.1 Representations made in the bid/proposal, including claims made in respect of commitments to dates of delivery, shall be considered binding on the Bidder on acceptance of the bid/proposal by the SABC and same will be form part of the contract to be concluded, unless specifically noted by the Bidder in the bid/proposal that same maybe subject to change;

11.0 COMPLIANCE WITH SABC POLICIES

11.1 SABC will not procure any goods, services, works or content from any employee or employee owned business, to ensure that suppliers competing for the SABC's business have confidence in the integrity of SABC's selection process.

11.2 SABC will not procure any goods, services, works or content from any SABC Independent Contractor's owned business, to ensure that suppliers competing for the SABC's business have confidence in the integrity of SABC's selection process.

11.3 No former employees, SABC's Non-Executive members and Independent Contractors will be awarded contracts with the SABC within a 2 years after resigning from SABC employment or not being engaged with the SABC.

11.4 Should former employees, SABC's Non-Executive members and Independent Contractors resign from the employment of the SABC or not being engaged with the SABC and become directors of other businesses bidding with SABC, such bid will not be considered until the cooling off period of 5 years has expired.

12.0 FAILURE TO COMPLY WITH THESE CONDITIONS

12.1 These conditions form part of the bid and failure to comply therewith may invalidate a bid.

13.0 RFP SCHEDULE

13.1 Bidders will be contacted as soon as practicable with a status update. At this time, short-listed Bidders may be asked to meet with SABC representatives. Bidders should provide a list of persons and their contact details who are mandated to negotiate on behalf of their company.

14.0 ADDITIONAL NOTES

14.1 All returnable documents as indicated in the bid form must be returned with the response

14.2 Bidders are to note that bids in which firm prices are quoted for the duration of any resulting contract may receive precedence over prices which are subject to adjustment.

14.3 Changes by the Bidder to his/her submission will not be considered after the closing date.

14.4 The person or persons signing the bids must be legally authorized by the Bidder to do so a list of the person(s) authorized to negotiate on your behalf must be submitted along with the bid.

14.5 SABC reserves the right to undertake post-bid negotiations with the preferred Bidder or any number of short-listed Bidders.

FAILURE TO OBSERVE ANY OF THE ABOVE-MENTIONED REQUIREMENTS MAY RESULT IN THE BID BEING OVER LOOKED.

15.0 DISCLAIMERS

15.1 Bidders are hereby advised that the SABC is not committed to any course of action as a result of its issuance of this BID and/or its receipt of a bid in response to it. In particular, please note that the SABC may:
15.2 change all services on bid and to have Supplier re-bid on any changes.
15.3 reject any bid which does not conform to instructions and specifications issued herein
15.4 disqualify bids after the stated submission deadline
15.5 not necessarily accept the lowest priced bid
15.6 reject all bids, if it so decides
15.7 award a contract in connection with this bid at any time
15.8 award only a portion as a contract
15.9 split the award of the contract to more than one Supplier
15.10 make no award of a contract.

Kindly note that SABC will not reimburse any Bidder for any preparation costs or other work performed in connection with this bid, whether or not the Bidder is awarded a contract.

END OF DOCUMENT B

DOCUMENT C

QUESTIONNAIRE TO BE COMPLETED WHEN BIDDING

If the information required in respect of each item cannot be inserted in the space provided, additional information may be provided on a separate sheet of paper with a suitable reference to the questionnaire number concerned.

1. Company's Treasury CSD unique registration reference number. (Attach full CSD profile)	
2. Have your company been issued with a SARS Compliance Status PIN.	
3. If yes, please provide PIN number. The provision of the PIN will be construed as your permission to SABC Procurement to access your tax status on-line.	
4. Are you registered in terms of section 23(1) or 23(3) of the Value-added Tax Act, 1991 (Act 89 of 1991)?	
5. If so, state your VAT registration number and original current tax clearance certificate to be submitted	
6. Are the prices quoted fixed for the full period of contract?	
7. Is the delivery period stated in the bid firm?	
8. What is the address in the Republic of South Africa where an item of the type offered by you may be inspected preferably under working conditions? (Where Applicable)	

9. What is the approximate value of stock in the Republic of South Africa for this particular item? (If required).	
10. Where are the stock held?	
11. What facilities exist for servicing the items offered?	
12. Where are these facilities available?	
13. What are the names and addresses of the factories/suppliers where the supplies will be manufactured and may be inspected, if required?	

*** ALSO INDICATE WHICHEVER IS NOT APPLICABLE**

END OF DOCUMENT C

DOCUMENT D

SBD-4 - DECLARATION OF INTEREST

1.0 Any legal person, including persons employed by the state, or persons having a kinship with persons employed by the state, including a blood relationship, may make an offer or offers in terms of this invitation to bid (includes a price quotation, advertised competitive bid, limited bid or proposal). In view of possible allegations of favouritism, should the resulting bid, or part thereof, be awarded to persons employed by the state, or to persons connected with or related to them, it is required that the bidder or his/her authorised representative declare his/her position in relation to the evaluating/adjudicating authority where-

- the bidder is employed by the state; and/or
- the legal person on whose behalf the bidding document is signed, has a relationship with persons/a person who are/is involved in the evaluation and or adjudication of the bid(s), or where it is known that such a relationship exists between the person or persons for or on whose behalf the declarant acts and persons who are involved with the evaluation and or adjudication of the bid.

2.0 In order to give effect to the above, the following questionnaire must be completed and submitted with the bid.

2.1 Full Name of bidder or his or her representative:

……

2.2 Identity Number: **……**

2.3 Position occupied in the Company (director, trustee, shareholder[2]):

……..

2.4 Company Registration Number: …….

2.5 Tax Reference Number:……..……

2.6 VAT Registration Number:……....

2.6.1. The names of all directors / trustees / shareholders / members, their individual identity numbers, tax reference numbers and, if applicable, employee / personnel numbers must be indicated in paragraph 3 below.

[1]"State" means –

(a) any national or provincial department, national or provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act No. 1 of 1999);
(b) any municipality or municipal entity;
(c) provincial legislature;

(d) national Assembly or the national Council of provinces; or
(e) Parliament.

[2]"Shareholder" means a person who owns shares in the company and is actively involved in the management of the enterprise or business and exercises control over the enterprise.

2.7 Are you or any person connected with the bidder presently employed by the state? **YES / NO**

2.7.1 If so, furnish the following particulars:

Name of person / director / trustee / shareholder/ member:

……

Name of state institution at which you or the person connected to the bidder is employed

……

Position occupied in the state institution:……

Any other particulars: ……

……

……

……

2.7.2 If you are presently employed by the state, did you obtain the appropriate authority to undertake remunerative work outside employment in the state? **YES/NO**

2.7.2.1 If yes, did you attached proof of such authority to the bid **YES/NO**

(Note: Failure to submit proof of such authority, where applicable, may result in the disqualification of the bid.

2.7.2.2 If no, furnish reasons for non-submission of such proof:

……

……

2.8 Did you or your spouse, or any of the company's directors / trustees / shareholders / members or their spouses conduct business with the state in the previous twelve months? **YES / NO**

2.8.1 If so, furnish particulars:

……

……

……

2.9 Do you, or any person connected with the bidder, have any relationship (family, friend, other) with a person employed by the state and who may be involved with the evaluation and or adjudication of this bid? **YES / NO**

2.9.1 If so, furnish particulars.

……

……

……

2.10 Are you, or any person connected with the bidder, aware of any relationship (family, friend, other) between any other bidder and any person employed by the state who may be involved with the evaluation and or adjudication of this bid? **YES/NO**

2.10.1 If so, furnish particulars**.**

……

……

……

2.11 Do you or any of the directors / trustees / shareholders / members of the company have any interest in any other related companies whether or not they are bidding for this contract? **YES/NO**

2.11.1 If so, furnish particulars:

……

……

……

3.0 Full details of directors / trustees / members / shareholders.

Full Name	**Identity Number**	**Personal Tax Reference Number**	**State Employee Number / Pers. Number**

4.0 DECLARATION

I, THE UNDERSIGNED (NAME)

……

CERTIFY THAT THE INFORMATION FURNISHED IN PARAGRAPHS 2 and 3 ABOVE IS CORRECT. I ACCEPT THAT THE SABC MAY REJECT THE BID OR ACT AGAINST ME IN TERMS OF PARAGRAPH 23 OF THE GENERAL CONDITIONS OF CONTRACT SHOULD THIS DECLARATION PROVE TO BE FALSE.

…….. ……
Signature Date

…… ……
Position Name of bidder

END OF DOCUMENT D

DOCUMENT E 1

PROJECT LA68 SCOPE OF WORK

TECHNICAL SPECIFICATION FOR:

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GENERATOR & MV ELECTRICAL INSTALLATION AT SABC AUCKALND PARK OFFICES.

1. BACKGROUND

The SABC is South Africa's national public broadcaster. The company's objectives are to provide a comprehensive range of distinctive programmes and services with the view to inform, educate, entertain, support and develop culture in all 11 official languages.

Currently, the company's principal activities comprises of television and radio broadcasting utilising 19 radio stations and 5 television channels.

The SABC is therefore calling on service providers to submit proposals for the Supply and Installation of Generator & MV Electrical Installation at SABC Auckland Park Radio Park offices. The document consists of document E 1 and Document E2 with all requirements and evaluation criteria, therefore the bidder must complete both document E1 & E2.

2. SCOPE OF SERVICES AND TECHNICAL SPECIFICATIONS

The scope of work for this project includes the following main items. The list does not include all that is required to provide a complete installation. The bidder shall allow for all items of equipment required to provide a complete installation.

2.1 Supply Installation and Commissioning.

1. **2x**1000 KVA prime rated with remote cooling radiator generator sets including synchronized change over panels for **FEEDER A**. The engine shall be fitted with a 1250kVA alternator.
2. **2x**1000 KVA prime rated with remote cooling radiator generator sets including synchronized change over panels for **FEEDER B**. The engine shall be fitted with a 1250kVA alternator.
3. **1x** 1650KVA prime rated containerised diesel generator set including controls. The generator to be equipped with a step up/down 1600kVA transformer for outside application. MV synchronised panel including SF6 breakers fitted in a weather proof enclosure shall be included. A new 11KV cable shall be installed from existing 11kV panel to the new synchronised change over panel and back to the existing 1600 kVA Transformer. Protection relay to be fitted into the new panel to provide protection for the new 1600 transformer and the existing 1600kVA transformer located in K1 plant room. The generator to synchronous with the mains on return.
4. Supply and install day tank for Feeder A (2x1000KVA) and Feeder B (2x1000KVA). The day tanks to include all pipe works form bulk diesel tank (diesel tank located in K2 plant room). Each day tank to be fitted with primary and back –up pump which is fully automated to fill up the tanks. Each tank should be fitted with alarms for low and full fuel levels monitoring.

5. 1x1600kVA transformers for each feeder.

6. It must be noted that the 1000kVA generators will be feeding a rotary UPS (3x330kva), which must start within the shortest period possible. Each 330kVA UPS will run at 2/3 of its capacity if one UPS fail, the remaining UPS will share the load equally at full load 2*330KVA.
7. The generator should be able to take a step load of 330KVA and be able to maintain frequency within ±5% of 50HZ.First step load of 330kVA and second step load of 330KVA or first step load off 220kVA, second step load 220kVA and third step load of 220kVA
8. Distribution boards.
9. 11kV cabling.
10. 11kV terminations.
11. New protection relay for the MV circuit breakers.
12. Reprogramming of existing 11kV circuit breakers.
13. LV cabling.
14. LV terminations.
15. Earthing.
16. Cable ladders.
17. Dummy load for on-site testing for all generators including the UPS output panels.
18. Install earth mat for the outside transformer and link all the equipment in the area to mat.
19. Busbars.
20. As built drawings.

2.2) Maintenance and Guarantee

The installation and equipment supplied under this contract shall be guaranteed and maintained for a period of twelve months from the date of acceptance by SABC in all respects and commissioned for continuous service. The bid price shall include the above, which will entail call outs after hours.

2.3) Relevant Standards and Specifications.

2.3.1 General

2.3.1.1 All material and equipment supplied and / or installed under this Contract shall be new and of good quality and shall comply with the requirements laid down in the latest editions of the relevant SABS, BS or IEC Specifications and there amendments (if any) and the requirements of this specification. The workmanship and finish of work shall be of high standard throughout and to the satisfaction of the Engineer/SABC.

2.3.1.2 Before the commencement of manufacture a full set of drawings showing all details of equipment, wiring (single line diagram) and layouts shall be submitted to the Engineer for approval.

2.3.1.3 All calculations, designs, documentation and drawings shall be submitted to the Engineer prior to the procurement, manufacture or construction of any part of the plant.

3. Laws, Regulations and Standards

The work shall be carried out strictly in accordance with the specifications and all material and equipment supplied shall comply with the following laws and regulations where applicable:

The cost of complying with the requirements of this clause shall be deemed to be included in the rates.

1. The latest version of the “Code of Practice for the wiring of Premises” SANS 10142-1: 2003 as amended.

2. The Occupational Health and Safety Act (No 85 of 1993) as amended.
3. The general safety regulations of 1986.
4. The construction regulations of 2003.
5. The “Electrical Supply By-Laws and Regulations” of the Supply Authority.
6. The local Fire Office Regulations.
7. The regulations of Telkom.
8. Specifications indicated in the detailed generator specification.

4. Additional Standardized Specifications

NO	DESCRIPTION	DETAILS
1	Hot-dip (galvanised) zinc coatings heavy duty	SABS 763 – 1988
2	National colour standards for paint	SABS 1091
3	Rotating electrical machines (Parts 1 to 18) (Applicable to low voltage motors)	SABS IEC 60034
4	Electric welded low Carbon steel pipes for aqueous fluids (ordinary duties)	SABS 719
5	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V)	SABS 1507 : 1990
6	The selection, handling and installation of electric power cables of rating not exceeding 33 kV	SABS 0198 Parts 1-12
7	Induction motors Part 2: Low-voltage three-phase standards motors	SABS 1804-2 :2001
8	Induction motors Part 1: IEC requirements	SABS 1804-1 :2001
9	Code of Practice for the wiring of premises	SABS 0142-1 :2006 (SANS 10142-1: 2006)
10	Low voltage switchgear and control gear assemblies Part 1 : Requirements for type-tested and partially type-tested assemblies	SABS 1473-1 (SANS 60439 – 1 : 2004)
11	Safety of distribution boards	SABS 1765
12	Earthing of low-voltage (LV) distribution systems	SABS 0292 :2001
13	Cable standard	SANS 1507 (Part 1-3) Electric cables with extruded solid dielectric insulation
14	Low voltage switchgear and control gear assemblies Part 1 : Type-tested and partially type-tested assemblies	SABS IEC 60439-1 :
15	The design and installation of an earth electrode	SABS 0199 :1985
16	Earth rods and couplers	SABS 1063 :1998
17	Low voltage switchgear and control gear assemblies Part 2 : Particular requirements for busbar trunking systems (busways)	SABS IEC 60439-2:
18	Low Voltage Switchgear and Control Gear Part 1: General Rules	SABS IEC 60947-1

19	Low Voltage Switchgear and Control Gear Part 2: Circuit Breakers	SABS IEC 60947-2
20	Low Voltage Switchgear and Control Gear Part 3: Switches, disconnectors switch-disconnectors and fuse-combination units	SABS IEC 60947-3
21	Low Voltage Switchgear and Control Gear Part 4 : Contactors and motor-starters Section 1 : Electromechanical contactors and motor-starters	SABS IEC 60947-4-1
22	Steel, cast iron and copper alloy flanges, tables 10/3, 25/3 or 64/3	BS 4505-1969
23	Specification General requirements for rotating electrical machines. Part 133	BS 4999
24	Specification for Acceptance tests for centrifugal, mixed flow and axial pumps – Part 2. Class B tests	BS 5316
25	Classification of insulating materials	IEC 60085
26	Occupational Health & Safety Act (Act 85 of 1993)	OHS Act

5. Drawings and Documents.

1) Drawings and Information Provided:

The Engineer shall produce cable schedules and such drawings necessary to adequately document the installation for the Contractor.
Three prints of each drawing shall be issued to the Contractor.

2) As Built Drawings

The Contractor shall be required to mark up these schedules and drawings with the “as built” information and return one print to the Engineer with all “as built” information entered thereon.

3) Information to be submitted by the successful bidder in respect of Control Panels.

The successful bidder shall submit three paper prints of each of the following drawings, in respect of the Control Panels to the Engineer for approval prior to manufacture.

a. Outline and general arrangement drawings, showing main overall dimensions and construction details.
b. Wiring diagrams.
c. Schematic line diagrams.

Prints of the following shall be supplied by the successful Bidder in respect of each of the final As Built layouts of the Control Panels.

a. Outline and general arrangement drawings of the DB’s.
b. Wiring diagrams
c. Schematic line diagrams.

6. TECHNICAL SPECIFICATIONS

Where contradiction occurs between the Detailed Technical Specification and the General Technical Specification, preference shall be given to the Detailed Technical Specification.

6.1 Conduit

Galvanised conduit bearing the SANS mark of approval must be used in the following instances.

a. Surface mounted to concrete slab soffits and walling

6.2 Cables

a) Specification

- All cables shall have stranded copper conductors and shall be of the PVC/PVC/SWA/PVC type, 600/1000V grade. Cables with aluminium conductors are unacceptable.
- The cables shall be armoured with a single layer of galvanised steel wire.
- All cables shall bear the SANS mark of approval and shall have colour coded PVC insulated conductors.

6.3 Numbering

The contractor shall fit a cable number at each cable gland. The cable number shall be in accordance with the cable number indicated on the respective cable schedules. The cable numbers shall be equal to the type manufactured by Bowthorpe Hellerman or similar approved.

6.4 Glands

All cable glands shall be suitable for use in highly corrosive locations and equal or similar to the CCG Posi guard and Posi seal types.

6.5 Trenches

Cables installed in trenches shall be installed in accordance with the General Technical Requirements. The electrical contractor shall carry out the excavation and backfilling of cable trenches. Cable trenches shall have a minimum depth of 600m.

6.6 Measurement

Cable quantities given in the Schedule of Quantities and Cable Schedules have been measured against scaled drawings. It is the contractor's responsibility to measure the exact cable lengths before purchasing / installing cables. All cables will be subject to re-measure by the engineer once installed.

6.7 Installation

LV cables shall be installed as specified. The installation shall be carefully planned to reduce the number of cable crossings to a minimum.
The following different types of installations shall be employed:

[a] On cable trays and ladders

[b] Inside sleeves in excavated cable trenches

6.8 Laying of cables in trenches

When laying cables in trenches excavated in soft or hard rock or containing sharp stones, rocks or other items most likely to injure cables, the following precautions shall be taken:

a. Before laying the cables all rocks, stones, etc shall be removed from the bottom of the trench. The floor of the trench shall be evenly covered with a layer of sifted backfill or sand to a level which is 75mm above the highest unevenness of the trench. The cost of this work shall be included in the contractor's price. The laying of cables shall not be commenced until the trenches have been inspected and approved. The cable shall be removed from the drum in such a way that no twisting, tension or mechanical damage is caused, and must be adequately supported at short intervals during the entire operation. Particular care must be exercised where it is necessary to draw cables through pipes and ducts to avoid abrasion, elongation or distortion of any kind. The ends of such pipes and ducts shall be sealed in an approved manner after drawing in of cables.
b. The cable shall be covered with a 150mm layer of sifted backfill of sand. All trenches shall be backfilled with damp soil, in layers not more than 150mm thick. Each layer shall be individually compacted in order to obtain the same degree of permeability as that of the surrounding undisturbed soil.
c. A distance of 300mm shall exist between instrumentation and power cable.

Tenderers are to note that:
Pickable Material -
Shall mean ground or rock that can be loosened by handpick and includes hard shale, compact ouklip and boulders from 75mm in diameter up to 0.03m² in volume.

6.9 Laying of cables into existing concrete cable trenches.

New cables installed in concrete cable trenches must be secured to existing cable ladders, and metal covers must be reinstated after cables have been installed.

6.10 Cable Ladder

- Cable ladders shall be OL76 (2mm thick) Cable Ladder as supplied by O-Line or similar approved. All nuts and bolts must be galvanised.
- Wherever possible all cable racks shall be installed in a vertical orientation to prevent accumulation of spillage and dust. Adequate space being provided behind the rack for the fixing of nuts and cable ties, etc.
- Cable racks shall be fixed to the building structure by means of stand-off galvanised supports at approximately two metre intervals, and also at the ends (joints) of each fabricated length.
- Each run of cable rack shall be bonded across all sections and be electrically continuous throughout. Where the electrical continuity cannot be guaranteed, a continuous bare copper conductor shall be provided for each run of cable tray and each section shall be bonded to this conductor. In addition all cable racks shall be bonded to the switchboard to which the cables it carries are connected.

- Cables on cable trays and ladders shall be neatly laid on the ladders and strapped to the ladders/trays at 1200mm intervals. A minimum of a half cable diameter space shall be allowed between cables.

6.11 400v Motorised Air Circuit Breakers

SABC has standardizing on ABB 400V motorised ACB's. Therefore, the ACB's indicated on drawings must be ABB or similar approved.

6.12 Existing Electrical Installation.

Bidder must note that the existing installation in Radio Park is in operation 24 hours a day and no interruption of broadcasting services will be allowed. Before any equipment is disconnected and new equipment connected, the contractor will have to obtain acceptable time slots from the SABC**.**

6.13 Transformers

The preferred transformer is the Cast Resin Dry Type air cooled enclosed 1600kVA 11/0.4kV distribution transformer or similar approved. The transformer must be manufactured to IEC 60076, BS 171 and SANS 780 specification. The primary (HV) winding shall be connected in delta and the secondary (LV) winding star. The neutral of the secondary (LV) winding shall be brought out to a separate insulated bushing.

Suitable arrangement for HV side box and LV side box shall be provided. The HV box shall be suitable to terminate 95mm² 3 core XLPE cable and the LT shall be able to terminate bus-bar system.

11kV / 400V, 1600kVA Transformer

	Mental Enclosure	IP31
	Altitude	1700 M
	Low voltage	400V
	High Voltage	11000V
	Number of Phases	Three + Neutral
	Frequency	50HZ
	ROLLERS:	4 AXLES 4 ROLLERS (BI-DIRECTIONAL)
	CABLE ENTRAY 11kV	TOP ENTRY
	CABLE ENTRY LV:	TOP ENTRY
	VECTOR GROUP	Dyn11
	WINDINGS	ALUMINIUM
	TAP SWITCH (-5%, -2.5%, 0%, +2.5%, +5%) OFF LOAD	
	LIFTING LUGS (WELDED ON)	
	PAINT:	AVOCADO-C12
	RATING PLATE:	ALUMINIUM
	EARTH BOSS	LV SIDE
	Temperature monitoring	Temperature monitoring probes
	IMP: 6.5%	NLL: 2800W LL: 14000W

Potential Transformers

The potential transformers must be of the 11kV/110V three-phase type with high voltage JIRC fuses protection, must have a rating of 10VA, must comply with BS 3941 class B and must be a star-star transformer. Arrangement of the potential transformer must allow easy access for removal without need for disassembling. Arrangement of the fuses must allow easy access for

replacement. All HV connections will be insulated before final inspection.

6.14 MV Cabling

a) XLPE cables shall be constructed in accordance with SABS 1339, and only type A individually screened and armoured cable shall be used.

b) Through joints shall not be permitted in cables of less than standard drum length. Where joints are deemed necessary, they shall be completed in one continuous operation.

c) All cables and through joints shall only be made by using terminating and jointing kits approved by the cable manufacturer, and by personnel trained by the manufacturer in the use of these kits. The manufacturer's instructions issued with the kits shall be strictly adhered to.

d) Each cable termination and or through joint shall be inspected by the Engineer or his representative prior to AC, LF pressure tests being carried out, the Engineer shall be notified timeously before any such tests are carried out.

e) The cables shall be firmly secured to their terminating switchgear or transformer by means of a clamp to obviate any stress on the cable or terminations. The copper tapes of the earth screen shall be bonded to the earth bar of the terminating equipment, but shall be removable for testing purposes.

6.15 MV Termination

a) The preferred MV termination & joint is Raychem or similar approved

6.16 MV Circuit Breakers

a) The existing 11kV circuit breakers will be used with a new protection relay programmed to provide protection for the new 1600 kVA transformers.

6.17 REMOTE MONITORING SYSTEM

b) The new generators must be equipment with remote monitoring system.
c) The system must be able to support multi-set generator system
d) The system must provide real time instrumentation & control, event log and automatic system alerts. These must be sent to different users via email and sms. The system should be viewed on smart phone, tablet or computer.
e) Each devise can be set to view only or able to control the system remotely.
f) The controller should be able to log all the event or changes done by each user.
g) 10" colour multi-set remote display to be installed in our k1 control room for viewing only.

6.18 BMS

(a) The new generator system must be able to communicate with the existing Johnson Controls Metasys BMS.

b) The relevant integration will be undertaken by a Johnson Controls Integrator, thus enabling the signals below to be transmitted from the generator's PLC to the existing BMS**.**

- Alternator Volts L1-N, L2-N, L3-N

- Alternator Volts L1-L2, L2-L3, L3-L1
- Alternator Amps L1, L2, L3
- Alternator Frequency Hz
- Alternator kVA L1, L2, L3, Total
- Alternator kW L1, L2, L3, Total
- Alternator pf L1, L2, L3, Average
- Alternator kVAr L1, L2, L3, Total
- Alternator KWh

- Alternator KVAh
- Alternator KVArh
- Alternator Phase Sequence
- Synchroscope Display
- Engine Speed RPM
- Engine Oil Pressure
- Engine Temperature
- Plant Battery Volts
- Engine Hours Run
- Number of Start Attempts
- Maintenance Display
- Log & display all alarms & shut down conditions (date & time stamped).
- Log & display status of all switchgear that is controlled (date & time stamped).

c) The above will enable monitoring of the generator from the BMS, however, no control of the generator will be possible from the BMS.

d) Fully remote monitoring & control monitoring units shall be fitted. The monitoring and control units shall come with different set up for each user:

- Each user to have different levels of control.
- Some user to be able to view the status only.
- Send notification on change of the status, e.g generator failed to start, low fuel.
- The remote monitoring system should be able to be viewed on PC or mobile app.

6.19 EARTHING

a) The complete Electrical Installation shall be earthed and bonded as required by the Code of Practice.

7. Generator Change over Panel

a) The contractor will be responsible for liaison with the supplier regarding programme, submission of workshop drawings, inspections at the factory, taking delivery, unpacking, placing in position and assembling, where required. Final connections to all Control Panels, testing, preparation of legend cards and commissioning shall be carried out by the contractor.
b) The fault levels are indicated on the schematic diagram. It is the responsibility of the distribution board manufacturer to select current limiting type circuit breakers and select suitable downstream switchgear to ensure that the fault levels indicated will be achieved.
c) The Control Panels manufacturers shall ensure that distribution boards are correctly sized in order that they may be fitted within the allocated spaces as indicated on the drawings. The Control Panel

must be manufactured by a reputable generator vendor.

7.1 Battery Charger

a) The change over panel shall contain three battery chargers for charging each of the 24V DC Engine Starting batteries and the 24V DC Control batteries from the 230V mains.
b) Each of the Engine Starting batteries will consist of 2 x 12V DC 200Ah batteries in parallel.
c) The control batteries must be supplied with the panel and must be housed inside a separate cubicle within the panel. The control batteries must consists of 2 x 12V DC 35Ah batteries in parallel. If the control batteries fail for whatever reason the engine batteries must supply control voltage to the panel.

d) The 24V battery chargers shall be of the fully automatic type and shall consist of an air cooled transformer, silicon bridge rectifier, fuses and switching arrangement. All equipment shall be suitably rated and designed to automatically deliver a trickle or boost charge as determined by the battery voltage. The boost charge in amps shall not exceed 20% of the rated battery capacity but must not be less than 10Amps.

e) A constant trickle charge facility is not acceptable. The charger shall switch off automatically when the battery is fully charged.

f) The charger must be provided with a Voltmeter indicating the battery voltage. This instrument must be mounted on the control panel door.

7.2 Change Over Panel

a) The switchboard / control panel must provide for the control, metering and switching of the diesel alternator sets. The switchboard will incorporate all the switchgear, control equipment and load busbars specified.

b) This section covers the design, manufacture and works testing of a switchboard/control panel for the automatic change over and control of the 400/230V 50Hz diesel generating sets.

c) Control equipment must provide advanced synchronizing functionality for diesel generating sets that include non-electronic and electronic engines.

d) Control of the sets will be undertaken by means of Programmable Deep Sea series 8610 Controllers or similar approved, and the control system must offer the end user maximum flexibility, reliability and ease of operation.

e) The hardware of the controllers must comprise inputs and outputs which are galvanically isolated from the C.P.U. (Central Processing Unit) input and output circuits.

f) The software development must be undertaken by the generating set contractor and shall be easily tailored to specific needs. Circuit development must be generated on a PC.

g) The switchboard will consist of a section for each generator, arranged with a Common Control section in the centre of the switchboard and the generator switching and control panels on either side of the Common Control section

h) The switchboard will be manufactured from 2mm cold rolled sheet steel and will be of folded construction. Each section of the switchboard will be physically separated from adjacent sections

and suitable barriers will be provided between control and switchgear sections of each panel.

i) Prior to epoxy painting, all sheet steel must be thoroughly de-rusted and primed with two coats of zinc chromate etching primer.

j) All internal chassis plates must be galvanised steel

k) The panel shall be fully labelled, and a wiring diagram shall be installed in each plant room, mounted on the wall in a wooden frame with removable Perspex protective cover.

l) The respective sections of the switchboard must be equipped as follows:

7.3 Generator Control and Switching

This section will contain all equipment relevant to the automatic control switching and monitoring of the diesel engine and generator that it controls.

The controller must be provided with the following functions:

a) Instrumentation
b) Generator Volts L1-N, L2-N, L3-N
c) Generator Volts L1-L2, L2-L3, L3-L1
d) Generator Amps L1, L2, L3
e) Generator Frequency Hz
f) Generator kVA L1, L2, L3, Total
g) Generator kW L1, L2, L3, Total
h) Generator pf L1, L2, L3, Average
i) Generator kVAr L1, L2, L3, Total
j) Generator KWh
k) Generator KVAh
l) Generator KVArh
m) Generator Phase Sequence
n) Synchroscope Display
o) Engine Speed RPM
p) Engine Oil Pressure
q) Engine Temperature
r) Plant Battery Volts
s) Engine Hours Run
t) Number of Start Attempts
u) Maintenance Display
v) Engine ECU diagnostics information via industry standard CAN interface
w) Enhanced metering via CAN when connected to an electronic engine

7.4 Control selectors and LCD Display

The module is operated using the front STOP/RESET, MANUAL, AUTO and START push buttons. Three of these push buttons include an LED indicator. Additional push buttons provide LCD display scroll, lamp test, mute functionality and breaker control.

- Electronic engine capability
- RS485 remote communications
- Back-lit LCD 4-line text display

- Voltage measurement
- Configurable inputs (9)
- Configurable outputs (5)
- Automatic start
- Manual start
- Audible alarm
- LED indicators
- Engine history event log
- Engine protection
- Configurable alarm timers
- Configurable start & stop timers
- Automatic load transfer
- Magnetic pick-up

7.5 Control Functions and Equipment

The module must be able to monitor under/over generator volts, over current, under/over generator frequency, under speed, over speed, charge fail, emergency stop, low oil pressure high engine temperature, fail to start, low/high DC battery volts, fail to stop, generator short circuit protection.

- ROCOF & vector shift
- Automatic hours run balancing of generator sets
- Dead bus sensing
- Direct communication from the module to the governor and AVR
- Volts & frequency matching.
- Synchronise with the mains on return for few seconds and remove the load from generator.
- Alarm message with SMS.
- If first generator failed on start-up or during operation the second generator shall start automatically.
- KW and Kvar load sharing with multiple generators.
- Refuel day tank automatically at 50%, at 30% send low fuel alarm at 5% shutdown the engine. Day tank fuel gauge to be calibrated on site and tested.

7.6 Switchgear

a) The following switchgear for switching and protection of each generator must be provided:

- Triple pole draw out type air circuit breaker complete with electronic overload and short circuit protection. This breaker will be suitable for remote electrical operation and will be equipped with a spring charging motor as well as closing and tripping coils.

- All by-pass circuit breaker to be fitted with locking mechanism to lock the breaker in “off” position. key to be removable in “off” position only

- Suitable ratio five amp current transformers.

- Set copper busbars rated for 1,67A per millimetre square operation. The busbars will be identified in phase colours.

b) The following ABB switchgear for switching and protection of the main incomer must be provided:

- Three pole draw out type air circuit breaker complete with electronic overload and short circuit protection. This breaker will be suitable for remote electrical operation and will be equipped with a spring charging motor as well as closing and tripping coils.

- Suitable ratio five amp current transformers.
- Set copper busbars rated for 1,67A per millimetre square operation. The busbars will be painted in phase colours.
- Programmable power meter (KVA, KWH, Kvar, V, I,pf, etc).

c) The following switchgear for switching and protection of the feeders must be provided:

- Triple pole draw out type air circuit breaker complete with electronic overload and short circuit protection. This breaker will be suitable for remote electrical operation and will be equipped with a spring charging motor as well as closing and tripping coils.
- Suitable ratio five amp current transformers.
- Set copper busbars rated for 1,67A per millimetre square operation. The busbars will be painted in phase colours.
- Programmable power meter (KVA, KWH, Kvar, V, I,pf, etc).

d) Testing

The control panels must be fully tested and the following control conditions must be simulated:

- Automatic Starting and Stopping of the Generators as describe above.
- Manual Control of the Generators.
- These tests must be witnessed by SABC representative.

e) Standards

The switchboard/control panel will be built to the following standards:

f) Control Circuit Wiring and Terminals

- All control wiring will be undertaken in stranded copper conductor having a minimum cross-sectional area of 1,0mm².
- All control wiring will present a neat appearance and will be suitably braced, placed in trunking, clipped to prevent vibration. Connections to equipment on swing doors will be so arranged to give a twisting motion and not a bending motion to the conductor.
- All panel and equipment terminals, labels etc., will be completely accessible after the wiring and cabling has been completed.
- All wires will be marked at both ends with an approved type of marking device identifying the conductor which corresponds to the circuit diagrams. Interlocking type ferrules with permanent black letters impressed on a white or yellow background will be used.
- All auxiliary terminals will be accessible from the front of the control board and all terminals will be mounted at a minimum height of 200mm above the gland plate.

- All terminals will be suitable for use with crimped lugs.
- Terminal blocks will be made from non-tracking insulating material and have a minimum clearance of 13mm between the connection point and earthed metal. Terminals where pressure is applied to the insulating moulding when tightening the connections will not be used.
- After completion, the wiring will be tested to withstand a test voltage of 1000V for two minutes.
- All busbars and cable connections will be pressure tested to withstand a test voltage of 2500V for two minutes.

g) Fuses

All fuses will be of the high breaking capacity type in accordance with IEC/EN60269-1.

All fuses will be so connected that the live wire terminal is at the top.

Each set of fuses will be provided with an engraved label, fixed to the panel adjacent to the fuses, inscribed with the fuse number and rating.

h) Instruments

All instruments will comply with the following standard unless otherwise stated.

Instruments	BS89
Instrument scales	BS3693
Indicating electrical instruments	I.E.C.51

i) Contactors

All contactors will comply with the requirements of IEC947-4-1.

j) Control Switches

Control switches will be of the rotary action air break type, suitable for controlling alternating or direct current loads.

k) Control Relays

Control relays will be of the totally enclosed plug-in type with contacts suitable for the current making, carrying and breaking conditions of the associated equipment.

l) Busbars and Busbar assemblies

In accordance with SABS IEC 60439 and SABS 1473 Part 1, all bus-bar assemblies and mountings must be have been tested by the NETFA test facility and the switchboard manufacturer must be approved to manufacture switchboards in accordance with this standard.

Fault Level - The board and its equipment shall be rated to operate at on a 400V 3phase 4 wire system having an assymetrical prospective fault level of 50 kA or as contained in the detailed specification of the Electrical Installation.

8. Busbars

The copper busbars shall contain R, W and B phases including a full N and external earth. The preferred busbar is Telemecanique Canalis 2350A KG5 RWBN + external earth copper busbars as supplied by DJ Busbars or similar approved.

- The busbar system must be enclosed in steel with ventilation facilities on the top and bottom.
- The steel casing must be of sound mechanical design and shall, together with the two side steel profiles, form a rigid enclosure to prevent mechanical damage.
- The steel casing must be powder coated to the colour specification.
- The conductors must be copper and shall consist of three phases and a neutral conductor.
- The cross sectional area of the neutral conductor must be the same as the cross sectional area of the phase conductors.
- The busbar system must be fitted with a copper earth conductor within the steel casing.
- The conductors must be supported on non-hygroscopic insulators.
- The phase conductors and the neutral conductor must be insulated over their entire length.
- All copper components must be 99.8 % electroliticaly pure copper.
- All joints must be made between tin plated components.
- No bi-metal joints must be used.
- Facilities must be available for fitting Tap off units at the busbar joints.
- The rated peak current of the busbar must be at least 60 times the normal current rating of the busbar.
- The Busbar Manufacturer must be listed in accordance with S A B S ISO 9001 of 2000.

9. Generators

9.0 Engines

9.1) General

The engine must comply with the requirements as laid down in BS 5514 (ISO 3046), and must be of the atomised injection, compression ignition type, running at a speed not exceeding 1500 r.p.m. The engine must be amply rated for the required electrical output of the set, when running under the site conditions. The starting period for either manual or automatic switching-on until the taking over by the generating set, in one step, of a load equal to the specified site electrical output, shall not exceed 15 seconds. This must be guaranteed by the Bidder.

9.2) Rating

set shall be capable of delivering the specified output continuously under the site conditions, without overheating. The engine shall be capable of delivering an output of 110 % of the specified output for one hour in any period of 12 hours consecutive running in accordance with BS 5514.

9.3) De-Rating

The engine must be de-rated for the site conditions as set out in the Specification 1,700 metres above sea level.

The de-rating of the engine for site conditions shall be strictly in accordance with BS 5514 of 1977 as amended to date. Any other methods of de-rating must have the approval of the SABC LTD and must be motivated in detail. Such de-rating must be guaranteed in writing and proved by the successful Bidder at the site test.

9.4) Starting and Stopping

The engine shall be fitted with an electric starter motor and be easily started from cold, without the use of any special ignition devices under summer as well as winter conditions.

Bidder must state what arrangements are provided to ensure easy starting in cold weather. Full details of this equipment must be submitted. In the case of water cooled engines, any electrical heaters shall be thermostatically controlled. The electrical circuit for such heaters shall be taken from the control panel, and must be protected by a suitable circuit breaker.

9.5) Starter Battery

The set must be supplied a fully charged lead-acid type battery, complete with necessary electrolyte. The battery must have sufficient capacity to provide the starting torque stipulated by the engine makers. The battery capacity shall not be less than 120 Ah and shall be capable of providing five consecutive start attempts from cold and thereafter a six attempt under manual control of not less than 20 seconds duration each. The battery must be of the heavy duty “low maintenance” type, house in a suitable battery box. A automatic battery charger to be supplied to keep in a fully charged state. The electrical circuit for the battery charger shall be taken from the control panel, and must be protected by a suitable circuit breaker.

9.6) Cooling

The engine may be either of the air of water cooled type. In the case of water-cooling, a built-on heavy duty, tropical type pressurised radiator must be fitted.

