MARYLAND TRANSPORTATION AUTHORITY
Baltimore, Maryland

Invitation for Bids

BALTIMORE HARBOR TUNNEL

Maryland
Transportation
Authority

Contract No. HT 705-000-002

Baltimore Harbor Tunnel Lane Control and Dynamic Message Sign System Upgrade

Anne Arundel County
Baltimore City

June 2009

NOTICE TO BIDDERS

Please review the checklist prior to submitting your bid on this Contract.

- When submitting your completed bid, do not separate the book. Submit the whole book including all addenda acknowledgment pages.

- Make sure that all addenda letters are attached outside of the front cover of the bid book.

- If the addendum has revised the Schedule of Prices, make sure that you have included the revised pages in your bid. Your price should reflect any and all changes.

- Prices must be written numerically and in words, unless approved substitute forms are used (Refer to GP-2.06). Don't leave any items blank.

- When tabulating your final price, make sure all your calculations are correct.

- Minority Business Enterprise Attachments A and B must be completed and submitted with your bid. If either of these attachments is missing your bid is non-responsive. Attachments C and D **should not** be submitted at time of bid.
  For additional information on how to complete the MBE Attachments, please see the insert named "Important Information regarding MBE Utilization and Bidding Requirements" located in the IFB.

- The Bid/Proposal Affidavit must be completely filled out and signed by all the parties as indicated.

- If Escrow is being offered in a contract, the contractor must indicate whether or not they wish to utilize an Escrow Account for Retained Funds on the provided form.

- A bid bond must accompany all bids of One Hundred Thousand Dollars ($100,000.00) or more. The bid bond document must be completely filled out and have an original Power of Attorney form attached.

- If the document is too large for the envelope that we have provided, you can place the document in another form of packaging that can be sealed and submitted. If the document is too large for the bid box, you should alert the receptionist.

- Make sure that your company's name, address, the contract number and the bid date appears on the front of the packaging.

- When submitting bid packages via US Mail, Federal Express, DHL, UPS or any other delivery service it is your responsibility to make sure that the bid reaches the bid box before the time deadline. It may be in your best interest to send the package 24 hours in advance of the deadline. Also, when sending packages this way, make sure that the labeling specifies that it is a bid submission.

Notice to Bidders/Offerors

EMaryland Marketplace Fee

In order to take advantage of Maryland State and Local government contracting opportunities, vendors/contractors are encouraged to register with eMaryland Marketplace. The free registration provides a means for businesses to receive e-mail notification of upcoming contracting opportunities in their specified areas of interest and expertise.

For registration requirements, visit:
www.eMarylandMarketplace.com.

IMPORTANT INFORMATION REGARDING MBE UTILIZATION AND BIDDING REQUIREMENTS

The Maryland Transportation Authority (the "Authority") has been forced to reject many recent bids/proposals due to bid submissions that were not in strict compliance with the stipulated MBE rules and regulations. The following checklist has been developed to highlight certain critical components of the MBE program requirements. This listing is not all-inclusive and the bidder **must** comply with all MBE rules and regulations listed throughout this entire proposal book.

Please read all of the instruction provided on Attachment A, B, C & D in its entirety before completing the forms.

Attachment A (Certified MBE Utilization and Fair Solicitation Affidavit) & Attachment B (MBE Participation Schedule) must be included with the submittal of the bid or offer. If the bidder or offeror fails to submit these forms with the bid/offer as required, the Procurement Officer **shall deem the bid non-responsive** or shall determine that the **offer is not reasonably susceptible** of being selected for award. MBE Prime Contractors must achieve the established MBE goal with other certified MBE contractors. A Prime MBE Contractor **can not** count itself as an MBE to obtain the goal.

ATTACHMENT A

When filling out Attachment A, make sure you complete the following:

- If the Prime Contractor can achieve the established overall goal and sub goals, you must check the appropriate box.
- If after making good faith efforts, you determine you can not achieve the established overall goal or subgoals, you must request a waiver by checking the appropriate box.
- If you do not request the waiver at time of bid and you **are not** meeting the established goal(s), your bid/offer will be considered **non-responsive or not reasonably susceptible of being selected for award.**
- Attachment A must be signed and dated.

ATTACHMENT B Part 2

When filling out Attachment B, make sure you have included the following:

- Prime Contractor's name, address and phone number.
- Project description.
- Project number/Solicitation Number.
- List the minority firm name(Column 1), certification number and MBE Classification (Column 2), Total sub contract dollar amount (Column 3) and NAICS Codes of the services to be performed or products to be supplied (Column 4)
- Clarify for each sub-contractor if it will provide services, is a supplier or will supply and install (Column 5)
- It is the Contractor's responsibility to ensure that the proposed subcontractors are certified to perform the proposed work. All Contractors are to submit an approvable MBE plan at time of bid. Approvable means, the subcontractors are certified in the applicable NAICS Codes through MDOT and can perform the proposed services for the required participation goal. Contractors pending MBE certification at time of bid are **not** eligible for participation. If you submit a firm that is not certified to perform the proposed services and your contract falls short of the established MBE goal, your firm will be considered **non-responsive or not reasonably susceptible of being selected for award.**
- Prime Contractors are strongly encouraged to check the MDOT database at www.mbe.mdot.state.md.us to see if the subcontractor is certified to perform the services and to make sure the subcontractor has not graduated from the listed NAICS codes. If you have questions after checking the data base, you may contact the Authority MBE Office at 410-537-1048 for further assistance.

  If you are using a supplier, the 60% rule applies. Please refer to the MBE Manual for the description of the 60% rule.

  Please provide details on how you arrived at the 60% on Attachment B (Column 5) (i.e. – $150,000.00 X 60% = $90,000.00).

- If you are requesting a third tier relationship, you must state that request on the Attachment B form (Column 1). Please note: Third Tier MBE/DBE subcontracting will be approved by the Authority only when the Authority is satisfied that there is no way except by Third Tier contracting that an MBE/DBE goal can be achieved. Specifics as to why a Third Tier contracting agreement must be included.

- Attachment B must be signed and dated.

- If you are the apparent low bidder, you will receive a letter from the Authority requesting your MBE Attachment C (Outreach Efforts Compliance Statement) and Attachment D (Subcontractor Project Participation Affidavit). You will have ten (10) working days to submit the attachments to the Authority. If you requested a waiver at time of bid, all of the back up documentation that complies with COMAR 21.11.03.11, must be submitted within the ten working days with Attachments C & D.

- If the apparent low bidder fails to return the required documentation within the allotted ten (10) days, the Procurement Officer may determine that the apparent low bidder is not responsible and therefore not eligible for contract award.

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MARYLAND TRANSPORTATION AUTHORITY
Baltimore, Maryland

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Contract No. HT 705-000-002

Baltimore Harbor Tunnel Lane Control
and
Dynamic Message Sign System Upgrade

Anne Arundel County
Baltimore City

June 2009

NOTICE TO BIDDERS

A "Pre-Bidding Session" for the purpose of answering or obtaining answers to questions of parties interested in constructing the work relative to Right-of-Way, Utilities, Design, and Construction Details will be conducted at **10:00am** on **June 30, 2009** , in the Conference Room, 1st Floor of Francis Scott Key Bridge Engineering/Finance Building at 300 Authority Drive in Dundalk, Maryland. While attendance at the Pre-Bid conference is not mandatory, this is the offeror's opportunity to raise questions and/or issues of concern regarding the project.

NOTICE TO ALL HOLDERS OF THIS CONTRACT DOCUMENT

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM (NCHRP) REPORT 350 IMPLEMENTATION SCHEDULE FOR DEVICES USED IN THE MAINTENANCE OF TRAFFIC

Except as otherwise specified in this Section, all items for the maintenance of traffic, including those listed under the following categories, shall be crashworthy in conformance with Level 3 or other Level as specified by the Engineer in conformance with the safety crash testing and performance criteria published in the National Cooperative Highway Research Program (NCHRP) Report 350, "Recommended Procedures for the Safety Performance Evaluation of Highway Features." When conformance with NCHRP Report 350 is required, the Contractor shall provide the Engineer with the manufacturers' certifications that the devices comply with the specified criteria.

Unless specifically waived by an attachment to these Contract Provisions, devices must be approved by the Office of Traffic and Safety.

Category 1 Devices

These devices are cones, tubular markers, flexible delineator posts, and drums, all without any accessories or attachments, which are used for channelization and delineation.

Category 2 Devices

These devices are Type I, II, and III barricades; portable sign supports with signs; intrusion alarms; and drums, vertical panels, and cones, all with accessories or attachments.

Category 3 Devices

(a) Truck Mounted Attenuators (TMAs).

(b) Temporary Barrier.

(1) Concrete Barrier.

(2) Traffic Barrier W Beam and Water Filled Barrier.

(c) Temporary End Treatments.

Category 4 Devices

These devices are area lighting supports, arrow panels, and portable variable message signs that are usually portable or trailer-mounted.

WORK ZONE DEVICES	IMPLEMENTATION SCHEDULE TO CONFORM TO NCHRP REPORT 350 CRITERIA
CATEGORY 1 Cones, tubular markers, flexible delineator posts, and drums (all without any accessories or attachments)	All devices shall conform to NCHRP Report 350 criteria.
CATEGORY 2 Type I, II, and III barricades; portable signs supports with signs; intrusion alarms; and drums, vertical panels, and cones (all with accessories or attachments)	All devices shall conform to NCHRP Report 350 criteria.
CATEGORY 3 (a) Truck Mounted Attenuators (TMA) (b) Temporary Barriers (1) Concrete Barrier (2) Traffic Barrier W Beam and Water Filled Barrier (c) Temporary End Treatments	All devices shall conform to NCHRP Report 350 criteria.
CATEGORY 4 Portable trailer mounted devices including area lighting supports, arrow panels, and changeable message signs	The Contractor may use devices that do not conform to NCHRP Report 350 criteria, until compliance dates are established. Use of these devices shall comply with the provisions of Part 6 of the MUTCD.

