**Electrical Inspection Plan Guidance**

**Reference to ESM Chapter 7, Electrical**

# Scope

This document provides guidance to the design engineer for developing a test and inspection plan (TIP) and/or Post Modification/Maintenance Test (PMT) for projects.

TIPs are required for Moderate and High Risk projects (2A/2B, etc.) by ESM [Chapter 16](https://www.lanl.gov/orgs/eng/engstandards/ESM_Chapters.shtml#esm16) IBC Program Section IBC-GEN, and a template for same is associated with Section IBC-IP (Att. I). This document may be useful in preparing the TIP, particularly when starting from Rev. 0 of Att I.

PMTs are required by [AP-341-801](https://coe.lanl.gov/APs/default.aspx). The PMT may credit the TIP as appropriate.

Projects that have a total installed cost over $300k are normally required to have a specification issued as a part of the construction documents.[[1]](#footnote-1) Part 3 of each specification section is titled “Execution” and contains the detailed requirements for the TIP for those projects. For projects that are less than $300k, specifications are not mandatory and may or may not be issued as part of the construction documents. Often in projects this size there will be some items that have specifications issued and some that do not. The overall perspective is that, when specifications are not issued for an item or work result, National Codes and Standards are adequate, and any additional information that is deemed necessary by engineering is captured on the drawings. The electrical world is unique, however, in that there are many items that are not on the construction drawings. These have to do with field routed/designed items and how they are installed. Examples of these include box sizing, and raceway routing, securing, and support.

Inspection has different scopes and might be performed by different entities.

* Inspection to ensure that what is installed is in alignment with what is on the construction drawings could be considered quality control (QC). As of now, QC is being performed by LANL’s CM/FE group (CONSTRENGR). For subcontracted projects, the intention is that the subcontractor perform this role with LANL auditing the process (QA). For self-performed projects, both the QC and QA functions would still be LANL’s responsibility.
* Inspection for adherence to the NEC is performed by LANL’s office of the Chief Electrical Inspector (OSH-ISH). This typically consists of two inspections: (1) a rough-in inspection where work is inspected before being covered up, and (2) a final inspection that ensures Code compliance. A successful final inspection is necessary before authorization to energize the system is given.[[2]](#footnote-2)
* Inspection for compliance with the International Building Code (IBC): The IBC amends the NEC for emergency systems and egress lighting. The groups above must also inspect such systems to the IBC requirements.
* Formal receipt inspection is not in the scope of this document. This is addressed by LANL’s P840‑1 document.

The items included in this document are organized by specification section number. This list can be used to help develop the TIP and/or PMT. Included in this list are hold points for critical inspections. The author of the TIP and the work planners can attempt to minimize the impact of hold points on a project by scheduling them to be as coincident as possible.

# Definitions

* Quality Control – work performed by the constructor to ensure the installation meets requirements of the construction package. This is accomplished through QC sheets that a quality inspector fills out on each applicable item. For self-performed work, this function is performed by LANL.
* Quality Assurance – work performed by LANL. This includes spot checks during field visits and a periodic audit of the subcontractor’s QC program, typically on an annual basis.

# General

Torqueing of electrical connections is a general topic that applies to many installation tasks. The subcontractor is responsible for submitting a certified tool and calibration program, as well as documentation for each item where electrical connections were installed with a torque tool.