For either method of cooling, protection must be provided against running at excessive temperatures. The operation of this protective device must give a visual and audible indication on the switchboard on the switchboard. Water-cooled engines shall in addition be fitted with a low water cut-out switch, installed in the radiator, to switch the set off in the event of a loss of coolant. The protection shall operate in the same way as the other cut-outs (e.g. low oil pressure). All air ducts for the cooling of the engine are to be allowed for. The air shall be supplied from the cooling fan cowling/radiator face to air outlet louvers in the plant room wall.

9.7) Lubrication

Lubrication of the main bearings and other important moving parts shall be by forced feed system. An automatic low oil pressure cut-out must be fitted, operating the stop solenoid on the engine and giving a visible and audible indication on the switchboard.

9.8) Fuel Pump

The fuel injection equipment is suitable for operation with the commercial brands of diesel fuel normally available in South Africa.

9.10) Fuel Tank

A 900L stainless steel fuel tank shall be installed in K1 plant room link to the bulk tank situated in K2 plant room with stainless steel pipes from the bulk tank.

Supply and install main stainless steel pipe from the bulk tank to each day tank including electric solenoid valve and pump for each tank. The piping & pump shall be size to replenish the day tank while the

generator is running at full load.

A water trap shall be fitted in the fuel pipeline from the day tank to the engine.

The tank shall be fitted with a suitable filter, a full height gauge glass, “low fuel level” alarm, giving an audible and visible signal on the switchboard as well as a low-low fuel level cut-out.

An automatic electrically operated pump to refuel the day tank from the main tank shall be fitted.

The interconnection fuel piping shall consist of stainless steel pipe and the connection to vibrating components shall be in flexible tubing with armoured covering.

9.11) Governor

The speed of the engine shall be controlled by a governor in accordance with class A2 of BS 5514 of 1977 if not otherwise specified in the Technical Specification.

The permanent speed variation between no load and full load shall not exceed 4,5% of the normal engine speed and the temporary speed variation shall not exceed 10% External facilities must be provided on the engine, to adjust the normal speed setting by ± 5% at all loads zero and rated load.

9.12) Flywheel

A suitable flywheel must be fitted, so that lights fed from the set will be free from any visible flicker.

The cyclic irregularity of the set must be within the limit laid down in BS 5514 of 1977.

9.13) Exhaust Silencer

It is essential to keep the noise level as low as possible. An effective exhaust silencing system of the residential type must be provided.

The exhaust pipe shall be installed in such a way that the expulsed exhaust fumes will not cause discomfort to the public/employees. The exhaust pipe must be flexibly connected to the engine to take up vibrations transmitted from the engine, which may cause breakage. The exhaust piping and silencer shall be lagged to reduce the heat and noise transmission into the plant room and shall be protected against the ingress of driving rain at 45° to the horizontal. The exhaust pipe must extend 0,5m above the roof gutters. It must be secured by flanges both sides of the wall at the point of exit. These flanges must be clamped to the wall with bolts through the wall.

The exhaust at News Block Plant room shall link to the existing system and mechanism installed to prevent fumes going back into the stationery engine. The bidder to take measurement and advice if the existing exhaust system has enough capacity to accommodate the new engine.

9.14) Accessories

The engine must be supplied complete with all accessories, air and oil filters, 3 instruction manuals, spare parts lists, the first fill of all lubricating oils, fuel, etc.

The engine shall be capable of starting from cold in winter conditions, and should be provided with a dual pre-heating system, separately wired, supplied from both normal and backup supplies (not smaller than 2kW each), acceptable to the Engineer.

An electronic speed governor of class A1 as stipulated by BS 5514 shall be provided.

The engines shall be rated **(prime capacity)** to operate at 1,700 metres above sea level (Gauteng Province), capable of driving the alternators to the capacity as specified.

Engines acceptable:

a) Cummins
b) Cat
c) Volvo
d) Deutz
e) Perkins
f) MTU
g) Scania
h) Kohler

9.15) Alternators

The alternators shall comply with the requirements of BS 5000, Part 3.

The alternators shall be of the self-excited brushless (Stamford/Leroy) type, capable of supplying the specified output continuously with a temperature rise not exceeding the limits laid down in BS 5000 for rotor and starter windings.

The alternator shall be capable of delivering an output of 110% of the specified output, for one hour in any period of 12 hours consecutive running

The alternators shall be self-regulated, the inherent voltage regulation not exceeding ± 2, 5% of the nominal voltage at all loads with the power factor between unity and 0, 8 and within the driving speed variations of 4, 5% between no load and full load.

The alternator shall be designed for rapid voltage recovery following sudden application of full load or motor starting currents. The voltage shall recover to within 2,5% of the steady state within 300 Ms following the application of full rated load, with the transient voltage dip not exceeding 18%.

The engine and alternator must be directly coupled by means of a high quality flexible coupling, equal and similar to the “HOLSET” type.

Types of Alternators acceptable:

a) Leroy Some
b) Stamford
c) Marathon
d) Marelli

9.16) Plant Ratings

The Standby Plant ratings shall apply under the following load/site conditions:

Power factor	:	0,8
Altitude above sea level	:	1700m above sea level
Maximum ambient temperature	:	30°C averages
Relative humidity at maximum	:	80% Average

9.17) Protection Equipment and Indicators

Provide a start attempt limit, limiting the number of start cycles to six attempts, thereby avoiding the batteries from being run down, should the engine fail to start or should the alternator fail to generate power for any reason.

Provide a speed sensing switch to isolate the starters after the engine has attained speed during the start cycle. In series with the speed sensing switch, provide an oil pressure switch, again to isolate the starter when the engine oil reaches operational pressure during the starting of the plant.

While the plant is in its stop cycle, the oil pressure switch shall delay engaging of the starters, until the engine has come to rest and the oil pressure has dropped completely. The above switches shall prevent the starters engaging while the engine is still rotating.

Provide engine over and under speed protection with short delay before shutting down the plant.

Provide low and high (adjustable) alternator voltage protection.

Other protective devices shall include:

- Set not in "auto" mode
- High engine temperature
- Low battery voltage
- Start sequence failure alarm

Single Common Alarm Output but shall have individual potential free contacts for remote monitoring via BMS

- Over-speed
- Under-speed
- Low fuel level
- Battery earth fault
- Generator "Run"
- Mains failure

Individual Alarm and individual potential free contacts for remote monitoring via BMS

The above devices shall operate indicator lamps, sound the alarm and shut down the plant, except as otherwise indicated.

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9.18) Brochures

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

10. TECHNICAL INFORMATION

The following information shall be supplied in full and in all respects for each plant and shall be submitted together with the bid

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10.1 Engine 1000KVA (Remote cooling)

NO	ITEM	REMARKS
1.	Manufacturer's Name	
2.	Manufacturer's model No. and year of manufacture	
3.	Continuous sea level rating after allowing for ancillary equipment : a) In kW	
4.	Percentage de-rating for site conditions, in accordance with BS 551.4 a) For altitude b) For temperature c) For humidity d) Total de-rating	
5.	Net output on site in kW	
6.	Nominal speed in r.p.m.	
7.	Number of cylinders	
8.	Fuel consumption of the complete generating set on site in l/h of alternator output at : a) Full load b) ¾ load c) ½ load NOTE : A tolerance of 5% shall be allowed above the stated value of fuel consumption.	
9.	Make of fuel injection system.	
10.	Capacity of fuel tank in litres	
11.	Is gauge glass fitted to tank?	
12.	Is electric pump for filling the fuel tank included?	
13.	Method of starting	
14.	Voltage of starting system	
15.	Method of cooling	
16.	Type of radiator if water-cooled	
17.	Type of heater for warming cylinder heads	
18.	Capacity of heater in kW	

19.	Method of protection against high temperature	
20.	Method of protection against low oil pressure	
21.	Type of governor	
22.	Speed variation in % a. Temporary b. Permanent	
23.	Minimum time required for as assumption of full load in seconds	
24.	Recommended interval in running hours for : a. Lubricating oil change b. Oil filter element change c. Decarbonising	
25.	Type of base	
26.	Can plant be placed on solid concrete floor?	
27.	Are all accessories and ducts included?	
28.	Is engine naturally aspirated?	
29.	Are performance curves attached?	
30.	Diameter of exhaust pipe	
31.	Noise level at tail of exhaust pipe in dBA	
32.	BMEP (4 stroke) at continuous rating (kPa)	
33.	% Load acceptance to BS 5514, Part 4, with 10% transient speed drop	

10.2) Engine (1650KVA)

NO	ITEM	REMARKS
1.	Manufacturer's Name	
2.	Country of Origin	
3.	Manufacturer's model No. and year of manufacture	
4.	Continuous sea level rating after allowing for ancillary equipment : b) In kW	
5.	Percentage de-rating for site conditions, in accordance with BS 551.4 a) For altitude b) For temperature c) For humidity d) Total de-rating	
6.	Net output on site in kW	
7.	Nominal speed in r.p.m.	
8.	Number of cylinders	
9.	Strokes per working cycle	

NO	ITEM	REMARKS
10.	Stroke in mm	
11.	Cylinder bore in mm	
12.	Swept volume in cm^3	
13.	Mean piston speed in m/min	
14.	Compression ratio	
15.	Cyclic irregularity	
16.	Fuel consumption of the complete generating set on site in l/h of alternator output at : a) Full load b) ¾ load c) ½ load NOTE : A tolerance of 5% shall be allowed above the stated value of fuel consumption.	
17.	Make of fuel injection system.	
18.	Capacity of fuel tank in litres	
19.	Is gauge glass fitted to tank?	
20.	Is electric pump for filling the fuel tank included?	
21.	Method of starting	
22.	Voltage of starting system	
23.	Method of cooling	
24.	Type of radiator if water-cooled	
25.	Type of heater for warming cylinder heads	
26.	Capacity of heater in kW	
27.	Method of protection against high temperature	
28.	Method of protection against low oil pressure	
29.	Type of governor	
30.	Speed variation in % a. Temporary b. Permanent	
31.	Minimum time required for as assumption of full load in seconds	
32.	Recommended interval in running hours for : a. Lubricating oil change b. Oil filter element change c. Decarbonising	
33.	Type of base	
34.	Can plant be placed on solid concrete floor?	
35.	Are all accessories and ducts included?	

NO	ITEM	REMARKS
36.	Is engine naturally aspirated?	
37.	Are performance curves attached?	
38.	Diameter of exhaust pipe	
39.	Noise level at tail of exhaust pipe in dBA	
40.	BMEP (4 stroke) at continuous rating (kPa)	
41.	% Load acceptance to BS 5514, Part 4, with 10% transient speed drop	

10.3) Alternator (1250KVA) for 1000kVA Engine

NO	ITEM	REMARKS
1.	Maker's name and model no.	
2.	Country of Origin and year of manufacture	
3.	Type of enclosure	
4.	Nominal speed in r.p.m.	
5.	Number of bearings	
6.	Terminal voltage	
7.	Sea level rating kVA at 0,8 power factor	
8.	De-rating for site conditions	
9.	Input required in kW	
10.	Method of excitation	
11.	Efficiency at 0,8 power factor and : a) Full load b) ¾ load c) ½ load	
12.	Maximum permanent voltage variation in %	
13.	Transient voltage dip on full load	
14.	Voltage recovery on full load application in milli-seconds	
15.	Is alternator brushless?	
16.	Class of insulation of windings	
17.	Is alternator tropicalized?	
18.	Symmetrical short circuit current at terminals n Ampere	
19.	Type of Coupling	

10.4) Alternator (1650KVA)

NO	ITEM	REMARKS

NO	ITEM	REMARKS
20.	Maker's name and model no.	
21.	Country of Origin and year of manufacture	
22.	Type of enclosure	
23.	Nominal speed in r.p.m.	
24.	Number of bearings	
25.	Terminal voltage	
26.	Sea level rating kVA at 0,8 power factor	
27.	De-rating for site conditions	
28.	Input required in kW	
29.	Method of excitation	
30.	Efficiency at 0,8 power factor and : a) Full load b) ¾ load c) ½ load	
31.	Maximum permanent voltage variation in %	
32.	Transient voltage dip on full load	
33.	Voltage recovery on full load application in milli-seconds	
34.	Is alternator brushless?	
35.	Class of insulation of windings	
36.	Is alternator tropicalized?	
37.	Symmetrical short circuit current at terminals n Ampere	
38.	Type of Coupling	

10.5) Switchboard

NO	ITEM	REMARKS
1.	Maker's Name	
2.	Country of Origin	
3.	Is board floor mounted?	
4.	Finish of board	
5.	Make of volt, amp, and frequency meters	
6.	Dial size of meters in mm	
7.	Scale range of voltmeter	
8.	Scale range of ammeters	
9.	Ration of current transformers	

NO	ITEM	REMARKS
10.	Make of hour meter	
11.	Range of cyclometer counter	
12.	Smallest unit shown on counter (Item 11)	
13.	Make of circuit breaker	
14.	Type of circuit breaker	
15.	Rating of circuit breaker in Amp and fault level in kA	
16.	Setting range of overload trips	
17.	Setting range of instantaneous trips	
18.	Make of change-over equipment	
19.	Make of voltage relay	
20.	Is control and protection equipment mounted on a small removable panel?	
21.	Type of control equipment	
22.	Make of mains isolator	
23.	Type of indicators for protective devices	
24.	Is battery charging	
25.	Are volt- and ammeters provided for charging circuit?	
26.	Is the alarm hooter of the continuous duty type?	
27.	Rating in Amps of : a. Change-over equipment b. Mains on load isolator c. By-pass switch d. Circuit breaker to outgoing feed	
28.	Is manufacture of switchboard/control panel to be sub-let?	
29.	If yes, state name and address of specialist manufacturer	

10.6) Battery

NO	ITEM	REMARKS
1.	Maker's Name	
2.	Country of Origin	
3.	Type of battery	
4.	Voltage of battery	
5.	Number of cells	
6.	Capacity in cold crank amp	

10.7) Dimensions (1000 KVA Remote cooling) Gen set

NO	ITEM	REMARKS
1.	Overall dimensions of set in mm	
2.	Overall mass	
3.	Is the generator room adequate for the installation of the set	

10.8) Dimensions of 1650 KVA containerized Gen set

NO	ITEM	REMARKS
1.	Overall dimensions of set in mm	
2.	Overall mass	

10.9) Spare Parts and Maintenance Facilities

NO	ITEM	REMARKS
1	Approximate value of spares carried in stock for this particular diesel engine and alternator	
2	Where are these spares held in stock	
3	What facilities exist for the servicing of the equipment offered	
4	Where are these facilities available	

10.10) Warranty

NO	ITEM	REMARKS
1	12 months warranty on delivery of generator set.	
2	12 months warranty after commissioning and acceptance of generator set by client.	
3	Any other warranties please state.	

10.11 Delivery

NO	ITEM	REMARKS
1	Delivery period in weeks	

10.12 SCHEDULE OF DRAWINGS

DRAWING NUMBER	DISCRIPTION	SHEET NUMBERING
ST 15056	RADIO PARK FEEDER A& B SCHEMATIC LAYOUT	SHEET 1 OF 7
ST 15056	UPS A&B INPUT AND OUTPUT PANEL SCHEMATIC LAYOUT	SHEET 2 OF 7

ST 15056	RADIO PARK K1 PLANT ROOM UPS & GENERATOR LAYOUT	SHEET 3 OF 7
ST 15056	RADIO PARK K2 PLANT ROOM GENERATOR RETICULATION	SHEET 4 OF 7
ST 15056	1650 KVA GENERATOR & TRANSFORMER LAYOUT	SHEET 5 OF 7
ST 15056	MV SYNCHRONISING PANEL	SHEET 6 OF 7
ST 15056	HVAC PANLE LAYOUT	SHEET 7 OF 7
ST 15058	UPS K1DB	SHEET 1 OF 33
ST 15058	IBM RROM 1 DB	SHEET 2 OF 33
ST 15058	IBM ROOM2 DB	SHEET 3 OF 33
ST 15058	SECURITY K1 UPS DB	SHEET 4 OF 33
ST 15058	SA FM UPS DB	SHEET 5 OF 33
ST 15058	MCR UPS DB	SHEET 6 OF 33
ST 15058	CHANNEL AFRICA UPS DB	SHEET 7 OF 33
ST 15058	RSG FM UPS DB	SHEET 8 OF 33
ST 15058	GROUND FLOOR PLANT ROOM UPS D	SHEET 9 OF 33
ST 15058	5 FM UPS DB	SHEET 10 OF 33
ST 15058	METRO FM UPS DB	SHEET 11 OF 33
ST 15058	RADIO 2000 GROUND FLOOR UPS DB	SHEET 12 OF 33
ST 15058	T6 UPS DB	SHEET 13 OF 33
ST 15058	A1 C RISER UPS DB	SHEET 14 OF 33
ST 15058	LESEDI FM UPS DB	SHEET 15 OF 33
ST 15058	UMHLOBO UPS DB	SHEET 16 OF 33
ST 15058	RADIO 2000 A UPS DB	SHEET 17 OF 33
ST 15058	RADIO 2000 B FM UPS DB	SHEET 18 OF 33
ST 15058	UKHOZI A UPS DB	SHEET 19 OF 33
ST 15058	UKHOZI B UPS DB	SHEET 20 OF 33
ST 15058	MOTSWEDING UPS DB	SHEET 21 OF 33
ST 15058	LOTUS FM UPS DB	SHEET 22OF 33
ST 15058	6TH FLOOR RISER ACCESS CONTROL UPS DB	SHEET 23 OF 33
ST 15058	22ND FLOOR RISER ACCESS CONTROL UPS DB	SHEET 24 OF 33
ST 15058	K1 LEVEL UPS DB'S LOCATION	SHEET 25 OF 33
ST 15058	GROUND FLOOR UPS DB'S LOCATION	SHEET 26 OF 33
ST 15058	A1 LEVELE UPS DB'S LOCATION	SHEET 27 OF 33
ST 15058	K1 TVOB UPS DB'S LOCATION	SHEET 28 OF 33
ST 15058	1st FLOOR UPS DB'S LOCATION	SHEET 29 OF 33
ST 15058	3rd FLOOR UPS DB'S LOCATION	SHEET 30 OF 33
ST 15058	6TH FLOOR UPS DB'S LOCATION	SHEET 31 O 33
ST 15058	6Th FLOOR riser ACCESS CONTROL UPS DB LOCATION	SHEET 32 OF 33
ST 15058	22nd FLOOR RISER ACCESS CONTROL DB LOCATION	SHEET 33 OF 33

11. GENERAL ELECTRICAL SPECIFICATION

11.1 GENERAL

The General Electrical Specification is to be read in conjunction with the Technical Specification.

Where the Technical Specification differs from the General Electrical Specification, the former shall apply to this contract.

11.2 COMPLIANCE WITH REGULATIONS

11.2.1 The installation shall be erected and carried out in compliance with:

a) The SANS - 10142 Code of Practice for the Wiring of Premises as amended;

b) The Machinery and Occupational Safety Act as amended;

c) The local Municipal & Supply Authority By-Laws and Regulations;

d) The local Fire Regulations;

e) The Regulations of Telkom;

f) The Standard Regulations of any Government Department of public service company where applicable;

g) The factory-built assemblies of low voltage switchgear and control gear IEC 439, as amended;

h) The degrees of protection of enclosures for low voltage switchgear and control gear IEC 144, as amended.

11.2.2 In addition, the Contractor shall issue all notices and pay all the required fees in respect of the installation to the local authorities, and shall exempt the Employer from all losses, costs or expenditures that may arise as a result of the Contractor's negligence to comply with the requirements of the regulations enumerated in paragraph 1.2.

11.2.3 It shall be assumed that the Contractor is conversant with the above mentioned requirements. Should any requirements, by-law or regulation, that contradict the requirements of this document, apply or become applicable during erection of the installation, such requirement, by-law or regulation shall overrule this document and the Contractor shall immediately inform the Engineer of such a contradiction. Under no circumstances shall the Contractor carry out any variations to the installation in terms of such contradictions without obtaining the written permission to do so from the Engineer.

11.3 ARRANGEMENTS WITH THE SUPPLY AUTHORITY

11.3.1 It shall be the responsibility of the Contractor to issue all notices and pay all monies that are due for the electrical builders / temporary supply connection, except where otherwise specified. If, according to the contract, these monies are reclaimable from the Employer, then these claims by the Contractor shall be substantiated with official receipts.

11.3.2 The Contractor shall supply and install all notices and warning signs that are required by the appropriate laws, regulations and/or by this document.

11.4 FIXING AND SUPPORTING OF EQUIPMENT AND MATERIALS

11.4.1 It is the responsibility of the Contractor to position and securely fix conduits, ducts, cables and cable channels, switchboards, fittings and all other equipment or accessories as required for the installation. The Contractor shall provide and fix all supports, clamps, brackets, hangers and other fixing materials.

11.4.2 All supporting steelwork shall be wire-brushed and given one coat of rust resisting primer, followed by one coat of high quality enamel paint before any other equipment is fixed.

11.4.3 All methods of suspension or supports shall be submitted to the Engineer for approval and for reference to the Structural Engineers where necessary, prior to manufacture or installation.

11.4.4 Supporting of any rotating equipment shall incorporate anti-vibration mountings of the type and selection specified in the applicable clauses referring to equipment bases herein.

11.4.5 Supports shall preferably be proprietary products such as UNISTRUT, or failing this, shall be of mild steel sections, purpose fabricated for their application. Under no circumstances whatsoever will sheet metal straps be accepted as a supporting method. All supports shall cradle the item to be supported; supports shall not be rivetted or welded to the equipment. Rod hangers shall not exceed 3000mm in length and be of minimum diameter 12mm. For longer suspensions use mild steel angles. Angle iron supports shall be of 38 x 5mm minimum section.

11.4.6 REDHEAD or RAWLBOLT anchor bolts, or their equivalent, shall be used for fixing supports to the building structure, it not being permissible to utilise gunpowder shot-driven bolts for this purpose unless prior permission has been obtained.

11.4.7 Where holes in equipment exist, bolts and fixing screws as specified shall be used. Where sizes are not specified, the largest bolt or screw that will fit into the hole shall be used.

11.4.8 Where the fixing holes in brick or concrete walls are smaller than 10mm diameter and where the mass of the equipment is less than 15kg, wall plugs may be used to fix conduits, cables and other equipment. Aluminium, fibre or plastic plugs only may be used. Wooden plugs are not acceptable. Plugs installed in seams between bricks are not acceptable. A masonry drill of the correct size shall be used to drill holes for plugs. Round headed screws shall be used throughout.

11.4.9 Brass screws, bolts and nuts shall be used to fix galvanised equipment.

11.4.10 Materials as sheet metal cable ducts or channels may be fixed against walls and concrete slabs by means of the shot-fired method designed for this purpose.

11.5 ELECTRICAL CONDUIT INSTALLATION

11.5.1 General

Where conduits are to be installed in concrete, this shall be done while the building work is still in progress. Surface mounted conduit shall only be installed after the concrete has

cured sufficiently.

11.5.2 Other Services

Conduits may not be installed closer than 150mm to pipes containing gas, steam, hot water or other materials that may damage the conduits. Conduits may not touch pipes or other service installations in order to prevent electrolytic corrosion. Where this is unavoidable, cathodic protection shall be provided. Where doubtful situations of this nature occur or where there are installation incompatibilities, the matter shall be reported to the Engineer without delay.

11.5.3 Galvanised Conduit

Galvanised conduit and accessories shall be used in the following circumstances:

a) In damp areas and areas exposed to the weather
b) For all installations within 30 kilometres of the coast
c) For surface mounted conduit installations
d) In conduit used for future extensions where 'free ends' exist
e) For connections to galvanised equipment.

Conduit & accessories for the above applications shall be hot-dipped galvanised to SANS 763.

11.5.4 Debris

Care shall be taken to prevent any debris or moisture from entering the conduit during and after installation of the conduits. All conduit ends shall be sealed by means of a solid plug that shall be screwed to the conduit end. All conduits shall be cleaned to remove all oil, moisture or other debris that may be present, before conductors are installed.

11.5.5 Defects

Each length of conduit shall be inspected for defects and all burrs shall be removed. All conduits that are split, dented or otherwise damaged or any conduits with sharp internal edges shall be removed from site. The Contractor shall ensure that conduits are not blocked.

11.5.6 Conduit Ends

Conduit ends shall be cut at right angles to ensure that ends butt squarely at joints. Threads shall not be visible at joints and connections except at running joints for steel conduits.

11.5.7 Joints

All conduit ends shall be reamed and all joints tightly screwed. Only approved couplings shall be used. Running joints with long threads shall be kept to a minimum and locknuts shall be provided to ensure a strong mechanical and a continuous electrical joint for steel conduits.

11.5.8 Finish (Steel)

All joints shall be painted with red lead to prevent them from rusting in damp areas, areas

within 30km of the coast, and in cases where the installation is exposed to the weather for any length of time. Where **the** galvanising or black paint has been damaged, the area shall first be cleaned and a coat of zinc base paint applied subsequently. Additional coats of paint shall only be applied after the undercoat has been completed.

11.5.9 Continuity (Steel)

Mechanical and electrical continuity shall be maintained throughout the conduit installation. Conduits may not be relied upon for earth continuity.

11.5.10 Inspection Type Accessories

Inspection type couplings, elbows and tees shall not be used except with the written consent of the Engineer. All outlet boxes and draw boxes shall however be of the inspection type.

11.5.11 Position of Outlets

All accessories such as socket outlets, switches, lights, etc., shall be accurately positioned. It is the responsibility of the Contractor to ensure that all accessories are installed level and square at the correct height from the floor, ceiling or roof level as specified. It shall be the responsibility of the Contractor to determine the correct final floor, ceiling and roof levels in conjunction with the Building Contractor. Draw boxes shall not be installed in positions where they will be inaccessible after completion of the installation. Draw boxes shall be installed in inconspicuous positions to the approval of the Engineer. All installed draw boxes shall be pointed out to the Engineer. The positions of all draw boxes shall be indicated on the 'as-built' drawings.

11.5.12 Draw Wires

Galvanised steel draw wires shall be installed in all unwired conduits, e.g. conduits for future extensions, telephone installations and other services.

11.5.13 Bends

A maximum of two 90° bends or the equivalent displacement will be allowed between outlets and/or draw boxes. Draw boxes shall be installed at maximum intervals of 12m in straight conduit runs. All bends shall be made without heating the conduit or without reducing the diameter of the conduit. The inside diameter of a bend shall not be less than three times the outside diameter of the conduit.

11.5.14 Wall Sockets

Where more than one socket outlet is connected to the same circuit, the conduit shall be looped from one outlet box to the following on the same circuit. Where a metal channel is used, the conduit may be installed from the channel directly to the outlet box on condition that the conductors can be looped from one outlet to the next without the jointing of wires.

11.5.15 Luminaires

Conduit end may not be used to solely support luminaires. Where luminaires are specified that are fixed directly to the pendant box, the pendant box shall be fixed

independently of the conduit installation except where the pendant box is cast into concrete.

11.5.16 Withdrawal of Conductors

To ensure that all electrical conductors shall be easily withdrawable from conduits, the Engineer reserves the right to have the conductors on any circuit removed at his discretion and replaced at the cost of the Contractor. If the conductors are damaged during removal, the damaged conductors shall be replaced and the cost of the replacement shall be borne by the Contractor.

11.5.17 Temperature Differences

Should the conduit installation be subject to temperature gradients at the same time, an expansion joint shall be installed in a suitable position to accommodate expansion and contraction. The conduit at the higher temperature shall be insulated from the rest of the installation with a suitable material. The above conditions for example apply where conduits leave cold rooms.

11.5.18 Flush Mounted Outlet Boxes

The edges of flush mounted outlet boxes shall not be deeper than 10mm from the final surface. Where this is not the case, an extension box that ends flush with the surface, shall be screwed to the outlet box. This method shall be used in partitions and clad surfaces.

11.5.19 Excess Holes

All excess holes in draw boxes, distribution boxes, switchboards, cable ducts or trunking, power skirting, etc., shall be securely blanked off to render the installation vermin proof.

11.5.20 PVC Conduit

The use of PVC conduit is permitted and shall be installed as per the detailed drawings.

11.5.21 Terminations

a) Switchboards, Power Skirting, Etc

A female bush and two lock nuts shall be installed where conduits terminate in pressed steel switchboards and distribution boxes, cable ducts, power skirting, etc. The conduit end shall only project far enough through the hole to accommodate the bush and lock nut.

b) Draw Boxes

A female bush and lock nut shall be used to terminate conduits at draw boxes and outlet boxes without spouts.

11.5.22 Open Roof Spaces

a) Sequence of Work

Conduits and wiring in open roof spaces above ceilings other than ceilings of concrete shall be installed before the ceilings and walls are painted and before removable ceiling tiles are installed. In roof spaces where access is limited after installation of the ceiling. It is the responsibility of the Contractor to ensure close liaison with the Building Contractor in connection with the work.

b) Fixing

All conduits in open roof spaces shall be installed parallel and at right angles to the roof members and shall be fixed to the structures at intervals not exceeding 1 metre. Approved saddles shall be used throughout. Clout nails, clamps or wood screws shall be used to secure the saddles to wooden roof members. Saddles that comply with the requirements of this specification shall be used to secure conduits against concrete slabs. Written permission shall be obtained to secure conduits to steel beams in that case saddles shall be fixed by means of bolts, nuts and lock washers or purpose made saddles shall be used.

c) Cross-Overs

Cross-Overs in conduit routes shall be minimised. Where cross-overs are unavoidable one conduit only shall be offset to cross the other conduit. Where several conduits enter the same draw box, they shall as far as possible be installed parallel to each other.

d) Draw Boxes

Draw boxes with metal cover plates shall be installed where required. Draw boxes shall as far as possible be installed near gangplanks. Socket and switch boxes will not be accepted as draw boxes in open roof spaces.

e) Positions of Accessories

In open roof spaces that afford access after completion of the building, conduit accessories shall be installed to allow wiring or inspection from above. In ceiling voids with less than 900mm clear space between the ceiling and the roof, conduits shall be installed to permit wiring and inspection from below. In the latter case, the shortest route may be followed i.e. conduits need not be installed parallel or perpendicular to roof members. Conduits shall be looped between outlet boxes.

f) Incandescent/LED Luminaires

Where luminaires are secured directly to draw boxes in false ceilings or where ceiling roses or special connections are used, flush mounted, rear entry round draw boxes that are independently fixed to roof beams, shall be provided.

g) Conduit Ends

All conduit ends for lighting outlets in ceilings shall be securely supported.

11.5.23 Installation in Concrete and Screeds

In order not to delay building operations, the Contractor shall ensure that all conduits and accessories, that are to be cast in concrete, are placed in position in good time. The

Contractor or his representative shall be in attendance when the concrete is cast.

a) **Draw Boxes**

Draw boxes, expansion joints and round ceiling boxes shall be installed where required and shall be neatly finished to match the finished slab and wall surfaces. Ceiling draw boxes shall be of the deep type. In hollow tile slabs, rear-entry draw boxes shall be used. In columns where flush mounted draw boxes are installed, the conduits shall be offset from the surface of the column immediately after leaving the draw box.

b) **Cover Plates**

Draw boxes and/or inspection boxes shall, where possible, be grouped together under a common approved cover plate. The cover plate shall be secured by means of screws.

c) **Fixing to the Shuttering**

All conduits, draw boxes etc., shall be securely fixed to the shuttering to prevent displacement when concrete is cast. Wire will not be accepted for securing boxes to the shuttering where off-shutter finishes are required. All draw boxes and outlet boxes shall be plugged with wet paper before they are secured to the shuttering.

d) **Concrete Floor Slabs**

Conduits will not be allowed in concrete floor slabs of boiler rooms (or boiler houses), laundries or other damp areas. Equipment in damp areas shall only be supplied from above by means of multi-core PVC-insulated cables that shall either be installed in galvanised steel ducting or on galvanised cable trays. All socket outlets and three phase outlets in damp areas shall be supplied from above.

e) **Screeds**

The installation of conduits in floor screeds shall be kept to a minimum. Where conduits are installed in screeds, the top of the conduit shall be at least 20mm below the surface of the screed. Where the screed is laid directly on the ground, galvanised conduits shall be used. This ruling will always be applicable to the lowest floor of a building. A minimum distance of twice the outside diameter of the conduit shall be left free between adjoining conduits. Conduits shall be secured to the concrete slab at intervals not exceeding 2,0m.

f) **Inspection**

All draw boxes, conduits, etc., that are installed in concrete shall be cleaned with compressed air and provided with draw wires two days after removal of the shuttering. Errors that occur during the installation of the conduits, or any lost draw boxes, or blocked conduits, shall be immediately reported to the Engineer in order that an alternative route can be planned and approved by the Engineer before the additional concrete is cast. Any additional cost shall be to the Contractor's account.

11.5.24 Surface Installation (steel)

Except where installed in ceiling spaces, the installation of conduit on the surface of walls and concrete slabs will only be allowed when authorised, in writing, by the Engineer. Where surface conduits are specified, saddles shall be of the hospital (spacer) type.

a) **Building Lines**

All conduits shall be installed horizontally or vertically as determined by the route and the Contractor shall take all measures to ensure a neat installation. Where conduits are to be installed directly alongside doorframes, beams, etc., that are not true, conduits shall be installed parallel to the frames, beams, etc. When in doubt, the Contractor shall consult the Engineer before installation is commenced.

b) **Saddles**

Conduits shall be firmly secured by means of saddles spaced at maximum intervals of 2000mm. Saddles shall be submitted to the Engineer for approval prior to commencement of installation. Where saddles are used to secure vertical lengths of conduit connected to surface mounted switch boxes or socket outlet boxes, the saddles shall be spaced so that the intervals between the box and the first saddle, between any two successive saddles and between the last saddle and the ceiling or roof are equidistant. Conduits shall be secured within 250mm before and after each 90° bend.

c) **Joints**

Joints will not be allowed in conduit lengths not exceeding 3500mm when these conduits are installed on the surface of a wall. Threads shall not be visible at joints of completed installations, except where running joints are used. Running joints will be allowed only when absolutely necessary. All running joints shall be provided with lock nuts and shall be painted with red lead immediately after installation.

d) **Accessories**

Inspection bends or tee pieces shall not be used. Non-inspection type bends may be used in the case of 40mm or 50mm diameter conduits. All draw boxes supporting luminaires or other equipment shall be fixed independently of the conduit installation.

11.5.25 Flexible Conduits

a. In installations where the equipment has to be moved frequently to enable adjustment during normal operation, for the connection of motors or any other vibrating equipment, for the connection to thermostats and sensors on equipment, for stove connections and where otherwise required by the Engineer, flexible conduit shall be used for the final connection to the equipment.

b. The lengths of flexible conduit shall be as short as possible to comply with the requirements of the particular connection but shall not exceed 600mm, except when specified or approved by the Engineer.

c. Flexible conduit shall preferably be connected to the remainder of the installation by means of a draw box. The flexible conduit may be connected directly to the end of a conduit if an existing draw box is available within 2000mm of the junction and if the flexible conduit can easily be rewired.

d. Flexible conduit shall consist of metal-reinforced plastic conduit or PVC covered metal conduit with an internal diameter of at least 15mm, unless approved to the contrary. In false ceiling voids, flexible conduit of galvanised steel construction may be used.

Connectors for coupling to the flexible conduit shall be of the gland or screw-in type, manufactured of either brass or cadmium or zinc plated mild steel. The requirements of paragraphs 4.5.9 are applicable.

e. Where the possibility exists that the conduit can come into contact with moisture, suitable covering and/or packing shall be installed to isolate the conduit from the moisture.

f. Flexible conduit connections shall be provided with an internal or external earth wire connection as required by the local Supply Authority, with preference given to internal earth wires where no specific local regulations apply.

11.5.26 Expansion Joints

a. Where conduits cross expansion joints in the structure, approved type draw boxes that provide a flexible connection in the conduit installation shall be installed.

b. The draw box shall be installed adjacent to the expansion joint of the structure and a conduit sleeve, one size larger than that specified for the circuit, shall be provided on the side of the draw box nearest the joint. The 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.

c. The circuit conduit passing through the sleeve shall be terminated 40mm inside the draw box. The gap between the sleeve and the conduit at the joint shall be sealed to prevent the ingress of wet cement.

d. The conduit boxes shall be drilled and tapped and the earth wire shall be bonded to the boxes by means a 2,5mm2 copper wire(minimum) with lugs and brass screws.

e. Draw boxes at the expansion joint shall be provided with a suitable steel cover plate fixed to the boxes by means of screws. The cover plates shall be installed before the ceilings are painted by others.

11.5.27 Chases and Builder's Work

a. Except where otherwise specified, the Contractor shall be responsible for the builder's work connected with conduits, outlet boxes, switchboard trays, bonding trays and other wall outlet boxes as well as the necessary chasing and cutting of walls and the provision of openings in ceilings and floors for luminaires and other electrical outlets. The Contractor shall notify the Building Contractor of his requirements and the responsibility lies with the Contractor to ensure that these requirements are met.

b. Electrical materials to be built in must be supplied, placed and fixed in position by the Contractor when required by the Building Contractor. The Contractor shall also ensure that these materials are installed in the correct positions.

c. Where no Building Contractor is on site the Contractor is required to cover conduits installed in chases by a layer of 4:1 mixture of coarse sand and cement, finished 6mm below the face of the plaster and roughened. In all cases chases shall be deep enough to ensure that the top of conduits are at least 12mm below the finished plaster surface.

d. The Contractor is responsible for the cutting of chases and the building-in of conduits

or other equipment. , He will be held responsible for all damage as a result of this work and will be required to make good to the satisfaction of the Engineer. Chases shall be made by means of a cutting machine.

e. Under no circumstances shall face brick walls or finished surfaces be chased or cut without the written permission of the Engineer. Where it is necessary to cut or drill holes in the concrete structure, then prior permission of the Structural Engineer shall be obtained to ensure that the structure is not weakened.

f. The Contractor shall maintain close co-operation with the Building Contractor and all his Contractors throughout the course of the contract. Should the Contractor not comply with these requirements, any additional costs resulting from lack of his co-operation will be recovered from him.

11.5.28 Connections to Switchboards

a) Wherever possible conduits connected to switchboards shall terminate in a common fabricated sheet steel draw box installed in the vicinity of the switchboard. In open roof spaces this draw box shall be placed in a roof space of not less than 900mm clearance. Lighting and plug circuits may be separately grouped in common conduits or metal ducts (trunking) from the distribution board to the draw box.

b) The draw box shall be of sheet steel with a minimum thickness of 1,6mm and shall be provided with a removable cover plate.

c**) Flush Mounted Switchboards**

Where flush mounted switchboards are required, the recessed switchboard tray shall be built into the brick or concrete wall. All conduits from the floor or roof shall be fully recessed and shall be bonded directly to the tray.

d) Surface Mounted Switchboards

Where surface mounted switchboards are specified but where the conduits can be fully recessed, the conduit shall be connected to a recessed connection box installed behind the switchboard. An opening with the same dimensions as the connection box shall be cut in the back of the switchboard and be provided with a suitable grommet

11.6 CABLE TRAYS AND LADDERS

11.6.1 Responsibility of the Contractor

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.

11.6.2 Cable Trays

Metal cable trays shall be manufactured from perforated rolled steel or an approved steel wire mesh type. Only the following metal cable tray types may be used:

a) Less than 200mm wide - 1,6mm minimum thickness with 12mm minimum return

b)	200mm ∃ 350mm	-	equivalent to trays supplied by "O-line" manufactured from 2mm thick steel with folded over returns and a minimum up-stand of 50mm.
c)	350mm and wider	-	2,4mm minimum thickness with 76mm return as alternative to (b) above.

