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| | | REFERENCE | REV |
|---|---|---|---|
| TITLE | STANDARD FOR INSTALLATION, COMMISSIONING AND MAINTENANCE OF POWER SYSTEM PROTECTION. | CP_TSSTAN_106 | 1 |
| | | DATE: | JULY 2024 |
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## FOREWORD

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## INTRODUCTION

City Power uses a range of protection systems to detect faults and abnormalities and isolate them to protect and prevent damages against its network. City Power requires an experienced Contractor to complement its internal staff through installation, maintenance.

## 1 SCOPE OF WORKS

The scope entails installation, commissioning, testing and maintenance of the protection and control schemes on the transmission and distribution network. The required functions shall be executed mainly on the protection and control systems of power transformers, power lines, capacitor banks, power cables, circuit breakers, isolators and bus-bars of the low, medium and high voltage networks. This service shall include the retrofitting, panel wiring, cabling, protection relay configuration and final commissioning of the affected equipment in order to restore the complete plant to normal service.

## 2 NORMATIVE REFERENCES

The following standards or documents contain provisions that, through reference in the text, constitute requirements of this document. At the time of publication, the editions indicated were valid. All standards and documents are subject to revision and the most recent editions shall apply.

IEC 61850, *Communication Networks and Systems in Substations.*

IEC 60870-6, *Telecommunication control Equipment and Systems.*

IEC 60529, *Degrees of Protection Provided by Enclosures (IP Code).4*

IEEE Std 525™, IEEE *Guide for the Design and Installation of Cable Systems in Substations.*

IEEE Std 1379™, IEEE *Recommended Practice for Data Communications between Intelligent electronic Devices IED and Remote Terminal Units RTU's in a Substation.*

IEEE Std 1588™, *IEEE Precision Clock Synchronization Protocol for Networked Measurement and Control Systems.*

IEEE Std 1613™, IEEE *Standard Environmental and Testing Requirements for Communications Networking Devices Installed in Electric Power Substations.*

IEEE Std 1615™, IEEE *Recommended Practice for Network Communication in Electric Power Substations.*

IEEE Std 1646™, IEEE *Standard Communication Delivery Time Performance Requirements for Electric Power Substation Automation.*

IEEE Std C37.115™, IEEE *Standard Test Method for Use in the Evaluation of Message Communications between Intelligent Electronic Devices in an Integrated Substation Protection, Control, and Data Acquisition System.*

TACSP106: *Standard Tactical Work Protection Inspection and Testing.*

## 3 DEFINITIONS AND ABBREVIATIONS

| | |
|---|---|
| **Abnormal hours** | All other times outside of Normal working hours (Normal hours of business) |
| **AutoCAD** | Commercial computer-aided design and drafting software application |
| **City Power Head Office** | City Power Head Office located at Reuven complex, 40 Heronmere Rd, Booysens, Johannesburg |
| **City Power Official** | The City Power employee who shall be responsible for the execution and administration of this contract |
| **The Contractor** | Person or company responsible for the execution of work as defined in this contract document. |
| **CT** | Current Transformer |
| **DC** | Direct Current |
| **Distribution Network** | – The 11kV and the 6.6kV network |
| **IED** | Microprocessor-based protection relays or circuit breaker controllers, with the capability of interfacing and communicating on various platforms such as Serial, Fiber and Ethernet. |
| **Normal working hours** | Normal hours of business –or 08h00 to 17h00, Monday to Friday. |
| **ORVHS -** | Operators Regulation to High Voltage Systems |
| **Relay** | Protection device and/or control device. |
| **SHERQ –** | Safety, Health, Environment, Risk and Quality |
| **SCT-** | Saturation of Current Transformer |
| **The Contractor** | Person or company responsible for the execution of work as defined in this contract document. |
| **Transmission Network** | The 22kV, 33kV, 44kV, 88kV, 132kVand 275kV network |
| **VT** | Voltage Transformer |
| **Work** | The maintenance or commissioning of the protection and control systems as detailed in this contract document. |

## 4 REQUIREMENTS

### 4.1 General Requirements.

4.1.1 The maintenance and installation, commissioning, testing of the Power System Protection systems shall take place during City Power normal hours of business. Provision however shall be made by the Contractor to work outside the normal business hours including weekends and public holidays when the need arises.

4.1.2 The Contractor's personnel on this contract shall possess their own tools, laptops, testing equipment and personal protective equipment needed to fully and comprehensively carry out their duties. City Power shall monitor the Contractor's staff members performing work under this contract and decide where and when work is to be executed.

4.1.3 Test certificates shall be provided by the Contractor after any modifications or alterations to the protection and control schemes are done. Test certificates shall also be provided for the commissioning of new, refurbished or modified protection and control schemes.

4.1.4 Two signed copies of test results and/or certificates shall be handed over to City Power upon completion of the work. No plant shall be re-energized unless test results and/or certificates are provided.

