

Section B: PROPOSAL SPECIFICATION.

Contents

Project Scope for Power Factor Correction (PFC)	4
1. City Power's Objective	4
2. Overview of the works	4
3. Site location	5
4. Site conditions.....	6
5. Scope of Works.....	6
6. Expected Outcomes	7
ENGINEERING (Section)	7
1. Labour Intensive Construction	7
2. Subcontracting	8
3. Construction	8
4. Variations and additional clauses to the standard and specifications	9
Table1: Civil Standards	10
1. Quality assurance documents.....	12
2. Plant	12
3. Project Management Plan	12
4. Construction Programme	13
5. Site Administration	14
6. Site Instructions.....	15
7. Site Meetings	15
8. Payment Certificates	15
SITE FACILITIES (Section)	16
1. Site considerations	16
2. Contractor's Camp	16
3. Source of Water Supply	16
4. Source of Power Supply	17
5. Housing.....	17
6. Name boards.....	18
7. Office building	18
8. Sanitary facilities	18

DESIGN (Section)	18
1. Design improvements /coordination	18
PRIMARY PLANT (Section)	19
Table 2: Electrical standards	19
1. Electrical conditions	22
2. Ratings	23
3. Medium Voltage (MV) Equipment.....	23
4. Instrumentation transformers	24
5. Low Voltage (LV) equipment	24
6. Auxiliary AC board.....	25
7. Degree of Protection	25
8. Control functionality	26
SECONDARY PLANT (Section)	27
1. DC Plant	27
2. Intelligent electronic devices.....	27
3. SCADA System	28
4. SCADA Functional design specification (FDS)	29
5. Inputs and Outputs requirements	30
6. Analogue inputs.....	30
7. Power Quality Unit	30
8. SCADA detail design specification (DDS)	31
9. Communication.....	31
10. Human Machine Interface (HMI) requirements	32
CABLES (Section)	32
1. Fibre Optic Cable.....	32
2. Cabling and Wiring.....	32
3. Protection cabling.....	33
4. Metering cables	33
5. SCADA cables	33
6. MV cable terminations	33
7. Cabling requirements	33
8. Cable Labelling.....	34
EARTHING (Section)	35

1. Earth Resistance Survey	35
ENCLOSURE (Section)	35
1. Installation	35
TESTING AND COMMISSIONING (Section)	36
1. Testing.....	36
2. Factory Acceptance Testing (FAT)	36
3. Site acceptance testing (SAT)	38
4. Commissioning Milestones	38
5. Acceptance Criteria	39
6. Warranty	39
7. Spares.....	39
8. Maintenance	40
DOCUMENTATION (Section)	40
1. Documents.....	40
2. Drawings	41
TRAINING (Section)	42
1. Training	42
SHERQ (Section)	42
1. Health, Safety and Environmental Requirements	42
Fire and Security (Section)	43
1. CCTV System.....	43
2. Fire Extinguishers.....	43
3. Security Locks	44
4. Signs and Notices	44
Annexure A: DRAWINGS	45
Annexure B: TECHNICAL SPECIFICATIONS	45
Annexure C: BILL OF QUANTITIES	45

Project Scope for Power Factor Correction (PFC)

1. City Power's Objective

1.1 City Power Johannesburg SOC Ltd ("City Power") is the municipal electricity distribution utility responsible for ensuring the reliable delivery of electricity services to the residents and businesses of the City of Johannesburg Metropolitan Municipality. Electricity distribution forms one of the most critical infrastructure services supporting economic development, urban functionality, and social wellbeing within modern metropolitan cities.

1.2 Reliable electricity infrastructure enables commercial activity, industrial productivity, public safety, and the functioning of essential services such as healthcare facilities, educational institutions, and public transport systems. As Johannesburg is the economic hub of South Africa and one of the most significant metropolitan economies on the African continent, the reliability and sustainability of the electricity distribution network are fundamental to maintaining economic competitiveness and attracting investment.

1.3 The objective of this project is to improve the City Power's Network power factor from its current level to a target value agreed after Network study by the utility, thereby reducing reactive power demand, reducing the penalty charges, improving system efficiency, and increasing the available capacity of the electrical Network distribution system.

2. Overview of the works

2.1 The scope of works include execution on turnkey basis with complete system Network study, design, planning, sourcing of equipment, manufacturer's quality assurance, factory testing, transportation, storage, erection including all civil/ structural works, site testing commissioning of all items & materials as elaborated below including all associated activities that though not exclusively specified herein but are required for the completion of the entire scope under this scope.

2.2 This project document intends to cover, but not restrict to, the following activities, services and works:

- a) Complete design and engineering of all the systems, sub-systems, equipment, material and services.
- b) Providing engineering data, drawings and O&M manuals, approval and records.
- c) Manufacturing, supply, testing, packing, transportation and insurance from the manufacturer's work to site.

- d) Receipt, storage, insurance, preservation and conservation of equipment at site.
- e) All civil and structural works as required.
- f) Fabrication, pre-assembly (if any), erection, testing and putting into satisfactory operation of all the equipment/materials including successful commissioning.

2.3 In addition to the requirements indicated in this section (Technical Specifications), all the requirements as stated in other sections shall also be considered as a part of this document as if completely bound herewith.

2.4 The Contractor shall be responsible for providing all material, equipment and services specified or otherwise which are required to ensure operability, maintainability and the reliability of the complete work covered under this document.

2.5 During Guarantee period, all the services and activities shall be carried out as per terms and conditions specified in the bid document.

2.6 The drawings shared with the Technical Specification in Annexure are generally of illustrative nature. In actual practice, notwithstanding any anomalies, discrepancies, omissions, incompleteness, etc. in these specifications and attached drawings, the design and constructional aspects, including materials and dimensions, will be subject to good engineering practice in conformity with the required quality of the product and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulation in that respect in the relevant South African National Standards, IEC standards and other statutory provisions.

2.7 The plant/equipment/material offered shall be complete with all parts necessary for their effective and trouble-free operation. Such parts will be deemed to be within the scope irrespective of whether they are specifically indicated in the Bid documents or not.

2.8 This project involves an installation of Power Factor Correction (PFC) equipment and related ancillary equipment and building alteration.

3. Site location

3.1 Crown Substation is located on South of Johannesburg (GPS coordinates TBA). This substation is classified as an Intake station from Eskom Transmission Network. The configuration is 132/11kV connected at 11kV from Eskom substation.

4. Site conditions

4.1 These site conditions are applicable to general knowledge, for detailed or specific information the Contractor shall source data from South African Weather Services:

- a) Altitude: +-1800m Above sea level.
- b) Ambient temperature: -5°C to +36°C (Summer daily max average +30°C).
- c) Lightning conditions: Severe, with a maximum lightning ground flash density of 15 flashes per km² per annum.
- d) Atmosphere: Normal climatic conditions.

5. Scope of Works

5.1 This scope details a Network study, Substation Design, Equipment supply, installation, testing and commissioning of all new equipment and related control and measurement systems at the Substation including SCADA system for enhanced monitoring and control of systems, implementation of overcurrent, earth fault and arc protection and the installation of new AC/DC panel, battery cabinet and battery charger. Additionally, it will include the installing of the new capacitor bank with controls and completing building alternations (Civil and Electrical related).

5.2 A generic scope of works not limited, is as follows:

- a) Install new switchgear equipment,
- b) Implementation of a SCADA system for enhanced monitoring and control of panels.
- c) Install new AC/DC system,
- d) Install battery charger and install new batteries in the control room.
- e) Re-configuration of the existing substation that includes building works necessary to accommodate new equipment,
- f) Install new capacitor banks equipment.
- g) Re-arranging of the cameras, fire monitoring within the substation.
- h) Installation of new cameras and fire monitoring sensors where required.
- i) Refurbishment and painting of entire switch room and including the floors.
- j) Lighting installation.

6. Expected Outcomes

6.1 After testing and commissioning City Power expects to achieve these comes from a successful project implementation:

- a) An improved power factor to at least 0.98,
- b) A reduced reactive power demand (kVAr),
- c) Eliminate or significantly reduce power factor penalties,
- d) Lower technical energy losses,
- e) An improved voltage regulation,
- f) An increase in feeder capacity,
- g) An improvement in system efficiency and
- h) Extend the operational life of electrical equipment.