The return of trays shall not be perforated and the top of the return shall be smooth. The same cable tray type shall be used in long parallel tray runs.

11.6.3 Cable Ladders

Metal cable ladders shall consist of 76mm high side rail of 2mm minimum thickness. Cross pieces consisting of OL3300 "O-line" (similar or equal) channel sections shall be spaced at maximum intervals of 250mm. Where cables of 10mm dia. or smaller are installed on cable ladders, the spacing of the cross pieces shall be 125mm. 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 that accommodate plastic or metal cable binding bands, may be used in vertical cable runs against walls, etc, where the prior approval of the Engineer has been obtained. These cross pieces are not acceptable in horizontal cable runs.

11.6.4 Plastic Cable Trays

Rigid PVC cable trays are acceptable. Only the following tray types may be used:

a)	Less than 250mm wide	-	3,0mm minimum thickness and 40mm minimum return.
b)	250mm and wider	-	4,0mm minimum thickness and 60mm minimum return.

11.6.5 Finishes

Metal cable trays and ladders shall be finished as follows:

a)	In coastal areas	-	hot-dip galvanised to SANS 763 or epoxy power coated
b)	False ceiling voids	-	electro-galvanised or epoxy power coated
c)	Vertical building ducts	-	hot-dip galvanised to SANS 763 or epoxy power coated
e)	Plant rooms, substations, epoxy powder coated	-	service tunnels, basements electro-galvanising or
e)	Damp areas, exposed to weather		-hot-dip galvanised to SANS 763 or epoxy powder coated
f)	Undercover industrial application		-hot-dip galvanised to SANS 763 or epoxy powder coated

The abovementioned finishes shall apply unless specified to the contrary in the Detailed Technical Specification. Hot-dipped galvanised or electro-galvanised trays and ladders shall be cold galvanised at all joints, 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.

11.6.6 Supports

Trays shall be supported at the following maximum intervals:

a)	1,6mm thick metal trays	-	1.5m maximum spacing
b)	2,4mm thick metal trays	-	1,5m spacing and 75mm return
c)	Metal cable ladders	-	1,5m spacing
d)	3,0mm thick PVC trays,	-	1,5m maximum spacing with 40mm return
e)	4,0mm thick PVC trays,	-	1,5m maximum spacing with 60mm return

In addition, trays and ladders shall be supported at each bend, offset and T-junction.

11.6.7 Joints

Joints shall be smooth without projections or rough edges that may damage the cables. The Contractor will be required to cover joints with rubber cement or other hardening rubberised or plastic compounds if in the opinion of the Engineer 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) and (c) of paragraph 3.6.2) be made by means of wrap-around splices of the same thickness as the tray and at least 450mm 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. Where joints that do not coincide with supports occurring in trays with folded over returns, tight fitting metal guide pieces, at least 450mm long, shall be inserted in the folded returns to provide the necessary support to the two cable tray ends. Splices as described above shall be provided if trays sag.

11.6.8 Fixing

Trays shall be bolted to supports by at least two hexagon headed bolts and nuts per support. Bolts shall be securely tightened to avoid cables being damaged during installation. The use of square nuts is not permitted.

11.6.9 Fixing to the Structure

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.

11.6.10 Accessories

Horizontal and vertical bends, T-junctions and cross connections shall be supplied by the Contractor. The dimensions of these connections shall correspond to the dimensions of the linear sections to that they are connected. The radius of all bends shall be 450mm minimum. The inside dimensions of 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 a 45º gusset.

All accessories shall be manufactured by the supplier of the ladder / tray, site fabricated accessories shall not be permitted unless prior written approval has been given by the

Engineer.

11.6.11 Installation of Cables

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 450mm below slabs, ceilings, etc, to facilitate access during installation.

11.6.12 Earthing

Metal trays and ladders shall be bonded to the earth bar of the switchboard to that 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.

11.7 CABLE CHANNELS

11.7.1 Responsibility of the Contractor

The Contractor shall supply and install all cable channels as specified or as required by the cable and wiring installation including the necessary supports, hangers, fixing materials, bends, angles, junction T-pieces end caps, etc.

11.7.2 Materials and Finishes

Cable ducts shall be of the "Cabstrut" type or similar. The ducts shall be rolled from 1,2mm minimum sheet steel and shall be finished as follows:

a)	In coastal areas (under all circumstances)	-	hot-dipped galvanised to SANS763 or epoxy powder coated
b)	Cast in concrete	-	pre-galvanised
c)	False ceiling voids	-	pre-galvanised
d)	Vertical building ducts	-	hot-dipped galvanised to SANS 763 or epoxy powder coated
e)	Surface mounted in plant rooms, sub-stations, service tunnels, basements	-	epoxy powder coated or electro-galvanised
f)	Damp areas, exposed to weather, underground	-	hot-dipped galvanised to SANS 763 or epoxy powder coated
g)	Undercover industrial applications	-	hot-dipped galvanised to SANS 763 or epoxy powder coated

The abovementioned finishes shall apply unless specifically to the contrary in the Detailed Technical Specification. Epoxy powder coats shall comply with paragraph 3.16.9. Hot-dipped galvanised or electro-galvanised ducts shall be cold galvanised at all joints, sections

that have been cut and at places where galvanising has been damaged. Powder coated ducts shall likewise be touched up at joints, cuts and damaged portions using spray canisters recommended by the manufacturers of the channels.

11.7.3 Cover Plates

All channels shall have metal snap-in cover plates. Cover plates for wider channels shall be fixed by means of screws that shall permanently be tapped into the cover plates spaced at suitable intervals to prevent warping.

11.7.4 Connections

Adjoining lengths shall be correctly aligned and securely joined by means of fishplates and mushroom bolts, washers and nuts or connection pieces that are pop-rivetted to both adjoining sections. All adjoining sections shall be rectangular and shall butt tightly. Covers shall fit tightly across the joint.

11.7.5 Support for Conductors

All conductors in inverted cable channels shall be retained by means of metal clips or metal spacer bars at not less than 1m centres.

11.7.6 Vermin Proofing

All cable channels shall be vermin proof after installation. Holes shall be covered by means of screwed metal plugs or by means of metal strips that are bolted or pop-rivetted to the channel. Wooden or other plugs that are driven into holes or other temporary plugs or covers are not acceptable.

11.7.7 Earth Continuity

Electrical and mechanical continuity shall be maintained throughout the channel installation. A tinned copper bonding strip shall be installed across each joint and secured to both adjoining channels by means of brass bolts, nuts and washers. The channel shall be bonded to the earth bar of the associated switchboard.

11.7.8 Internal Finishes

All bends shall be of easy sweep design with 45º gussets. Burrs and sharp edges shall be removed and the inside edges of all joints shall be lined with rubber cement or other suitable rubberised or plastic compound to prevent conductor insulation laceration.

11.7.9 Services

Multiple duct runs or internal metal partitions shall be used where conductors for power, control and other services are present.

11.7.10 Vertical Installation

Where vertical duct lengths exceed 5m, conductors shall have intermediate fixings.

11.7.11 Number of Conductors

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.

11.7.12 Fixing

The Contractor shall supply and install all hangers, supports or fixings for the channels. Channels up to 75 x 75mm shall be supported at maximum intervals of 1m and larger channels at maximum intervals of 2m. Channel runs shall be carefully planned to avoid clashes with other services and to ensure that all covers can be removed after completion of the entire installation. The method of fixing the channels or supports to the structure shall comply with paragraph 3.4 with particular reference to paragraphs 3.4.6 and 3.4.8. Purpose made cable clamps, hangers, etc shall be used as required.

11.7.13 Installation in Concrete

Where channels are cast into concrete, the reinforced type shall be used. Additional spacer blocks shall be used where necessary to prevent ducts from being bent while 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.

11.7.14 Fire Barrier

Where channels pass through walls, fire stopping filling shall be installed around the conductors to serve as a fire barrier.

11.7.15 Conduit Connection

All conduit connections shall be terminated by means of two lock nuts and a brass female bush. All holes through that conductors pass shall be equipped with grommets.

11.8 INSTALLATION OF LUMINAIRES

11.8.1 Positions

The mounting positions of luminaires shall be verified on site. All luminaires shall be placed symmetrically with respect to ceiling panels, battens, beams, columns or other architectural features of the space. The layout as shown in the documents shall generally be adhered to but any discrepancies or clashes with structural or other features must be referred to the Engineer before commencing erection of the installation. Should the Contractor neglect to refer such discrepancies to the Engineer, costs incurred as a result of subsequent alterations to suit the architectural features shall be to the Contractor's account.

11.8.2 Cover Plates

Cover plates shall be fitted over all draw boxes and outlets for luminaires that are not covered by the luminaire canopy, lamp-holder, ceiling rose or similar accessories.

11.8.3 Hanger and Supports

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 fixing method approved by the Engineer.

11.8.4 Suspended Cable Channels

Luminaires (especially fluorescent luminaires) may also be suspended from ceilings by means of suspended metal channels. The channel may be supported by conduits or threaded rods.
Should metal rods be utilised, these shall be screwed to anchor bolts fixed in the roof slab.

Wiring shall either be installed in conduits fixed to the metal channel or in the metal channels. Purpose-made clamps shall be used to fix the fittings to the cable channel.

11.8.5 False Ceilings

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 installation. Should any doubt exist in this regard, the matter shall be referred to the Engineer.

In cases where the mass 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.

11.8.6 Fluorescent Luminaires Fixed to Concrete Slabs

Fluorescent luminaires to be installed directly against concrete slabs or walls shall be fixed to the outlet box and at two additional points. The additional fixing can be effected by:

a) bolts built into the ceiling or wall,

b) screws an approved plugs, or

c) anchor bolts.

Shot-fired fixings are not acceptable. If specified or where approved by the Engineer, fluorescent fittings may be fixed to metal channels installed against concrete slabs or walls. The metal channel fixing may in this case be short-fired or fixed by any of the abovementioned methods. Purpose-made clamps shall be used to fix fittings to cable channels.

11.8.7 Fluorescent Luminaires Fixed to False Ceilings

When fixing fluorescent luminaires to false ceilings, a gap shall not be visible, except where the ceiling tile is of non-fire resistant material, between the fitting and the ceiling. The luminaire shall be fixed directly to the ceiling beams by means of 40mm round-head wood screws and washer or alternatively be fixed to 50 x 76mm wooden supports that are fixed to the ceiling beams. In the case of tiled ceilings with exposed or concealed T-section supports, the luminaires shall be fixed to the metal supports by means of butterfly screws, pop-rivets or bolts with nuts and washers. Self-tapping screws may not be used.

11.8.8 Continuous Rows of Luminaires

In cases where fluorescent luminaires are installed in tandem, only one connection outlet need be supplied per circuit. All luminaires shall be coupled to one another by means of nipples or brass bushes and lock nuts to ensure that wiring is not exposed and that earth continuity is maintained. Luminaires on the same circuit may be wired through the channel

formed by the fitting canopies. In this case silicon-rubber insulated conductors shall be used and internal connections shall be made at terminal blocks.

Screw connectors are not acceptable. The wiring for any other circuits or outlets, even though these may be in the same row may not be installed through the fitting canopies. The Contractor shall ensure that continuous rows are straight and parallel to the relevant building lines.

11.8.9 Recessed Luminaires

Where recessed luminaires are required, the Contractor shall maintain close liaison with the Ceiling Contractor. In the case of tiled ceilings, the luminaires shall be installed while the metal supports are being installed and before the tiles are placed in position. The Contractor shall be responsible for the co-ordination of the cutting of ceiling tiles with the Building Contractor and the Ceiling Contractor concerned. All mounting rings and other accessories shall fit closely into cut-outs to ensure a proper finish.

11.8.10 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 to the ceiling.

11.8.11 Waterproof Luminaires

Waterproof and flameproof luminaires shall be screwed directly to the conduit end. Draw boxes that may be required must be approved by the Engineer beforehand.

11.8.12 Bulkhead Luminaires

Surface mounted bulkhead luminaires shall not be screwed directly to conduit ends. The conduit shall terminate in a round draw box at the top or back of the fitting. The PVC-insulated conductors shall terminate in a porcelain terminal strip in the draw box. Asbestos or silicon-rubber insulated conductors shall be used from the terminal strip to the luminaire lamp-holder. Porcelain-screw connectors will also be allowed.

11.10 INSTALLATION OF SOCKET OUTLETS

11.10.1 Mounting Heights

Unless otherwise specified outlets shall be installed at the following heights above finished floor level:

Flush mounted socket outlets in general	-	300mm
Surface mounted socket outlets in general	-	1200mm
Kitchens and prep area, surface or flush mounted	-	1200mm
Shops - surface or flush mounted	-	300mm
Offices - surface or flush mounted	-	300mm

All mounting heights shall be measured from finished floor level to the centre of the outlet box.

11.12 OVERHEAD BUSBARS OR RISING MAINS

11.12.1 Where specified, overhead busbars or rising mains shall be provided from and to transformers, main low voltage switchgear and for low voltage distribution in buildings.

11.12.2 Material

Unless clearly stated to the contrary, all busbars shall be manufactured of solid drawn high conductivity copper or solid aluminium, with a rectangular cross-section in accordance with SANS 784 as amended.

11.12.3 Rating

The current rating of copper busbars shall be determined as shown in the table below.

CURRENT RATINGS FOR SINGLE COPPER BUSBARS

WIDTH (mm)	THICKNESS (mm)						
	2,5	3,15	4,0	6,3	10	12,5	16
12,5	155	180					
16	190	220	250				
20	230	265	300				
25	280	320	365	470			
31,5	340	385	440	560			
40	420	475	540	680	870		
50	510	575	650	820	1030	1160	
63			790	990	1240	1370	
80			970	1200	1480	1640	
100			1160	1430	1760	2180	
125				1710	2100	2310	2570
160				2070	2530	2780	3090
200						3290	3660
250						3900	4300
315						4630	5120
400							6230

Note: The distance between laminations shall be the thickness of one lamination plus 3mm. The ratings apply for a maximum ambient temperature of 40ºC. Current densities shall be decreased proportionally if the expected ambient temperature will exceed 40ºC.

Where busbars consist of two or more laminations per phase, the ratings in the table below shall be multiplied with the following factors to determine the total current rating:

Width	No. of Laminations		
	2	3	4
Less than 50mm	1,84	2,70	3,50
Less than 75mm	1,82	2,66	3,45
Less than 100mm	1,80	2,63	3,40
Less than 150mm	1,78	2,58	3,20

More than 150mm	1,76	2,50	2,95

11.12.4 Fault Level

The rating and method of fixing of busbars shall be suitable to withstand the maximum mechanical forces and temperature effects to that the busbars will be subjected to during fault conditions. Mechanical forces shall be calculated as follows:

$$F = \frac{16 \times I^2}{10000 \times d}$$

Where
F = Force (N/m)
I = Maximum symmetrical fault current in ampere (r.m.s.) and
d = Spacing between adjacent busbars (in metre)

In addition to the requirements of paragraph 3.12.3, the cross-section of busbars shall be adequate to withstand thermal effects during fault conditions. If no other method of calculation is specified, the cross-section shall be calculated to allow a temperature rise of 90ºC for the maximum fault current following for 1,5 seconds for an ambient temperature of 40ºC.

Temperature rises shall be proportionally lower for expected ambient temperatures in excess of 40ºC. Suitable curves of I(squared) shall be used where

I = Maximum symmetrical fault current in amperes (r.m.s.)
t = Time that fault current flows in sec
A = Cross sectional area of busbar in mm, and
T = Temperature rise in □C

The necessary correction factors for various busbar configurations shall be applied.

11.12.5 Busbar Trunking

All busbar systems shall be covered on four sides by rectangular metal trunking consisting of a U-shaped channel and removable cover plates. The channel and cover plates shall be manufactured of 2mm minimum thickness sheet steel and finished inside and outside in compliance with paragraph 3.16.9. The trunking shall be insect-proof, rodent-proof and drip-proof.

11.12.6 Construction of Trunking

The U-shaped channel shall be constructed in easily manageable lengths and shall be connected to adjoining lengths by 2 x 4mm thick fish plates and 8 x 12mm diameter (minimum) cadmium plated steel bolts, washers and nuts per fish plate. The channel shall have a turn-over to that cover plates are bolted. Cover plates shall be constructed in lengths not exceeding 1m and shall have overlapping ends. Fixing bolts for the covers shall be welded to the inside of the channel turn-over. 6 x 8mm diameter (minimum) cadmium plated steel bolts and washers shall be provided per cover. Self-tapping screws are not acceptable.

11.12.7 Busbar Supports

Busbars shall be installed horizontally or vertically with the longest side in the vertical plane. Busbars shall be suitably supported to withstand the mechanical forces determined according to paragraph 1.12.4 with a maximum distance of 1m between supports. Supports shall consist of a suitable insulating and non-tracking material.

11.12.8 Thrust Blocks

Thrust blocks of insulating material, shall be provided at the base of each rising busbar main to prevent strain on the supply cable and after each expansion joint..

11.12.9 Expansion

Flexible copper braided busbars shall be provided at intervals of 20m to allow expansion and contraction of the busbar system.

11.12.10 Fire Barriers

Where busbars pass through walls or floor slabs, a fire barrier shall be provided. These barriers shall be provided at each floor level where rising busbar mains are installed in vertical building ducts. Fire barriers may not be considered as busbar supports. Barriers shall consist of moulded sleeves of non-tracking inorganic mica/glass based plastic positioned so that they are self-aligning in relation to the busbars and not subject to shock under fault conditions. Two separate asbestos cement panels with cut-outs that fit tightly around the busbar sleeves shall be installed at right angles to the busbars. The panels shall totally block off the inside of the busbar trunking. The asbestos cement panels shall be located on either side of the wall or floor. The intervening space shall be packed with loose asbestos wool.

11.12.11 Earth Busbar

An earth busbar with a cross-sectional area of at least 70mm² shall be bolted to the outside of the busbar trunking. For overhead busbars in sub-stations the earth busbar may be omitted where specified. The earth busbar shall be bonded to the earth conductor and gland plate.

11.12.12 Identification of Phases

Busbars shall have colour markings, i.e. red, white and blue for phase and black for the neutral, so that the phases and neutral may be identified when a cover plates is removed.

11.12.13 Joints

Busbar ends to be jointed shall overlap sufficiently to provide a large contact area to ensure that the full rated current can flow without causing localised heating. Both contact surfaces shall be tinned and bolted down with cadmium plate steel bolts, spring washers and nuts with an applied torque of at least 55 NM. Busbars shall be factory drilled.

11.12.14 Feeder Cables

A suitable cable box and gland plate shall be supplied where feeder cables have to be connected to busbars. Cable cores shall be bolted to busbars by means of crimped lugs. Connections shall comply with the requirements of the previous paragraph. Other

cables may not be installed in the busbar trunking.

11.12.15 Connections to Transformers

A suitable metal connection box that covers the transformer terminals shall be provided. The connection between the transformer and busbars shall consist of flexible braided copper of the same current carrying capacity located within the connection box. Current transformers for earth fault protection shall be located inside the connection box.

11.12.16 Connections to Switchboard

Where busbars terminate at switchboards, as in the case of overhead busbars from transformers to low tension switchboards, the busbar trunking shall be bolted to the switchboard panels to maintain mechanical and electrical continuity. Overhead busbars shall be supported independently of the switchboard busbars.
Where tee-off points on continuous busbar runs consisting of fuse switches and switchboards are provided, these shall be purpose-made and shall form an integral part of the busbar system. Tee-off connections, that do not form an integral part of the busbar system, shall consist of armoured PVC-insulated cables glanded to the trunking and connected as specified in paragraphs 3.12.13 and 3.12.14.

11.12.17 Inspection

Busbar runs shall be inspected and accepted by the Engineer before cover plates are installed. All fixing bolts shall be checked with a torque wrench at the request of the Engineer. The trunking shall be thoroughly cleaned before cover plates are installed.

11.13 CABLING

11.13.1 General

Unless otherwise specified the following cable types shall be used:

a) High voltage supplies (6,6/11k/V) : PILCDSTA or XLPE.

b) Low voltage supplies in ground: PVC-insulated, armoured.

c) Low voltage supplies in substations and to main switchboards: PVC-insulated, armoured.

d) Supplies to sub-distribution boards: PVC-insulated, armoured or unarmoured when installed in conduit, sleeves or metal channels.

e) Connections to equipment: PVC-insulated, armoured, or without armouring when installed in conduit or metal channels.

11.13.2 Competence of Personnel

It is a definite requirement that the Contractor shall only instruct competent personnel to install and connect the various cable types.

11.13.3 Standards

All cables used shall conform to the relevant SANS or BS specifications and shall be

installed, protected and terminated according to approved methods in compliance with the manufacturer's requirements.

11.13.4 Minimum Sizes

Cables with conductors smaller than 1,5mm² may not be used except for communication systems or control systems with a system voltage of less than 50V. Where cables are grouped together (in cable channels, pipe, etc) the minimum conductor size shall be 2,5mm² or greater as determined from the appropriate sections of the SANS Code of Practice.

11.13.5 Unarmoured Cables

All unarmoured cables shall be installed in metal wiring channels or conduit unless another method has been approved by the Engineer.

11.13.6 Voltage Ratings

All cables shall be suitable for the voltage to be applied between phases and between each phase and earth.

All cables to be used in systems with a system voltage between 50V and 600V shall have a voltage rating or 600/1000V.

All 6,6/11kV cables shall be factory-tested according to SANS 91 and all 600/1000V cables to SANS 150. Test certificates shall be handed to the Engineer. Each cable shall be subjected to a pressure test in accordance with SANS 97 and 150 after installation. The Contractor shall supply the necessary instrumentation and all costs relating to these tests shall be included in his tender and rates.

The same group derating and ambient temperature correction factors stated in the SANS Code of Practice for PVC cables shall be applicable.

Cable ends shall be terminated strictly in accordance with the manufacturer's specification to prevent tracking and contamination. The termination shall withstand the same test voltage as the rest of the cable.

Cable cores shall be marked with colour tape to identify the phase colour.

11.13.7 Low Voltage PVC Insulated Cables

Cables

All low voltage cables shall be manufactured according to SANS 150 - 1970 and shall bear the SANS mark.

The voltage gradient of the PVC dielectric shall be for 600/1000 Volts and for general purpose use unless otherwise stated.

All low voltage PVC insulated cables shall have stranded copper annealed conductors unless otherwise called for.

11.13.8 Underground Cables

a) Precautions

The storage, transport, handling and installation of underground cables shall be executed according to approved methods and the Contractor shall ensure that suitable labour and equipment is available. Only armoured cables may be installed along underground cable routes.

b) Installation Depth

Unless specified to the contrary, low voltage cables shall be installed at a depth of 600mm and high voltage cables installed at a depth of 1000mm below ground level. Where cables are installed in layers the uppermost layer shall comply with the above and each additional layer shall be at least 300mm lower.

C) Trenching

The Contractor shall be responsible for all trenching unless specified to the contrary and shall take all necessary precautions and provide the necessary warning signs and/or lights to ensure that the public and/or employees on site are not endangered.

The Contractor shall ensure that the trenches will not endanger existing structures, road, railways or other property.

The Contractor shall verify the existence of all other services and ensure that they are not damaged during trenching operations.

Trenches between the points indicated shall be straight. Any deviations due to obstructions or existing services shall be approved by the Engineer.

d) Dimension of Trenches

Cable trenches shall not be less than 200mm wide at the lowest point where one or two cables are to be installed and the width shall be increased where more cables are to be installed so that cables can be installed at least one cable diameter apart throughout the run.

Unless specified to the contrary, dimensions of trenches will be as follows:

a.) High Voltage Cable trenches

Width : 400mm
Depth : 1 000mm

b.) Low Voltage Cable trenches (Main / Feeder cables)

Width : 400mm
Depth : 600mm

c.) Low Voltage Cable trenches (Service & Streetlight cable)

Width : 300mm
Depth : 400mm

d.) Telkom Cable/sleeve trenches

Width : 300mm

Depth : 600mm

e) Bedding

Cables shall be bedded in river sand or sifted soil (not clay). The bed shall extend 75mm below and 100mm above the cable. Under no circumstances may stone bigger than 50mm mesh be allowed to come into contact with the cables.

f) Laying of Cables

Cables installed in the same trench shall be laid parallel to each other at least one cable diameter apart. The cable shall be removed from the drum in such a manner that no twisting, tension or mechanical damage is caused and must be adequately supported at short intervals during the whole installation operation.
Cable rollers shall be used as far as possible. Where cables have to be drawn through pipes or ducts, a suitable cable sock shall be used and particular care shall be exercised to avoid abrasion, elongation or distortion of any kind. Ends of all pipes and ducts shall be sealed with a non-hardening watertight compound.

g) Inspection of Trenches

Trenches may not be refilled before the Engineer has inspected the cable and trenches. Should the Contractor ignore this requirement, trenches may be re-opened at the cost of the Contractor should the Engineer wish to carry out an inspection.

h) Backfilling

Backfilling shall be of earth of a proper grading to ensure settling without voids. The earth shall be tamped down after the addition of every 150mm layer. The surface shall be made good to match the surrounding surface area.

i) Pipes

Where cables cross roads, railways or other service areas and where cables enter buildings, the cables shall be installed in asbestos cement, pitch fibre, hard walled PVC or earthenware pipes.

Where pipes have to be built into the structure, the Contractor shall issue the pipes to the Building Contractor and ensure that they are installed correctly.

The ends of all pipes shall be sealed with a non-hardening watertight compound after the installation of cables. All pipes intended for future use shall be sealed.

11.13.9 Cables in Building Trenches

a. **Grouping**

Cables installed in floor trenches in buildings or substations shall comply with the requirements of paragraph 11.13.8.

b. Installation

Cables shall be installed in one of the following ways:

a) Laid on the floor of the trench providing that cables are separated by a distance at least equal to the diameter of the largest cable installed.

b) On vertical cable trays or metal supports fixed to the side of the trench. Cables shall be suitable clamped in position.

c. Covers

All floor trenches shall be covered with suitable reinforced chequer plates and shall be supplied and installed by the Building Contractor unless specified to the contrary.

d. Filled Trenches

Floor trenches may have to be filled with sand in certain instances. The trench shall then be filled with sand and covered in one of the following ways:

1) Reinforced concrete planks or tiles

2) A screed of sand and cement

3) Cast iron frames filled with concrete in cases where motorcar traffic is present, e.g. parking garages.

4) Removable chequered cover plates.

Cables shall leave filled cable trenches via a pipe that protrudes at least 300mm beyond the cover. These pipes shall be firmly fixed in position and sealed with a non-corroding non-hardening watertight compound.

11.13.10 Grouping of Cables

a) Correction Factors

All cables shall be spaced to comply with the correction factors that are applicable to the current rating in accordance with the SANS Code of Practice for the Wiring of Premises. All cables shall be spaced apart unless specifically approved by the Engineer.

b) Cables for other Services

Cables for telephones, communication systems and other extra low voltage systems (less than 50V) shall be separated from power cables. In vertical building ducts a physical barrier shall be provided between power cables and cables for other services.

Where armoured cables are used for such other services, they shall be installed in separate cable trays or shall otherwise be at least 1m away from power cables. Where unarmoured cables are used for these other services, they shall be installed in separate conduits or metal channels.

11.13.11 Fixing of Cables

Installation

Cables may be installed in one of the following ways:

a) On horizontal cable trays,

b) Against vertical cable trays with suitable clamps

c) Against horizontal or vertical metal supports or brackets with suitable clamps, or

c) On clamps that are fixed to the structure.

Distance between Fixings

The maximum spacing between cleats (clamps) to that cables are fixed in horizontal and vertical cable routes shall be determined from the table below. Additional cleats shall be installed at each bend or offset in the cable run.

The maximum distance between supports or cleats for multi-core cables shall be 20 times the outside diameter of the cable with a maximum spacing of 550mm for unarmoured cables and 30 times the outside diameter of the cable with a maximum spacing of 900mm for armoured cables.

11.13.12 Sleeves

Where cables penetrate floors, walls or other structural elements, suitable sleeves of asbestos cement, earthenware, steel or pitch fibre shall be provided. Both ends of the sleeves shall be sealed with a non-corrosive, watertight, non-hardening compound.

11.13.13 Earth Conductor

Unless clearly specified to the contrary, earth continuity conductors shall be installed with all cables that form part of the low voltage distribution system.

The earth continuity conductor shall consist of one of the following:

a) A bare stranded copper conductor

b) One of the cable cores. In this case a green heat-shrunk sleeve shall be placed over the conductor end to clearly identify the core that is being used as earth conductor

c) Copper wire strands that form part of the armouring. In this case a special gland designed for this purpose shall be used.

The cross-sectional area of the earth conductor shall be as determined from the SANS Code of Practice but shall not be less than 2,5mm². A single conductor may be used where parallel cables supply the same load.

A single conductor may be installed serving several underground cable routes. Where branch circuits occur, an earth conductor shall be bolted and brazed to the main earth conductor.

The earth conductor shall be connected to the earth busbar of the switchboards to that the associated cables are connected. The earth conductor shall also be bonded to the cable armouring and lead sheath (if appropriate) at both ends and at all joints.

11.13.14 Identification of Cables

All cables shall be identified at both ends and at all joints and as otherwise specified according to a code or number system. These numbers shall appear on the as-built drawings.

Cables shall be marked with non-deteriorating bands with raised or punched numbers. PVC tape with punched numbers is not acceptable for this purpose.

11.13.15 Conduits and Channels

All conductors shall be installed in conduits, cable channels (trunking) or power skirting and shall under no circumstances be exposed. Cable channels and power skirting shall be of metal construction unless specifically approved otherwise.

11.13.16 Order of Work

Wiring shall only be carried out after the conduit installation and plasterwork is completed, but before painting has commenced. No conductors shall be installed before the conduits have been cleaned of all debris and moisture.

11.13.17 Circuits

Conductors that are connected to different switchboards shall not be installed in the same conduit. The wiring of one circuit only will be allowed in 20mm diameter conduit with the exception of the wiring between switchboards and fabricated sheet metal boxes close to switchboards, in that case more than one circuit will be allowed.

11.13.18 Looping

Please note : No conductor jointing will be accepted.

All wiring shall be carried out according to the loop-in system. If a conductor joint is found necessary in an isolated case, jointing will only be accepted in cable channels and not in conduits. Conductor jointing shall be executed by approved ferruling properly covered with PVC-insulated tape.

11.13.19 Grouping of Conductors

In cases where the conductors of more than one circuit are installed in conduit, cable channels or power skirting, the conductors of each separate circuit (earth conductor inclusive) shall be taped at intervals of one metre with PVC-insulation tape. The conductors of different circuits shall however remain separate in order that any given circuit can be withdrawn.

Conductors entering switchboards or control boards shall be grouped and bound by means of plastic or metal bands (not tape).

11.13.20 Different Phases

With the exception of three phase outlets, circuits of different phases shall not be present at

lighting, switch or socket outlet boxes.

11.13.21 Connections

The insulation of conductors shall only be removed over a portion of the conductors that enter the terminals of switches, plugs or other equipment. When more than one conductor enters a terminal, the strands shall be securely twisted together.

11.13.22 Earthing Conductors

When earth continuity conductors are looped between terminals of equipment, the looped conductor ends shall be twisted together and then be soldered or ferruled to ensure that earth continuity is maintained when the conductors are removed from a terminal.

11.13.23 Colours

The colours of conductor insulation for wiring purposes shall comply with the SANS Code of Practice. The colours for sub-circuits shall as far as possible correspond with the colour of the supply phase.
The colours of conductors for wiring to two-way and intermediate switches shall differ from phase conductors.

11.13.24 Single Pole Switches

Single pole switches shall be connected to the phase conductor and not to the neutral conductor.

11.13.25 Size of Conductors

Where conductor sizes are not specified, the following minimum conductor sizes shall be used:

Lighting circuits	2,5 mm² - 1,5mm²
Plugs circuits	2,5mm² + 2,5mm² earth conductor
Stove circuits	10mm² + 6mm² earth conductor
Geyser circuits (up to 3kW)	2,5mm² + 2,5mm² earth conductor
Geyser circuits (+3 to 6kW)	4,0mm² + 2,5mm² earth conductor
Motor circuits	2,5mm² (minimum)
Bell circuits	1,5mm²

11.13.26 Partitions

When wiring is installed in removable partitions, the vertical and/or horizontal metal supports of the walls may be utilised for wiring on condition that:

i) the conductors are not exposed,

ii) the metal supports are properly earthed,

iii) a separate earth continuity conductor is drawn in together with the current carrying conductors and is earthed to the metal parts of the switches and/or the plugs, and

iv) conductors are installed in the metal and non-inflammable sections of the partitions.

Conductors enclosed in a copper braid are especially suited to the wiring of partitions where the copper braid is used as an earth continuity conductor. Copper braided cables shall be connected to the rest of the installation at a draw box.

11.14 EARTHING

a) Substations

The main earthing system shall be installed by specialist under a separate contract.

The Contractor shall be responsible for all earthing from the point of entry of the main earthing tails where they enter the building.

b) Earthing of the Installation

The installation shall be earthed properly in accordance with the SANS Code of Practice for the Wiring of Premises and with the by-laws of the Local Authority. All earth conductors shall be bare stranded copper conductors or stranded conductors with green PVC-insulation.

c) Earth Busbar

The main substation earth bar or, where no separate substations earth is provided, the earth busbar of the main switchboard, shall be connected to the earthing electrode by means of two lengths of solid copper strapping or two stranded conductors, each with the following cross-sectional area:

Total installed capacity in kVA	Cross-sectional area in mm²
Less than 50	50
50 - 100	100
100 - 150	150
More than 150	240

The two copper straps or conductors shall be connected at opposite ends of the main distribution board earth bar or, in the case of a separate sub-station earth, shall be connected midway between the centre and either end of the earth bar.

The connections to the earth electrodes shall be soldered and bolted.

The earth of the Local Authority's supply shall also be connected to the earth busbar. Where the abovementioned connections are mounted on the outside of buildings, the connections shall be installed in galvanised conduit run 300mm under ground level.

d) Sub-Distribution Boards

A separate earth connection, consisting of bare stranded copper conductors and supplied along the same routes as the supply cables, shall be supplied between the earth busbar in each sub-distribution board and the earth busbar in the main switchboard.
If the supply connections consist of conductors in conduit, the earth conductors shall be drawn in the same conduit. The sizes of earth conductors shall be in accordance with the SANS Code of Practice for the Wiring of Premises.

f) Ring Mains

Common earth conductors may be used where various circuits are installed in the same wiring channel. In such instances, the sizes of earth conductors shall be determined in collaboration with the Engineer. Earth conductors for individual circuits branching from the ring main shall be connected to the common earth conductor with T-ferrules or soldered. The common earth shall not be broken.

g) Connections

Under no circumstances shall any connection points, bolts, screws, etc used for earthing be utilised for any other purpose.
It will be the responsibility of the Contractor to supply earth terminals or clamps where others do not provide these. The ends of all bare earth conductors shall be tinned. All earth connections shall be tinned and fixed with approved ferrules. The entire connection shall then be soldered.

h) Power Skirting

All power skirting to accommodate socket outlets shall be earthed with a 2,5mm² earth conductor. This conductor shall be installed over the entire length of the power skirting and connected to the earth busbar in the nearest switchboard. The conductor shall be bolted to the skirting on both sides. The conductor may not be used as an earth conductor for the plug circuits and shall be independent of any other earth conductor.

i) Wiring Channels and Cable Racks

The ends of all metal channels and racks containing cables or conductors under load shall be earthed to the nearest switchboard with copper strapping or 2,5mm² stranded conductors. Adjoining rack sections shall be connected at joints with copper strapping or 2,5mm² conductors, unless the Engineer specifies that the method of joining the racks is sufficient for earth continuity. In cases where metal channels or racks are installed less than 2,0m above floor level, those shall be earthed by the same method as for power skirting.

j) Conduit

All metal conduits shall terminate in switchboards or junction boxes as specified in paragraph 3.5.22. Where this cannot be done the conduit end shall be earthed separately with a 2,5mm² bare copper stranded conductor.

k) Plastic Conduit

Where plastic conduit is installed, stranded copper earth conductors shall be installed in the conduits and fixed securely to all metal appliances and equipment, including switchboxes, plug boxes, draw boxes, switchboards, luminaires, etc.

l) Flexible Conduit

An external earth conductor shall be installed together with all non-metal flexible conduit. The earth conductor shall be connected securely to the metal parts on both ends.

m) Water Pipes at hot water Cylinders

Cold and hot water pipes within 1 metre from the geyser shall be bonded with solid or perforated 12 x 1,8mm copper strapping and earthed via a 10mm² BCEW.

11.15 CONNECTIONS

11.15.1 Connections to Luminaires

a) **Connections**

Connections to the wiring of luminaires and other appliances, where connectors are used, shall be effected by means of brass screw couplers shrouded in porcelain, neoprene or PVC, or by means of porcelain or PVC screw connectors.

b) **Knock-Outs**

Where knock-outs are used for the wiring of luminaires and other appliances, brass bushes or gripper glands shall be used.

c) **Type of Conductor**

In luminaires capable of housing incandescent lamps above 60 watts, the wiring from the lamp-holder to the general wiring shall be varnished cambric insulated, roved and braided asbestos or heat resisting silicon compound insulated conductors.

d) **Incandescent Luminaires**

Connections to luminaires with incandescent lamps shall be installed in a box situated behind the luminaire or ceiling rose.

e) **Fluorescent Luminaires**

Connections to luminaires with fluorescent lamps may be installed inside the metal canopy on condition that the frame and/or diffuser holder where applicable can be removed without disconnecting the conductors.

f) **Screwed Lamp-holders**

The central terminal of Edison Screw (E.S.) lamp-holders shall be connected to the phase conductor (i.e. conductor with red insulation) and the screwed housing to the neutral conductor (i.e. conductor with black insulation).

11.15.5 Connections to Motors

Connections to motors or other vibrating equipment may be made as follows:

a) Metal reinforced plastic or PVC covered metal flexible conduits shall be used with individual conductors or a multi-core PVC-insulated cable and separate bare earth conductor installed inside the conduit. The flexible conduit shall not be longer than 600mm. Screwed conduit shall be used from the end of the flexible conduit to the isolator and/or starter.

b) In the case of high voltage motors armoured XLPE or PILCDSTA cables of the correct voltage rating shall be used and shall be terminated as described in this specification.

c) An isolator and/or starter shall be mounted within 2m of the motor. Unless specified to the contrary, the starter will be supplied by others but the Contractor shall install and provide the connection to the motor and starter.

d) Supply cables may not be installed across floors that are for general use. All cables and/or flexible conduits shall terminate in suitable glands and shall have sufficient slack to allow positioning of the motor, especially where slide rails have been provided.

11.16 SWITCHBOARDS AND DISTRIBUTION BOARDS

11.16.1 Design and Construction of Free Standing Switchboards

Switchboards shall be factory built assemblies of switchgear and control gear (FBAs) of the multi-cubicle type and shall comply with IEC 439.

