CHAPTER 20 – SERVICE EQUIPMENT

SERVICE EQUIPMENT

Service equipment includes service cabinets and the equipment and materials necessary for installation.

20.1 Signal Service Cabinet

For MnDOT traffic control signal system projects, the contractor must furnish and install a signal service cabinet (SSB) with battery backup capabilities. The signal service cabinet must be MnDOT approved and listed on the MnDOT Approved/Qualified Products List (APL) for signals.

For wood pole installations, the meter socket is located directly above the disconnecting means. Detailed information regarding traffic control signal service cabinet installation is presented in Chapter 21.

The height of the weatherhead must be approved by the local electric utility. Sufficient length of power conductors must extend beyond the weatherhead for connection to the power conductors from the source of power and a drip loop. Connection of the source of power is coordinated by the contractor and is be made by the local electric utility.

20.1.1 SIGNAL SERVICE CABINET TYPE WIRING AND OPERATION WITH UNINTERRUPTED POWER SUPPLY (UPS)

When a plan calls for batteries and an uninterrupted power supply (UPS) to be installed in the SSB with battery backup, there are a few items that are the contractors’ responsibility.

The plan will call for a 6 pair 19 AWG (6PR/ #19) telephone cable for outdoor conduit or direct burial use to be pulled from the SSB cabinet to the traffic control signal cabinet in the communications conduit. This cable must be terminated as shown in detail in the Appendix.
The contractor must terminate wires on the inverter. See Error! Reference source not found. for correct wire termination on the inverter.

When the UPS and traffic control signal are fully wired and the batteries are fully charged the UPS operation should be tested as follows:

1. Make sure the bypass switch is in BBS mode and not in bypass.
2. Shutting off the main breaker in the SSB cabinet will remove power from the signal cabinet and the UPS.
   a. At this point the UPS should switch into operation and the traffic control signal should continue to operate.
   b. The strobe on the side of the cabinet should begin to flash as soon as the main breaker has been tripped.
3. Reset the main breaker and after 30 seconds the UPS should qualify the incoming AC voltages, at this time the UPS will stop supplying power to the traffic control signal cabinet and switch over to utility power.

Once the initial power up test is completed the event and run time counters should be reset. After these initial resets are completed and the intersection is placed in automatic operation the event and run time counters should never be reset.

Battery backup systems should operate as follows when the AC power from the electric utility is lost:

1. The battery backup system should run the traffic control signal for two hours in automatic operation.
2. After two hours, the UPS will close a set of relay contacts which should place the intersection in remote all red flash. The intersection will remain in flash until one of two events happen.
   a. The 120 VAC line is restored by the local electric utility. The traffic control signal system will begin to operate on utility power and UPS will stop supplying power to the traffic control signal.
   b. The batteries reach a point where they can no longer be discharged. If this event occurs the 120 VAC coming out of the inverter will be shut down and the intersection will go black. The traffic control signal system will resume operation when utility power is restored. After utility power is restored battery discharge levels need to be checked to ensure the UPS is recharging the batteries.
Based on a traffic control signal cabinet with a 3-amp current draw in automatic operation and a 1.5 amp draw in all red flash, we would expect the intersection to operate in auto operation for two hours and in flash for an additional six to ten hours. This is assuming the batteries are new and fully charged. Wires must be terminated on the UPS power module correctly to ensure that the battery backup system operates as intended during a power outage.

20.1.2 OTHER SIGNAL SERVICE CABINET CONSIDERATIONS

The contractor is required to fill out an Electric Service Information form for each traffic control signal system project. A sample of this form is included in the Appendix.

The contractor must also provide available fault current calculations for each service cabinet. These calculations require a label be placed inside the SSB cabinet showing the results. Consult the contract documents for further details.

All meter sockets must be approved by the local power utility and must contain a positive bypass mechanism having lugs that will allow power conductors to be stripped and laid into the lugs without being cut. The meter itself must be furnished and installed by the electric utility.
**Step-Down Transformer**

If a step-down transformer is needed, the transformer must be an outdoor, general purpose dry-type transformer. Transformer specifications and mounting details are listed in the contract documents. The transformer must be National Recognized Testing Laboratory (NRTL) listed for indoor-outdoor applications and must meet applicable NEMA and IEEE standards.