ENGINEERING (Section)

A detail scope of Works, Network Study and proposed substation designs supported by equipment specifications shall be defined by the Service Provider in partnership with City Power.

1. Labour Intensive Construction

1.1 Labour Intensive Construction shall mean the economically efficient employment of as great a portion of labour as is technically feasible to produce a standard of construction as demanded by the Specifications with completion by the Due Completion Date, thus the effective substitution of labour for equipment. Appropriate portions of the Works included in the Contract shall be executed using labour intensive construction methods. These portions of the Works shall be constructed utilising only locally employed labour and/or the labour of local sub-contractors, supplemented to the extent necessary and unavoidable by the Contractors key personnel as provided, unless otherwise instructed by the Engineer. The portions of the Works to be executed using labour intensive construction methods are:

- a) Painting and building related works.
- b) clearing and grubbing of the Site;

- c) bedding, selected fill, backfilling and compaction of all cable trenches irrespective of depth, but assisted by mechanical compaction equipment in order to achieve the specified densities;
- d) transportation and spoiling of all trench materials, where the disposal site is located within 20 metres of source;
- e) dismantling and re-erection of fences; and
- f) cleaning and tidying up of the Site.

1.2 In respect of those portions of works which are not listed above, the construction methods adopted and plant utilised shall be at the discretion of the Contractor, provided always that the construction methods adopted and plant utilised by the Contractor are appropriate in respect of the nature of the Works to be executed and the standards to be achieved in terms of the Contract.

2. Subcontracting

2.1 The Contractor shall appoint such authorities and/or specialist subcontractors and suppliers as may be designated or nominated by the Employer or the Engineer for those portions of the Works specified in the Scope of Works. As required by the Conditions of Contract, the Contractor shall be responsible for all work carried out by sub-contractors (whether nominated by the Employer or selected by the Contractor) on his behalf. The Engineer will not liaise directly with any such subcontractor, nor will he become involved in any problems and/or disputes related to payments, programming, workmanship, etc, unless provided for in the Conditions of Contract. Such problems and/or disputes shall remain the sole concern of the Contractor and his sub-contractors.

3. Construction

The whole Substation will be live at any given time during execution of this project, therefore works shall be planned and conducted with the consideration that the substation will be live at all times.

3.1 The Standard Specifications on which this contract is based are the South African Bureau of Standard's Standardized Specifications for Civil Engineering Construction (SABS 1200). (Note: "SABS has been changed to "SANS"; the SABS 1200 specifications are due to be replaced in the foreseeable future by SANS 2001 amongst other specifications). Although not bound in nor issued with this Document, the relevant sections of the standard specifications shall form part of this Contract.

3.2 These documents are available at the Contractor's expense from the SA Bureau of Standards, Private Bag X191, PRETORIA, 0001.

3.3 The applicable SABS 1200 Standardised Specification for this Contract shall be the following:

- a) A - General
- b) AA - General (small works)
- c) AB - Engineers office
- d) AH - General (structural)
- e) DB - Earth Work for trenches
- f) C - Site clearance
- g) G - Concrete (structural)
- h) GA - Concrete (small works)
- i) GB - Concrete (ordinary buildings)
- j) GE - Precast concrete
- k) HA - Structural steelwork (sundry items)
- l) HB - Cladding and sheeting
- m) HC - Corrosion protection of structural steelwork
- n) LB - Bedding (pipes)
- o) LC - Cable ducts

3.4 The various documents listed in section shall be treated as mutually explanatory. However, should any standard conflict with any requirement of the Standardised Specifications or with any requirement of the Particular Specifications, then the requirement of clause shall prevail.

4. Variations and additional clauses to the standard and specifications

4.1 All equipment supplied under this scope shall comply with the requirements stated. The Supplier shall, nevertheless, ensure that all equipment and software supplied is suitable for the intended purpose and environment. The Supplier shall furthermore accept all responsibility for the satisfactory quality, design and workmanship of the System and all equipment of which the system is comprised, whether manufactured by him or not.

4.2 The equipment shall be designed to facilitate preventative and corrective maintenance and operation with high availability for a period of at least ten years. The design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operation and maintenance of the equipment supplied. The equipment shall not generate any type of interference especially electromagnetic interference at a level which could be detrimental to the performance of other equipment, or which could cause annoyance or discomfort to personnel.

4.3 All equipment shall be designed to take into account the provisions of local statutory regulations, in particular the Occupational Health and Safety Act 85 of 1993, as amended. All metal equipment enclosures and the metalwork of desks shall be securely bonded to the earth network at the location concerned. No equipment shall contain any material/substance that will constitute a health hazard to personnel at any time.

4.4 The Supplier shall submit a document stating section by section whether they comply with the specifications and explaining any deviations from the specifications. The following variations and additions to the Standard and Particular Specifications will be applicable to this project:

Table1: Civil Standards

Document No.	Description
SANS 1200	Civil Engineering Construction (all relevant parts)
SANS 10400	Application of National Building Regulations (all relevant parts)
SANS 10109-2	Finishes to concrete floors
SANS 10142-1	Wiring of premises Part 1
SANS 10142-2	Wiring of premises Part 2
SANS 10114 –1	Interior Lighting
SANS 10139	Primary standard for fire detection
SANS 10021	Waterproofing of buildings
SANS 1029	Miniature substations
SANS 1507	Electric cables with extruded solid dielectric insulation for fixed installations (300 / 500 V to 1900/ 3300 V)
SANS 1411	Materials of insulated electric cables and flexible cords
SANS 60694	Common specifications for HV switchgear and Control gear standards
SANS 62711	Part 100 – High voltage alternating current circuit breakers
SANS 62271-	AC metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV
SANS 62271-100	Alternating-current circuit-breakers
SANS 1574	Electric flexible cores, cords and cables with solid extruded dielectric insulation
SANS 60227	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V

SANS 1885 ANNEX A	Rules for application of standard wire numbering
SANS 1652	Battery chargers (not attached)
SANS 1632	Batteries parts 2 & 3(not attached)
SANS 1019	Standard voltages, currents and insulation levels for electricity supply
SANS IEC 60529	Degrees of protection provided by enclosures (IP code)
SANS IEC 60793	Optical fibres
SANS IEC 60794	Optical fibre cables
SANS IEC 61000	Electromagnetic compatibility (EMC)
SANS 61073-1	Splices for optical fibres and cables
SANS IEC 61131	Programmable controllers - All parts
NRS 037-1 2006:1	Telecontrol protocol Part 1: Telecontrol protocol for stand-alone remote terminal units
BS 4579-1	The performance of mechanical and compression joints in electric cable and wire connectors
BS 9520	Electrical connectors of assessed quality for DC and low frequency application: generic data, methods of test and capability approval procedures
IEC 60255	Electrical relays - Part 3 to 25
IEC 60870-5-101	Tele-control equipment and systems – Part 5: Transmission protocols – Section 101: Companion standard for basic Telecontrol tasks
IEC 60870-5-103	Tele-control equipment and systems – Part 5-103: Transmission protocols – Companion standard for the informative interface of protection equipment
SANS 121:2011	Hot dip galvanized coatings on fabricated iron and steel articles.
IEC 61274	Fibre optic adaptors
IEC 61850	Communication networks and systems in substations
IEC 62063	The use of electronic and associated technologies in auxiliary equipment of switchgear and control gear
SANS 1339	Cross-linked polyethylene (XLPE) insulated cables for rated voltages 3,8/6,6 kV to 19/33 kV
SANS 97	Impregnated paper insulated metal-sheathed cables for rated voltages 3,3/3,3 kV to 19/33 kV (excluding pressure assisted cables)
SANS 10198	The selection, handling and installation of electric power cables of rating not exceeding 33 kV (all parts)
OHSA	The Occupational Health and Safety Act 85 of 1993
ISO 9001	Model to Quality Assurance in Design Development, Production, Installation and Services.

