SECTION 01810

start-up, testing and commissioning

# GENERAL

## DESCRIPTION

### This Specification discusses pre-commissioning and commissioning activities. Pre-commissioning activities include all the activities associated with the first time startup of all equipment, instruments, electrical gear and/or process. This includes all checks and tests prior to running equipment and any laboratory tests that may be required to verify proper operation of processes. For the purpose of this Project, the commissioning phase will start after EVMWD’s has approved all pre-commissioning activities. Full operational tests that demonstrate functionality and reliability will be done during commissioning. It may be necessary to include the installation of temporary facilities to support testing and the removal of temporary facilities when testing is complete. It is the CONTRACTOR’s responsibility to execute proper planning, notification and scheduling. The commissioning activities will involve the ENGINEER, CONSULTANT, CONTRACTOR, EVMWD project team, and EVMWD staff responsible for the operation, maintenance and facilities oversight.

### This section identifies the tests and documentation that the CONTRACTOR shall be responsible for in order to complete pre-commissioning and commissioning. All pre-commissioning and commissioning Work, as described in this section, shall be performed by the CONTRACTOR.

## RELATED WORK SPECIFIED UNDER OTHER SECTIONS:

### The requirements of the following sections and divisions apply to the Work of this section. Other sections and divisions, not referenced below, shall also apply to the extent required for proper performance of this Work.

#### Section 01300, Shop Drawings and Submittals

#### Section 01783, Operating and Maintenance Data

#### Refer to Specification divisions and/or sections for additional requirements relating to commissioning, including, but not limited to, the following:

##### Division 11, Equipment

##### Division 15, Mechanical

##### Division 16, Electrical

##### Section 16950, Electrical Testing

##### Division 17, Instrumentation and Control

### In the event of a conflict or contradiction between the specific provisions of the General Requirements and Division 01 “Additional General Requirements”, the respective provisions of the latter shall govern while those other provisions of the General Requirements not in conflict shall remain in full force and effect.

## DEFINITIONS

### Commissioning Coordinator: A member of the CONTRACTOR’s team. Individual must be approved by EVMWD.

#### **Process Control and Instrumentation System Supplier (PCIS supplier):** The DISTRICT’s supplier of the PCIS system, including PCIS products and programming services.

#### **Process Instrumentation and Control Integrator (PICI):** A member of the CONTRACTOR’s team or a sub-contractor thereof. The PICI will assist the CONTRACTOR with startup activities and operator training. Refer to Division 17 for additional information regarding PICI requirements.

#### **Gate Report:** A report that is accepted by the ENGINEER prior to the CONTRACTOR’s authorization to proceed to the next phase of commissioning.

#### **Operational Acceptance:** In addition to the General Conditions definition, the successful completion of operator training, Factory Acceptance Testing, Site Acceptance Testing and submittal of current updated redlined As-built Drawings shall be requirements of Operational Acceptance. The ENGINEER will issue a Notice of Operational Acceptance to the CONTRACTOR when all requirements are met.

#### **Substantial Completion:** The CONTRACTOR may apply for Substantial Completion after the ENGINEER has accepted all Reliability Acceptance Tests and the CONTRACTOR has submitted all Manufacturers’ Certificates of Proper Installation. Also see General Conditions.

#### **Final Completion:** Includes all Work under the Contract see General Conditions.

#### **System:** A system means the overall process, or a portion thereof, that performs a specific function.

#### **Manufacturer’s Representative:** Employee of manufacturer who is factory trained and knowledgeable in technical aspects of their products and systems.

#### **Start-up and Commissioning Plan (Commissioning Plan):** A complete written plan submitted by the Contractor to accurately identify and document all phases of Start-up and Commissioning. The Plan must be accepted prior to beginning any Start-up and Commissioning activities. A sample plan is included in these specifications

## PRE-COMMISSIONING Work

### A pre-commissioning workshop shall precede the work activities. Parties that must attend the workshop are the General Contractor, Electrical Contractor, CM, PICI and EVMWD. The Commissioning Coordinator shall lead the workshop. The purpose of the workshop is to go over the Start-up and Commissioning activities and discuss the Commissioning Plan. The Contractor is to submit an outline of the Plan for approval prior to scheduling the meeting. Any obstacles that may impede the CONTRACTOR’s progress should be identified and discussed.

### Pre-commissioning is made up of all the activities that shall be completed before the CONTRACTOR is permitted to begin Commissioning. Attachment B illustrates some of the standard tasks. Additional tasks may be required depending on the project.

#### The primary activities for this are construction, factory testing, documentation, component testing and stand-alone equipment testing. This includes pipe pressure testing and electrical continuity testing. The intent is to test isolated equipment and components. Pre-commissioning testing shall conclude with EVMWD’s acceptance of the Pre-Commissioning Report.

#### Once all components have been tested individually and all required deliverables have been accepted by EVMWD, the CONTRACTOR may request to proceed to Commissioning. If EVMWD agrees that the CONTRACTOR has successfully performed all tests and provided all required documentation, the ENGINEER will notify the CONTRACTOR in writing that he may begin Commissioning.

## Commissioning Work

### Commissioning is composed of two parts, Phase 1 and Phase 2. Attachment B illustrates some of the standard tasks. Additional tasks may be required depending on the project.

#### Phase 1 Commissioning will include operator training as well as comprehensive testing. The tests will include the Site Acceptance Test – Part 2 (SAT-2). The purpose of SAT-2 is to test all equipment, instruments and software as an integrated system. The successful completion of the Site Acceptance Test – Part 2 (SAT-2) will allow the CONTRACTOR to request that the facility has obtained Operational Acceptance. When all deliverables have been accepted and operator and maintenance training is complete, EVMWD will notify the CONTRACTOR in writing that the facility has achieved Operational Acceptance and they may proceed to the next phase of Commissioning.

[Note to the Engineer: Coordinate with the DISTRICT if Beneficial Occupancy/Operational Acceptance should be after SAT-2, or possibly after RAT, or after 30-Day Test.]

#### Phase 2 Commissioning is designed to functionally test the facility as an integrated system under normal operating conditions. The testing includes the Reliability Acceptance Test (RAT) that will be conducted over a period of time that demonstrates the operational reliability of the system. After successful completion of the RAT and all Manufacturers’ Certificates of Proper Operation have been submitted to EVMWD, the CONTRACTOR may request that the facility is Substantially Complete (see General Conditions). Final Completion is achieved when the requirements of the General Conditions are met and the following Final Documents and activities are complete and accepted by EVMWD:

##### Final Operation and Maintenance Manuals

##### Final Punch List

##### Final As-built Drawings

##### Commissioning Reports

##### Start-up Plan has been completely signed off, submitted and accepted by EVMWD

## Commissioning Team

### The Commissioning Team shall be made up of personnel from the CONTRACTOR, EVMWD and the CONSULTANT. The CONTRACTOR shall assemble a commissioning team under the direction of a Commissioning Coordinator, duly authorized to commit the CONTRACTOR’s personnel and resources.

### CONTRACTOR, Subcontractor, and equipment suppliers shall provide technical labor support staff during pre-commissioning and commissioning.

### COMMISSIONING COORDINATOR. The Commissioning Coordinator shall lead all pre-commissioning and commissioning efforts and utilize representatives of the CONTRACTOR’s mechanical, electrical and instrumentation Subcontractors, and others as appropriate for Pre-commissioning and Commissioning activities and testing. This team shall be available at the Work site during normal working hours (8 hours a day, 5 days a week, except Saturdays, Sundays and legal holidays) and shall be available within 2 hours notice at all other times upon notice by telephone. This team shall at all times be equipped and ready to provide for emergency repairs, adjustments and corrections to the equipment and systems installed and modified as a part of this Contract.

#### Responsibilities. The Commissioning Coordinator shall direct and be responsible for all pre-commissioning and commissioning tests. The Commissioning Coordinator shall also provide technical instruction for pre-commissioning and commissioning and shall direct the facility operation during equipment testing and facility testing. All facility operation and tests shall be performed in the presence of EVMWD personnel unless such presence is expressly waived in writing by EVMWD. The Commissioning Coordinator shall be responsible for the Commissioning Plan and pre-commissioning and commissioning submittals.

#### Other responsibilities include:

##### Initiate and chair Commissioning Plan workshops as required to coordinate development of the Plan. Coordinator shall provide agendas and workshop minutes. Workshop attendees, at a minimum, shall include the General Contractor, Electrical Contractor, PICI, and PCIS supplier, and appropriate equipment suppliers.

##### Prepare the submittals required for the Work of this Section

##### Develop and implement test procedures for inclusion into the Commissioning Plan.

##### Develop and implement the Commissioning Plan. The Plan shall:

###### Be acceptable to EVMWD.

###### Include equipment name.

###### Have provisions for recording dates of completion for checking, inspection by manufacturer, verification of instrumentation and controls, and completion of tests.

###### Provide space for problems remaining with equipment and for signature of EVMWD and manufacturer’s representatives indicating acceptance.

###### Follow the sample Plan included in these specifications.

[Note to the Engineer: Suggest to include a sample Plan or remove this sentence.]

##### Develop a detailed Pre-commissioning and Commissioning Schedule. This schedule must include tasks that refer to the tasks listed in Attachment B and any others not listed that may be required to demonstrate proper operation. The task numbers “ (“T numbers, ie. T1, T2, etc, as shown in Attachment B at the end of this Section) must be used in the CONTRACTOR’s schedule so EVMWD staff can cross reference it.

##### Develop Commissioning Forms to be used to record testing of each equipment item. Some example forms are included in Attachment A.

##### Furnish labor, materials, consumables, tools, instruments, oils, fluids, test water and services for checking and testing all equipment during pre-commissioning and commissioning. This includes services from manufacturers’ representatives, Subcontractors, electricians, instrumentation technicians, and pipe-fitters that may be required during pre-commissioning and commissioning.

##### Notify EVMWD and all respective equipment manufacturers at least twenty one (21) days prior to the date when each equipment system is scheduled to be initially started; also submit testing plan stating schedule and quantity and source of utilities and other materials needed.

##### Be responsible for all maintenance and servicing of all equipment, electrical gear and instrumentation during pre‑commissioning and commissioning.