Switchboards shall be floor mounted with exterior panelling including doors and covers presenting a flush and uniform appearance. A channel section base-frame shall be provided.

a) Switchboard operation on cable access shall be as follows:

- front operation with rear cable access
- front operation with front cable access
- back to back switchboards with front and rear operation and cable access
- cable entry from above and below

b) Compartments shall be provided for:

- main busbars
- auxiliary busbars, if applicable
- cabling
- incoming and outgoing functional units

c) Segregation in the base-frame shall be provided to correspond with divisions in the switchboard sections when cable entry is from below. Access for sealing the cable slot with vermiculite cement shall be provided from the front or rear of the section to:

- reduce the danger of fire spreading
- prevent vermin entering

The base-frame shall be sealed with a cover plate when cable entry is from above.

d) Increase in depth of certain sections of switchboards for high current ratings shall be subject to the Engineer's approval.

e) Switchboards shall be designed to confine internal arcing faults and to direct arcs and gases arising from these away from the operator.

f) The arrangement of functional units and spacing between them shall be such that forced cooling is not necessary.

g) Conductors passing through holes in compartments shall be protected by means of neoprene grommets. Bevelling of sheet steel will not be accepted as a substitute.

h) Measures shall be taken to prevent electrolytic corrosion where dissimilar metals are in contact with each other.

i) Bolts shall be of the correct size for the holes provided and shall be fitted with matching sizes of washers and lock washers. Where removable covers are provided with bolt fastening, the nuts shall be either welded in position or securely fixed by means of a mechanical fixing device. Self-tapping screws, captive head nuts or cage nuts are not acceptable.

i) Switchboards shall be designed to permit the addition of identical sections.

11.16.2 Barriers

Functional units other than fuse switches within their own enclosures, shall be located in their own compartments, separated from each other and the busbars. Barriers shall be provided to prevent accidental contact with live conducting parts of the circuit and to protect the unit from falling objects.

Fused switches, moulded case circuit breakers, etc, within their own enclosures, shall be barrier protected from falling objects and accidental contact with live conducting parts of the circuit and adjacent switches.

Barriers shall be robust with high impact strength and made of material that is self-extinguishing or resistant to flame propagation.

11.16.3 Doors and Covers

Each functional unit compartment and cable compartment shall be provided with individual hinged doors for easy access except where flush mounted equipment prevents this. Power and control busbar compartments shall be provided with removable covers requiring the use of a tool for their removal.

Doors shall have adequate points of hinging and latching and shall be reinforced to prevent distortion when open. Non-ferrous fasteners shall be of the type detailed in Part 4 with four keys being supplied per switchboard. A release mechanism shall be provided on the cable compartment door hinges to allow the doors to be removed.

All removable doors and covers shall be identified to enable replacement in the correct position.

Doors shall have stops to prevent over swing of the door when opening and to avoid interference with adjacent compartments. Dust-proof seals shall be provided on all doors.

11.16.4 Gland Plates

When cables enter a switchboard from below, a cable gland plate shall be provided at a minimum height of 300mm above the point of entry. In case of cables entering from above, the cable gland plate shall be mounted at the point of entry.

The gland plate shall be removable and shall be supported to prevent movement of the cables.

When cables enter a switchboard from below, adequate access shall be provided beneath the gland plate to ensure that once the cables have been installed, the floor slot can be sealed from above using vermiculite cement. The arrangement shall be such that once this slot is sealed level with the floor, each base frame sub-section shall be sealed from

the adjacent base frame sub-section.

When cables enter from above, the gland plates shall effectively seal the switchboard opening.

11.16.5 Degree of Protection

The switchboards shall be designed and manufactured to the degree of protection specified in Part 4 in accordance with IEC 144.

The minimum degree of protection shall apply when all functional units are connected. In the test, disconnected and removed positions, adequate protection shall be provided against contact with live parts.

11.16.6 Busbars

Busbars shall be made of hard drawn copper of suitable dimensions and in accordance with IEC 439 with regard to temperature rise at the specified altitude and mechanical strength for the rated fault conditions. The neutral busbar shall have a current carrying capacity of half that of the phase busbar unless otherwise specified.

Busbars shall be contained within their own compartment. Duplicate busbars shall have individual compartments to provide access for maintenance to either set of busbars with the other set energised.

Busbars shall be rated in accordance with the requirements as previously detailed in this specification.

Small leads connected directly to the busbars, shall be provided with a 20 amp HBC fuse mounted at the busbar.

Conductors between the busbars and the supply side of a single functional unit shall be rated for the same fault level as the busbars. Where the conductors to the components included in the unit are phase segregated, braced and substantially fault free, they shall be capable of withstanding the let-through current of the protection device in the unit.

Busbars and connections shall be air insulated and shall be taped and/or shrouded on all sections where accidental contact is possible. Insulating materials shall be resistant to flame propagation, non-hygroscopic and resistant to tracking.

Joints and tees in busbar connections shall be made with sherardised bolts, nuts and washers of not less than 12mm diameter. High tensile (black) bolts of not less than 10mm diameter and having a reference symbol 'R' for the tensile range in accordance with BS 970 will be accepted as an alternative.

Joints shall be made with at least two bolts and the overlap shall be sufficient to ensure ample mechanical strength and joint conductivity. Unless otherwise approved, the overlap shall not be less than six times the thickness or shall equal the width of the busbar material, thatever is the greater.

11.16.7 Identification of Busbars

AC or DC busbars and functional unit conductors and connections shall be clearly marked to indicate the supply phase or pole they are connected to. The phases shall be coloured

red, white and blue, with the neutral colour black and the protective conductor (earth bar) green and yellow. DC busbars shall be coloured red for positive and black for negative.

11.16.8 Protective Conductor (Earth Bar)

A separate copper protective conductor to that all metal parts are connected shall be installed in the inside rear of each switchboard along the entire length. The bar shall be in an accessible position to allow for the earthing of cables.

The protective conductor shall have a current carrying capacity sufficient to withstand the earth fault current that may occur in the switchboard. The cross-section shall be calculated with the aid of the formula in Appendix B of IEC 439 but shall not be less than 200mm².

The neutral busbar shall be connected to the protective conductor by means of a removable bolted link on the cable side of each incoming functional unit. The link shall be easily accessible from the front of the switchboard for removal and testing.

Non-current carrying parts, including relays, metres, etc, shall be effectively connected to the protective conductor by means of their mounting arrangement on the panel or by a separate earthing conductor connected to the protective conductor. This shall include the earth terminals provided on equipment.

All parts of the protective circuit within the switchboard shall be designed to withstand the highest thermal and dynamic stresses that may occur.

11.16.9 Construction of Flush Mounted Switchboard

a) Bonding Tray

Bonding trays for flush mounted switchboards shall be of rigidly constructed 1,6mm thick galvanised steel, braced and reinforced. Formed gussets shall be provided at the corners. All the tray joints shall be properly welded or securely bolted with a brass or cadmium plated steel earth connecting stud and nut.

b) Expanded Metal

Where switchboards are to be built into 116mm thick walls, expanded metal shall be spot welded to the rear of the bonding trays. The expanded metal shall protrude at least 150mm on each side to prevent plaster from cracking.

c) Knock-Outs

Ample knock-outs shall be provided in the top and bottom ends of each switchboard tray to allow for the installation of conduits for the specified and future circuits. Knock-outs shall be allowed for any size of specified conduit. Provision shall however be made for termination of at least 2 x 25mm diameter conduits at top and 2 x 25mm diameter conduits at the bottom of each tray.

d) Architrave Frame

The architrave frame shall be of 2,0mm thick sheet steel with bevelled edges. The architrave frame shall accommodate the chassis, panels and doors. The architrave shall overlap the bonding tray by at least 25mm on each side. The architrave frame shall be

fixed to the tray in such a fashion to allow for depth adjustment and irregularities of the wall.

e) Extension Frames

Semi-flush mounted switchboards shall be equipped with extension frames. Generally the frame depths shall be 50mm but may be altered to suit each application.

f) Chassis

The chassis for mounting of switchgear and equipment shall be of rigid construction and shall be fixed securely to the architrave frame or bonding tray by means of bolts screwed into tapped holes or bolts and nuts. Self-tapping screws are not acceptable. The chassis position shall be adjustable in the horizontal plane.

g) Panel (Faceplate)

A suitably stiffened panel manufactured of 2,0mm thick sheet steel shall be installed in the architrave frame for flush mounting of switchgear. The panels shall have machined punched slots for housing the specified and future switchgear, instruments, fuse holders, isolating switches, indicator lamps, etc. In exceptional cases contractors will be allowed to protrude through the panel. Blanking plates shall be provided in positions where future switchgear will be installed. The distance between the inside of the closed doors and the panels shall be not less than 40mm. No equipment may be mounted on the panel (faceplate) unless it is permanently hinged to the switchboard frame.

h) Fixing of Panels

The panel for each switchboard shall be secured to the architrave frame by means of captive fasteners such as "DZUS" or "CAMLOC". Alternatively, the panel may be secured to the architrave frame by means of two pins at the bottom and a latch or lock at the top of the panel. Self-tapping screws or dome nuts will not be allowed. Where it is required that equipment be mounted on the panel, the panel shall be securely hinged to the switchboard frame.

i) Panel Handles

Two chromium plated handles shall be provided on each front cover. The handles shall be mounted at the top and bottom of each panel. Handles can be omitted if "DZUS" or "CAMLOC" fasteners are used.

j) Hinged Panels

Where hinged panels are specified, the hinges shall be fixed to the architrave frame and the panel shall be secured by means of studs and hexagonal chromium plated nuts or by means of a suitable lock or latch that can be operated with a screwdriver. The panel shall be removable when it is in the open position.

11.16.10 Construction of Surface Mounted Switchboards

NB This section refers to surface mounted sub-switchboards and not to floor standing main switchboards in substations or sub-main switchboards.

a) Switchboard Tray

Surface mounted switchboards shall be equipped with a 1,6mm sheet steel reinforced tray. Securing lugs shall be provided to fix the tray to walls or any other structure. A solid brass or cadmium plated steel earth connection stud and nut shall be provided.

b) Construction

All joints shall be welded or securely bolted. The tray shall be square and neatly finished without protrusions. The front tray sides shall be rounded with an edge of at least 20mm to accommodate flush doors.

The requirements for chassis, panels and doors shall be as specified for flush mounted switchboards. The doors shall be hinged and shall fit flush in the frame in the closed position. Knock-outs shall not be provided unless specifically called for.

11.16.11 Power and Control Wiring

a) Power circuit wiring and connections in a switchboard shall be rated to the full rating of the associated equipment, i.e. fused switch, contactor, circuit-breaker, etc, and not to the circuit or fuse rating.

b) Neutral connections shall have the same rating as the phase connections unless otherwise approved.

c) Control circuits shall be wired using a minimum of 2,5mm² conductors. Current and voltage transformer circuits shall be wired using a minimum of 4mm².

d) Conductors shall be general purpose 600/1000V grade PVC-insulated wire to SANS 150.

e) Wiring for circuits up to 50V shall be in 0,5mm² flexible 300/500V grade PVC-insulated wire in accordance with SANS 150.

f) Single or solid conductor wire shall not be used.

g) Joints or splices in any wiring are not acceptable.

h) Panel and equipment terminals, labels, etc, shall be accessible after the wiring has been completed.

i) Terminals that are on the live side of fuses and isolating switches shall be completely shrouded to prevent accidental contact.

j) Aluminium conductors are not acceptable.

11.16.12 Wiring Supports

Wiring shall present a neat appearance and shall be braced, clipped and/or laced to prevent vibration and to ensure that it shall not deform under fault conditions. Connections to equipment on swing doors shall be arranged so as to give a twisting motion and not a bending motion to the conductor.

a) Wiring Identification

Power wires shall bear the colour along their entire length of the phase to that they are connected.

Control wire sheaths shall be coloured grey for AC circuits.

Control wiring leads shall be marked at both ends with an interlocking type of ferrule with permanent black letters impressed on a white background.
For all control wires without lug terminations the numbered ferrule must not fall off when disconnecting the wire and in this regard, the use of one strand of wire to retain the ferrule is acceptable.

b) Wiring of Moulded-Case Circuit Breakers

Single pole and double pole moulded-case circuit breakers shall be wired in a way that the supply to the switchboard is equally balanced.

c) Control Wiring and Cable Terminations

Stripping of insulation shall not result in damage to the conductors. The stripping tools used shall be of the type that permits the length of strip to be preset. Control wiring shall be terminated with pre-insulated, crimped or compression type lugs. Crimping tools shall be of the type that will not release the termination during normal operation until the conductor crimp has been correctly formed. Any damaged wiring will be rejected.

Lugs shall be of the hooked blade type when used in conjunction with screw clamp spring loaded insertion type terminals, ring tongue type when used with stud or direct screw mounted connections and wire pin when used with pinch screw type connections such as indicating lamp fittings.

Not more than two conductors shall be connected to any side of a terminal.

Each terminal strip shall be provided with not less than 10% spare terminals, with a minimum of two, unless otherwise approved.

d) Power Wiring and Cable Terminations

Terminations for power wiring and cabling shall be provided with pressure type clamping connections or bolted connections capable of accepting crimped or compression type lugs on conductors.

An undrilled solid copper bar shall be provided for terminating all external power cables above 70mm, or where three or more cables in parallel are specified. The arrangement shall be suitable for accepting cable lugs of conductors up to 630mm^2.

e) Cable Terminal Arrangements

Cables shall be made off directly onto Circuit breakers, switches, contractors, thermal-overloads, etc. Terminals or solid copper terminating conductors shall be provided where necessary. Provision shall be made for bracing and for fixing the cable leads to prevent vibration.

Where a large number of control terminals are mounted in close proximity, the terminals shall be in vertical rows with a minimum of 125mm below rows. Spare terminals shall be mounted at the bottom of the row unless the cabling drawing shows otherwise.

Terminals shall be provided for all cores of external control cable as indicated on the drawings whether internally connected or not.

11.16.13 Testing

Electrical switch panels shall be inspected by the Engineer at their place of manufacture, prior to delivery to site. At such inspection and testing, the Contractor shall demonstrate the functioning of the switch panel to the Engineer. Any defects in materials, finishes and operation of the switch panels shall be corrected at their place of manufacture prior to delivery to site.

Type and routine tests shall be carried out on either a complete switchboard or a representative portion thereof to verify its characteristics.

Type tests shall be performed in accordance with IEC 439.

- verification of temperature rise limits
- verification of dielectric properties
- verification of the short circuit strength
- verification of the effectiveness of the protective circuit
- verification of clearances and creepage distances
- verification of mechanical operation
- verification of degree of protection

If evidence is available of type tests already made on similar equipment, this may, subject to the Engineer's approval, be acceptable in lieu of these tests,

Copies of test certificates shall be submitted to the Engineer.

Routine test shall be performed in accordance with IEC 439:

- inspection of the switchboard including inspection of wiring and electrical operation tests
- dielectric test. This test shall have a duration of 60 seconds
- checking of protective measures and of the electrical continuity of the protective circuits.

11.16.14 Construction of LV Switch Cubicles (Kiosks)

Switch cubicles shall be of sufficient size to accommodate all the specified equipment with 25% spare capacity for future.

a) Framework

Switch cubicles shall be manufactured of mild steel sheet metal with a minimum

thickness of 2mm or cold rolled 3CR 12 sheet metal with a minimum thickness of 1,6mm. Fibre re-inforced or other corrosion proof material (e.g. glass fibre) may also be used if adequately reinforced.

b) Ventilation

Two ventilation slots or grilles, approximately 150 x 125mm and covered on the inside with copper mesh, shall be provided on opposite sides of the cubicle.

c) Doors

Doors shall be provided in the front and back panels and shall swivel through 180°. Rigid padlocks and base plates for security latches shall be provided on the doors. Openings for security latches shall be blanked with chromed brass discs.

d) Warning Sign

Warning & danger signs shall be mounted on each door in compliance with the requirements.

e) Base

The kiosk shall be mounted on a well finished concrete base, with minimum height of 150mm above ground level in the case of mild steel and any of the other specified acceptable materials. The kiosk can be made for direct mounting into the ground in that case it shall be equipped with a base, forming part of the structure, for this purpose. The switch cubicle shall protrude at least 10mm past the edges of the base to prevent water collecting on the base.

f) Panel

All equipment shall be mounted flush behind a single front panel with the exception of metres and time switches. The panel shall be fixed by means of captive fasteners such as "DZUS" or "CAMLOC". Chromed handles shall be provided on the panel. Metres and time switches may be installed on the surface of the flush panels.

11.16.15 Mounting of Equipment

a. **Clearance and Access**

A minimum clearance of 50mm shall be maintained between items of equipment and the side of the compartment. Where extra equipment is specified after the design has been finalised, this clearance requirement may be altered subject to the Engineer's approval.

No piece of equipment shall be mounted in any position where it is not visible and accessible to a viewer looking into the compartment through the door opening.

b. **Mounting of Circuit Breakers**

All moulded case circuit breakers shall be flush mounted with only toggles pro-truding. Miniature circuit breakers may be installed in clip-in trays mounted on the frame. Special provision shall be made for large main switches. Circuit breakers shall be installed so that the toggles are in the up position when "ON" and down when "OFF".

c. **Mounting of Contactors**

Contactors shall only protrude through the panel in special cases. Plastic covers or other coverings will not be required.

d) Instrumentation

i. All metering instruments shall be mounted flush in the front panel unless otherwise specified. In certain instances it may be required that instruments be mounted flush in the door. In these instances the back of metres shall be covered by removable covers of isolating material fixed to the door to protect the terminals of instruments and to prevent accidental contact. Equipment mounted normally on the surface, e.g. time switches and relays, shall be mounted behind the front panel. In these cases hinged access panels shall be provided in the front panel.

e) Fuse-Links and Carriers

ii. Fuses shall be of the high rupturing capacity type and shall be mounted on insulated draw-out carriers that shall hold the fuses positively after withdrawal. In all cases the top terminal shall be the live terminal. This applies also for MCB's.

iii. DC circuits shall have fuses in the positive and negative leads.

iv. Fuses shall be so positioned that they are readily accessible to a person standing on the floor.

v. Fuses for instrumentation shall be mounted on the outside of the compartment door adjacent to or below the instrument.

vi. Fuses shall be provided with labels giving their rating and duty.

vii. Solid link holders shall be coloured white.

f) Spare Fuses

One spare fuse of each type and size used in each board shall be fitted on 'Terry' clip holders on the inside of the front panel.

g) Control Equipment

All equipment performing control functions, e.g. control relays, transducers, and time relays not requiring adjustment, shall be mounted behind the front panel.

h) Current Transformers

- Current transformers shall comply with SANS 3939.
- Current transformers shall be accessible and easily removable.
- Secondary windings of current transformers shall be earthed at one point only. Each group of current transformers, i.e. protection, metering, etc, shall be earthed directly to the protective conductor (earth bar).
- Current transformers shall be naturally air-cooled, and shall be able to withstand

the maximum fault current for the duration of time taken by the functional unit to clear, with protective devices set at the maximum time delay settings.

i) Main Circuit Breakers

Rack-out type air circuit breakers shall be mounted in a separate compartment with the handle or operating mechanism only protruding. A positive device shall be provided to ensure that the circuit breaker is secured in the:

- connected position
- test position
- disconnected position

It shall be possible to remove the circuit breaker from its compartment. It shall not be possible to insert a circuit breaker into a circuit of higher rating.

Automatically-operated shutters shall be provided so that on racking out the circuit breaker, these shutters cover the isolating sockets to prevent inadvertent contact with live busbars and circuits. Busbar shutters shall be labelled with the word BUSBARS in letters of at least 50mm high.

Mechanical interlocks shall be provide to ensure that:

- the circuit breaker main contacts cannot be engaged and disengaged unless the circuit breaker contacts are fully open

- the circuit breaker cannot be closed unless it is in the connected, disconnected or test position

- the action of disengaging the circuit breaker from the connected, disconnected or test position shall automatically trip the circuit breaker.

Circuit breakers shall be capable of carrying continuously the load current stated in the drawings at site altitude when mounted within the compartment specified without forced ventilation.

If the main switch is a moulded case circuit breaker or isolator, it shall be installed flush in a separate compartment.

Contractors controlling the supply shall be installed behind separate front panels.

All metering, protection and indicating equipment shall be clearly visible from the front of the board. Where doors are specified the equipment shall be installed flush in the doors and covered as described in 'Instrumentation' above.

Fuses or control gear providing back-up protection for circuit breakers shall be installed behind separate front panels.

j)Standby Supplies

i. Where standby power from a diesel-generator set or other source is available and has to be connected to some of the equipment on a switchboard, the switchboard shall be divided into electrically separate sections with sheet metal division plates to isolate power and mains power sections.

ii. A means shall be provided to isolate both the standby and mains power supplies simultaneously. For this purpose, either a 6-pole rotary switch or mechanically and electrically interlocked circuit breakers may be used.
iii. Electrical interlocking alone is not sufficient. Rotary switches may only be used on boards where the fault level does not exceed 10kA.

iv. A separate 3-pole isolator, fuse switch or circuit breaker shall be provided as main switch for both the standby power section and the mains power section in addition to the isolator of (b) above.

v. Where a 6-pole rotary switch is used as isolator for the incoming supplies, this switch may be located in the standby section of the switchboard in that case the rotary switch can also serve as the isolator for the standby section. This arrangement is acceptable where the equipment on the mains power section of the switchboard can be turned off whenever it is necessary to work on the standby section of the switchboards.

vi. The main switches to the standby and mains power sections shall be interlocked with the doors providing access to those sections to ensure that the door can only be opened when the switches are in the OFF position.

11.16.16 General

a) Size

All switchboards shall be of ample size to accommodate all the specified switchgear and provide space for future switchgear. For every 4 (or part of 4) circuit breakers of a kind on a switchboard, space for an additional circuit breaker of similar size shall be allowed unless future space requirements are clearly specified. The clearance between adjoining switchgear or switchgear openings shall be as specified in paragraph 3.16.7 of this specification.

b) External Dimensions

All specified external dimensions for switchboards shall be strictly adhered to. If the clearances specified in paragraph 3.16.7 cannot be adhered to as a result of restricting external dimensions, the Contractor or Manufacturer shall obtain the opinion of the Engineer before manufacturing the switchboards.

c) Positions

The Contractor shall ascertain the exact position of switchboards and shall arrange timeously for the installation of cable sleeves, openings in the structure, flush draw trays behind switchboards and supports over cable trenches.

d) Mounting Heights

In general, flush and surface mounted switchboards shall be mounted 2000mm above finished floor level - measured to the top of the switchboard. The upper ends of switchboards may not be higher than 2,1m above finished floor level.

e) Labels

In addition to paragraph 3.19 of this specification, the following labels shall be provided for switchboards:

a) Main labels: A white traffolite label shall be provided to clearly identify each switchboard and subsections of switchboards.

The fixing of main labels shall be done as per paragraph 3.19.2. Lettering shall be black with a maximum height of 20mm letters.

b) Compartment labels: Front panels shall be identified with white traffolite labels fixed to the doors or front panel respectively. The function of the equipment and circuits shall be clearly identified.

The fixing of compartment labels shall be done as per paragraph 11.19

Lettering shall be black with a maximum height of 8mm letters.

c) Equipment labels : All equipment shall be identified with the necessary labels. The labels for equipment mounted on doors shall be identified with white traffolite labels having black lettering engraved on them, with a maximum height of 3mm letters.

The equipment labels shall be secured by means of high quality double sided tape.

The labels for all equipment, installed behind panels, shall be fixed to the chassis close to the equipment.

If this equipment is positioned too close to each other to accommodate descriptive engraved labels, the equipment may be identified by a code or number label that shall be fixed close to the equipment. The code or number shall be identified on a legend board that shall be installed on the switchboard behind a protective cover.

The types of labels for equipment behind the doors or covers shall be subject to the Engineer's approval.

f) Drawings

- A set of three prints of the shop drawings for the switchboards shall be submitted to the Engineer for approval before the boards are manufactured. The following information shall be presented:

- A complete wiring diagram of the equipment on the boards, and the internal wiring of such equipment.

- A complete layout of the arrangement of the switchboards indicating all equipment dimensions and the construction of the boards. The positions and method of fixing of busbars shall be shown.

- All labelling information on a separate sheet.

- The make, catalogue number and capacity of all equipment such as isolators, circuit breakers, fuses, contractors, etc.

The approval of drawings shall not relieve the Contractor of his responsibility to the Employer to supply the switchboards according to the requirements of this specification or to the requirements of the Detailed Technical Specification.

A complete set of "Record" transparent drawings of all switchboards shall be submitted to the Engineer immediately after completion of the installation. The following information shall be presented:

a) Items (a) and (d) of the previous paragraph.

b) Terminal strip numbers, numbers and colours of conductors connected to the terminal strips and numbers and colours of the conductors utilised for the internal wiring.

c) A separate schedule of all equipment.

Where such transparent drawings as called for above are modified during the execution of the contract, the Contractor shall at his own expense modify or replace such drawings. Accurate drawings of the equipment shall be forwarded to the Employer.

11.16.17 Paint Finish

Finish Required

Metal components of the framework, panels and chassis shall be finished with a high quality paint applied according to the best available method. Baked enamel, electrostatically applied powder coating or similar proven methods may be used. Care shall be taken to ensure that all edges and corners are properly covered. Thatever finishing method is employed, it shall be backed up by written certification that the quality of finish complies with the relevant SANS standard.

Baked Enamel Finish

Prior to painting, all metal parts shall be thoroughly cleaned of rust, mill scale, grease and foreign matter to a continuous metallic finish. Sand or shot blasting, or acid pickling and washing may be employed for this purpose. Immediately after cleaning all surfaces shall be covered by an electrolytically applied rust inhibiting, tough, unbroken metal phosphate film and then thoroughly dried.

Within forty-eight (48) hours after phosphatising, a passivating layer consisting of a high quality zinc chromate primer shall be applied, followed by two (2) coats of high quality baked enamel to SANS 783 type 1. The minimum paint thickness after baking shall be 0.06mm. The paint shall have a shock resistance of 25kg / cm on 0,9mm soft steel plate and a scratch resistance of 2000 grams.

Powder Coated Finish

Prior to painting, all metal parts shall be thoroughly cleaned of rust, mill scale, grease and foreign matter to a continuous metal finish. Sand or shot blasting, or acid pickling and washing may be employed for this purpose. The metal parts shall be pre-heated and then covered by a microstructured paint powder applied electrostatically. The paint shall be baked on and shall harden within 10 minutes at a temperature of 190□C. The minimum paint thickness after baking shall be 0,5mm and shall have a shock resistance of 25kg / cm on 0,9mm soft steel plate and a scratch resistance of 2000 grams.

Colour

Refer to Part 4 of this specification for switchboard colours.

Before the installation is handed over, the Contractor shall ensure that all paint surfaces are clean and undamaged.

11.17 NOISE AND VIBRATION

11.17.1 If in the opinion of the Engineer, any equipment operates with, or transmits from it, objectionable noise or vibration, it will be necessary to rectify or replace such plant in order that the system operates at conditions acceptable to the Engineer. Remedial measures taken to achieve satisfactory noise and vibration levels shall be at no additional cost to the Employer.

11.17.2 The following measures shall be taken where necessary, whether specifically stipulated in these documents or not, all to ensure quiet, vibration-free operation of the installations:

a) Equipment shall be mounted on vibration isolators of the correct type and selection, dependent upon deflection requirements versus vibrating frequency.

b) Pipework and ductwork shall be suspended or mounted using suitable supports with vibration isolators to prevent transmission of vibration from them to the structure to that they are attached.

11.18 COMMISSIONING AND TESTING

11.18.1 The Contractor shall commission and test the entire installation at his own expense, including provision of all test equipment, such testing to be done in the presence of the Engineer, who shall have been notified of the dates and approximate duration of the tests sufficiently early to allow him to witness tests if necessary.

11.18.2 The Contractor shall properly test and call for inspection by the Engineer any work that is to be covered, concealed, built-in, otherwise closed up or rendered inaccessible, before such closing up takes place. The Engineer may require any work of this nature that he has not been called on to inspect before closing up, to be uncovered or made accessible to him entirely at the Contractor's expense, making good included.

11.18.3 It is in the interest of the Contractor to notify the Engineer when the installation reaches various stages of completion (e.g. before plastering, final finishes, before casting concrete, etc) in order that the Engineer may inspect the installation and point out discrepancies. These inspections shall be considered informal and under no circumstances will they, in part or in whole, invalidate the requirements of the document. Any costs incurred in correcting discrepancies shall be to the Contractor's account.

11.18.4 The Contractor shall keep full and proper written records of all tests conducted and commissioning information, such data to be properly indexed and submitted to the Engineer for his records.

11.18.5 The Contractor shall test electrical wiring for compliance with regulations and have the complete installation tested by the relevant authorities.

11.18.6 The Engineer reserves the right to inspect any item of equipment during manufacture or before delivery to site. The Contractor shall make available any item for such inspection. The Engineer shall also be furnished with manufacturer's test certificates whenever these

are required by law or called for by the Engineer.

11.18.7 The Contractor shall commission the complete installation prior to inviting the Engineer to accept it, commissioning including inter alia the following services, as relevant:

a) The Contractor shall record all motor running currents and set overload protection devices to correct values.

b) The Contractor shall adjust and set all time clocks, time delay relays, automatic control devices and check their function for correctness and response.

c) The Contractor shall remedy any defects apparent on the installation prior to calling upon the Engineer to accept the plants.

11.19 LABELLING AND IDENTIFICATION

11.19.1 All equipment shall be labelled and identified using white traffolite labels having black lettering engraved on them; where two similar items exist, they shall additionally be numbered for clarity in identification.

11.19.2 Labels shall be secured by means of white rivets, slotted label holders or screwed on. Self-tapping screws will not be allowed.

11.19.3 All other equipment including metres, instruments, indicator lights, switches, push-buttons, circuit breakers, fuses, etc, shall be identified. The function of the equipment and circuits shall be clearly identified. Flush mounted equipment within doors or front panels shall be identified with labels fixed to the doors or front panels respectively.

11.20 OPERATING AND MAINTENANCE MANUALS; "AS BUILT" OR "AS INSTALLED" RECORD DRAWINGS

11.20.1 Provide three hard copies and one disk of all operating and maintenance manuals and record drawings.

11.20.2 Provide a MSWORD for WINDOWS disk copy for any word processed elements of the operating and maintenance manuals. Employ a specialist to prepare manuals for the form and content of the operating and maintenance manuals.

11.20.3 Agree format and contents with the Employer Operating and maintenance manuals must include, but are not limited to the following:

- ndex of Contents
- A full description of each of the systems installed, written to ensure that the Employer's staff fully understand the scope and facilities provided. Description to include data on general design parameters, normal associated operating conditions and manufacturer's information concerning correct operation, etc., based on commissioning results.
- A description of the mode of operation of all systems.

- Diagrammed drawings to each system (including distribution boards) indicating principal items of plant, equipment, valves, etc.

- A photo-reduction of all record drawings, together with an index.

  Size A4
  Size A3
  Legend for all colour-coded services.

- Schedules (system by system) of plant, equipment, valves, etc, stating their locations within the building, duties and performance figures. Ensure each item has a unique code number cross-referenced to the record and diagrammatic drawings and schedules.

- The name, address and telephone number of the manufacturer of every item of plant and equipment together with catalogue list and order acknowledgement numbers.

- Manufacturer's technical literature for all items of plant and equipment, assembled specifically for the project, excluding irrelevant matter and including detailed drawings, electrical circuit details and operating and maintenance instructions.
- A copy for all Test Certificates, Certificates of Compliance, Inspection and Test Records, Commissioning and Performance Test Records (including, but not limited to, electrical circuit tests, corrosion tests, type tests, start and commissioning tests) for the installations and plant, equipment, valves, etc, used in the installations.

- A copy of all manufacturers' guarantees or warranties.

- Copies of Insurance and Inspecting Authority Certificates and Reports.

- Starting up, operating and shutting down instructions for all equipment and systems installed.

- Details of procedures to maintain plant in safe working conditions.

- Control sequences for all systems installed.

- Schedule of all fixed and variable equipment settings established during commissioning.

- Back-up copies of any system software.

- Documentation of the procedures for updating and/or modifying software operating systems and control programs.

- Instructions for the creation of
- Control procedure routines.
- Graphic diagrams

- Details of the software revision for all programs provided.

- Two back-up copies of all software items, as commissioned.

- Details of lubrication systems and lubrication schedules for all lubricated items.

- A list of normal consumable items.
- A list of recommended spares to be kept in stock by the Employer, being those items subject to wear or deterioration and that may involve the Employer in extended deliveries when replacements are required at some future date.
- A list of any special tools needed for maintenance cross referenced to the particular item for that required.
- Procedures for fault finding.
- Emergency procedures, including telephone numbers for emergency services.
- Copies of all items incorporated in the plantroom and switchroom schedules and schematics.
- Encase the Manuals in A4 size, plastic-covered, loose leaf, four ring binders with hard covers, each indexed, divided and appropriately cover-titled. Fold drawings larger than A4 and include in the binder so that they may be unfolded without being detached from the rings.
- Provide record drawings. Include the provision of relevant framed plasticised drawings in all electrical rooms.
- Three copies of all “AS BUILT” or “AS INSTALLED” record drawings, in print form, are required to be handed to the Engineer before completion of the project. There shall have been previously submitted to the Electrical Engineer for comment and approval. The Electrical Engineer also requires 2 copies of all record drawings to be made available on disk on CAD format. All “AS BUILT” or “AS INSTALLED” record drawings are to be prepared by the Electrical contractor in CAD format.

11.21 MAINTENANCE INSTRUCTIONS AND GUARANTEES

Retain copies of all maintenance instructions and guarantees delivered with components and equipment (failing that, obtain), register with manufacturer as necessary and handover to the Employer on or before Practical Completion. Notify the Employer of telephone numbers for emergency services by Specialist Contractors and Suppliers after Practical Completion.

DOCUMENT E 2

ES20 SCOPE OF WORK

TECHNICAL SPECIFICATION FOR:

1.1 Supply Installation and Commissioning.

1.1.1. **2x 1250KVA** open set remote cooling generators with synchronizing panel. Changeover will be done on different panels. Sub A, Sub B and Sub F change over panel.
1.1.2. **2X 500KVA** prime rated containerised generator sets with attenuators rated for 75dB at 7m.
1.1.3. Distribution boards.
1.1.4. LV cabling.
1.1.5. LV terminations.
1.1.6. Earthing.
1.1.7. Cable ladders.
1.1.8. Dummy load for on-site testing for all generators
1.1.9. As built drawings.
1.1.10. Trenching
1.1.11. Minor Building works

2.2) Maintenance and Guarantee

The installation and equipment supplied under this contract shall be guaranteed and maintained for a period of twelve months from the date of acceptance by SABC in all respects and commissioned for continuous service. The bid price shall include the above, which will entail call outs after hours.

2.3) Relevant Standards and Specifications.

2.3.2 General

2.3.1.1 All material and equipment supplied and / or installed under this Contract shall be new and of good quality and shall comply with the requirements laid down in the latest editions of the relevant SABS, BS or IEC Specifications and there amendments (if any) and the requirements of this specification. The workmanship and finish of work shall be of high standard throughout and to the satisfaction of the Engineer/SABC.

2.3.1.2 Before the commencement of manufacture a full set of drawings showing all details of equipment, wiring (single line diagram) and layouts shall be submitted to the Engineer for approval.

2.3.1.4 All calculations, designs, documentation and drawings shall be submitted to the Engineer prior to the procurement, manufacture or construction of any part of the plant.

3. Laws, Regulations and Standards

The work shall be carried out strictly in accordance with the specifications and all material and equipment supplied shall comply with the following laws and regulations where applicable:

The cost of complying with the requirements of this clause shall be deemed to be included in the rates.

1. The latest version of the “Code of Practice for the wiring of Premises” SANS 10142-1: 2003 as

amended.
2. The Occupational Health and Safety Act (No 85 of 1993) as amended.
3. The general safety regulations of 1986.
4. The construction regulations of 2003.
5. The "Electrical Supply By-Laws and Regulations" of the Supply Authority.
6. The local Fire Office Regulations.
7. The regulations of Telkom.
8. Specifications indicated in the detailed generator specification.

3.1 Additional Standardized Specifications

NO	DESCRIPTION	DETAILS
1	Hot-dip (galvanised) zinc coatings heavy duty	SABS 763 – 1988
2	National colour standards for paint	SABS 1091
3	Rotating electrical machines (Parts 1 to 18) (Applicable to low voltage motors)	SABS IEC 60034
4	Electric welded low Carbon steel pipes for aqueous fluids (ordinary duties)	SABS 719
5	Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V)	SABS 1507 : 1990
6	The selection, handling and installation of electric power cables of rating not exceeding 33 kV	SABS 0198 Parts 1-12
7	Induction motors Part 2: Low-voltage three-phase standards motors	SABS 1804-2 :2001
8	Induction motors Part 1: IEC requirements	SABS 1804-1 :2001
9	Code of Practice for the wiring of premises	SABS 0142-1 :2006 (SANS 10142-1: 2006)
10	Low voltage switchgear and control gear assemblies Part 1 : Requirements for type-tested and partially type-tested assemblies	SABS 1473-1 (SANS 60439 – 1 : 2004)
11	Safety of distribution boards	SABS 1765
12	Earthing of low-voltage (LV) distribution systems	SABS 0292 :2001
13	Cable standard	SANS 1507 (Part 1-3) Electric cables with extruded solid dielectric insulation
14	Low voltage switchgear and control gear assemblies Part 1 : Type-tested and partially type-tested assemblies	SABS IEC 60439-1 :
15	The design and installation of an earth electrode	SABS 0199 :1985
16	Earth rods and couplers	SABS 1063 :1998
17	Low voltage switchgear and control gear assemblies Part 2 : Particular requirements for busbar trunking systems (busways)	SABS IEC 60439-2:

18	Low Voltage Switchgear and Control Gear Part 1: General Rules	SABS IEC 60947-1
19	Low Voltage Switchgear and Control Gear Part 2: Circuit Breakers	SABS IEC 60947-2
20	Low Voltage Switchgear and Control Gear Part 3: Switches, disconnectors switch-disconnectors and fuse-combination units	SABS IEC 60947-3
21	Low Voltage Switchgear and Control Gear Part 4 : Contactors and motor-starters Section 1 : Electromechanical contactors and motor-starters	SABS IEC 60947-4-1
22	Steel, cast iron and copper alloy flanges, tables 10/3, 25/3 or 64/3	BS 4505-1969
23	Specification General requirements for rotating electrical machines. Part 133	BS 4999
24	Specification for Acceptance tests for centrifugal, mixed flow and axial pumps – Part 2. Class B tests	BS 5316
25	Classification of insulating materials	IEC 60085
26	Occupational Health & Safety Act (Act 85 of 1993)	OHS Act

3.2 Drawings and Documents.

3.2.1 Drawings and Information Provided:

The Engineer shall produce cable schedules and such drawings necessary to adequately document the installation for the Contractor.
Three prints of each drawing shall be issued to the Contractor.

3.2.2 As Built Drawings

The Contractor shall be required to mark up these schedules and drawings with the “as built” information and return one print to the Engineer with all “as built” information entered thereon.

3.2.3 Information to be submitted by the successful bidder in respect of Control Panels.

The successful bidder shall submit three paper prints of each of the following drawings, in respect of the Control Panels to the Engineer for approval prior to manufacture.

- Outline and general arrangement drawings, showing main overall dimensions and construction details.
- Wiring diagrams.
- Schematic line diagrams.

Prints of the following shall be supplied by the successful Bidder in respect of each of the final As Built layouts of the Control Panels.

- Outline and general arrangement drawings of the DB’s.
- Wiring diagrams

- Schematic line diagrams.

4. Technical specifications

Where contradiction occurs between the Detailed Technical Specification and the General Technical Specification, preference shall be given to the Detailed Technical Specification.

4.1 Conduit

a) Galvanised conduit bearing the SANS mark of approval must be used in the following instances.

b) Surface mounted to concrete slab soffits and walling

4.2 Cables

a) Specification

- All cables shall have stranded copper conductors and shall be of the PVC/PVC/SWA/PVC type, 600/1000V grade. Cables with aluminium conductors are unacceptable.
- The cables shall be armoured with a single layer of galvanised steel wire.
- All cables shall bear the SANS mark of approval and shall have colour coded PVC insulated conductors.

