Guidelines for the Preparation of Traffic Signal & Signal Communications Plans by Private Engineering Firms

INTRODUCTION

Use the following Guidelines in conjunction with the Traffic Signal & Signal Communications Scope of work provided in the Project Scoping Meeting, Request for Proposal, or Design-Build Submittal Guidelines (if applicable) to the development of Traffic Signal and Signal Communications plans ("plans").

GENERAL PROCEDURES AND REQUIREMENTS

The plans must include all existing and proposed traffic signals, metal pole loading diagrams (if applicable), electrical and programming details, utility make-ready plans, communications cable and conduit routing plans (if applicable), wireless communications plans (if applicable), and project special provisions.

Ensure the development of the plans follow the most current:

- Manual on Uniform Traffic Control Devices for Streets and Highways
- North Carolina Supplement to the Manual on Uniform Traffic Control Devices for Streets and Highways
- NCDOT TSMO Unit Design Manual
- National Electrical Safety Code
- National Electric Code
- NCDOT Roadway Standard Drawings
- NCDOT Standard Specifications for Roads and Structures

NCDOT's 2018 *Roadway Standard Drawings* – Section 1700 contains traffic signal and communications cable standard details. These will need to be incorporated into the plans for most work activities.

MicroStation cell libraries may be found at this address under the link entitled "CADD Consultant Resources": https://connect.ncdot.gov/resources/safety/Pages/ITS-and-Signals.aspx

Links to the TSMO Unit Design Manual, Project Special Provisions, and metal pole resources may be found at the above address after reading and acknowledging the disclaimer.

PLAN LAYOUT

General Overview

Submit plan sheets that comply with the following:

- Titlesheet showing an overview of all traffic signals along the corridor
- Temporary and permanent traffic signal designs (including electrical details)
- Metal pole loading diagrams/details
- Standard plate sheets
- Communications Cable & Conduit Routing Plans (including splice details)
- Communications Cable Construction Notes sheet
- Wireless Communications Plans (if applicable)
- Half-size sheets - 11" x 17"

- Electronic submittal of .pdf plan sheets, or download link
- Number all sheets (see Plan Sheet Numbering section below)

Title Sheet

The Title sheet must include the following:

- Overview of project (with signal locations identified)
- Project name/number
- Index of plan sheets
- Vicinity map
- Legend

Title Sheet must also contain the following:

- NCDOT TSMO Contact Information
- Phone Number (919) 814-5000
- Names of project contact personnel as determined by the Regional Signal Engineer coordinating the review

Traffic Signal Plans

Traffic Signal Plans shall be prepared for permanent and temporary installations on the standard size border and shall include, but not be limited to, the following information with all supporting documentation:

- Traffic signal analysis of the intersections to determine the necessary criteria (cycle lengths, clearance intervals, maximum intervals, etc.) for the required phasing
- Phasing diagrams for each active movement through the intersection. Phasing diagrams shall show all movements during both normal and preemption phases (if applicable). "Typicals" will not be accepted.
- Table of operations
- Timing chart
- Intersection plan view including, but not limited to: vehicular lane assignments, detection zone layouts, stop bars, crosswalks (if applicable), pole (and/or pedestal) locations, signal head arrangements, traffic signal related signing, driveway entrances, etc..
- Graphic scale
- North arrow
- Legend
- Route numbers and street names as appropriate
- Street grades
- Posted speed limits (Design speeds, if applicable)
- Plan notes
- Loop/detection installation charts for all detection devices
- Locations, sizes, arrangements, and identification of signal heads (both vehicular and pedestrian)
- Location of proposed poles (stationed) and messenger cable arrangements
- Location of proposed underground conduit and pull boxes
- Location of proposed lead-in routing
- Location of existing utility poles as shown on the roadway construction plans. (Only if in conflict with design.)
- Location of right of way
- Title block information
- Consultant name and contact information
- Coordination of the traffic signal plans with the final pavement marking plan to show the final

detection locations and the associated detection charts

- Metal pole designs (with or without mastarms) to include, but not be limited to the following information with all supporting documentation:
  - Reference to the "Typical" loading case (when applicable)
  - Loading diagrams (including dimensions on a plan view and dimensions of all signal heads, signs, and luminaires utilized and attachment heights) (when applicable)
  - Angles between spans for metal strain poles
  - Angle of rotation of the mastarm in relation to the roadway plans
  - Documentation in the form of cross-sections, typicals, etc.