GENERAL (Section)

1. Quality assurance documents

1.1 All material used in the Works shall, where such mark has been awarded for a specific type of material, bear the SABS mark. Alternatively, the Contractor shall furnish the Engineer with certificates of compliance of materials, which bear the official mark of the appropriate standard.

1.2 The Contractor shall ensure availability of the following Quality Assurance Documents:

- a) All Non-Destructive Examination procedures, stress relief and weld repair procedure used during fabrication and reports including radiography interpretation reports.
- b) Factory test results for testing required as per applicable quality plan/technical specifications/drawing etc as applicable.

2. Plant

2.1 Except where the use of plant is essential in order to meet the specified requirements by the Due Completion Date, the Contractor shall use only hand tools and equipment in the construction of those portion(s) of the Works that are required in terms of the Scope of Works to be constructed using labour intensive construction methods.

3. Project Management Plan

3.1 The Contractor is required to prepare and submit a project management plan for the construction. The contents that should be included in the Contractor's Project Management Plan are listed below:

- **Project structures and agreements**

3.2 The Contractor shall indicate how responsibility for the various work packages will be divided between partners (where applicable) and sub-contractors. A contract organogram shall be provided showing work apportionment and project management responsibilities. The division of work shall match the established capabilities and capacities of each particular partner or subcontractor.

- **Plant, materials and equipment**

3.3 The Contractor shall prepare a Plant and Materials procurement plan, indicating the source of key Plant and Materials designated for inclusion in the scope, and demonstrating that such Plant and Materials have a proven track record of successful maintenance support in South Africa. The Contractor shall also prepare a plan of Contractor's Equipment, indicating the source and details of construction equipment planned for use on the Contract and based on the Contractor's particular approach.

- **Staffing plan**

3.4 The Contractor shall prepare a detailed staffing plan showing in an organogram all key members of the Contractor's Personnel, providing a detailed CV for each such key position. The Contractor shall also show the numbers and source of all non-key staff and indicating the local content offering of the Contractor.

- **Method statements**

3.5 The Contractor shall clearly describe the overall methodology proposed for construction of the Works and include method statements for each work discipline included in the scope.

- **Hold Points**

3.6 The contractor is to include hold points for critical activities in the project and obtain the engineers approval prior to proceeding with following activities. Hold points are to be listed by the contractor and approved by the engineer prior to project commencement. In addition, the contractor is to provide quality control plan before commencing with the works.

4. Construction Programme

4.1 The Contractor shall submit within the period stated in the Contract Data a suitable and realistic construction programme for the consideration of the Engineer.

4.2 The programme shall be in the form of a Gantt chart and shall include the following details:

- a) A work breakdown structure, identifying the major activity groups.
- b) For each activity group further details shall be provided regarding the scheduled start and end dates of individual activities.

- c) The linkages between activities shall be clearly indicated and the logical network upon which the programme is based shall be separately submitted to the engineer if requested. Any constraints shall be classified as being time-related or resource-related.

5. Site Administration

• Daily Site Diary

5.1 The daily site diary in accordance with the pro forma appended shall be kept up to date by the Contractor's Site Agent and will be signed daily by the Engineer's Representative.

• Information in Respect of Plant

5.2 Information relating to plant on Site shall be recorded in the daily site diary. In addition, the Contractor shall deliver to the Engineer, monthly, a detailed summary of construction plant kept on the Site, full particulars given for each day of the month. Distinction shall be made between plant in working order and plant out-of-order. Such inventory shall be submitted by the first day of the month following the month to be reported.

• Information in Respect of Employees

5.3 Information relating to labour and management on Site shall be recorded in the daily site diary. In addition, the Contractor shall deliver to the Engineer, monthly, a detailed summary of supervisory staff, labour employed (own and local labour) by category, and sub-contractors (both local and imported) for each day of the month. Such return shall be submitted by the first day of the month following the month to be reported.

• Rainfall Records

5.4 Rainfall records for the period of construction shall be taken on Site and recorded in the daily site diary. The Contractor shall provide and install all the necessary equipment for accurately measuring the rainfall. The Contractor shall also provide, erect and maintain a security fence plus gate, padlock and keys at each measuring station, all at his own cost. The Engineer or his Representative shall take and record the daily rainfall readings. The Contractor shall be permitted to attend these readings, in the company of the Engineer's Representative. Access to the measuring gauge(s) shall at all times be under the Engineer's control.

6. Site Instructions

6.1 Site instructions by the Engineer, addressed to the Contractor at his office on the Site, will be numbered consecutively and will be deemed to have been received by the Contractor's Representative unless a break in the sequence of numbers is brought to the notice of the Engineer in writing immediately.

7. Site Meetings

7.1 The Contractor and his authorised representative shall attend all meetings held on the Site with the City Power and the professional team at dates and times to be determined by the Engineer. Such meetings will be held to evaluate the progress of the Contract, and to discuss matters pertaining to the Contract which any of the parties represented may wish to raise. It is not the intention to discuss day-to-day technical matters at such meetings.

8. Payment Certificates

8.1 Monthly Progress Payment Certificates shall be submitted to the Engineer's Representative on Site not later than the 20th of each month (or on the last working day prior to this date) in order to allow for checking and reconciliation of all quantities, rates, extensions and additions in the certificate.

8.2 Each progress payment certificate shall include work executed or reasonably expected to be executed up to the 30th day of the specific month. The Engineer's Representative shall have a period of five (5) calendar days to review the draft certificate in collaboration with the Contractor. All quantity calculations and certificates submitted by the Contractor for checking shall be in accordance with the Engineer's standard site administration forms and formats as referred.

8.3 Upon agreement by the Engineer's Representative by not later than the 25th of each month, the certificate shall be submitted by the Contractor in a neat typed form in accordance with the prescribed format, and with the correct spelling, to the Engineer by not later than the 28th of each month (or on the first working day thereafter), together with one additional copies, for certification.

8.4 Where dayworks have been instructed by the Engineer, the Contractor shall submit the returns to the Engineer for signature and approval within twenty-four (24) hours of the end of the working day on which the work was executed. Daywork returns shall be submitted on forms according to the

Engineer's standard format. Failure to comply with the terms of this clause will result in non-payment for such dayworks.

SITE FACILITIES (Section)

1. Site considerations

1.1 The Contractor shall ensure that neither his operations nor those of his subcontractors nor the activities of his employees shall interfere with or hinder the operations (Including power supply) of the City Power or of other Contractors and he shall indemnify the City Power against all claims arising through default of this requirement.

1.2 The Contractor shall hand over portions of the Site or completed portions of the sections when required by the City Power or detailed elsewhere in this document. The Contractor shall cause no interference with or delays in the execution of these contiguous contracts.

1.3 The Contractor shall protect all known existing services as well as all activities being carried out and structures being erected on the Site by other Contractors. Any damage caused to these services or structures, or any obstructions or hindrance caused to other contractors by the Contractor, and all claims arising there from, will be the sole responsibility of the Contractor.

1.4 All repair work shall be carried out at the Contractor's expense to the entire satisfaction of the Engineer. The same obligations shall be imposed to City Power and on other Contractors in respect of the activities being executed under this Contract.

2. Contractor's Camp

2.1 A Site will be made available by the Employer for the Contractor's camp and depot adjacent to the site. The exact location of the site should be request from the Engineer prior to the contractor establishing site.

3. Source of Water Supply

3.1 The Contractor shall be responsible under the Contract for the supply and distribution at his cost of all water that he may require for purposes of constructing the Works. Accordingly, the Contractor

shall pay all connection fees and consumption charges, and at his cost provide all connections, consumption meters, pipework, storage tanks, transport and other items associated with the supply of water for the Works. Should water be supplied by the water utility.

3.2 The Contractor shall, subject to the approval of the Engineer, make any necessary arrangements with the Joburg Water for the connection(s), and shall provide in his tender for the payment of all charges and costs that are associated with making water available for purposes of constructing the Works.

4. Source of Power Supply

4.1 The Contractor shall be responsible under the Contract for the supply and distribution at his cost of all electricity that he may require for purposes of constructing the Works. Should an electricity connection be available, the contractor will be required to install a prepaid meter to measure the power utilised in kwh per month. These electricity costs will be offset from the contractor's payment certificate. Should electricity be supplied by the power utility.

