When you are tasked with implementing a new substation security system, the commissioning process may seem like a time-consuming, but necessary, final step. For optimal success, the time to begin verifying that a security system operates as designed should start long before the system is handed over.
INTRODUCTION
Commissioning of substation security systems commonly starts just weeks before the system is to be handed over to the security operation center. But that can be a mistake.

An integrator that doesn’t pre-test a system prior to commissioning, for example, may find the number of punch list items to be overwhelming, often preventing the system from passing the commissioning test.

Experience suggests that outcomes are far better when commissioning is treated as an ongoing process that spans multiple stages in a security system’s design and installation. That process begins during the security system design phase with the development of a commissioning plan. Following this step-by-step approach is a recipe for successful outcomes with minimal disruptions during the process.

STEP ONE: THE COMMISSIONING PLAN
The security designer or commissioning agent can start creating commissioning forms and schedules as soon as the substation security system design is issued for bid or construction, depending on the project delivery method.

These documents provide a commissioning agent with the tools needed to precheck the security system during factory testing and other early testing opportunities.

Commissioning documents that should be created during a project’s design phase typically include:

Commissioning schedule — This schedule, which includes dates for document reviews, factory tests, site visits and acceptance testing, enables the commissioning agent to plan for pre-commissioning tasks. The schedule should include some flexibility, as dates may need to fluctuate to accommodate changes in the project’s timeline.

Inspection checklist — This checklist covers all the security devices, video recorders, card readers, servers, door panels, cabling and other equipment and operating scenarios that require inspection. Using a pass-fail format, the checklist is a tool the commissioning agent can use to verify and document that an item is installed correctly, labeled, cleaned and operating properly. This checklist should also address how the item integrates with other security systems.

Site and floor plans — These plans should identify the initial placement of and field of view for each security camera. Those details will help an agent determine if the cameras are installed correctly.

Network schedule — This document, which lists the IP address for each security device and piece of equipment attached to the network, should be distributed to the owner’s IT department to coordinate IP addresses, subnets and other details. This schedule also can be used to help verify if existing switches have the needed capacity or if additional network switches are needed.

STEP TWO: FACTORY TESTING
While factory tests are rarely required by designers or owners, they can be valuable in solving integration issues prior to installation. For this reason, a savvy commissioning agent will take an active role in factory testing.

Performed at the system integrator’s offices, factory testing involves setting up a security system, including cameras, card readers, door locks and other devices. Then, using the current version of the commissioning checklist as a guide, each device is tested at its connection point on the system.

For these tests, all security equipment should be installed, and most security devices should be connected...
to it. Some devices, such as fence detection systems and vehicle gate motors, can’t be installed in a factory test setting. The integrator should create scenarios that simulate alarms for these devices.

The integrator also should set up a security workstation to verify that each point on the security equipment matches the device shown on the workstation.

After individual device testing is complete, integration testing between the security systems begins. This involves testing alarm points to verify that the correct cameras are activating, alarms are properly labeled and other security systems are initiating the correct response to an alarm.

**STEP THREE: SECURITY SYSTEM INSTALLATION**

A smart commissioning agent will likewise conduct periodic site visits during security system installation. The agent can use these visits to verify that security equipment, devices and cabling are being installed according to the construction documents. While the agent’s role during these visits is to advance the commissioning process, rather than to perform construction administration duties, it is the agent’s duty to inform the design team if it appears that guidelines are not being followed.

During installation, the agent also should verify that the equipment, cabinets, devices and cabling are labeled as prescribed in the design documents, which should match the commissioning checklist. Proper cable management and device installation should be verified during each visit.

Once installation is complete, the commissioning agent should verify that the as-built drawings and operation and maintenance manuals correspond with the commissioning checklist.

**STEP FOUR: SECURITY SYSTEM PRE-TESTING**

Pre-testing is performed to make sure a security system is operating properly so that acceptance testing can begin. This testing is typically performed by the integrator, with the commissioning agent making periodic site visits to the substation to observe.