##### Provide all documentation that equipment is ready for testing.

##### Provide all test reports after each test. The report shall include all data collected during the test.

##### Organize NETA acceptance testing performed by the CONTRACTOR during the Pre-commissioning phase in accordance with Division 16, Section 16080, Electrical Testing. Tests on newly-installed power systems and apparatus shall be conducted before energizing, to ensure that the installation and equipment comply with Specifications and intended use as well as with regulatory and safety requirements.

##### Perform the actual pre-commissioning tests and/or supervise the performance of pre-commissioning tests by manufacturer’s field service representatives for various pieces of equipment.

##### Perform the Site Acceptance Test – Part 1 (SAT-1) Operational Readiness Tests.

##### Perform the Site Acceptance Test – Part 2 (SAT-2).

##### Operate the facility during SAT’s and RAT with the support of EVMWD operators. At the discretion of EVMWD, EVMWD may choose to intervene and direct operations during the SAT’s and RAT in order to protect public health, safety and water quality.

##### Formally request training facilities for the classroom portion of the operator and maintenance training thirty (30) days prior to use.

##### Provide operator and maintenance training to EVMWD staff in accordance with Division 01, Section 01820, Training of EVMWD Personnel.

##### Provide Operation and Maintenance Manuals in accordance with Division 01, Section 01783, Operation and Maintenance Manuals.

##### Conduct monthly commissioning meetings from EVMWD’s acceptance of Commissioning Coordinator until the start of the SAT-1 Operational Readiness Test Part 1.

##### Conduct weekly commissioning meetings from the start of SAT-1 until the completion of the Reliability Acceptance Test.

### EVMWD

#### Responsibilities

##### Observe the following tests for compliance with the Contract requirements. EVMWD may engage their CONSULTANT to witness some or all of the tests and participate in the evaluation of the performance. EVMWD will not be obligated to provide more than two teams during witnessing of FAT-2, SAT’s, or RAT.

###### Factory Acceptance Test

###### Site Acceptance Tests

###### Reliability Acceptance Test

##### Furnish and install process control software and programming as specified in Section 17000 and Section 17300, Programming by PCIS supplier. It is intended that PCIS supplier will provide labor and services to supplement the Commissioning Coordinator’s staff during the Factory Acceptance Test(s) to support the integration of EVMWD-furnished process control software and hardware.

[NOTE TO THE ENGINEER: ADJUST ITEM ‘b’ ABOVE IF THE PCIS SUPPLIER IS A SUB-CONTRACTOR TO THE CONTRACTOR (IN LIEU OF DISTRICT-FURNISHED PCIS SYSTEM EQUIPMENT AND SERVICES).]

##### Provide operator support for the equipment during the Site Acceptance Test.

##### Provide classroom facilities for operator and maintenance training.

### CONSULTANT

#### Responsibilities

##### Will assist EVMWD in review of all submittals and test data.

##### May witness all Factory Acceptance Testing.

## Manufacturer's Field Services

### It is the CONTRACTOR’s responsibility to arrange for the services of the manufacturer’s representatives that apply during equipment installation, facilities testing, pre-commissioning, commissioning, and training of EVMWD personnel. Where manufacturer’s services are specified, the CONTRACTOR shall furnish a qualified representative of the manufacturer to provide these services.

#### Submittals

##### CONTRACTOR shall submit the following under this section, as specified in General Requirements, Shop Drawing Submittals:

#### Qualifications and experience records of proposed manufacturers’ representatives who will assist installation and testing of equipment and conduct training sessions.

#### After equipment installation, each manufacturer’s representative shall submit to EVMWD a written report (Certificate of Proper Installation) certifying that the all equipment specified in Division 11, through Division 17 is installed properly, in accordance with the manufacturer’s installation instructions. All such submittals must be received by OWNER no later than 30 days after SAT – Part 1.

#### During Phase 2 of Commissioning (RAT and 30-Day Test), each manufacturer's representative shall submit to EVMWD a written report (Certificate of Proper Operation) certifying that the all equipment specified in Division 11through Division 17 has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated per specifications. All such submittals must be received by EVMWD no later than 30 days after SAT – Part 2.

##### Scheduling of Manufacturer’s Field Services

#### The manufacturer’s representative shall be an experienced, competent, and an authorized representative of the manufacturer of each item of equipment for which field services are indicated in the individual sections of the Contract Specifications. He shall visit the site of the Work to inspect, check, adjust if necessary, and approve the equipment installation. In each case, the manufacturer's representative shall be present when the equipment is being tested and placed in operation. The manufacturer's representative shall revisit the jobsite as often as necessary until all trouble is corrected.

#### The scheduling of all visits to the site by the manufacturer’s field services representative shall be determined by the CONTRACTOR and accepted by ENGINEER. It is intended that the manufacturers’ representatives’ visits are for the purpose of making equipment inspections and normal adjustments, and not for the purpose of remedying defective Work.

#### Manufacturers’ representatives shall resolve assembly or installation problems attributable to or associated with, their products and equipment.

#### During the testing, the manufacturer’s representative shall assist, as applicable, to perform initial equipment and system adjustments and calibrations.

#### After all acceptance tests have been completed, but prior to Substantial Completion, the CONTRACTOR shall recheck all equipment for proper alignment and adjustment, check oil levels, re-lubricate all bearing and wearing points, and, in general, assure that all equipment is in proper condition for regular continuous operation.

# PRODUCTS

## Commissioning plan

### The Commissioning Coordinator shall be responsible for preparing the Commissioning Plan. In developing the Commissioning Plan, the Commissioning Coordinator shall use Attachment B – Commissioning Flowchart, as a guide for the separate Commissioning Plan articles that must be prepared.

### As a condition precedent to receiving progress payments in excess of 50 percent of the Contract amount the Commissioning Coordinator shall submit and receive the ENGINEER’s acceptance for the Commissioning Plan. The EVMWD shall require fifteen (15) copies, both hardcopy and electronic, electronic shall be searchable PDF format, to review the submitted Commissioning Plan.

### Once the ENGINEER has accepted the Commissioning Plan, the Commissioning Coordinator shall reproduce the Plan in sufficient number for the Commissioning Coordinator’s purposes and an additional ten (10) copies for delivery to EVMWD. No test Work shall begin until the Commissioning Coordinator has delivered the specified number of Final Commissioning Plans to EVMWD. The Commissioning Plan must be submitted at least 90 days prior to the start of Site Acceptance Testing - Part 1.

### The Commissioning Coordinator shall print one hard copy of the approved plan and label it as the “Record Copy”. It is the Coordinators responsibility to ensure the plan is available for wet signatures when needed. The Coordinator shall maintain the plan and submit it with final close-out documentation at the conclusion of commissioning.

### An example of a Commissioning Plan is included in these specifications. The example identifies the level of detail and typical formatting required.

[Note to the Engineer: Suggest to include an example Commissioning Plan or remove the above sentence.]

### Testing

#### The Commissioning Coordinator shall develop test Plans detailing the coordinated, sequential testing of each item of equipment and system installed under this Contract. Each test plan shall be specific to the item of equipment or system to be tested. Test Plans shall identify by specific equipment or tag number each device or control station to be manipulated or observed during the test procedure. The specific results to be observed or obtained shall be identified in the plan. Test Plans shall also be specific as to support systems required to complete the test Work, temporary systems required during the test Work, Subcontractors' and manufacturers' representatives to be present and expected test duration. As a minimum, the test Plans shall include the following features. Test plans shall be revised until it is acceptable to EVMWD:

##### FAT/SAT checkout procedures reviewed and accepted by the respective equipment manufacturers, and EVMWD.

##### Detailed Plans, setting forth step-by-step descriptions of the procedures proposed by the CONTRACTOR for the systematic testing of all equipment and systems installed under this Contract. Some of the tests that may be required are:

###### Metallurgical tests

###### Factory performance tests

###### Accelerometer recordings made during shipment

###### Field calibration tests

###### Field pressure tests

###### Field performance tests

###### Field operational tests

Procedures shall include a statement indicating test objectives, test descriptions, expected test result for each step, forms, and checklists to be used to control and document the required tests. Procedures shall include the following at a minimum;

###### Test Number

###### Purpose of the test: Describe what is being verified by this particular test.

###### Test Method: Describe the setup for the test and the steps required to complete the test.

###### Criteria: Describe the criteria for passing or failing the test.

###### Provide space on the form for the ENGINEER’s comments and for individual sign-off.

###### Test on a loop-by-loop basis. Every loop shall be signed off individually.

###### Provide a list of all test equipment to be available for the tests.

###### Provide a block diagram showing the test setup arrangement. The diagram shall illustrate the equipment under test, any special test equipment and indicate equipment interconnections.

Step-by-step proving procedure for all control and electrical circuits by imposing low voltage currents and using appropriate indicators to affirm that the circuit is properly identified and connected to the proper device.

Calibration and configuration of all instruments, drives, actuators, etc., and all equipment requiring programming parameters. Calibration documentation shall include identification (by make, manufacturer, model, and serial number) of all test equipment, date of original calibration, subsequent calibrations, calibration method, and test laboratory.

Performance testing of each individual item of mechanical, electrical, and instrumentation equipment. Performance tests shall be selected to duplicate the operating conditions described in the Contract Documents.

System tests designed to duplicate, as closely as possible, operating conditions described in the Contract Documents.

Staffing for each test identifying roles and responsibilities. Provide a description of previous experience on similar projects of both personnel and testing companies to be employed in pre-commissioning and commissioning, include list of references complete with phone numbers.

### Training

#### Identify each operator and maintenance training class

#### Lesson plan outline for each class

#### See Section 01820, Training of EVMWD Personnel, for more details.

### Schedule

#### The Commissioning Coordinator shall produce a testing schedule setting forth the sequence contemplated for performing the test Work.

#### The schedule shall detail the equipment and systems to be tested, and shall be part of the CONTRACTOR’s Baseline Construction Schedule specified in Division 01 – Additional General Requirements.

#### The schedule shall show the contemplated start date, duration of the test and completion of each pre-commissioning and commissioning activity.

#### At a minimum the schedule will show all NETA testing, FAT’s, SAT’s, RAT, and 30-Day Test.

#### Show all operations and maintenance training classes. Operator training must be conducted no less than 30 days prior to the start of SAT – Part 2.

#### Show all document submittal dates.

#### The test schedule shall be submitted, reviewed, and accepted by the ENGINEER with the Baseline Construction Schedule.