4.3 Numbering

The contractor shall fit a cable number at each cable gland. The cable number shall be in accordance with the cable number indicated on the respective cable schedules. The cable numbers shall be equal to the type manufactured by Bowthorpe Hellerman or similar approved.

4.4 Glands

All cable glands shall be suitable for use in highly corrosive locations and equal or similar to the CCG Posi guard and Posi seal types.

4.5 Trenches

Cables installed in trenches shall be installed in accordance with the General Technical Requirements. The electrical contractor shall carry out the excavation and backfilling of cable trenches. Cable trenches shall have a minimum depth of 600m.

4.6 Measurement

Cable quantities given in the Schedule of Quantities and Cable Schedules have been measured against scaled drawings. It is the contractor's responsibility to measure the exact cable lengths before purchasing / installing cables. All cables will be subject to re-measure by the engineer once installed.

4.7 Installation

LV cables shall be installed as specified. The installation shall be carefully planned to reduce the

number of cable crossings to a minimum.
The following different types of installations shall be employed:

[a] On cable trays and ladders
[b] Inside sleeves in excavated cable trenches

4.8 Laying of cables in trenches

When laying cables in trenches excavated in soft or hard rock or containing sharp stones, rocks or other items most likely to injure cables, the following precautions shall be taken:

c) Before laying the cables all rocks, stones, etc shall be removed from the bottom of the trench. The floor of the trench shall be evenly covered with a layer of sifted backfill or sand to a level which is 75mm above the highest unevenness of the trench. The cost of this work shall be included in the contractor's price. The laying of cables shall not be commenced until the trenches have been inspected and approved. The cable shall be removed from the drum in such a way that no twisting, tension or mechanical damage is caused, and must be adequately supported at short intervals during the entire operation. Particular care must be exercised where it is necessary to draw cables through pipes and ducts to avoid abrasion, elongation or distortion of any kind. The ends of such pipes and ducts shall be sealed in an approved manner after drawing in of cables.
d) The cable shall be covered with a 150mm layer of sifted backfill of sand. All trenches shall be backfilled with damp soil, in layers not more than 150mm thick. Each layer shall be individually compacted in order to obtain the same degree of permeability as that of the surrounding undisturbed soil.
e) A distance of 300mm shall exist between instrumentation and power cable.
f) Tenderers are to note that:
Pickable Material -
Shall mean ground or rock that can be loosened by handpick and includes hard shale, compact ouklip and boulders from 75mm in diameter up to 0.03m² in volume.

4.9 Laying of cables into existing concrete cable trenches.

New cables installed in concrete cable trenches must be secured to existing cable ladders, and metal covers must be reinstated after cables have been installed.

4.10 Cable Ladder

- Cable ladders shall be OL76 (2mm thick) Cable Ladder as supplied by O-Line or similar approved. All nuts and bolts must be galvanised.
- Wherever possible all cable racks shall be installed in a vertical orientation to prevent accumulation of spillage and dust. Adequate space being provided behind the rack for the fixing of nuts and cable ties, etc.
- Cable racks shall be fixed to the building structure by means of stand-off galvanised supports at approximately two metre intervals, and also at the ends (joints) of each fabricated length.
- Each run of cable rack shall be bonded across all sections and be electrically continuous throughout. Where the electrical continuity cannot be guaranteed, a continuous bare copper conductor shall be provided for each run of cable tray and each section shall be bonded to this conductor. In addition all cable racks shall be bonded to the switchboard to which the cables it carries are connected.

- Cables on cable trays and ladders shall be neatly laid on the ladders and strapped to the ladders/trays at 1200mm intervals. A minimum of a half cable diameter space shall be allowed

between cables.

4.11 400v Motorised Air Circuit Breakers

SABC has standardizing on ABB 400V motorised ACB's. Therefore, the ACB's indicated on drawings must be ABB or similar approved.

4.12 Existing Electrical Installation.

Bidder must note that the existing installation in Radio Park is in operation 24 hours a day and no interruption of broadcasting services will be allowed. Before any equipment is disconnected and new equipment connected, the contractor will have to obtain acceptable time slots from the SABC**.**

4.17 REMOTE MONITORING SYSTEM

a) The new generators must be equipment with remote monitoring system.
b) The system must be able to support multi-set generator system
c) The system must provide real time instrumentation & control, event log and automatic system alerts. These must be sent to different users via email and sms. The system should be viewed on smart phone, tablet or computer.
d) Each devise can be set to view only or able to control the system remotely.
e) The controller should be able to log all the event or changes done by each user.
f) 10" colour multi-set remote display to be installed in our k1 control room for viewing only.

4.18 BMS

a) The new generator system must be able to communicate with the existing Johnson Controls Metasys BMS.

b) The relevant integration will be undertaken by a Johnson Controls Integrator, thus enabling the signals below to be transmitted from the generator's PLC to the existing BMS**.**

- Alternator Volts L1-N, L2-N, L3-N
- Alternator Volts L1-L2, L2-L3, L3-L1
- Alternator Amps L1, L2, L3
- Alternator Frequency Hz
- Alternator kVA L1, L2, L3, Total
- Alternator kW L1, L2, L3, Total
- Alternator pf L1, L2, L3, Average
- Alternator kVAr L1, L2, L3, Total
- Alternator KWh

- Alternator KVAh
- Alternator KVArh
- Alternator Phase Sequence
- Synchroscope Display
- Engine Speed RPM
- Engine Oil Pressure
- Engine Temperature
- Plant Battery Volts
- Engine Hours Run
- Number of Start Attempts
- Maintenance Display
- Log & display all alarms & shut down conditions (date & time stamped).
- Log & display status of all switchgear that is controlled (date & time stamped).

c) The above will enable monitoring of the generator from the BMS, however, no control of the generator will be possible from the BMS.

d) Full remove monitoring & controller shall be fitted. The monitoring and control unit shall come with different set up for each user:

- Each user to have different levels of control.
- Some user to be able to view the status only.
- Send notification on change of the status, e.g generator failed to start, low fuel.
- The remote monitoring system should be able to be viewed on PC or cellphone app.

4.19 EARTHING

a) The complete Electrical Installation shall be earthed and bonded as required by the Code of Practice.

5. Generator Change over Panel

g) The contractor will be responsible for liaison with the supplier regarding programme, submission of workshop drawings, inspections at the factory, taking delivery, unpacking, placing in position and assembling, where required. Final connections to all Control Panels, testing, preparation of legend cards and commissioning shall be carried out by the contractor.

h) The fault levels are indicated on the schematic diagram. It is the responsibility of the distribution board manufacturer to select current limiting type circuit breakers and select suitable downstream switchgear to ensure that the fault levels indicated will be achieved.

i) The Control Panels manufacturers shall ensure that distribution boards are correctly sized in order that they may be fitted within the allocated spaces as indicated on the drawings. The Control Panel must be manufactured by a reputable generator vendor.

5.1 Battery Charger

j) The change over panel shall contain three battery chargers for charging each of the 24V DC Engine Starting batteries and the 24V DC Control batteries from the 230V mains.

k) Each of the Engine Starting batteries will consist of 2 x 12V DC 200Ah batteries in parallel.

l) The control batteries must be supplied with the panel and must be housed inside a separate cubicle within the panel. The control batteries must consists of 2 x 12V DC 35Ah batteries in parallel. If the control batteries fail for whatever reason the engine batteries must supply control voltage to the panel.

m) The 24V battery chargers shall be of the fully automatic type and shall consist of an air cooled transformer, silicon bridge rectifier, fuses and switching arrangement. All equipment shall be suitably rated and designed to automatically deliver a trickle or boost charge as determined by the battery voltage. The boost charge in amps shall not exceed 20% of the rated battery capacity but must not be less than 10Amps.

n) A constant trickle charge facility is not acceptable. The charger shall switch off automatically when the battery is fully charged.

o) The charger must be provided with a Voltmeter indicating the battery voltage. This instrument must be mounted on the control panel door.

5.2 Change Over Panel

a) The switchboard / control panel must provide for the control, metering and switching of the diesel alternator sets. The switchboard will incorporate all the switchgear, control equipment and load busbars specified.

b) This section covers the design, manufacture and works testing of a switchboard/control panel for the automatic change over and control of the 400/230V 50Hz diesel generating sets.

c) Control equipment must provide advanced synchronizing functionality for diesel generating sets that include non-electronic and electronic engines.

d) Control of the sets will be undertaken by means of Programmable Deep Sea series 8610 Controllers or similar approved, and the control system must offer the end user maximum flexibility, reliability and ease of operation.

e) The hardware of the controllers must comprise inputs and outputs which are galvanically isolated from the C.P.U. (Central Processing Unit) input and output circuits.

f) The software development must be undertaken by the generating set contractor and shall be easily tailored to specific needs. Circuit development must be generated on a PC.

g) The switchboard will consist of a section for each generator, arranged with a Common Control section in the centre of the switchboard and the generator switching and control panels on either side of the Common Control section

h) The switchboard will be manufactured from 2mm cold rolled sheet steel and will be of folded construction. Each section of the switchboard will be physically separated from adjacent sections and suitable barriers will be provided between control and switchgear sections of each panel.

i) Prior to epoxy painting, all sheet steel must be thoroughly de-rusted and primed with two coats of zinc chromate etching primer.

j) All internal chassis plates must be galvanised steel

k) The panel shall be fully labelled, and a wiring diagram shall be installed in each plant room, mounted on the wall in a wooden frame with removable Perspex protective cover.

l) The respective sections of the switchboard must be equipped as follows:

5.3 Generator Control and Switching

This section will contain all equipment relevant to the automatic control switching and monitoring of the diesel engine and generator that it controls.

The controller must be provided with the following functions:

a) Instrumentation
b) Generator Volts L1-N, L2-N, L3-N
c) Generator Volts L1-L2, L2-L3, L3-L1
d) Generator Amps L1, L2, L3
e) Generator Frequency Hz
f) Generator kVA L1, L2, L3, Total
g) Generator kW L1, L2, L3, Total
h) Generator pf L1, L2, L3, Average
i) Generator kVAr L1, L2, L3, Total
j) Generator KWh
k) Generator KVAh
l) Generator KVArh
m) Generator Phase Sequence
n) Synchroscope Display
o) Engine Speed RPM
p) Engine Oil Pressure
q) Engine Temperature
r) Plant Battery Volts
s) Engine Hours Run
t) Number of Start Attempts
u) Maintenance Display
v) Engine ECU diagnostics information via industry standard CAN interface
w) Enhanced metering via CAN when connected to an electronic engine

5.4 Control selectors and LCD Display

The module is operated using the front STOP/RESET, MANUAL, AUTO and START push buttons. Three of these push buttons include an LED indicator. Additional push buttons provide LCD display scroll, lamp test, mute functionality and breaker control.

- Electronic engine capability
- RS485 remote communications
- Back-lit LCD 4-line text display
- Voltage measurement
- Configurable inputs (9)
- Configurable outputs (5)
- Automatic start

- Manual start
- Audible alarm
- LED indicators
- Engine history event log
- Engine protection
- Configurable alarm timers
- Configurable start & stop timers
- Automatic load transfer
- Magnetic pick-up

5.5 Control Functions and Equipment

The module must be able to monitor under/over generator volts, over current, under/over generator frequency, under speed, over speed, charge fail, emergency stop, low oil pressure high engine temperature, fail to start, low/high DC battery volts, fail to stop, generator short circuit protection.

- ROCOF & vector shift
- Automatic hours run balancing of generator sets
- Dead bus sensing
- Direct communication from the module to the governor and AVR
- Volts & frequency matching.
- Synchronise with the mains on return for few seconds and remove the load from generator.
- Alarm message with SMS.
- If first generator failed on start-up or during operation the second generator shall start automatically.
- KW and Kvar load sharing with multiple generators.
- Refuel day tank automatically when at 50%, when at 30% send low fuel alarm. When level reach 90% refuelling must stop and when at 100% a second stop signal must be send including full fuel alarm. Day tank fuel gauge to be calibrated on site and tested.

5.6 Switchgear

m) The following switchgear for switching and protection of each generator must be provided:

- Triple pole draw out type air circuit breaker complete with electronic overload and short circuit protection. This breaker will be suitable for remote electrical operation and will be equipped with a spring charging motor as well as closing and tripping coils.

- Suitable ratio five amp current transformers.

- Set copper busbars rated for 1,67A per millimetre square operation. The busbars will be identified in phase colours.

n) The following ABB switchgear for switching and protection of the main incomer must be provided:

- Three pole draw out type air circuit breaker complete with electronic overload and short circuit protection. This breaker will be suitable for remote electrical operation and will be equipped with a spring charging motor as well as closing and tripping coils.

- Suitable ratio five amp current transformers.

- Set copper busbars rated for 1,67A per millimetre square operation. The busbars will be painted in phase colours.

- Programmable power meter (KVA, KWH, Kvar, V, I,pf, etc).

o) The following switchgear for switching and protection of the feeders must be provided:

- Triple pole draw out type air circuit breaker complete with electronic overload and short circuit protection. This breaker will be suitable for remote electrical operation and will be equipped with a spring charging motor as well as closing and tripping coils.
- Suitable ratio five amp current transformers.
- Set copper busbars rated for 1,67A per millimetre square operation. The busbars will be painted in phase colours.
- Programmable power meter (KVA, KWH, Kvar, V, I,pf, etc).

p) Testing

The control panels must be fully tested and the following control conditions must be simulated:

- Automatic Starting and Stopping of the Generators as describe above.
- Manual Control of the Generators.
- These tests must be witnessed by SABC representative.

q) Standards

The switchboard/control panel will be built to the following standards:

r) Control Circuit Wiring and Terminals

- All control wiring will be undertaken in stranded copper conductor having a minimum cross-sectional area of 1,0mm².
- All control wiring will present a neat appearance and will be suitably braced, placed in trunking, clipped to prevent vibration. Connections to equipment on swing doors will be so arranged to give a twisting motion and not a bending motion to the conductor.
- All panel and equipment terminals, labels etc., will be completely accessible after the wiring and cabling has been completed.
- All wires will be marked at both ends with an approved type of marking device identifying the conductor which corresponds to the circuit diagrams. Interlocking type ferrules with permanent black letters impressed on a white or yellow background will be used.
- All auxiliary terminals will be accessible from the front of the control board and all terminals will be mounted at a minimum height of 200mm above the gland plate.
- All terminals will be suitable for use with crimped lugs.
- Terminal blocks will be made from non-tracking insulating material and have a minimum clearance of 13mm between the connection point and earthed metal. Terminals where pressure is applied to the insulating moulding when tightening the connections will not be used.

- After completion, the wiring will be tested to withstand a test voltage of 1000V for two minutes.
- All busbars and cable connections will be pressure tested to withstand a test voltage of 2500V for two minutes.

s) Fuses

All fuses will be of the high breaking capacity type in accordance with IEC/EN60269-1.

All fuses will be so connected that the live wire terminal is at the top.

Each set of fuses will be provided with an engraved label, fixed to the panel adjacent to the fuses, inscribed with the fuse number and rating.

t) Instruments

All instruments will comply with the following standard unless otherwise stated.

Instruments	BS89
Instrument scales	BS3693
Indicating electrical instruments	I.E.C.51

u) Contactors

All contactors will comply with the requirements of IEC947-4-1.

v) Control Switches

Control switches will be of the rotary action air break type, suitable for controlling alternating or direct current loads.

w) Control Relays

Control relays will be of the totally enclosed plug-in type with contacts suitable for the current making, carrying and breaking conditions of the associated equipment.

x) Busbars and Busbar assemblies

In accordance with SABS IEC 60439 and SABS 1473 Part 1, all bus-bar assemblies and mountings must be have been tested by the NETFA test facility and the switchboard manufacturer must be approved to manufacture switchboards in accordance with this standard.

Fault Level - The board and its equipment shall be rated to operate at on a 400V 3phase 4 wire system having an assymetrical prospective fault level of 50 kA or as contained in the detailed specification of the Electrical Installation.

7. Generators

7.0 Engines

7.1) General

The engine must comply with the requirements as laid down in BS 5514 (ISO 3046), and must be

of the atomised injection, compression ignition type, running at a speed not exceeding 1500 r.p.m. The engine must be amply rated for the required electrical output of the set, when running under the site conditions. The starting period for either manual or automatic switching-on until the taking over by the generating set, in one step, of a load equal to the specified site electrical output, shall not exceed 15 seconds. This must be guaranteed by the Bidder.

7.2) Rating

The set shall be capable of delivering the specified output continuously under the site conditions, without overheating. The engine shall be capable of delivering an output of 110 % of the specified output for one hour in any period of 12 hours consecutive running in accordance with BS 5514.

7.3) De-Rating

The engine must be de-rated for the site conditions as set out in the Specification 1,700 metres above sea level.

The de-rating of the engine for site conditions shall be strictly in accordance with BS 5514 of 1977 as amended to date. Any other methods of de-rating must have the approval of the SABC LTD and must be motivated in detail. Such de-rating must be guaranteed in writing and proved by the successful Bidder at the site test.

7.4) Starting and Stopping

The engine shall be fitted with an electric starter motor and be easily started from cold, without the use of any special ignition devices under summer as well as winter conditions.

Bidder must state what arrangements are provided to ensure easy starting in cold weather. Full details of this equipment must be submitted. In the case of water cooled engines, any electrical heaters shall be thermostatically controlled. The electrical circuit for such heaters shall be taken from the control panel, and must be protected by a suitable circuit breaker.

7.5) Starter Battery

The set must be supplied a fully charged lead-acid type battery, complete with necessary electrolyte. The battery must have sufficient capacity to provide the starting torque stipulated by the engine makers. The battery capacity shall not be less than 120 Ah and shall be capable of providing five consecutive start attempts from cold and thereafter a six attempt under manual control of not less than 20 seconds duration each. The battery must be of the heavy duty “low maintenance” type, house in a suitable battery box. A automatic battery charger to be supplied to keep in a fully charged state. The electrical circuit for the battery charger shall be taken from the control panel, and must be protected by a suitable circuit breaker.

7.6) Cooling

The engine may be either of the air of water cooled type. In the case of water-cooling, a built-on heavy duty, tropical type pressurised radiator must be fitted.

For either method of cooling, protection must be provided against running at excessive temperatures. The operation of this protective device must give a visual and audible indication on the switchboard on the switchboard. Water-cooled engines shall in addition be fitted with a low water cut-out switch, installed in the radiator, to switch the set off in the event of a loss of coolant. The protection shall operate in the same way as the other cut-outs (e.g. low oil pressure). All air

ducts for the cooling of the engine are to be allowed for. The air shall be supplied from the cooling fan cowling/radiator face to air outlet louvers in the plant room wall.

7.7) Lubrication

Lubrication of the main bearings and other important moving parts shall be by forced feed system. An automatic low oil pressure cut-out must be fitted, operating the stop solenoid on the engine and giving a visible and audible indication on the switchboard.

7.8) Fuel Pump

The fuel injection equipment is suitable for operation with the commercial brands of diesel fuel normally available in South Africa.

7.10) Fuel Tank

A 900L stainless steel fuel tank shall be installed at k2 and k1 plant rooms link to the existing 2x9000L bulk tank with approved seamless steel pipes from the bulk tank.

Supply and install main pipe from the bulk tank to each day tank including electric solenoid valve and pump for each tank. The piping & pump shall be size to replenish the day tank while the generator is running at full load.

A water trap shall be fitted in the fuel pipeline from the day tank to the engine.

The tank shall be fitted with a suitable filter, a full height gauge glass, “low fuel level” alarm, giving an audible and visible signal on the switchboard as well as a low-low fuel level cut-out.

An automatic electrically operated pump to refuel the day tank from the main tank shall be fitted.

The fuel lines should not be made of copper as there is a risk of oxidation due to condensation. The sulphur content in the fuel can also have a negative effect on the copper.

The interconnection fuel piping shall consist of seamless steel pipe and the connection to vibrating components shall be in flexible tubing with armoured covering.

7.11) Governor

The speed of the engine shall be controlled by a governor in accordance with class A2 of BS 5514 of 1977 if not otherwise specified in the Technical Specification.

The permanent speed variation between no load and full load shall not exceed 4,5% of the normal engine speed and the temporary speed variation shall not exceed 10% External facilities must be provided on the engine, to adjust the normal speed setting by ± 5% at all loads zero and rated load.

7.12) Flywheel

A suitable flywheel must be fitted, so that lights fed from the set will be free from any visible flicker.

The cyclic irregularity of the set must be within the limit laid down in BS 5514 of 1977.

7.13) Exhaust Silencer

It is essential to keep the noise level as low as possible. An effective exhaust silencing system of **9**the residential type must be provided.

The exhaust pipe shall be installed in such a way that the expulsed exhaust fumes will not cause discomfort to the public/employees. The exhaust pipe must be flexibly connected to the engine to take up vibrations transmitted from the engine, which may cause breakage. The exhaust piping and silencer shall be lagged to reduce the heat and noise transmission into the plant room and shall be protected against the ingress of driving rain at 45° to the horizontal. The exhaust pipe must extend 0,5m above the roof gutters. It must be secured by flanges both sides of the wall at the point of exit. These flanges must be clamped to the wall with bolts through the wall.

The exhaust at News Block Plant room shall link to the existing system and mechanism installed to prevent fumes going back into the stationery engine. The bidder to take measurement and advice if the existing exhaust system has enough capacity to accommodate the new engine.

7.14) Accessories

The engine must be supplied complete with all accessories, air and oil filters, 3 instruction manuals, spare parts lists, the first fill of all lubricating oils, fuel, etc.

The engine shall be capable of starting from cold in winter conditions, and should be provided with a dual pre-heating system, separately wired, supplied from both normal and backup supplies (not smaller than 2kW each), acceptable to the Engineer.

An electronic speed governor of class A1 as stipulated by BS 5514 shall be provided.

The engines shall be rated **(prime capacity)** to operate at 1,700 metres above sea level (Gauteng Province), capable of driving the alternators to the capacity as specified.

Engines acceptable:

Cummins
Cat
Volvo
Deutz
Perkins
MTU
Scania

7.15) Alternators

The alternators shall comply with the requirements of BS 5000, Part 3.

The alternators shall be of the self-excited brushless (Stamford/Leroy) type, capable of supplying the specified output continuously with a temperature rise not exceeding the limits laid down in BS 5000 for rotor and starter windings.

The alternator shall be capable of delivering an output of 110% of the specified output, for one hour in any period of 12 hours consecutive running

The alternators shall be self-regulated, the inherent voltage regulation not exceeding ± 2, 5% of the nominal voltage at all loads with the power factor between unity and 0, 8 and within the driving speed variations of 4, 5% between no load and full load.

The alternator shall be designed for rapid voltage recovery following sudden application of full load or motor starting currents. The voltage shall recover to within 2,5% of the steady state within 300 Ms following the application of full rated load, with the transient voltage dip not exceeding 18%.

The engine and alternator must be directly coupled by means of a high quality flexible coupling, equal and similar to the “HOLSET” type.

Types of Alternators acceptable:

Leroy Some
Stamford
Marathon
Marelli

7.16) Plant Ratings

The Standby Plant ratings shall apply under the following load/site conditions:

Power factor	: 0,8
Altitude above sea level	: 1700m above sea level
Maximum ambient temperature	: 30°C averages
Relative humidity at maximum	: 80% Average

7.17) Protection Equipment and Indicators

Provide a start attempt limit, limiting the number of start cycles to six attempts, thereby avoiding the batteries from being run down, should the engine fail to start or should the alternator fail to generate power for any reason.

Provide a speed sensing switch to isolate the starters after the engine has attained speed during the start cycle. In series with the speed sensing switch, provide an oil pressure switch, again to isolate the starter when the engine oil reaches operational pressure during the starting of the plant.

While the plant is in its stop cycle, the oil pressure switch shall delay engaging of the starters, until the engine has come to rest and the oil pressure has dropped completely. The above switches shall prevent the starters engaging while the engine is still rotating.

Provide engine over and under speed protection with short delay before shutting down the plant.

Provide low and high (adjustable) alternator voltage protection.

Other protective devices shall include:

- Set not in "auto" mode
- High engine temperature
- Low battery voltage
- Start sequence failure alarm
- Over-speed

} Single Common Alarm Output but shall have individual potential free contacts for remote monitoring via BMS

- Under-speed
- Low fuel level
- Battery earth fault
- Generator "Run"
- Mains failure

} Individual Alarm and individual potential free contacts for remote monitoring via BMS

The above devices shall operate indicator lamps, sound the alarm and shut down the plant, except as otherwise indicated.

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7.18) Brochures

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

8. Technical Information

The following information shall be supplied in full and in all respects for each plant and shall be submitted together with the bid

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8.1 Engine 1250 KVA (Remote cooling)

NO	ITEM	REMARKS
1.	Manufacturer's Name	
2.	Manufacturer's model No. and year of manufacture	
3.	Continuous sea level rating after allowing for ancillary equipment : c) In kW	
4.	Percentage de-rating for site conditions, in accordance with BS 551.4 a) For altitude b) For temperature c) For humidity d) Total de-rating	
5.	Net output on site in kW	
6.	Nominal speed in r.p.m.	
7.	Number of cylinders	
8.	Fuel consumption of the complete generating set on site in l/h of alternator output at : a) Full load b) ¾ load c) ½ load NOTE : A tolerance of 5% shall be allowed above the stated value of fuel consumption.	
9.	Make of fuel injection system.	

10.	Capacity of fuel tank in litres	
11.	Is gauge glass fitted to tank?	
12.	Is electric pump for filling the fuel tank included?	
13.	Method of starting	
14.	Voltage of starting system	
15.	Method of cooling	
16.	Type of radiator if water-cooled	
17.	Type of heater for warming cylinder heads	
18.	Capacity of heater in kW	
19.	Method of protection against high temperature	
20.	Method of protection against low oil pressure	
21.	Type of governor	
22.	Speed variation in % a. Temporary b. Permanent	
23.	Minimum time required for as assumption of full load in seconds	
24.	Recommended interval in running hours for : a. Lubricating oil change b. Oil filter element change c. Decarbonising	
25.	Type of base	
26.	Can plant be placed on solid concrete floor?	
27.	Are all accessories and ducts included?	
28.	Is engine naturally aspirated?	
29.	Are performance curves attached?	
30.	Diameter of exhaust pipe	
31.	Noise level at tail of exhaust pipe in dBA	
32.	BMEP (4 stroke) at continuous rating (kPa)	
33.	% Load acceptance to BS 5514, Part 4, with 10% transient speed drop	

8.2) Engine 500 KVA

NO	ITEM	REMARKS
1.	Manufacturer's Name	
2.	Country of Origin	
3.	Manufacturer's model No. and year of manufacture	

NO	ITEM	REMARKS
4.	Continuous sea level rating after allowing for ancillary equipment : d) In kW	
5.	Percentage de-rating for site conditions, in accordance with BS 551.4 a) For altitude b) For temperature c) For humidity d) Total de-rating	
6.	Net output on site in kW	
7.	Nominal speed in r.p.m.	
8.	Number of cylinders	
9.	Strokes per working cycle	
10.	Stroke in mm	
11.	Cylinder bore in mm	
12.	Swept volume in cm^3	
13.	Mean piston speed in m/min	
14.	Compression ratio	
15.	Cyclic irregularity	
16.	Fuel consumption of the complete generating set on site in l/h of alternator output at : a) Full load b) ¾ load c) ½ load NOTE : A tolerance of 5% shall be allowed above the stated value of fuel consumption.	
17.	Make of fuel injection system.	
18.	Capacity of fuel tank in litres	
19.	Is gauge glass fitted to tank?	
20.	Is electric pump for filling the fuel tank included?	
21.	Method of starting	
22.	Voltage of starting system	
23.	Method of cooling	
24.	Type of radiator if water-cooled	
25.	Type of heater for warming cylinder heads	
26.	Capacity of heater in kW	
27.	Method of protection against high temperature	

NO	ITEM	REMARKS
28.	Method of protection against low oil pressure	
29.	Type of governor	
30.	Speed variation in % a. Temporary b. Permanent	
31.	Minimum time required for as assumption of full load in seconds	
32.	Recommended interval in running hours for : a. Lubricating oil change b. Oil filter element change c. Decarbonising	
33.	Type of base	
34.	Can plant be placed on solid concrete floor?	
35.	Are all accessories and ducts included?	
36.	Is engine naturally aspirated?	
37.	Are performance curves attached?	
38.	Diameter of exhaust pipe	
39.	Noise level at tail of exhaust pipe in dBA	
40.	BMEP (4 stroke) at continuous rating (kPa)	
41.	% Load acceptance to BS 5514, Part 4, with 10% transient speed drop	

8.3) Alternator (1250KVA)

NO	ITEM	REMARKS
1.	Maker's name and model no.	
2.	Country of Origin and year of manufacture	
3.	Type of enclosure	
4.	Nominal speed in r.p.m.	
5.	Number of bearings	
6.	Terminal voltage	
7.	Sea level rating kVA at 0,8 power factor	
8.	De-rating for site conditions	
9.	Input required in kW	
10.	Method of excitation	
11.	Efficiency at 0,8 power factor and : a) Full load b) ¾ load c) ½ load	
12.	Maximum permanent voltage variation in %	

NO	ITEM	REMARKS
13.	Transient voltage dip on full load	
14.	Voltage recovery on full load application in milli-seconds	
15.	Is alternator brushless?	
16.	Class of insulation of windings	
17.	Is alternator tropicalized?	
18.	Symmetrical short circuit current at terminals n Ampere	
19.	Type of Coupling	

8.4 Alternator (500KVA)

NO	ITEM	REMARKS
1.	Maker's name and model no.	
2.	Country of Origin and year of manufacture	
3.	Type of enclosure	
4.	Nominal speed in r.p.m.	
5.	Number of bearings	
6.	Terminal voltage	
7.	Sea level rating kVA at 0,8 power factor	
8.	De-rating for site conditions	
9.	Input required in kW	
10.	Method of excitation	
11.	Efficiency at 0,8 power factor and : a) Full load b) ¾ load c) ½ load	
12.	Maximum permanent voltage variation in %	
13.	Transient voltage dip on full load	
14.	Voltage recovery on full load application in milli-seconds	
15.	Is alternator brushless?	
16.	Class of insulation of windings	
17.	Is alternator tropicalized?	
18.	Symmetrical short circuit current at terminals n Ampere	
19.	Type of Coupling	

8.5) Switchboard

NO	ITEM	REMARKS
1.	Maker's Name	
2.	Country of Origin	
3.	Is board floor mounted?	
4.	Finish of board	
5.	Make of volt, amp, and frequency meters	
6.	Dial size of meters in mm	
7.	Scale range of voltmeter	
8.	Scale range of ammeters	
9.	Ration of current transformers	
10.	Make of hour meter	
11.	Range of cyclometer counter	
12.	Smallest unit shown on counter (Item 11)	
13.	Make of circuit breaker	
14.	Type of circuit breaker	
15.	Rating of circuit breaker in Amp and fault level in kA	
16.	Setting range of overload trips	
17.	Setting range of instantaneous trips	
18.	Make of change-over equipment	
19.	Make of voltage relay	
20.	Is control and protection equipment mounted on a small removable panel?	
21.	Type of control equipment	
22.	Make of mains isolator	
23.	Type of indicators for protective devices	
24.	Is battery charging	
25.	Are volt- and ammeters provided for charging circuit?	
26.	Is the alarm hooter of the continuous duty type?	
27.	Rating in Amps of : a. Change-over equipment b. Mains on load isolator c. By-pass switch d. Circuit breaker to outgoing feed	
28.	Is manufacture of switchboard/control panel to be sub-let?	
29.	If yes, state name and address of specialist manufacturer	

8.6) Battery

NO	ITEM	REMARKS
1.	Maker's Name	
2.	Country of Origin	
3.	Type of battery	
4.	Voltage of battery	
5.	Number of cells	
6.	Capacity in cold crank amp	

8.7) Dimensions (1250KVA Remote cooling) Gen set

NO	ITEM	REMARKS
1.	Overall dimensions of set in mm	
2.	Overall mass	
3.	Is the generator room adequate for the installation of the set	

8.9) Dimensions (500 KVA) Gen set

NO	ITEM	REMARKS
1.	Overall dimensions of set in mm	
2.	Overall mass	

8.11) Spare Parts and Maintenance Facilities

NO	ITEM	REMARKS
1	Approximate value of spares carried in stock for this particular diesel engine and alternator	
2	Where are these spares held in stock	
3	What facilities exist for the servicing of the equipment offered	
4	Where are these facilities available	

8.12) Warranty

NO	ITEM	REMARKS
1	12 months warranty on delivery of generator set.	
2	12 months warranty after commissioning and acceptance of generator set by client.	
3	Any other warranties please state.	

NO	ITEM	REMARKS
1	Delivery period in weeks	

8.13 SCHEDULE OF DRAWINGS

DRAWING NUMBER	DISCRIPTION	SHEET NUMBERING
ST 15055	RADIO PARK 2X500KVA PLANT ROO M LAYOUT	SHEET 1 OF 7
ST 15055	RADIO PARK 1250 KVA PLANT ROOM LAYOUT	SHEET 2 OF 7
ST 15055	RADIO PARK 1250 KVA SCHEMATIC LAYOUT	SHEET 3 OF 7
ST 15055	RADIO PARK K2 PLANT ROOM GEN RETICULATION	SHEET 4 OF 7
ST 15055	RADIO PARK K2 MAIN LT BOARD SUB-B SCHEMATIC LAYOUT	SHEET 5 OF 7
ST 15055	RADIO PARK C-SUB SCHEMATIC LAYOUT	SHEET 6 OF 7
ST 15055	RADIO PARK F-SUB SCHEMATIC LAYOUT	SHEET 7 OF 7

9. GENERAL ELECTRICAL SPECIFICATION

9.1 GENERAL

The General Electrical Specification is to be read in conjunction with the Technical Specification.

Where the Technical Specification differs from the General Electrical Specification, the former shall apply to this contract.

9.2 COMPLIANCE WITH REGULATIONS

9.2.1 The installation shall be erected and carried out in compliance with:

a) The SANS - 10142 Code of Practice for the Wiring of Premises as amended;

b) The Machinery and Occupational Safety Act as amended;

c) The local Municipal & Supply Authority By-Laws and Regulations;

d) The local Fire Regulations;

e) The Regulations of Telkom;

f) The Standard Regulations of any Government Department of public service company where applicable;

g) The factory-built assemblies of low voltage switchgear and control gear IEC 439, as amended;

h) The degrees of protection of enclosures for low voltage switchgear and control gear IEC 144, as amended.

9.2.2 In addition, the Contractor shall issue all notices and pay all the required fees in respect of the installation to the local authorities, and shall exempt the Employer from all losses, costs or expenditures that may arise as a result of the Contractor's negligence to comply with the requirements of the regulations enumerated in paragraph 1.2.

9.2.3 It shall be assumed that the Contractor is conversant with the above mentioned requirements. Should any requirements, by-law or regulation, that contradict the requirements of this document, apply or become applicable during erection of the installation, such requirement, by-law or regulation shall overrule this document and the Contractor shall immediately inform the Engineer of such a contradiction. Under no circumstances shall the Contractor carry out any variations to the installation in terms of such contradictions without obtaining the written permission to do so from the Engineer.

9.3 ARRANGEMENTS WITH THE SUPPLY AUTHORITY

9.3.1 It shall be the responsibility of the Contractor to issue all notices and pay all monies that are due for the electrical builders / temporary supply connection, except where otherwise specified. If, according to the contract, these monies are reclaimable from the Employer, then these claims by the Contractor shall be substantiated with official receipts.

9.3.2 The Contractor shall supply and install all notices and warning signs that are required by the appropriate laws, regulations and/or by this document.

9.4 FIXING AND SUPPORTING OF EQUIPMENT AND MATERIALS

9.4.1 It is the responsibility of the Contractor to position and securely fix conduits, ducts, cables and cable channels, switchboards, fittings and all other equipment or accessories as required for the installation. The Contractor shall provide and fix all supports, clamps, brackets, hangers and other fixing materials.

9.4.2 All supporting steelwork shall be wire-brushed and given one coat of rust resisting primer, followed by one coat of high quality enamel paint before any other equipment is fixed.

9.4.3 All methods of suspension or supports shall be submitted to the Engineer for approval and for reference to the Structural Engineers where necessary, prior to manufacture or installation.

9.4.4 Supporting of any rotating equipment shall incorporate anti-vibration mountings of the type and selection specified in the applicable clauses referring to equipment bases herein.

9.4.5 Supports shall preferably be proprietary products such as UNISTRUT, or failing this, shall be of mild steel sections, purpose fabricated for their application. Under no circumstances whatsoever will sheet metal straps be accepted as a supporting method. All supports shall cradle the item to be supported; supports shall not be rivetted or welded to the equipment. Rod hangers shall not exceed 3000mm in length and be of minimum diameter 12mm. For longer suspensions use mild steel angles. Angle iron supports shall be of 38 x 5mm minimum section.

9.4.6 REDHEAD or RAWLBOLT anchor bolts, or their equivalent, shall be used for fixing supports to the building structure, it not being permissible to utilise gunpowder shot-driven bolts for this purpose unless prior permission has been obtained.

9.4.7 Where holes in equipment exist, bolts and fixing screws as specified shall be used. Where sizes are not specified, the largest bolt or screw that will fit into the hole shall be used.

9.4.8 Where the fixing holes in brick or concrete walls are smaller than 10mm diameter and where the mass of the equipment is less than 15kg, wall plugs may be used to fix conduits, cables and other equipment. Aluminium, fibre or plastic plugs only may be used. Wooden plugs are not acceptable. Plugs installed in seams between bricks are not acceptable. A masonry drill of the correct size shall be used to drill holes for plugs. Round headed screws shall be used throughout.

9.4.9 Brass screws, bolts and nuts shall be used to fix galvanised equipment.

9.4.10 Materials as sheet metal cable ducts or channels may be fixed against walls and concrete slabs by means of the shot-fired method designed for this purpose.

9.5 ELECTRICAL CONDUIT INSTALLATION

9.5.1 General

Where conduits are to be installed in concrete, this shall be done while the building work is still in progress. Surface mounted conduit shall only be installed after the concrete has cured sufficiently.

9.5.2 Other Services

Conduits may not be installed closer than 150mm to pipes containing gas, steam, hot water or other materials that may damage the conduits. Conduits may not touch pipes or other service installations in order to prevent electrolytic corrosion. Where this is unavoidable, cathodic protection shall be provided. Where doubtful situations of this nature occur or where there are installation incompatibilities, the matter shall be reported to the Engineer without delay.

9.5.3 Galvanised Conduit

Galvanised conduit and accessories shall be used in the following circumstances:

a) In damp areas and areas exposed to the weather
b) For all installations within 30 kilometres of the coast
c) For surface mounted conduit installations
d) In conduit used for future extensions where 'free ends' exist
e) For connections to galvanised equipment.

Conduit & accessories for the above applications shall be hot-dipped galvanised to SANS 763.

9.5.4 Debris

Care shall be taken to prevent any debris or moisture from entering the conduit during and after installation of the conduits. All conduit ends shall be sealed by means of a solid plug that shall be screwed to the conduit end. All conduits shall be cleaned to remove all oil, moisture or other debris that may be present, before conductors are installed.

9.5.5 Defects

Each length of conduit shall be inspected for defects and all burrs shall be removed. All conduits that are split, dented or otherwise damaged or any conduits with sharp internal edges shall be removed from site. The Contractor shall ensure that conduits are not blocked.

