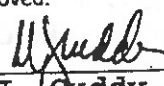


To: SUPERSEDED BY <u>EB 06-004</u> EFFECTIVE 9/7/06		ENGINEERING INSTRUCTION <i>New York State Department of Transportation</i>	95-003 Supersedes:
Title: REQUIREMENTS FOR MAINTENANCE AND PROTECTION OF TRAFFIC DURING NIGHTTIME CONSTRUCTION			
Distribution: ☒ Main Office(30) ☒ Local Gov.(31) ☒ Regions(32) ☒ Contractors/AGC(39) ☒ Consultants(34) ☐ _____ ()		Approved:  M.J. Guddy, Chief Engr. <u>1/18/95</u> Date	

This EI transmits requirements for Maintenance and Protection of Traffic (M&PT) During Nighttime Construction. These requirements are to be followed for all construction activities that are regularly scheduled to occur after sunset and before sunrise. Occasional or unplanned construction activities that carry over past sunset or start before sunrise are not subject to these provisions. Nonetheless, these requirements should be viewed as guidance to ensure safe traffic flow on such occasional nighttime work as well.

In addition to the requirements transmitted by this EI, an Addenda has been developed for §619 of the Standard Specifications to add requirements for night construction, and a new specification has been developed to provide lighting requirements for night construction. Those specifications will be issued by EI 95-004 and EI 95-005.

The attached requirements are to be addressed in Traffic Control Plans (TCP) for night construction. Whenever possible, the decision to schedule work at night should be made prior to completion of PS&E, and these requirements and procedures are to be included in the design of the TCP. When the decision to schedule construction during night hours is made after the project is let, it will be necessary to revise the TCP to incorporate these requirements and procedures. When night-work is added to ongoing projects, whether initiated by the contractor or by the Department, the Construction Group will be responsible for coordinating revisions to the TCP with Design, including review and comment by the Regional Traffic Group. That coordination and review must be completed, and all equipment and devices required for the revised TCP must be acquired and on the project, prior to the start of night operations.

These requirements are to be reflected in TCPs developed for projects beginning with the letting of May 25, 1995. For earlier Letting Dates, these requirements should be addressed to the extent possible. For projects that will involve significant nighttime construction activities in 1995, it is essential that these requirements are addressed in the TCP. If the PS&E is nearly complete, consideration should be given to delaying the letting date or revising the TCP by amendment.

For 1995 projects that have been let, or that are too close for amendment, it will be necessary to review the TCP after letting. If any of the requirements transmitted by this EI are not

substantially met, it will be necessary to change the TCP by order-on-contract. The intention of this EI is to ensure that all significant nighttime construction activities in 1995 are in compliance with the requirements and the related specifications, regardless of letting date.

It is expected that the M&PT requirements transmitted by this EI will be incorporated into the Highway Design Manual and the Construction Supervision Manual in the future. In the interim period, this material is to be followed by both Design and Construction to develop and revise TCPs for night construction operations.

Questions relating to this EI should be referred to Jim Bryden in the Construction Division (518-485-1834) or to Steve Witham in the Design Quality Assurance Bureau (513-457-7284).

**NYS DEPT. OF TRANSPORTATION
OFFICE OF ENGINEERING
MAINTENANCE AND PROTECTION OF TRAFFIC
FOR NIGHTTIME CONSTRUCTION**

1/12/95

INTRODUCTION

Continued growth in traffic and the size of the construction program, especially in urban and suburban areas, has resulted in increased conflicts between construction activities, traffic, and adjacent land-use. To reduce traffic disruption and other adverse impacts associated with construction activities in congested areas, the Department is increasing the use of nighttime construction. Typical activities considered for night work include paving, joint/pavement repairs, bridge demolition and steel erection over traffic, and other activities that require lane closures on high-volume roadways. For the purposes of this document, nighttime construction is those activities that are regularly scheduled to occur after sunset and before sunrise.

Moving these operations to late-night hours is intended to accomplish the work when traffic volumes are lowest so the necessary lane closures do not result in objectionable levels of congestion or interference with adjacent land-use activities. While this advantage is important, night construction activities entail significant tradeoffs, particularly increased difficulty in ensuring safe traffic flow through the project. A number of factors make it more difficult to ensure safe traffic flow at night:

- Visibility is greatly reduced, both for drivers and workers.
- Speeds are frequently higher because volumes are lower.
- Confusion and lessened visibility tend to reduce lane capacity below daytime levels.
- Impaired drivers (alcohol, drugs, fatigue) are a greater concern.
- Drivers are unaccustomed to encountering construction at night.
- Workers may be more prone to fatigue and associated mental errors.
- Coordination with supervisory and support staff is more difficult.

It is expected that the Department will rely more heavily on night construction to mitigate adverse impacts of construction. To ensure that night work is done in a manner that provides a safe environment for workers and travelers, high-quality Maintenance and Protection of Traffic (M&PT) is essential. Not only must it adhere to established standards, procedures, and principles that apply to all Department construction projects, M&PT for night construction must be enhanced in several regards to address the factors listed above.

The Department's goal regarding traffic control on night construction is to ensure that M&PT

is designed, implemented, and managed in a uniform, consistent manner to provide a high level of traffic safety for workers and the traveling public. This must be done in a manner that minimizes delays and inconvenience to travelers, and disruptions to the community where the project is located. Additionally, the Traffic Control Plan (TCP) should permit the contractor to operate in an efficient manner to facilitate completion of the construction in a timely manner and at a reasonable cost. Acceptable results cannot be obtained by simply modifying daytime TCPs through the addition of lights and reflective devices. Instead, TCPs for night operations are to be designed specifically for that application, taking into consideration the added factors that must be addressed at night.

PLANNING FOR NIGHTTIME CONSTRUCTION

Guidance on deciding whether to schedule construction activities at night is addressed at length in EI 91-04. The Department is currently considering a number of options to mitigate adverse impacts of construction activities. Those considerations are beyond the scope of this document. However, once the decision is made to include night operations, M&PT is to be governed by these requirements and procedures.

