

Intelligent Transportation Systems

Construction Engineering and Inspection Training, for Closed-Circuit Television Cameras

Lesson 4

Welcome to the Intelligent Transportation Systems Construction Engineering and Inspection Training, for Closed-Circuit Television Cameras, Lesson 4: Testing and Resources.

The Construction Engineering and Inspection, or CEI, personnel could be required to oversee the following tests: Field Acceptance Test, Subsystem Test, Systems Test, and the 30 Day Acceptance Test. It is important that the CEI personnel review the contract documents because the types of tests could vary for each project.

Typically, for the CCTV system, a factory acceptance test is not required. The FDOT Traffic Engineering Research Lab performs verification testing of the CCTV against the FDOT Standard Specifications for Road and Bridge Construction. CCTV models that are approved are given an Approved Products List Certification number. The CEI personnel should only verify that the CCTV is on the FDOT Approved Products List.

The Field Acceptance Test plans, Subsystem Test Plans, Systems Test Plans, and the 30 Day Acceptance Test Plan shall be developed by the Contractor. The plans will be approved by the Engineer of Record and the Department prior to testing.

The CCTV subsystem will be tested to ensure that the installed products meet all of the contractual requirements. A test plan will be provided for each of the following tests: Field Acceptance Test, Subsystem Test, System Test and 30 Day Acceptance Test. The test plans must be submitted for Department approval in advance of any testing. The plans will be reviewed by the CEI personnel, District Network Administrator, and the District Traffic Management Center Manager. The Contract will specify when the test plans are to be submitted for review and approval.

The format of the test plan will be a step-by-step procedure. All calibrated tools and equipment required for testing will be supplied by the Contractor. Each test step will yield an actual result. The Inspector will compare the actual result with the expected result.

If the device does not exhibit the expected test results from any test step, then the device will be determined as having failed the test. A Test Discrepancy Report will be generated by the Contractor and submitted to the Inspector. The Contractor will either resolve the issue or replace the device in kind. The complete test must be repeated on the repaired or replaced device. If the device exhibits the expected result in each step, then it is considered to have passed the test. The Department or the Department representative witnessing each test will sign the test procedure.

The contractor or his representative will perform the actual testing with the CEI personnel on hand as an observer. The approved test plans and procedures will show the individual test steps and the expected outcome of each step. If each test step has been performed successfully, the CEI personnel will sign off that the test has been properly performed.

The CEI personnel should note the firmware version being tested and verify that it is the same as that listed in the project submittal. The CEI personnel should verify that the test equipment matches the test plan and that the calibration certificate has been submitted. The serial number of the CCTV camera should be documented on the test plan.

The Field Acceptance Test, also referred to as the Stand Alone Test, is a test that is performed in the field by the contractor and witnessed by the Department or Department representative.

During the Field Acceptance Test, individual components of a Closed-Circuit Television system are tested to ensure that they operate correctly. Each component is tested independently without other system components. On-site field acceptance tests verify that the device is correctly installed, functioning, integrated, and configured from the ITS field cabinet to the device. This test includes thorough examination and measurement of installation quality, especially the camera feed, camera operation, lightning protection, power systems and the power supply provided, in accordance with the project contract and standards that pertain to the specific project.

Usually, the vendor's software is used for this local testing, which requires the use of a laptop connected either directly to the device or connected through the Managed Field Ethernet Switch, or MFES. The CEI inspector will witness the functionality of the CCTV on the Contractor's laptop. The Contractor will exercise the CCTV camera by panning, tilting, and zooming the camera. The inspector should look for any lag associated between the time the controls are engaged and the movement of the camera. The inspector should also take notice of any disruption in the video stream or any quality issues. In addition, he/she should also look for any lag between live traffic and what is shown on the video screen.

The camera is tested in accordance with FDOT approved test plans and specifications to show that the camera is installed properly. This test is performed when the Closed-Circuit Television device is properly installed at the site and all power, grounding and communication connections, including the Managed Field Ethernet Switch, are established. The field acceptance test should be completed on all CCTV devices prior to starting the subsystem test.

