1. GENERAL

1.1 Intent

.1 Except where otherwise specified, arrange and pay for testing, adjusting, balancing and related requirements specified herein.

.2 If test results do not conform with applicable requirements, repair, replace, adjust or balance equipment and systems. Repeat testing as necessary until acceptable results are achieved.

.3 Provide all labour, materials, instruments and equipment necessary to perform the tests specified.

.4 All tests shall be witnessed by persons designated by the City, who shall also sign the test documentation.

.5 Submit procedures proposed in writing for approval two (2) weeks prior to test.

1.2 Related Work

.1 Electrical General Requirements: Section 16010

.2 Starting of Electrical Systems and Equipment: Section 16960

1.3 Manufacturer's Production Test Records

.1 If requested, submit copies of production test records for production tests required by EEMAC and CSA standards for manufactured electrical equipment.

1.4 Site Testing Reports

.1 Log and tabulate test results on appropriate test report forms.

.2 Submit forms to Contract Administrator for approval prior to use.

.3 Submit completed test report forms as specified, immediately after tests are performed.

1.5 Reference Documents

.1 Perform tests in accordance with:

.1 The Contract Documents

.2 Requirements of authorities having jurisdiction

.3 Manufacturer's published instructions

.4 Applicable CSA, IEEE, IPCEA, EEMAC and ASTM standards

.2 If requirements of any of the foregoing conflict, notify Contract Administrator before proceeding with test and obtain clarification.

1.6 Manufacturer's Site Services

.1 Arrange and pay for the site services of appropriately qualified manufacturer's representatives where site testing, adjusting, or balancing of electrical equipment or systems' performed by Manufacturer's representatives is:

.1 Specified, or

.2 Otherwise required to ensure that electrical equipment and systems are operational in full compliance with the Contract Documents

1.7 Sequencing and Scheduling

.1 Except where otherwise specified, perform all testing, adjusting, balancing and related requirements specified herein prior to Interim Acceptance of the Work.

.2 Perform voltage testing and adjusting after user occupancy or utilization of facility.

2. PRODUCTS

2.1 Test Equipment

.1 Provide all equipment and tools necessary to perform testing, adjusting and balancing specified herein and as otherwise required.

3. EXECUTION

3.1 Testing of Wiring and Wiring Devices

.1 All power and control wiring shall be tested for insulation resistance value with a 1000 volt megger. Resistance values shall be as recommended by cable manufacturer. Test results shall be properly tabulated, signed, dated and submitted with maintenance manuals.

.2 Test service grounding conductors for ground resistance.

.3 Test all wiring devices for correct operation.

.4 Test all receptacles for proper polarity and circuitry.

3.2 Ground Resistance Testing

.1 Measure ground resistance with earth test meter to verify compliance with CSA C22.2 No. 0.4 and Canadian Electrical Code.

3.3 Load Balance Testing

.1 Perform load tests when as many loads as possible, prior to Interim Acceptance of the Work, are operable.

.2 Turn on all possible loads.

.3 Test load balance on all feeders at distribution centres, motor control centre and panelboards.

.4 If load balance exceeds 15%, reconnect circuits to balance loads.

3.4 Voltage Testing and Adjusting

.1 Test voltage at all panelboards.

.2 Adjust transformer tap settings to compensate for under-voltage or over-voltage conditions, if directed to do so by Contract Administrator.

3.5 Testing of Transformer

.1 Each transformer shall be completely factory tested and the results certified, proving the performance of the units to provide capacities as listed in these specifications.

.2 Factory tests for each transformer to include:

.1 Resistance measurements of all windings

.2 Ratio test at rated connection and on all taps

.3 Polarity and phase relation tests

.4 Audible sound level tests

.5 No load loss at rated voltage and losses at 25%, 50%, 75% and 100% load

.6 Exciting current at rated voltage

.7 Impedance

.8 Applied potential test

.9 Induced potential test

.10 95 kV B.I.L. test

.11 Hi-pot test

.12 Heat run, temperature rise tests on each transformer.

.3 Submittals

.1 Submit for review, shop drawings of all items specified in this section in accordance with "Shop Drawings" in the General Conditions.

.2 At completion of work the prior to final acceptance, provide maintenance manuals for all items specified in this section.