9.5.6 Conduit Ends

Conduit ends shall be cut at right angles to ensure that ends butt squarely at joints. Threads shall not be visible at joints and connections except at running joints for steel conduits.

9.5.7 Joints

All conduit ends shall be reamed and all joints tightly screwed. Only approved couplings shall be used. Running joints with long threads shall be kept to a minimum and locknuts shall be provided to ensure a strong mechanical and a continuous electrical joint for steel conduits.

9.5.8 Finish (Steel)

All joints shall be painted with red lead to prevent them from rusting in damp areas, areas within 30km of the coast, and in cases where the installation is exposed to the weather for any length of time. Where **the** galvanising or black paint has been damaged, the area shall first be cleaned and a coat of zinc base paint applied subsequently. Additional coats of paint shall only be applied after the undercoat has been completed.

9.5.9 Continuity (Steel)

Mechanical and electrical continuity shall be maintained throughout the conduit installation. Conduits may not be relied upon for earth continuity.

9.5.10 Inspection Type Accessories

Inspection type couplings, elbows and tees shall not be used except with the written consent of the Engineer. All outlet boxes and draw boxes shall however be of the inspection type.

9.5.11 Position of Outlets

All accessories such as socket outlets, switches, lights, etc., shall be accurately positioned. It is the responsibility of the Contractor to ensure that all accessories are installed level and square at the correct height from the floor, ceiling or roof level as specified. It shall be the responsibility of the Contractor to determine the correct final floor, ceiling and roof levels in conjunction with the Building Contractor. Draw boxes shall not be installed in positions where they will be inaccessible after completion of the installation. Draw boxes shall be installed in inconspicuous positions to the approval of the Engineer. All installed draw boxes shall be pointed out to the Engineer. The positions of all draw boxes shall be

indicated on the 'as-built' drawings.

9.5.12 Draw Wires

Galvanised steel draw wires shall be installed in all unwired conduits, e.g. conduits for future extensions, telephone installations and other services.

9.5.13 Bends

A maximum of two 90° bends or the equivalent displacement will be allowed between outlets and/or draw boxes. Draw boxes shall be installed at maximum intervals of 12m in straight conduit runs. All bends shall be made without heating the conduit or without reducing the diameter of the conduit. The inside diameter of a bend shall not be less than three times the outside diameter of the conduit.

9.5.14 Wall Sockets

Where more than one socket outlet is connected to the same circuit, the conduit shall be looped from one outlet box to the following on the same circuit. Where a metal channel is used, the conduit may be installed from the channel directly to the outlet box on condition that the conductors can be looped from one outlet to the next without the jointing of wires.

9.5.15 Luminaires

Conduit end may not be used to solely support luminaires. Where luminaires are specified that are fixed directly to the pendant box, the pendant box shall be fixed independently of the conduit installation except where the pendant box is cast into concrete.

9.5.16 Withdrawal of Conductors

To ensure that all electrical conductors shall be easily withdrawable from conduits, the Engineer reserves the right to have the conductors on any circuit removed at his discretion and replaced at the cost of the Contractor. If the conductors are damaged during removal, the damaged conductors shall be replaced and the cost of the replacement shall be borne by the Contractor.

9.5.17 Temperature Differences

Should the conduit installation be subject to temperature gradients at the same time, an expansion joint shall be installed in a suitable position to accommodate expansion and contraction. The conduit at the higher temperature shall be insulated from the rest of the installation with a suitable material. The above conditions for example apply where conduits leave cold rooms.

9.5.18 Flush Mounted Outlet Boxes

The edges of flush mounted outlet boxes shall not be deeper than 10mm from the final surface. Where this is not the case, an extension box that ends flush with the surface, shall be screwed to the outlet box. This method shall be used in partitions and clad surfaces.

9.5.19 Excess Holes

All excess holes in draw boxes, distribution boxes, switchboards, cable ducts or trunking, power skirting, etc., shall be securely blanked off to render the installation vermin proof.

9.5.20 PVC Conduit

The use of PVC conduit is permitted and shall be installed as per the detailed drawings.

9.5.21 Terminations

c) Switchboards, Power Skirting, Etc

A female bush and two lock nuts shall be installed where conduits terminate in pressed steel switchboards and distribution boxes, cable ducts, power skirting, etc. The conduit end shall only project far enough through the hole to accommodate the bush and lock nut.

d) Draw Boxes

A female bush and lock nut shall be used to terminate conduits at draw boxes and outlet boxes without spouts.

9.5.22 Open Roof Spaces

h) Sequence of Work

Conduits and wiring in open roof spaces above ceilings other than ceilings of concrete shall be installed before the ceilings and walls are painted and before removable ceiling tiles are installed. In roof spaces where access is limited after installation of the ceiling. It is the responsibility of the Contractor to ensure close liaison with the Building Contractor in connection with the work.

i) Fixing

All conduits in open roof spaces shall be installed parallel and at right angles to the roof members and shall be fixed to the structures at intervals not exceeding 1 metre. Approved saddles shall be used throughout. Clout nails, clamps or wood screws shall be used to secure the saddles to wooden roof members. Saddles that comply with the requirements of this specification shall be used to secure conduits against concrete slabs. Written permission shall be obtained to secure conduits to steel beams in that case saddles shall be fixed by means of bolts, nuts and lock washers or purpose made saddles shall be used.

j) Cross-Overs

Cross-Overs in conduit routes shall be minimised. Where cross-overs are unavoidable one conduit only shall be offset to cross the other conduit. Where several conduits enter the same draw box, they shall as far as possible be installed parallel to each other.

k) Draw Boxes

Draw boxes with metal cover plates shall be installed where required. Draw boxes shall as far as possible be installed near gangplanks. Socket and switch boxes will not be

accepted as draw boxes in open roof spaces.

l) Positions of Accessories

In open roof spaces that afford access after completion of the building, conduit accessories shall be installed to allow wiring or inspection from above. In ceiling voids with less than 900mm clear space between the ceiling and the roof, conduits shall be installed to permit wiring and inspection from below. In the latter case, the shortest route may be followed i.e. conduits need not be installed parallel or perpendicular to roof members. Conduits shall be looped between outlet boxes.

m)Incandescent/LED Luminaires

Where luminaires are secured directly to draw boxes in false ceilings or where ceiling roses or special connections are used, flush mounted, rear entry round draw boxes that are independently fixed to roof beams, shall be provided.

n) Conduit Ends

All conduit ends for lighting outlets in ceilings shall be securely supported.

9.5.23 Installation in Concrete and Screeds

In order not to delay building operations, the Contractor shall ensure that all conduits and accessories, that are to be cast in concrete, are placed in position in good time. The Contractor or his representative shall be in attendance when the concrete is cast.

g) **Draw Boxes**

Draw boxes, expansion joints and round ceiling boxes shall be installed where required and shall be neatly finished to match the finished slab and wall surfaces. Ceiling draw boxes shall be of the deep type. In hollow tile slabs, rear-entry draw boxes shall be used. In columns where flush mounted draw boxes are installed, the conduits shall be offset from the surface of the column immediately after leaving the draw box.

h) **Cover Plates**

Draw boxes and/or inspection boxes shall, where possible, be grouped together under a common approved cover plate. The cover plate shall be secured by means of screws.

i) **Fixing to the Shuttering**

All conduits, draw boxes etc., shall be securely fixed to the shuttering to prevent displacement when concrete is cast. Wire will not be accepted for securing boxes to the shuttering where off-shutter finishes are required. All draw boxes and outlet boxes shall be plugged with wet paper before they are secured to the shuttering.

j) **Concrete Floor Slabs**

Conduits will not be allowed in concrete floor slabs of boiler rooms (or boiler houses), laundries or other damp areas. Equipment in damp areas shall only be supplied from above by means of multi-core PVC-insulated cables that shall either be installed in

galvanised steel ducting or on galvanised cable trays. All socket outlets and three phase outlets in damp areas shall be supplied from above.

k) **Screeds**

The installation of conduits in floor screeds shall be kept to a minimum. Where conduits are installed in screeds, the top of the conduit shall be at least 20mm below the surface of the screed. Where the screed is laid directly on the ground, galvanised conduits shall be used. This ruling will always be applicable to the lowest floor of a building. A minimum distance of twice the outside diameter of the conduit shall be left free between adjoining conduits. Conduits shall be secured to the concrete slab at intervals not exceeding 2,0m.

l) **Inspection**

All draw boxes, conduits, etc., that are installed in concrete shall be cleaned with compressed air and provided with draw wires two days after removal of the shuttering. Errors that occur during the installation of the conduits, or any lost draw boxes, or blocked conduits, shall be immediately reported to the Engineer in order that an alternative route can be planned and approved by the Engineer before the additional concrete is cast. Any additional cost shall be to the Contractor's account.

9.5.24 Surface Installation (steel)

Except where installed in ceiling spaces, the installation of conduit on the surface of walls and concrete slabs will only be allowed when authorised, in writing, by the Engineer. Where surface conduits are specified, saddles shall be of the hospital (spacer) type.

f) **Building Lines**

All conduits shall be installed horizontally or vertically as determined by the route and the Contractor shall take all measures to ensure a neat installation. Where conduits are to be installed directly alongside doorframes, beams, etc., that are not true, conduits shall be installed parallel to the frames, beams, etc. When in doubt, the Contractor shall consult the Engineer before installation is commenced.

g) **Saddles**

Conduits shall be firmly secured by means of saddles spaced at maximum intervals of 2000mm. Saddles shall be submitted to the Engineer for approval prior to commencement of installation. Where saddles are used to secure vertical lengths of conduit connected to surface mounted switch boxes or socket outlet boxes, the saddles shall be spaced so that the intervals between the box and the first saddle, between any two successive saddles and between the last saddle and the ceiling or roof are equidistant. Conduits shall be secured within 250mm before and after each 90° bend.

h) **Joints**

Joints will not be allowed in conduit lengths not exceeding 3500mm when these conduits are installed on the surface of a wall. Threads shall not be visible at joints of completed installations, except where running joints are used. Running joints will be allowed only when absolutely necessary. All running joints shall be provided with lock nuts and shall be painted with red lead immediately after installation.

i) **Accessories**

Inspection bends or tee pieces shall not be used. Non-inspection type bends may be used in the case of 40mm or 50mm diameter conduits. All draw boxes supporting luminaires or other equipment shall be fixed independently of the conduit installation.

9.5.25 Flexible Conduits

g. In installations where the equipment has to be moved frequently to enable adjustment during normal operation, for the connection of motors or any other vibrating equipment, for the connection to thermostats and sensors on equipment, for stove connections and where otherwise required by the Engineer, flexible conduit shall be used for the final connection to the equipment.

h. The lengths of flexible conduit shall be as short as possible to comply with the requirements of the particular connection but shall not exceed 600mm, except when specified or approved by the Engineer.

i. Flexible conduit shall preferably be connected to the remainder of the installation by means of a draw box. The flexible conduit may be connected directly to the end of a conduit if an existing draw box is available within 2000mm of the junction and if the flexible conduit can easily be rewired.

j. Flexible conduit shall consist of metal-reinforced plastic conduit or PVC covered metal conduit with an internal diameter of at least 15mm, unless approved to the contrary. In false ceiling voids, flexible conduit of galvanised steel construction may be used. Connectors for coupling to the flexible conduit shall be of the gland or screw-in type, manufactured of either brass or cadmium or zinc plated mild steel. The requirements of paragraphs 4.5.9 are applicable.

k. Where the possibility exists that the conduit can come into contact with moisture, suitable covering and/or packing shall be installed to isolate the conduit from the moisture.

l. Flexible conduit connections shall be provided with an internal or external earth wire connection as required by the local Supply Authority, with preference given to internal earth wires where no specific local regulations apply.

9.5.26 Expansion Joints

f. Where conduits cross expansion joints in the structure, approved type draw boxes that provide a flexible connection in the conduit installation shall be installed.

g. The draw box shall be installed adjacent to the expansion joint of the structure and a conduit sleeve, one size larger than that specified for the circuit, shall be provided on the side of the draw box nearest the joint. The 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.

h. The circuit conduit passing through the sleeve shall be terminated 40mm inside the draw box. The gap between the sleeve and the conduit at the joint shall be sealed to prevent the ingress of wet cement.

i. The conduit boxes shall be drilled and tapped and the earth wire shall be bonded to the

boxes by means a 2,5mm2 copper wire(minimum) with lugs and brass screws.

j. Draw boxes at the expansion joint shall be provided with a suitable steel cover plate fixed to the boxes by means of screws. The cover plates shall be installed before the ceilings are painted by others.

9.5.27 Chases and Builder's Work

g. Except where otherwise specified, the Contractor shall be responsible for the builder's work connected with conduits, outlet boxes, switchboard trays, bonding trays and other wall outlet boxes as well as the necessary chasing and cutting of walls and the provision of openings in ceilings and floors for luminaires and other electrical outlets. The Contractor shall notify the Building Contractor of his requirements and the responsibility lies with the Contractor to ensure that these requirements are met.

h. Electrical materials to be built in must be supplied, placed and fixed in position by the Contractor when required by the Building Contractor. The Contractor shall also ensure that these materials are installed in the correct positions.

i. Where no Building Contractor is on site the Contractor is required to cover conduits installed in chases by a layer of 4:1 mixture of coarse sand and cement, finished 6mm below the face of the plaster and roughened. In all cases chases shall be deep enough to ensure that the top of conduits are at least 12mm below the finished plaster surface.

j. The Contractor is responsible for the cutting of chases and the building-in of conduits or other equipment. , He will be held responsible for all damage as a result of this work and will be required to make good to the satisfaction of the Engineer. Chases shall be made by means of a cutting machine.

k. Under no circumstances shall face brick walls or finished surfaces be chased or cut without the written permission of the Engineer. Where it is necessary to cut or drill holes in the concrete structure, then prior permission of the Structural Engineer shall be obtained to ensure that the structure is not weakened.

l. The Contractor shall maintain close co-operation with the Building Contractor and all his Contractors throughout the course of the contract. Should the Contractor not comply with these requirements, any additional costs resulting from lack of his co-operation will be recovered from him.

9.5.28 Connections to Switchboards

a) Wherever possible conduits connected to switchboards shall terminate in a common fabricated sheet steel draw box installed in the vicinity of the switchboard. In open roof spaces this draw box shall be placed in a roof space of not less than 900mm clearance. Lighting and plug circuits may be separately grouped in common conduits or metal ducts (trunking) from the distribution board to the draw box.

b) The draw box shall be of sheet steel with a minimum thickness of 1,6mm and shall be provided with a removable cover plate.

c**) Flush Mounted Switchboards**

Where flush mounted switchboards are required, the recessed switchboard tray shall be

built into the brick or concrete wall. All conduits from the floor or roof shall be fully recessed and shall be bonded directly to the tray.

d) Surface Mounted Switchboards

Where surface mounted switchboards are specified but where the conduits can be fully recessed, the conduit shall be connected to a recessed connection box installed behind the switchboard. An opening with the same dimensions as the connection box shall be cut in the back of the switchboard and be provided with a suitable grommet

9.6 CABLE TRAYS AND LADDERS

9.6.1 Responsibility of the Contractor

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.

9.6.2 Cable Trays

Metal cable trays shall be manufactured from perforated rolled steel or an approved steel wire mesh type. Only the following metal cable tray types may be used:

a)	Less than 200mm wide	-	1,6mm minimum thickness with 12mm minimum return
b)	200mm to 350mm	-	equivalent to trays supplied by "O-line" manufactured from 2mm thick steel with folded over returns and a minimum up-stand of 50mm.
c)	350mm and wider	-	2,4mm minimum thickness with 76mm return as alternative to (b) above.

The return of trays shall not be perforated and the top of the return shall be smooth. The same cable tray type shall be used in long parallel tray runs.

9.6.3 Cable Ladders

Metal cable ladders shall consist of 76mm high side rail of 2mm minimum thickness. Cross pieces consisting of OL3300 "O-line" (similar or equal) channel sections shall be spaced at maximum intervals of 250mm. Where cables of 10mm dia. or smaller are installed on cable ladders, the spacing of the cross pieces shall be 125mm. 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 that accommodate plastic or metal cable binding bands, may be used in vertical cable runs against walls, etc, where the prior approval of the Engineer has been obtained. These cross pieces are not acceptable in horizontal cable runs.

9.6.4 Plastic Cable Trays

Rigid PVC cable trays are acceptable. Only the following tray types may be used:

a)	Less than 250mm wide	-	3,0mm minimum thickness and 40mm minimum return.

b) 250mm and wider - 4,0mm minimum thickness and 60mm minimum return.

9.6.5 Finishes

Metal cable trays and ladders shall be finished as follows:

a) In coastal areas - hot-dip galvanised to SANS 763 or epoxy power coated

b) False ceiling voids - electro-galvanised or epoxy power coated

c) Vertical building ducts - hot-dip galvanised to SANS 763 or epoxy power coated

j) Plant rooms, substations, service tunnels, basements - electro-galvanising or epoxy powder coated

e) Damp areas, exposed to weather -hot-dip galvanised to SANS 763 or epoxy powder coated

f) Undercover industrial application -hot-dip galvanised to SANS 763 or epoxy powder coated

The abovementioned finishes shall apply unless specified to the contrary in the Detailed Technical Specification. Hot-dipped galvanised or electro-galvanised trays and ladders shall be cold galvanised at all joints, 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.

9.6.6 Supports

Trays shall be supported at the following maximum intervals:

a) 1,6mm thick metal trays - 1.5m maximum spacing
b) 2,4mm thick metal trays - 1,5m spacing and 75mm return
c) Metal cable ladders - 1,5m spacing
d) 3,0mm thick PVC trays, - 1,5m maximum spacing with 40mm return
e) 4,0mm thick PVC trays, - 1,5m maximum spacing with 60mm return

In addition, trays and ladders shall be supported at each bend, offset and T-junction.

9.6.7 Joints

Joints shall be smooth without projections or rough edges that may damage the cables. The Contractor will be required to cover joints with rubber cement or other hardening rubberised or plastic compounds if in the opinion of the Engineer 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) and (c) of paragraph 3.6.2) be made by means of wrap-around splices of the same thickness as the tray and at least 450mm 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. Where joints that do not coincide with supports occurring in trays with folded over returns, tight fitting metal guide pieces, at

least 450mm long, shall be inserted in the folded returns to provide the necessary support to the two cable tray ends. Splices as described above shall be provided if trays sag.

9.6.8 Fixing

Trays shall be bolted to supports by at least two hexagon headed bolts and nuts per support. Bolts shall be securely tightened to avoid cables being damaged during installation. The use of square nuts is not permitted.

9.6.9 Fixing to the Structure

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.

9.6.10 Accessories

Horizontal and vertical bends, T-junctions and cross connections shall be supplied by the Contractor. The dimensions of these connections shall correspond to the dimensions of the linear sections to that they are connected. The radius of all bends shall be 450mm minimum. The inside dimensions of 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 a 45º gusset.

All accessories shall be manufactured by the supplier of the ladder / tray, site fabricated accessories shall not be permitted unless prior written approval has been given by the Engineer.

9.6.11 Installation of Cables

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 450mm below slabs, ceilings, etc, to facilitate access during installation.

9.6.12 Earthing

Metal trays and ladders shall be bonded to the earth bar of the switchboard to that 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.

9.7 CABLE CHANNELS

9.7.1 Responsibility of the Contractor

The Contractor shall supply and install all cable channels as specified or as required by the cable and wiring installation including the necessary supports, hangers, fixing materials, bends, angles, junction T-pieces end caps, etc.

9.7.2 Materials and Finishes

Cable ducts shall be of the "Cabstrut" type or similar. The ducts shall be rolled from 1,2mm minimum sheet steel and shall be finished as follows:

a)	In coastal areas (under all circumstances)	-	hot-dipped galvanised to SANS763 or epoxy powder coated
b)	Cast in concrete	-	pre-galvanised
c)	False ceiling voids	-	pre-galvanised
d)	Vertical building ducts	-	hot-dipped galvanised to SANS 763 or epoxy powder coated
e)	Surface mounted in plant rooms, sub-stations, service tunnels, basements	-	epoxy powder coated or electro-galvanised
f)	Damp areas, exposed to weather, underground	-	hot-dipped galvanised to SANS 763 or epoxy powder coated
g)	Undercover industrial applications	-	hot-dipped galvanised to SANS 763 or epoxy powder coated

The abovementioned finishes shall apply unless specifically to the contrary in the Detailed Technical Specification. Epoxy powder coats shall comply with paragraph 3.16.9. Hot-dipped galvanised or electro-galvanised ducts shall be cold galvanised at all joints, sections that have been cut and at places where galvanising has been damaged. Powder coated ducts shall likewise be touched up at joints, cuts and damaged portions using spray canisters recommended by the manufacturers of the channels.

9.7.3 Cover Plates

All channels shall have metal snap-in cover plates. Cover plates for wider channels shall be fixed by means of screws that shall permanently be tapped into the cover plates spaced at suitable intervals to prevent warping.

9.7.4 Connections

Adjoining lengths shall be correctly aligned and securely joined by means of fishplates and mushroom bolts, washers and nuts or connection pieces that are pop-rivetted to both adjoining sections. All adjoining sections shall be rectangular and shall butt tightly. Covers shall fit tightly across the joint.

9.7.5 Support for Conductors

All conductors in inverted cable channels shall be retained by means of metal clips or metal spacer bars at not less than 1m centres.

9.7.6 Vermin Proofing

All cable channels shall be vermin proof after installation. Holes shall be covered by means of screwed metal plugs or by means of metal strips that are bolted or pop-rivetted to the channel. Wooden or other plugs that are driven into holes or other temporary plugs or covers are not acceptable.

9.7.7 Earth Continuity

Electrical and mechanical continuity shall be maintained throughout the channel installation. A tinned copper bonding strip shall be installed across each joint and secured to both adjoining channels by means of brass bolts, nuts and washers. The channel shall be bonded to the earth bar of the associated switchboard.

9.7.8 Internal Finishes

All bends shall be of easy sweep design with 45º gussets. Burrs and sharp edges shall be removed and the inside edges of all joints shall be lined with rubber cement or other suitable rubberised or plastic compound to prevent conductor insulation laceration.

9.7.9 Services

Multiple duct runs or internal metal partitions shall be used where conductors for power, control and other services are present.

9.7.10 Vertical Installation

Where vertical duct lengths exceed 5m, conductors shall have intermediate fixings.

9.7.11 Number of Conductors

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.

9.7.12 Fixing

The Contractor shall supply and install all hangers, supports or fixings for the channels. Channels up to 75 x 75mm shall be supported at maximum intervals of 1m and larger channels at maximum intervals of 2m. Channel runs shall be carefully planned to avoid clashes with other services and to ensure that all covers can be removed after completion of the entire installation. The method of fixing the channels or supports to the structure shall comply with paragraph 3.4 with particular reference to paragraphs 3.4.6 and 3.4.8. Purpose made cable clamps, hangers, etc shall be used as required.

9.7.13 Installation in Concrete

Where channels are cast into concrete, the reinforced type shall be used. Additional spacer blocks shall be used where necessary to prevent ducts from being bent while 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.

9.7.14 Fire Barrier

Where channels pass through walls, fire stopping filling shall be installed around the conductors to serve as a fire barrier.

9.7.15 Conduit Connection

All conduit connections shall be terminated by means of two lock nuts and a brass female

bush. All holes through that conductors pass shall be equipped with grommets.

9.8 INSTALLATION OF LUMINAIRES

9.8.1 Positions

The mounting positions of luminaires shall be verified on site. All luminaires shall be placed symmetrically with respect to ceiling panels, battens, beams, columns or other architectural features of the space. The layout as shown in the documents shall generally be adhered to but any discrepancies or clashes with structural or other features must be referred to the Engineer before commencing erection of the installation. Should the Contractor neglect to refer such discrepancies to the Engineer, costs incurred as a result of subsequent alterations to suit the architectural features shall be to the Contractor's account.

9.8.2 Cover Plates

Cover plates shall be fitted over all draw boxes and outlets for luminaires that are not covered by the luminaire canopy, lamp-holder, ceiling rose or similar accessories.

9.8.3 Hanger and Supports

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 fixing method approved by the Engineer.

9.8.4 Suspended Cable Channels

Luminaires (especially fluorescent luminaires) may also be suspended from ceilings by means of suspended metal channels. The channel may be supported by conduits or threaded rods.
Should metal rods be utilised, these shall be screwed to anchor bolts fixed in the roof slab.

Wiring shall either be installed in conduits fixed to the metal channel or in the metal channels. Purpose-made clamps shall be used to fix the fittings to the cable channel.

9.8.5 False Ceilings

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 installation.
Should any doubt exist in this regard, the matter shall be referred to the Engineer.

In cases where the mass 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.

9.8.6 Fluorescent Luminaires Fixed to Concrete Slabs

Fluorescent luminaires to be installed directly against concrete slabs or walls shall be fixed to the outlet box and at two additional points. The additional fixing can be effected by:

a) bolts built into the ceiling or wall,

b) screws an approved plugs, or

c) anchor bolts.

Shot-fired fixings are not acceptable. If specified or where approved by the Engineer, fluorescent fittings may be fixed to metal channels installed against concrete slabs or walls. The metal channel fixing may in this case be short-fired or fixed by any of the abovementioned methods. Purpose-made clamps shall be used to fix fittings to cable channels.

9.8.7 Fluorescent Luminaires Fixed to False Ceilings

When fixing fluorescent luminaires to false ceilings, a gap shall not be visible, except where the ceiling tile is of non-fire resistant material, between the fitting and the ceiling. The luminaire shall be fixed directly to the ceiling beams by means of 40mm round-head wood screws and washer or alternatively be fixed to 50 x 76mm wooden supports that are fixed to the ceiling beams. In the case of tiled ceilings with exposed or concealed T-section supports, the luminaires shall be fixed to the metal supports by means of butterfly screws, pop-rivets or bolts with nuts and washers. Self-tapping screws may not be used.

9.8.8 Continuous Rows of Luminaires

In cases where fluorescent luminaires are installed in tandem, only one connection outlet need be supplied per circuit. All luminaires shall be coupled to one another by means of nipples or brass bushes and lock nuts to ensure that wiring is not exposed and that earth continuity is maintained. Luminaires on the same circuit may be wired through the channel formed by the fitting canopies. In this case silicon-rubber insulated conductors shall be used and internal connections shall be made at terminal blocks.

Screw connectors are not acceptable. The wiring for any other circuits or outlets, even though these may be in the same row may not be installed through the fitting canopies. The Contractor shall ensure that continuous rows are straight and parallel to the relevant building lines.

9.8.9 Recessed Luminaires

Where recessed luminaires are required, the Contractor shall maintain close liaison with the Ceiling Contractor. In the case of tiled ceilings, the luminaires shall be installed while the metal supports are being installed and before the tiles are placed in position. The Contractor shall be responsible for the co-ordination of the cutting of ceiling tiles with the Building Contractor and the Ceiling Contractor concerned. All mounting rings and other accessories shall fit closely into cut-outs to ensure a proper finish.

9.8.10 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 to the ceiling.

9.8.11 Waterproof Luminaires

Waterproof and flameproof luminaires shall be screwed directly to the conduit end. Draw boxes that may be required must be approved by the Engineer beforehand.

9.8.12 Bulkhead Luminaires

Surface mounted bulkhead luminaires shall not be screwed directly to conduit ends. The conduit shall terminate in a round draw box at the top or back of the fitting. The PVC-insulated conductors shall terminate in a porcelain terminal strip in the draw box. Asbestos or silicon-rubber insulated conductors shall be used from the terminal strip to the luminaire lamp-holder. Porcelain-screw connectors will also be allowed.

9.9 INSTALLATION OF LIGHT SWITCHES

9.9.1 Mounting

All light switches shall be installed 1400mm above the finished floor level unless specified to the contrary. Mounting heights given shall be measured from the finished floor level to the centre of the switch.

9.9.2 Doors

Unless specified to the contrary, switches adjacent to doors shall be installed on the side containing the lock. If the position of the lock is not shown on the drawings, the position shall be verified before the switch box is installed. Switch boxes in brick or concrete walls, shall be installed 150mm from the door frame. Light switches installed in partitions or door frames shall be of the type designed for that purpose.

9.9.3 Walls

Where the lower portion of a wall is face brick and the upper portion plastered, light switches shall be installed wholly in the plaster, provided that the lower edge of the plaster is not higher than 1600mm above the finished floor level. In general where different wall finishes are used in the same area, switches shall be installed within the same finish and not on the dividing lines between finishes.

9.9.4 Switch Boxes

Switches shall be installed in standard rustproof (galvanised) pressed steel switch boxes with the necessary knock-outs for the proper termination of conduits. The installation of switch boxes shall comply with the requirements of paragraph 1.5 of this specification. Boxes shall be flush mounted or recessed as specified for the whole installation.

9.9.5 Cover Plates

Cover plates that overlap the switchbox and that fit tightly against the wall finishes shall be installed in the case of flush mounted switch-boxes. All fixing screws in cover plates and switch grids shall be supplied and securely fitted.

9.9.6 Escutcheon Plates

Where flush mounted switches are installed in special wall finishes, e.g. wood or board panels, acoustic tiles or other cladding, etc, and where the wall finishes have to be cut to accommodate the switch, it may be necessary to fix an escutcheon plate to the wall to cover the cut-outs. The escutcheon plate shall fit closely around the switch box and shall be fixed independently of the switch box and cover plate. Bevelled cover plates that overlap the switch boxes shall be used. Cover plates shall be fixed to the switch boxes and shall fit firmly against the escutcheon plate.

9.9.7 Surface Mounted Switches

Surface mounted switches shall consist of a metal switch-box, cover plate and switch specially manufactured for the purpose. Switch boxes shall be fixed to the surface as described in paragraph 3.4 of this specification.

9.9.8 Cutting of Cover Plates

Cover plates shall under no circumstances be cut unless specifically authorised in exceptional cases by the Engineer.

9.9.9 Partitions

Light switches installed in partitions shall preferably be of the type designed for this purpose to be accommodated in the partition design. Switches installed in the metal support do not require switch boxes. Switches may not be flush mounted in partition walls without switch boxes.

9.9.10 Waterproof Switches

Switches that are exposed to the atmosphere or are installed in damp areas, shall be of the waterproof type.

9.9.11 Appearance

The sides of adjacent switches, plugs, push-buttons, etc, shall be parallel or perpendicular to each other and uniformly spaced. A common escutcheon plate shall be used for flush mounted outlets and accessories where the cover plates do not cover the cut-outs in the finishes.

9.10 INSTALLATION OF SOCKET OUTLETS

9.10.1 Mounting Heights

Unless otherwise specified outlets shall be installed at the following heights above finished floor level:

Flush mounted socket outlets in general	-	300mm
Surface mounted socket outlets in general	-	1200mm
Kitchens and prep area, surface or flush mounted	-	1200mm
Shops - surface or flush mounted	-	300mm
Offices - surface or flush mounted	-	300mm

All mounting heights shall be measured from finished floor level to the centre of the outlet box.

9.11 PROVISION FOR TELEPHONE INSTALLATION

9.11.1 General

This specification covers only the supply and installation of outlet points and wiring channels and/or conduits for telephones in buildings. The telephone installation will be carried out by Telkom personnel or Specialist Contractor.

9.11.2 Regulations

All provisions for telephones in buildings shall comply with the latest issue of "FACILITIES FOR TELECOMMUNICATION SERVICES IN BUILDINGS" as issued by Telkom. In cases where the provision of this publication and the requirements of the Detail Technical Specification are in conflict, the latter shall take precedence.

9.11.3 Sleeves for Main Cables

One or more asbestos-cement or PVC sleeves as specified, shall be installed from a point at the boundary of the stand, (position indicated by the Engineer), to the main telephone distribution board or the main telephone building duct , 600mm below ground level.

A manhole with steel cover shall be installed at each bend in the underground route or at intervals not exceeding 50m in straight sections.

The inner radius of bends shall not be less than 12 times the outside diameter of the sleeves.

All sleeves, manhole covers and accessories shall be supplied by the Contractor including the building work of the manhole, unless specified to the contrary.

9.11.4 Separation of Services

Cables or conductors for telephone services shall be separated from all other services by:

a) installation in separate metal channels or conduits, or

b) installing the cables at a minimum distance of 300mm from all power cables, conductors and accessories, or

c) an earthed metal barrier installed to ensure that the minimum distance through free air space between the telephone cables and other services is at least 300mm.

Conduits or wiring channels installed for telephone services may not be used for any other purpose. Where non-metallic channels are used, the separation as stated in (b) above shall be maintained through the installation.

9.11.5 Main Telephone Distribution Board

The size and position of the Main Telephone Distribution Board where required, shall be installed according to the requirements of the Detailed Technical Specification.

The board shall consist of a metal tray, architrave frame and hinged doors and shall be flush mounted in the position shown on the drawings.

A 20mm thick wooden panel shall be installed in the main telephone distribution board and shall cover the entire back of the board.

The finish of the board shall comply with the requirements of paragraph 3.16.9.
All conduits to telephone outlets or sub-distribution boards in the building as well as the main incoming sleeves, shall terminate at the main distribution board as indicated on the drawing.

Where 100 x 100 x 50mm draw boxes are specified, the boxes shall be provided with a cover plate. A wooden panel need not be provided in these cases.

9.11.6 Telephone Outlets

The Contractor shall make provision for outlets with blank cover plates only.

Telephone outlets in walls shall consist of flush mounted 100 x 50 x 50mm draw boxes with blank cover plates.

Telephone outlets in floors shall be of the same type as floor outlets for power sockets that may be specified in the Detailed Technical Specification.

These provisions also apply to underfloor ducting. If no floor outlets are specified, 100 x 100 x 50mm flush mounted draw boxes with blank cover plates shall be provided in the floor at the positions indicated on the drawings.

Where twin underfloor ducts are provided and where the one duct is intended for telephone cables, the separation between the ducts shall be maintained throughout the underfloor ducting installation, including power outlets and telephone outlets.

Where power skirting is specified for telephone installations, the Contractor need only install the skirting with covers since the telephone socket outlet will be fixed directly to the cover.

Where multiple power skirting is provided containing other services, no other cables may be installed in the section intended for telephone cables and the separation between the sections shall be maintained throughout the installation.

9.11.7 Connection of Telephone Outlets

Telephone outlets shall be inter-connected and connected to the telephone distribution boards as shown on the drawings.

If the inter-connecting conduits are not specified, conduit sizes shall be 25mm diameter for a maximum of 10 outlets and 32mm diameter for 11 to a maximum of 20 outlets.

Metal channels or power skirting installed on the same floor level on opposite walls of the same area as well as parallel runs of underfloor ducting intended for the installation of telephone cables, shall be inter-connected at intervals of 8 metres. Conduits may be used for these inter-connections.

All conduit and all ducts or channels that do not have removable covers, shall be provided with galvanised steel draw wires.

Conduit connections to power skirting or surface mounted metal channels, shall be made by means of a 100 x 100 x 50mm draw box that is flush mounted immediately behind the duct or channel in that the telephone cables are to be installed. A hole shall be cut in the back of the duct or channel, immediately opposite the draw box. The edges of the hole shall be grommetted. The draw box shall be accessible from the front when the cover is removed.

Purpose-made accessories for the connection of conduits to underfloor ducts shall be used. Where these are not available a 100 x 100 x 50mm draw box shall be installed below the underfloor duct opposite a floor telephone outlet. A hole shall be cut in the back of the duct

opposite the draw box. The draw box shall be accessible from the top via the floor outlet.

9.12 CABLING

9.12.1 General

Unless otherwise specified the following cable types shall be used:

a) High voltage supplies (6,6/11k/V) : PILCDSTA or XLPE.

b) Low voltage supplies in ground: PVC-insulated, armoured.

c) Low voltage supplies in substations and to main switchboards: PVC-insulated, armoured.

d) Supplies to sub-distribution boards: PVC-insulated, armoured or unarmoured when installed in conduit, sleeves or metal channels.

e) Connections to equipment: PVC-insulated, armoured, or without armouring when installed in conduit or metal channels.

9.12.2 Competence of Personnel

It is a definite requirement that the Contractor shall only instruct competent personnel to install and connect the various cable types.

9.12.3 Standards

All cables used shall conform to the relevant SANS or BS specifications and shall be installed, protected and terminated according to approved methods in compliance with the manufacturer's requirements.

9.12.4 Minimum Sizes

Cables with conductors smaller than 1,5mm² may not be used except for communication systems or control systems with a system voltage of less than 50V. Where cables are grouped together (in cable channels, pipe, etc) the minimum conductor size shall be 2,5mm² or greater as determined from the appropriate sections of the SANS Code of Practice.

9.12.5 Unarmoured Cables

All unarmoured cables shall be installed in metal wiring channels or conduit unless another method has been approved by the Engineer.

9.12.6 Voltage Ratings

All cables shall be suitable for the voltage to be applied between phases and between each phase and earth.

All cables to be used in systems with a system voltage between 50V and 600V shall have a voltage rating or 600/1000V.

All 6,6/11kV cables shall be factory-tested according to SANS 91 and all 600/1000V cables to SANS 150. Test certificates shall be handed to the Engineer. Each cable shall be

subjected to a pressure test in accordance with SANS 97 and 150 after installation. The Contractor shall supply the necessary instrumentation and all costs relating to these tests shall be included in his tender and rates.

The same group derating and ambient temperature correction factors stated in the SANS Code of Practice for PVC cables shall be applicable.

Cable ends shall be terminated strictly in accordance with the manufacturer's specification to prevent tracking and contamination. The termination shall withstand the same test voltage as the rest of the cable.

Cable cores shall be marked with colour tape to identify the phase colour.

9.12.7 Low Voltage PVC Insulated Cables

Cables

All low voltage cables shall be manufactured according to SANS 150 - 1970 and shall bear the SANS mark.

The voltage gradient of the PVC dielectric shall be for 600/1000 Volts and for general purpose use unless otherwise stated.

All low voltage PVC insulated cables shall have stranded copper annealed conductors unless otherwise called for.

9.12.8 Underground Cables

a) Precautions

The storage, transport, handling and installation of underground cables shall be executed according to approved methods and the Contractor shall ensure that suitable labour and equipment is available. Only armoured cables may be installed along underground cable routes.

b) Installation Depth

Unless specified to the contrary, low voltage cables shall be installed at a depth of 600mm and high voltage cables installed at a depth of 1000mm below ground level. Where cables are installed in layers the uppermost layer shall comply with the above and each additional layer shall be at least 300mm lower.

C) Trenching

The Contractor shall be responsible for all trenching unless specified to the contrary and shall take all necessary precautions and provide the necessary warning signs and/or lights to ensure that the public and/or employees on site are not endangered.

The Contractor shall ensure that the trenches will not endanger existing structures, road, railways or other property.

The Contractor shall verify the existence of all other services and ensure that they are not damaged during trenching operations.

Trenches between the points indicated shall be straight. Any deviations due to obstructions or existing services shall be approved by the Engineer.

d) Dimension of Trenches

Cable trenches shall not be less than 200mm wide at the lowest point where one or two cables are to be installed and the width shall be increased where more cables are to be installed so that cables can be installed at least one cable diameter apart throughout the run.