#### The test schedule shall be updated weekly, showing actual dates of test Work, indicating systems and equipment testing completed satisfactorily and meeting the requirements of the Contract Documents.

#### Daily Schedule for Testing

##### The Commissioning Coordinator shall begin each day of witnessed testing by meeting with EVMWD.

##### The meeting purpose is to review the test schedule, the test results from the previous day, and where applicable, to coordinate the testing schedule with Plant Operations.

##### Note that the Commissioning Coordinator will need to schedule some testing outside normal working hours because of plant operational requirements. The Commissioning Coordinator may be required to rearrange portions of the testing schedule at short notice to accommodate unanticipated plant conditions such as equipment failure or unusually high sewage flows caused by wet weather.

## PRE-commissioning and Commissioning Tests

### The following tests are conducted by the Commissioning Coordinator during Pre-commissioning and Commissioning.

### Pre-commissioning

#### The CONTRACTOR shall successfully complete each test and receive written confirmation prior to starting any Commissioning Tests.

#### FAT-1 – Factory Acceptance Test – Part 1 The purpose of this test is for the CONTRACTOR to inspect and witness the testing of the Contract equipment at the manufacture’s facility.

#### FAT-2 – Factory Acceptance Test – Part 2 The purpose of this test is for the EVMWD representative(s) to inspect and witness the testing of the Contract equipment at the manufacture’s facility.

#### SAT-1 – Operational Readiness Test – Part 1. This test is performed after installation and calibration & configuration of instruments is complete. The test purpose is for the Electrical Contractor to conduct point-to-point wire “ring-out” checks while referencing approved loop drawings. The point-to-point ring-out checks to include continuity wire tests, verification of correct wire numbers, and verify correct wire termination points. The Electrical Contractor is to provide a certification of 100% accuracy upon completion of the wire ring-out test. This could be a check-box in the Commissioning Plan.

#### SAT-1 – Operational Readiness Test – Part 2. This test is performed after SAT-1 Operational Readiness Test Part 1 is complete. The test purpose is for the CONTRACTOR to check and document the complete control system, including I/O to/from PLC register and ensure all programming functions as intended (Local Hand and Local Auto Modes). Simulations should be kept to a minimum. The Contractor is responsible for arranging all chemicals, water or other materials required to perform tests and shall do so at their expense

### Commissioning

#### Commissioning Phase I, Site Acceptance Test – Part 2 (SAT-2). The SAT-2 is a combined effort between PCIS supplier, EVMWD and the CONTRACTOR. The combined software/hardware system is tested from this point forward. The purpose for the test is to ensure that the PLC and Operator Graphics software configuration is working in conjunction with the hardware and plant as intended. This test is accomplished with the system on-line under normal operating conditions. Equipment will operate with reclaimed water.

#### Commissioning Phase II, RAT – Reliability Acceptance Test. The Purpose for this test is for the CONTRACTOR to demonstrate that all systems are capable of operating continuously in the intended manner for an extended period without failing. During the RAT, the system under test will be operated within design parameters reflecting the day-to-day operation of the facilities for an uninterrupted period of [Status] calendar days.

## Pre-commissioning and commissioning Documentation

### Pre-commissioning

#### The following documentation shall be up to date and accepted by the ENGINEER prior to starting any Commissioning activities. The ENGINEER will give written notice to the CONTRACTOR when all the documents are accepted.

#### Equipment Submittal Process Complete

#### RFIs and Responses up to Date

#### All Electrical Equipment Tests (Section 16080 and Division 16)

#### All Process and Instrumentation Equipment Tests (Section 01740 and Division 17)

[Note to the Engineer: Adjust identified Sections as appropriate for project specific sections to be provided.]

#### All Mechanical Equipment Tests (Division 11, Equipment, Division 13, Special Construction, and Division 15, Mechanical).

#### FAT Data

#### As built Loop Drawings

#### As built elementary drawings and as built shop drawings.

#### P&ID Drawings, updated Project P&ID’s reflecting Pre-Commissioning field modifications.

#### CONTRACTOR Lock-out Tag-out (LOTO) Procedures for every system, provide LOTO procedures prior to any LOTO activities.

#### All Vendor and Manufacturer Certificates of Proper Installation

#### All Pressure Test Reports

#### All Pre-Commissioning Loop Test Reports

#### All Conductivity Test Reports

#### All Instrument Calibration Reports

#### All Electrical Breaker Setting Reports

#### All Mechanical Alignment Reports

#### Local/Manual and Local/Auto Test Reports

#### Draft Operation and Maintenance Manual (submitted 120 days prior to FAT - Part 1)

#### Any and All Operating Permits

#### Commissioning Plan: Due 90 days prior to the start of SAT – Part 1

#### Operator Training Plan

#### Pre-commissioning Report

### Commissioning

#### The following documents shall be submitted by the Commissioning Coordinator to ENGINEER during commissioning:

#### Redline As-built Drawings (submitted 15 days prior to operator training)

#### Final Operation and Maintenance Manuals

#### Final Punch List

#### Final As-built Drawings

#### Pre commissioning satisfactory completion report

#### Commissioning – Phase 1 Report

#### Commissioning – Phase 2 Report

## documentation

### The Commissioning Coordinator shall develop a records keeping system to document compliance with the requirements of this section. Documentation included in this section shall be a combination of the Commissioning Plan, various testing forms and other described miscellaneous items.

#### Equipment and system documentation shall include date of test, equipment number or system name, nature of test, test objectives, test results, test instruments employed for the test and signature spaces for EVMWD’s witness and the CONTRACTOR’s Quality Control Manager. The Commissioning Coordinator shall develop test documentation forms specific to each item of equipment and system installed under this Contract.

#### Once the ENGINEER has reviewed and taken no exception to the forms proposed by the Commissioning Coordinator, the Commissioning Coordinator shall produce sufficient forms, at his expense, to provide documentation of all testing Work to be conducted as a part of this Contract.

### Reference Documentation

#### The Commissioning Coordinator shall make two sets of the following documentation available to the EVMWD or its representatives, at the test site:

##### All Drawings, Specifications, Addenda and Change-Orders;

##### Copy of the accepted test procedure for the specific equipment being tested; and

##### Copy of Drawings and hardware submittals for equipment being tested.

## gate reports

### The CONTRACTOR shall submit several Gate Reports to the ENGINEER for acceptance in order to continue with the Commissioning process. The reports are described below.

#### Pre-commissioning Report

##### The Pre-commissioning Report is a collection of all test reports, test data, certificates and commissioning forms that are produced during the Pre-commissioning Stage. The first section of this document will be a summary of the contents certifying that all prescribed tests and procedures have been successfully completed. The results of individual tests will be recorded in this document. The Commissioning Coordinator is responsible for producing this document.

#### Commissioning – Phase I Report

##### The Commissioning Phase I Report is a collection of all test reports, test data, certificates and commissioning forms that are produced during the Phase I Stage. The first section of this document will be a summary of the contents certifying that all prescribed tests and procedures have been successfully completed. The Commissioning Coordinator is responsible for producing this document.

#### Commissioning – Phase II Report

##### The Commissioning Phase II Report is a collection of all test reports, test data, certificates and commissioning forms that are produced during the Phase II Stage. The first section of this document will be a summary of the contents certifying that all prescribed tests and procedures have been successfully completed. The Commissioning Coordinator is responsible for producing this document. Scan all documents – searchable PDF format.

## SUBMITTALS

### CONTRACTOR shall submit the following information in addition to specific equipment where specified in individual sections and paragraphs:

#### Manufacturer’s Certification of Proper Installation of all equipment before Commissioning begins.

#### A complete description of the CONTRACTOR’s plan for documenting the results of all testing, including:

##### Proposed plan for documenting the calibration of all test instruments.

##### Proposed plan for calibration of all instrument systems, including flow meters and all temperature, pressure, weight, and analysis systems.

##### Sample forms for documenting the results of field pressure and performance tests.

#### The resumé of the proposed Commissioning Coordinator.

#### The resumé of the proposed PICI.

#### The credentials and certification of the testing laboratory proposed by the CONTRACTOR for calibration of all test equipment.

#### Detailed commissioning plan with schedule, prepared by the Commissioning Coordinator, for each equipment item and system. Submit schedule updates showing testing Work not less than 90 days in advance of first scheduled tests. Schedules shall list each piece of equipment or component to be tested, as specified in this section or by the various sections of the Specifications. Schedules shall include sequence and duration for all testing required including Pre-commissioning Testing and Commissioning Testing.

#### Manufacture’s Certificates of Proper Operation for each equipment prior to the Notice of Substantial Completion.

#### O&M manuals as described in Section 01783, Operation and Maintenance Manuals. EVMWD reserves the right to delay Commissioning if the manuals submitted are incomplete, inaccurate or otherwise unsuitable for use by EVMWD. No contract extension or extra cost will be allowed for the delays in Commissioning due to O&M Manual submittal delay.

#### Lock-out and Tag-out Procedures and Policies that will be used by the CONTRACTOR during pre-commissioning and commissioning

##### Submit design and details of temporary test facility (if required).

##### Submit test reports in conformance with requirements specified herein.

#### Preliminary copies of test data in field report form will be made available to the ENGINEER within two days after completion of each test. This information will remain available to the ENGINEER for the duration of the Project.

#### Formal Reports

##### Submit ten (10) hardbound copies of Gate Reports within thirty days after completion of last test. In addition to the hardcopy reports, submit one electronic copy that shall be in a searchable PDF format.

## TRAVEl

### If the FAT-2 test is held at a location more than 100 miles away from OWNER’s facility, as measured by Google Maps shortest driving route, then the CONTRACTOR must, at their expense, make air and ground travel arrangements and lodging accommodations for two (2) DISTRICT staff to attend the testing. The DISTRICT will appoint two staff members to attend the testing. The DISTRICT may at its own discretion, appoint Consultants in lieu of staff members to attend the testing. Any other parties attending the FAT-2 test on behalf of the DISTRICT are required to make their own travel and lodging arrangements. “Red eye” flights are not acceptable, unless approved by the OWNER in advance. Flights booked by the CONTRACTOR must arrive on the same day they depart.