Additional guidance is provided by EI 91-01, "Method of Traffic Maintenance During Construction" to determine the approach to traffic control to be utilized. A number of options may be considered for night work:

- Road closure with designated detours.
- Road closure without detours.
- Lane closures using traffic barriers (temporary CMB or others).
- Lane closures using only channelizing devices.

Considering the added risk factors inherent in night operations, it is preferable to provide as much separation as possible between construction activities and traffic, while providing all necessary information and guidance for drivers to safely traverse the detour or travel through the project. Lane closures using channelizing devices provide the least separation, but some projects will be forced to utilize this option because reasonable detour routes are not available, and all travel lanes must be available to carry traffic during daylight hours. Where the work area will remain at a fixed location for more than a few days, consideration should be given to using movable concrete barriers. However, for typical night construction operations such as paving and pavement/joint repairs, the work area is not fixed, and it becomes necessary to rely on channelizing devices to form temporary lane closures on a nightly basis.

Regardless of the method of traffic maintenance selected, the requirements and procedures presented here are to be followed. In addition, the Addendum to §619 of the Standard Specifications transmitted by EI 95-004 lists specific M&PT requirements for nighttime construction.

MANAGING AND SUPERVISING NIGHTTIME M&PT

§619 and other sections of the Standard Specifications require the contractor to manage and

supervise M&PT throughout the project. Existing Department procedures provide for inspection of M&PT activities as part of the overall inspection and management of construction projects. Nighttime operations frequently entail more complex M&PT requirements and higher risks if the TCP is not constantly maintained at a high quality level. It is therefore essential to establish clear-cut responsibilities for managing and supervising nighttime M&PT operations. This section establishes requirements that are to be addressed in the development of the TCP, and that must be met by the contractor and by inspection staff and Department supervisors in implementing and maintaining the TCP.

GENERAL REQUIREMENTS - The following points are to be addressed in the PS&E. Most of these requirements should normally be covered by notes in the TCP, but in some cases it may be appropriate to address them by special notes in the proposal. When nighttime construction is added to ongoing contracts, it will be necessary to convey these requirements in writing to the contractor, and for the contractor to acknowledge these requirements, prior to the start of night operations:

1. Stipulate permissible hours for lane closures/road closures/other night operations in the TCP.
2. Consider whether night operations will be permitted on Friday and/or Saturday nights. These nights are generally at higher risk for DWI and have higher late-night volumes. Sunday through Thursday may be a better choice for a 5-night operation, although Sunday night may require wage premiums. State workday restrictions in the TCP.
3. Where a facility serves substantial nighttime work or commuter traffic (2nd or 3rd shifts, etc.), weekends may be better nights for full road closure to minimize inconvenience to such traffic. State any such requirements in the TCP.
4. Restrict the actual length of lane closure in place to the minimum necessary to accomplish the work safely and efficiently. Long lane closures with no work activity present may compromise safety by encouraging deliberate encroachment by impatient drivers. In addition, they are counter to good public relations, and add to traffic delay and congestion. However, a single long closure is preferred over several short enclosures located close to each other. In most cases, the appropriate length of closure can best be determined by the EIC and contractor, although in some cases, the designer can develop estimates for fixed operations. In either case, provide an appropriate note in the TCP.
5. Any restrictions or special requirements on paving or other operations, such as restricting the length of paving passes in a single lane, must be clearly stated in the PS&E.
6. Special requirements, if any, to reduce noise levels must be stated in the TCP or proposal. In addition, any special safety restrictions such as limitations on vehicle backing must be stated.
7. To the extent project and traffic conditions permit, the contractor should take advantage

of daylight hours before and after the shift for the setup/removal of traffic controls and other preparatory and cleanup work. Address this issue in the TCP notes if applicable.

CONTRACTOR MANAGEMENT - The §619 Addendum transmitted by EI 95-004 requires the contractor to take specific steps to implement and maintain the TCP, including:

- full time traffic control supervisor
- full time traffic control crew
- trained flaggers
- Constant project site patrol

The first two requirements are waived where the work does not require lane, ramp, or roadway closure, or work adjacent to an active lane. However, the contractor must still provide adequate supervision and crews to maintain the TCP, and address the subject in the operational plan. Thirty days prior to the start of night work, the contractor must submit a written operational plan to the EIC, listing qualifications of traffic control personnel and providing details on how the TCP will be implemented and maintained. The operational plan must be updated if necessary as the work progresses. It must identify foreseeable problems and emergencies and the contingency steps that will be taken to address them. These requirements are to ensure that the contractor develops an acceptable method of operating at night, obtains the necessary equipment and materials, and provides qualified and trained personnel to patrol the site on a regular basis to adjust, restore, and replace elements of the TCP as needed. The supervisor and crew must be prepared to identify and correct operational problems such as long queues extending past the advance signs, backups into intersections, equipment failures, vehicle breakdowns, glare from construction lighting, and other situations that require immediate correction.

DEPARTMENT MANAGEMENT - The EIC will review the contractor's operational plan to ensure that it conforms to the requirements of the §619 Addendum transmitted by EI 95-004. The EIC will acknowledge receipt of the plan in writing. If the plan fails to address any of the points required by the §619 addenda, the EIC will notify the contractor in writing of the specific points that are not acceptable. Under no circumstances shall night operations be permitted to start until the operational plan is accepted, trained and qualified staff are on hand, and all of the necessary traffic control devices and other safety and lighting equipment are on the project and operational. Prior to the start of night operations, the EIC will schedule a meeting with the contractor to review and discuss the operational plan. Inspection staff, contractor's supervisors, material suppliers, and involved police agencies are to be present at the meeting.