4.1.5 The maintenance duties shall include routine maintenance, fault finding, repair and testing of protection and control systems and related equipment. The Contractor shall also be required to do upgrade, retrofitting, modification and general repairs of protection equipment where necessary and upon request by City Power.

4.1.6 Protection and control schematics shall be marked up after any alterations to the circuitry are done or if any deviation from the schematic is discovered. The mark ups shall be done using a red ball point pen. All marked up schematics shall be returned to the City Power Protection Engineer.

4.1.7 The generation of new as-built drawings for City Power protection and control schemes shall be done on an ad-hoc basis on the request of City Power. Drawings shall be in the AutoCAD, Dxf. file format as well as pdf for future references.

4.1.8 Special requests shall be made by City Power for the review, reprogramming and configuration of relay settings, s the review of relay settings and configurations, protection time grading/co-ordination, network modeling for fault level calculation, protection scheme optimization and Power System Protection systems audit.

4.1.9 The Contractor shall investigate on system disturbances/faults, equipment damaged and provide detailed reports as per City Power template attached.

## 4.2 Resource Qualifications and Access requirements.

4.2.1. The Contractor shall have skilled and experienced resources with a National Diploma in Electrical Engineering (HC) as a minimum qualification and a minimum of two years' experience in the Electricity networks protection and control environment. Skilled staff shall be knowledgeable and familiar with the standards under normative reference.

4.2.2. Access to City Power's network shall be granted subject to a valid ORHVS certificate as per OHS ACT and City Power's System Operating Regulation. The Contractor resources are expected to be in possession of valid ORHVS certificates. Equivalency certificates by an accredited organization shall be validated and approved by City Power's authorized personnel.

4.2.3. City Power shall only recognize names that were submitted with the tender document as qualifying and available to work on City Power's network. Additional and replacement personnel shall not be permitted unless approved and authorized by City Power System Protection management following a written application, with valid reasons, accompanied by the required supporting documents and the above mentioned qualification criterion.

4.2.4. Contractors shall not access or work on City Power's network in absence of City Power authorized personnel. The standard Contractor's responsibility form shall be signed to authorize and grant access. Access shall be granted subjected to all requirements stated in clause 4.2 being met and the Contractor shall be penalized for the deployment of unrecognized and unapproved resources on City Power's Network.

4.2.5. The Contractor's personnel on this contract shall possess their own tools, laptops and the necessary testing equipment needed to fully and comprehensively carry out their duties. City Power shall monitor the contractor's staff members performing work under this contract and decide where and when work is to be executed.

# 5 MAINTENANCE AND COMMISSIONING

## 5.1 City Power's Responsibilities

City Power will provide the following items and services as part of this Project:

5.1. 1 Overall supervision of the Contractor's resources

5.1. 2 Review and approval of the Contractor's designs, drawings, and recommendations.

5.1. 3 Review and approval of test procedures.

5.1. 4 Participation in and approval of factory and site acceptance tests where testing is required.

5.1. 5 Providing support and access to facilities at the sites.

5.1. 6 Coordination of the Contractor's activities.

5.1. 7 Overall inspection and approval of the Contractor's installation, commissioning and maintenance duties

5.1. 8 Consumables and all necessary material needed to resolve defects shall be provided by City Power upon request.

5.1. 9 Provide a pro-forma invoice for repairs or replacement protection equipment that may affect the proper functioning of the Protection System, so as to source, install and commission such equipment after having City Power's approval.

## 5.2 Contractors Responsibilities

5.2.1 The Contractor shall execute planned maintenance and/or commissioning work (e.g. panel wiring, cabling, primary injection, secondary injection, current transformer testing, configuration of relays, and replacement of relays) at intervals determined by City Power.

5.2.2 The Contractor shall evaluate Relay/IED test results according to the manufacturer's documents. Given the outcome, it shall be the responsibility of the Contractor to resolve all defects found.

5.2.3 Typical maintenance work shall include the testing of protection and control schemes after faulty equipment is repaired, testing due to non-performance of a scheme, testing after any modifications or alterations to a scheme is done (including settings). Typical commissioning work shall include the testing of new or modified protection and control schemes.

5.2.4 The contractor shall perform inter-trip testing in accordance to City Power procedures. Ensure that faulty inter-tripping equipment or circuitry is repaired and reinstated to service as soon as possible. The contractor shall perform auto re-close testing on overhead lines in accordance with City Power procedures. Ensure that faulty auto re-close equipment or circuitry is repaired and reinstated to service as soon as possible.

5.2.5 The contractor shall perform circuit breaker speed tests in accordance with City Power procedures.

5.2.6 The contractor shall perform function testing on protection and control automation schemes and ensure that faulty protection and control automation equipment or circuitry is repaired and reinstated to service as soon as possible

5.2.7 The contractor shall perform maintenance in accordance with TACSP106 (Standard Tactical Work Protection Inspection and Testing) on all Power System Protection equipment, but not be limited to the following: For the 24 hour emergency service requirement, the Contractor shall supply a contact person for a 24hour services to the Protection Manager or Senior Technician.