### The FAT-2 location must be within the contiguous United States. If the CONTRACTOR proposes a location outside the contiguous United States, then EVMWD’s staff will not attend the FAT. If the OWNER cannot arrange for a proxy representative to attend the FAT, then the CONTRACTOR shall conduct the FAT at the OWNER’s facility when equipment is shipped to the project site. Any extra cost involved in conducting the FAT at OWNER’s facility will be solely the CONTRACTOR’s responsibility.

# EXECUTION

## Pre-commissioning and commissioning activities

### The following is a partial list of activities that shall be complete during each stage of Commissioning.

### Pre-commissioning

#### Electrical Service Tie-ins

#### Electrical Testing (Division 16, Section 16080)

#### Electrical Equipment is Clean and Energized

#### Mechanical Equipment is Clean and Energized

#### Verify Rotation of Motors

#### Perform Local Manual Mode Tests

#### Piping Equipment is Complete and Pressure Tested

#### Pipe Supports Complete

#### Pipe is Clean of Debris (inside and out)

#### Verify Valve Operation and Positions for Commissioning

#### Perform NETA Tests

#### Check for correct operation and perform calibration tests of position, pressure, level, flow, speed, temperature and all other monitoring instruments

#### I&C System is Complete and Energized

#### Perform Wiring and Loop Tests

#### Operate pump & motor systems (e.g., motor cooling, seal water, lubrication, etc.) to verify proper operation.

#### Operate all mechanical systems to verify proper operation:

##### Plumbing and drainage systems

##### Ventilation systems

##### Plant water, industrial water, City water and plant air systems.

#### Check and operate pipeline accessories such as air valves and blowoffs.

#### Verify electrical operation of auxiliaries including:

##### Solenoids

##### Limit switches

##### Remote indicating devices

##### Position, pressure and level transmitters.

#### Inspect and verify proper anchorage and grounding of equipment.

#### Perform leak tests of pipe, fittings, gaskets and seals.

#### Perform tests of on-off controls, limit switches and indicating lamps.

#### Perform tests of alarms, signals, and fail-safe or system shutdown controls.

#### Programming by PCIS supplier, complete

#### Perform Factory Acceptance Tests (FAT-1 and FAT-2)

#### Perform Site Acceptance Test – Part 1 (SAT-1)

#### Pre-commissioning Requirements Section 17405, Process Instrumentation and Control

### Commissioning

#### Perform Site Acceptance Test – Part 2 (SAT-2)

#### Operator Training

#### Prepare As-built Drawings

#### Reliability Acceptance Test (RAT)

#### 30-Day Continuous Plant Operation Test

#### Prepare Final Operation and Maintenance Manuals

#### Complete Final Punch List

## General Equipment and System Testing

### This section covers general equipment, instrumentation and system testing during pre-commissioning and commissioning.

### Testing Coordination

#### Coordination of Testing with Plant Operation: CONTRACTOR shall notify EVMWD not less than 72 hours in advance of the planned start of equipment testing in order to coordinate Project testing with plant operation.

### Materials and Equipment

#### Provide all testing and recording devices required for specified tests. The Commissioning Coordinator shall determine or approve the type, number and quality of all such devices. Obtain ENGINEER's acceptance of such equipment including oscillograph and test equipment calibration certification.

#### Provide all lubricating oil, hydraulic oil, grease, packing, and insulating and lubricating fluids and filters required to clean, blow out, flush, and initially charge equipment and systems.

### Pre-commissioning Tests and Checks

#### Cleaning and Checking: Prior to testing of all equipment:

##### Inspect and clean equipment, devices, and connected piping so they are free of foreign material.

##### Lubricate equipment in accordance with manufacturer’s instructions.

##### Turn rotating equipment by hand and check motor-driven equipment for correct rotation.

##### Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.

##### Check power supply to electric-powered equipment for correct voltage.

##### Check for proper equipment alignment.

##### Obtain manufacturer’s certification of proper installation.

#### Ready-To-Test Determination: All equipment shall be determined ready to test by the ENGINEER based on the following:

##### Notification in writing by the Commissioning Coordinator of equipment and system readiness for testing

##### Submittal and acceptance of detailed Commissioning Plan

##### Receipt of accepted Operation and Maintenance Manuals as specified in General Requirements, Operation and Maintenance Manuals.

##### Cleanliness of equipment, devices, and connected Work

##### Adequate completion of Work adjacent to, or interfacing with, equipment to be tested

##### Availability and acceptability of manufacturer’s representative to assist testing of respective equipment, and satisfactory fulfillment of other specified manufacturers’ responsibilities.

#### Perform Pre-commissioning Tests and make adjustments as needed. Conduct operating tests for all mechanical equipment, systems and accessories specified in Divisions 11, 13, and 15 Technical Specification sections.

##### Perform tests recommended by the manufacturer’s field service representatives and/or as required by manufacturer's catalogs or specifications.

##### Additional tests required by manufacturer's modifications to meet specified requirements, or tests required due to failures of CONTRACTOR-furnished equipment, shall be at the CONTRACTOR's expense with no additional cost to EVMWD.

##### FAT-1 and FAT-2 shall be directed by the Commissioning Coordinator.

#### Commissioning Phase I Tests

##### Commissioning Phase I tests shall be directed by the Commissioning Coordinator to determine that all features and equipment systems and subsystems have been properly designed, manufactured, installed and adjusted, function properly as specified and are capable of operating simultaneously and continuously in the “local” and “auto” control modes at all capacities throughout their operating range.

##### CONTRACTOR shall submit a list of all required tests for review by Engineer. Submittal shall be in Microsoft Excel spreadsheet format. The list must include proposed start dates for each test. To be included in the Commissioning Plan.

#### Pump and Motor Testing Using Temporary Piping

##### Tests of pumps, motors and VFD’s shall be performed to verify pump performance and operation over the full operating range from minimum head / low flow up to maximum head / maximum flow. This testing may require temporary piping. CONTRACTOR shall size, design, furnish, install, remove when done and store onsite at a location designated by EVMWD, the temporary test piping to facilitate field testing of the pumps and motors as specified in Section 11210, Pumps and Equipment, General.

##### CONTRACTOR shall submit Drawings and all details of the test loop facility in accordance with General Requirements, Section 29, Shop Drawing Submittals.

###### The test piping should include the following key components:

The piping connection shall include a flow metering device. The flow metering device may be an orifice plate, insertion magmeter, or other device proposed by CONTRACTOR and accepted by EVMWD. The full range accuracy of the flow metering device shall be plus or minus one percent (±1%).

The piping shall include a throttling valve that creates a backpressure on the pumps to replicate the full and reduced speed head operating range of the pumps.

The piping connection shall include necessary pipeline appurtenances such as air release and vacuum relief valves, drains, and instrumentation connections. All appurtenances shall be coated in accordance with Section 09800, Protective Coating.

### CONTRACTOR shall note that EVMWD staff generally work four days per calendar week.

### Site Acceptance Test – Part 2

#### Site Acceptance Test shall be directed by the Commissioning Coordinator.

#### The combined software/hardware system is tested from this point forward. The purpose of the test is to ensure that the interlocks from local & PLC, and Operator Graphics software configuration is working in conjunction with the hardware and plant as intended. This test is accomplished with the system on-line under normal operating conditions. Equipment will operate with clean water when possible. Application software and hard-wired problems encountered during the test will be investigated and corrected by the CONTRACTOR. Problems with PLC and/or SCADA software programming done by the EVMWD will be corrected by the EVMWD. The CONTRACTOR shall provide a qualified person familiar with the installation and of PLC panels, full time for the duration of the test. The software programming will be done by EVMWD. The CONTRACTOR will be required to provide all other field and panel wiring items.

#### The CONTRACTOR shall:

##### Check the complete control system for proper installation and adjustment on a loop by loop and component by component basis.

##### Test and calibrate all equipment connected to the control system, whether supplied by the CONTRACTOR or not. Equipment connected to the control system but not supplied by the CONTRACTOR includes existing primary elements, transmitters, cabling, junction boxes, pumps, automatic valves, etc.

##### Notify the ENGINEER in writing if equipment tested but not supplied by the CONTRACTOR is faulty.

##### Perform tests with power applied to the equipment. Check loops from the primary element in the field through all cabling and junction boxes to the PLC database register. The PICI will verify signals in PLC are correct which will validate that the field wiring is correct.

##### Coordinate with the EVMWD staff before testing major equipment not supplied by the CONTRACTOR. (For example, variable frequency drives).

##### Exercise equipment in a manual mode, which is independent of the computer system.

##### Stroke all valves and gates between end of travel limits. Verify stop positions.

##### Bump all motor-driven devices.

##### Prove all hardwired interlocks with equipment energized.

##### Use loop status reports to organize and track inspection, adjustment and calibration of each loop. The report shall include the following:

###### Project name and loop number

###### Tag number for each component

###### Check off/sign offs for each component

###### Tag/identification in place in accordance with the EVMWD requirements.

###### Installation complete in accordance with the EVMWD requirements

###### Termination wiring

###### Calibration/Configuration/adjustment

###### The checked out loop drawings, and/or redlined loop drawings.

##### Check-offs and sign-offs for the loop:

###### Panel interface terminations

###### Input/Output interface terminations with the PLC

###### Input/Output checked to PLC database

###### Total loop operational

###### Correct loop drawing and/or redlined loop drawing and associated correct elementary diagrams for the equipment under testing.

##### Note all deviations from specified final operating configuration.

##### Maintain Loop Status Reports and Calibration Sheets at the Project site and make them available to the ENGINEER at all times.

### Commissioning Phase II Tests

#### Commissioning Phase II consisting of the entire Project, or a specified portion thereof, shall be overseen by the Commissioning Coordinator after the Phase I Tests are completed and accepted by EVMWD.

#### Equipment shall be operated only by the Commissioning Coordinator’s personnel. EVMWD personnel may operate equipment but only under the direction of the Commissioning Coordinator and with the consent of EVMWD.

### Commissioning Phase II – Reliability Acceptance Test

#### Subject to EVMWD acceptance, the Reliability Acceptance Test shall begin as soon as possible after completion of the Site Acceptance Test – Part 2. This test shall be directed by the Commissioning Coordinator. The Reliability Acceptance Test will be considered complete, in the opinion of EVMWD, when the entire Project or specified portion thereof has operated properly for seven (7) continuous days without significant interruption.