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OCCUPYING WETLANDS

The Contractor is hereby alerted to the importance of preserving wetland areas. The Administration, in conjunction with the various environmental agencies, has developed these Contract Documents so as to minimize or eliminate disturbance and damage to existing wetland areas. In order to accomplish this, the following must be rigidly adhered to:

(a) Prior to performing any work on the project, the areas of wetland will be identified and marked as directed by the Administration. All personnel of the Contractor or sub-contractors shall be alerted to these designated areas.

(b) The Contractor or sub-contractors shall not impact any wetland or waterway, whether it be permanently or temporarily unless otherwise stipulated in the permit application and approved as an authorized action by the appropriate regulatory agency. No fill shall be placed in these areas without a permit.

(c) If a Contractor or sub-contractor has to impact a wetland or waterway that is not covered by an existing wetland permit, they shall immediately notify the Engineer. The Engineer will notify the Environmental Programs Division to determine the extent of any permit modification. At that time the Environmental Programs Division will request a permit modification or submit a permit application.

(d) If the Contractor impacts any wetland or waterway for which they do not have a wetland permit, they shall be responsible for restoring the wetland areas and possibly mitigating the wetland impacts to the full satisfaction of the environmental agencies, which could include monetary compensation.

(e) The cost of restoration and mitigation of the impacted areas shall be at no additional cost to the Administration.

The importance of not abusing the wetland areas cannot be overemphasized. Abuse of wetland areas could jeopardize the operation of the total Contract and could be cause for a shut-down. If a shut-down occurs because of the Contractor's failure to secure the required permits (i.e. the Contractor's method of work includes impacts not approved by previously acquired permits), the Contractor's negligence or operations, all costs and damages to the Contractor and to the State will be at no additional cost to the Administration. Noncompliance with these requirements will not be considered for an extension of Contract time.

NOTICE TO ALL HOLDERS OF THIS CONTRACT DOCUMENT

HIGH VISIBILITY SAFETY APPAREL POLICY

BACKGROUND. Research indicates that high visibility garments have a significant impact on the safety of employees who work on highways and rights-of-way. In addition, high visibility garments may help to prevent injuries and accidents and to make highway workers more visible to the motoring public, which ultimately improves traffic safety.

STATEMENT OF POLICY.

(a) The High Visibility Safety Apparel Policy provides a standardized apparel program.

(b) The program seeks to improve the visibility of all persons who work on Administration highways and rights-of-way.

(c) All apparel shall contain the appropriate class identification label.

(d) Compliance with this policy is retroactive and becomes effective immediately. All affected employees shall receive high visibility apparel awareness training.

APPLICABILITY. This policy applies to all Administration employees and all other persons who work on Administration highways and rights-of-way. All workers shall wear, at a minimum, Class 2 ANSI/ISEA 107/2004 apparel.

(a) For Administration employees, this apparel shall have a fluorescent yellow-green background material color and be the outermost garment worn.

(b) Retro-reflective material color for Administration employee apparel shall be silver or white and be visible at a minimum distance of 1,000 feet. The retro-reflective safety apparel shall be designed to clearly recognize and differentiate the wearer from the surrounding work environment. The retro-reflective material may be contrasted by fluorescent orange background material not exceeding one and one half inches on either side of the retro-reflective material.

(c) For non-Administration employees, this apparel shall be either fluorescent orange-red or fluorescent yellow-green background material color and be the outermost garment worn.

(d) Retro-reflective material color for non-Administration employee apparel shall either be orange, yellow, white, silver, yellow-green, or a fluorescent version of these colors, and be visible at a minimum distance of 1,000 feet. The retro-reflective safety apparel shall be designed to clearly recognize and differentiate the wearer from the surrounding work environment.

REFERENCES.

(a) ANSI/ISEA 107/2004 standard – American National Safety Institute/International Safety Equipment Association

(b) MUTCD 2003 – Manual for Uniform Traffic Control Devices - Sections 6D.03B and 6E.02

(c) Visibility Research – The VCTR 1989 report concludes that fluorescent colors, when compared with non-fluorescent colors, enhance the daytime conspicuity of worker clothing.

DEFINITIONS.

(a) Apparel – The outermost high-visibility garment worn by employees who work on Administration highways and rights-of-way.

(b) Highways – All roads owned by the Maryland Department of Transportation and maintained by the Administration.

(c) High Visibility – The ability for workers to be distinguishable as human forms to be seen, day and night, at distances that allow equipment operators and motorists to see, recognize, and respond.

SP 1-1 PROJECT DESCRIPTION

CONTRACT NO.:	**HT 705-000-002**
TITLE:	Baltimore Harbor Tunnel Thruway Lane Control and Dynamic Message Sign System Upgrade
FACILITY:	Baltimore Harbor Tunnel Thruway ("BHT")
LOCATION:	Baltimore City, Baltimore County and Anne Arundel County
ADVERTISED:	**June 16, 2009**
PRE-BID MEETING:	**June 30, 2009 at 10:00 a.m.** in the Conference Room at the Maryland Transportation Authority, 300 Authority Drive, 1st Floor, Engineering Building, Baltimore, MD 21222
PROJECT CONTACT:	Project Manager: David Dabkowski (410) 537-7852 Contract Administration: Ms. Maggie Johnson (410) 537-7807
BIDS DUE:	**12 Noon, July 14, 2009** in the Bid Box on the 1st floor of the Maryland Transportation Authority, Engineering Building, 300 Authority Drive, Baltimore, MD 21222
CLASSIFICATION:	Class – D ($1,000,001 – $2,500,000)
CONTRACT TIME:	Three Hundred Fifteen (315) Calendar Days
LIQUIDATED DAMAGES:	**$500.00 per Calendar Day**
MINIMUM MBE GOALS:	Overall 30% Women owned businesses 10% African-American owned businesses 9%
BID DOCUMENTS:	**$25.00** - Bid documents can be purchased between 7:30 a.m. and 3:30 p.m., Mondays, Wednesdays, Thursdays and Fridays and between 10:00 a.m. and 4:00 p.m. on Tuesdays at the Ticket Office located at the Francis Scott Key Bridge, Maryland Transportation Authority, Administration Building, 303 Authority Drive, Baltimore, Maryland 21222.

SP 1-1 DESCRIPTION

This project is located at the Baltimore Harbor Tunnel of the Maryland Transportation Authority. The Maryland Transportation Authority ("Authority") desires to remove existing dynamic message signs, lane control signs, controllers, and speed limit signs, and replace with a new lane control signal ("LCS") and dynamic message sign ("DMS") systems at locations in the vicinity of the Baltimore Harbor Tunnel ("BHT").

SP 1-2 SPECIFICATIONS

All work on this project shall conform to the Maryland Department of Transportation, State Highway Administration's Specifications entitled, "Standard Specifications for Construction and Materials" dated July 2008, revisions thereof, or additions thereto, and the Special Provisions included in this Invitation for Bids.

SP 1-3 ORIGINAL FACILITY PLANS AND SITE VISITS

The original facility plans are on file at the Engineering/Finance Building of the Francis Scott Key Bridge and will be made available for inspection to prospective bidders. Parties interested in viewing the plans should contact David Dabkowski at (410) 537-7852. Parties interested in visiting the site should contact the following:

Baltimore Harbor Tunnel – Mr. David Roehmer, Facility Administrator at (410) 537-1310

SP 1-4 - PROMPT PAYMENT TO SUBCONTRACTORS

The prime Contractor is responsible for making timely payments to all Subcontractors and Suppliers and provide written certification as required in Section 17-106 of the State Finance and Procurement Article of the Annotated Code of Maryland, as amended.

This contract requires the Contractor to make payment to all Subcontractors within ten (10) days of receiving payment from the Authority.

Each month, the construction Project Engineer will review the current pay items with the prime Contractor and all involved Subcontractors to ensure that all work satisfactorily completed within specifications is included in the monthly progress payment. For payment purposes, the same quantity totals used to compute the payment to the prime Contractor will be the basis for payment to the Subcontractor.

If the Subcontractor does not receive payment within the required ten (10) days, the Subcontractor shall notify the Project Engineer in writing of the amount in dispute including the item numbers and payment quantity for each. The Project Engineer will then notify the Chief of Construction of the dispute. The Chief of Construction or his representative will verbally contact the prime Contractor within 48 hours to ascertain whether or not a

performance dispute exists which necessitates non-payment to the Subcontractor. If a performance dispute exists, the prime Contractor must demonstrate that there is a valid basis to withhold payment from the Subcontractor. If the prime Contractor withholds payment from a Subcontractor, the prime Contractor shall provide to the Subcontractor written notice of the withholding of payment. The notice shall detail the reasons for withholding payment as well as the amount. A copy of the notice shall be provided to the Surety and the Authority. If no valid dispute exists, the prime Contractor will be directed to make immediate payment to the Subcontractor. The Subcontractor will be responsible for notifying the Chief of Construction if this payment is not made. Upon receipt of notification, the Chief of Construction will schedule a meeting with the Contractor and Subcontractor to verify and discuss the non-payment issue. This meeting will be held at the Authority's offices within two (2) working days of the Authority's contact with the Subcontractor. If it is determined that the prime Contractor has withheld payment to the Subcontractor without cause, further progress payments to the prime Contractor will be withheld until the Subcontractor is paid. In addition, the Authority may order a suspension of work or other administrative actions as it sees fit.