The supporting documentation for each signal design shall include:

- Signed clearance chart with distances (show dimensions)
- Autoturn simulations for left-turning vehicles
- Controller timings for all existing signalized locations
- Most recent traffic counts with breakdown (vehicular and pedestrian)
- Roadway plan sheet for intersection
- Profile at intersection
- Summary of Quantity Sheet
- Division requests for specialized items (preemption, pedestrian signals, metal poles, etc.)
- Notes on all correspondence with Department personnel

Acceptance by the Department must be given on the phasing and detection methods used.

Coordinate the traffic signal plans with the construction staging to determine whether interim traffic signal treatment will be necessary to maintain actuated signalized operation during construction phasing. Interim traffic signal treatment may be defined as the following:

- Moving traffic signal poles out of the construction zone.
- Temporary traffic signals (to be removed at the completion of the construction) which require new traffic signal plans.
- Revised phasing at existing traffic signal locations which require revised traffic signal plans.
- Temporary traffic signals installed during a construction phase which will be revised during another construction phase and/or for final traffic patterns.

All Traffic Signal Plans must be sealed by the Engineer. The Engineer must be duly registered to practice engineering in North Carolina. **Plans must be provided in an electronically sealed/signed, text searchable .pdf format.**

Electrical and Programming Plans

Electrical and Programming Detail Plans shall be prepared for all traffic signal plans with supporting documentation to include but not be limited to the following information:

- Signal head hook-up charts showing the connection in the controller cabinet for each signal head
- Conflict monitor/Malfunction management unit programming card details showing the required jumpers and switch settings
- Overlap details showing all required programming
- Equipment information sections showing the controller brand (when required) and model number, controller software, cabinet type and mounting style (pole-mounted or base-mounted), number of loadbay positions, loadswitches used, phases used, and overlaps used
- Input file position layout, connection and programming charts for detectors defining the detector pin functions and the connection on the loop termination panel or detector rack set-up
- Backup protection details showing required programming for phase omits

- Special detector wiring details showing any special wiring needed for detection operation; details will be required for detection other than inductive detection loops (microwave, ultrasonic, machine vision, etc.).
- Preemption panel wiring details showing the preemption panel and all connections.
- Detail notes addressing installation and programming procedures in sufficient detail for construction. Notes shall address start-up programming, start-up phases, power-up flash times, unused phases, conflict-flash, etc.
- Special cabinet wiring details showing any special wiring needed to the controller cabinet.
- All non-standard controller programming shall be shown such as preemption programming, time- of-day programming, special ring configurations, etc. All controller display screens and menus needed to program these features shall be shown.
- The Department may request, at no additional cost, that a database configuration file be provided for any location. Ensure the file includes all the necessary programming entries to achieve the desired operation of the Signal Design for the location. The file should be compatible with the local controller software that is being used and should be able to be downloaded directly to the controller unit without conversion.

Final electric and programming detail plans must be sealed by the Engineer. The Engineer must be duly registered to practice engineering in North Carolina. **Plans must be provided in an electronically sealed/signed, text searchable .pdf format.**

Utility Make-Ready Plans (if applicable)
In conjunction with the development of the signal communications plans and traffic signal plans a set of **Utility Make-Ready Plans** shall also be developed. The utility make-ready plans must be developed in accordance with the *National Electrical Safety Code* and all applicable Utility Codes.

Develop and submit to the Department a set of utility make-ready plans for the routing of the proposed communications cable, either aerial, underground, or a combination of both. Plans shall be coordinated with utility representatives from the appropriate utility agencies and should address any modifications or adjustments deemed necessary to provide a pole attachment and/or show the underground installation location for the communications cable. The plans shall also address any aerial or underground utility adjustments necessary to facilitate the safe installation of the signal poles around each intersection. The Firm shall be responsible for coordinating and obtaining any utility make-ready adjustments.

If wireless communications will be used, a wireless signal strength survey will need to be conducted to determine best locations for attachments of radio antennae.

Plans should show, as a minimum:
- Final roadway
- Joint - use utility pole locations
- Signal poles
- Intersection controller cabinets
- Signal inventory numbers
- Right of way
- Driveways/streets
- Legend
- Intended NCDOT cable attachment points
- A description of each pole showing the type of utility make-ready work required

Utility Make-Ready Plans do not require an Engineer's seal.