#### “Significant interruption” during the Reliability Acceptance Test is defined as follows:

##### Failure of a system (e.g. influent pumping, filter backwash, chemical injection) such that operators must run the system in hand. Failures caused purely by programming errors will not count against the CONTRACTOR.

##### A copper or fiber network link that experiences more than an accumulated 0.5 percent downtime over the course of the test. Downtime due to Force Majeure will not count against the CONTRACTOR. For example, if it rains heavily and the building is flooded out and network communications stops, the CONTRACTOR is not at fault. However, if it rains heavily and water seeps into a network cabinet that the CONTRACTOR was supposed to make watertight, which causes the network to stop working, then the CONTRACTOR is at fault.

##### A radio communication link that experiences more than an accumulated 1 percent downtime over the course of the test. Downtime due to Force Majeure will not count against the CONTRACTOR. For example, if the CONTRACTOR fails to point an antenna directly at the receiving and communications are intermittent, then the CONTRACTOR is at fault. If a drunk driver crashes into the radio cabinet causing the communication link to go down, then the CONTRACTOR is not at fault.

##### Equipment or process alarms that exceed 20 in a single hour or average more than 2 per hour for at least eight consecutive hours.

#### The OWNER will notify the CONTRACTOR in writing of any qualifying significant interruption event. The test shall be paused with credit given for the number of days of testing up to the date of the notification. The CONTRACTOR shall make all corrections necessary to remedy the problem(s). If the CONTRACTOR can demonstrate that the interruption was not due to faulty work on their part or one of their subcontractors or equipment suppliers, then the test will resume, otherwise the test will restart from Day equals 0.

### Retesting of Equipment

#### When testing or operation of the equipment demonstrates that the equipment does not meet the specified requirements, CONTRACTOR shall repeat or perform all additional tests as necessary and required by EVMWD.

#### When the re-testing is caused by failure of CONTRACTOR to perform the Work satisfactorily, as a required procedure, or for minor changes to the equipment, CONTRACTOR will not be granted an increase in the Contract Price, nor an extension of Contract Time. The DISTRICT reserves the right to back-charge the Contractor for services provided by DISTRICT to troubleshoot contractor-related device/gear that is not functioning to Contract requirements.

### Commissioning Phase II – Continuous Operation

#### After successful Reliability Acceptance Test of a particular equipment type or system, EVMWD may elect to operate a portion of the equipment or system for continuous operation. Such operation will not interfere with testing of other equipment and systems that may still be underway, and shall not preclude the need to start up the portion operated in combination with the rest of the facility when all testing is completed.

END OF TEXT

**Section 01810**

**ATTACHMENT A**

**REFERENCE FORMS**

Form No. Title

01300‑A Submittal Transmittal Form

01815‑A Equipment Test Report Form

01783‑A Operation and Maintenance Transmittal Form

01783‑B Equipment Summary Form

01783‑C Equipment Record Form

11000‑A Manufacturer's Installation Certification Form

11000‑B Manufacturer's Instruction Certification Form

11000‑C Unit Responsibility Certification Form

11060‑A Motor Data Form

16010‑A Wire and Cable Resistance Test Data Form

16010‑B Installed Motor Test Data Form

16010‑C Dry Transformer Test Data Form

16010‑D Motor Control Center Test Form

16010‑E Medium Voltage Motor Starter Test Form

16010‑F Medium Voltage Switchgear Test Form

16010‑G Protective Relay Test Form

16010‑H Low Voltage Switchgear Test Form

16010‑I Medium Voltage Load Interrupter Switch Test Form

16010‑J Liquid‑Filled Transformer Test Form

16010‑K Automatic Transfer Switch Test Form (not used)

17000‑A Loop Wiring and Insulation Resistance Test Data Form

17000‑D Panel Indicator Calibration Test Data Form

17000‑G Field Switch Calibration Test Data Form

17000‑H Transmitter Calibration Test Data Form

17000‑I Miscellaneous Instrument Calibration Test Data Form

17000‑J Individual Loop Test Data Form

17000‑K Loop Commissioning Test Data Form

01300-A SUBMITTAL TRANSMITTAL FORM:

SUBMITTAL TRANSMITTAL

Submittal Description: Submittal No:

Spec Section:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Routing | Sent | Received |
| EVMWD: | CONTRACTOR/EVMWD |  |  |
| PROJECT: | EVMWD/Engr. |  |  |
|  | Engr/EVMWD |  |  |
| CONTRACTOR: | EVMWD/CONTRACTOR |  |  |

We are sending you 🞎Attached 🞎Under separate cover via

🞎Submittals for review and comment

🞎Product data for information only

Remarks:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Item | Copies | Date | Section  No. | Description | Review  actiona | Reviewer  initials | Review  comments  attached |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

aNote: NET = No exceptions taken; MCN = Make corrections noted; A&R = Amend and resubmit;

R = Rejected Attach additional sheets if necessary.

**CONTRACTOR**

Certify either A or B:

🞎A. We have verified that the material or equipment contained in this submittal meets all the specified requirements, including coordination with all related Work, (no exceptions).

🞎B. We have verified that the material or equipment contained in this submittal meets all the requirements specified except for the attached deviations.

|  |  |  |
| --- | --- | --- |
| No. |  | Deviation |
|  |  |  |
|  |  |  |
|  |  | Certified by:  CONTRACTOR's Signature |

**01815-A EQUIPMENT TEST REPORT FORM:**

NOTE: This example equipment test report is provided for the benefit of the CONTRACTOR and is not specific to any piece of equipment to be installed as a part of this Project. The example is furnished as a means of illustrating the level of detail required for the preparation of equipment test report forms for this Project.

CITY OF SAMPLE

**EXAMPLE WATER TREATMENT PLANT**

**STAGE IV EXPANSION PROJECT**

ABC Construction Company, Inc., General CONTRACTOR

Sample County Sanitation District, ENGINEER

EQUIPMENT TEST REPORT

Equipment Name: Sludge Pump 2

Equipment Number: P25202

Specification Ref: 11390

Location: East Sedimentation Basin Gallery

PREOPERATIONAL CHECKLIST

|  |  | CONTRACTOR | | |  | ENGINEER | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Verified |  | Date |  | Verified |  | Date |
| Mechanical |  |  |  |  |  |  |  |  |
| Lubrication |  |  |  |  |  |  |  |  |
| Alignment |  |  |  |  |  |  |  |  |
| Anchor bolts |  |  |  |  |  |  |  |  |
| Seal water system operational |  |  |  |  |  |  |  |  |
| Equipment rotates freely |  |  |  |  |  |  |  |  |
| Safety guards |  |  |  |  |  |  |  |  |
| Valves operational |  |  |  |  |  |  |  |  |
| Hopper purge systems operational |  |  |  |  |  |  |  |  |
| Sedimentation tank/hopper clean |  |  |  |  |  |  |  |  |
| O&M manual information complete |  |  |  |  |  |  |  |  |
| Manufacturer's installation certificate complete |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Electrical (circuit ring-out and high-pot tests)  Circuits:  Power to MCC 5 |  |  |  |  |  |  |  |  |
| Control to HOA |  |  |  |  |  |  |  |  |
| Indicators at MCC:  Red (running) |  |  |  |  |  |  |  |  |
| Green (power) |  |  |  |  |  |  |  |  |
| Amber (auto) |  |  |  |  |  |  |  |  |
| Indicators at local control panel |  |  |  |  |  |  |  |  |
| Wiring labels complete |  |  |  |  |  |  |  |  |
| Nameplates: |  |  |  |  |  |  |  |  |
| MCC |  |  |  |  |  |  |  |  |
| Control station |  |  |  |  |  |  |  |  |
| Control panel |  |  |  |  |  |  |  |  |
| Equipment bumped for rotation |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Piping Systems |  |  |  |  |  |  |  |  |
| Cleaned and flushed: |  |  |  |  |  |  |  |  |
| Suction |  |  |  |  |  |  |  |  |
| Discharge |  |  |  |  |  |  |  |  |
| Pressure tests |  |  |  |  |  |  |  |  |
| Temporary piping screens in place |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Instrumentation and Controls |  |  |  |  |  |  |  |  |
| Flowmeter FE2502F calibration |  |  |  |  |  |  |  |  |
| Flow recorder FR2502G calibrated against transmitter |  |  |  |  |  |  |  |  |
| VFD speed indicator calibrated against  independent reference |  |  |  |  |  |  |  |  |
| Discharge overpressure shutdown  switch calibration |  |  |  |  |  |  |  |  |
| Simulate discharge overpressure  shutdown |  |  |  |  |  |  |  |  |

FUNCTIONAL TESTS

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | CONTRACTOR | | |  | ENGINEER | | |
|  |  | Verified |  | Date |  | Verified |  | Date |
| Mechanical |  |  |  |  |  |  |  |  |
| Motor operation temperature satisfactory |  |  |  |  |  |  |  |  |
| Pump operating temperature satisfactory |  |  |  |  |  |  |  |  |
| Unusual noise, etc. |  |  |  |  |  |  |  |  |
| Pump operation: 75 gpm/50 psig |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Measurement: |  |  |  |  |  |  |  |  |
| Flow |  |  |  |  |  |  |  |  |
| Pressure |  |  |  | Test gage number | | |  |  |
| Alignment hot |  |  |  |  |  |  |  |  |
| Dowelled in |  |  |  |  |  |  |  |  |

Remarks:

|  |  | CONTRACTOR | | |  | | ENGINEER | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Verified |  | Date |  | | Verified | |  | | Date | |
| Electrical |  |  |  |  |  | |  | |  | |  | |
| Local switch function: |  |  |  |  |  | |  | |  | |  | |
| Runs in *HAND* |  |  |  |  |  | |  | |  | |  | |
| No control power in *OFF* |  |  |  |  |  | |  | |  | |  | |
| Timer control in *AUTO* |  |  |  |  |  | |  | |  | |  | |
| Overpressure protection switch PS2502C functional in both *HAND* and *AUTO* |  |  |  |  |  | |  | |  | |  | |
| Overpressure protection switch PS2502C set at 75 psig |  |  |  |  |  | |  | |  | |  | |
| PLC 2500 set at 24-hour cycle, 25 min *ON* |  |  |  |  | |  | |  | |  | |  | |
|  |  |  |  |  | |  | |  | |  | |  | |
| Operational Test |  |  |  |  | |  | |  | |  | |  | |
| 48-hour continuous test. Pump cycles as specified, indicators functional, controls functional, pump maintains capacity, overpressure protection remains functional, hour meter functional |  |  |  |  | |  | |  | |  | |  | |