If an action is taken as stated above the Contractor shall notify the Authority's Project Engineer when payment is made. After the Authority's Project Engineer verifies that payment has been made to the Subcontractor the Authority shall release withheld progress payments.

Nothing in this Special Provision shall be construed to prevent the Subcontractor from pursing a claim with the surety under the prime Contractor's payment bond at any time.

SP 1-5 WORK HOURS

Refer to Section 104 in SP 2-10, "Maintenance of Traffic" for lane closures and other work hour restrictions.

The Contractor shall cooperate with any other Contractors that are on site during the term of the project, as stated in GP-5.06 of the Standard Specifications.

Except for the above restrictions, the Contractor will be permitted to work 24 hours a day, 7 days a week. However, no lane or bridge closures will be permitted during high winds (greater 25 mph), rain, snow or other precipitation event, when ice or snow is on the roadway or the potential for fog, as determined by the Authority.

SP 1-6 INSURANCE

TC-5.01 INSURANCE

Section TC 5.01 of the Standard Specifications is supplemented as follows:

1. The Contractor shall not commence work under this contract until it has obtained all of the minimum amounts of insurance required by these Special Provisions and the

insurance has been approved by the Engineer. The Contractor shall furnish to the Maryland Transportation Authority ("Authority") duly executed certification of all required insurance on forms satisfactory to the Authority. The certificates of insurance shall state that it is in force and cannot be cancelled, release or non-renewed except upon thirty (30) days prior written notice, registered mail to the Authority. All Contractors' insurance policies, with the exception of the Worker's Compensation and Employer's Liability, shall be endorsed to provide as additional insureds the Maryland Transportation Authority and the State of Maryland.

2. The Contractor shall purchase and maintain such insurance as is specified herein which will provide the Authority, its members, employees and agents, as well as the Contractor from claims which may arise out of or as a result of the Contractor's operations under this contract, whether such operations be by the Contractor, by any subcontractor, by anyone directly or indirectly employed by any of them or by anyone whose acts any of them may be liable. This insurance shall be maintained in full force until the Contract has been accepted by the Authority and final payment is made.

3. The Authority requires the following minimum levels of insurance coverage for this contract:

   a) Worker's Compensation and Employer's Liability

      The Contractor shall, at all times, maintain and keep in force such insurance as will protect him from claims under the Worker's Compensation Act of the State of Maryland and maintain and keep Employer's Liability Insurance at a limit of One Hundred Thousand Dollars ($100,000.00). The Contractor shall also maintain United States Long Shore and Harbors Act coverage, if such exposure exists.

   b) Comprehensive General Liability Insurance

      The Contractor shall maintain Comprehensive General Liability Insurance in the amount of at least One Million Dollars ($1,000,000.00) Combined Single Limit for Bodily Injury Liability and Property Damage Liability Insurance per occurrence and in the aggregate. Such insurance shall specifically include the Comprehensive General Liability Broad Form Endorsement and indicate explosion, collapse, and underground damage coverage.

   c) Comprehensive Automobile Liability Insurance

      The Contractor shall maintain Comprehensive Automobile Liability Insurance (including all automotive equipment owned, operated, rented, or leased), in the amount of at least Five Hundred Thousand Dollars ($500,000.00) Combined Single Limit for bodily injury and property damage.

   d) Additional Insurance

The Contractor shall also procure and keep in effect:

Excess liability (umbrella coverage) in excess of and applicable to the coverage in the Comprehensive General Public Liability and Property Damage Insurance, "X, C, U" and Comprehensive Automobile Insurance in the amount of at least Two Million Dollars ($2,000,000.00) for each occurrence.

4. Accident Notification - The Contractor shall send a written report to the Engineer and to the Maryland Transportation Authority within twenty-four (24) hours of any accident or other event arising in any manner from the performance of the contract which results in or might result in personal injury or property damage.

5. Failure to comply with these Special Provisions may lead to termination for default or convenience.

6. There will be no special payment for the insurance as required by this contract and all costs incidental thereto shall be included in the Lump Sum for "Mobilization", (refer to Section 108), or if the Contract does not include such an item, the insurance costs are to be included in pay items for the Proposal.

SP 1-7 MINORITY BUSINESS ENTERPRISE REGULATIONS GOVERNING CONSTRUCTION CONTRACTS IN EXCESS OF $50,000 EFFECTIVE JULY 1, 2001

GP – 7.29 of the General Provisions is supplemented as follows:

MBE participation goal for this contract is as indicated in these Special Provisions.

The Contractor shall:

1. Identify specific work categories appropriate for subcontracting;

2. At least ten (10) days before bid opening, solicit Minority Business Enterprises, through written notice that:

   a) Describe the categories of work: and,

   b) Provide information regarding the type of work being solicited and specific instructions on how to submit a bid.

3. Attempt to make personal contact with Minority Business firms:

4. Assist Minority Business Enterprises to fulfill bonding requirements or to obtain a waiver of these requirements; and

5. Upon acceptance of a bid, provide the Maryland Transportation Authority ("Authority") with a list of Minority Businesses with whom the Contractor negotiated, including price quotes from Minority and Non-minority firms.

Third Tier Subcontracting:

Third Tier MBE/DBE Subcontracting will be approved by the Authority only when the Authority is satisfied that there is no way except by Third Tier contracting that an MBE/DBE goal can be achieved. The Contractor's written request must be submitted prior to Contract award and contain specifics as to why a Third Tier contracting agreement is being requested.

Waivers:

If for any reason the bidder/offeror is unable to achieve the specified overall Contract goal or subgoals for each certified MBE classification, the bidder/offeror must request, in writing, on Attachment A, (Certified MBE Utilization and Fair Solicitation Affidavit), a waiver at the time of bid.

Strict adherence regarding documentation of the rationale for the waiver request and documentation of "Good Faith Efforts" of the Contractor are required for consideration of any waiver. For additional information on waivers, please see **COMAR 21.11.03.11.**

Criminal Fraud Provisions:

All Contractors are reminded that Criminal Fraud Provision and Administrative Sanctions may be imposed for failure to achieve and maintain established MBE/DBE goals.

SP 1-8 PROGRESS SCHEDULE REQUIREMENTS

Refer to SP 2-12 and Section 109 of the Standard Specifications.

SP 1-9 CORPORATE REGISTRATION

A foreign corporation is any corporation not incorporated under the Laws of the State of Maryland. All foreign corporations, prior to performing any services for the Authority, must register with the Maryland State Department of Assessment and Taxation in compliance with Subtitle 2, Title 7, of the Corporations and Associations Article of the Annotated Code of Maryland. Compliance is required of the successful vendor as well as the proposed subcontractors.

To accomplish the required registration, a foreign corporation must request and complete "Qualification Application Forms" which can be obtained from the Department of Assessment and Taxation, State Office Building, Room 803, 301 West Preston Street, Baltimore, Maryland

21201. Forms can be obtained via the Maryland Department of Assessments and Taxation website at www.dat.state.md.us.

The Contractor will be responsible for documenting compliance with the aforesaid. This documentation will be required prior to the execution of a contract with the successful bidder.

SP 1-10 CONTRACTOR'S EMPLOYEE IDENTIFICATION

The Contractor shall provide to the Authority, a list containing the following for Contractor and all sub-contractors that would be working at the site. This shall include trucking companies who would come to the site on a repetitive basis for supply or removal of materials:

Name of Company
Name and title of contact person
Address of the Company
Phone number
Facsimile number
E-Mail address of contact person (if any)

All Contractor's employees, including employees of subcontractors, on this project, present at the site, shall be in possession of a valid employee identification card provided by the Employer, which shall contain a photograph and identify the employee by name and job title. The employee must produce the said identification if required by the Engineer or the Authority Police.

When working in or around the Authority's buildings, said employees identification shall be displayed at all times.

While working in the Tunnels or on one of the major bridges of the Authority, Contractor's personnel shall have an ID decal displayed on their hardhat. These decals will be provided by the Authority. All of the Contractors' vehicles shall have a parking decal, attached to the rear view mirror. These parking decals will also be provided by the Authority and a distribution list will be maintained. At the time of project completion these decals shall be returned to the Authority. Requests for hardhat and rearview mirror decals shall be made to the Construction Section before the beginning of construction and should include the number required of each type of decal.

All costs associated with identification cards will not be paid for separately and shall be incorporated under other items of payment in the Contract.

GENERAL PROVISIONS
GP-SECTION 1
DEFINITIONS AND TERMS

GP 1.03 – ORGANIZATIONAL DEFINITIONS

Revise the definitions of Administration to read as follows:

Administration – The word "Administration" shall mean "Maryland Transportation Authority".

Except for Office of Materials and Technology, all references to the Maryland State Highway Administration's offices and positions shall mean the Authority's corresponding offices and positions.

GENERAL PROVISIONS
GP- SECTION 1
DEFINITIONS AND TERMS

GP 1.05 - DEFINITIONS

Add the following definitions:

Highway Standards - The official Book of Standards for Highway and Incidental Structures, edited by the State Highway Administration, with the latest incorporated revisions issued on or before the date of advertisement on the Contract.

