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DEPARTMENT OF TRANSPORTATION

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**SUBJECT:** Design Guidelines for Long-Term Temporary Signal Control in Work Zones

**TO:** District Executives

**FROM:** Richard N. Roman, P.E., Director *Richard N. Roman /s/*
Bureau of Maintenance and Operations

This Strike-off Letter (SOL) identifies the guidelines to follow when designing for long term temporary signal control in a work zone.

The design guidelines are to further clarify temporary signal requirements when determining location specific long-term temporary signal plans in compliance with PATA 705 (Temporary signals on fixed supports for long-term stationary operations) and PATA 706 (Portable temporary signals for long-term stationary operations).

These guidelines will be added to Appendix D of Publication 213 (Temporary Traffic Control Guidelines) in the next update.

Should you have any questions, please contact Daniel Farley, Chief, Traffic Operations Deployment and Maintenance Section, at 717.783.0333.

Attachments

4920/MLD/hmq

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# Design Guidelines for Long-Term Temporary Signal Control in Work Zones

The following design guidelines are to further clarify temporary signal requirements when determining location specific long-term temporary signal plans in compliance with PATA 705 (Temporary signals on fixed supports for long-term stationary operations) and PATA 706 (Portable temporary signals for long-term stationary operations). Once finalized, these guidelines will be added to Appendix D of Publication 213 (Temporary Traffic Control Guidelines).



## Preliminary Design

The following information should be determined at an initial scoping meeting prior to submitting any temporary signal control plans in work zones.

- Determine work zone limits including the length of the closure or lane restriction.
- Determine the type of work zone control on the project (i.e., detour, ½ width construction, temporary roadways, etc.…)
- Determine existing field conditions (such at the AADT, grades, geometry, etc.…) and appropriate clear zones.
- Determine the project schedule to determine how long the work zone will be in operation and whether it would be in operation over the winter.
- After determining the work zone limits, the traffic control for all driveways, local highways, and state highways within the work area needs to be evaluated. The purpose of the scoping meeting is to clarify any changes to the initial traffic control of the work zone.
- Work zone tapers, transitions, lane widths, and other key factors need to be discussed and agreed to at the initial project scoping.
- Pedestrian Accommodations and Needs and Location and Operation of Existing Driveways within the influence area of the traffic signal.
- When Temporary Signals are selected, conduct a preliminary assessment with proper justification documented to determine the type of temporary signals to be used. The designer and/or applicant should consider and document their decisions based on the "Guidelines for the Selection of Temporary Traffic-Control Signals in work zones" identified in Publication 213, Appendix D.
- Complete all of the data requested within the TE-952P (Application for Permit to Operate Temporary Traffic Control Signals). While application does not need to be filled out completely, the data requested within this form is needed to answer the previous bullets.
- Any preliminary plans that have been developed and that have not been submitted to the Department.

The initial project scoping meetings should be completed prior to any submissions to the Department. It is highly recommended that the information provided above be provided to the Department at least five business days prior to the scoping meeting. Contact the appropriate District Traffic Engineer or identified traffic unit representative to set up an appropriate date and time for the meeting. The meeting can be held either in person (office or field) or through a web conference call to help streamline the process.

**Long-Term Temporary Signal Design**

- Temporary Pole or Portable Signal Placement –
  - When installing poles, contact PA-1 Call to appropriately mark all subsurface utilities.
  - Field evaluate and mark the pole or portable signal placement locations to determine any safety concerns with sight distance limitations due to horizontal and/or vertical curvature.
  - If the alternative portable signal locations or another alternative to PATA's 705 and 706 are selected, provide justification as to why this option was selected. Signal supports should be a minimum of two feet off the edge of the travel way as identified within Publication 149, Chapter 5.

- Signal Head Placement –
  - 12-inch Housing with backplates are required. Retro-reflective tape around the border could be considered, but visibility and sight distance concerns should be documented and justification provided.
  - The mounting height of the bottom of the traffic signal housing should be 17-feet above the center of the roadway surface. Additional mounting heights may be considered, but they need prior approval from the appropriate District.
  - Circular indications are typically used, but other arrow indications may be needed. If these arrow indications are needed, then the added and/or replaced indications will need to provide appropriate engineering judgement and justification, such as meeting conflict factor thresholds (see Publication 149 Chapter 3 – Operational Requirements).
  - For fixed support signal configurations, two signal indications over the roadway are preferred with one indication approximately 3-feet to the right of the existing double yellow markings and the other indication shall be approximately spaced (desirable distance is 12-feet, but it may need to be reduced to 8-feet apart). If another configuration is being considered, contact the appropriate District with the concerns and/or issues. Additional supplemental signal indications either on the column of the pole, on the portable unit, or another separate portable unit may be considered if appropriate justifications to geometric, safety, and sight distance concerns can be documented.
  - Full tunnel visors should be installed on the temporary signal indications. If louvers, other type of visors, or optically programmed signals are needed, then additional justification and engineering judgement should be provided indicating the safety and mobility benefits for installing the alternative solutions such as geometric, safety, or sight distance concerns.

