

Part 1 General**1.1 RELATED SECTIONS**

- .1 Section 23 21 23 – Hydronic Pumps.
- .2 Section 23 64 26.01 – Modular Water Chillers
- .3 Section 23 74 00 – Packaged Outdoor HVAC Equipment
- .4 Section 23 82 19 – Fan Coil Units
- .5 Section 25 01 11 – EMCS: Start-Up, Verification and Commissioning.
- .6 Section 26 05 00 – Common Work Results for Electrical.
- .7 Section 26 05 21 – Wires and Cables (0 – 1000 V).
- .8 Section 26 05 28 – Grounding – Secondary.
- .9 Section 26 28 16.02 – Moulded Case Circuit Breakers.

1.2 REFERENCES

- .1 National Electrical Testing Association (NETA)
 - .1 Acceptance Testing Specifications for Electrical Power Equipment & Systems, 2013 Edition.

1.3 QUALIFICATIONS

- .1 Prior to start of Work, submit name of organization or Contractor personnel proposed to perform services. Designate who has managerial responsibilities for coordination of entire testing and adjusting.
- .2 Retain the services of a recognized Testing Agency to employ qualified technicians for the testing verification and commissioning of electrical systems equipment and components including:
 - .1 Temporary Chiller System
 - .2 Permanent Chiller system
 - .3 Control Systems
 - .4 Feeders
 - .5 Breakers
- .3 Submit documentation to confirm organization and/or personnel compliance with quality assurance provision.
- .4 Submit one (1) preliminary specimen copy of each report form proposed for use.

1.4 ROLES AND RESPONSIBILITIES

- .1 Responsibility for the satisfactory completion of the project and demonstration that the requirements of commissioning are satisfied rests with the Contractor, who will employ and pay for the specialist supervision, inspection and testing as required to complete the work described. This shall include a commissioning manager with experience in performance verification, testing commissioning, integrated system testing and training on projects with similar components and at least equal complexity to those included in this project.
- .2 The roles and responsibilities of the Departmental Representative and the Contractor for the Commissioning Process are as follows:
 - .1 The Departmental Representative is responsible for the oversight of the overall performance verification and commissioning process.
 - .2 The Departmental Representative may participate in some or all of the testing and verification of project components, systems, and integrated systems to meet the client and project objectives.
 - .3 The Contractor shall participate in all of the performance testing and verification of components, systems, and integrated systems to ensure that project components, systems, and integrated systems work correctly as per the project requirements and design intent.
 - .4 The Contractor shall be responsible for organizing and implementing all aspects of the performance verification and commissioning process outlined herein. The Contractor shall arrange with his suppliers and subcontractor's free access for the Departmental Representative to the plants where equipment is being manufactured, for witnessing in plant operational performance testing.
- .3 Further defined in this specification section are:
 - .1 The Contractor's and the Departmental Representative's responsibilities with respect to the performance verification and commissioning process as it applies to each of the phases of the project.
 - .2 The Contractor's and the Departmental Representative's responsibilities relating to the coordination and implementation of the Integrated Systems Testing and Fine Tuning requirements.

1.5 PERFORMANCE VERIFICATION AND COMMISSIONING PLAN

- .1 Prepare and submit a plan outlining the procedures and processes for the performance verification and commissioning of all components and systems. Submit the plan to the Departmental Representative within two (2) weeks of receipt of reviewed shop drawings. The Departmental Representative will review the plan submitted and return with comments within two (2) weeks. Make the indicated revisions and resubmit within one (1) week.
- .2 The plan shall include a schedule for performance verification and commissioning integrated with the overall project schedule. It shall include separate line items for each procedure and process.
- .3 The plan shall also include activities for Instruction and Training as described under Section 01 99 00 – Demonstration and Training.
- .4 The plan shall include a description of the co-ordination and activities of all sub-trades with respect to performance verification and testing.

- .5 The plan shall also include the co-ordination and activities for integrated systems testing. This includes existing components and systems and components and systems being supplied under the work of other related contracts. Related systems requiring integration with systems and components whether or not supplied under this contract include:
 - .1 Temporary Chiller System
 - .2 Permanent Chiller system
 - .3 Control Systems
- .6 The schedule shall include meetings for review and co-ordination of performance verification, commissioning and training activities.
- .7 The plan shall include data sheets for each system and component as listed herein. The first part of each data sheet shall be completed from information contained in the reviewed shop drawings.

1.6 VERIFICATION FORMS

- .1 The Contractor shall develop project specific verification forms and/or check lists for each component and system.
- .2 Verification forms are to include specific data covering the final tested and/or calibrated condition as left for each component and assembly.

1.7 REPORTS

- .1 Submit completed reports immediately after inspections and/or tests are performed.
- .2 Record all data gathered on site on approved verification forms.
- .3 Provide the Departmental Representative with original of each completed verification form.
- .4 Maintain one photocopy on site of all data taken during starting and testing period.
- .5 Maintain one copy of all final starting, testing, balancing, and adjusting reports on site up to interim acceptance of the work for reference purposes.
- .6 All final verification forms are to be typewritten.
- .7 Submit to the Departmental Representative for approval.
- .8 Make corrections and resubmit as requested by the Departmental Representative.