The line side of the transformer must be protected by a circuit breaker mounted in a NEMA 3R rain tight enclosure for outdoor use.

Circuit breaker enclosure specifications and mounting are listed in the contract documents. The circuit breaker shall be NRTL listed for indoor-outdoor applications and meet applicable NEMA and IEEE standards and have provisions for a padlock.

The contractor is responsible for coordinating and making the necessary arrangements to obtain the power connection.

**Circuit Breaker Load Center**

At some locations, the disconnecting means must be a 3-wire, solid neutral, 100 amps, 120/240-volt AC, NEMA 3R rain tight enclosure for outdoor use, NRTL listed for use as service equipment. The mounting of the circuit breaker enclosure is detailed in the contract documents.

The load center must have a front cover and inner dead front cover that is hinged at the top and snap closes at the bottom. Both covers must be easily removable to allow for easy installation and maintenance.

The contractor must furnish circuit breakers in the load center as specified in the contract documents.

Circuit breakers must be 120/240-volt AC, and have clearly marked “ON” and “OFF” positions. The circuit breakers and the load center enclosure must be made by the same manufacturer. Each breaker must be identified by the load they are carrying; Signals or Lighting.

As presented in Figure 20-9, the service equipment must utilize copper wires and must have connections that are UL listed for use with copper wire. All the lugs required for the connection of the power conductors in the load center must be solderless (set screw type), and must be the appropriate size for the conductors used.

The circuit breaker load center must be provided with an isolated, bondable neutral bar with the capacity to handle the number and size of the neutral and grounding conductors listed in the contract.
documents. Bonding of the neutral conductor must be in accordance with the National Electrical Code (NEC).

### 20.2 Lighting Service Cabinets (Standard Specifications 3850)

Lighting service cabinets Type L1, Type L2, Type B, and Type RLF are on MnDOT’s APL for roadway lighting.

The lighting service cabinets described below can accommodate branch circuits for roadway lighting as indicated.

Lighting service cabinets are rated for either 120/240 or 240/480 VAC single phase service.

General material requirements must be in accordance with MnDOT Standard Specification 2545.2.

#### 20.2.1 TYPE L1 SERVICE CABINET

This is an equipment pad-mounted service cabinet with power distribution blocks, a two pole 100 ampere main circuit breaker and 4-two pole 20 ampere branch circuit breakers. A 3-wire locking type mounting receptacle is located inside the cabinet at the PEC windows for the photoelectric control device.

Type L1 cabinets that are 240/480V may include a cold sequence disconnect (ahead of the meter) that meets the requirements of the electric utility company.

#### 20.2.2 TYPE L2 SERVICE CABINET

This is an equipment pad mounted service cabinet with power distribution blocks, 2-two pole 100 ampere circuit breakers and 8-two pole 20 ampere branch circuit breakers. A 3-wire locking type mounting receptacle is located inside the cabinet at the PEC windows for the photoelectric control device.

Similar to Type L1, Type L2 cabinets that are 240/480V may include a cold sequence disconnect (ahead of the meter) that meets the requirements of the electric utility company.

Xcel Energy does not allow the use of the cold sequence disconnect.

Information on equipment pads for service cabinets can be found in Chapter 10 Foundations & Equipment Pads.
20.2.4 TYPE B SERVICE CABINET
This pole mounted service cabinet has a 60 ampere two pole main circuit breaker and 2- two pole 20 ampere branch circuit breakers. This allows for two runs from the cabinet. A 3-wire locking type mounting receptacle is located inside the cabinet at the PEC windows for the photoelectric control device.

Figure 20-10: Type B Service Cabinet

Figure 20-11: Type B Details
20.2.5 RURAL LIGHTING AND FLASHER (RLF) SERVICE CABINET

Some MnDOT lighting system and flasher system projects may require the contractor to provide and install a service cabinet type rural lighting and flasher (RLF) 120/240 VAC cabinet. This equipment pad mounted RLF 120/240 VAC service cabinet is used for smaller lighting and flasher systems. A 3-wire locking type mounting receptacle is located inside the cabinet at the PEC windows for the photoelectric control device.