When night operations begin, the EIC or the designated M&PT inspector will check the TCP setup at the beginning of the shift, at regular intervals throughout the night, and at the end of the shift to make sure the roadway is restored to normal operations and all devices and equipment are safely stored. A mobile communication system such as cellular telephones or radios is required by the specification addendum so project staff can maintain contact with the contractor's traffic supervisor, with the work operation, and with the police patrols if dedicated

police are present. While the contractor's traffic supervisor and crew are responsible for checking and maintaining the TCP on a constant basis, inspection staff are responsible for inspecting the operation for compliance, and for providing direction to the contractor when situations arise that require an adjustment to the TCP.

In addition to the project inspection staff, construction group management staff must inspect night operations on at least an occasional basis to confirm that all of the activities, especially M&PT, conform to requirements. Depending on Regional staffing, the Regional Construction Engineer, Construction Supervisor, Regional Construction Safety Coordinator, or other support staff will perform this function. In the case of very complex TCPs, or operational problems, Regional Design and Traffic staff should visit the project during night operations to determine if the TCP is working as intended, and to assist in resolving significant problems.

TRAFFIC CONTROL PLAN ELEMENTS

This section addresses specific traffic control devices and other elements that are to be included in TCPs for nighttime construction, and provides required standards for their use. Because of the greater risks inherent in nighttime operations, it is Office of Engineering policy that these requirements shall be met or exceeded on all projects. Adherence to these requirements is essential to ensure an acceptable level of traffic control on all nighttime operations. Equally important, adherence to these requirements will provide drivers with uniform traffic control from project to project and Region to Region, thus simplifying the driving task, and make it easier for contractors to bid and comply with M&PT requirements.

The traffic control elements presented are minimum requirements. Where site conditions require higher standards or more or larger devices, these requirements should be enhanced as appropriate to accommodate actual project demands. However, changes to these traffic control elements are not to be made based solely on individual or Regional preferences. The points that follow primarily cover enhancements for night operations, and list specific practices to be followed. These requirements are more specific than existing Department requirements and guidelines, such as the MUTCD and other Els, which provide a range of acceptable practice to suit a variety of situations. However, requirements in the MUTCD, the specifications, and Department procedures remain applicable and must be considered. It is noted that this document enhances or adds to existing requirements and guidelines, but in no case does it contradict them.

DESIGN OF ROAD CLOSURES - Where feasible detour facilities are available, or where traffic conditions are otherwise suitable (low volumes of strictly local traffic), closing the roadway to public traffic should be considered. When the decision to completely close a road is made, the following traffic control elements are to be provided:

- Type III barricades are to be used to close a roadway or ramp, as required by the MUTCD.
- Appropriate "ROAD CLOSED" or related signs, as described in Part 218 of the MUTCD, are required, mounted on or above the barricades.

- Flashing warning lights are to be provided on Type III barricades at the point of closure. However, they are not to be installed in a longitudinal display such as at a lane closure that diverts traffic onto a ramp.
- Appropriate advance warning signs as described in Part 238 of the MUTCD are required prior to all closures. Type B flashing high intensity warning lights should be considered to enhance sign visibility on freeways and in other locations where there is concern that drivers may fail to notice these signs.
- Portable arrestor nets should be considered for use on mainlines or entrance ramps where there is a risk of traffic circumventing the closure. Design information is presented in EI 92-039.
- Redundancy is essential for all closures. An additional set of Type III barricades should be provided some distance beyond the primary closure and in front of arrestor nets to alert drivers who circumvent or breach the primary closure.

DESIGN OF LANE CLOSURES - When traffic must be maintained through the project during work hours, lane or shoulder closures are necessary to provide separation between traffic and the contractor's operations. The use of traffic barriers (temporary concrete median barrier, etc.) is desirable to provide positive separation, but is often not feasible. Most lane closures that are set up and removed nightly must rely on channelizing devices to mark the closed lanes. All lane and shoulder closures, whether barriers or only channelizing devices are used, must adhere to the following requirements:

- Closures must be started at locations providing optimum visibility, i.e., before curves and crests. Closure locations should take advantage of available escape paths such as wide medians and shoulders, and avoid bridges, underpasses, and other locations without available escape paths.
- Closures should be located away from other conflict points such as on-ramps and intersections whenever possible.
- Longitudinal buffer space should be provided between the downstream end of the closure and the start of the work area. A length equal to the AASHTO stopping sight distance is desirable, as a minimum, but site conditions may not always permit the full length desired. Any available buffer space is helpful, and should be utilized if the full length is not available.
- Lane closure taper lengths must adhere to the requirements of §262.22 and §292.1 of the MUTCD (refer to §200.8 of the MUTCD to determine metric equivalents). The standard taper length, L, must be provided as a minimum for lane closures, except where intersections or other site situations necessitate shorter tapers. For multiple lane closures, a tangent section 2L in length is required between adjacent lane closure tapers. The required shoulder closure taper length is 1/3L.
- For roadways with relatively high speeds and free-flowing traffic, longer tapers may

help to facilitate merging. However, for slower speed roadways where traffic volumes approach congestion, increasing the taper length may prolong the merge conflict, and should be avoided.

- Where temporary traffic barrier is used to close lanes or shoulders, the closure must first be formed using channelizing devices on the appropriate taper length. Immediately downstream of the closure, an appropriate buffer space is to be provided in advance of the temporary barrier as noted above. The barrier is then introduced beyond the buffer space using the flare rate listed in EI 84-002.
- The type of channelizing device to be used is listed in §619-3.13 of the specifications, and is discussed in the section below on channelizing devices.
- Close spacing of channelizing devices, as listed in §619-3.13 of the specifications, is essential to discourage encroachments into the work area. For lane closure tapers and tangents, maximum channelizing device spacing is as follows:

<u>Estimated Operating Speed</u>		<u>Maximum Spacing</u>	
km/h	mph	m	ft
30	20	6	20
50	30	9	30
70	40 or higher	12	40

The longest allowable spacing is equal to the broken lane-line spacing, and is thus easy to follow during setup. These spacings are maximums, and more devices should be used when conditions indicate the need to more clearly define the travel path.