GENERAL PROVISIONS
GP-SECTION 2
BIDDING REQUIREMENTS AND CONDITIONS

GP 2.04 SITE INVESTIGATION

Revise the paragraph to read as follows:

The Contractor acknowledges that it has investigated and satisfied itself as to the conditions affecting the work, including but not restricted to those bearing upon transportation, disposal, handling, and storage of materials; availability of labor, water, electric power, roads; uncertainties of weather, river stages, tides, or similar physical conditions at the site; and confirmation and conditions of the ground, the character of equipment and facilities needed preliminary to and during prosecution of the work. The Contractor further acknowledges that it has satisfied itself as to the character, quality and quantity of surface and subsurface materials or obstacles to be encountered insofar as the information is reasonably ascertainable from an inspection of the site, including all exploratory INFORMATION IN POSSESSION OF THE STATE, as well as from information presented by the drawings and Specifications made part of this contract. Any failure by the Contractor to acquaint itself with the available information may not relieve it from responsibility for estimating properly the difficulty or cost of successfully performing the work. The State assumes no responsibility for any conclusions or interpretations made by the Contractor on the basis of the information made available by the State.

GENERAL PROVISIONS
GP-SECTION 2
BIDDING REQUIREMENTS AND CONDITIONS

GP-2.06 PREPARATION OF THE BID

GP9 **ADD**: After paragraph (a), the following.

The Contractor may elect to submit its bid on forms he has generated in the development of its bid. These may be submitted in lieu of the schedule of prices bid forms furnished by the Administration in the Invitation for Bids. These forms shall emulate the forms currently furnished by the Administrations and, as a minimum, contain the following information.

(1) State Contract No.;
(2) State Item Nos.;
(3) State's Proposed Quantities;
(4) Description of Items;
(5) Unit Price;
(6) Total Cost of Each Item; and
(7) Total Bid Amount.

The document shall be 8-1/2 x 11 inches, and oriented in a landscape format. The font size shall be no less than 10 point with horizontal lines dividing each item. Any addendum which revised items or quantities shall be noted on all affected schedule of prices sheets. Any special bid requirements that are noted in the schedule of prices shall also be listed on the form.

Should the Contractor elect to submit bids on the Contractor's own forms, the Contractor shall submit a sample of the form to the Administration at least two (2) weeks prior to the scheduled opening of bids. The use of Contractor generated forms shall be approved, in writing, prior to their use. If the Contractor's forms were previously approved in writing on another Administration project and have not changed, they need not be resubmitted for this project.

Sample forms shall be submitted to:

Ms. Linda McGill
Chief of Engineering Procurement
Maryland Transportation Authority
300 Authority Drive
Baltimore, Maryland 21222

GENERAL PROVISIONS
GP-SECTION 2
BIDDING REQUIREMENTS AND CONDITIONS

GP 2.23 - BID PROTESTS

Section GP 2.23 of the General Provisions is supplemented as follows:

The Board of Public Works does not have the jurisdiction to consider protests relating to this solicitation or an award of this contract under this solicitation.

All protests relating to this solicitation, the selection, and/or award must be filed in writing with the Authority's Procurement Officer, within the time limitations set forth in COMAR 21.10.07 and 21.10.02. Bid protests shall be filed not later than seven (7) days after the basis for protest is known, or should have been known, whichever is earlier. Oral protests will not be considered.

The specific details of the protest procedures shall be followed by aggrieved actual or prospective bidders or offerors are contained in COMAR 21.10.

GENERAL PROVISIONS
GP SECTION 4
SCOPE OF WORK

GP 4.10 - WARRANTY OF CONSTRUCTION

GP 4.10 of the Standard Specifications is revised to read as follows:

Delete: The first paragraph in its entirety.

Insert: The following:

The Warranty as defined under paragraphs A through G in GP 4.10 "Warranty of Construction" shall apply to this Maryland Transportation Authority Contract unless specified elsewhere in this Invitation for Bids.

GENERAL PROVISIONS
GP SECTION 5
CONTROL OF WORK

GP 5.12 - FAILURE TO MAINTAIN ENTIRE PROJECT

Delete: Section GP 5.12 in its entirety

Insert: Revise the paragraph to read as follows:

Failure on the part of the Contractor, at any time, to RESPOND TO the provisions of GP 5.11 above, will result in the procurement officer's immediately notifying the Contractor to comply with the required maintenance provisions. In the event that the Contractor fails to PROCEED WITH CORRECTIONS TO UNSATISFACTORY MAINTENANCE SO AS TO CONFORM TO THE PROVISIONS OF GP 5.11 within four (4) hours of receipt of such notice, the procurement officer MAY NOTIFY THE CONTRACTOR TO SUSPEND ALL OTHER WORK ON THE CONTRACT UNTIL SUCH TIME AS THE UNSATISFACTORY MAINTENANCE IS CORRECTED. In the event that the Contractor fails to RESPOND TO unsatisfactory maintenance within four (4) hours after receipt of such notice, the procurement officer will immediately proceed with adequate forces and equipment to maintain the project, and the entire cost of this maintenance will be deducted from monies due the Contractor ON THE NEXT MONTHLY ESTIMATE.

GENERAL PROVISIONS
GP SECTION 8
PROSECUTION AND PROGRESS

GP 8.09 - LIQUIDATED DAMAGES

Delete: Section GP 8.09 in its entirety

Insert: Time is an essential element of the Contract and it is important that the work be vigorously prosecuted until completion.

For every calendar day that the Contract remains uncompleted after the expiration of the Contract time specified herein, or amended by extra work authorization, change orders or supplemental agreements, the Contractor will be liable for Liquidated Damages. The amount of Liquidated Damages shall be as specified in Contract Time and Bonding. This amount shall be deducted from any money due the Contractor, not as a penalty, but as Liquidated Damages. Damages in excess of any retained percentage shall be paid to the Authority by the Contractor.

Refer to Contract time and Bonding sheet contained elsewhere herein. See Table of Contents.

GENERAL PROVISIONS
GP SECTION 9
PAYMENT

GP 9.05 LATE PAYMENTS

ADD the following:

(e) Payments will be made within thirty (30) days of the date when the Contract amount becomes due and payable or the date of receipt of a proper invoice, whichever is later. The State's failure to remit payment within forty-five (45) days from that date may entitle the Contractor to interest at the rate of 10 percent per annum beginning on the 31st day.

TERMS AND CONDITIONS
TC SECTION 4
CONTROL OF WORK

TC 4.01 - SHOP PLANS AND WORKING DRAWINGS

DELETE SECTION (a) IN ITS ENTIRETY AND REPLACE WITH THE FOLLOWING:

ADD:

(a) General. The Plans will be supplemented by working drawings, catalog cuts, schematics, material data, installation plans and manuals, user manuals, and other data necessary to demonstrate to the Engineer adequate control of the work, proper installation and handling, conformance to the specifications, and that the proposed materials and equipment is suitable for the intended use. All authorized alterations affecting the requirements and information given on the working drawings shall be in writing to the Engineer. Any deviations from the Specifications, Special Provisions, or Plans shall be clearly highlighted and explained. When reference is made to the working drawings, the interpretation shall be the working drawings as affected by all authorized alterations then in effect. When reference is made to the working drawings, the interpretation shall be that working drawings include working drawings, catalog cuts, schematics, material data, installation plans and manuals, user manuals, and other data necessary to demonstrate to the Engineer adequate control of the work, proper installation and handling, conformance to the specifications, and that the proposed material or equipment is suitable for the intended use.

Working drawings will show details of all structures, lines, grades, typical cross section of roadway, general cross sections, location and designation of all units and elements. Cabinet drawings shall be to-scale showing the location of all equipment proposed to be mounted within the cabinet. One-line diagrams and schematics shall be provided for equipment cabinets showing the interconnection of all devices located therein. Equipment layouts shall include rack-level elevation views as well as floor plans for all equipment racks. All working drawings, regardless if submitted as specified or submitted as equal substitutes, shall be furnished with complete, specific, detailed information from the manufacturer or supplier for the material or equipment the Contractor proposes to furnish, in which the requirements of the Specifications and Special Provisions shall be clearly shown to be met.

When any article is specified by trade name of manufacturer with or without the clause "or equal," it is intended to establish the quality of the article. If the Contractor proposes to use material or equipment of another manufacturer as an "or equal" to the material or equipment specified, all working drawings shall conform to the following requirements, conditions, and procedures:

1. Substitution of equipment or materials other than those specified will be considered, providing, in the opinion of the Engineer, such equipment or material is equal to, or better than specified. The decision of the Engineer with respect to approval or disapproval of any material or equipment proposed to be substituted as an "or equal" is final. The Contractor shall have no claim of any sort by reason of such decision.

2. If the Contractor proposes to substitute materials or equipment as "or equal" to those specified, it shall be his responsibility to furnish, in addition to the information discussed above, a point by point comparison of the material or equipment specified under the Contract and that proposed to be substituted. The burden of responsibility in furnishing this information is with the Contractor.

3. If the substitute material or equipment requires any re-design or affects other aspects of the project, the Contractor shall be responsible to provide such re-design including details and to adjust elements as necessary to achieve the re-design at no additional cost to the Administration. Cost saving re-designs will be considered under the value engineering specifications.

If incomplete or irrelevant data is submitted as evidence of compliance with Specifications, Special Provisions, or Plans, the data will be returned and the request for approval of working drawings will be denied.

The Contractor shall provide, at no additional cost to the Administration, all required working drawings and shall have them adequately checked, after which they shall be submitted to the Engineer for review. The Engineer may reject working drawings and return them for revisions, in which case the Contractor shall submit revised working drawings as required. No items involving working drawings shall be incorporated into the work until working drawings have been accepted by the Engineer, however, acceptance shall not relieve the Contractor of any responsibility in connection with the working drawings.

The working drawings shall be prepared on sheets no smaller than 8.5" x 11" and no larger than 22" x 36". The sheet size and scale of the drawings shall be appropriate for the work depicted.