RECOMMENDED FOR BENEFICIAL OCCUPANCY

Engineer Date

ACCEPTED FOR BENEFICIAL OCCUPANCY

EVMWD's Representative Date

**01783-A OPERATION AND MAINTENANCE TRANSMITTAL FORM:**

Date: Submittal No:

To: Contract No:

Spec. Section:

Submittal Description:

From:

Attention:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | CONTRACTOR |  | Construction Manager |  |
| Checklist | Satisfactory | N/A | Accept | Deficient |
| 1. Table of contents |  |  |  |  |
| 2. Equipment record forms |  |  |  |  |
| 3. Manufacturer information |  |  |  |  |
| 4. Vendor information |  |  |  |  |
| 5. Safety precautions |  |  |  |  |
| 6. Operator pre-start |  |  |  |  |
| 7. Start-up, shutdown, and post-shutdown procedures |  |  |  |  |
| 8. Normal operations |  |  |  |  |
| 9. Emergency operations |  |  |  |  |
| 10. Operator service requirements |  |  |  |  |
| 11. Environmental conditions |  |  |  |  |
| 12. Lubrication data |  |  |  |  |
| 13. Preventive maintenance plan and schedule |  |  |  |  |
| 14. Troubleshooting guides and diagnostic techniques |  |  |  |  |
| 15. Wiring diagrams and control diagrams |  |  |  |  |
| 16. Maintenance and repair procedures |  |  |  |  |
| 17. Removal and replacement instructions |  |  |  |  |
| 18. Spare parts and supply list |  |  |  |  |
| 19. Corrective maintenance man-hours |  |  |  |  |
| 20. Parts identification |  |  |  |  |
| 21. Warranty information |  |  |  |  |
| 22. Personnel training requirements |  |  |  |  |
| 23. Testing equipment and special tool information |  |  |  |  |

Remarks:

CONTRACTOR's Signature

01783-B E**QUIPMENT SUMMARY FORM:**

1. EQUIPMENT ITEM

2. MANUFACTURER

3. EQUIPMENT IDENTIFICATION NUMBER(S)

(maps equipment number)

4. LOCATION OF EQUIPMENT

5. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS)

1. NAMEPLATE DATA -

Horsepower

Amperage

Voltage

Service Factor (S.F.)

Speed

ENC Type

Capacity

Other

7. MANUFACTURER'S LOCAL REPRESENTATIVE

Name

Address

Telephone Number

8. MAINTENANCE REQUIREMENTS

9. LUBRICANT LIST

10. SPARE PARTS (recommendations)

11. COMMENTS

01783-C E**QUIPMENT RECORD FORM:**

**MECHANICAL INFORMATION**

|  |  |
| --- | --- |
| Description | |
| Asset Type | |
| Loop Tag No. | Manufacturer |
| Loop | Vendor |
| Location | Model No. |
| Area | Serial No. |

|  |  |  |
| --- | --- | --- |
| Drive | Bushing | Shaft Size |
| Drive Belt | Insert | Chain |
|  |  | Amount |

|  |  |  |
| --- | --- | --- |
| Drive | Bushing | Shaft Size |
| Drive Belt | Insert | Chain |
|  |  | Amount |

|  |  |  |
| --- | --- | --- |
| Input RPM | Output RPM | Ratio |
| Frame | Rotation | Mech. Size |
| Service Factor | Cylinders | HP |
| Lubrication | Amount | Volume |
| Type | | PSI |

**DRIVEN UNIT INFORMATION**

|  |  |
| --- | --- |
| Capacity | Rotation |
| Total Dynamic Head | Impeller Material |
| Impeller Size | Wear Ring Material |
| Trim Size | Front Seal |
| Suction Size | Shaft Seal |
| Discharge Size | Front Bearing |
| Bhp Required | End Shaft Bearing |
| Discharge Capacity | Lubrication |
| Driven Unit RPM | Frame |
| Coupling Data | |

Page 2 of 4

**DRIVER INFORMATION**

|  |  |  |
| --- | --- | --- |
| Lubrication | Speed | Max. |
| Frame |  | Min. |
| Class |  | |
| Drive End Bearing | Voltage | High |
| Opposite Bearing |  | Low |
| Fuse | Amperage | High |
| Breaker |  | Low |
| Thrust Bearing |  | |
| Horsepower | KVA | |
| Service Factor | Impedance | |
| Starter Size | Hz | |
| Heater Size | Phase | |

Page 3 of 4

**INSTRUMENTATION INFORMATION**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Description | | | | | | | | | | | |
| Asset Type | | | | | | | | | | | |
| Loop Tag No. | | | | | | Manufacturer | | | | | |
| Loop | | | | | | Vendor | | | | | |
| Location | | | | | | Model No. | | | | | |
| Area | | | | | | Serial No. | | | | | |
|  | | | | | | | | | | | |
| PLC Address | | | | | | Part No. | | | | Catalog No. | |
| Current Type | Voltage | | kVA | | | | | Watts | | | Amps |
| Circuit No. | | | | | | MCC No. | | | | | |
| Liner Material | | | | | | | | | | | |
|  | | | | | | | | | | | |
| Isolation Fuse No. | | | | | Isolation Fuse Location | | | | | | |
| Duty | | | | | Instrument Rating | | | | | | |
| Accuracy | | | | | Operating Temperature | | | | | | |
| Control Function | | | | | Style | | | | | | |
|  | | | | | | | | | | | |
| Output Range | | | | Signal Output | | | | | No. of Outputs | | |
| Input Range | | | | Signal Input | | | | | No. of Channels | | |
| Totalizer Factor | | | | Enclosure Type | | | | | | | |
| Sensitivity | | | | Sensor Type | | | | | | | |
| Repeatability | | | | Mounting Configuration | | | | | | | |
|  | | | | | | | | | | | |
| IC Power Source | | | | | | Primary Power | | | | Unit | |
| Reference Volts | | Unit | | | | Control Panel No. | | | | | |
| Items Controlled | | | | | | | | | | | |
| Process Fluid | Unit | | | | | | | | | | |
| Max. Differential | Unit | | | | | | Throat Diameter | | | | |
| Operating Pressure | Unit | | | | | | | | | | |

Page 4 of 4

**ELECTRICAL INFORMATION**

|  |  |  |  |
| --- | --- | --- | --- |
| Description | | | |
| Asset Type | | | |
| Loop Tag No. | Manufacturer | | |
| Loop | Vendor | | |
| Location | Model No. | | |
| Area | Serial No. | | |
|  | | | |
| Breaker | | | |
| Amps | Breaker Volts | | |
| Catalog | Style | | |
|  | | | |
| Starter | Size | Volts | High |
|  | | Low |
|  | | | |
| Heaters | | | |
| Contact No. | Max. HP | | |
| Coil No. | Auxiliary No. | | |
| Series | Series Type | | |
|  | | | |
| Transformer | Part No. | | |
| kVA | Fuse | | |
| Transformer Type | Amps | | |

**11000‑A MANUFACTURER'S INSTALLATION CERTIFICATION FORM:**

Contract No: Specification section:

Equipment name:

CONTRACTOR:

Manufacturer of equipment item:

The undersigned manufacturer of the equipment item described above hereby certifies that they have checked the installation of the equipment and that the equipment, as specified in the Project manual, has been provided in accordance with the manufacturer's recommendations, and that the trial operation of the equipment item has been satisfactory.

Comments:

Date Manufacturer

Signature of Authorized Representative

Date CONTRACTOR

Signature of Authorized Representative

**11000‑B MANUFACTURER'S INSTRUCTION CERTIFICATION FORM:**

Contract No: Specification section: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Equipment name:

CONTRACTOR:

Manufacturer of equipment item:

The undersigned manufacturer certifies that a service engineer has instructed the OWNER’s operating personnel in the proper maintenance and operation of the equipment designated herein.

Operations Check List (check appropriate spaces)

Start‑up procedure reviewed

Shutdown procedure reviewed

Normal operation procedure reviewed

Others:

Maintenance Check List (check appropriate spaces)

Described normal oil changes (frequency)

Described special tools required

Described normal items to be reviewed for wear

Described preventive maintenance instructions

Described greasing frequency

Others:

Date Manufacturer

Signature of Authorized Representative

Date Signature of EVMWD’s Representative

Date Signature of CONTRACTOR’s Representative

**11000-C UNIT RESPONSIBILITY CERTIFICATION FORM:**

**(Job Title)** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**CERTIFICATE OF UNIT RESPONSIBILITY**

for Specification Section

(Section title)

In accordance with paragraph 11000-1.02 C of the contract documents, the undersigned manufacturer accepts unit responsibility for all components of equipment furnished under specification Section . We hereby certify that these components are compatible and comprise a functional unit suitable for the specified performance and design requirements.

Notary Public Name of Corporation

Commission expiration date Address

Seal:

By:

Duly Authorized Official

Legal Title of Official

Date:

**11060‑A MOTOR DATA FORM:**

Equipment Name Equipment No.(s)

Site Location

Nameplate Markings

Mfr Mfr Model Frame HP

Volts Phase RPM Service factor

FLA LRA Freq Ambient temp rating \_\_\_\_\_\_degrees C

Time rating Design letter

(NEMA MG1-10.35) (NEMA MG‑1.16)

KVA code letter Insulation class

The following information is required for explosion-proof motors only:

A. Accepted by UL for installation in Class \_\_\_\_\_, Div \_\_\_\_\_\_\_

B. UL frame temperature code \_\_\_\_\_\_; Group \_\_\_\_\_\_\_ Atmosphere

(NEC Tables 500‑2 and 500‑2(b))

The following information is required for all motors 1/2 horsepower and larger:

A. Guaranteed minimum efficiency

(paragraph 11060-2.04 G)

B. Nameplate or nominal efficiency

Data Not Necessarily Marked on Nameplate

Type of enclosure Enclosure material

Temp rise degrees C (NEMA MG1‑12.41,42)

Space heater included?\_\_\_\_\_\_\_ Yes \_\_\_\_\_\_\_ No; if Yes, \_\_\_\_\_\_watts \_\_\_\_\_\_volts

Type of motor winding over-temperature protection, if specified:

Use the space below to provide additional information on other motor modifications, if specified:

**16010‑A WIRE AND CABLE RESISTANCE TEST DATA FORM:**

Wire or Cable No.: Temperature, Degrees F

Insulation

resistance,

Location of Test megohms

2.