- Channelizing devices must be carefully aligned at intersecting ramps, gores, and other critical locations to clearly define the intended travel path for drivers. Spacing at these locations is to be $\frac{1}{2}$ the tangent spacing listed in the above table.
- Closed lanes are to be reinforced by two channelizing devices (or one Type III barricade) placed transversely across the lane at least every 225 m (750 ft.). The transverse devices should be positioned to discourage traffic from using the closed lanes, while permitting passage of construction traffic. They may be temporarily omitted where required by paving or other work operations, and replaced when the operation has passed.
- Where construction operations are restricted to a shoulder or only 1 lane of a three lane roadway, consideration should be given to providing additional lateral buffer space by closing an additional travel lane adjacent to the work operation. This decision must be based on the tradeoff between traffic flow and worker safety. In addition to potentially reducing traffic speeds, the added lane closure reduces the risk of equipment or workers straying into the open lane. However, this option cannot be used where it results in objectionable congestion and delays.

- Where space is available on the shoulder, traffic can be shifted further away from construction operations by locating channelizing devices on the open lane side of the lane line.
- Where neither of the above options is possible to provide an adequate lateral buffer space to protect the paving crew, a flagger/spotter should be stationed with the workers.
- Arrow boards are required for all lane closures on nighttime construction, regardless of traffic speed. See EI 93-018 for details on arrow board use. One arrow board operated in the flashing arrow mode is to be used for each lane closed, placed as close to the start of the upstream end of the taper as possible. Arrow boards are discouraged for shoulder closures and lane shifts, and are not to be used for these purposes unless operating in the caution mode (corners flashing – no flashing bar permitted).
- It is essential that arrow board visibility is not obstructed by signs, other equipment, or roadside features, and that all bulbs are working properly. Arrow boards must be dimmed to avoid glare that may blind drivers. If necessary, the arrow board may be aimed to further reduce glare while maintaining adequate visibility for approaching traffic. These points are to be checked at the start of each night shift.
- Black-on-orange single arrow signs – W1-11, W1-12 – may be used at strategic locations (i.e., intersections, lane shifts, crossovers, etc.) to emphasize lane closures. They must be mounted a minimum of 1.5 m (5 ft.) high to the bottom of the sign. Placement on top of Type III barricades spaced periodically throughout the lane closure is especially effective.
- Regulatory "DO NOT PASS" signs – R4-1 – may be spaced periodically throughout lane closures where traffic is restricted to a single lane and there is concern that vehicles will momentarily enter a closed lane to pass slower vehicles. These signs are to be placed on the right adjacent to the open lane, and may be placed both on the left and right where space is available.
- During paving operations and other construction operations, it is often necessary to change the lane closure from left to right or vice versa during the night. It is often simpler to leave the original closure in place and shift traffic into the reopened lanes using channelizing devices. The shift should occur at a minimum distance of 2L downstream from the closure. The shift taper length must be at least $\frac{1}{2}L$. Single arrow panels should be used to mark the shift, but arrow boards are not to be used. Channelizing devices must be spaced to confine traffic to a single lane throughout the shift without allowing an opportunity to form additional lanes.
- When one lane closure will be maintained throughout the night, with a lane shift used to adjust lane use, the lane to be closed should be based on site conditions and available sight distance. All other things being equal, it is generally preferable to close the left lane.

RAMP CONTROL - When a roadway is closed, all on-ramps must be closed as well, following the principles listed above under **Design of Road Closures**. When the mainline is open to traffic, special considerations must be given to controlling traffic at ramps, and in some cases, it will be necessary to selectively close on or off ramps while the mainline remains open. The following points are to be addressed to ensure adequate control of traffic on ramps:

- Depending on mainline and ramp volumes, appropriate traffic control must be provided at the intersection of on-ramps with the mainline. This control may consist of stop or yield signs, flagger control, or provision of an acceleration lane with an adequate merge length.
- For facilities with existing ramp metering equipment, it may be necessary to adjust the ramp metering cycle or turn the system off when the construction operation is underway.
- When paving or other operations require providing the contractor full use of the lanes adjacent to off-ramps, it is necessary to temporarily close individual off-ramps. In such cases, it is essential to provide advance warning that the ramp is closed, and to provide information on alternate ramps or detours. This information must be provided well upstream of the decision point using large Information Signs or Variable Message Signs. In addition to advance Information Signs, regulatory "Ramp Closed" signs are required in the area of the ramp. To emphasize the closure, channelizing device spacing should be halved through the ramp area.
- In addition to full road closures, on-ramp closures may be necessitated by closure of the right lane for contractor's operations, or because restriction of all mainline traffic to the right lane does not provide adequate gaps for entering traffic to merge safely. In either case, closure of an on-ramp must be addressed in a similar manner to the points listed above for a full road closure.
- When entering or existing traffic must cross closed lanes, the travel path must be clearly defined using channelizing devices spaced at one-half the spacing defined in the table above.
- Temporary "Exit" panels on portable supports are to be provided in relocated gores to direct traffic to open off-ramps.
- For on-ramps carrying high-speed, high-volume traffic, consideration should be given to using variable message signs to alert drivers to nighttime construction activities.

CHANNELIZING AND GUIDING DEVICES - Because of reduced visibility and increased presence of impaired drivers, work zone intrusions are a higher risk at night. Enhanced channelization and driver guidance is required to protect workers and the public from the severe consequences of vehicle intrusions into night work areas. The following requirements are to be met for channelizing and guiding devices used for nighttime construction operations:

- Because visibility is more critical, all channelizing devices must be clean and in good

condition at all times, and equipped with reflective sheeting meeting the requirements of the specifications and the MUTCD. Makeshift application of reflective sheeting is not allowed. All devices must meet the condition requirements shown in "Quality Guidelines for Work Zone Traffic Control Devices". Any devices that do not provide good reflectivity must be replaced at once.