Pre-testing begins with troubleshooting the system to confirm that all security devices have been connected to the correct points on the security equipment, and that all programming is finalized. A sizable portion of troubleshooting issues are traced to incorrect labeling of cables and minor programming errors. A mislabeled motion detector or camera, for example, will bring up the wrong location when an alarm activates.

Other tasks performed by the integrator during pre-testing include cleaning equipment cabinets, equipment filters and security devices so they perform optimally. By this stage, the integrator should use the final commissioning checklist to perform a commissioning test of the entire security system.

**STEP FIVE: SECURITY SYSTEM BURN-IN**

The purpose of burn-in is to give a security system time — often two to four weeks — to operate in real-world conditions, during which time the equipment might “learn” from analytics and integrators can detect system anomalies. This period usually, but not always, takes place prior to acceptance testing. Weather events during burn-in, for example, can bring to light vulnerabilities that can be corrected before acceptance testing begins.

Burn-in is important because it helps make sure the system is operating correctly using normal operating procedures. Substation personnel should use the system during burn-in as if it has been accepted.
During this phase, the security system alarm report is used to create a punch list. The integrator uses this list to verify false alarms using video the system has recorded. If an alarm is determined to be a nuisance, the integrator can take corrective action to solve the issue.

Punch list items should be resolved as they occur. If issues persist, the owner should consider extending the burn-in period until the system is ready for acceptance testing.

**STEP SIX: ACCEPTANCE TESTING**

Acceptance testing — the final tests before a security system is turned over to the owner — should be scheduled by the integrator and commissioning agent prior to the burn-in phase. At a minimum, the commissioning agent, owner representative and integrator should be involved in the final acceptance test. Most work will be performed from the substation, where they will activate alarms, verify device installation and perform other tests. One person is typically stationed at the Security Operations Center to verify that the system is functioning properly.

While performing the acceptance test, the commissioning agent should verify alarm naming conventions, map and floor plan symbol locations, and network connectivity. Acceptance testing should include:

**Alarm testing** — Each alarm should be tested by simulating the conditions that would set off the alarm. To verify the alarm, the agent should confirm that it calls up the correct camera. In some situations, more than one camera may be used to verify alarms.

**Security system device verification** — The agent should verify that card readers, cameras, fence detection and other security devices are operating properly.

**Camera views and fence zones** — The agent should compare camera views and fence zones against design documents to verify that the devices are correctly mounted and aimed.

**Labeling** — The accuracy of labels on equipment in cabinets and field devices should be verified through comparisons to design documents, security workstation symbols and alarms.

**Installation verification** — The commissioning agent should have verified that equipment, devices and cabling was properly installed during installation. During acceptance testing, the commissioning agent should perform spot checks of the installation.

**Penetration tests** — Time permitting, the commissioning team should perform random penetration tests during both day and night to find vulnerabilities an attacker could exploit.

If the integrator and commissioning agent have worked well together in resolving issues throughout the project, acceptance testing should be relatively simple and trouble-free.

**CONCLUSION**

Commissioning a substation security system is no small undertaking. The theoretical simplicity of checking things off a list can belie the importance of the process. Getting better results and performing the process efficiently is best achieved by making commissioning an ongoing element of the project.

Taking a step-by-step approach, beginning with a comprehensive plan during design development, lays a foundation for successful commissioning. Multistage testing, installation and burn-in time set the table for acceptance testing, owner satisfaction and timely handover of the system to the owner.

**BIOGRAPHY**

**TERRY HARLESS** is a senior physical security specialist at Burns & McDonnell, with more than 18 years’ experience in electronic security system design and commissioning. In addition to writing specifications for commissioning processes and procedures, attending factory tests and assisting integrators with pre-commissioning tests, he has tested and commissioned security systems on many complex security projects in electric utility markets.