All working drawings shall be submitted by the Contractor, no working drawings submitted directly by subcontractors, fabricators, suppliers, etc. shall be accepted. Acceptance of a material source or equipment source by the Engineer or Administration shall NOT constitute approval of the material or equipment nor approval of the materials or equipment as a substitute or an "equal" product.

ADD:

(b) The working drawings shall be submitted electronically as files (FAXES are NOT acceptable). Electronic submission may be made via email for small submissions. Email is the preferred submission method. The email submissions shall be made to the email addresses provided by the Administration upon notice to proceed of the project and shall include ddabkowski@mdta.state.md.us. Where electronic submittals are larger than email can support (currently about 8MB), the submission may be made using one or more of the following alternatives:

1. Posted on a contractor supported FTP server, or other via another service that may be accessed by the administration as long as an email notice is made with the "cover" sheet.
2. Copied onto a CD, DVD, or other supported data media and submitted to the Administration via standard mail. At least five (5) copies of the media shall be provided for in-house distribution. The address to mail such media transfers is:

   Maryland Transportation Authority
   Engineering Division
   300 Authority Drive
   Baltimore, MD 21222
   ATTN: David Dabkowski

ADD:

(c) Electronic Submittal Format. All electronic submittals shall be in a format readable by the Administration. The submittals shall be in Adobe portable document format ("PDF") compatible with version 6.0 of Adobe Acrobat.

Each submittal shall be a single file. Multi-file submittals shall not be accepted.

The first page of each submittal shall be a cover page. The cover page must be in the 8.5 x 11" sheet format. The cover page must include:

1. The Contract number.

2. The Contract title.

3. Submittal Number. For each project (Contract), a sequential number starting with number 1 shall be used. Where a submittal is rejected, or otherwise requires resubmittal or replacement, the Submittal number shall be appended with an "R" followed by the revision number.

4. The Contractor's name, mailing address, contact phone number, contact email address.

5. The relevant line items in the Contract that the submittal is associated with.

6. A brief description of the materials or data represented in the submittal package.

7. The date of the submittal.

8. The manufacturer's name, web site address, mailing address, and contact phone number, if applicable.

9. The vendor's or reseller's name, web site address, mailing address, and contact phone number if applicable.

10. The cover page must contain a 6" x 3" blank space where engineering stamps may be placed (electronically) without covering data in the page.

The electronic file must not be secured. The review process for electronic submittals will place electronic stamps and may include electronic comments in the electronic submittals by the Contractor. Any security or compatibility problems that prevent the use of the electronic stamps or electronic commenting will render the submittal unacceptable. The returned file may be secured to prevent accidental changes.

ADD:

(d) File Naming Conventions and rules. It is necessary and required that file naming conventions and rules be followed to lend to organization and reduce confusion regarding the electronic submissions. Submittals that do not follow the file naming conventions described herein will be rejected without review. Strict adherence to the file naming rules is required. The file names for electronic submissions shall follow these rules:

1. The first five characters must be the first five characters of the contract number. For example, for contract MA435-000-006, the first five characters of the file name must be MA435.

2. The sixth character must be a dash.

3. The seventh through ninth characters shall be the text "SUB," which is short for submittal. Which is used to indicate that the file is a submittal from a Contractor.

4. The tenth character must be a dash.

5. The eleventh through thirteenth characters must be the submittal number, e.g., 001.

6. In the event of a re-submittal, the 14th character will be an R followed by the re-submittal number.

7. The remaining filename characters may be any short descriptive characters that may be useful to identify the nature of the submittal (fewer than 40 additional characters)

8. Examples of filenames:

   i. MA435-SUB-001-Conduit.pdf
   ii. MA435-SUB-001R2-Conduit.pdf
   iii. MA434-SUB-015-Fiber Optic Cable.pdf

9. After the submittal has been reviewed, the text 'SUB' will be replaced by the text 'TRN' by the administration and the electronic file with electronic stamps and possibly containing electronic comments will be returned to the contractor via email, CD, DVD, or similar electronic file transfer.

ADD:

(e) Upon completion of the project, all electronic files that have been transmitted to the Contractor (TRN's) shall be transferred to CD's, DVD's or other media by the Contractor and provided to the Administration along with as-built data. Data provided shall include any original files in original format, used to generate the PDF submittals, these may include CADD, Visio, Word, Excel, MathCad, Access/DataBase, HTML, JPG/Pictures, Power point, or any other format that may have been used as the originating document. Provide three (3) copies of all media.

TERMS AND CONDITIONS
TC SECTION 4
CONTROL OF WORK

TC-4.02 FAILURE TO ADEQUATELY MAINTAIN PROJECT.

16 **ADD**: To the existing paragraph.

Additionally, an appropriate deduction will be made from the Contractor's next progress estimate for each day or portion thereof that Maintenance of Traffic deficiencies exist, and will continue until the deficiencies are satisfactorily corrected and accepted by the Engineer. Any portion of a day will be assessed a full day deduction. The deduction will be equal to a pro-rata share of the lump sum price bid for Maintenance of Traffic or an amount prorated from the Engineer's estimate, whichever is more. The amount prorated will be the per diem amount established by using the working days (based upon calendar dates when required) divided into the total value of the bid item or the Engineer's estimate of that item, whichever is more.

The above noted deduction will be assessed on the next progress estimate if:

> The Contractor does not take action to correct the deficiencies and properly assume the responsibilities of maintaining the project (as determined by the Engineer) within four (4) hours of receiving a notice to comply with the required maintenance provisions.

The deduction will be equal to the daily prorated share of the lump sum price bid for Maintenance of Traffic or One Thousand Dollars ($1,000.00) per day, whichever is more for each day or portion thereof that the deficiencies exist, and will continue until the deficiencies and proper assumption of the required maintenance provisions are satisfactorily corrected and accepted by the Engineer. The amount of monies deducted will be a permanent deduction and are not recoverable. Upon satisfactory correction of the deficiencies, payment of the Maintenance of Traffic lump sum item will resume.

TERMS AND CONDITIONS
TC SECTION 5
LEGAL RELATIONS AND PROGRESS

TC-5.01 INSURANCE.

17 **DELETE:** The first three paragraphs under TC-5.01 in their entireties.

INSERT: The following.

The requirement of GP-7.14 (Liability Insurance) to submit Certificate of Insurance prior to starting work is modified for Administration Contracts to require the certificate of insurance to be submitted prior to the execution of the Contract.

The Contractor shall maintain in full force and effect third party legal liability insurance necessary to cover claims arising from the Contractor's operations under this agreement which cause damage to the person or property of third parties. The insurance shall be under a standard commercial general liability ("CGL") form endorsed as necessary to comply with the above requirements; or other liability insurance form deemed acceptable by the State. The State of Maryland shall be listed as an additional named insured on the policy. The limit of liability shall be no less than One Million Dollars ($1,000,000.00) per occurrence/ Two Million Dollars ($2,000,000.00) general aggregate. The insurance shall be kept in full force and effect until all work has been satisfactorily completed and accepted. The policies shall be endorsed to provide thirty (30) days notice of cancellation or non-renewal to:

Director of Construction
Maryland Transportation Authority
304 Authority Drive
Baltimore, Maryland 21222

TERMS AND CONDITIONS
TC SECTION 7
PAYMENT

29 **DELETE:** TC-7.02 PAYMENT ALLOWANCES FOR STORED MATERIALS in its entirety.

INSERT: The following:

TC-7.02 PAYMENT ALLOWANCES FOR STORED MATERIALS.

When the Contractor requests payment allowance for materials, the following terms and conditions shall apply:

(a) For superstructure members delivered on the project site, an allowance of 100 percent of the material cost plus freight charges as invoiced may be made provided the cost does not exceed 90 percent of the Contract price of the applicable Contract item. The allowance will be based upon validated invoices or bills for material including freight charges, and a copy thereof shall be made a part of the documented records for the project.

(b) For reinforcement steel, piling, pipe, traffic barrier, signs and sign assemblies, and other nonperishable material in storage on the project, but excluding aggregates, cement, seed, plants, fertilizer or other perishable items, an allowance of 100 percent of the invoiced cost of the material plus freight charges to the Contractor may be made provided the cost does not exceed 90 percent of the Contract price of the applicable Contract item. Such material shall be delivered and stock-piled at the project site, and have been tested by the Administration and found to have conformed to the Specifications or have been accepted under an approved certification program prior to the allowance.

(c) No allowance will be made for fuels, form lumber, falsework, temporary structures or other materials of any kind which will not become an integral part of the finished construction.

No payment for stored material will be made if it is anticipated that the material will be incorporated into the work within thirty (30) days of the written request.

Only end product manufactured material or fully fabricated products that are awaiting installation or incorporation into the finished work are eligible for prepayment. Components, elements, or ingredients of a finished product are not eligible for prepayment.

(d) Material for which an allowance is requested shall be stored in an approved manner in areas within the State of Maryland where damage is not likely to occur. If any of the stored materials are lost or become damaged in any manner, the Contractor shall be responsible for repairing or replacing the damaged materials. The value of the lost or damaged material will be deducted from the Contractor's subsequent

estimates until replacement has been accomplished. The request for allowances for any materials stored on private property within the State of Maryland shall be accompanied by a release from the owner and/or tenant of such property agreeing to permit the removal of the materials from the property without cost to the State of Maryland.

The material shall be clearly marked with the Administration's Contract number on individual units. If the material is normally shipped to the project in bundles or other forms of packaging, the Administration's Contract number shall be clearly marked or affixed to the package. When the material is not stored at the actual project site, the material shall be physically separated by fencing or equivalent barrier from other materials stored at the same site. The material shall be accessible to the Administration at all times.