Unless specified to the contrary, dimensions of trenches will be as follows:

a.) High Voltage Cable trenches

Width : 400mm
Depth : 1 000mm

b.) Low Voltage Cable trenches (Main / Feeder cables)

Width : 400mm
Depth : 600mm

c.) Low Voltage Cable trenches (Service & Streetlight cable)

Width : 300mm
Depth : 400mm

d.) Telkom Cable/sleeve trenches

Width : 300mm
Depth : 600mm

e) Bedding

Cables shall be bedded in river sand or sifted soil (not clay). The bed shall extend 75mm below and 100mm above the cable. Under no circumstances may stone bigger than 50mm mesh be allowed to come into contact with the cables.

f) Laying of Cables

Cables installed in the same trench shall be laid parallel to each other at least one cable diameter apart. The cable shall be removed from the drum in such a manner that no twisting, tension or mechanical damage is caused and must be adequately supported at short intervals during the whole installation operation.
Cable rollers shall be used as far as possible. Where cables have to be drawn through pipes or ducts, a suitable cable sock shall be used and particular care shall be exercised to avoid abrasion, elongation or distortion of any kind. Ends of all pipes and ducts shall be sealed with a non-hardening watertight compound.

g) Inspection of Trenches

Trenches may not be refilled before the Engineer has inspected the cable and trenches. Should the Contractor ignore this requirement, trenches may be re-opened at the cost of the Contractor should the Engineer wish to carry out an inspection.

h) Backfilling

Backfilling shall be of earth of a proper grading to ensure settling without voids. The earth shall be tamped down after the addition of every 150mm layer. The surface shall be made good to match the surrounding surface area.

i) Pipes

Where cables cross roads, railways or other service areas and where cables enter buildings, the cables shall be installed in asbestos cement, pitch fibre, hard walled PVC or earthenware pipes.

Where pipes have to be built into the structure, the Contractor shall issue the pipes to the Building Contractor and ensure that they are installed correctly.

The ends of all pipes shall be sealed with a non-hardening watertight compound after the installation of cables. All pipes intended for future use shall be sealed.

9.12.9 Cables in Building Trenches

a. Grouping

Cables installed in floor trenches in buildings or substations shall comply with the requirements of paragraph 9.13.

b. Installation

Cables shall be installed in one of the following ways:

Laid on the floor of the trench providing that cables are separated by a distance at least equal to the diameter of the largest cable installed.

On vertical cable trays or metal supports fixed to the side of the trench. Cables shall be suitable clamped in position.

c. Covers

All floor trenches shall be covered with suitable reinforced chequer plates and shall be supplied and installed by the Building Contractor unless specified to the contrary.

b. Filled Trenches

Floor trenches may have to be filled with sand in certain instances. The trench shall then be filled with sand and covered in one of the following ways:

1) Reinforced concrete planks or tiles

2) A screed of sand and cement

3) Cast iron frames filled with concrete in cases where motorcar traffic is present, e.g. parking garages.

4) Removable chequered cover plates.

Cables shall leave filled cable trenches via a pipe that protrudes at least 300mm beyond the cover. These pipes shall be firmly fixed in position and sealed with a non-corroding non-hardening watertight compound.

9.13 Grouping of Cables

a) Correction Factors

All cables shall be spaced to comply with the correction factors that are applicable to the current rating in accordance with the SANS Code of Practice for the Wiring of Premises. All cables shall be spaced apart unless specifically approved by the Engineer.

b) Cables for other Services

Cables for telephones, communication systems and other extra low voltage systems (less than 50V) shall be separated from power cables. In vertical building ducts a physical barrier shall be provided between power cables and cables for other services.

Where armoured cables are used for such other services, they shall be installed in separate cable trays or shall otherwise be at least 1m away from power cables. Where unarmoured cables are used for these other services, they shall be installed in separate conduits or metal channels.

9.14 Fixing of Cables

Installation

Cables may be installed in one of the following ways:

a) On horizontal cable trays,

b) Against vertical cable trays with suitable clamps

c) Against horizontal or vertical metal supports or brackets with suitable clamps, or

On clamps that are fixed to the structure.

Distance between Fixings

The maximum spacing between cleats (clamps) to that cables are fixed in horizontal and vertical cable routes shall be determined from the table below. Additional cleats shall be installed at each bend or offset in the cable run.

The maximum distance between supports or cleats for multi-core cables shall be 20 times the outside diameter of the cable with a maximum spacing of 550mm for unarmoured cables and 30 times the outside diameter of the cable with a maximum spacing of 900mm for armoured cables.

9.15 Sleeves

Where cables penetrate floors, walls or other structural elements, suitable sleeves of asbestos

cement, earthenware, steel or pitch fibre shall be provided. Both ends of the sleeves shall be sealed with a non-corrosive, watertight, non-hardening compound.

9.16 Earth Conductor

Unless clearly specified to the contrary, earth continuity conductors shall be installed with all cables that form part of the low voltage distribution system.

The earth continuity conductor shall consist of one of the following:

a) A bare stranded copper conductor

b) One of the cable cores. In this case a green heat-shrunk sleeve shall be placed over the conductor end to clearly identify the core that is being used as earth conductor

c) Copper wire strands that form part of the armouring. In this case a special gland designed for this purpose shall be used.

The cross-sectional area of the earth conductor shall be as determined from the SANS Code of Practice but shall not be less than 2,5mm². A single conductor may be used where parallel cables supply the same load.

A single conductor may be installed serving several underground cable routes. Where branch circuits occur, an earth conductor shall be bolted and brazed to the main earth conductor.

The earth conductor shall be connected to the earth busbar of the switchboards to that the associated cables are connected. The earth conductor shall also be bonded to the cable armouring and lead sheath (if appropriate) at both ends and at all joints.

9.17 Identification of Cables

All cables shall be identified at both ends and at all joints and as otherwise specified according to a code or number system. These numbers shall appear on the as-built drawings.

Cables shall be marked with non-deteriorating bands with raised or punched numbers. PVC tape with punched numbers is not acceptable for this purpose.

9.18 Conduits and Channels

All conductors shall be installed in conduits, cable channels (trunking) or power skirting and shall under no circumstances be exposed. Cable channels and power skirting shall be of metal construction unless specifically approved otherwise.

9.19 Order of Work

Wiring shall only be carried out after the conduit installation and plasterwork is completed, but before painting has commenced. No conductors shall be installed before the conduits have been cleaned of all debris and moisture.

9.20 Circuits

Conductors that are connected to different switchboards shall not be installed in the same conduit. The wiring of one circuit only will be allowed in 20mm diameter conduit with the exception of the

wiring between switchboards and fabricated sheet metal boxes close to switchboards, in that case more than one circuit will be allowed.

9.21 Looping

Please note : No conductor jointing will be accepted.

All wiring shall be carried out according to the loop-in system. If a conductor joint is found necessary in an isolated case, jointing will only be accepted in cable channels and not in conduits. Conductor jointing shall be executed by approved ferruling properly covered with PVC-insulated tape.

9.22 Grouping of Conductors

In cases where the conductors of more than one circuit are installed in conduit, cable channels or power skirting, the conductors of each separate circuit (earth conductor inclusive) shall be taped at intervals of one metre with PVC-insulation tape. The conductors of different circuits shall however remain separate in order that any given circuit can be withdrawn.

Conductors entering switchboards or control boards shall be grouped and bound by means of plastic or metal bands (not tape).

9.23 Different Phases

With the exception of three phase outlets, circuits of different phases shall not be present at lighting, switch or socket outlet boxes.

9.24 Connections

The insulation of conductors shall only be removed over a portion of the conductors that enter the terminals of switches, plugs or other equipment. When more than one conductor enters a terminal, the strands shall be securely twisted together.

9.25 Earthing Conductors

When earth continuity conductors are looped between terminals of equipment, the looped conductor ends shall be twisted together and then be soldered or ferruled to ensure that earth continuity is maintained when the conductors are removed from a terminal.

9.26 Colours

The colours of conductor insulation for wiring purposes shall comply with the SANS Code of Practice. The colours for sub-circuits shall as far as possible correspond with the colour of the supply phase.
The colours of conductors for wiring to two-way and intermediate switches shall differ from phase conductors.

9.27 Single Pole Switches

Single pole switches shall be connected to the phase conductor and not to the neutral conductor.

9.28 Size of Conductors

Where conductor sizes are not specified, the following minimum conductor sizes shall be used:

Lighting circuits	2,5 mm² - 1,5mm²
Plugs circuits	2,5mm² + 2,5mm² earth conductor
Stove circuits	10mm² + 6mm² earth conductor
Geyser circuits (up to 3kW)	2,5mm² + 2,5mm² earth conductor
Geyser circuits (+3 to 6kW)	4,0mm² + 2,5mm² earth conductor
Motor circuits	2,5mm² (minimum)
Bell circuits	1,5mm²

9.29 Partitions

When wiring is installed in removable partitions, the vertical and/or horizontal metal supports of the walls may be utilised for wiring on condition that:

i) the conductors are not exposed,

ii) the metal supports are properly earthed,

iii) a separate earth continuity conductor is drawn in together with the current carrying conductors and is earthed to the metal parts of the switches and/or the plugs, and

iv) conductors are installed in the metal and non-inflammable sections of the partitions.

Conductors enclosed in a copper braid are especially suited to the wiring of partitions where the copper braid is used as an earth continuity conductor. Copper braided cables shall be connected to the rest of the installation at a draw box.

10. EARTHING

e) Substations

The main earthing system shall be installed by specialist under a separate contract.

The Contractor shall be responsible for all earthing from the point of entry of the main earthing tails where they enter the building.

f) Earthing of the Installation

The installation shall be earthed properly in accordance with the SANS Code of Practice for the Wiring of Premises and with the by-laws of the Local Authority. All earth conductors shall be bare stranded copper conductors or stranded conductors with green PVC-insulation.

g) Earth Busbar

The main substation earth bar or, where no separate substations earth is provided, the earth busbar of the main switchboard, shall be connected to the earthing electrode by means of two lengths of solid copper strapping or two stranded conductors, each with the following cross-sectional area:

Total installed capacity in kVA	Cross-sectional area in mm²
Less than 50	50
50 - 100	100
100 - 150	150

More than 150	240

The two copper straps or conductors shall be connected at opposite ends of the main distribution board earth bar or, in the case of a separate sub-station earth, shall be connected midway between the centre and either end of the earth bar.

The connections to the earth electrodes shall be soldered and bolted.

The earth of the Local Authority's supply shall also be connected to the earth busbar. Where the abovementioned connections are mounted on the outside of buildings, the connections shall be installed in galvanised conduit run 300mm under ground level.

h) Sub-Distribution Boards

A separate earth connection, consisting of bare stranded copper conductors and supplied along the same routes as the supply cables, shall be supplied between the earth busbar in each sub-distribution board and the earth busbar in the main switchboard.
If the supply connections consist of conductors in conduit, the earth conductors shall be drawn in the same conduit. The sizes of earth conductors shall be in accordance with the SANS Code of Practice for the Wiring of Premises.

i) Sub-Circuits

The earth conductors of all sub-circuits shall be connected to the earth busbar of the supply board. All single phase socket outlet circuits shall be supplied with 2,5mm² earth conductors. All lighting circuits shall be supplied with 2,5mm² earth conductors.

All single phase and three phase outlets, electrical appliances, equipment, electrical motors, etc, shall be earthed as stipulated in the SANS Code of Practice for the Wiring of Premises. The requirement specified in paragraph 3.13.20 shall be strictly adhered to.

f) Ring Mains

Common earth conductors may be used where various circuits are installed in the same wiring channel. In such instances, the sizes of earth conductors shall be determined in collaboration with the Engineer. Earth conductors for individual circuits branching from the ring main shall be connected to the common earth conductor with T-ferrules or soldered. The common earth shall not be broken.

g) Connections

Under no circumstances shall any connection points, bolts, screws, etc used for earthing be utilised for any other purpose.
It will be the responsibility of the Contractor to supply earth terminals or clamps where others do not provide these. The ends of all bare earth conductors shall be tinned. All earth connections shall be tinned and fixed with approved ferrules. The entire connection shall then be soldered.

h) Power Skirting

All power skirting to accommodate socket outlets shall be earthed with a 2,5mm² earth conductor. This conductor shall be installed over the entire length of the power skirting and connected to the earth busbar in the nearest switchboard. The conductor shall be bolted to the skirting on both sides. The conductor may not be used as an earth conductor for the plug circuits and shall be independent

of any other earth conductor.

i) Wiring Channels and Cable Racks

The ends of all metal channels and racks containing cables or conductors under load shall be earthed to the nearest switchboard with copper strapping or 2,5mm² stranded conductors. Adjoining rack sections shall be connected at joints with copper strapping or 2,5mm² conductors, unless the Engineer specifies that the method of joining the racks is sufficient for earth continuity. In cases where metal channels or racks are installed less than 2,0m above floor level, those shall be earthed by the same method as for power skirting.

j) Conduit

All metal conduits shall terminate in switchboards or junction boxes as specified in paragraph 3.5.22. Where this cannot be done the conduit end shall be earthed separately with a 2,5mm² bare copper stranded conductor.

k) Plastic Conduit

Where plastic conduit is installed, stranded copper earth conductors shall be installed in the conduits and fixed securely to all metal appliances and equipment, including switchboxes, plug boxes, draw boxes, switchboards, luminaires, etc.

l) Flexible Conduit

An external earth conductor shall be installed together with all non-metal flexible conduit. The earth conductor shall be connected securely to the metal parts on both ends.

m) Water Pipes at hot water Cylinders

Cold and hot water pipes within 1 metre from the geyser shall be bonded with solid or perforated 12 x 1,8mm copper strapping and earthed via a 10mm² BCEW.

11. CONNECTIONS

11.1 Connections to Luminaires

g) **Connections**

Connections to the wiring of luminaires and other appliances, where connectors are used, shall be effected by means of brass screw couplers shrouded in porcelain, neoprene or PVC, or by means of porcelain or PVC screw connectors.

h) **Knock-Outs**

Where knock-outs are used for the wiring of luminaires and other appliances, brass bushes or gripper glands shall be used.

i) **Type of Conductor**

In luminaires capable of housing incandescent lamps above 60 watts, the wiring from the lamp-holder to the general wiring shall be varnished cambric insulated, roved and braided asbestos or heat resisting silicon compound insulated conductors.

j) **Incandescent Luminaires**

Connections to luminaires with incandescent lamps shall be installed in a box situated behind the luminaire or ceiling rose.

k) **Fluorescent Luminaires**

Connections to luminaires with fluorescent lamps may be installed inside the metal canopy on condition that the frame and/or diffuser holder where applicable can be removed without disconnecting the conductors.

l) **Screwed Lamp-holders**

The central terminal of Edison Screw (E.S.) lamp-holders shall be connected to the phase conductor (i.e. conductor with red insulation) and the screwed housing to the neutral conductor (i.e. conductor with black insulation).

11.2 Connections to Motors

Connections to motors or other vibrating equipment may be made as follows:

a) Metal reinforced plastic or PVC covered metal flexible conduits shall be used with individual conductors or a multi-core PVC-insulated cable and separate bare earth conductor installed inside the conduit. The flexible conduit shall not be longer than 600mm. Screwed conduit shall be used from the end of the flexible conduit to the isolator and/or starter.

b) In the case of high voltage motors armoured XLPE or PILCDSTA cables of the correct voltage rating shall be used and shall be terminated as described in this specification.

c) An isolator and/or starter shall be mounted within 2m of the motor. Unless specified to the contrary, the starter will be supplied by others but the Contractor shall install and provide the connection to the motor and starter.

d) Supply cables may not be installed across floors that are for general use. All cables and/or flexible conduits shall terminate in suitable glands and shall have sufficient slack to allow positioning of the motor, especially where slide rails have been provided.

11.3 SWITCHBOARDS AND DISTRIBUTION BOARDS

11.3.1 Design and Construction of Free Standing Switchboards

Switchboards shall be factory built assemblies of switchgear and control gear (FBAs) of the multi-cubicle type and shall comply with IEC 439.

Switchboards shall be floor mounted with exterior panelling including doors and covers presenting a flush and uniform appearance. A channel section base-frame shall be provided.

a) Switchboard operation on cable access shall be as follows:

- front operation with rear cable access

- front operation with front cable access
- back to back switchboards with front and rear operation and cable access
- cable entry from above and below

b) Compartments shall be provided for:

- main busbars
- auxiliary busbars, if applicable
- cabling
- incoming and outgoing functional units

c) Segregation in the base-frame shall be provided to correspond with divisions in the switchboard sections when cable entry is from below. Access for sealing the cable slot with vermiculite cement shall be provided from the front or rear of the section to:

- reduce the danger of fire spreading
- prevent vermin entering

The base-frame shall be sealed with a cover plate when cable entry is from above.

d) Increase in depth of certain sections of switchboards for high current ratings shall be subject to the Engineer's approval.

e) Switchboards shall be designed to confine internal arcing faults and to direct arcs and gases arising from these away from the operator.

f) The arrangement of functional units and spacing between them shall be such that forced cooling is not necessary.

g) Conductors passing through holes in compartments shall be protected by means of neoprene grommets. Bevelling of sheet steel will not be accepted as a substitute.

h) Measures shall be taken to prevent electrolytic corrosion where dissimilar metals are in contact with each other.

i) Bolts shall be of the correct size for the holes provided and shall be fitted with matching sizes of washers and lock washers. Where removable covers are provided with bolt fastening, the nuts shall be either welded in position or securely fixed by means of a mechanical fixing device. Self-tapping screws, captive head nuts or cage nuts are not acceptable.

i) Switchboards shall be designed to permit the addition of identical sections.

11.3.2 Barriers

Functional units other than fuse switches within their own enclosures, shall be located in their own compartments, separated from each other and the busbars. Barriers shall be provided to prevent accidental contact with live conducting parts of the circuit and to protect the unit from falling objects.

Fused switches, moulded case circuit breakers, etc, within their own enclosures, shall be barrier protected from falling objects and accidental contact with live conducting parts of the

circuit and adjacent switches.

Barriers shall be robust with high impact strength and made of material that is self-extinguishing or resistant to flame propagation.

11.3.3 Doors and Covers

Each functional unit compartment and cable compartment shall be provided with individual hinged doors for easy access except where flush mounted equipment prevents this. Power and control busbar compartments shall be provided with removable covers requiring the use of a tool for their removal.

Doors shall have adequate points of hinging and latching and shall be reinforced to prevent distortion when open. Non-ferrous fasteners shall be of the type detailed in Part 4 with four keys being supplied per switchboard. A release mechanism shall be provided on the cable compartment door hinges to allow the doors to be removed.

All removable doors and covers shall be identified to enable replacement in the correct position.

Doors shall have stops to prevent over swing of the door when opening and to avoid interference with adjacent compartments. Dust-proof seals shall be provided on all doors.

11.3.4 Gland Plates

When cables enter a switchboard from below, a cable gland plate shall be provided at a minimum height of 300mm above the point of entry. In case of cables entering from above, the cable gland plate shall be mounted at the point of entry.

The gland plate shall be removable and shall be supported to prevent movement of the cables.

When cables enter a switchboard from below, adequate access shall be provided beneath the gland plate to ensure that once the cables have been installed, the floor slot can be sealed from above using vermiculite cement. The arrangement shall be such that once this slot is sealed level with the floor, each base frame sub-section shall be sealed from the adjacent base frame sub-section.

When cables enter from above, the gland plates shall effectively seal the switchboard opening.

11.3.5 Degree of Protection

The switchboards shall be designed and manufactured to the degree of protection specified in Part 4 in accordance with IEC 144.

The minimum degree of protection shall apply when all functional units are connected. In the test, disconnected and removed positions, adequate protection shall be provided against contact with live parts.

11.3.6 Protective Conductor (Earth Bar)

A separate copper protective conductor to that all metal parts are connected shall be installed in the inside rear of each switchboard along the entire length. The bar shall be in

an accessible position to allow for the earthing of cables.

The protective conductor shall have a current carrying capacity sufficient to withstand the earth fault current that may occur in the switchboard. The cross-section shall be calculated with the aid of the formula in Appendix B of IEC 439 but shall not be less than 200mm².

The neutral busbar shall be connected to the protective conductor by means of a removable bolted link on the cable side of each incoming functional unit. The link shall be easily accessible from the front of the switchboard for removal and testing.

Non-current carrying parts, including relays, metres, etc, shall be effectively connected to the protective conductor by means of their mounting arrangement on the panel or by a separate earthing conductor connected to the protective conductor. This shall include the earth terminals provided on equipment.

All parts of the protective circuit within the switchboard shall be designed to withstand the highest thermal and dynamic stresses that may occur.

11.3.7 Construction of Flush Mounted Switchboard

a) Bonding Tray

Bonding trays for flush mounted switchboards shall be of rigidly constructed 1,6mm thick galvanised steel, braced and reinforced. Formed gussets shall be provided at the corners. All the tray joints shall be properly welded or securely bolted with a brass or cadmium plated steel earth connecting stud and nut.

b) Expanded Metal

Where switchboards are to be built into 116mm thick walls, expanded metal shall be spot welded to the rear of the bonding trays. The expanded metal shall protrude at least 150mm on each side to prevent plaster from cracking.

c) Knock-Outs

Ample knock-outs shall be provided in the top and bottom ends of each switchboard tray to allow for the installation of conduits for the specified and future circuits. Knock-outs shall be allowed for any size of specified conduit. Provision shall however be made for termination of at least 2 x 25mm diameter conduits at top and 2 x 25mm diameter conduits at the bottom of each tray.

d) Architrave Frame

The architrave frame shall be of 2,0mm thick sheet steel with bevelled edges. The architrave frame shall accommodate the chassis, panels and doors. The architrave shall overlap the bonding tray by at least 25mm on each side. The architrave frame shall be fixed to the tray in such a fashion to allow for depth adjustment and irregularities of the wall.

e) Extension Frames

Semi-flush mounted switchboards shall be equipped with extension frames. Generally the frame depths shall be 50mm but may be altered to suit each application.

f) Chassis

The chassis for mounting of switchgear and equipment shall be of rigid construction and shall be fixed securely to the architrave frame or bonding tray by means of bolts screwed into tapped holes or bolts and nuts. Self-tapping screws are not acceptable. The chassis position shall be adjustable in the horizontal plane.

g) Panel (Faceplate)

A suitably stiffened panel manufactured of 2,0mm thick sheet steel shall be installed in the architrave frame for flush mounting of switchgear. The panels shall have machined punched slots for housing the specified and future switchgear, instruments, fuse holders, isolating switches, indicator lamps, etc. In exceptional cases contractors will be allowed to protrude through the panel. Blanking plates shall be provided in positions where future switchgear will be installed. The distance between the inside of the closed doors and the panels shall be not less than 40mm. No equipment may be mounted on the panel (faceplate) unless it is permanently hinged to the switchboard frame.

h) Fixing of Panels

The panel for each switchboard shall be secured to the architrave frame by means of captive fasteners such as "DZUS" or "CAMLOC". Alternatively, the panel may be secured to the architrave frame by means of two pins at the bottom and a latch or lock at the top of the panel. Self-tapping screws or dome nuts will not be allowed. Where it is required that equipment be mounted on the panel, the panel shall be securely hinged to the switchboard frame.

i) Panel Handles

Two chromium plated handles shall be provided on each front cover. The handles shall be mounted at the top and bottom of each panel. Handles can be omitted if "DZUS" or "CAMLOC" fasteners are used.

j) Hinged Panels

Where hinged panels are specified, the hinges shall be fixed to the architrave frame and the panel shall be secured by means of studs and hexagonal chromium plated nuts or by means of a suitable lock or latch that can be operated with a screwdriver. The panel shall be removable when it is in the open position.

11.3.8 Construction of Surface Mounted Switchboards

NB This section refers to surface mounted sub-switchboards and not to floor standing main switchboards in substations or sub-main switchboards.

a) Switchboard Tray

Surface mounted switchboards shall be equipped with a 1,6mm sheet steel reinforced tray. Securing lugs shall be provided to fix the tray to walls or any other structure. A solid brass or cadmium plated steel earth connection stud and nut shall be provided.

b) Construction

All joints shall be welded or securely bolted. The tray shall be square and neatly finished without protrusions. The front tray sides shall be rounded with an edge of at least 20mm to accommodate flush doors.

The requirements for chassis, panels and doors shall be as specified for flush mounted switchboards. The doors shall be hinged and shall fit flush in the frame in the closed position. Knock-outs shall not be provided unless specifically called for.

11.3.9 Power and Control Wiring

a) Power circuit wiring and connections in a switchboard shall be rated to the full rating of the associated equipment, i.e. fused switch, contactor, circuit-breaker, etc, and not to the circuit or fuse rating.

b) Neutral connections shall have the same rating as the phase connections unless otherwise approved.

c) Control circuits shall be wired using a minimum of 2,5mm² conductors. Current and voltage transformer circuits shall be wired using a minimum of 4mm².

d) Conductors shall be general purpose 600/1000V grade PVC-insulated wire to SANS 150.

e) Wiring for circuits up to 50V shall be in 0,5mm² flexible 300/500V grade PVC-insulated wire in accordance with SANS 150.

f) Single or solid conductor wire shall not be used.

g) Joints or splices in any wiring are not acceptable.

h) Panel and equipment terminals, labels, etc, shall be accessible after the wiring has been completed.

i) Terminals that are on the live side of fuses and isolating switches shall be completely shrouded to prevent accidental contact.

j) Aluminium conductors are not acceptable.

11.3.10 Wiring Supports

Wiring shall present a neat appearance and shall be braced, clipped and/or laced to prevent vibration and to ensure that it shall not deform under fault conditions. Connections to equipment on swing doors shall be arranged so as to give a twisting motion and not a bending motion to the conductor.

a) Wiring Identification

Power wires shall bear the colour along their entire length of the phase to that they are connected.

Control wire sheaths shall be coloured grey for AC circuits.

Control wiring leads shall be marked at both ends with an interlocking type of ferrule with permanent black letters impressed on a white background.

For all control wires without lug terminations the numbered ferrule must not fall off when disconnecting the wire and in this regard, the use of one strand of wire to retain the ferrule is acceptable.

b) Wiring of Moulded-Case Circuit Breakers

Single pole and double pole moulded-case circuit breakers shall be wired in a way that the supply to the switchboard is equally balanced.

c) Control Wiring and Cable Terminations

Stripping of insulation shall not result in damage to the conductors. The stripping tools used shall be of the type that permits the length of strip to be preset. Control wiring shall be terminated with pre-insulated, crimped or compression type lugs. Crimping tools shall be of the type that will not release the termination during normal operation until the conductor crimp has been correctly formed. Any damaged wiring will be rejected.

Lugs shall be of the hooked blade type when used in conjunction with screw clamp spring loaded insertion type terminals, ring tongue type when used with stud or direct screw mounted connections and wire pin when used with pinch screw type connections such as indicating lamp fittings.

Not more than two conductors shall be connected to any side of a terminal.

Each terminal strip shall be provided with not less than 10% spare terminals, with a minimum of two, unless otherwise approved.

d) Power Wiring and Cable Terminations

Terminations for power wiring and cabling shall be provided with pressure type clamping connections or bolted connections capable of accepting crimped or compression type lugs on conductors.

An undrilled solid copper bar shall be provided for terminating all external power cables above 70mm, or where three or more cables in parallel are specified. The arrangement shall be suitable for accepting cable lugs of conductors up to 630mm^2.

e) Cable Terminal Arrangements

Cables shall be made off directly onto Circuit breakers, switches, contractors, thermal-overloads, etc. Terminals or solid copper terminating conductors shall be provided where necessary. Provision shall be made for bracing and for fixing the cable leads to prevent vibration.

Where a large number of control terminals are mounted in close proximity, the terminals shall be in vertical rows with a minimum of 125mm below rows. Spare terminals shall be mounted at the bottom of the row unless the cabling drawing shows otherwise.

Terminals shall be provided for all cores of external control cable as indicated on the drawings whether internally connected or not.

11.3.11 Testing

Electrical switch panels shall be inspected by the Engineer at their place of manufacture, prior to delivery to site. At such inspection and testing, the Contractor shall demonstrate the functioning of the switch panel to the Engineer. Any defects in materials, finishes and operation of the switch panels shall be corrected at their place of manufacture prior to delivery to site.

Type and routine tests shall be carried out on either a complete switchboard or a representative portion thereof to verify its characteristics.

Type tests shall be performed in accordance with IEC 439.

- verification of temperature rise limits
- verification of dielectric properties
- verification of the short circuit strength
- verification of the effectiveness of the protective circuit
- verification of clearances and creepage distances
- verification of mechanical operation
- verification of degree of protection

If evidence is available of type tests already made on similar equipment, this may, subject to the Engineer's approval, be acceptable in lieu of these tests,

Copies of test certificates shall be submitted to the Engineer.

Routine test shall be performed in accordance with IEC 439:

- inspection of the switchboard including inspection of wiring and electrical operation tests
- dielectric test. This test shall have a duration of 60 seconds
- checking of protective measures and of the electrical continuity of the protective circuits.

11.3.12 Mounting of Equipment

a. **Clearance and Access**

A minimum clearance of 50mm shall be maintained between items of equipment and the side of the compartment. Where extra equipment is specified after the design has been finalised, this clearance requirement may be altered subject to the Engineer's approval.

No piece of equipment shall be mounted in any position where it is not visible and accessible to a viewer looking into the compartment through the door opening.

b. **Mounting of Circuit Breakers**

All moulded case circuit breakers shall be flush mounted with only toggles pro-truding. Miniature circuit breakers may be installed in clip-in trays mounted on the frame. Special provision shall be made for large main switches. Circuit breakers shall be installed so that the toggles are in the up position when "ON" and down when "OFF".

c. **Mounting of Contactors**

Contactors shall only protrude through the panel in special cases. Plastic covers or other coverings will not be required.

d. Instrumentation

viii. All metering instruments shall be mounted flush in the front panel unless otherwise specified. In certain instances it may be required that instruments be mounted flush in the door. In these instances the back of metres shall be covered by removable covers of isolating material fixed to the door to protect the terminals of instruments and to prevent accidental contact. Equipment mounted normally on the surface, e.g. time switches and relays, shall be mounted behind the front panel. In these cases hinged access panels shall be provided in the front panel.

e. Fuse-Links and Carriers

ix. Fuses shall be of the high rupturing capacity type and shall be mounted on insulated draw-out carriers that shall hold the fuses positively after withdrawal. In all cases the top terminal shall be the live terminal. This applies also for MCB's.

x. DC circuits shall have fuses in the positive and negative leads.

xi. Fuses shall be so positioned that they are readily accessible to a person standing on the floor.

xii. Fuses for instrumentation shall be mounted on the outside of the compartment door adjacent to or below the instrument.

xiii. Fuses shall be provided with labels giving their rating and duty.

xiv. Solid link holders shall be coloured white.

f) Spare Fuses

One spare fuse of each type and size used in each board shall be fitted on 'Terry' clip holders on the inside of the front panel.

g) Control Equipment

All equipment performing control functions, e.g. control relays, transducers, and time relays not requiring adjustment, shall be mounted behind the front panel.

h) Current Transformers

- Current transformers shall comply with SANS 3939.
- Current transformers shall be accessible and easily removable.

- Secondary windings of current transformers shall be earthed at one point only. Each group of current transformers, i.e. protection, metering, etc, shall be earthed directly to the protective conductor (earth bar).

- Current transformers shall be naturally air-cooled, and shall be able to withstand the maximum fault current for the duration of time taken by the functional unit to clear, with protective devices set at the maximum time delay settings.

i) Main Circuit Breakers

Rack-out type air circuit breakers shall be mounted in a separate compartment with the handle or operating mechanism only protruding. A positive device shall be provided to ensure that the circuit breaker is secured in the:

- connected position
- test position
- disconnected position

It shall be possible to remove the circuit breaker from its compartment. It shall not be possible to insert a circuit breaker into a circuit of higher rating.

Automatically-operated shutters shall be provided so that on racking out the circuit breaker, these shutters cover the isolating sockets to prevent inadvertent contact with live busbars and circuits. Busbar shutters shall be labelled with the word BUSBARS in letters of at least 50mm high.

Mechanical interlocks shall be provide to ensure that:

- the circuit breaker main contacts cannot be engaged and disengaged unless the circuit breaker contacts are fully open

- the circuit breaker cannot be closed unless it is in the connected, disconnected or test position

- the action of disengaging the circuit breaker from the connected, disconnected or test position shall automatically trip the circuit breaker.

Circuit breakers shall be capable of carrying continuously the load current stated in the drawings at site altitude when mounted within the compartment specified without forced ventilation.

If the main switch is a moulded case circuit breaker or isolator, it shall be installed flush in a separate compartment.

Contractors controlling the supply shall be installed behind separate front panels.

All metering, protection and indicating equipment shall be clearly visible from the front of the board. Where doors are specified the equipment shall be installed flush in the doors and covered as described in 'Instrumentation' above.

Fuses or control gear providing back-up protection for circuit breakers shall be installed behind separate front panels.

j)Standby Supplies

vii. Where standby power from a diesel-generator set or other source is available and has to be connected to some of the equipment on a switchboard, the switchboard shall be divided into electrically separate sections with sheet metal division plates to isolate power and mains power sections.

viii. A means shall be provided to isolate both the standby and mains power supplies simultaneously. For this purpose, either a 6-pole rotary switch or mechanically and electrically interlocked circuit breakers may be used.

ix. Electrical interlocking alone is not sufficient. Rotary switches may only be used on boards where the fault level does not exceed 10kA.

x. A separate 3-pole isolator, fuse switch or circuit breaker shall be provided as main switch for both the standby power section and the mains power section in addition to the isolator of (b) above.

xi. Where a 6-pole rotary switch is used as isolator for the incoming supplies, this switch may be located in the standby section of the switchboard in that case the rotary switch can also serve as the isolator for the standby section. This arrangement is acceptable where the equipment on the mains power section of the switchboard can be turned off whenever it is necessary to work on the standby section of the switchboards.

xii. The main switches to the standby and mains power sections shall be interlocked with the doors providing access to those sections to ensure that the door can only be opened when the switches are in the OFF position.

11.3.13 General

a) Size

All switchboards shall be of ample size to accommodate all the specified switchgear and provide space for future switchgear. For every 4 (or part of 4) circuit breakers of a kind on a switchboard, space for an additional circuit breaker of similar size shall be allowed unless future space requirements are clearly specified. The clearance between adjoining switchgear or switchgear openings shall be as specified in paragraph 3.16.7 of this specification.

b) External Dimensions

All specified external dimensions for switchboards shall be strictly adhered to. If the clearances specified in paragraph 3.16.7 cannot be adhered to as a result of restricting external dimensions, the Contractor or Manufacturer shall obtain the opinion of the Engineer before manufacturing the switchboards.

c) Positions

The Contractor shall ascertain the exact position of switchboards and shall arrange timeously for the installation of cable sleeves, openings in the structure, flush draw trays behind switchboards and supports over cable trenches.

d) Mounting Heights

In general, flush and surface mounted switchboards shall be mounted 2000mm above finished floor level - measured to the top of the switchboard. The upper ends of

switchboards may not be higher than 2,1m above finished floor level.

e) Labels

In addition to paragraph 3.19 of this specification, the following labels shall be provided for switchboards:

a) Main labels: A white traffolite label shall be provided to clearly identify each switchboard and subsections of switchboards.

The fixing of main labels shall be done as per paragraph 3.19.2. Lettering shall be black with a maximum height of 20mm letters.

b) Compartment labels: Front panels shall be identified with white traffolite labels fixed to the doors or front panel respectively. The function of the equipment and circuits shall be clearly identified.

Lettering shall be black with a maximum height of 8mm letters.

c) Equipment labels : All equipment shall be identified with the necessary labels. The labels for equipment mounted on doors shall be identified with white traffolite labels having black lettering engraved on them, with a maximum height of 3mm letters.

The equipment labels shall be secured by means of high quality double sided tape.

The labels for all equipment, installed behind panels, shall be fixed to the chassis close to the equipment.

If this equipment is positioned too close to each other to accommodate descriptive engraved labels, the equipment may be identified by a code or number label that shall be fixed close to the equipment. The code or number shall be identified on a legend board that shall be installed on the switchboard behind a protective cover.

The types of labels for equipment behind the doors or covers shall be subject to the Engineer's approval.

f) Drawings

- A set of three prints of the shop drawings for the switchboards shall be submitted to the Engineer for approval before the boards are manufactured. The following information shall be presented:

- A complete wiring diagram of the equipment on the boards, and the internal wiring of such equipment.

- A complete layout of the arrangement of the switchboards indicating all equipment dimensions and the construction of the boards. The positions and method of fixing of busbars shall be shown.

- All labelling information on a separate sheet.

- The make, catalogue number and capacity of all equipment such as isolators, circuit breakers, fuses, contractors, etc.

The approval of drawings shall not relieve the Contractor of his responsibility to the Employer to supply the switchboards according to the requirements of this specification or to the requirements of the Detailed Technical Specification.

A complete set of "Record" transparent drawings of all switchboards shall be submitted to the Engineer immediately after completion of the installation. The following information shall be presented:

a) Items (a) and (d) of the previous paragraph.

b) Terminal strip numbers, numbers and colours of conductors connected to the terminal strips and numbers and colours of the conductors utilised for the internal wiring.

c) A separate schedule of all equipment.

Where such transparent drawings as called for above are modified during the execution of the contract, the Contractor shall at his own expense modify or replace such drawings. Accurate drawings of the equipment shall be forwarded to the Employer.

11.3.14 Paint Finish

Finish Required

Metal components of the framework, panels and chassis shall be finished with a high quality paint applied according to the best available method. Baked enamel, electrostatically applied powder coating or similar proven methods may be used. Care shall be taken to ensure that all edges and corners are properly covered. Thatever finishing method is employed, it shall be backed up by written certification that the quality of finish complies with the relevant SANS standard.

Baked Enamel Finish

Prior to painting, all metal parts shall be thoroughly cleaned of rust, mill scale, grease and foreign matter to a continuous metallic finish. Sand or shot blasting, or acid pickling and washing may be employed for this purpose. Immediately after cleaning all surfaces shall be covered by an electrolytically applied rust inhibiting, tough, unbroken metal phosphate film and then thoroughly dried.

Within forty-eight (48) hours after phosphatising, a passivating layer consisting of a high quality zinc chromate primer shall be applied, followed by two (2) coats of high quality baked enamel to SANS 783 type 1. The minimum paint thickness after baking shall be 0.06mm. The paint shall have a shock resistance of 25kg / cm on 0,9mm soft steel plate and a scratch resistance of 2000 grams.

Powder Coated Finish

Prior to painting, all metal parts shall be thoroughly cleaned of rust, mill scale, grease and foreign matter to a continuous metal finish. Sand or shot blasting, or acid pickling and washing may be employed for this purpose. The metal parts shall be pre-heated and then covered by a microstructured paint powder applied electrostatically. The paint shall be baked on and shall harden within 10 minutes at a temperature of 190□C. The minimum paint thickness after baking shall be 0,5mm and shall have a shock resistance of 25kg /

cm on 0,9mm soft steel plate and a scratch resistance of 2000 grams.

Colour

Refer to Part 4 of this specification for switchboard colours.

Before the installation is handed over, the Contractor shall ensure that all paint surfaces are clean and undamaged.

11.4 NOISE AND VIBRATION

11.4.1 If in the opinion of the Engineer, any equipment operates with, or transmits from it, objectionable noise or vibration, it will be necessary to rectify or replace such plant in order that the system operates at conditions acceptable to the Engineer. Remedial measures taken to achieve satisfactory noise and vibration levels shall be at no additional cost to the Employer.

11.4.2 The following measures shall be taken where necessary, whether specifically stipulated in these documents or not, all to ensure quiet, vibration-free operation of the installations:

a) Equipment shall be mounted on vibration isolators of the correct type and selection, dependent upon deflection requirements versus vibrating frequency.

b) Pipework and ductwork shall be suspended or mounted using suitable supports with vibration isolators to prevent transmission of vibration from them to the structure to that they are attached.