4.2 The Contractor shall, subject to the approval of the Engineer, make any necessary arrangements with the City Power for the connection(s), and shall provide in his tender for the payment of all charges and costs that are associated with making electricity available for purposes of constructing the Works.

5. Housing

5.1 The Contractor shall be permitted to house Key Personnel only within his camp site(s). At the commencement of the Contract, the Contractor shall inform the Engineer of his intentions regarding the housing of Key Personnel on Site, and he shall thereafter ensure that all such accommodation is kept neat and tidy, hygienic and properly controlled at all times.

5.2 Should at any stage of the Contract the Employer and/or the Engineer be of the opinion that the housing of Key Personnel within the camp site(s) of the Contractor is causing disturbance or inconvenience to the landowner or the Employer, then the authority granted by this clause for the Contractor to house Key Personnel on Site may be withdrawn, either partially or entirely.

5.3 The Contractor shall constantly conform to all requirements contained in law or bylaws, as well any other requirements set by the controlling local authority.

6. Name boards

6.1 A name board conforming to the standard requirements of the South African Association of Consulting Engineers must be provided and erected on site, details to be provided by the Engineer.

7. Office building

7.1 The Contractor shall provide Office accommodation, meeting facility, ablution facilities for male and female, carports, cleaning and maintenance, as well as 24-hour security for the office for the duration of the contract period. The Contractor shall provide insurance for the above-mentioned period for the buildings as well as the contents of the buildings at the replacement cost for new buildings and contents.

8. Sanitary facilities

8.1 Male and female Flush toilets or Chemical toilets shall be provided and maintained for the use of the Contractor's personnel at all camp sites that the Contractor may establish for construction of the Works. In addition, the Contractor shall at all times during construction of the Works provide adequate sanitary facilities on site so that all employees are at all times within easy reach of sanitary facilities. The flush toilets or chemical toilet facilities for male and female is to be provided for every 100m radius.

DESIGN (Section)

1. Design improvements /coordination

1.1 The Contractor shall be responsible for detailed design and engineering of overall system, sub-systems, elements, system facilities, equipment, auxiliary services, etc. It shall include proper definition and execution of all interfaces with systems, equipment, material and services of City Power for proper and correct design, performance and operation of the project.

1.2 The bidder shall note that the equipment offered by him in the dib only shall be accepted for supply. However, City Power or Contractor may propose changes in the specification of the equipment or thereof and if City Power & Contractor agree upon any such changes, the specification shall be modified accordingly.

1.3 If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the changes. Following such agreement, the provision thereof shall be deemed to have been amended accordingly.

1.4 The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and terminations shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from City Power.

ELECTRICAL

PRIMARY PLANT (Section)

The Supplier shall submit a document stating section by section whether they comply with the specifications and explaining any deviations from the specifications. The following variations and additions to the Standard and Particular Specifications will be applicable to this project:

Table 2: Electrical standards

Transformers and Reactors	
IEC 60076 (Part 1 to 5)	Power Transformers
IEC 60289	Reactors
IEC 60076-10	Determination of Transformer and Reactor Sound Levels
Circuit Breakers	
IEC 62271-100	High-voltage switchgear and control gear – part 100: Alternating current circuit-breaker
IEC 62271-109	High-voltage switchgear and control gear – Part 109: Inductive load
IEC 62271-110	High-voltage switchgear and control gear – Part 110: Inductive load

Current transformers, Voltage transformers	
IEC 61869-1	General requirement of Current transformers
IEC 61869-2	Additional requirement of Current transformers
IEC 60044-5	Instrument transformers – Part 5: Capacitor voltage transformers
IEC 60358	Coupling capacitors and capacitor dividers
IEC 60044-4	Instrument transformers: Measurement of Partial Discharges
IEC 60481	Coupling devices for power line carrier systems
Bushing	
IEC 60137	Insulated bushings for alternative voltage above 1000V
Surge Arresters	
IEC 60099-4	Metal oxide surge arrestors without gaps
IEC 60099-5	Selection and application recommendation
Cubicles and Panels & Other related equipment	
IEC 60068 - 2	Basic environmental testing procedures Part 2: Test B: Dry heat
IEC 60529	Degree of Protection provided by enclosures
IEC 60947-4-1	Low voltage switchgear and control gear
IEC 61095	Electromechanical Contactors for household and similar purposes
IEC 60439 (P1 & 2)	Low voltage switchgear and control gear assemblies
Disconnecting switches	
IEC 62271-102	High-voltage switchgear and control gear -Part 102: Alternating current disconnectors and earthing switches
IEC 60265 (Part 1 & 2)	High Voltage switches
PLCC and Line Traps	
IEC 60353	Line traps for A.C. power systems
IEC 60481	Coupling Devices for power line carries systems
IEC 60495	Single sideboard power line carrier terminals
IEC 60683	Planning of (Single Side-Band) power line carrier terminals
Protection and Control Equipment	

IEC 60051: (P1 to P9)	Recommendation for Direct Acting indicating analogue electrical measuring instruments and their accessories
IEC 60255 (P1 to P23)	Electrical relays
IEC 60297 (P1 to P4)	Dimensions of mechanical structure of the 482.6mm (19inches) series
IEC 60359	Expression of the performance of electrical & electronic measuring equipment
IEC 60387	Symbols for alternative -current electricity meters
IEC 60447	Man machine interface (MMI) – Actuating principles
IEC 60521	Class 0.5, 1 and 2 alternating current watt hour meters
IEC 60547	Modular plug-in Unit and standard 19-inch rack mounting unit based on NIM standard (for electronic nuclear instruments)
Motors	
IEC 60034 (P1 to P19)	Rotating electrical machines
Electronic equipment and components	
IEC 60068 (P1 to P5)	Environmental testing
IEC 60326 (P1 to P2)	Printed boards, Material and workmanship standards
Batteries and Batteries charger	
IEC 60896 -21& 22	Lead Acid Batteries Valve Regulated types – Methods of Tests & Requirements
IEC 60623	Vented type Nickel Cadmium batteries
IEC 60622	Secondary Cells & Batteries – Sealed Ni-Cd rechargeable single cell
IEC 60623	Secondary Cells & Batteries – Vented Ni-Cd rechargeable single cell
IEC 60896-11	Stationary Lead Acid Batteries – Vented Type - General requirements & method of tests
IEEE-485	Recommended practices for sizing Lead Acid Batteries
IEEE-1115	Sizing of Ni-Cd Batteries
IEEE-1187	Recommended practices for design & installation of VRLA Batteries
IEEE-1188	Recommended practices for design & installation of VRLA Batteries
IEEE-1189	Guide for selection of VRLA
Battery Charger	

IEEE 484	Recommended Design for installation design and installation of large lead storage batteries for generating stations and substation
IEEE 485	Sizing large lead storage batteries for generating stations and substations
Wire and Cables	
IEC 60096 (P0 to P4)	Radio Frequency cables
IEC 60183	Guide to the selection of High Voltage Cables
IEC 60189 (P1 to P7)	Low frequency cables and wires with PVC insulation and PVC sheath
IEC 60227 (P1 to P7)	Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750V
IEC 60228	Conductors of insulated cables
IEC 60230	Impulse tests on cables and their accessories
IEC 60287 (P1 to P3)	Calculation of the continuous current rating of cables (100% load factor)
IEC 60304	Standard colours for insulation for low-frequency cables and wires
IEC 60331	Fire resisting characteristics of Electrical cables
IEC 60332 (P1 to P3)	Tests of electric cables under fire conditions
IEC 60502	Extruded solid dielectric insulated power cables for rated voltages from 1kV up to 30kV
IEC 754 (P1 of P2)	Tests on gases evolved during combustion of electric cables
PG Test procedures	
NFPA-13	Standard for the installation of sprinkler system
NFPA-15	Standard for water spray fixed system for the fire protection
NFPA-12A	Standard for Halog 1301 Fire Extinguishing System
NFPA-72E	Standard on Automatic Fire Detectors
NFPA-12	Standard on Carbon Dioxide extinguisher systems

NOTE: The list of standards mentioned above is a generic list. Some of the items may not be applicable and need not be referred to as a particular substation package.