- Time Phasing and Sequencing –
  - Phasing – Traffic signal phasing should be evaluated to determine the most appropriate and most efficient operation. If this is not an existing traffic signal, phasing should be established to minimize delay on the main highway. Existing traffic signal phasing should be evaluated and considered, but appropriate documentation and justification should be provided if phasing changes are being recommended.
  - Sequencing – Establishing the sequencing of a traffic signal should take into account the location specific factors. Typical sequencing is recommended, but if more complex sequencing would be needed then a more detailed evaluation would need to be reviewed, documented, and justification provided.

  - Timing –
    - All-Red Clearance Interval – Use the calculations developed in PennDOT Publication 46. Additional time needs to have good documentation and justification.
    - Yellow Vehicle Change Interval – Use the calculations developed in PennDOT Publication 46. Additional time needs to have good documentation and justification.
    - Green Times – Minimum and maximum green times should be initially developed based on the amount of traffic obtained from either previous traffic counts or through Department published HPMS data. Highway Capacity Manual (HCM) Analysis and/or micro simulation may be used to determine the anticipated impact of the work zone. Field adjustments may be needed, but all adjustments should be justified and provided on the temporary traffic signal permit plan.
    - Pedestrian clearance times (if needed) – Use the calculations developed in PennDOT Publication 46. Additional time needs to have good documentation and justification.
    - The traffic signal should rest in red for all of the approaches during off peak periods. Rest in red would apply to all approaches. Other types of operation could be considered, but appropriate justification and documentation would be needed.
    - All traffic signal detection zones should be on locking mode to ensure that all calls placed on the traffic signal are serviced unless using non-locking is justified. Other types of operation could be considered, but appropriate justification and documentation are needed.
    - Other factors – other traffic signal controller settings such as delay, volume density operation, and other operational improvements can be considered, documented, and justification provided.

- <u>Sign and Pavement Marking Placement</u>
  - Sign and pavement markings should be in compliance with the layout and parameters provided within PATA 705 and 706. Additional sign and pavement markings would require documentation and justification.
  - Typically “No Turn on Red” signs shall be provided for all controlled driveways and side roadways. Other applications could be considered, but appropriate justification and documentation would be needed.
  - Typically “No Pedestrian Crossing Signs” are only needed when a pedestrian restriction is needed. Note that all the Department’s policies and procedures regarding pedestrian accommodations need to be considered.
  - Additional signs required for the location should be discussed at the initial scoping meeting. The additional signs should be documented and justified why they are needed for the project.

- <u>Vehicle Detection Placement</u> –
  - All temporary traffic signals should be fully actuated at each approach
  - Non-Intrusive video or radar detection are the preferred methods. Mounting and positioning of devices shall be per the manufacturers guidelines. If other alternatives are being considered then documentation and justification is needed.
  - All detection equipment used shall be Bulletin 15 approved.

- Pedestrian Detection –
  - Pedestrian Push Buttons – If previously available at the intersection or if needed for operational improvements. All new pedestrian push buttons shall meet existing ADA accessible criteria. Existing pushbuttons shall meet the same ADA accessible criteria and the temporary pedestrian push button should have the same functionality as the previous button (i.e., APS previously then APS needs to be installed for the temporary condition). If there is an official pedestrian detour that does not use a temporary signal location, then that location may not need pushbuttons based on engineering judgement.