3.

4.

5.

6.

7.

CERTIFIED Date

CONTRACTOR's Representative

WITNESSED Date

EVMWD’s Representative

16010‑B INSTALLED MOTOR TEST FORM:

Motor Equipment Number Date of test

Equipment Driven

MCC Location

Ambient temp \_\_\_\_\_\_\_oF

Resistance:

Insulation resistance phase‑to‑ground megohms:

Phase A , Phase B , Phase C

Current at Full Load:

Phase Current, amps

Phase Current, amps

Phase Current, amps

Thermal Overload Device: Manufacturer/catalog # Amperes

Circuit breaker (MCP) setting:

Motor Nameplate Markings:

Mfr  Mfr type Frame \_\_\_\_\_\_ HP\_\_\_\_\_

Volts \_\_\_\_\_\_\_ Phase \_\_\_\_\_\_\_ RPM \_\_\_\_\_\_\_ \*\*Service factor \_\_\_\_\_\_\_\_

Amps \_\_\_\_\_\_ Freq \_\_\_\_\_\_ Ambient temp rating \_\_\_\_\_\_\_ Degrees C

Time rating \*\*Design letter

(NEMA 1‑10.35) (NEMA MG‑1.16)

Code letter Insulation class

\*\*Required for 3‑phase squirrel cage induction motors only.

CERTIFIED Date

CONTRACTOR's Representative

WITNESSED Date

EVMWD’s Representative

16010‑C DRY TRANSFORMER TEST DATA FORM:

Equipment No. Temperature

Location:

Winding: Primary Secondary

A. INSULATION‑RESISTANCE TEST:

The test shall be made with a megohmmeter at the test voltage for a period of 1 minute.

Test results (megohms)

Voltage rating Test voltage Phase Phase

0‑600 1000 A‑GRD A‑B \_\_\_

601‑5000 2500 B‑GRD B‑C \_\_\_

5000+ 5000 C‑GRD C‑A \_\_\_

Resistance readings less than the manufacturer's recommended value or less than 10 megohms shall be brought to the attention of the Engineer.

B. DIELECTRIC‑ABSORPTION TEST:

The test shall be made with a megohmmeter at the test voltage for a period of 10 minutes.

1. TEST RESULTS: Phase Phase

(megohms) A‑GRD A‑B \_\_\_\_\_

B‑GRD B‑C \_\_\_\_\_

C‑GRD C‑A \_\_\_\_\_

2. POLARIZATION INDEX:

(from paragraph "A" above)

Phase Phase

A‑GRD A‑B \_\_\_\_

B‑GRD B‑C \_\_\_\_

C‑GRD C‑A \_\_\_\_

Polarization index values less than 2 shall be brought to the attention of the Engineer.

CERTIFIED Date

CONTRACTOR's Representative

WITNESSED Date

EVMWD’s Representative

16010‑D MOTOR CONTROL CENTER TEST FORM:

Equipment No. Ambient room temperature

Location

A. MECHANICAL CHECK:

All bolted connections either bus to bus or cable to bus shall be torqued to the manufacturer's recommendations.

B. ELECTRICAL TESTS:

1. Measure insulation resistance of each bus section phase to phase and phase to ground for one minute using a megohmmeter at 1000 volts.

Test results (megohms)

Phase Phase

A‑GRD A‑B

B‑GRD B‑C

C‑GRD C‑A

2. Set the circuit breaker in the starter unit to comply with the requirements of NEC, Article 430‑52 and Table 430‑152.

3. Motor overload heater elements shall be sized and installed based on the actual nameplate full load amperes of the motor connected to the starter.

CERTIFIED Date

CONTRACTOR's Representative

WITNESSED Date

EVMWD’s Representative

16010‑E MEDIUM VOLTAGE MOTOR STARTER TEST FORM:

Equipment No.

Location

Room Temperature

The protective devices shall be set in accordance with the specification before the tests are performed.

1. Measure contact resistance (micro‑ohms)

Phase: A B C \_\_\_\_

Contacts shall be replaced if resistance exceeds 50 micro‑ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase A B C

Pole to ground megohms

Across open pole megohms

Pole to pole AB\_\_ BC\_\_ CA\_\_ megohms

3. Perform minimum pickup voltage tests on trip and close coils.

4. Motor RTDs shall be tested by using a hot oil bath. The temperature at which the sensor trips shall be recorded for each RTD.

5. The Contactor shall be tripped by operation of each protective device.

16010‑F MEDIUM VOLTAGE SWITCHGEAR TEST FORM:

Equipment No.

Location

Room Temperature

The protective devices shall be set in accordance with the specification before the tests are performed.

1. Measure contact resistance (micro‑ohms)

Phase: A B C

Contacts shall be replaced if resistance exceeds 50 micro‑ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase A B C

Pole to ground megohms

Across open pole \_ megohms

Pole to pole AB BC CA megohms

3. Perform minimum pickup voltage tests on trip and close coils.

4. Verify the instrument transformer ratios. Check the trans­former's polarity electrically.

5. The CONTRACTOR shall be tripped by operation of each protective device.

16010‑G PROTECTIVE RELAY TEST FORM:

Location

Switchgear Breaker No.

Protective Relay Description

The protective relays shall be tested in the following manner:

1. Each protective relay circuit shall have its insulation resistance tested to ground.

2. Perform the following tests on the specified relay setting:

a. Pickup parameters on each operating element.

b Timing test shall be performed at three points on the time dial curve.

c. Pickup target and seal‑in units.

The results shall be recorded and signed. A copy shall be given to the ENGINEER in accordance with paragraph 16010‑1.05 B.

16010‑H LOW VOLTAGE SWITCHGEAR TEST FORM:

Equipment No.

Location

Room Temperature

The protective devices shall be set in accordance with the specification before the tests are performed.

1. Measure contact resistance (micro‑ohms)

Phase: A\_\_\_\_\_ B\_\_\_\_\_\_ C \_\_\_\_\_\_\_

Contacts shall be replaced if resistance exceeds 50 micro‑ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase A B C

Pole to ground megohms

Across open pole megohms

Pole to pole AB BC CA megohms

3. Minimum pickup current shall be determined by primary current injection.

4. Long time delay shall be determined by primary injection at three hundred percent (300%) pickup current.

5. Short time pickup and time delay shall be determined by primary injection of current.

6. Instantaneous pickup current shall be determined by primary injection.

7. Trip unit reset characteristics shall be verified.

8. Auxiliary protective devices, such as ground fault or under voltage relays, shall be activated to ensure operation of shunt trip devices.

16010‑I MEDIUM VOLTAGE LOAD INTERRUPTER SWITCH TEST FORM:

Equipment Number

Location

Date

1. Measure switch blade resistance (micro‑ohms).

Phase: A\_\_\_\_\_ B\_\_\_\_\_ C\_\_\_\_\_

Contacts shall be replaced if resistance exceeds 50 micro‑ohms.

2. Perform an insulation resistance test (1000 volts dc for 1 minute).

Phase A B C

Pole to ground megohms

Across open pole megohms

Pole to pole AB BC CA megohms

The results shall be recorded and signed. A copy shall be given to the Engineer in accordance with paragraph 16010‑2.06 B.

CERTIFIED Date

CONTRACTOR's Representative

WITNESSED Date

EVMWD’s Representative

16010‑J LIQUID‑FILLED TRANSFORMER TEST FORM:

Equipment Number

Location

Date/Weather Conditions

A. Perform the "Insulation‑Resistance Test" and "Dielectric Absorption Test" using Form 16010‑C, Dry Transformer Test Data Form.

B. Perform an applied voltage (low frequency dielectric) test in accordance with ANSI C57.12.90, paragraph 10.5, Applied Voltage Test. Applied voltage levels shall be 75 percent of recommended factory test levels or recommended test levels of ANSI C57.12.00, Table 5.

C. Insulating oil shall be sampled and shall be laboratory tested for the following:

1. Dielectric strength.

2. Acid neutralization.

3. Interfacial tension.

4. Color.

5. Power factor.

D. Perform a turns ratio test between the windings for all tap positions.

E. The temperature and pressure switches shall be tested using a hot oil bath and air pump.

The results shall be recorded and signed by the CONTRACTOR and ENGINEER. A copy shall be given to the ENGINEER in accordance with paragraph 16010-2.06 D. Any readings which are abnormal to ANSI industry standards shall be reported to the ENGINEER.

16010‑K AUTOMATIC TRANSFER SWITCH TEST FORM:

Equipment Number

Location

Date

1. Perform an insulation resistance test (1000 volts dc for 1 minute):

Phase

A B C

Pole to ground megohms

Pole to pole AB BC CA megohms

2. Perform the following operations and initial:

a. Manual transfer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. Loss of normal power; sec delay

c. Return to normal power; sec delay

The results shall be recorded and signed. A copy shall be given to the ENGINEER in accordance with paragraph 16010‑2.06 B.

CERTIFIED Date

CONTRACTOR's Representative

WITNESSED \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date

EVMWD’s Representative

17000‑A LOOP WIRING AND INSULATION RESISTANCE TEST DATA FORM:

Loop No:

List all wiring associated with a loop in table below. Make applicable measurements as indicated after disconnecting wiring.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  | Continuity Resistancea | | |  | Insulation Resistanceb | | | | | | |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Wire No. |  | Panel Tie |  | Field TB |  | Cond./ Cond. |  | Cond./ Cond. |  | Shield/ Gnd. |  | Shield/ Cond. |  | Cond./ Gnd. |  | Shield/ Shield |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| A |  |  |  |  |  | -- |  | (A/S) |  |  |  |  |  |  |  |  |
| B |  |  |  |  |  | (A/B) |  | -- |  |  |  |  |  |  |  |  |
| C |  |  |  |  |  | (A/C) |  | -- |  |  |  |  |  |  |  |  |
| D |  |  |  |  |  | (A/D) |  | -- |  |  |  |  |  |  |  |  |
| etc. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

1. Continuity Test. Connect ohmmeter leads between wires A and B and jumper opposite ends together. Record resistance in table. Repeat procedure between A and C, A and D, etc. Any deviation of plus or minus two (+2) ohms between any reading and the average of a particular run indicates a poor conductor, and corrective action shall be taken before continuing with the loop test.
2. Insulation Test. Connect one end of a 500 volt megohmmeter to the panel ground bus and the other sequentially to each completely disconnected wire and shield. Test the insulation resistance and record each reading.