These pictures show the field inspection of a camera lowering device. The picture shows the camera lowering tool mounted to the CCTV pole handhole. Ensure that the lowering tool is securely attached to the lower lip of the handhole. The tool's winch cable will be attached to the CCTV lowering cable. Ensure that the clip connecting both cables is securely engaged. Ensure that no one is standing under the camera while it is being lowered.

The Contractor should lower the camera to ground level and raise the camera back to its mounted position. Ensure that no one is standing beneath the camera while it is being lowered. Also, ensure that the camera clears any obstacles while being lowered. Once raised back to its mounted position, check to see if the camera continues to display a quality video stream and is able to be controlled.

The picture shows the inspection of the camera lowering device junction box. This is where the surge protective devices are housed and other wiring connections are performed. Ensure that the amount and types of surge protective devices match the project equipment requirements. Ensure that all of the camera conductors and the correct camera lowering cable conductor are terminated to their respective surge protective device.

Subsystem Testing: The CCTV subsystem test is only conducted if it is required by the contract. The test is performed after the successful completion of the Field Acceptance Test and is performed on all new devices within the project.

The Subsystem test involves the testing of all CCTV cameras that have been installed and integrated into the District's network. Subsystem tests verify connectivity of the CCTV camera to the Regional Transportation Management Center, or RTMC. Usually this test is done from the RTMC using the

vendor control software. It can also be performed from an Intelligent Transportation Systems Hub shelter, using a laptop connected to the Layer 3 Switch. The software and location used to perform the CCTV subsystem test should be mentioned in the test plans.

Similar to the field acceptance test, the Contractor will perform several CCTV camera movement exercises. The inspector should look for any delays between the movement commands and the actual camera movement.

System Testing: A System Test is typically required by the contract. System testing is performed on the entire system in the context of the contract and any governing standards. The testing process is concerned with finding errors that result from unanticipated interactions between subsystems and its components. This test is performed from the RTMC using the SunGuide® software. System tests verify the integration of the CCTV camera with SunGuide® software.

The System Test is performed after the successful completion of Subsystem Testing on all sub systems within the project.

According to the FDOT Standard Specifications for Road and Bridge Construction, the 30 Day Acceptance Test only applies to the Dynamic Message Signs. However, the contract documents would typically require that the 30 Day Acceptance Test be conducted for all of the subsystems, not just the DMS subsystem.

The 30 Day Acceptance Test commences after the System Test has been successfully completed. If any equipment on the subsystem fails to operate during the 30 day period, testing of the entire system will be restarted. The Engineer may select to pause and extend the 30 day test period by the number of days lost by failure and repair time in lieu of restarting the full 30 day test. The Engineer will submit to the Contractor a letter of approval and completion stating the first and last day of the 30 day test period.

The 30 Day Acceptance Test creates an environment whereby the system's operational environment is simulated during the testing. Operational Testing consists of a set of steps that Traffic Management Center operators perform during their day to day operations. For the CCTV subsystem, this would include pan, tilt, zoom functions as well as checking for low gas pressure and video quality.

The CEI personnel will perform an inspection for final acceptance of device installations as part of all work under the Contract in accordance with FDOT Standard Specifications for Road and Bridge Construction, Section 5-11. The inspection will be performed only after satisfactory completion of the 30 day acceptance test.

All punch list items must be completed by the contractor or Design-Build firm prior to the final construction inspection. When, upon completion of the final construction inspection of the entire project, the Engineer determines that the Contractor has satisfactorily completed the work, the Engineer will submit written notice of final acceptance to the Contractor.

The Contractor will transfer warranties and guarantees on all equipment to the Department in accordance with FDOT Standard Specifications for Road and Bridge Construction, Section 608, Manufacturers' Warranties for Traffic Control Signals and Devices.