1. Electrical conditions

1.1 The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves but intended to complete each other.

1.2 The Contractor shall also note that list of standards presented in this document/specification are not complete. Whenever necessary the list of standards shall be considered in conjunction with specific SANS/IEC standards. When the specific requirements stipulated in the specifications exceed or differ than those required by the specification shall take precedence.

1.3 The equipment and system shall be designed to meet technical parameters as per specifications and below requirements:

- a) The supply substation is Eskom 132/11kV Switch station.
- b) The City Power Substation supply is at three phases: 11kV, 50Hz.
- c) Three phase fault level is 19.14 kA.
- d) Single phase fault level is 18.92 kA.
- e) The phase rotation is Standard: RWB – Anti-Clockwise. However, the contractor is to confirm this on site by using a phase rotation tester.

1.4 The Supplier shall submit a document stating section by section whether they comply with the specifications and explaining any deviations from the specifications.

2. Ratings

2.1 MV and LV equipment ratings shall be according to SANS standards and City Power Specifications. All MV and LV cables shall be tested as per the required specifications. The rated frequency shall be 50 Hz. The earthing shall be in accordance with the requirements of NRS 004.

3. Medium Voltage (MV) Equipment

3.1 The Supplier shall submit a document stating section by section whether they comply with the specifications and explaining any deviations from the specifications.

3.2 The circuit breakers shall be vacuum interrupter type. It shall be maintenance free. The position of the power and earthing contacts shall be clearly visible on the front of the switchboard. The position indicator shall provide positive contact indication in accordance with IEC 62271-100 standard.

3.3 The circuit breakers shall have 3 positions: open-disconnected, closed and earthed and shall be constructed in such a way that natural interlocks prevent all unauthorised operations. The rated current of circuit breaker as network points shall be **of 630 A**.

3.4 The rated current of circuit breaker feeders shall be sized according to the PFC equipment. An operating mechanism can be used to manually close the circuit breaker and charge the mechanism in a single movement. It shall be fitted with a local system for manual tripping by an integrated push button. The MV breakers will also be designed for remote control via the SCADA system.

4. Instrumentation transformers

4.1 The Supplier shall submit a document stating section by section whether they comply with the specifications and explaining any deviations from the specifications.

4.2 The supplier shall ensure that the current and voltage transformer specifications comply with the intended loading. The supplier shall liaise with the City Power to ensure the compatibility of the voltage and current transformers into the overall protection scheme. The supplier should take note of the following specific requirements: voltage and current transformers are specified equipment as per shared specifications.

5. Low Voltage (LV) equipment

5.1 The Supplier shall submit a document stating section by section whether they comply with the specifications and explaining any deviations from the specifications.

5.2 The LV side should be fitted with outgoing circuit breakers that connect the LV of the substation to the new LV cable that will feed the existing LV board located in the relevant building. The size and quantity of the outgoing circuit breaker ratings will be based on the number of LV circuits and the expected loading. Typical sizes include 100A, 150A, 200A, 300A, 400A, 630A, 800A, and 1000A. The LV ASSEMBLY shall comply with the requirements of SANS 1973-1.

5.3 LV power and control cabling and accessories shall comply with the relevant codes of practices and standards. Installation of the cables shall comply with SANS 10142-1:2024. The contractor shall supply and install all the necessary multi core control cables and power cables required for the correct operation of the installation. Cables shall be terminated using suitably sized compression glands.

5.4 Outdoor glands shall have an IP rating of better than or equal to the enclosures IP rating to which the cable is being terminated. Outdoor glands shall be provided with a neoprene shroud which is UV protected. Cables shall be neatly installed on cable racks, ladders or basket and properly secured at regular intervals by means of clamps, straps and ties. Plastic / PVC ties shall not be allowed outdoors. All cable trays, basket and ladders shall be neatly installed, properly secured and free of sharp edges.

5.5 All cable trays, baskets and ladders and their accessories shall be hot dip galvanised. Cable fixing accessories shall be fit for purpose and installed to the engineer's satisfaction. Power cables shall be de-rated as necessary to SANS 10142 were installed in exposed locations or in trenches with other current carrying cables. Wiring diagram and schematic wiring diagram of control circuits for each type of panel shall be provided. On the wiring diagrams internal wiring of relays shall be shown. Wiring diagrams shall give details of all control cables required between items of equipment.

6. Auxiliary AC board

6.1 Supply, install and terminate 3x 600-1000V 4C Cu cable from local sub to the AC distribution board in the MV switch room and the AC Distribution board in the HV Control room adjacent.

7. Degree of Protection

7.1 The enclosures of the cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under in general or higher degree if specified separately.

- a) Installed outdoor: IP-55,
- b) Installed indoor in air-conditioned area: IP-31,
- c) Installed in covered area: IP-52,
- d) Installed indoor in non-air-conditioned area where possibility of entry of water is limited: IP-41 and
- e) For AC & DC distribution boards: IP-52.

7.2 The degree of protection shall be in accordance with IEC 60947-1/IEC 60529.

7.3 All parts of the work shall be protected against corrosion under service conditions. For painted steel enclosures/cubicles, manufacturers shall prove it's resistance against pollution by passing 1000 hours salt spray test in accordance with ASRTM B117 standard.

8. Control functionality

8.1 These control functions should be accommodated into the Network Study and Design for the substation equipment:

- a) Three-phase overcurrent protection with definite-time and IDMT (IEC) characteristic, low-set element.
- b) Three-phase overcurrent protection with definite time characteristic, high-set element.
- c) Three-phase overcurrent protection with definite time or instantaneous characteristic, high-set element.
- d) Non-directional ground-fault protection with definite-time and IDMT (IEC) characteristic, low-set element.
- e) Non-directional ground-fault protection with definite time characteristic, high-set element.
- f) Non-directional ground-fault protection with definite time or instantaneous characteristic, high-set element.
- g) CBF -Circuit Breaker Fail protection.
- h) ARC protection (Integrated).
- i) Negative-sequence overcurrent protection for detecting unbalanced faults, which can be critical for motors and generators.
- j) Thermal overload protection using an IEC/IEEE thermal model to prevent overheating of conductors and equipment.
- k) Instantaneous ground fault protection using a dedicated sensor (if applicable).
- l) Reclosing function to automatically restore power after temporary faults, improving system reliability.
- m) Undervoltage protection to detect abnormal voltage dips that may indicate faults or instability.
- n) Overvoltage protection to detect dangerous voltage rises that can damage insulation and equipment.

- o) Directional ground fault protection for selective tripping in distribution networks with specific grounding schemes.
- p) Over/Underfrequency protection to detect system instability and load shedding conditions.

SECONDARY PLANT (Section)

1. DC Plant

1.1 The Supplier shall submit a document stating section by section whether they comply with the specifications and explaining any deviations from the specifications.

1.2 Details of DC equipment that will be installed as part of this project are as follows:

Currently, the substation protection relays, circuit breaker coils (tripping and closing), status & indication circuit, telecommunication system and SCADA system are supplied by a 185 Ah battery bank which is insufficient in terms of capacity to supply an additional feeder board and upgraded SCADA system. The existing DC system needs to be upgraded as per the recommendations below:

1.3 Two linear mode battery chargers, refer to specification CP_TSSPEC_160 and two 110 V battery banks, refer to specification CP_TSSPEC_151. Redundancy is recommended to ensure continuity and increased uptime.

2. Intelligent electronic devices

2.1 All equipment and technical requirements proposed shall comply to the following specification documents:

- a) *CP_TSSPEC_214* Specification for protection relays
- b) *CP_TSGUID_002* Specification for low voltage insulated wire, power and multi core control cables.

2.2 The protection requirements for each scheme shall be designed as detailed in the specification CP_TSSPEC_214. The secondary circuitry offered shall be in compliance with standard drawings CP_TSDRAW_051 (Feeder), CP_TSDRAW_052 (Bus-Section) and CP_TSDRAW_054 (Incomer). Interfacing of primary plant network to the control plant. Interfacing of protection IED to SCADA RTU.