5.2.8 The Contractor shall be penalized for outages and prolonged outages that result from the negligence and poor performance including the resultant damages.

5.2.9 The Contractor shall fill in time sheets which shall be approved by the City Power Personnel. The timesheets shall indicate the location of the work, nature of the work performed, the date the

## 5.3 Routine Tests and Repairs

The Routine tests duties shall include without being limited to the following testing of any new, refurbished or modified protection and control systems:

5.3.1 Current transformer magnetization curve test.

5.3.2 Current transformer primary injection test.
5.3.3 Current transformer polarity test
5.3.4 Current transformer ratio test
5.3.5 Relay secondary injection test.
5.3.6 Circuit breaker speed/time test.
5.3.7 Testing and repairing of pilot cable schemes.
5.3.8 Substation battery earth fault location and repair.
5.3.9 Simulation and/or repair of relay data points for Scada functionality where applicable.
5.3.10 Checking and correcting of Power System Protection settings and configuration.
5.3.11 Protection and control scheme testing and repair.
5.3.12 Auto re-close testing on overhead power lines.
5.3.13 The replacement of all Power System Protection equipment.
5.3.14 Gathering and documenting of substation protection and control information.
5.3.15 Marking up existing schematics for any alterations or deviations.
5.3.16 Generation of new schematics using AutoCAD.

## 6 Response times.

**Table1. All faults shall be handled as critical within response timelines tabled below.**

| | Acknowledgement | Response Time | Commencement | Feedback | Maximum time to repair |
|---|---|---|---|---|---|
| **Response Time** | **½ HR** | **½ hr.** | **1 hr.** | **On site** | **4 hours** |

## 7 DOCUMENTATION

The Contractor shall submit following documents for work performed:

7.1 Schematic drawings;
7.2 Numbering, Marking, labeling document;
7.3 Test results;
7.4 Configuration diagram;
7.5 Fault investigation reports
7.6 Each test report submitted by the Contractor shall have as a minimum the following information displayed on the front page:
7.6.1 The Contractor's company logo.
7.6.2 The name and signature of the person who has compiled the report.
7.6.3 The date and time of the test.
7.6.4 The substation name and the equipment/relay designation.
7.7 Each test report submitted by the Contractor shall have as a minimum the following information:
7.7.1 **Panel Information** – Substation name, Panel designation, Panel number, Panel make, Panel type, Rated voltage and Panel serial number.
7.7.2 **Breaker Information** – Make, type, rated voltage, rated current, rated fault current and serial number.
7.7.3 **Current/Voltage Transformer Information** – CT/VT make, type, ratio, VA, class, SCT, application, ratio selected. These shall be indicated for each core.
7.7.4 **Protection Information** – Relay make, type/model, serial number and the settings on the relay.

7.7.5 **Test Results** – Protection relay test results, meter results, circuit breaker test result (speed test, minimum trip voltage, trip and close coil resistances), loop resistance tests, on load readings from each CT core.

7.7.6 **DC Test results** – DC voltage shall be measured between positive – negative, positive – earth and negative – earth.

7.7.7 **Check and defect list** – This list shall be provided for each bay and shall highlight the outstanding items that could not be corrected and the reason for not correcting them.

7.7.8 The settings and configuration of each relay/IED shall be checked against the provided copy and the discrepancies shall be noted and corrected.

**NB. No handwritten reports shall be accepted, reports shall be typed**

## 8 QUALITY MANAGEMENT

A quality management system/plan shall be set up to assure the quality during manufacture, installation, removal, transportation, and disposal. Guidance on the requirements for a quality management system may be found in the following standards: ISO 9001:2015. The details shall be subject to an agreement between the purchaser and supplier.

## 9 HEALTH AND SAFETY

A health and safety system/plan shall be set up to ensure proper management and compliance during manufacture, installation, removal, transportation, and disposal. Guidance on the requirements of a health and safety plan shall be found in ISO 45001:2018 standards. The details shall be subject to an agreement between City Power and the Supplier.

## 10 ENVIRONMENTAL MANAGEMENT

An environmental management system/ plan shall be set up to ensure the proper environmental management and compliance is adhered to during manufacturing, installation, removal, transportation, and disposal. Guidance on the requirements for an environmental management system shall be found in ISO 14001:2015 standards. The details shall be subject to an agreement between City Power and the Supplier. This is to ensure that the asset created conforms to environmental standards and City

## Annex A – Bibliography

None

## Annex B – Revision information

| DATE | REV. NO. | NOTES |
|---|---|---|
| February 2019 | 0 | First issue |
| July 2024 | 1 | Second issue<br>Updated Iso requirements |