When it is considered impractical to store materials on the actual project, the Engineer may approve storage areas in the vicinity of the actual project which will be considered at the project site.

When storage of the materials within the State of Maryland is not practical, approval shall be obtained from the District Engineer for storage elsewhere. Storage of materials outside the State of Maryland will be subject to the conditions set forth in this provision and limited to materials exceeding Twenty-Five Thousand Dollars ($25,000.00), which are designed and fabricated exclusively for use on a specific project.

(e) Material for which payment has been made, either wholly or partially, shall not be removed from the approved location until such time that it is to be incorporated into the work unless authorized by the Engineer.

(f) The Contractor shall submit a written request for payment to the District Engineer at least two (2) weeks prior to the estimate cutoff date established by the District Engineer. The following items shall accompany the written request for payment:

(1) Consent of surety specifying the material type and the item(s) in which the material is to be used.

(2) Validated invoices with the signature of an officer of the company supplying the material showing actual cost.

(3) A notarized statement from the Contractor attesting that the invoices as submitted do not include charges or fees for placing, handling, erecting or any other charges or markups other than the actual material cost, sales tax(es), if applicable, and freight charges.

(4) Bills of lading showing delivery of the material. The request for allowances for any materials stored on property outside the State of Maryland shall be accompanied by a release from the owner or tenant of such property agreeing to permit verification by the Inspector that the material is stored at the approved location, and to permit the removal of the materials from the property without cost to the State of Maryland.

(5) Inspection test reports, certifications and/or a written statement from the Inspector attesting to the inspection and approval of the material.

Upon receipt of the above by the District Engineer and verification by the Inspector that the material is stored at the approved location, the District Engineer will authorize payment.

(6) A statement explaining why the material can not be stored on the project, if the Contractor is requesting to store material at a location other than the project site. The statement shall include the methods of storage, separation, and identification to be used by the Contractor. The Contractor shall provide a method of inventory control and withdrawal satisfactory to the Administration which shall be used by the Contractor to monitor materials not stored on the project.

(7) A breakdown of the Contract line item bid unit price showing the relationship of the cost of the stored material to the costs of all other materials, labor, and components of the work included in the Contract line item unit price bid by the Contractor.

Upon receipt of the above by the District Engineer and verification by the Inspector that the material is stored at the approved location, the District Engineer will authorize payment.

The Contractor shall pay the material provider the amount shown on the invoice within ten (10) calendar days of receipt of payment from the Administration. Evidence of payment shall be provided to the Administration. Failure to make invoice payments as specified will be cause to deduct the monies from future estimates and/or deny future stored materials payment requests.

Copies of all pertinent data shall be made by the Contractor and distributed to the Inspector for retention as part of the documented records for the project.

TC-7.03 FORCE ACCOUNT WORK.

(e) Subcontracting.

35 **ADD:** The following to the end of the paragraph.

"or five hundred dollars ($500) which ever sum is greater."

DELETE: TC-7.05 PROGRESS PAYMENTS Subsection (a) (3) Variable Retainage

INSERT: The following:

(3) **VARIABLE RETAINAGE.** The Contract will be subject to a variable retainage based upon the Authority's performance evaluations of the Contractor.

Those qualifying may have retainage reduced upon request of the Contractor with consent of surety. This request must be processed through the Construction Manager. If at any time during the performance of the project, the evaluation of the Contractor changes, retainage reduction may be reconsidered.

Contractors with "A" evaluations for the last two years may be reduced from 5 percent to 2.0 percent upon request after 15 percent project completion. Project completion percentage will be based upon actual work completed (excluding monies paid for stored materials). An interim evaluation of the current project must be completed and must be an "A". Contractors with "A" evaluations for the last two years may petition to have all retainage at that point released upon completion of a significant milestone. Retainage will continue at 2.0 percent until the next milestone of completion of the Contract.

Contractors with "B" evaluations or any combination of "A" and "B" evaluations for the last two years may be reduced from 5 percent to 2.5 percent at 50 percent project completion and remain at that level until released upon final payment. Project completion percentage will be based upon actual work completed (excluding monies paid for stored materials). An interim evaluation of the current project shall be completed and shall be an "A" or "B".

Contractors with "C" evaluations or any combination of "C" and "D" evaluations for the last two years will begin and remain at 5 percent for the life of the project. An interim evaluation of the current project shall be completed and shall be a "C" or better rating.

Contractors with a "D" evaluation for the last two years will begin at 5 percent. Project performance will be evaluated monthly. Should the contractor performance remain at the "D" level, to protect the State's interest 10 percent of the progress payment will be withheld until performance improves to a "C".

New Bidders. Contractors who have not been previously rated by the Authority may be eligible for a reduction in retainage. To be eligible, their past performance on highway and bridge work shall be documented by the government agency with whom they had a contract and their performance shall be documented on Authority forms.

All other Contractors who do not fit into the above criteria would require a 5 percent retainage throughout the life of the Contract.

TC SECTION 7
PAYMENT

TC-7.06 FINAL ACCEPTANCE AND FINAL PAYMENT

128 **DELETE:** (b) in its entirety.

INSERT: The following.

(b) The Contractor shall then have a period of 30 days, dating from the date upon which he received the aforementioned tabulation from the Administration, in which:

(1) To decide whether or not he will accept final payment upon such a basis, and

(2) To notify the Administration, in writing, of his decision. The Contractor may request an additional period up to 30 days in which to notify the Administration of his decision. In the event the Contractor notifies the Administration that he protests final payment on such a basis, that notification shall outline the reasons for said protest.

CATEGORY 100
PRELIMINARY

SECTION 103 — ENGINEERS OFFICE TYPE C

103.03 CONSTRUCTION.

143 **DELETE:** 103.03.06 Microcomputer System for all Offices in its entirety.

INSERT: The following.

103.03.06 Microcomputer System for all Offices.

(a) Desktop Unit.

(1) IBM compatible with an Intel Pentium 4 or AMD processor.

(2) Minimum microprocessor speed of 3.0 GHz.

(3) Minimum hard drive storage of 80 GB (gigabyte).

(4) Minimum of 2.0 GB RAM (Random Access Memory).

(5) Enhanced 101 key keyboard with wrist rest.

(6) Super Video Graphics Accelerator ("SVGA") with minimum 64MB memory.

(7) Modem 56K BPS, ITU V.92 compliant – required for remote dial-in to the computer to provide MCMS system administration.

(8) Full Duplex Sound Card (Sound Blaster Pro & Windows Compatible).

(9) Audio Speakers.

(10) Mouse with mouse pad.

(11) One CDRW/DVDRW combo drive. Min Speed = 48X.

(12) One Parallel Port, One Serial Port, Two USB Ports.

(b) Operating System. Minimum Microsoft® Windows XP.

(c) Video Monitor. Color Super VGA monitor conforming to Energy Star requirements with a minimum screen size of 17-inch flat panel.

(d) Printer. HP Compatible Laser Jet Printer with minimum resolution of 1200 DPI (dots per in.) and a minimum of 8 MB of RAM. Officejets and Bubblejets will not be accepted. Printer shall have a minimum print speed of 10 PPM (pages per minute) network capable.

(e) Software.

(1) Microsoft® Office 2000/XP Professional for Windows™ or later.

(2) Antivirus software shall be installed and configured to perform an automatic update when the microcomputer system connects to the Internet.

(f) Internet Access. The microcomputer system shall be provided with unlimited DSL/Broadband or better Internet access approved by the Engineer.

(g) Accessories.

(1) Uninterruptible power supply ("UPS").

(2) Standard computer workstation with minimum desk space of 60 X 30 in, and a swivel type office chair, padded with arm rests.

(3) 8-1/2 X 11 in. xerographic paper to be supplied as needed.

(4) Toner or ink as needed for printer.

(5) Maintenance agreement to provide for possible down time.

(6) Physical security system to deter theft of computer components.

(7) Blank recordable CD-R media for re-writable CD-ROM drive to be supplied as needed.

(8) One – USB 2.0 Flash Drive (1GB of Memory).

(h) Notes.

(1) The microcomputer system shall be completely set up ready for use on or before the day the Engineer's Office is to be occupied.

(2) All software stated above shall be supplied on original disks with manuals and be retained in the construction field office for the duration of the Contract.

(3) If for any reason the system fails to operate, the system shall be replaced or repaired within 48 hours.

(4) When the microcomputer system is no longer required, the Construction Management software system including original user/operator guide manuals, program disks, and all data files will be removed by the Engineer and delivered to the District Engineer and become the property of the Administration. The remaining microcomputer system shall remain the property of the Contractor.

MEASUREMENT AND PAYMENT

When specified in the Contract Documents, ENGINEERS OFFICE TYPE C will be measured and paid for at the Contract lump sum.

Item 1003	ENGINEERS OFFICE TYPE C	LUMP SUM

SP 2-1 GENERAL REQUIREMENTS

The Maryland Transportation Authority ("Authority") desires to remove existing dynamic message signs, lane control signals, signals for lane control, colored traffic dots, controllers, and speed limit signs and replace with new lane control signals ("LCS"), signals for lane control ("SLC"), dynamic message signs ("DMS") and colored traffic dot systems ("pucks"), removal of existing cabinets and installation of new cabinets at locations in the vicinity of the Baltimore Harbor Tunnel ("BHT").

SP 2-1.1 EXISTING TRAFFIC CONTROL SYSTEM

The BHT traffic control system includes:

- Authority Operations Center ("AOC") components
- Field components
- Dedicated data communications between the AOC and field components

SP 2-1.1.1 Operations Center Components

The existing AOC components consist of a primary and secondary traffic computer that support asynchronous serial communications to existing proprietary field controllers and Remote Communications Units ("RCU") located in field cabinets where LCS, SLC and DMS are mounted.