2.3 Provision for all auxiliary relays, wiring, contacts, and other equipment that may be required to provide fully functional schemes. The Contractor shall supply and install new control cables complete with terminations for all equipment to be installed under this contract. The Cabling shall comply with City Power specification CP_TSSPEC_002_Rev05.

3. SCADA System

3.1 The Supplier shall submit a document stating section by section whether they comply with the specifications and explaining any deviations from the specifications.

3.2 The scope of the contract will consist of the supply, installation and commissioning of a complete SCADA system for the Substation complete with associated equipment, fully configured, tested and commissioned in accordance with the specification. The SCADA system shall also but not limited to be equipped to accommodate the HV and MV protection schemes which shall be installed in the phases of the project.

3.3 A GSM Module with modem shall be supplied and installed to establish remote communication, this is to include the setup on the Control room computers. The contractor shall be responsible for the supply, installation and commissioning of the interface. The protocol internal to the substation (between the protection and control IEDs and the substation IED / HMI) will comply with the IEC61850 and DNP3 standard.

3.4 Currently, the substation uses the **SEL-2240 Axion** Remote Terminal Unit (RTU) which has a capacity of 64 Intelligent Electronic Devices (IEDs). The addition of the transformer, bus section, and feeder-board will increase the number of the IED to 88. Therefore, the additional IEDs will exceed the required IED number for the RTU to operate properly. Hence, the existing RTU must be replaced with the higher IEDs capacity RTU. Same brand RTU is recommended for seamless integration of the existing devices and the RTU database. Two managed industrial ethernet multilink switches are also required to connect the new IEDs.

3.5 The RTU replacement or upgrade of the RTU shall involve design, supply, installation, integration with the existing substation IEDs and the new IEDs and commissioning in compliance with the City power SCADA RTU specification CP_TSSPEC_268_Rev1.

3.6 All substations will be fitted with GSM modules to allow for communication to the main SCADA system. The substation remote monitoring and control system shall include an industrial-grade LTE Wi-Fi IoT router with dual SIM support for 4G cellular connectivity, integrated Wi-Fi, and at least four Ethernet ports to ensure reliable communication for remote operations.

3.7 The router must feature automatic WAN failover to maintain uninterrupted network connectivity and minimize downtime. It shall operate on an industrial-grade operating system with customisation options for professional use and support automation features to optimize performance. Security features, including VPN support, must be included to ensure encrypted and secure communication.

3.8 Additionally, the system shall be compatible with a remote management system (RMS) for secure remote configuration, monitoring, and management, reducing on-site intervention and operational costs. The hardware must be robust, reliable, and suitable for industrial environments to support continuous monitoring and control of the substation.

3.9 The router must be vandal proof and have DNP3 and Modbus Protocol Integrated into MV to allow for communication and integration with the master G100 SCADA unit or similar to be installed in the 11kV control room. The communication will facilitate remote monitoring of the substation alarms, loading and status indicators.

3.10 The successful supplier shall compile a functional design specification and once approved, followed by a detail design specification detailing the functionality for acceptance & approval by the City Power.

4. SCADA Functional design specification (FDS)

4.1 The successful supplier shall generate a functional design specification (FDS) document describing in sufficient detail how their system intends to offer the functionality specified and highlighting any aspect where the system offered deviate from the specification. The purpose of the FDS is for the supplier to prove that the proposed system complies with the minimum system requirements and/or to highlight where the system offered will provide the specified functionality in a different fashion.

4.2 The document will detail the overall system composition, proposed communication system design, software configuration and related equipment to ensure compliance with the specification. The FDS document shall be to the satisfaction of and be approved by City Power engineer before the detail design specification (DDS) is compiled.

5. Inputs and Outputs requirements

5.1 Minimum fifteen digital inputs, monitoring as a minimum circuit breaker status, earth switch status, circuit breaker racking status and external trip/ close commands. The contractor will however assess the additional requirements specified for each scheme in this specification and the Schedule for SCADA requirements from an IED perspective and provide the required number of inputs to conform to the specified requirements.

5.2 Where more inputs are required, the supplier will offer additional means to provide the required number of inputs. These input/outputs shall be equipped with the following capabilities:

- a) Two high-speed power outputs for tripping the circuit breaker.
- b) Minimum four user configurable power outputs suitable for closing and inter-tripping circuit breakers.
- c) Minimum six user configurable signal outputs for alarm and busbar blocking protection purposes.

6. Analogue inputs

6.1 Current transformer inputs will have optional 1A inputs with the following minimum thermal ratings: Continuous: $4 \times I_n$, 1s Short time: $100 \times I_n$ and Dynamic half cycle: $250 \times I_n$.

7. Power Quality Unit

7.1 The contractor shall install a power quality unit capable to monitoring the following requirements:

- a) Power Quality Monitoring: Real-time tracking of voltage and current harmonics up to 25kHz, with advanced event detection and classification.
- b) Synchro phasor Data (PMU+): Visualization of synchro phasor measurements, including ultra-fast and accurate frequency estimations, even under distorted conditions.

- c) Grid Stability Analysis: Monitoring of oscillation phasors with 20ms update intervals, enabling detection and estimation of multiple oscillation modes simultaneously.
- d) Metering and Billing Information: Time-of-use tariffs, energy import/export data, and synchronised billing information for comprehensive energy management.

8. SCADA detail design specification (DDS)

8.1 On acceptance of the FDS, the successful supplier shall generate a detail design specification (DDS) describing in detailing the functionality and deliverables of the system to be supplied. The purpose of the DDS is to document in detail exactly what the supplier will supply under this contract in terms of hardware, software, functionality, signal mapping, training, documentation, etc.

8.2 The DDS will also be used as the standard against which the factory acceptance testing & site acceptance testing will be performed / measured. The DDS document shall be to the satisfaction of the City Power engineer and shall be approved by the engineer before the SCADA system is configured / programmed.

9. Communication

9.1 The Supplier shall submit a document stating section by section whether they comply with the specifications and explaining any deviations from the specifications.

9.2 Proposed Ethernet Switches shall have dual high-power AC or DC supply provided the additional load is included in the sizing calculations, multimode ST type glass fibre ports for connection to IED's within the substation, dual gigabit ports (2 x 10/100/1000mbit/s TX RJ45) for switch-to-switch connections within a substation.

9.3 Communication enables the following functions to be carried out remotely:

- a) measurement readings,
- b) status readings,
- c) event readings and,
- d) time- stamped measurements (2 tables of 100 events available)
- e) time setting and synchronisation,
- f) remote control of breakers.

10. Human Machine Interface (HMI) requirements

10.1 Indication LED's clearly indicating relay healthy, relay alarm/ fail states, protection function starting and tripping states. Minimum number of user configurable LED's, preferably programmable to latch, flash or reset under specific alarm conditions.

10.2 Liquid crystal display to allow easy access to control functions, measured values and setting parameters. Front serial communication interface for use as PC interface to configure and change setting parameters on the relay. Rear communication port for connection to the SCADA system.

10.3 All internal substation communications will comply with the IEC-61850 standard. External protocol requirements and communication infrastructure will be determined by the SCADA system requirements. Display of primary current, voltage and energy values on LCD.

CABLES (Section)

1. Fibre Optic Cable

1.1 The Supplier shall submit a document stating section by section whether they comply with the specifications and explaining any deviations from the specifications.

1.2 The fibre optic cables connecting the panel IEDs and the switches shall be ruggedised glass fibre with connectors as dictated by the IED). The installation of the fibre is part of this contract.

2. Cabling and Wiring

2.1 All multi-core cables shall be manufactured in accordance with SABS 1507-1990 (or SABS 150-1970) and visibly identified as of flame retardant, low toxicity types. Where a cable is to be installed in a location that may render it liable to mechanical damage, it shall be protected by wire armouring, or by other approved means.

2.2 All cabling shall be neatly run and fitted in or upon such cable trays, trenches, ducts or conduits as may be appropriate to the layout and equipment.