11.5 COMMISSIONING AND TESTING

11.5.1 The Contractor shall commission and test the entire installation at his own expense, including provision of all test equipment, such testing to be done in the presence of the Engineer, who shall have been notified of the dates and approximate duration of the tests sufficiently early to allow him to witness tests if necessary.

11.5.2 The Contractor shall properly test and call for inspection by the Engineer any work that is to be covered, concealed, built-in, otherwise closed up or rendered inaccessible, before such closing up takes place. The Engineer may require any work of this nature that he has not been called on to inspect before closing up, to be uncovered or made accessible to him entirely at the Contractor's expense, making good included.

11.5.3 It is in the interest of the Contractor to notify the Engineer when the installation reaches various stages of completion (e.g. before plastering, final finishes, before casting concrete, etc) in order that the Engineer may inspect the installation and point out discrepancies. These inspections shall be considered informal and under no circumstances will they, in part or in whole, invalidate the requirements of the document. Any costs incurred in correcting discrepancies shall be to the Contractor's account.

11.5.4 The Contractor shall keep full and proper written records of all tests conducted and commissioning information, such data to be properly indexed and submitted to the Engineer for his records.

11.18.5 The Contractor shall test electrical wiring for compliance with regulations and have the complete installation tested by the relevant authorities.

11.5.6 The Engineer reserves the right to inspect any item of equipment during manufacture or before delivery to site. The Contractor shall make available any item for such inspection. The Engineer shall also be furnished with manufacturer's test certificates whenever these are required by law or called for by the Engineer.

11.5.7 The Contractor shall commission the complete installation prior to inviting the Engineer to accept it, commissioning including inter alia the following services, as relevant:

a) The Contractor shall record all motor running currents and set overload protection devices to correct values.

b) The Contractor shall adjust and set all time clocks, time delay relays, automatic control devices and check their function for correctness and response.

c) The Contractor shall remedy any defects apparent on the installation prior to calling upon the Engineer to accept the plants.

11.6 LABELLING AND IDENTIFICATION

11.6.1 All equipment shall be labelled and identified using white traffolite labels having black lettering engraved on them; where two similar items exist, they shall additionally be numbered for clarity in identification.

11.6.2 Labels shall be secured by means of white rivets, slotted label holders or screwed on. Self-tapping screws will not be allowed.

11.6.3 All other equipment including metres, instruments, indicator lights, switches, push-buttons, circuit breakers, fuses, etc, shall be identified. The function of the equipment and circuits shall be clearly identified. Flush mounted equipment within doors or front panels shall be identified with labels fixed to the doors or front panels respectively.

11.7 OPERATING AND MAINTENANCE MANUALS; "AS BUILT" OR "AS INSTALLED" RECORD DRAWINGS

11.7.1 Provide three hard copies and one disk of all operating and maintenance manuals and record drawings.

11.7.2 Provide a MSWORD for WINDOWS disk copy for any word processed elements of the operating and maintenance manuals. Employ a specialist to prepare manuals for the form and content of the operating and maintenance manuals.

11.7.3 Agree format and contents with the Employer Operating and maintenance manuals must include, but are not limited to the following:

- Index of Contents
- A full description of each of the systems installed, written to ensure that the Employer's staff fully understand the scope and facilities provided. Description to include data on general design parameters, normal associated operating conditions and manufacturer's information concerning correct operation, etc., based on commissioning results.
- A description of the mode of operation of all systems.

- Diagrammed drawings to each system (including distribution boards) indicating principal items of plant, equipment, valves, etc.

- A photo-reduction of all record drawings, together with an index.

Size A4
Size A3
Legend for all colour-coded services.

- Schedules (system by system) of plant, equipment, valves, etc, stating their locations within the building, duties and performance figures. Ensure each item has a unique code number cross-referenced to the record and diagrammatic drawings and schedules.

- The name, address and telephone number of the manufacturer of every item of plant and equipment together with catalogue list and order acknowledgement numbers.

- Manufacturer's technical literature for all items of plant and equipment, assembled specifically for the project, excluding irrelevant matter and including detailed drawings, electrical circuit details and operating and maintenance instructions.
- A copy for all Test Certificates, Certificates of Compliance, Inspection and Test Records, Commissioning and Performance Test Records (including, but not limited to, electrical circuit tests, corrosion tests, type tests, start and commissioning tests) for the installations and plant, equipment, valves, etc, used in the installations.

- A copy of all manufacturers' guarantees or warranties.

- Copies of Insurance and Inspecting Authority Certificates and Reports.

- Starting up, operating and shutting down instructions for all equipment and systems installed.

- Details of procedures to maintain plant in safe working conditions.

- Control sequences for all systems installed.

- Schedule of all fixed and variable equipment settings established during commissioning.

- Back-up copies of any system software.

- Documentation of the procedures for updating and/or modifying software operating systems and control programs.

- Instructions for the creation of
- Control procedure routines.
- Graphic diagrams

- Details of the software revision for all programs provided.

- Two back-up copies of <u>all</u> software items, <u>as commissioned</u>.

- Details of lubrication systems and lubrication schedules for all lubricated items.

- A list of normal consumable items.
- A list of recommended spares to be kept in stock by the Employer, being those items subject to wear or deterioration and that may involve the Employer in extended deliveries when replacements are required at some future date.
- A list of any special tools needed for maintenance cross referenced to the particular item for that required.
- Procedures for fault finding.
- Emergency procedures, including telephone numbers for emergency services.
- Copies of all items incorporated in the plantroom and switchroom schedules and schematics.
- Encase the Manuals in A4 size, plastic-covered, loose leaf, four ring binders with hard covers, each indexed, divided and appropriately cover-titled. Fold drawings larger than A4 and include in the binder so that they may be unfolded without being detached from the rings.
- Provide record drawings. Include the provision of relevant framed plasticised drawings in all electrical rooms.
- Three copies of all “AS BUILT” or “AS INSTALLED” record drawings, in print form, are required to be handed to the Engineer before completion of the project. There shall have been previously submitted to the Electrical Engineer for comment and approval. The Electrical Engineer also requires 2 copies of all record drawings to be made available on disk on CAD format. All “AS BUILT” or “AS INSTALLED” record drawings are to be prepared by the Electrical contractor in CAD format.

11.8 MAINTENANCE INSTRUCTIONS AND GUARANTEES

Retain copies of all maintenance instructions and guarantees delivered with components and equipment (failing that, obtain), register with manufacturer as necessary and handover to the Employer on or before Practical Completion. Notify the Employer of telephone numbers for emergency services by Specialist Contractors and Suppliers after Practical Completion.

Vendors are requested to respond to the tender in the following formats:

12. Technical Response

a. A point-by-point response is required, i.e. a comment for each point or paragraph that is associated with the numbering should be made.
b. The response to technical requirements must state “Comply” or “Non-Comply.” The vendor must further specify how the system/product meets or differs, for each aspect as stated below, including references or supporting information to clarify the response.
c. A mere “Comply” or “Partially Comply” statement or no response, without detail shall be seen as “Non-Compliant” and will be scored as such.

The onus lies with the bidder to ensure that all relevant and required documents are included in their submission, each page initialled and all declarations signed.

13. Pricing Breakdown Model

- Bidders must provide a detailed cost breakdown by pricing all items for the delivery of a total solution as per the specification. All deviations should be stipulated as options with the indicative unit prices.

- All hardware, software and licenses, installation, integration, training and support etc. must be specified, broken down into individual elements on a Bill of Materials (BOM) and the pricing of each, specified on hard copy (paper copy) and in soft copy (Excel format).

- Bidders must submit unit and total pricing in SA Rands (Excluding VAT), and where applicable, use the Foreign currency rate below to calculate the Rand value. Use Annexure A to indicate the total amount subject to exchange rate variation.

14. EVALUATION CRITERIA

14.1 Evaluation Criteria

- Responses will be evaluated using a predetermined set of evaluation criteria. The evaluation criteria is designed to reflect the SABC's requirements in terms of identifying a suitable service provider and ensure the selection process is transparent and afford all the bidders a fair opportunity for evaluation and selection.

- During the evaluation process, the SABC may require a bidder's representative to answer questions with regard to the proposal and/or require certain bidders to make a formal presentation to the evaluation team.

14.2 Technical Evaluation

14.2.1 The tender submission will be technically evaluated out of a minimum **score of 123 and a maximum score 146 for (phase 1),** should the bidder/s not meets the minimum score of **123** points; they will be disqualified and will not qualify for further evaluation.

14.2.2 The tender submission **(phase 2)** will be technically evaluated out of a **minimum 43** and a **maximum of 60** , should the bidder/s not meet the minimum required points of 43, they will be disqualified and will not qualify for further evaluation.

14.2.3 The tender submission **(phase 3)** site inspection will be evaluated out of a maximum of **30** and should the bidders not met the maximum point of 30 they will be declared non-responsive and therefore will not continue forward for evaluation of BBBEE & Price Preference.

14.2.4 The evaluation is based on functionality for both **Document E1 and E2**, which will be evaluated using the following criteria and points:

Item	Description	Bidder to indicate compliance		Min	Max
		Yes /No	Comments	Points	Points
1	**Supply, Installation and Commissioning:**			7	7
	2x1000KVA Synchronized prime rated generator sets with remote radiators. **(5)**				
	Stainless steel exhausts system complete with silencer and lagging. **(2)**				
2	**Controller: Synchronizing two generators & mains**			28	31
	Synchronizing & load sharing auto start controller **(5) C**				
	Generator Volts L1-N, L2-N, L3-N **(1) C**				
	Generator Amps L1, L2, L3 **(1) C**				
	Generator Frequency Hz **(1) C**				
	Generator Current and power monitor (kW, kvar,kVA & pf) **(1)**				
	Generator Phase Sequence **(1) C**				
	Engine Speed RPM **(1)**				
	Engine Oil Pressure **(1) C**				
	Engine Temperature **(1)C**				
	Plant Battery Volts **(1)**				
	Engine Hours Run **(2)C**				
	Over and under speed protection**(2) C**				
	Over temperature protection**(1) C**				
	Over & Low voltage protection**(1) C**				
	Short circuit protection**(1) C**				
	Governor & AVR control**(1) C**				
	USB, RS232, RS485 & Ethernet communication port**(1) C**				
	Can be integrated into building management system (BMS)**(2) C**				
	Remote monitoring**(2) C**				
	SMS messaging**(1) C**				
	Start & stop via remote monitoring system**(1) C**				
	Configurable maintenance alarms**(1) C**				
	Water level input**(1) C**				
3	**Engines acceptable(Any one of the engines below):(10) None of the below is zero**			10	10
	Cummins				

	Cat				
	Volvo				
	Deutz				
	Perkins				
	MTU				
	Scania				
	Mitsubishi				
	Kohler				
4	**Types of Alternators acceptable(any one of the alternators below) (400/230V): (10) None of the below is zero**			**10**	**10**
	Leroy Somer				
	Stamford				
	Marathon				
	Marelli				
5	**Supply, Installation and Commissioning:**			**7**	**7**
	1X1650kVA gen set synchronized with mains on return prime rated generator set mounted in a silent container. **(5)**				
	Electronic governor**(1) C**				
	Stainless steel exhausts system complete with silencer and lagging. **(1)**				
6	**Supply, Installation and Commissioning:**			**7**	**7**
	2x1250kVA Synchronized with independent change overs on distribution boards prime rated generator set. **(5)**				
	Electronic governor**(1) C**				
	Stainless steel exhausts system complete with silencer and lagging. **(1)**				
7	**Supply, Installation and Commissioning:**			**7**	**7**
	2x500kVA prime rated generator set mounted in a silent container. **(5)**				
	Electronic governor**(1) C**				
	Stainless steel exhausts system complete with silencer and lagging. **(1)**				
8	**Controller: Synchronizing with mains**			**25**	**33**
	Synchronizing & load sharing auto start controller **(5) C**				
	Generator Volts L1-N, L2-N, L3-N **(1) C**				
	Generator Amps L1, L2, L3 **(1) C**				
	Generator Frequency Hz **(1)**				
	Generator Current and power monitor (kW, kvar,kVA & pf) **(1)**				
	Generator Phase Sequence **(2)**				
	Engine Speed RPM **(1) C**				
	Engine Oil Pressure **(1) C**				
	Engine Temperature **(1)C**				

	Plant Battery Volts **(1)**				
	Engine Hours Run **(1)**				
	Number of Start Attempts**(1)**				
	Over and under speed protection**(2) C**				
	Low oil protection**(1) C**				
	Over temperature protection**(1) C**				
	Over & Low voltage protection**(1) C**				
	Short circuit protection**(1) C**				
	Fuel level**(1)**				
	Governor & AVR control**(1) C**				
	USB, RS232, RS485 & Ethernet communication port**(1) C**				
	Reverse power alarms**(1) C**				
	Can be integrated into building management system (BMS)**(1) C**				
	Remote monitoring**(1) C**				
	SMS messaging**(1) C**				
	Start & stop via remote monitoring system**(1) C**				
	Configurable maintenance alarms**(1) C**				
	Water level input**(1) C**				
9	**Controller: Single set auto mains failure**			**25**	**32**
	Auto start controller **(5) C**				
	Generator Volts L1-N, L2-N, L3-N **(1) C**				
	Generator Amps L1, L2, L3 **(1) C**				
	Generator Frequency Hz **(1) C**				
	Generator Current and power monitor (kW, kvar,kVA & pf) **(1)**				
	Generator Phase Sequence **(2) C**				
	Engine Speed RPM **(1) C**				
	Engine Oil Pressure **(1) C**				
	Engine Temperature **(1)C**				
	Plant Battery Volts **(1)C**				
	Engine Hours Run **(1)C**				
	Number of Start Attempts**(1)**				
	Over and under speed protection**(3) C**				
	Over temperature protection**(1) C**				
	Over & Low voltage protection**(1) C**				
	Short circuit protection**(1) C**				
	Fuel level**(1) C**				
	Governor & AVR control**(1) C**				
	USB, RS232, RS485 & Ethernet communication port**(1) C**				
	Can be integrated into building management system (BMS)**(1) C**				

	Remote monitoring**(1) C**				
	SMS messaging**(1) C**				
	Start & stop via remote monitoring system**(1) C**				
	Configurable maintenance alarms**(1) C**				
	Total			**126**	**144**

14.2.5 Bidders who obtain less than the minimum threshold of **126 points** out of maximum **144 points** will be declared non-responsive and will be eliminated from phase 2.

Phase 2

EVALUATION AREA	EVALUATION CRITERIA	MIN POINTS	MAX POINTS
Past Relevant Experience	Bidders must have specific experience in Installing Generator Sets, Transformer, medium voltage, low voltage, distribution boards, Bus-Bars and submit at least five recent references**(on client company letter head)** in respect of similar work undertaken. The reference must include the relevant contact person, nature of service, contract amount, project duration, telephone number, fax number and email address (you can submit more than one job profile on one letter). - Submission of Ten (10) or more provable experience related to similar projects – **35** - Submission of Five (5) to Nine (9) provable experience related to similar projects -***25*** - Submissions below 5 provable experience related to similar projects – **0**	**25**	**35**
Project Execution Plan (PEP)	- Provide a brief step-by-step project execution plan including major milestones. A programme including duration encompassing the following - In-depth site investigation **(3 points)** - Removal of old equipment/ infrastructure **(3 points)** - Preparation of Site **(3 Points)** - Implementation stages **(2 points)** - Commissioning **(2 points)** - Hand over **(2 point)**	**10**	**15**
Warranty	Warranty period: - More than 12 months with no financial implication to the SABC **– (after acceptance) 10** - Equal to 12 months –***(after acceptance) (8)*** - Less than12 months – **0**	**8**	**10**
		43	**60**

14.2.6 Bidders who obtain less than the minimum threshold of **43 points** out of maximum **60 points** will be declared non-responsive and will be eliminated from phase 3.

Phase 3-Site Inspection for Previously Completed Projects

EVALUATION AREA	EVALUATION CRITERIA	MAX POINTS
SITE INSPECTION	Bidders must submit two (2) reference sites where similar installation was commissioned successfully.	**30**

	Provide a letter from your client's company letter head indicating the contact person, contact details and physical address.	
	- Transformer installation-10 - MV change over panel-10 - Synchronised generators-10	

14.2.7 Bidders who obtain less than the maximum points of 30 will be declared non-responsive and will be eliminated from further evaluation BBBEEE and Price.

14.3 PREFERENCE EVALUATION

BBBEE and Price

14.3.1 The tender responses will be evaluated on either 80/20 or 90/10 preference point system whichever one will be applicable once Total Cost of Ownership is assessed.

14.3.2 Financial Stability

a. The financial stability evaluation is used to assess the financial risk of the shortlisted bidders. (Where applicable)

b. . Respondents are required to submit their audited financial statements for the past 3 years with their Proposal/Bid in order to enable the SABC to establish financial stability as follows:-

Area	**Assessment Criteria**
Financial Due Diligence	Bidders financial due diligence will be assessed based on submitted audited financial statements using financial ratios. **(where applicable)**

END OF DOCUMENT E

Annexures to Document E:

ANNEXURE A: TENDER SUMMARY FOR BOTH DOCUMENT E1 AND E2

ANNEXURE B: BRIEFING SESSION GUIDELINES

ANNEXURE C: BILL OF QTY

Annexure D: DRAWINGS

DOCUMENT F

CONFIDENTIALITY

All information related to this bid both during and after completion is to be treated with strict confidence. Should the need however arise to divulge any information gleaned from the service which is either directly or indirectly related to the SABC, written approval to divulge such information will have to be obtained from SABC.

The bidders must ensure that confidential information is: maintained confidential; not disclosed to or used by any unauthorised person; so as to prevent any disclosure or unauthorised use with at least the standard of care that bidders maintain to protect their own confidential information; only used for the purpose of considering and responding to this RFP; and not reproduced in any form except as required for the purpose of considering and responding to this bid. Bidders must ensure that: access to confidential information is only given to those of its partners, officers, employees and advisers who require access for considering and responding to this RFP; and those partners, officers, employee and advisers are informed of the confidential information section and keep that information confidential. This bid remains at all times the property of the SABC. No rights other than as provided in this bid and in respect of the confidential information are granted or conveyed to bidder/s

NAME OF BIDDER:_____

PHYSICAL ADDRESS: _____

_____

Bidder's contact person: Name: _____

Telephone: _____

Mobile: _____

Fax.: _____

E-mail address: _____

END OF DOCUMENT F

DOCUMENT G

SBD 6.1

PREFERENCE POINTS CLAIM FORM IN TERMS OF THE PREFERENTIAL PROCUREMENT REGULATIONS 2017

This preference form must form part of all bids invited. It contains general information and serves as a claim form for preference points for Broad-Based Black Economic Empowerment (B-BBEE) Status Level of Contribution

NB: BEFORE COMPLETING THIS FORM, BIDDERS MUST STUDY THE GENERAL CONDITIONS, DEFINITIONS AND DIRECTIVES APPLICABLE IN RESPECT OF B-BBEE, AS PRESCRIBED IN THE PREFERENTIAL PROCUREMENT REGULATIONS, 2017.

1.0 GENERAL CONDITIONS

1.1 The following preference point systems are applicable to all bids:

- the **90/10** system for requirements with a Rand value above R50 million (all applicable taxes included).

1.2 The value of this bid is estimated to be below R50 million (all applicable taxes included) and therefore the……**…80/20**……system shall be applicable.

1.3 Preference points for this bid shall be awarded for:

(a) Price; and
(b) B-BBEE Status Level of Contribution.

1.3.1 The maximum points for this bid are allocated as follows:

		POINTS
1.3.1.1	PRICE	90
1.3.1.2	B-BBEE STATUS LEVEL OF CONTRIBUTION	10
	Total points for Price and B-BBEE must not exceed	**100**

1.4 Failure on the part of a bidder to fill in and/or to sign this form and submit a B-BBEE Verification Certificate from a Verification Agency accredited by the South African Accreditation System (SANAS) together with the bid, will be interpreted to mean that preference points for B-BBEE status level of contribution are not claimed.

1.5 The SABC reserves the right to require of a bidder, either before a bid is adjudicated or at any time subsequently, to substantiate any claim in regard to preferences, in any manner required by the SABC.

2.0 DEFINITIONS

2.1 **"all applicable taxes"** includes value-added tax, pay as you earn, income tax, unemployment insurance fund contributions and skills development levies;

2.2 **"B-BBEE"** means broad-based black economic empowerment as defined in section 1 of the Broad -Based Black Economic Empowerment Act;

2.3 "**B-BBEE status level of contributor"** means the B-BBEE status received by a measured entity based on its overall performance using the relevant scorecard contained in the Codes of Good Practice on Black Economic Empowerment, issued in terms of section 9(1) of the Broad-Based Black Economic Empowerment Act;

2.4 **"bid"** means a written offer in a prescribed or stipulated form in response to an invitation by an organ of state for the provision of services, works or goods, through price quotations, advertised competitive bidding processes or proposals;

2.5 **"Broad-Based Black Economic Empowerment Act"** means the Broad-Based Black Economic Empowerment Act, 2003 (Act No. 53 of 2003);

2.6 **"comparative price"** means the price after the factors of a non-firm price and all unconditional discounts that can be utilized have been taken into consideration;

2.7 **"consortium or joint venture"** means an association of persons for the purpose of combining their expertise, property, capital, efforts, skill and knowledge in an activity for the execution of a contract;

2.8 **"contract"** means the agreement that results from the acceptance of a bid by an organ of state;

2.9 **"EME"** means any enterprise with an annual total revenue of R10 million or less as per the Amended Codes of Good Practice (COGP).

2.10 **"Firm price"** means 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 the 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;

2.11 **"functionality"** means the measurement according to predetermined norms, as set out in the bid documents, of a service or commodity that is designed to be practical and useful, working or operating, taking into account, among other factors, the quality, reliability, viability and durability of a service and the technical capacity and ability of a bidder;

2.12 **"non-firm prices"** means all prices other than "firm" prices;

2.13 **"person"** includes a juristic person;

2.14 "**rand value**" means the total estimated value of a contract in South African currency, calculated at the time of bid invitations, and includes all applicable taxes and excise duties;

2.15 "**sub-contract**" means the primary contractor's assigning, leasing, making out work to, or employing, another person to support such primary contractor in the execution of part of a project in terms of the contract;

2.16 "**total revenue**" bears the same meaning assigned to this expression in the Codes of Good Practice on Black Economic Empowerment, issued in terms of section 9(1) of the Broad-Based Black Economic Empowerment Act;

2.17 "**trust**" means the arrangement through which the property of one person is made over or bequeathed to a trustee to administer such property for the benefit of another person; and

2.18 "**trustee**" means any person, including the founder of a trust, to whom property is bequeathed in order for such property to be administered for the benefit of another person.

3.0 ADJUDICATION USING A POINT SYSTEM

3.1 The bidder obtaining the highest number of total points will be awarded the contract.
3.2 Preference points shall be calculated after prices have been brought to a comparative basis taking into account all factors of non-firm prices and all unconditional discounts;.
3.3 Points scored must be rounded off to the nearest 2 decimal places.
3.4 In the event that two or more bids have scored equal total points, the successful bid must be the one scoring the highest number of preference points for B-BBEE.
3.5 However, when functionality is part of the evaluation process and two or more bids have scored equal points including equal preference points for B-BBEE, the successful bid must be the one scoring the highest score for functionality.
3.6 Should two or more bids be equal in all respects, the award shall be decided by the drawing of lots.

4.0 AWARDED FOR PRICE

4.1 THE 80/20 OR 90/10 PREFERENCE POINT SYSTEMS

A maximum of 80 or 90 points is allocated for price on the following basis:

80/20 **or** **90/10**

$$Ps = 80\left(1 - \frac{Pt - P\min}{P\min}\right) \quad \text{or} \quad Ps = 90\left(1 - \frac{Pt - P\min}{P\min}\right)$$

Where

Ps = Points scored for comparative price of bid under consideration

Pt = Comparative price of bid under consideration

Pmin = Comparative price of lowest acceptable bid

5.0 Points awarded for B-BBEE Status Level of Contribution

5.1 In terms of Regulation 5 (2) and 6 (2) of the Preferential Procurement Regulations, preference points must be awarded to a bidder for attaining the B-BBEE status level of contribution in accordance with the table below:

B-BBEE Status Level of Contributor	**Number of points (90/10 system)**	**Number of points (80/20 system)**
1	*10*	*20*
2	*9*	*18*
3	*6*	*14*
4	*5*	*12*
5	*4*	*8*
6	*3*	*6*
7	*2*	*4*
8	*1*	*2*
Non-compliant contributor	*0*	*0*

6.0 BID DECLARATION

6.1 Bidders who claim points in respect of B-BBEE Status Level of Contribution must complete the following:

7.0 B-BBEE STATUS LEVEL OF CONTRIBUTION CLAIMED IN TERMS OF PARAGRAPHS 1.3.1.2 AND 5.1

7.1 B-BBEE Status Level of Contribution:…… = ……(maximum of 10 or 20 points)
(Points claimed in respect of paragraph 7.1 must be in accordance with the table reflected in paragraph 5.1 and must be substantiated by means of a B-BBEE affidavit or certificate issued by a Verification Agency accredited by SANAS.

8.0 SUB-CONTRACTING

8.1 Will any portion of the contract be sub-contracted? **YES / NO** (delete which is not applicable)

8.1.1 If yes, indicate:

(i) what percentage of the contract will be subcontracted? ....……%

(ii) the name of the sub-contractor? ……

(iii) the B-BBEE status level of the sub-contractor? ……..……

(iv) whether the sub-contractor is an EME? YES / NO (delete which is not applicable)

9.0 DECLARATION WITH REGARD TO COMPANY/FIRM

9.1 Name of company/firm: ……
9.2 VAT registration number: ……
9.3 Company registration number ……

9.4 Type Of Company/ Firm - [Tick applicable box]

- ☐ Partnership/Joint Venture / Consortium
- ☐ One person business/sole propriety
- ☐ Close corporation
- ☐ Company
- ☐ (Pty) Limited

9.5 Describe Principal Business Activities

……..... ……..……..

..... ……..

.....

.....

9.6 Company Classification - [Tick applicable box]

- ☐ Manufacturer
- ☐ Supplier
- ☐ Professional service provider
- ☐ Other service providers, e.g. transporter, etc.

9.7 Total number of years the company/firm has been in business? ……

9.8 I/we, the undersigned, who is / are duly authorised to do so on behalf of the company/firm, certify that the points claimed, based on the B-BBE status level of contribution indicated in paragraph 7 of the foregoing certificate, qualifies the company/ firm for the preference(s) shown and I / we acknowledge that:

(i) The information furnished is true and correct;
(ii) The preference points claimed are in accordance with the General Conditions as indicated in paragraph 1 of this form.
(iii) In the event of a contract being awarded as a result of points claimed as shown in paragraph 7, the contractor may be required to furnish documentary proof to the satisfaction of the SABC that the claims are correct;
(iv) If the B-BBEE status level of contribution has been claimed or obtained on a fraudulent basis or any of the conditions of contract have not been fulfilled, the SABC may, in addition to any other remedy it may have;

a) disqualify the person from the bidding process;

b) recover costs, losses or damages it has incurred or suffered as a result of that person's conduct;

c) cancel the contract and claim any damages which it has suffered as a result of having to make less favourable arrangements due to such cancellation;

d) restrict the bidder or contractor, its shareholders and directors, or only the shareholders and directors who acted on a fraudulent basis, from obtaining business from any organ of state for a period not exceeding 10 years, after the audi alteram partem (hear the other side) rule has been applied; and

e) forward the matter for criminal prosecution

WITNESSES:

1. ……

2. ……

SIGNATURE(S) OF BIDDER(S)

DATE: ……..

ADDRESS: ……..……..……

……..……..……..……

……..……..……..……

……..……..……..……..……

END OF DOCUMENT G

DOCUMENT H

SBD 8

DECLARATION OF BIDDER'S PAST SUPPLY CHAIN MANAGEMENT PRACTICES

1.0 This Standard Bidding Document must form part of all bids invited.

2.0 It serves as a declaration to be used by institutions in ensuring that when goods and services are being procured, all reasonable steps are taken to combat the abuse of the supply chain management system.

3.0 The bid of any bidder may be disregarded if that bidder, or any of its directors have-

a. abused the institution's supply chain management system;
b. committed fraud or any other improper conduct in relation to such system; or
c. failed to perform on any previous contract.

4.0 In order to give effect to the above, the following questionnaire must be completed and submitted with the bid.

Item	Question	Yes	No
4.1	Is the bidder or any of its directors listed on the National Treasury's Database of Restricted Suppliers as companies or persons prohibited from doing business with the public sector? (Companies or persons who are listed on this Database were informed in writing of this restriction by the Accounting Officer/Authority of the institution that imposed the restriction after the *audi alteram partem* rule was applied). **The Database of Restricted Suppliers now resides on the National Treasury's website(www.treasury.gov.za) and can be accessed by clicking on its link at the bottom of the home page.**	Yes ☐	No ☐
4.1.1	If so, furnish particulars:		
4.2	Is the bidder or any of its directors listed on the Register for Tender Defaulters in terms of section 29 of the Prevention and Combating of Corrupt Activities Act (No 12 of 2004)? **Register for Tender Defaulters can be accessed on the National Treasury's website (www.treasury.gov.za) by clicking on its link at the bottom of the home page.**	Yes ☐	No ☐

Item	Question	Yes	No
4.2.1	If so, furnish particulars:		
4.3	Was the bidder or any of its directors convicted by a court of law (including a court outside of the Republic of South Africa) for fraud or corruption during the past five years?	Yes ☐	No ☐
4.3.1	If so, furnish particulars:		
4.4	Was any contract between the bidder and any organ of state terminated during the past five years on account of failure to perform on or comply with the contract?	Yes ☐	No ☐
4.4.1	If so, furnish particulars:		

CERTIFICATION

I, THE UNDERSIGNED (FULL NAME)……
CERTIFY THAT THE INFORMATION FURNISHED ON THIS DECLARATION FORM IS TRUE AND CORRECT.

I ACCEPT THAT, IN ADDITION TO CANCELLATION OF A CONTRACT, ACTION MAY BE TAKEN AGAINST ME SHOULD THIS DECLARATION PROVE TO BE FALSE.

……... **……..**
Signature **Date**

……. **……..**
Position **Name of Bidder**

END OF DOCUMENT H

DOCUMENT I

SBD 9

CERTIFICATE OF INDEPENDENT BID DETERMINATION

1.0 This Standard Bidding Document (SBD) must form part of all bids[1] invited.

2.0 Section 4 (1) (b) (iii) of the Competition Act No. 89 of 1998, as amended, prohibits an agreement between, or concerted practice by, firms, or a decision by an association of firms, if it is between parties in a horizontal relationship and if it involves collusive bidding (or bid rigging).[2] Collusive bidding is a *pe se* prohibition meaning that it cannot be justified under any grounds.

3.0 Treasury Regulation 16A9 prescribes that accounting officers and accounting authorities must take all reasonable steps to prevent abuse of the supply chain management system and authorizes accounting officers and accounting authorities to:

a. disregard the bid of any bidder if that bidder, or any of its directors have abused the institution's supply chain management system and or committed fraud or any other improper conduct in relation to such system.

b. cancel a contract awarded to a supplier of goods and services if the supplier committed any corrupt or fraudulent act during the bidding process or the execution of that contract.

4.0 This SBD serves as a certificate of declaration that would be used by institutions to ensure that, when bids are considered, reasonable steps are taken to prevent any form of bid-rigging.

5.0 In order to give effect to the above, the attached Certificate of Bid Determination (SBD 9) must be completed and submitted with the bid:

[1] Includes price quotations, advertised competitive bids, limited bids and proposals.

[2] Bid rigging (or collusive bidding) occurs when businesses, that would otherwise be expected to compete, secretly conspire to raise prices or lower the quality of goods and / or services for SABCs who wish to acquire goods and / or services through a bidding process. Bid rigging is, therefore, an agreement between competitors not to compete.

CERTIFICATE OF INDEPENDENT BID DETERMINATION

I, the undersigned, in submitting the accompanying bid RFP ***No. RFP/HEN/2020/29***
in response to the invitation for the bid made by:

South African Broadcasting Corporation SOC Limited "SABC"

---

do hereby make the following statements that I certify to be true and complete in every respect:

I certify, on behalf of:_____ that:
(Name of Bidder)

1. I have read and I understand the contents of this Certificate;
2. I understand that the accompanying bid will be disqualified if this Certificate is found not to be true and complete in every respect;
3. I am authorized by the bidder to sign this Certificate, and to submit the accompanying bid, on behalf of the bidder;
4. Each person whose signature appears on the accompanying bid has been authorized by the bidder to determine the terms of, and to sign the bid, on behalf of the bidder;
5. For the purposes of this Certificate and the accompanying bid, I understand that the word "competitor" shall include any individual or organization, other than the bidder, whether or not affiliated with the bidder, who:
   (a) has been requested to submit a bid in response to this bid invitation;
   (b) could potentially submit a bid in response to this bid invitation, based on their qualifications, abilities or experience; and
   (c) provides the same goods and services as the bidder and/or is in the same line of business as the bidder
6. The bidder has arrived at the accompanying bid independently from, and without consultation, communication, agreement or arrangement with any competitor. However communication between partners in a joint venture or consortium[3] will not be construed as collusive bidding.
7. In particular, without limiting the generality of paragraphs 6 above, there has been no consultation, communication, agreement or arrangement with any competitor regarding:
   (a) prices;

(b) geographical area where product or service will be rendered (market allocation)

(c) methods, factors or formulas used to calculate prices;

(d) the intention or decision to submit or not to submit, a bid;

(e) the submission of a bid which does not meet the specifications and conditions of the bid; or

(f) bidding with the intention not to win the bid.

8. In addition, there have been no consultations, communications, agreements or arrangements with any competitor regarding the quality, quantity, specifications and conditions or delivery particulars of the products or services to which this bid invitation relates.
9. The terms of the accompanying bid have not been, and will not be, disclosed by the bidder, directly or indirectly, to any competitor, prior to the date and time of the official bid opening or of the awarding of the contract.

[3] **Joint venture or Consortium means an association of persons for the purpose of combining their expertise, property, capital, efforts, skill and knowledge in an activity for the execution of a contract.**

10. I am aware that, in addition and without prejudice to any other remedy provided to combat any restrictive practices related to bids and contracts, bids that are suspicious will be reported to the Competition Commission for investigation and possible imposition of administrative penalties in terms of section 59 of the Competition Act No 89 of 1998 and or may be reported to the National Prosecuting Authority (NPA) for criminal investigation and or may be restricted from conducting business with the public sector for a period not exceeding ten (10) years in terms of the Prevention and Combating of Corrupt Activities Act No 12 of 2004 or any other applicable legislation.

…… ……

Signature Date

…… ……

Position Name of Bidder

END OF DOCUMENT I

DOCUMENT J

ACCEPTANCE OF CONDITIONS OF BID

By signing the BID document, the Bidder is deemed to acknowledge and accept that all the conditions governing this BID, including those contained in any printed form stated to form part thereof and SABC Limited will recognize no claim for relief based on an allegation that the Bidder overlooked any such condition or failed properly to take it into account for the purpose of calculating bided prices or otherwise**.**

SIGNED at _____ this _____ day of _____2020.

NAME OF COMPANY_____

NAME OF THE SIGNATORY (IES) _____

CAPACITY:_____

Are you authorised to sign on behalf of the company (YES/NO) _____

WITNESSES:

1. _____

2. _____

_____

BIDDER

END OF DOCUMENT J

ANNEXURE A

TENDER PRICE SUMMARY (LA68)

BREAKDOWN OF AN ALL-INCLUSIVE TENDER PRICE

Fixed Amount (Duration of Contract) R_____

Variable Amount (Exchange Rate dependent) R_____ @USD=**R17.3122**

_____ @ EURO= **R20.7837**

_____ @GBP=**R 23.1179**

SUB TOTAL R_____

Add 15% Vat R_____

TOTAL TENDER AMOUNT **R**_____

BIDDER DETAILS:

Name of Tenderer: _____

Address: _____

_____

_____

E-mail address: _____

Telephone: _____

Signature: _____

Date: _____

Annexure A

TENDER PRICE SUMMARY (ES20)

BREAKDOWN OF AN ALL-INCLUSIVE TENDER PRICE

Fixed Amount (Duration of Contract) R_____

Variable Amount (Exchange Rate dependent) R_____ @USD= **R17.3122**

_____ @EURO= **R20.7837**

_____GBP=**R23.1179**

SUB TOTAL R_____

Add 15% Vat R_____

TOTAL TENDER AMOUNT **R**_____

BIDDER DETAILS:

Name of Tenderer: _____

Address: _____

_____

_____

E-mail address: _____

Telephone: _____

Signature: _____

Date: _____

END OF THE REQUEST FOR PROPOSAL DOCUMENT

ANNEXURE B

GUIDELINE FOR BRIEFING SESSION

Applicable where Briefing Sessions are not compulsory or mandatory:

Due to the Covid-19 pandemic, and in compliance with National Treasury Instruction Note 5, institutions are advised as far as possible to avoid convening briefing sessions. Therefore a briefing session **WILL NOT BE SCHEDULED** in cases where it is avoidable and the following will apply:

- Bidders are requested to submit their queries related to the bid via email
- Bidders must send their queries to the Bid Office via the email tenderqueries@sabc.co.za
- The queries must be submitted at least within 10 days after the tender has been advertised on the National Treasury E-Tender Portal and the SABC Website.
- The Bid Office will forward the queries to the Bid Specification Team for relevant response.
- All queries and responses will be consolidated into a schedule of questions and answers and published on all the platforms that were utilized to advertise the tender within 5 days after the query deadline.

Applicable where Briefing Sessions are unavoidable:

Where a briefing session cannot be avoided and, to the extent permitted by the Disaster Management Act (DMA) Regulations, the following will apply:

- The briefing session meeting will be arranged by means of an online session using the Microsoft TEAMS or similar enablers, the date and time of which will be published on the E-Tender Portal and SABC Website.
- Bidders who have access to Microsoft Teams or similar enablers are kindly requested to advice of their interest to participate in the online briefing session by sending an email to tenderqueries@sabc.co.za 3 days before the briefing session so as to be invited.
- On the date and time of the briefing session, bidders will be invited via Microsoft Teams or similar enablers to attend the online briefing session meeting.
- Bidders who are unable to connect via Microsoft TEAMS or similar enablers are requested to submit their queries related to the bid via email. The aforementioned process will follow

- Site Inspection will not be made compulsory however; the bidders should be advised that non-attendance of such will be to their disadvantage. Should the need arise for a site inspection to be part of a briefing session, the following will apply:

  - SABC seeks to apply stringent precautionary measures to ensure maximum adherence to COVID-19 protocols and ensure a safe work environment by enforcing social distancing in the workplace. Only a **maximum number of 15 people per session** will be permitted to attend the briefing session at a time. The SCM Practitioner will arrange multiple sessions to accommodate only the allowed maximum number. The first come first rule will apply. If the first session is full, Bidders will attend the next session.
  - The dates and times of the briefing sessions will be advertised on the National Treasury E-Tender Portal and the SABC Website.
  - Bidders are required to confirm attendance at least one day in advance of session date using the email tenderqueries@sabc.co.za.
  - Bidders must wear masks and practise social and physical distancing at all times.
  - Bidders must comply with SABC COVID 19 screening process. Should the bidder's entry be denied due to high temperature or related COVID 19 restriction, such bidder's attendance should be acknowledged, and alternative Site Inspection be arranged if needed for a different representative from the same company.
  - All queries and responses from the various briefings sessions will be consolidated into a schedule of questions and answers and communicated to all Bidders who have attended the compulsory briefing sessions.