The Authority utilizes an existing proprietary solution for controlling the LCS, SLC and DMS system provided under the MA328-000-006 Contract.

The Contractor shall subcontract with the MA328-000-006 Contractor to integrate the new LCS and DMS to the AOC DYNAC control system. At all times during execution of this contract, the Contractor shall coordinate any and all work associated with the new LCS and DMS units, communications, control/status signals and interfacing with the MA328-000-006 Contractor.

SP 2-1.1.2 Field Components

The existing field components consist of Ferranti-Packard FP9000 controllers and SIFU-110 or SIFU 710 system interface units tied together by fiber optic cable. These controllers and system interface units operate the existing LCS, SLC and DMS. Each controller and system interface unit is installed in a metal cabinet pole-mounted to the sign support end-frame or

mast-arm pole with the exception of the signals mounted on the bridge faces. In these cases, the controller cabinet is attached to the concrete wall along the service road overpasses.

SP 2–1.1.3 Existing Communications

The existing communications scheme consists of two separate multi-drop communication links used to connect the LCS, SLC and DMS with the central operating system. These links are asynchronous, operating at 9600 bps. Each system interface unit is equipped to accept two pairs of primary lines and two pairs of secondary lines and is designed to switch over to the secondary channel if the primary communications channel fails resulting in no loss of communications beyond the point of breakage.

SP 2–1.2 EXISTING LANE CONTROL OPERATIONS

The northbound bore of the BHT consists of two 11′ lanes, and under normal conditions, the northbound bore is used by northbound I-895 traffic. The southbound bore of the BHT consists of two 11′ lanes and, under normal conditions, the southbound bore is used by southbound I-895 traffic.

SP 2–1.2.1 Lane Closures

Under conditions where there is a lane closure, a red "X" is displayed on the LCS, red indication of the SLC and a "canned" message on the DMS. In advance of the lane closure, a yellow "X" is shown on the LCS and red or yellow/amber indications on the SLC, permitting an adequate distance for vehicles to merge into one of the open lanes prior to the actual lane closure.

Other conditions result in different operational plans and procedures, which are published and provided by the Authority for their operational staff at the BHT.

SP 2–1.3 STAFF AND SYSTEMS AT THE OPERATIONS CENTER

The operators at the AOC are responsible for LCS, SLC and DMS operations. These include the use of the Graphical User Interface ("GUI"), which controls LCS, SLC and DMS in the tunnel.

Operational procedures for lane control in the tunnel are well-defined using predefined response plans, as well as tailored responses configured using the GUI workstation, which permit development of custom display plans based on closure locations.

SP 2–1.4 GENERAL SCOPE OF THE PROJECT

The scope of the project includes, but is not limited to:

- Replace existing fiber optic LCS with LED LCS;
- Replace existing SLC with LED SLC;
- Replace existing flip-disk DMS and install LED DMS;
- Furnish and install catwalk for proposed DMS;
- Replace Ferranti-Packard FP9000 controllers with new microprocessor-based controllers (internal with the DMS and provided by the DMS manufacturer);
- Replace remote control equipment cabinets with new NEMA field cabinets or refurbishing of existing cabinets, as required by the Authority;
- Replace wiring between new LCS, SLC and DMS, and NEMA cabinets, and at other locations, as shown on the Plans;
- Replace lane control "pucks" inside BHT;
- Connection of all LCS and DMS to fiber backbone;
- Furnishing and installing all connections, interfaces and incidental items necessary to integrate the new equipment with existing components, to provide a complete, functional traffic control system, in accordance with the Plans and Special Provisions;
- Thorough testing of all installed components at the lane and controller level; and
- Provide "as-built" drawings for any new equipment installations and/or any modifications to existing equipment installations.

The Plans and Special Provisions do not necessarily include or define everything necessary for a complete and operational system. When required, the Contractor shall provide any modifications, fabrications, extra hardware and equipment necessary for the satisfactory installation and operation of the BHT Traffic Control System.
Equipment deployed for this project will be subjected to environmental extremes. This includes vehicle exhaust and seasonal temperature extremes. All equipment used shall be capable of handling these extremes. Lightning and surge suppression shall be required for all modems, controllers and any other equipment to be exposed to potential power surges.

SP 2–1.5 SAFETY AND PROTECTION

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work. The Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:

- All persons on the work site or who may be affected by the work.
- All the work and materials and equipment to be incorporated therein, whether in storage on or off the site; and

- Other property at the site or adjacent thereto, including trees, shrubs, pavements, roadways, structures, utilities, and underground facilities not designated for removal, relocation, or replacement in the course of construction.

The Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the work or adjacent property to stresses or pressures that will endanger it.

SP 2–1.6 CODES AND REGULATIONS

In addition to the requirements of these plans and specifications, material and work shall conform to the latest requirements of NFPA No. 70, National Electrical Code, and ANSI C2, National Electrical Safety Code, the Standards of IEEE, NFPA, ASTM, ANSI, NEMA, RMA, MUTCD, OSHA, UL, ITE, IMSA, EIA, TIA, and Bellcore, except where superseded by applicable laws. The term code as referred to in this document shall be the NFPA No. 70, National Electrical Code, and ANSI C2, National Electrical Safety Code.

Except as otherwise noted on these Plans and Specifications all work shall be in accordance with the Maryland State Highway Administration's ("MSHA") Book of Standards for Highways and Incidental Structures, current edition, available online at:
http://www.sha.state.md.us/businesswithsha/bizStdsSpecs.asp?id=B157+B159 .

Except as otherwise specified in these special provisions, specifications or plans, all conduit supplied shall not exceed the fill requirements for AC conductors as specified in the National Electrical Code (latest revision). Additionally, all communications signal lines or cabling shall be placed in separate conduit from that carrying AC conductors. All conduit used outside shall be Galvanized rigid steel. Refer to the specific sections (i.e. DMS, LCS) for conduit sizes required. No conduit shall be used on this project that is below the size of 3/4 inch.

Installation shall comply with all applicable local, state, and federal government rules, regulations, codes, and laws.

SP 2–1.7 MEASUREMENT AND PAYMENT

Payment for General Requirements will not be measured, but the cost will be incidental to each dynamic message sign installed, lane control signal furnished and installed, signal for lane control furnished and installed, Colored Traffic Dots ("Pucks") furnished and installed, each field equipment cabinet furnished, installed or refurbished and shall include all items necessary for the installation, testing, and acceptance of the signs. Costs for all electrical material needed under this contract will be incidental to the items stated in this document. Actual costs for integrating the new LCS and DMS to the AOC DYNAC control system will be paid for under

contract item 8018 and the Contractor shall subcontract with the MA328-000-006 Contractor, Transdyn for this work.

Item 8018	DYNAC modifications	LUMP SUM

SP 2–2 INSTALLATION OF DYNAMIC MESSAGE SIGNS AND INTEGRATED CONTROLLERS

This work shall consist of removing existing Dynamic Message Signs ("DMS") any type and installing the DMS with integrated controllers at locations shown on the plans. This equipment has been purchased by the Authority under separate contract and will be provided to the Contractor as required. The Contractor will be required to coordinate and schedule with the Authority delivery of the equipment to the site. The Contractor will be responsible for coordinating and working with the DMS Manufacturer Representative during the installation of the DMS and integrated controllers. The Contractor shall coordinate the work with MA328-000-006 Contractor associated with the new LCS and DMS units, communications, and control and status signals as interfaced to the AOC DYNAC control system.

SP 2–2.1 GENERAL REQUIREMENTS

This item consists of installing new Dynamic Message Signs with integrated Sign Controllers to replace the existing flip-disk DMS and the existing FP9000 controllers respectively, in accordance with the Plans and Special Provisions, or as directed by the Engineer. The DMS and Controllers shall operate as part of an integrated Traffic Control System, including the central system, new communications network, and field cabinets.

The DMS Manufacturer will be responsible for providing the following:

- Dynamic Message Sign (ready for installation);
- Controller and the appropriate software/firmware;
- Communication and power cables from the controller cabinet to the DMS;
- Final connections and testing of communications and control wiring;
- Means of disconnecting sign power at the DMS.

The Contractor will be responsible for providing the following:

- Removal of existing DMS signs and controllers as shown on the plans;
- Disposal of existing signs and controllers, however, the Authority shall have right of first refusal of any existing equipment;

- Installation of New DMS Signs (excluding work items identified above for DMS Manufacturer)
- Design, fabrication and installation of catwalks for DMS access;
- Installation of control and power cables from the controller cabinet to the DMS;
- Connection of the utility power to the DMS;
- Verification and measurement to ensure the ground/grounding system present is 10 Ohms or less for the earth ground to be used for the DMS. In the event that the earth ground is not adequate, present or in excess of 10 Ohms, the Contractor shall install an earth ground system to meet these requirements.
- All coordination with Authority and DMS Manufacturer.

SP 2–2.2 DYNAMIC MESSAGE SIGN INSTALLATION

The Contractor shall install the new Dynamic Message Sign (DMS) on the existing overhead sign structure. The DMS Manufacturer will provide the horizontal Z-bar pre-installed to the DMS, vertical W4x13 support members for connection between the horizontal Z-bar and overhead sign structure, and mounting hardware between the horizontal Z-bar and vertical W4x13 as detailed on the DMS shop drawings. The contractor shall be responsible for field drilling all holes in both the horizontal Z-bar and vertical W4x13 members, and making connections of these members with hardware supplied by the DMS Manufacturer. The contractor shall supply 3M™ Polyethylene Protective Tape 8179, or approved equal, to place between horizontal Z-bar and vertical W4x13 members. Contractor shall be responsible for field drilling all holes, supplying u-bolts and all hardware, and making these final connections to connect the vertical W4x13 to the overhead/cantilever sign structure. The contractor shall notify the Authority seven days in advance of the installation. The existing DMS shall be removed and disposed of by the Contractor. The Authority may take 20 percent of all parts before disposal.