- Adequate ballast must be provided to ensure that devices are not dislodged by passing traffic.
- Drums or 300 mm X 600 mm (12" X 24") vertical panels are preferred for lane closures set up and removed nightly, and are required for tapers. Because they are much easier to set up and remove, especially for lane closures, 900 mm (36") traffic cones may be used in the tangent section of lane closures.
- At gores, ramps, and intersections where reduced spacing is used, at least every other device is to be a drum or vertical panel. 900 mm (36") cones may be used as the intermediate devices.
- Type III barricades are required by the MUTCD to form road closures on mainlines and ramps. They may be supplemented by drums, vertical panels, and 900 mm (36") cones, as defined above, to form tapers and otherwise direct traffic past closures.
- Because they are more difficult to set up and remove, Type III barricades are not to be used as the primary channelizing devices in tapers or tangent sections of lane closures set up and removed nightly. They may be used at periodic intervals, with or without single arrow signs, to reinforce lane closures and to add emphasis at critical points.
- Because of their 1.5 m (5 ft.) height, Type III barricades may interfere with sight distance at intersections and roadway entrances. Care must be taken to ensure that these devices are not placed where they will interfere with sight distance.
- Type C steady burning low intensity warning lights do not significantly enhance the visibility of reflectorized channelizing devices such as drums, 300 mm X 600 mm (12" X 24") vertical panels, and Type III barricades. They also increase the risk of windshield breakage and may become a dangerous projectile if impacted. In addition, they are expensive and time consuming to maintain. Type C warning lights are not to be used on reflectorized channelizing devices unless justified by reduced visibility conditions such as heavy fog. However, they provide useful delineation on non reflectorized safety devices such as temporary CMB, and they should be used as needed to delineate temporary barrier or similar objects that are located close to travel lanes.
- Type A flashing low intensity warning lights are excellent devices for directing driver attention to roadway hazards. The first two channelizing devices at the start of lane closure tapers, shoulder closures, and other locations defining roadway hazards, are to be equipped with Type A warning lights. Type B flashing high intensity warning lights may be substituted where the device is left in place during daytime, and where

additional emphasis is desirable.

Type III barricades used to form roadway or ramp closures are to be equipped with flashing warning lights (either Type A or Type B). Two lights are to be provided on each barricade.

- Flashing warning lights are not to be used on channelizing devices or traffic barrier in a longitudinal series along the path of traffic.
- In addition to channelizing devices, other guiding devices such as raised reflective pavement markers, post-mounted delineators, and reflective panels should be considered to mark travel paths and temporary concrete barriers when site conditions do not dictate the use of channelizing devices or warning lights.

WARNING SIGNS - Extra care is needed to ensure that warning signs provide adequate visibility and legibility at night. The following considerations are to be addressed for warning signs used in nighttime construction:

- Because drivers are not accustomed to encountering construction activities at night, enhanced advance warning distances are important. A minimum of 1.6 km (one mile) advance warning is to be provided on roadways with operating speeds of 80 km/h (50 mph) or higher except as noted in the next point. Distances may be shortened to 450 m (1500 ft.) on roadways with speeds of 60 km/h (40 mph) or less.
- Location of advance warning signs should consider exiting and entering traffic. It is not generally desirable to start a warning sign series upstream from a major exit or intersection, except when it is desirable to divert traffic off the route at that point.
- Standard distances to be used on countdown warning signs include 1.6 km, 800 m, 450 m, 300 m, and 150 m (1 mile, ½ mile, 1500 ft., 1000 ft., and 500 ft.). Generally, three signs are adequate for a countdown series with the specific distances selected to fit site conditions. Non-standard distances such as 240 m, 180 m, 90 m (800 ft., 600 ft., 300 ft.), etc. are not to be used unless it is imperative to provide precise distance information to drivers.
- Where single advance warning signs are provided on ramps or minor intersecting roads, the "Ahead" wording rather than a specific distance is preferred because it is easier to adapt to site conditions and reduces sign inventory needs for the contractor.
- Actual distance from a warning sign to the condition should be close to the stated distance on the sign. However, positioning of the sign to enhance visibility and avoid conflicts with other traffic control devices and roadway features is more important than precise agreement with the stated distance.
- Warning signs must be located to provide adequate visibility distance to drivers. They must not be blocked by foliage, roadway features, or other signs and traffic control devices. They should not be located where glare from light sources behind the sign

may reduce visibility.

- Signs must be adequately spaced to provide recognition and legibility. On high speed roadways, signs must be spaced at least 150 m (500 ft.) apart. This applies equally to construction signs and permanent signs.
- Sign placement must consider low-beam headlight patterns. Signs on short-radius curves or mounted higher than normal may not be visible at night.
- Reflectorized signs must be oriented essentially perpendicular to the direction of traffic to provide adequate brightness. Supports that result in tilted signs are unacceptable. The brightness of a sign made with high-intensity sheeting is reduced to only 1/4 to 1/3 of its maximum brightness when it is tilted 30 degrees in any direction from perpendicular.
- In situations where signs cannot be located to be visible under headlight illumination, artificial illumination should be considered to enhance visibility and legibility, or the sign must be moved.
- Warning signs used at night must use Class B sheeting (or fluorescent orange for warning signs in certain contracts), as required in the specifications, and must be kept clean and in good condition to provide good legibility as shown in "Quality Guidelines for Work Zone Traffic Control Devices." Painted sign panels and flexible panels (roll up signs) are not to be used.
- Poor legend quality reduces legibility, especially at night. Makeshift legends such as temporary overlays or hand-painted legends are not to be permitted.
- Larger sign sizes enhance sign legibility, especially at night. The largest series available, either D or E warning signs, are to be used on all nighttime construction operations to make signs as legible as possible.
- Warning signs on one-way roadways are to be double-posted (both sides of the roadway) for all nighttime operations, regardless of the number of lanes.
- Type B flashing high intensity warning lights should be considered to enhance the visibility of isolated warning signs for nighttime operations where high-speed, free-flowing traffic raises concerns that drivers will fail to notice the advance warning signs. The lights are to be mounted above the sign panel such that the battery and lens do not obscure any part of the sign panel. If remote batteries are used, they must be placed at ground level.
- Unneeded or unapplicable signs are especially distracting to drivers at night, and must be completely covered or removed. Sign covers must be opaque, and must cover the sign face completely. Partially visible signs distract drivers, and may divert attention away from traffic and other devices.