The RLF service cabinet must be MnDOT approved and listed on the MnDOT APL for lighting.

MnDOT requires available fault current calculations be made for all of our electrical services.

A form is included in the special provisions that needs to be filled out and a label must be placed on the dead front door of the cabinet. A copy of the required form is located in the Appendix of this Field Guide.

Standard Specification 2565.3CC is presented in Figure 20-17.

<table>
<thead>
<tr>
<th>CC Available Fault Current Calculations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide available fault current calculations as required by Article 110.24 of the NEC and as follows:</td>
</tr>
<tr>
<td>(1) Provide calculations for the available fault current at the line side of the meter socket for each electrical service.</td>
</tr>
<tr>
<td>(2) Provide and install labels for the calculation results meeting the following requirements:</td>
</tr>
<tr>
<td>(2.1) Self-adhering label.</td>
</tr>
<tr>
<td>(2.2) Machine printed numbers and letters.</td>
</tr>
<tr>
<td>(2.3) Suitable for placement in damp locations</td>
</tr>
<tr>
<td>(2.4) Paper based labels are not acceptable.</td>
</tr>
<tr>
<td>(2.5) Placed in the inside of the service cabinet on the dead front door so it is visible when the dead front door is closed.</td>
</tr>
<tr>
<td>(2.6) Containing the following information:</td>
</tr>
<tr>
<td>Transformer Size in KVA</td>
</tr>
<tr>
<td>Available fault current in amps at the terminations of the utility transformer</td>
</tr>
<tr>
<td>Available fault current in amps at the line side of the meter socket.</td>
</tr>
<tr>
<td>The date the calculations were made.</td>
</tr>
</tbody>
</table>

Figure 20-14: Standard Specification 2565.3CC
20.3 Lighting Service Equipment Installation (2545.3L)

All wiring within the lighting service cabinets must meet the requirements of the NEC. All L1 and L2 lighting service cabinets must have utility termination lugs installed on the line side wire way, unless the cabinets are being installed in the Xcel Energy service area. Lighting service cabinets must include all required wiring, internal and external, for a complete lighting service cabinet installation.

All components are to be listed by a NRTL.

Install lighting service cabinets in accordance with MnDOT Standard Specification 2545.3L.

Position the cabinet door from 90 degrees to 180 degrees to the roadway, away from traffic.

The electric utility company must be contacted for information on size of meter socket, exact location of meter, etc. Meters are furnished and installed by others.

Lighting service cabinets are large enough for additional equipment to be installed internally if requested by the electric utility company.

Circuit breakers must be labeled in accordance with Standard Specification 2545.3P.2.a.

The contractor is required to fill out an Electric Service Information Form for each lighting service on the project. A sample of this form is included in the Appendix.

The contractor is required to calculate available fault current at the meter socket in accordance with the NEC Article 110.24. Required contractor supplied labels are defined in contract documents.
20.3.1 PHOTORELECTRIC CONTROLS
Currently MnDOT uses a photovoltaic control inside the service cabinets for turning "ON" and "OFF" the roadway luminaires on signal and lighting systems. The photovoltaic controls are installed in a 3-wire locking type mounting receptacle located inside the cabinet at the PEC windows.

MnDOT approved photovoltaic controls are listed on MnDOT's APL for roadway lighting.

Standard photovoltaic controls used on MnDOT projects must be an ANSI Multi-volt 105-305 Volt (colored blue) photocontrol.

Position the photovoltaic controls to face north. The photovoltaic control may face east or west only if facing it north is not an option due to service cabinet orientation.

20.4 Labeling Lighting Service Cabinets
Lighting service cabinets must have two feed point labels five feet above the concrete foundation.

One label is required on the front door and one on the side of the cabinet that faces the roadway.

MnDOT approved labels are listed on MnDOT's APL for roadway lighting.

20.5 Chapter 20 Resources
- National Electric Code
- MnDOT Approved Products List (APL)
- MnDOT Standard Specifications for Construction 2545.2, 2565.3CC, 2545.3L, 2545.3P.2.a.