3.6 Coordination and Short Circuit Study

.1 Provide a coordination/protective system study and short circuit study of all equipment specified herein and submit for review.

.1 Include the following:

.1 Utility overcurrent and fault protection devices

.2 Primary switchgear

.3 Primary and 600v cable thermal damage curves

.4 600v air circuit breaker overcurrent, overload and ground fault devices

.5 347/600 and 120/208v panelboards, MCCs and switchgear, connecting feeder cables and bus duct

.6 5 kV and 600v transformer damage curves, magnetizing currents for all transformers 150 kVA and larger

.7 Locked rotor currents, acceleration times and damage curves for motors 75 kW and larger

.8 Any additional data necessary for successful completion of the coordination and short circuit study.

.2 Data shall clearly state the operating time in cycles of each breaker and indicate whether the time current curves for relays are inclusive of breaker tripping time or otherwise.

.3 Prepare a summation chart showing all ratings and settings with easy reference to the appropriate curve.

.4 Symmetrical and asymmetrical fault current calculations shall be submitted to verify the correct choice of the protective elements of the System.

.5 Prepare a systems single line diagram on which the resultant short circuit values, device numbers and ratings are shown.

.2 Relate Work in Other Sections

.1 Unit sub-station to 15 KV: Section 16311

.2 CDP Panelboards and Molded Case Air Circuit Breakers: Section 16477

.3 Panelboards: Section 16430

.3 Qualifications

.1 This study shall be provided by the suppliers of the SKU and 600V switchgear.

.2 This study shall be performed by and bear the stamp of the Professional Engineer registered in the Province of Manitoba.

.4 Submittals

.1 Submit the complete study for review prior to carrying out calibration and verification.

.5 Tripping Devices

.1 Relay styles, CT ratios and fuse sizes have been selected on a preliminary basis for design purposes.

Final selection shall be based on the results of this study and shall be included at no extra cost.

.6 Execution

.1 Provide the 600V switchgear supplier with all relevant data for equipment not provided by the supplier.

3.7 Calibration and Verification

.1 Description

.1 Calibrate and verify the following equipment items supplied under this contract:

.1 Primary switchgear

.2 5 kV 600V Unit Subdistribution Transformers

.3 600V switchgear

.2 The calibration and Verification shall be carried out in the field after installation and connection of equipment, but prior to energization, in the presence of the City and the Contract Administrator.

.3 Related Work in Other Sections

.1 Unit substation to 15 kV: Section 16311

.2 Coordination and Short Circuit Study: Section 16405

.4 Submittals

.1 Submit details of all test procedures and instruments, together with technicians names, to the Contract Administrator, prior to proceeding.

.2 Submit written verification report after installation is completed to reflect as-built conditions.

.5 Qualification

.1 Work shall be performed by a firm specializing in and with relevant experience in testing 15 kV and 600V switchgear and protective relaying.

.2 This firm shall also perform the final checkout and testing of the equipment specified in Item 3.7 of this Section.

.6 Products

.1 Not applicable.

.7 Calibration and Verification

.1 The calibration and verification shall be carried out in the following stages:

.1 Primary switchgear

.2 5 kV Unit Substation Transformer

.3 600v switchgear

.2 The Electrical Contractor shall advise well in advance when each stage is ready for the calibration and verification and he shall:

.1 Ensure that all equipment is installed, connected and cleaned inside and out.

.2 Provide 120V convenience receptacles.

.3 Provide one qualified electrician to assist in the calibration and verification.

.4 Provide all other facilities, equipment and personnel as reasonably required to assist in the calibration and verification.

.3 For each circuit breaker, calibrate all protective relays and overcurrent device time and instantaneous trips in accordance with requirements of the protected equipment and overall coordination scheme. Field set each relay according to the recommend settings.

.4 Verify all transformer ratios, insulation values, fuse sizes, C.T. and P.T. ratios, etc. and certify that the installation is in accordance with the requirements of the manufacturer and the Coordination/Short Circuit Study. Submit a written report on this verification to the Contract Administrator.

.5 Carry out the tests required of calibration and verification firm as specified in the other related sections.

.6 Ensure all bus and cable connections are tightened to manufacturer's specifications.

.7 All relays are to be cleaned with dry, dust fee compressed air.

END OF SECTION