- Messages on warning signs should identify specific conditions to the greatest extent possible. Appropriate messages include lane and shoulder closure, alignment and intersection signs, flagger and worker symbol signs, road or bridge closed, detour, and other appropriate texts as described in the MUTCD.
- General warning signs such as "Road Work XX Ft" should be limited to the first sign in a countdown series. "Road Work Ahead" may be used separately where a more specific message is not appropriate, or as the first sign in a warning sign series on minor side roads where distance information is not necessary.
- All warning signs must be mounted at a minimum height of 1.5 m (5 ft.) above the pavement, measured to the bottom of the sign, to enhance visibility, and reduce the risk of windshield intrusion if a sign is impacted.

REGULATORY AND GUIDE SIGNS - Requirements and guidance for warning signs are generally applicable to regulatory and guide signs as well. When guide signs are used to alert drivers to night operations and to provide information on road and ramp closures, the sign messages must be designed to ensure legibility. Messages must be simple and concise so drivers can read them at prevailing operating speeds. Long or involved messages cannot be read, and may distract drivers from other tasks. If it is necessary to provide messages more than a few words in length, they must be split between two or more signs placed at least 150 m (500 ft.) apart. To ensure that drivers comprehend the total message, no intervening signs should be placed between the two, and the distance between the signs should not be extended such that the connection between the two is lost. The same as for warning signs, any unneeded or unapplicable signs are distracting or misleading, and must be completely covered or removed.

VARIABLE MESSAGE SIGNS (VMS) - These devices are an excellent method for providing added warning and information to drivers concerning changing conditions. The following points relating to VMSs are to be considered for nighttime construction operations:

- VMSs should be used on high-speed, high volume roadways (and on other roadways as needed) as a supplement to static signs to alert drivers to nighttime construction activities and road closures.
- VMSs should be placed well upstream of work areas and road closures or detours to allow time for driver response and diversion to other routes when possible.
- Simple, specific messages are essential to ensure that they can be read and understood. Messages are to provide specific instructions and information. "Paving Ahead / Right Lanes Closed", "Exit 45 Closed / Use Exit 46", and "Expressway Closed / Use Service Roads" are examples of specific messages.
- General or cautionary messages are not helpful, and are not to be used. Examples of such messages include "Caution", "Drive Carefully", "Slow Down", or "Road Work Ahead".

- Messages should be limited to 2-part, 3-word text if possible. Longer messages cannot be read at typical freeway speeds.

- Messages should be developed by the TCP designer or the Regional Traffic Group. A list of suitable messages should be included in the TCP notes. If the VMS is added after the project is let, assistance is to be obtained from the designer or from the Regional Traffic Group to develop appropriate messages.

- When not needed to provide information specific to a construction operation, VMSs are to be turned off and if possible, stored outside of the clear zone. Under no circumstances shall they be reprogrammed to display generic messages such as "Drive Safely" or "Have A Nice Day". VMS credibility can best be preserved by limiting use to important messages specific to the operation underway.

- VMSs cannot provide adequate warning for construction operations by themselves. All required static signs must be in place regardless of the use of VMSs.

SHADOW VEHICLES - For construction operations where the activities are concentrated at specific locations, whether fixed or moving slowly, shadow vehicles equipped with a truck-mounted-attenuator (TMA) protect both workers and travelers from work zone intrusions. Requirements for shadow vehicles equipped with TMAs are provided in §619, but are required by the Standard Specifications only for moving operations not protected by fixed lane closures. Where the operation and work zone configuration permit, shadow vehicles with TMAs are to be added for nighttime operations on high-speed roadways where channelizing devices separate the work area from traffic. The following points are to be addressed:

- When required, shadow vehicles with TMAs are to be included in the TCP, and included in the TCP notes. Payment is to be included in 619-01.

- A shadow vehicle should be located upstream from each work activity where workers will be concentrated. Additional shadow vehicles should be shown in the TCP at other points where intrusions are a concern.

- Shadow vehicles used in moving operations not protected by channelizing devices must be equipped with operational arrow boards. Shadow vehicles used in closed lanes defined by channelizing devices must not display a flashing arrow display. If equipped with an arrow board, it must display a flashing corner caution mode, or be turned off.

- Shadow vehicles should be positioned just upstream from work activities where workers are present. The buffer space between the work operation and the shadow vehicle must be long enough that an impacted shadow vehicle is not pushed forward into the workers, but short enough to minimize the risk of errant vehicles entering the buffer space and striking the workers. Shadow vehicles must be moved with the work activity to maintain the proper position.

ARRESTOR NETS - These devices protect against vehicles breaching road or ramp closures. Consideration should be given to adding arrestor nets in the TCP, or by change-order when

night work is initiated after the letting, at any locations where there is a concern that drivers will enter the closed roadway. The following points are to be addressed if arrestor nets are used:

- Arrestor net locations are to be shown in the TCP. Payment will be by the appropriate item for Arrestor Nets (see EI 92-039).
- Type III barricades, with flashing warning lights and appropriate Road/Ramp Closed signs must be provided in front of the net.
- Where the net is located some distance beyond the closure, a secondary set of barricades should be placed immediately in front of the net to alert construction traffic and any drivers that circumvent the primary closure.
- Adequate stopping distance free of all objects and vehicles must be provided beyond the nets. Required stopping distances are listed in EI 92-039.
- Consideration should be given to providing access for construction vehicles and other official traffic to enter the closed roadway.
- When there is a concern that drivers will deliberately try to enter the closed roadway by driving around the net, stationing a watchman or police officer at the entry point should be considered. The vehicle should be equipped with appropriate warning lights and positioned where it is visible to approaching traffic, but in a location where it is not at risk of being struck. The watchman should be equipped with a radio to alert the work area of any vehicle intrusions.