All documents, firmware and software, and spare parts must be furnished to FDOT by the contractor or DB firm. Documents such as User Manuals, Operation Manuals, Troubleshooting and Service Manuals, Assembly and Installation Instructions, Training Materials, Equipment Warranty, FDOT ITS

Inspection Checklist, Firmware and Software Licenses, Test Results, Field Inventory List, ITS Facilities Management data, Spare Parts list, IP Address List, and any As-Built drawings should be provided to FDOT.

The Engineer may also perform an inspection for partial acceptance under the Contract in accordance with FDOT Standard Specifications for Road and Bridge Construction, Section 5-10 of a device installation upon its completion in accordance with the Contract Documents. Partial Acceptance occurs when only one system such as a Closed-Circuit Television system is tested and approved.

Prior to performing an inspection for partial acceptance, the Engineer will require the satisfactory completion of the 30 day acceptance test of completed installations in accordance with the requirements of FDOT Standard Specification for Road and Bridge Construction, Section 611-4. The Engineer will perform an inspection for partial acceptance in accordance with FDOT Standard Specifications for Road and Bridge Construction, Section 5-10 in company with a Contractor's representative and, when applicable, a representative of the agency designated to accept maintenance responsibility.

All of the inspection aspects covered here are also in the newly developed FDOT Field Acceptance Test Procedures, developed by the State Traffic Engineering and Operations Office. Prior to final acceptance, the Contractor will submit the following documentary items obtained from the manufacturer:

- Operation Manual
- Troubleshooting and Service Manual
- Assembly and installation instructions
- Pictorial layout of components and schematics for circuit boards
- Parts list
- Diagram of the field installation wiring, which is not applicable to the detectors
- and Warranty information

Look through the data, make sure that two copies of the operation manual, trouble shooting and service manual, and the assembly and installation instructions are provided. Some manufacturers combine part or all of these documents, so you may not actually see all three. But make sure that, if not provided separately, they are, at minimum, components of a larger, comprehensive manual.

Make sure that the manuals for the CCTV camera, Camera Lowering Device, Surge Protective Devices, Cables, and the Power Supply are submitted. The contract and the project governing standards may require the Contractor to provide training on the CCTV camera system. Training will always be required for the Camera Lowering Device System. The Contractor will supply the training material, which is typically the User's Manual.

Ensure that the CCTV cameras have a manufacturer's warranty covering defects for a minimum of three years from the date of final acceptance by the Engineer in accordance with FDOT Standard Specifications for Road and Bridge Construction Section 5-11 and Section 608. Some manufacturers' standard warranties do not meet the FDOT standard specifications. The contractor may purchase an extended warranty to warrant the product for the specified duration.

Check the project specifications for additional warranty requirements. Make sure information on warranty return service is provided. Make sure the owner is named by the warranty provider. Make sure there is a Warranty for all components including: Closed-Circuit Television camera, Camera Lowering Device, and Surge Protective Device. CCTV Steel Poles should have a warranty of 5 years. Surge Protective Devices should have a 10 year warranty.

The Statewide Construction Quality Assurance and Quality Control Inspection Guide List is a multi-sectioned document with important items to be inspected and references the FDOT Standard Plans for further detailed requirements. ITSFM is a statewide database that tracks the inventory of the ITS devices. The information contained in this database include the make, model, serial number, manufacture date, firmware, MAC address, IP address, geographical location and install date. The FDOT Traffic Engineering Research Lab uses the compliance matrix, CM-682-1.2.1-01, to evaluate the CCTV cameras, and CM-641-2.2-01, to evaluate camera lowering devices.

This concludes the Intelligent Transportation Systems Construction Engineering and Inspection Training, for Closed-Circuit Television Cameras, Lesson 4: Testing and Resources.

For more information about Construction Engineering and Inspection Training, please contact the State Traffic Engineering and Operations Office, Transportation Systems Management and Operations Section.

Thank you for your time and attention.