- Preemption –
  - Emergency Vehicle Preemption – Location specific documentation and justification are needed. The following geometric, safety, mobility, or service criteria should be used to assist with engineering judgement
    - Identification that this is a known and critical route used by emergency responders.
    - Within two miles from a hospital
    - At a work zone location with a minimal sight distance of 1,000 feet
    - Along extreme curves where end of the work zone cannot be seen
    - Other unusual situations need to be approved by the Highway Safety and Traffic Operations Division (HSTOD)

    Once it is determined that emergency vehicle preemption is needed then the type of preemption (optical or acoustic) needs to be evaluated and properly documented.
  - Ramp Preemption – Note that temporary signals within 1,000-feet from a limited Access ramp should be considered. Location specific documentation and justification is needed. The justification should identify any geometric, safety, mobility, or ramp service issues that would require the placement of Ramp Preemption.
  - Railroad Preemption – Note that temporary signals within 1,000-feet from a railroad should be considered. Location specific documentation and justification is needed. The justification should identify any geometric, safety, mobility, or railroad service issues that would require the placement of Railroad Preemption.
  - Queue Preemption – Location specific documentation and justification is needed. The following geometric, safety, mobility, or service criteria should be used to assist with the engineering judgement:
    - Along an existing documented and known crash location
    - Along approaches that have limited vertical and/or horizontal sight distance
    - Along approaches with negative grades exceeding 4%
    - At an intersection with approaches that have an existing posted speed limit at or above 40mph
    - Along approaches where the traffic queue exceeds the temporary advanced sign locations
    - Along approaches where it may back-up onto a limited access facility
    - Other unusual situations need to be approved by HSTOD

- Lighting –
  - Location specific documentation and justification is needed. The following geometric, safety, mobility, or service criteria should be used to assist with the engineering judgement:
    - Along an existing documented and known crash location
    - Along approaches that have limited vertical and/or horizontal sight distance
    - Along approaches with negative grades exceeding 4%
    - At an intersection with approaches that have an existing posted speed limit at or above 40mph
    - At an intersection where there is pedestrian accommodations
    - Other unusual situations need to be approved by HSTOD

- Other Alternatives –
  - Advanced Message Board Synchronization – Location specific documentation and justification is needed. The following geometric, safety, mobility, or service criteria should be used to assist with the engineering judgement:
    - All locations with an AADT above 10,000
    - Along an existing documented and know crash location
    - Along approaches that have limited vertical and/or horizontal sight distance
    - Along approaches with negative grades exceeding 4%
    - Along approaches that have an existing posted speed limit at or above 40mph
    - Along approaches where traffic queue exceeds the temporary advanced sign locations
    - Other unusual situations need to be approved by HSTOD

    Once it is determined that advanced message board synchronization is needed then the type of message needs to be evaluated and properly documented
  - Generators and/or Battery-Back-up – Location specific documentation and justification is needed. The following geometric, safety, mobility, or service criteria should be used to assist with the engineering judgement:
    - All locations with an AADT above 10.000
    - Along an existing documented and known crash location
    - At intersections with complex phasing (more than 5 phases)
    - At intersections with railroad preemption
    - Other unusual situations need to be approved by HSTOD
  - Advanced Work Zone Communications – Location specific documentation and justification is needed. The following geometric, safety, mobility, or service criteria should be used to assist with the engineering judgement:
    - At intersections where traffic signal interconnection with another traffic signal or ITS are required
    - Other unusual situations need to be approved by HSTOD

- Additional Bike/Pedestrian Accommodations or animal drawn vehicles – Location specific documentation and justification is needed. The following geometric, safety, mobility, or service criteria should be used to assist with the engineering judgement:
  - Along an existing documented and known pedestrian or bike crash location
  - Along approaches that have limited vertical and/or horizontal sight distance and pedestrian accommodations will be provided
  - At locations where a defined trail crossing is near the work zone
  - Documentation of any animal drawn vehicle routes
  - Other unusual situations need to be approved by HSTOD

- Plan Presentation –
  - Temporary Signal Permit Plan presentation is to be in conformance with the same guidance provided for permanent signal permit plans identified within Publication 14, (DM-3).
  - Temporary Signal Permit Plans should have a signature block for the District Traffic Engineer and the Contractor. *(Note: Additional approvals should be completed internally prior to the District Traffic Engineer signature)*
  - The following General Notes should be provided on the temporary signal permit plan:
    - Signals must flash a minimum of three days and a maximum of seven days prior to red, yellow, green operation, unless otherwise directed by the District Traffic Engineer.
    - Contact the appropriate District Traffic Engineer or District Signal Supervisor one week prior to the anticipated temporary signal flash, turn-on, and phase change.
    - The Project Engineer or the District Traffic Unit representatives have the right to modify this plan in order to move traffic more safely and expeditiously according to accepted traffic engineering practices.
    - For other signing, see the Maintenance and Protection of Traffic plan, and/or Pennsylvania Department of Transportation Publication 213, Latest Edition.
    - Install, operate and maintain this temporary traffic signal in accordance with the Pennsylvania Department of Transportation Regulations on Specifications (Publication 408/2011), Traffic Control Standards (Publication 148), Traffic Signal Design Handbook (Publication 149), and Traffic Engineering Manual (Publication 46)
    - All maintenance necessary for the proper visibility of the signals, including trimming trees, is the responsibility of the contractor.
    - Contractor/Project Manager is responsible to contact all stakeholders (PennDOT, Municipality, etc.) to explain temporary traffic signal installation to ensure safe work zone operations.
    - The contractor installs and maintains all signs and pavement markings indicated on the temporary signal permit, unless otherwise indicated.
    - All stop bars are to be placed perpendicular to the centerline of the roadway.
    - All temporary pavement markings are to be removed upon completion of the project.
    - Remove all existing pavement markings and signs that conflict with the temporary signal permit.
    - All traffic control devices, tapers and signing to be installed as shown and in accordance with Pennsylvania Publication 213.