FLAGGING OPERATIONS - Flagging operations may be necessary or helpful to supplement other traffic control procedures at night. However, night flagging operations are inherently more difficult, and must be conducted with extreme care if they are to be safe for drivers and the flaggers. The following points are to be addressed:

- Whenever possible, flaggers should be stationed at areas that are brightly illuminated by temporary floodlights or roadway lighting. Vehicle headlights are not acceptable for flagger station illumination.
- Flaggers are to use stop/slow paddles or flags at lighted flagging stations. Where it is not possible to provide illumination, only lighted wands are to be used.
- Flaggers must wear orange hard hats and vests with white reflective markings. Vests must be clean, in good condition, and closed front and rear.
- Flaggers may be stationed adjacent to work areas to serve as spotters to provide a warning of vehicle intrusions. These flaggers should be provided with hand-held audible alarms.
- Flaggers may be necessary to assist haul trucks and other construction vehicles in

entering and exiting the work area. Flaggers must not stop moving traffic to permit construction vehicles to exit the work area. Rather, they should hold the construction vehicle, and direct it to proceed when it can do so safely.

- When construction vehicles will be exiting the work area into heavy traffic on a regular basis, consideration should be given to including a temporary traffic signal in the TCP. Temporary signals should be installed subject to all requirements of the MUTCD, including an engineering study to evaluate its need, sight distance requirements, and other considerations.

VEHICLE PROTECTION - All vehicles and equipment involved must be equipped with warning lights so they are clearly visible to drivers and other work vehicles. They must be clearly identified as work vehicles so that traffic does not attempt to follow them out of the open travel lanes. The following considerations address warning lights and other requirements for vehicles and equipment involved in night operations:

- Requirements for warning lights and reflectivity on construction vehicles and equipment are provided in §619-3.13 of the specifications.
- Inspector's vehicles and other official vehicles must display an amber revolving light at all times in the work zone, except as noted below.
- In addition to amber revolving lights, all contractor and inspection vehicles should display 4-way flashers when stopped or moving slowly in or adjacent to open traffic lanes.
- Warning lights and flashers should be turned off when vehicles are moving at normal speeds in traffic, or when out of traffic in a protected position, and turned on in advance of slowing, stopping, or exiting the travel lanes. Unneeded warning lights in or adjacent to the traffic stream distract drivers' attention and reduce driver credibility for lights in general, and should be avoided.
- Required warning lights are to be displayed at all times on closed roadways to alert workers and other construction traffic, and to denote vehicles that are authorized to be on the closed roadway. Vehicles stopped or parked on closed roadways must display warning lights or flashers so they can be seen by other construction traffic. The only exception to this requirement is vehicles parked safely off the roadway or in areas designated for worker parking which are adequately lighted or identified so as to be visible to construction traffic.
- Reflective tape on trucks and construction equipment must be kept clean and in good condition to make it as visible as possible.
- To avoid confusing traffic, work vehicles in closed lanes or shoulders adjacent to open traffic lanes should travel in the same direction as traffic. The only exception is for rollers and other equipment that must move in both directions. When vehicles must move against traffic, such as for picking up lane closures, the vehicle should back up

at a controlled speed to avoid confusing traffic, and to avoid the need to turn around adjacent to traffic.

WORKER PROTECTION - Reduced visibility and a higher likelihood of impaired drivers place workers at greater risk of being struck by vehicles or equipment at night. Based on past experience, work vehicles and equipment represent a significant threat to workers, and adequate steps must be taken to guard against this hazard, especially on roadways closed to traffic, where workers may develop a false sense of security. The following points are to be addressed for worker protection:

- Requirements for high visibility apparel and hard hats are stated in the specifications. Workers, inspection staff, and all visitors to night work areas are to adhere to these requirements at all times.
- Safe access to the work area for workers is a special concern at night. Crossing or walking adjacent to high-speed traffic to reach work areas places workers at risk. The need for worksite access protection is to be considered, following the guidelines and requirements of EI 93-013 and EB 93-008.
- Workers need to be aware of the risks inherent in night work. Worksite safety training -
- "tailgate safety programs" -- need to address this issue both for workers and for inspection staff. This training must instruct workers to be alert at all times to traffic, especially construction traffic on closed roadways, and not to place themselves in vulnerable positions where they cannot see or be seen. Drivers and equipment operators need to be trained to be especially alert for workers at night.
- Backing accidents are a serious worker safety concern at night when workers behind trucks and equipment may be nearly invisible. In congested work areas, spotters and flaggers should be required to guide all backing operations. Required back-up alarms must be operable at all times. Unless spotters are used to guide backing vehicles, any vehicles or equipment with inoperable back-up alarms must be removed from service at once until repairs are completed. There is no grace period on this requirement. In residential areas, backing alarms may cause objectionable noise -- if this is a concern, limitations on backing should be stated in the TCP notes.

LIGHTING REQUIREMENTS - Worksite lighting is an essential element in TCPs for nighttime construction operations to permit the contractor to complete the work in a satisfactory manner. Equally important, illumination of the work area is essential for safety considerations -- traffic must be able to see and identify workers and the work activity, and work vehicles must be able to see and avoid workers. Specific requirements for worksite lighting are provided in EI 95-005 and the accompanying specification. Those requirements should be integrated into the development of the TCP, and must be fully addressed by the contractor and inspection staff prior to the start of nighttime operations.

POLICE SERVICES

Visible police enforcement is highly desirable on nighttime construction operations to encourage driver adherence to traffic regulations, and to manage incidents such as accidents, breakdowns, and major congestion. To the extent that agreements with police agencies are in effect, and the agency can provide the desired coverage, dedicated enforcement is to be provided for all significant nighttime construction operations involving temporary lane closures on high speed, multi-lane roadways. This includes paving and pavement repair projects, and other activities where construction operations will take place in closed lanes or shoulders adjacent to traffic. Police shall also be present during the setup of full closures on major roadways. For occasional or short term night work, where a reasonable level of police presence can be obtained through cooperative arrangements, dedicated enforcement is not required. Department procedures for obtaining dedicated State Police Enforcement on Department projects are provided in EI 93-030.