3. Protection cabling

3.1 The installation of all the cabling between the protection panels and other related equipment as well as any bus wiring must be included for under the unit rates for the switchgear. All this cabling shall be installed neatly on cabling racking of which the cost must also be included under the unit rates for the switchgear.

4. Metering cables

4.1 Supply and install all the required internal wiring of the metering panel. Supply and install all the required cabling between the incomers and metering panel.

5. SCADA cables

5.1 All Cu cables / twisted pair cables as well as fibre cable required to ensure a complete and fully operational SCADA system including any station alarms must be included for under the SCADA unit rates. This includes, but is not limited to, DC.

6. MV cable terminations

6.1 The Supplier shall submit a document stating section by section whether they comply with the specifications and explaining any deviations from the specifications.

6.2 The size of the cable used between the busbars and the feeder circuit-breaker shall be selected to suit the current rating of the circuit and the fault rating of the equipment.

6.3 Two (hexagon) adjustable cable clamps manufactured from HDPE suitable for clamping cable sizes up to one 150 mm² 3-core PILC/XLPE cables (refer figure C.12 (b) SANS 876. Cable support clamps: Termination of MV cables: Provision shall be made for the support (refer figure C.12 (b) SANS 876.

7. Cabling requirements

7.1 The screens and armouring of power cables running out of the substation to other locations are to be earthed on both sides to prevent dangerous high inductive voltages from occurring. All control

cables shall be laid, glanded, numbered and terminated according to the protection drawings and specifications.

7.2 Control cable lengths shall be made to reach the furthestmost terminal block in the panel. No joints shall be made. Spare cores shall be earthed at one end only and not at both ends. Correct sizes of ferrule numbers shall be used per cable size and shall be black lettering on a yellow background. All cable or wire numbering shall be so that it is readable from one position.

7.3 Numbering shall not be inverted. All crimping tools shall be fit for purpose and the dies suitably sized for a specific lug size to prevent over or under crimping. Where insulated lugs are used the correct crimping tool shall be used. All lugs shall be fit for purpose and suitably sized.

7.4 The screen of any control cable shall only be earthed at the end always furthest away from the yard equipment. The supplier shall supply, transport and off-load all the material and equipment necessary for installing all the cables. All cables must be armoured. Control cables installed on cable racks shall be fixed thereto by appropriate means without causing damage to the cable sheath.

7.5 All cable terminations must be provided with a fit for purpose and suitably sized cable gland. All multi-core cables shall be manufactured in accordance with SABS 1507-1990 (or SABS 150- 1970) and visibly identified as of flame retardant, low toxicity types. All cabling shall be neatly run and fitted in or upon such cable trays, trenches, ducts or conduits as may be appropriate to the layout and equipment. Bending radii as specified by the manufacturers shall be adhered to at all times. Consequential damage of failing to do so will be for the supplier's account.

7.6 All 11kV cable terminations and joints will be of the heat shrink kind. All 11kV cables, cable terminations and joints will be pressure tested to the relevant specification. Cable route markers must be installed where MV cables are jointed as well as where deviations occur. Where a cable is to be installed in a location that may render it liable to mechanical damage, it shall be protected by appropriate means. All existing services must be exposed by hand.

8. Cable Labelling

8.1 All cables shall be clearly and permanently labelled as per City Power Standards. A uniform method of labelling shall be followed across the whole system. This will consist of an Aluminium or stainless-steel strip with the origin and/or destination indicated thereon. All 11kV power cables are

to be labelled at their termination points via a punched aluminium strip strapped to the cable, with a 7mm font size.

EARTHING (Section)

1. Earth Resistance Survey

1.1 The Contractor will be responsible to have an earth resistance survey carried out on site by a specialist in this field, to be approved by the Engineer

1.2 The Engineer shall attend the survey. The Contractor shall inform the Engineer in good time when the test is scheduled to take place. If it is done without the Engineer or his representative being present, the test shall be repeated in the Engineer's presence at no additional cost. The results of this survey will be used to adjust the earthing system as specified herein, if necessary, on the basis of the quoted rates. Payment for the services of the specialist shall be borne by the Contractor. The test is to be redone once the platform is complete.

1.3 The number and lengths of earthing electrodes shall be determined from the resistivity tests above. Earthing electrodes shall be of the extendible rod type. The rods shall be of copper clad steel and the copper to steel weld shall be a true molecular bond. As part of the Civil Contract, the total main earthing system of less than 1 ohm (as provided and tested), shall be installed

ENCLOSURE (Section)

1. Installation

1.1 Subsystems and components shall be easily maintainable. It shall be possible to remove items of equipment for maintenance with minimal interference with respect to other equipment. Components which generate a lot of heat shall be adequately spaced from their mounting boards and from other components.

1.2 All components shall be adequately supported and secured. Components shall not be mounted directly on wiring terminal blocks unless adequately protected from damage.

TESTING AND COMMISSIONING (Section)

1. Testing

1.1 All equipment shall be tested at the Factory and Onsite, to comply with set quality standards and warranty requirements offered by the Original Equipment Manufacturer (OEM). These standards tests shall be performed as per classification:

- a) Insulation Resistance Tests.
- b) Continuity Tests.
- c) Functional testing of all protection devices.
- d) APFC relay configuration.
- e) Capacitor stage operation verification.
- f) Harmonic measurements.
- g) Load testing.
- h) Verification of target power factors.
- i) System performance monitoring under varying load conditions.

2. Factory Acceptance Testing (FAT)

2.1 Each equipment will go through a proper FAT process. The employer or their nominated representative will witness the FAT procedure and approve all FAT documentation before approval will be given to transport equipment to site.

2.2 The following FAT procedure will be applicable:

Responsibilities

2.3 FAT will be conducted within the following framework:

- The equipment supplier will be primarily responsible for conducting the FAT and to compile all FAT documentation.

- The employer or his representatives will only witness FAT as a Quality Control function and does not take responsibility for the correctness of the equipment supplied.
- The equipment supplier will remain responsible for the rectification of any defects found during FAT or SAT.

Pre-Fat Checks:

2.4 The equipment supplier will complete all pre-FAT checks and notify City Power at least 2 weeks in advance before checks will commence and when the pre-FAT documents will be completed and ready for inspection. The City Power might request to witness specific tests. Once these tests are completed, the City Power will verify the test results and request to witness specific items.

Pre-FAT checks will include, but not be limited to the following:

- Ring out of all wiring,
- Insulation tests on all wiring circuits,
- Equipment nameplate verification based on a comprehensive equipment list,
- Marked up schematic diagrams and equipment lists,
- Circuit breaker test results, including pressure test, vacuum bottle test, speed tests, trip and close coil tests, mechanical checks,
- Mechanical operation and alignment checks,
- Apply DC and check operational functionality,
- Current transformer magnetization curves, ratio and polarity checks with the CT installed and wired into the panel,
- Voltage transformer polarity and ratio checks with the VT installed and wired into the panel,
- Provide and upload protection relays with approved logics and configuration settings.

Protection settings will be provided by City Power Infrastructure Support Services.

Fat Tests:

2.5 On completion and approval of all pre-FAT documentation, the equipment supplier will commence with the functional testing of protection schemes. City Power will be notified at least 2

weeks in advance before FAT commences to allow The City Power and Contractor representative to witness these tests. Once these tests are completed, The Employer will verify the test results and request to witness specific items.

2.6 FAT tests will include but not be limited to:

- Extensive functional testing of each panel protection and control scheme to prove relay configuration, wiring, logics, protection and control philosophies,
- Secondary injection to prove relay configuration and correct application of protection settings,
- Overall scheme tests, i.e. Busbar Arc protection, Busbar Blocking, Interlocking etc.
- Where required, scheme testing will be done with primary injection.

3. Site acceptance testing (SAT)

3.1 The Equipment supplier will be responsible for SAT, the rectification of any defects (and the associated cost) during SAT will remain the responsibility of the equipment supplier.

3.2 The supplier shall provide assistance during the hot commissioning phase and shall be responsible for all on-line measurement directly following hot commissioning. Commissioning assistance will be provided by either one of the following:

- The design engineer primarily responsible for the design to date, or
- Competent suitable qualified commissioning technician that will be approved by the employer.
- Sub-contractors providing commissioning assistance must be approved by the engineer prior to any commissioning taking place.
- Commissioning support shall be included in the tender price.