Signal Communications Plans
Signal communications plans include Communications Cable & Conduit Routing Plans and/or Wireless Communications Plans will include the following information with all supporting documentation and information:

- Title Sheet
- Construction notes and legend, typical details, and any plan specific details.
- Construction plans. The construction plans should show as a minimum:
- Final roadway
- Right of way
- Driveways / streets
- Joint-use utility pole locations
- Signal poles
- Intersection controller cabinets with signal inventory numbers
- Communications cable attachment locations
- General construction notes
- Splice Plans (This information will address how the communications cable will be terminated at each location)
- Wireless communications layout showing all antennae locations (based on results gathered from wireless signal strength site survey)
- Consultant name and contact information

All Signal Communications Plans must be sealed by the Engineer. The Engineer must be duly registered to practice engineering in North Carolina. **Plans must be provided in an electronically sealed/signed, text searchable .pdf format.**

Project Special Provisions
Project special provisions must include the following information with all supporting documentation and information:

- The project special provisions will cover all items of work, material, equipment, and methods of construction for the installation of a complete traffic signal installation that are not otherwise covered in the Standard Specifications for Roads and Structures, dated January 2018 and all addendum.
- Each section of the project special provisions must contain subsections titled: Description, Material, Construction Methods, and Measurement and Payment. The Firm should utilize the TSMO Unit's most current version of generic Project Special Provisions in developing the project special provisions.
- Project special provisions must be sealed by the Engineer. The Engineer must be duly registered to practice engineering in North Carolina.

Project Special Provisions must be provided in an electronically sealed/signed, text searchable .pdf format.

Plan Sheet Numbering
Number all sheets (within Microstation) according to the following conventions:

- Titlesheet → Sig. 1.0
- Standard plate sheets (if required) → Sig. 1.1, 1.2, etc.
- 1st Signal plan → Sig. 2.0
- 1st Electrical detail(s) → Sig. 2.1, Sig. 2.2, Sig. 2.3, etc.
- 1st Metal pole loading diagrams → Sig. 2.X, Sig. 2.X+1, etc.(X=last electrical detail +1)

- 2nd Signal plan → Sig. 3.0
- 2nd Electrical detail(s) → Sig. 3.1, Sig. 3.2, Sig. 3.3, etc.
- 2nd Metal pole loading diagrams →Sig. 3.X, Sig. 3.X+1, etc.(X=last electrical detail +1)
- Subsequent plan sheets will follow the same numbering format starting with sheet number Sig. 4.0
- Standard Metal Pole Sheets → Sig. M1 thru Sig. M8 (if used, include all 9 sheets)
- Signal Communications Plans → SCP 1, SCP 2, SCP 3, etc.

PDF Naming Convention

Name all final PDF files according to the following sequential naming convention:

- "260_###_File Name.pdf" → Signal plans / electrical details / metal pole loading diagrams / signal communications plans. Do not add anything else. **NO TIP #s**.
- "270_###_File Name.pdf" → ITS plans
- Where, ### = 3 digit sequence (010, 020, 030,…), leave an appropriate gap between sheets
- "…File Name.pdf" should use the following naming conventions:

Plan Type	**File Name** (example)
Signal design (geometric) = "g"	012345-20140701g
Electrical Detail = "e"	012345-20140701e
Temporary plan = "t" (if more than one temporary plan put the number)	012345-20140701g-t1 012345-20140701e-t2
Metal Pole loading diagrams = "m" (take note at the top of the plan as to the number of the poles listed, i.e. Metal Pole 1 and 2)	012345-20140701m1&m2
Plan of Record = "por"	012345-20140701g-por 012345-20140701e-por
Revisions = "r" (include the # of the revision)	012345-20140701g-r1 012345-20140701e-r2
Plan of Record with Revision	012345-20140701g-r1-por 012345-20140701e-r5-por
Signal Communications Plans = "scp" (These are normally associated with TIP Projects but can be for Special Projects. Naming these can be done by the TIP or several Signal Inventory Numbers that are listed on the plans.)	R-1234A-012345-20140701scp1 or 012345, 016789-20140701scp3
TIP Title Sheets	R-1234A_Signals_Title_Sheet
Special Provisions for Traffic Signals	M_R-1234A_Signal_Specs
Special Provisions for ITS Projects	N_R-1234A_ITS_Specs

CADD/Electronic Files

Once the final plan package has been approved, an electronic submittal of all CADD drawing files in Microstation format, or a link to the electronic files, for the signal plan package, including signal plans, electrical programming details, metal pole loading sheets, and signal communications plans must be provided. All CADD files must be free of reference files, so that all relevant information is contained within the individual file. Each intersection must have separate CADD files for each temporary and final design for the signal plan, electrical programming details, and metal pole loading details, however, multiple sheets of the same discipline (all electrical programming details or multiple signal plan sheets) may be combined into one CADD file.

A word file of the Project Special Provisions must also be included as part of this submittal of electronic plans.