

**Part 1 General****1.1 RELATED SECTIONS**

- .1 Section 01 00 10 – General Instructions.
- .2 Section 01 91 13 - General Commissioning (Cx) Requirements.
- .3 Section 01 79 00 - Demonstration and Training.
- .4 Section 25 05 01 - EMCS: General Requirements.

**1.2 DEFINITIONS**

- .1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.
- .2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.
- .3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:
  - .1 Outage of main power supply in excess of back-up power sources provided that:
    - .1 Automatic initiation of back-up was accomplished.
    - .2 Automatic shut-down and re-start of components was as specified.
  - .2 Failure of communications link provided that:
    - .1 Controller automatically and correctly operated in stand-alone mode.
    - .2 Failure was not due to failure of any specified EMCS equipment.
  - .3 Functional failure resulting from individual sensor inputs or output devices provided that:
    - .1 System recorded said fault.
    - .2 Equipment defaulted to fail-safe mode.
    - .3 AEL of total of all input sensors and output devices is at least 99% during test period.

**1.3 DESIGN REQUIREMENTS**

- .1 Confirm with Departmental Representative that Design Criteria and Design Intent are still applicable.
- .2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intent.

**1.4 SUBMITTALS**

- .1 Submittals in accordance with Section 01 00 10 – General Instructions.

- .2 Final Report: submit report to Departmental Representative.
  - .1 Include measurements, final settings and certified test results.
  - .2 Bear signature of commissioning technician and supervisor
  - .3 Report format to be approved by Departmental Representative before commissioning is started.
  - .4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative in accordance with Section 01 00 10 – General Instructions.
  - .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

## **1.5 CLOSEOUT SUBMITTALS**

- .1 Provide documentation, O&M Manuals, and training of O&M personnel for review of Departmental Representative before interim acceptance in accordance with Section 01 00 10 – General Instructions.

## **1.6 COMMISSIONING**

- .1 Do commissioning in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.
- .2 Carry out commissioning under direction of Departmental Representative and in presence of Departmental Representative.
- .3 Inform, and obtain approval from, Departmental Representative in writing at least 14 days prior to commissioning or each test. Indicate:
  - .1 Location and part of system to be tested or commissioned.
  - .2 Testing/commissioning procedures, anticipated results.
  - .3 Names of testing/commissioning personnel.
- .4 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.
- .5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- .6 Load system with project software.
- .7 Perform tests as required.

## **1.7 COMPLETION OF COMMISSIONING**

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Departmental Representative.

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**Part 2            Products****2.1                EQUIPMENT**

- .1        Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.
- .2        Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.
- .3        Locations to be approved, readily accessible and readable.
- .4        Application: to conform to normal industry standards.

**Part 3            Execution****3.1                PROCEDURES**

- .1        Test each system independently and then in unison with other related systems.
- .2        Commission integrated systems using procedures prescribed by Departmental Representative.
- .3        Debug system software.
- .4        Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.

**3.2                FIELD QUALITY CONTROL**

- .1        Completion Testing.
  - .1        General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
  - .2        Include following activities:
    - .1        Test and calibrate field hardware including stand-alone capability of each controller.
    - .2        Verify each A-to-D convertor.
    - .3        Test and calibrate each AI using calibrated digital instruments.
    - .4        Test each DI to ensure proper settings and switching contacts.
    - .5        Test each DO to ensure proper operation and lag time.
    - .6        Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
    - .7        Test operating software.
    - .8        Test application software and provide samples of logs and commands.
    - .9        Debug software.
    - .10      Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and Departmental Representative. This document will be used in final start-up testing.

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- .3 Final Start-up Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative and provide:
    - .1 One technical personnel capable of re-calibrating field hardware and modifying software.
    - .2 Detailed daily schedule showing items to be tested and personnel available.
    - .3 Departmental Representative's acceptance signature to be on executive and applications programs.
    - .4 Commissioning to commence during final start-up testing.
    - .5 O&M personnel to assist in commissioning procedures as part of training.
    - .6 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.
    - .7 Commission systems considered as life safety systems before affected parts of the facility are occupied.
    - .8 Operate systems as long as necessary to commission entire project.
    - .9 Monitor progress and keep detailed records of activities and results.
  - .4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
    - .1 Prior to beginning of 30 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
      - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
    - .2 Test to last at least 30 consecutive 24 hour days.
    - .3 Tests to include:
      - .1 Demonstration of correct operation of monitored and controlled points.
      - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
    - .4 System will be accepted when:
      - .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
      - .2 Requirements of Contract have been met.
    - .5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
    - .6 Correct defects when they occur and before resuming tests.
  - .5 Departmental Representative to verify reported results.

**3.3            ADJUSTING**

- .1        Final adjusting: upon completion of commissioning as reviewed by Departmental Representative, set and lock devices in final position and permanently mark settings.

**3.4            DEMONSTRATION**

- .1        Demonstrate to Departmental Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 79 00 - Demonstration and Training.

**END OF SECTION**