        - This drawing cannot be used as a construction drawing unless the contractor complies with the provisions of Act 287, as amended, prevention of damage to underground utilities. Prior to construction contact utility companies as well as proper notification to PA 1-call.
        - No adjustments shall be made to the stop bar lengths without approval from the district traffic unit.
        - The contractor is responsible for coordination of any relocation of overhead utilities that may interfere with the clear vision of the signal heads.
        - All Pavement Markings and signs must be restored to their original configuration at the completion of the project.
        - Install all signs and pavement markings as indicated on the temporary signal permit plan before the signals are placed in red, yellow, green operation.
    - Additional general notes and/or information should be documented and justification provided. If possible, this information should be provided at the initial scoping meeting.
    - The designer shall have their professional engineer seal and signature on each temporary signal plan title sheet.

- <u>Field Adjustments and Traffic Signal Permitting</u> –
    - All initial time, sequencing, and phasing are to be documented on the initial temporary signal permit plan. Any field modifications and/or adjustments should be initially documented on As-Built drawings, but then updated on the temporary signal permit plans. All adjustments should be documented and justification provided.
    - The District Traffic Unit will be notified at least 1-week prior to a temporary signal turn on or phase shift. The District may have a representative available to review and approve compliance to the temporary signal permit plan.
    - Temporary signal flashing is to be coordinated with the District and discussed at the project scoping meeting. Signals must flash a minimum of three days and a maximum of seven days prior to red, yellow, green operation, unless otherwise directed by the District Traffic Engineer. Alternatives to flashing could be the placement of portable changeable message signs prior to the installation of a temporary signal to notify motorists of the future operational change.
    - The initial turn on or any phase changes is to occur on a Tuesday, Wednesday, or Thursday from 9am to 2pm unless otherwise authorized by the District Traffic Engineer. The temporary traffic signal is not to be turned on the day before or after a holiday. It is highly suggested that the placement of the temporary signals be established prior to placement of barrier and pavement markings *(<u>Note</u>: all conflicting markings and signs need to be covered prior to this occurring)*. Therefore, if the temporary signal is initially in place, then the traffic signal representative can verify the temporary signal field conditions, time, phasing and sequencing so that the signal can be officially turned on prior to all barrier and pavement marking construction activities have been completed. Channelizing devices can be used temporarily until the markings can be installed.
    - The temporary signal permit initial design is to be approved by the Department. All contractor signatures and TE-925P need to be completed prior to the field inspection. The Department will not issue the official temporary signal permit until field conditions and operational improvements have been evaluated. Typically the District will bring the temporary signal permit and plan to the field review of the initial turn-on or phase change.

**Temporary Signal Design Submission Materials**

The following are required when submitting a temporary signal plan for the Department's review:

- Completed and Signed TE-952P (Application for Permit to Operate Temporary Traffic Control Signals)
- Completed Work Zone Traffic Control Plan
- Completed and Signed Temporary Signal Permit Plan
- Appropriate Signal calculations (i.e., clearance calculations, pedestrian calculations, HCM analysis, Synchro analysis, etc….)
- Additional documentation and justification as outlined within these design guidelines
- Project scoping meeting minutes or documentation
- Source of Supply information for either the portable traffic signal and/or the temporary signal equipment on fixed supports

**Temporary Signal Review Comments**

The Temporary Signal review should take into account what was discussed and agreed to at the initial scoping meeting. As specified above, if additional documentation and justification is needed for the comments (i.e., addition or deletion of materials) then this should be provided in the comments provided to the designer. It is suggested that, if more than two submissions and/or if additional clarification is needed, then an additional meeting or conversation should be conducted with the designer.