The Department primarily relies on the NYS Division of State Police for dedicated police services. The need should be identified as early in the design of the project as possible so the local Troop Commander can be notified well in advance, and the necessary Supplemental Memorandum of Understanding (MOU) can be negotiated. For situations where State Police cannot provide the necessary services, it will be necessary to arrange for dedicated services through local police agencies. This involves negotiation of an MOU by the Office of Legal Affairs, and a long lead time is required. In such cases, the Region must alert Legal Affairs as soon as the need is identified so the necessary contractual arrangements can be initiated.

The following requirements and considerations are to be addressed concerning police enforcement related to night work:

- When dedicated police services are utilized on a project, the actual level of police presence and their location on the project should generally be under the control of the EIC.
- Police should be stationed upstream with lights operating when lane closures or full road closures are being set up on high-speed roadways.
- After the lane closure has been implemented and work is underway, the patrol car should normally be stationed upstream from the work area with the lights in operation. However, it can be moved to other locations when the need arises.
- Patrol cars can be used to temporarily stop traffic or to create a rolling roadblock to provide the contractor full access to the roadway for brief periods to set up lane and road closures, and to shift closures from one side of the road to the other.
- To maintain driver credibility with enforcement efforts, a second patrol car should occasionally be stationed downstream from the work area to issue citations for speeding or other violations through the project.

- Patrol cars equipped with radar should operate the radar whenever possible to activate radar detectors on vehicles approaching the work zone.
- Whether or not dedicated police services are utilized, all police agencies in the vicinity of the project should be notified that night operations will be underway to permit planning for any traffic impacts on their routine activities, and if possible, to concentrate traffic enforcement activities on detours and other roadways impacted by the project.

PUBLIC AWARENESS ACTIVITIES

Successful traffic control at nighttime construction activities is enhanced by informing drivers and other parties impacted by the work of the planned activities, and enlisting their support and cooperation. Prior to the start of night work, steps should be taken to inform the public on the nature, schedule, and duration of the planned night work. This will ordinarily be done through the public news media, by direct contacts to night trip generators and public agencies, and by posting specific information adjacent to the project.

Specific information should be developed to describe the location and nature of the construction activities, including the expected impact on traffic patterns. When feasible, suggestions for alternative travel patterns and detours should be provided. The specific schedule (work hours and days) and duration of the work should also be included.

This information should be provided to local news media in the form of press releases in advance of the start of night work. The press releases should identify contact persons in the Department for questions and follow-up. When feasible, the Region should establish working contacts with principle local news outlets so that schedule changes and progress updates can be provided on a regular basis, preferably at least weekly. In addition to news media, information should also be provided to local automobile clubs and to major night traffic generators, including large employers with night shifts, shopping centers, and entertainment complexes such as sports facilities and theaters.

In addition to local police agencies, other emergency services agencies (fire department, ambulance services, etc.) must be informed of road closures and detours so they can plan appropriate changes in emergency response procedures.

On projects that normally carry significant commuter and other local traffic at night, advance notice of the night work should be posted adjacent to the project. Large information signs — black-on-orange — can be used to list work locations and dates, and to suggest alternate routes. To be legible at operating speeds, the messages on these signs must be restricted to no more than three lines of text, with no more than a few words per line. When it is necessary to provide longer messages, the information must be displayed on multiple signs spaced at least 150 m (500 ft.) apart, with no other signs between them. It is important for these signs to be located where good sight distance is available, and where they will not interfere with other signs. On roadways with 3 or more lanes, these signs should be posted on both the left and right.

When variable message signs are available to the project, they should supplement fixed signs for a few days before work begins by displaying specific information on the nature of the work and the schedule. An example of an appropriate 2-part message is "Night Paving: 10 PM - 6 AM / Starts Aug. 15." When the work is actually underway, messages on the VMS should be revised to provide information specific to that operation. An example of an appropriate message would be "Night Paving Ahead / Left 2 Lanes Closed / Expect Delays." During non-working hours and days-off, the message would revert to "Night Paving: 10 PM - 6 AM / Sun-Thurs / Thru Sept. 15."

Highway Advisory Radio (HAR) is also useful to inform drivers. Specific details on night work operations should be broadcast on HAR when equipment is available. Signs advising drivers of the availability of HAR should be posted in advance of the project. To enhance credibility of HAR, it is important that only concise, up-to-date information providing specific travel instructions are actually provided. Use of HAR to broadcast general information or safety slogans may cause drivers to question its value. Likewise, it is important that signs alerting drivers to the availability of HAR must be displayed only when HAR is operational. These signs must be removed or covered when HAR is not operational to maintain system credibility.

REFERENCES AND RELATED MATERIALS

These requirements provide an overview of the points that must be addressed for M&PT on nighttime construction operations. There are a number of other Department policies, procedures, and guidelines that are also applicable. Key points from existing documents have been included in these requirements. However, it is essential for designers of TCPs to be familiar with all of these documents, and to include this information when appropriate. It will also be necessary for EICs to be aware of these documents and to refer to them when more specific detail is needed.

The following EIS and other documents should be referenced when more detail is needed:

- EI 91-01 Method of Traffic Maintenance During Construction
- EI 91-04 Night-time Construction Policy
- EI 91-05 Justification for Variable Message Signs
- EI 92-039 Vehicle Arresting Barrier (Net Type)
- EI 93-013 Traffic Control Plans - Safe Worksite Access
- EB 93-008 Safe Worksite Access
- EI 93-018 Flashing Arrowboards - Use and Procedures
- EI 93-022 Revisions: Section 619-Standard Specifications, Construction Supervision Manual Section on Flagging
- EI 93-009 Innovative Safety Barrier
- EI 93-030 Dedicated Police Services on Department Construction Projects
- EI 84-002 Concrete Barrier End Treatments in Construction Work Zones

American Traffic Safety Services Association - "Quality Guidelines for Work Zone Traffic Control Devices for Use on NYSDOT Projects"