# Required and Recommended Inspections

| **Section Number** | **Title** | **Rough-in[[3]](#footnote-3)** | **Final[[4]](#footnote-4)** | **Quality Control[[5]](#footnote-5)** | **Hold Point** |
| --- | --- | --- | --- | --- | --- |
| 26 0519 | Low Voltage Electrical Power Conductors and Cables | * + - Visually inspect for damage     - Inspect for Code compliant installation | n/a | * + - conductors and cables are correct type | None |
| 26 0526 | Grounding and Bonding for Electrical Systems | * + - Separately Derived systems       * Ensure only one bonding location     - Services       * Ensure there is no additional conductive path between the utility transformer and the service disconnect     - Effective ground-fault current paths       * Visual check for integrity of paths |  |  | visually inspect grounding electrode system before it is made inaccessible |
| 26 0533 | Raceway and Boxes for Electrical Systems | * + - Inspect boxes for proper size, especially conduit bodies     - Inspect securing and supporting     - Inspect number of bends     - Inspect bonding of system | Ensure all boxes have proper covers installed | * + - Size and type of raceway     - Number of bends     - Box sizing | Installation of expansion joints based on temperature on day of installation |
| 26 0536 | Cable Trays for Electrical Systems | * + - Support     - Cable/Conductor fill     - Presence of expansion joints, if necessary     - Bonding     - Securing of cable in tray     - Proper partitions based on voltage classes |  | Size and type of cable tray | Installation of expansion joints based on temperature on day of installation |
| 26 0553 | Identification for Electrical Systems |  | Presence of labels on equipment | Labels meet requirements of construction package |  |
| 26 0700 | Induction Motors[[6]](#footnote-6) | Inspect for Code compliant installation |  | Follow Part 3 of project specification. Individual motors will not be purchased without a specification |  |
| 26 0813 | Electrical Acceptance Testing | Not an item to be inspected | | | |
| 26 2213 | Low Voltage Distribution Transformers | * + - Clearances have been met (working space and ventilation)     - Bonding is tied together in single location       * EGC from primary       * SSBJ to Secondary panel       * SBJ, if in transformer       * GEC, if SBJ is in transformer |  | * + - Correct size and ratings     - Provisions for shipping have been removed |  |
| 26 2300 | Low Voltage Switchgear | * + - Highest handle is within 6’ 7” requirement     - Curb extends no more than 6” in front of switchgear     - Working clearances have been met |  | Submit settings of all adjustable circuit breakers | If switchgear was sent in multiple sections, torqueing of bus must be witnessed |
| 26 2413 | Switchboards | * + - Highest handle is within 6’7” requirement     - Curb extends no more than 6” in front of switchgear     - Working clearances have been met |  | Submit settings of all adjustable circuit breakers | If switchboard was sent in multiple sections, torqueing of bus must be witnessed |
| 26 2416 | Panelboards | * + - Highest handle is within 6’ 7” requirement     - Clearances have been met |  | Submit settings of all adjustable circuit breakers |  |
| 26 2419 | Motor Control Centers | * + - Highest handle is within 6’ 7” requirement     - Curb extends no more than 6” in front of switchgear     - Working clearances have been met |  | Submit settings of all adjustable circuit breakers |  |
| 26 2500 | Enclosed Bus Assemblies | * + - Supported properly | Working Clearances are met | Follow Part 3 of project specification. Bus Assemblies will not be purchased without a specification. | Joints that are assembled with torqued fasteners must be witnessed during installation |
| 26 2713 | Electrical Metering |  | Inspection by UI | Follow Part 3 of project specification. Metering will not be purchased without a specification. | May be necessary to install meter if a power outage is required |
| 26 2726 | Wiring Devices | * + - Proper height |  |  |  |
| 26 2816 | Enclosed Switches And Circuit Breakers | * + - Meets working clearance requirements |  |  |  |
| 26 2913 | Enclosed Controllers | * + - Meets working clearance requirements |  |  |  |
| 26 2923 | Variable Frequency Motor Controller[[7]](#footnote-7) |  | Meets working clearance requirements | Follow Part 3 of project specification. VFDs will not be purchased without a specification. |  |
| 26 3334 | Stored Emergency Power Supply System |  |  | Follow Part 3 of project specification. These will not be purchased without a specification. |  |
| 26 3353 | Static UPS |  |  | Follow Part 3 of project specification. Uninterruptible Power supply systems will not be purchased without a specification. |  |
| 26 4100 | Facility Lightning Protection |  |  | Follow Part 3 of project specification. Lightning Protection systems will not be purchased without a specification. |  |
| 26 4115 | Lightning Protection for Explosive Facilities |  |  | Follow Part 3 of project specification. Lightning Protection systems will not be purchased without a specification. |  |
| 26 4300 | Surge Protective Devices[[8]](#footnote-8) | N/A -- these are part of other equipment | | | |
| 26 5100 | Interior Lighting |  |  | Follow Part 3 of project specification. Interior Lighting will not be purchased without a specification. |  |
| 26 5200 | Safety Lighting |  |  | Follow Part 3 of project specification. Safety Lighting (egress lighting) will not be purchased without a specification. |  |
| 26 5600 | Exterior Lighting |  |  | Follow Part 3 of project specification. Bus Assemblies will not be purchased without a specification. |  |

1. ESM Chapter 1 Section Z10 Att F, Specifications [↑](#footnote-ref-1)
2. [P101-13](http://int.lanl.gov/policy/safety.shtml), Electrical Safety Program [↑](#footnote-ref-2)
3. “Inspect for Code compliant installation” could be inserted in every one of the cells below. Instead, it is footnoted here as a general requirement. Code compliancy is determined by LANL’s Chief Electrical Inspector. [↑](#footnote-ref-3)
4. Same footnote as above [↑](#footnote-ref-4)
5. The primary function of Quality Control is to ensure that what is installed in the field matches what is on the drawings. If a cell below is blank, there are no additional requirements for Quality Control other than that which is indicated in the construction package. [↑](#footnote-ref-5)
6. It is very rare that LANL would ever purchase an individual motor. Usually, motors are purchased as part of mechanical packages. [↑](#footnote-ref-6)
7. VFDs have become common in some mechanical packaged units such as refrigeration systems. This document may be expanded to include inspection points for such. [↑](#footnote-ref-7)
8. When SPDs are purchased separately, to be installed in existing systems, they will be purchased with a project specification and will be inspected per the requirements of Part 3 of the specification. [↑](#footnote-ref-8)