CERTIFIED Date

CONTRACTOR’s Representative

WITNESSED Date

EVMWD’s Representative

17000‑D PANEL INDICATOR CALIBRATION TEST DATA FORM:

Tag No. and Description:

Make and Model No.: Serial No.:

Input:

Scale: Range:

PV Scale Calibration

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Percent of Range | | |  | Input | | |  | | Expected Reading | | | |  | Actual Reading | |  | | Percent Deviation | |
|  | | |  | | |  | | |  | |  | |  | | |  |  | | |  | |
| 0 | | | | | |  | | |  | |  | |  | | |  |  | | |  | |
| 50 | | | | | |  | | |  | |  | |  | | |  |  | | |  | |
| 100 | | | | | |  | | |  | |  | |  | | |  |  | | |  | |
|  | |  | | | | |  |  | | | |  | |  |  | |  |  | | | | |
| Percent Deviation Allowed: | | | | | | |  | | | | | | | | | |  |  | | | | |

CERTIFIED Date

CONTRACTOR’s Representative

WITNESSED Date

EVMWD’s Representative

17000‑G FIELD SWITCH CALIBRATION TEST DATA FORM:

Tag No. and Description:

Make and Model No.: Serial No.:

Input:

Range:

Set Point (s):

Simulate process variable (flow, pressure, temperature, etc.) and set desired set point(s). Run through entire range of switch and calculate deadband.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Set Point |  | Incr. Input Trip Point |  | Decr. Input Trip Point |  | Calc. Deadband |  | Required Deadband |
|  |  |  |  |  |  |  |  |  |

CERTIFIED Date

CONTRACTOR’s Representative

WITNESSED Date

EVMWD’s Representative

17000‑H TRANSMITTER CALIBRATION TEST DATA FORM:

Tag No. and Description:

Make and Model No.: Serial No.:

Input:

Output:

Range: Scale:

Simulate process variable (flow, pressure, temperature, etc.) and measure output with appropriate meter.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Percent of Range | |  | | | Input | |  | | | | Expected Output | | |  | | | Actual Output | | |  | | | Percent Deviation | | |
|  | | | | |  | | | | |  |  | | |  | | |  | | |  | | |  | | |  | | |
| 0 | |  | | |  | |  | | | |  | | |  | | |  | | |  | | |  | | |
| 50 | |  | | |  | |  | | | |  | | |  | | |  | | |  | | |  | | |
| 100 | |  | | |  | |  | | | |  | | |  | | |  | | |  | | |  | | |
|  | | | | |  | | | | |  |  | | |  | | |  | | |  | | |  | | |  | | |
| Percent Deviation Allowed: | | | | | | | | | |  | | | | | | | | | | | | |  | | |  | | |

CERTIFIED Date

CONTRACTOR’s Representative

WITNESSED Date

EVMWD’s Representative

17000‑I MISCELLANEOUS INSTRUMENT CALIBRATION TEST DATA FORM:

(For instruments not covered by any of the preceding test forms, the CONTRACTOR shall create a form containing all necessary information and calibration procedures.)

CERTIFIED Date

CONTRACTOR's Representative

WITNESSED Date

EVMWD's Representative

17000‑J INDIVIDUAL LOOP TEST DATA FORM:

Loop No.:

Description:

(Give complete description of loop's function using tag numbers where appropriate.)

P&ID No.:

(Attach copy of P&ID.)

a. Wiring tested:

(Attach test form 17000‑A)

b. Instrumentation tubing/piping tested:

(Attach test form 17000‑B)

c. Instruments calibrated:

(Attach test forms 17000‑C through I)

d. List step-by-step procedures for testing loop parameters. Test loop with instruments, including transmitters and control valves, connected and functioning. If it is not possible to produce a real process variable, then a simulated signal may be used with the Construction Manager's acceptance.

CERTIFIED Date

CONTRACTOR's Representative

WITNESSED Date

EVMWD's Representative

17000‑K LOOP COMMISSIONING TEST DATA FORM:

Project Name:

*{Create form in Microsoft Excel with the following column headers.}*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **LOOP NUMBER** | **I/O TYPE** | **LOCATION** | **PROCESS AREA NUMBER** | **DWG. NO.** | **FIELD INSTRUMENT TAG** | **DCS TAG** | **DESCRIPTION** | **FIELD/ LOOP POWER** | **MODULE** | **PLC ADDRESS** | **PLC RACK NO.** | **PLC SLOT NO.** | **PLC CHANNEL/POINT** | **TB ROW NO.** | **TERMINAL NO.** | **LOW RANGE** | **HIGH RANGE** | **ENGG. UNITS** | **ON LABEL** | **OFF LABEL** | **NOTES** | **TESTER SIGNITURE** | **OWNER SIGNITURE** |

CERTIFIED Date

CONTRACTOR's Representative

WITNESSED Date

EVMWD's Representative

**ATTACHMENT B**

**COMMISSIONING FLOW CHART**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Phase** | **No** | **Task** | **Role/ Participation** | **Schedule Constraint** |
| **Pre-Commissioning** | T1 | Equipment Submittal Process Complete | GC | NTP |
| T2 | RFIs and Responses up to Date | GC | NTP |
| T3 | Equipment Data for Asset Management. GC to provide to the District in electronic format able to upload into the CMMS. | GC | TBD |
| T4 | SAT Data | PICI | TBD |
| T5 | As built Loop Drawings, interconnection drawings, elementary drawings and shop drawings | GC | TBD |
| T6 | As built P&ID Drawings | GC | TBD |
| T7 | CONTRACTOR Lock-out Tag-out Procedures | GC | TBD |
| T8 | All Manufacturer Certificates of Proper Installation | GC | TBD |
| T9 | All Conductivity and Megger Test Reports | GC | TBD |
| T10 | All configuration reports in print and native Excel format | GC | TBD |
| T11 | Power systems study with Arc Flash labeling complete. Labels installed. | GC | TBD |
| T12 | All Electrical Breaker Setting Reports All NETA Test Reports | GC | TBD |
| T13 | Any and All Operating Permits | GC | TBD |
| T14 | Operator & Maintenance Training Plan | GC | TBD |
| T15 | Commissioning Plan (accepted prior to 50 percent Progress Payment) | GC, Ops,  PCIS supplier | T19 – 90 days |
| T16 | Draft O&M Manuals (received 120 days prior to FAT - Part 1) | GC | T17 – 120 days |
| T17 | Factory Acceptance Test - Part 1 (FAT-1) | GC | TBD |
| T18 | Factory Acceptance Test - Part 2 (FAT-2) | GC | TBD |
| T19 | Site Acceptance Test - Part 1 (SAT-1), Operational Readiness Test Part 1.  Wire ringout is complete and a certification of 100% accuracy is provided by the EC. (This could be a check-box in the Commissioning Plan) | EC | TBD |
| T20 | Site Acceptance Test - Part 1 (SAT-1), Operational Readiness Test Part 2 | GC/PICI/Ops | TBD |
| T21 | Submit Manufacturer's Certificate of Proper Installation | GC | T19 + 30 days |
| T22 | Any and all utilities must be complete/functional; e.g. power, fiber, phone all work. |  |  |
| T23 | Pre-Commissioning Report | GC/PICI | TBD |
| T24 | **Obtain EVMWD Acceptance to Proceed to Commissioning** | **Ops, CM** | **TBD** |
| **Commissioning - Phase I (Individual Systems)** | T25 | Prior to any field testing, Contractor shall perform "Un-witnessed" testing prior to "Witnessed" testing. | GC/PICI | T19 |
| T26 | EC to perform un-witnessed Loop Testing with PCIS supplier and Equipment providers. EC to sign off on this item in the Commissioning Plan. If problems arise that prove the EC did not test this properly there would be a back charge. | EC/  PCIS supplier | TBD |
| T27 | All required Spare Parts are onsite and properly inventoried and stored. | GC | TBD |
| T28 | Redline As-Built Drawings received 15 days prior to Operator Training | GC/PICI | TBD |
| T29 | Operator Training (received 30 days prior to Phase 2) | GC/PICI/Ops | T30 – 30 days |
| T30 | Site Acceptance Test - Part 2 (SAT-2) | GC/PICI/  PCIS supplier | TBD |
| T31 | Submit Manufacturer's Certificate of Proper Operation | GC | TBD |
| T32 | Commissioning – Phase I Report | GC/PICI | TBD |
| T33 | **Beneficial Occupancy/Operational Acceptance (if applicable)** | **Ops, CM** | TBD |
| T34 | **Obtain EVMWD Acceptance to Proceed to RAT** | **Ops, CM** | T32 |
| **Commissioning - Phase II (Project Wide/Plant Wide Systems)** | T35 | Kick Off Meeting for the System Wide Reliability Acceptance Test (RAT) | GC, CM,  PCIS supplier | TBD |
| T36 | System Wide Reliability Acceptance Test (RAT) (Duration of[Status]days) | GC,  PCIS supplier | TBD |
| T37 | All Manufacturer Certificates of Proper Operation | GC | T30 + 30 days |
| T38 | Commissioning – Phase II Report | GC | TBD |
| T39 | Substantial Completion/Connected and Operating into the System | Ops, CM | T36, T37, T38 |
| T40 | Start of 30 Day Continuous Plant Operation with Corrections Made | GC | TBD |
| T41 | Final Operations & Maintenance (O&M) Manuals | GC | TBD |
| T42 | Final Punch List | GC, Ops, CM | TBD |
| T43 | Final As-Built Drawings | GC, CM | TBD |
| T44 | **Final Completion** | **Ops, CM** | T40, T41, T42, T43 |

|  |  |
| --- | --- |
| **Role** | **Role Description** |
| PICI | Contractor’s Process Instrumentation and Control Integrator |
| CM | Construction Manager |
| PCIS supplier | District’s Process Control and Instrumentation System supplier |
| EC | Electrical Contractor |
| GC | General Contractor |
| Ops | Operations Staff |
|  |  |

End of Section