4. Commissioning Milestones

4.1 Dry testing as part of construction milestone shall include the following:

- a) Visual checking of general appearance and equipment labelling,
- b) Checking of all terminations,
- c) Verification of correctness of field equipment statuses in relation to SCADA System,

- d) Testing of cables,
- e) Checking of all safety settings and
- f) General safety of installation.

5. Acceptance Criteria

5.1 The project shall be considered complete when:

- a) The APFC system is fully operational.
- b) The target power factor has been achieved and verified.
- c) All testing and commissioning activities have been successfully completed.
- d) All documentation has been submitted and approved.
- e) The City Power has accepted the installation and signed the commissioning certificate.

6. Warranty

6.1 The supplier will provide a warranty for a period of twenty-four months after handover of the system to City Power and shall provide the following services as part of the warranty support during this period: Repair or replace all faulty components damaged by normal operation or during first 24 months of operation. Respond to call outs as follows:

- a) Substation equipment interface and communication faults,
- b) Modules to be replaced within 5 working days of fault reports,
- c) Provide user support consisting of telephonic support of users who have successfully attended the relevant training course,
- d) The supplier shall regard the training courses as a method of minimising their user support costs during this period and
- e) The response time for user support requests shall be no longer than eight working hours.

7. Spares

7.1 The supplier shall provide a list of spares for commissioning and maintenance within the scope of this project. The spares holding shall consider the probability of failure as well as the effect on the

system should a spare item not be available. The supplier shall also provide prices of spares with a guaranteed availability of ten years.

8. Maintenance

8.1 City Power requires a system where the maintenance requirement is minimal. Hardware maintenance shall be no more than what is required for a normal personal computer installation and the communication equipment shall be virtually maintenance free.

DOCUMENTATION (Section)

1. Documents

1.1 A Service Provider (SP) shall be required to provide the following documents, in order to support equipment maintenance and operation of the required project scope:

- a) As-built drawings.
- b) Test certificates.
- c) Factory Acceptance Test (FAT) reports where applicable.
- d) Site Acceptance Test (SAT) reports.
- e) Equipment manuals.
- f) Maintenance manuals.
- g) Warranty certificates.
- h) Commissioning reports.

1.2 The “as built” documents shall be updated and submitted to City Power not later than one month after the successful completion of the site acceptance test and system hand-over. The documents shall be supplied on electronic media at that stage. The final payment certificate will not be processed until it has been submitted with: As built drawings of the MV cable route indicating joints

and deviations with distances from boundaries or buildings and Test certificates of all tested MV cables together with the COC for the LV installation

2. Drawings

2.1 The contractor shall be responsible for the preparation of Scheme drawings, Logic Diagrams and schedules for the installation of cables as per the proposed control schemes and provide updates to complete the cable block diagrams.

2.2 Construction drawings will be shared in hard Copy and Electronic format. Only signed drawings of which the signature as certified will be accepted as official construction drawings. Construction drawings will be shared by means of an electronic issue list which will record the latest version of the drawing issued and the issue date. The Contractor shall sign the issue list and return the signed issue list to the Engineer to confirm that the drawings have been received. The latest version of the drawing issued shall be applicable from the date of issue.

2.3 All information in the possession of the Contractor that is required by the Engineer's Representative in order to complete the As-Built drawings and to prepare a completion report for City Power must be submitted to the Engineer's Representative before a Certificate of Practical Completion will be issued for the Works. Similarly, the Contractor will be required to submit full details of all pipes, valves, meters and specials in a suitable loose bound format, including any special operational and maintenance procedures related thereto, for incorporation in the overall operation and maintenance manual for the Scheme prior to the issue of a Certificate of Completion for the Works.

2.4 The schedule dates for the submission of the drawing as well as for, any data/information to be furnished by the Contractor would be discussed and finalised at the time of award.

2.5 One A3 set of paper prints of the construction drawings will be made available to the Contractor on or before the handing over of Site for information purposes only. No further paper copies will be issued to the Contractor. The onus will be on the Contractor to ensure that paper copies of the latest issued electronic format construction drawings are available on Site for construction purposes.

2.6 Only figured dimensions on the Drawings may be used in the interpretation thereof, and the Drawings shall not be scaled unless the Contractor is so instructed by the Engineer in writing. The Contractor shall notify the Engineer in writing of any lack of information or conflict in the information

on the Drawings. The Engineer will upon written request provide any dimensions that may have been omitted from the Drawings.

TRAINING (Section)

1. Training

1.1 A Service Provider (SP) shall be required to provide training on the following, in order to achieve the required project scope.

1.2 This training shall be covering:

- a) APFC system operation.
- b) Routine inspection.
- c) Preventive maintenance.
- d) Alarm interpretation.
- e) Troubleshooting procedures.
- f) Safety precautions.

SHERQ (Section)

1. Health, Safety and Environmental Requirements

1.1 All work shall comply with applicable occupational health and safety legislation, electrical installation regulations, City Power permit procedures, environmental requirements, and the relevant electrical standards. Appropriate personal protective equipment (PPE) shall be worn throughout the execution of the project.

1.2 The maintenance of safe work practice at all times and in all sections of the execution of the works is embedded in the day-to-day site activities of all the Contractor's management, staff and workforce on the contract.

1.3 The introduction of the Construction Regulations in 2003 requires from the Employer to ensure that the Contractor has made adequate provision for the execution of the works within the specifications of said regulations. The contractor shall comply to the Health and Safety Specification bound into section C3.4.3 of this document.

1.4 It must be noted that the lists below are not exhaustive and that many items have been traditionally priced by the Contractor as an integral part of his Preliminary and General items or as part of the overhead costs of other items. The tender document, although not detailed with regards the Construction Regulations, requires that the Contractor ensures adherence to the Occupational Health and Safety Act (Act 85 of 1993) the Construction Regulations, 2014.

1.5 According to the NEMA regulations, the contractor should comply with the Environmental Authorisation (RoD), the Environmental Management Programme (EMPr) as well as Best Practices. The Contractor shall comply with all the conditions of the Environmental Agents (MDA) requirements as the EMPr is still in process. The contractor is to adhere to environmental control officer's requirements.

Fire and Security (Section)

1. CCTV System

1.1 Details of the CCTV security equipment that will be installed as part of this project shall include the following: Perimeter coverage is needed as well as an additional PTZ camera to cover the sides of the substation. Thermal cameras should be considered in terms of design and recording capabilities. One 3KVA Pure Sine wave online UPS, Rack mount surge arrestor, network patch panel and other accessories shall be provided as per specification.

1.2 The Supplier shall submit a document stating section by section whether they comply with the specifications and explaining any deviations from the specifications.

2. Fire Extinguishers

2.1 Fire extinguishers with signage, mounting brackets shall be installed in the building as per safety standards. The fire extinguishers shall be of the CO₂ type suitable for electrical fires. The successful contractor will be responsible to determine the "exact" requirements for the substation and utilise

the supplied drawings and document as a guideline for substations requirements. Any approvals required will be the responsibility of the contractor and City Power.

3. Security Locks

3.1 It is required of this scope that the contractor shall supply and install all security lock systems for locking of entrance gates (internal and external) as well as locks for the locking of substation doors.

3.2 In addition to the abovementioned locks, the contractor shall also supply and install all the required security locks for locking equipment in the open or closed position.

3.3 All locks shall be provided with triplicate keys and locks shall be of the standard types normally used by City Power. It shall be the responsibility of the Contractor to obtain the required information from City Power prior to purchasing of locks. All locking systems shall in addition be to the full approval of the Engineer.

4. Signs and Notices

4.1 The provision and installation of the necessary danger signs, warning signs and notices required in terms of statutory regulations, as well as all fire extinguishers and the necessary first aid kits, forms an integral part of this Contract. All these items shall be supplied and installed on positions to be approved by the Engineer prior to the commissioning of the substation.

Annexure A: DRAWINGS

Annexure B: TECHNICAL SPECIFICATIONS

Annexure C: BILL OF QUANTITIES