1.8 MANUFACTURER'S REPORTS AND SPECIAL TESTING AGENCY

- .1 Arrange for manufacturer's to submit copies of all production test records for production tests required by these specifications prior to shipping.
- .2 These production test records will be certified by the manufacturer that the item meets the testing performance criteria specified.
- .3 Arrange to obtain from the Chiller System equipment supplier manufacturer a step by step description of entire starting and operating procedures.
- .4 Modify procedures detrimental to equipment performance and review same with manufacturer, before start-up.

1.9 WITNESS AND PERFORMANCE VERIFICATION AND COMMISSIONING

- .1 Provide sufficient notice (minimum ten working days) prior to commencing tests.
- .2 The Departmental Representative may witness all or any portion of testing and starting procedures performed by the Contractor.
- .3 Contractor to be present for all tests.

1.10 AVAILABLE DOCUMENTATION

- .1 The Contractor shall have contract documents, shop drawings, product data, and operation and maintenance data on hand during equipment performance verification process.

Part 2 Products**2.1 CONTRACTOR TESTING INSTRUMENTS**

- .1 Contractor to provide effective two way radios capable of transmitting signals clearly throughout the facility, ladders and other equipment as required to complete the program and as outlined in this specification.
- .2 Contractor to provide all safety equipment required for personnel involved in the starting, testing, adjusting, and balancing program.

2.2 CONTRACTOR TESTING PERSONNEL

- .1 Contractor to provide sufficient 'qualified' personnel to the Departmental Representative's satisfaction at field locations and at the central operation work (monitoring) station to successfully test and commission components, systems, and integrated systems.

Part 3 Execution**3.1 TESTING OVERVIEW**

- .1 Ensure integrated system operations conform with design documents providing required performance with proper interaction between related systems.
- .2 Verify performance of components and systems operating in conjunction with one another under all conditions (normal and abnormal) and modes of operation.
- .3 Each system is to be operated for as long as required to complete commissioning.
- .4 Commissioning Manager to verify that reported results of testing and procedures are checked and verified to be correct. If inconsistencies appear between reported results and demonstrated values, the relevant testing procedures are repeated and adjustments made until satisfactory results are obtained.

3.2 COMPLETION

- .1 Thoroughly overhaul and restore to new condition all equipment which has been operated by the contractor during the construction phase.

- .2 Permanently mark all final settings in such a manner that they cannot be eradicated or obliterated in any way.
- .3 Record all final settings and record drawings. Include 'As Commissioned' Performance data within Operations and Maintenance Manuals.
- .4 Verify the implementation of all identification procedures as specified in the Contract Documents.
- .5 Due to seasonal requirements, some systems may have to be tested after the facility has been handed over, accepted, and during the warranty period.
- .6 If necessary, occupancy shall be coordinated so as to avoid interference with, or interruption of, any integrated systems testing activities.

3.3 INTEGRATED SYSTEMS TESTING

- .1 Integrated systems testing shall take place only after testing, performance verification and demonstration of satisfactory operation for each individual component and/or system has been completed and accepted by the Departmental Representative.

3.4 DOCUMENTATION AVAILABLE

- .1 Component and system testing shall not take place until operation and maintenance manuals have been reviewed and accepted by the Departmental Representative.

3.5 RESPONSIBILITIES

- .1 The Departmental Representative will do the following during Systems and Integrated System Testing and Fine tuning:
 - .1 Witness and provide instruction in a series of pre planned integrated system performance tests under conditions simulating, to the extent possible, full and partial operating loads and emergency load conditions.
 - .2 Review and verify Contractor recorded test results.
 - .3 Diagnose problems and determine whether or not they are a result of Contract Deficiencies.
 - .4 Request repeat tests as required following correction of Contract Deficiencies.
 - .5 Conduct user surveys and take environmental measurements as necessary to identify existing and potential problems.
 - .6 Provide direction and instruct in the fine tuning of the systems under test to satisfy the operating requirements.
- .2 Contractor/testing personnel to perform the following during Systems and Integrated Systems testing and Fine Tuning:
 - .1 Employ all coordination, resources, services, measures and responsibilities to execute the entire testing and commissioning program (process) without damage to project systems or components, at no additional cost to Crown.
 - .2 Modify operating parameters of the systems to satisfy the fine tuning requirements outlined by the Departmental Representative so to ensure proper system operation. For example:
 - .1 Make adjustments which may become apparent as testing proceeds.

- .2 Undertake modifications to suit changes as equipment settles down during the running in period.
- .3 Documentation of results.
- .4 Diagnosis of problems.
- .5 Correct contract deficiencies previously outstanding as well as any identified during Systems and Integrated Systems Testing and Fine Tuning.
- .6 Fine Tuning will provide for the adjustment of the system where the integrated systems testing have shown a need, such as but not limited to:
 - .1 Adjustments to timing of control devices.
 - .2 Adjustments to software to achieve the desired outputs.
 - .3 Calibration of motors and instrumentation devices.
 - .4 Adjustment to protective relaying.

3.6 COMPONENT, SYSTEM AND INTEGRATED SYSTEM TESTING AND DOCUMENTATION

- .1 The contractor is to develop detailed Performance Verification (P.V.) Forms as required for the complete project for all equipment components and major systems and submit them to the Departmental Representative for review and acceptance.
- .2 All performance data to be documented by the installing Contractor.
- .3 Commission each component, system, and integrated system and complete the requirements of each test. Record all test data on verification forms, checklists and other reports. Submit reports to the Departmental Representative.

END OF SECTION