If the Z-bar mounting hardware is not suitable for mounting the new DMS, the Contractor shall design and implement an alternative mounting arrangement. Shop drawings detailing the alternative mounting arrangement shall be submitted by the Contractor to the Authority for approval prior to the installation of the DMS. The Contractor shall notify the Authority a minimum of seven (7) days in advance of the installation.

SP 2–2.3 DMS CATWALK

The Contractor shall procure and install a suitable catwalk and safety railing that shall provide safe continuous access to the DMS, with adequate clearance to open the door, as detailed in the Plans.

The catwalk shall have a fold-down safety handrail and shall be designed and constructed in accordance with all applicable OSHA and AASHTO standards for signing/lighting catwalks and platforms. The catwalk shall support at least 2,000 pounds with no discernible displacement. A landing area (or platform) shall be provided to allow total opening of the door. The catwalk shall be designed and constructed to be lightweight and as wind resistant as possible.

The Contractor shall prepare full catwalk structure construction drawings to satisfy the requirements at each location as defined on the Plans. The Contractor shall determine exact placement of the DMS on the sign support to calculate the length of catwalk required. Shop drawings shall be submitted to the Authority for approval prior to fabrication. Payment for the materials and installation of the catwalks is considered incidental to the cost of installing the DMS.

SP 2–2.4 ELECTRICAL DISTRIBUTION

The power distribution shall be through a panel board with overload protection consisting of thermal magnetic circuit breakers. Power shall be supplied through the pole-mounted control cabinet utilizing 15 and 20 amp branch circuits to connect devices.

Within the sign, the following minimum loads shall be identified and provided:

1) Heating loads shall be on separate circuits.
2) The ventilation system shall be on separate circuits.
3) The DMS power supplies shall have dedicated circuits.
4) Any communications devices, interface boards, or other microprocessor-controlled devices shall have a dedicated circuit.
5) A circuit shall be provided for sign convenience outlets.
6) A circuit shall be provided for interior lighting, and other miscellaneous devices.

All panels shall have 200 percent neutral busses due to the heavy use of switching power supplies common to the DMS design. The neutral conductor from the ground-mounted cabinet to sign shall be 200 percent rated. A cover plate shall be provided and installed on panel boards. It shall not be possible to make inadvertent contact with the bus bars. All circuits must be labeled and the phases of the electrical circuit shall be balanced. Devices that introduce

harmonic distortion or sudden load changes shall be located on one phase and microprocessor-controlled devices on the other phase of the 240V/120V circuit.

The sign and traffic cabinet must be grounded according to the provisions outlined in Articles 250 and 600 of the National Electrical Code. An earth ground wire must be connected from either the earth ground buss on the inside of the panel board (load center) inside the sign or the ground lug on the outside rear of the sign housing, to an earth ground rod or rods at the base of the sign or sign structure. The earth ground rod or rods should be located as close to the base of the sign as possible, and must be within at least 10 feet of the base of the sign. Under no circumstances, shall the sign support structure be utilized for earth grounding of the DMS.

A ground resistance of 10 Ohms or less must be achieved. This shall be checked and recorded immediately upon completion of the installation of the sign and connection to the grounding system (if installed) or upon installation of the grounding system if not present or if the current grounding exceeds 10 Ohms. The Wire used shall be at least 8 AWG. The quantity and size of the ground rod(s) should be at least as specified in the National Electrical Code. Terminate wires at the ground rod(s) using brass or copper connections at a minimum. Tunnel installed equipment shall bond to the existing tunnel grounding system with the addition of an insulated grounding conductor.

If a traffic cabinet is used with the sign, an earth ground conductor shall be included in the power cable or wires from the power source to the traffic cabinet, and in the power cable or wires from the traffic cabinet to the sign. If no ground or pole mounted traffic cabinet is used with the sign, an earth ground conductor shall be included in the power cable or wires from the power source to the sign.

Earth ground rods or grounding systems that exceed the above resistance limit may require the contractor to use corrosion proof grounding systems, such as those offered from Lyncole (www.lyncole.com) or equal.

SP2 - 2.5 Wiring

All conductors for 120 volts, 60 hertz, AC branch circuits shall use a minimum 12 AWG conductor, type THHN/THWN, 600V insulation. AC branch circuits for 120VAC, 20 ampere service, which are longer than 75 feet shall use a minimum 10 AWG conductor, type THHN/THWN insulation. Conductor sizes are based on copper and any other material used for the conductor shall be pre-approved for use by the Authority Project Engineer. Conductors used for 120 volts, 60 hertz on AC branch circuits that carry more than 25 amps continuous shall use a minimum 10AWG conductor, type THHN/THWN, or for conductors that carry 30 amps continuous, shall use 8 AWG conductor, type THHN/THWN.

Conductors carrying AC power shall not be in the same wiring harness as conductors carrying DC control or communication signals.

Every conductor, except a conductor contained entirely within a single piece of equipment, shall terminate either in a connector or on a terminal block. The Contractor shall provide and install the connectors and terminal blocks as required. Authority approved splice kits shall be used instead of connectors and terminal blocks for underground splicing of power cables, only when approved by the Authority Project Engineer prior to installation.

Wiring shall be arranged so that any removable assembly can be removed without disturbing wiring that is not associated with the assembly being removed.

AC conductor color codes shall comply with the current revision of NFPA 70 National Electrical Code (Articles 210 and 310).

SP 2–2.6 CONDUIT

The contractor shall replace old conduit with new conduit from the field equipment cabinet to the dynamic message sign. New electrical or fiber optic wire or cable shall be installed in new conduit or raceway by the contractor.

When new wire conductors or cable are installed in conduit, for lengths of more than 20 feet, cable lubricant shall be used when pulling the wire/cable through the conduit. Conduit shall have pull ropes installed. Conduit grounding collars of conduits that enter the base of a ground-mounted traffic cabinet should also be connected into the earth grounding system.

All conduit, conduit fittings and mounting hardware shall be in conformance with Maryland SHA Standard Specifications for Construction and Materials, July 2008, Section 805 and Section 921.7 "Electrical Conduit and Fittings."

SP 2–2.7 MEASUREMENT AND PAYMENT

Removal of Existing Dynamic Message Signs will be measured per each. Work will include removal of controllers, all incidentals and delivery to site or disposal as determined by the Authority.

Installation of Dynamic Message Signs (any type) and Integrated Controllers will be measured per each. Work will include all incidentals, development of shop drawings, and all incidentals as required.

Installation of new conduit will be measured per linear foot. Work will include removal of the existing conduit and installation of new conduit as indicated on the plan sheets. Payment

includes labor for removal and installation and material. See Section *SP 2-5 Field Equipment Cabinets* for line item.

The payment shall be full compensation for all materials, labor, equipment and all other incidentals necessary to complete this work. The Authority will make payment for the following items only upon completion of the installation and commissioning of the DMS and acceptance by the Authority.

Item 8001	Removal of Existing DMS and Controllers	Each
Item 8002	Installation of New Type I Modified DMS with Integrated Controllers	Each
Item 8013	Furnish and Install new GRS conduit	Linear Foot

SP 2–3 LANE CONTROL SIGNALS

This work shall consist of removing existing Electronic Speed Limit Signs (any type),, Lane Control Signals ("LCS") (any type), and the furnishing and installation of new LCS and wiring at locations shown on the plans. The complete LCS system shall consist of signal housing, display modules, driving electronics, photocell sensor control, associated cables and wiring and mounting assembly. The LCS shall be controlled from a Programmable Logic Controller ("PLC") provided by others or by a 2070[1] type controller, as specified by the Authority Engineer. The Contractor will be required to coordinate and schedule with the Authority delivery of the equipment to the site. If advised by the Authority that the DYNAC system is controlling Traffic Control Devices, the Contractor shall coordinate with the MA328-000-006 Contractor for integration of the new LCS with the DYNAC system for communications, control and status signals.

All LCS equipment components, modular assemblies, and other materials located in the LCS housing shall be removable, transportable, and capable of being installed by a single technician utilizing a catwalk to an access panel(s). All components furnished under this functional specification shall be current production equipment and of recent manufacture. To ensure overall system compatibility, all LCS shall be from the same manufacturer.

SP 2–3.1 GENERAL REQUIREMENTS

The LCS face shall be a rectangular or square shape. Four types of LCS shall be specified as follows:

- **Type 1** - Within the face, the signal shall contain one Light Emitting Diode ("LED") display of a red "X" symbol. The display shall create the appropriate symbol by a single stroked row of clustered LED pixels. The character size shall be nominal 18" x 18". The dimensions of LCS and housing shall be 39" x 27".
- **Type 2** - Within the face, the signal shall contain three Light Emitting Diode ("LED") displays. Each display shall be designated to display a red "X" symbol, a yellow "X" symbol or a green "arrow" symbol. Each display shall create the appropriate symbol by a single stroked row of clustered LED pixels. Each character size shall be nominal 18". It shall be permissible for the yellow "X" character to be located to the left of the overlapping green arrow / red "X",

[1] Advanced Traffic Controller (ATC) Standard for the Type 2070 Controller, issued by AASHTO, ITE, and NEMA, v01.05 or latest version.

however, the LED face shall not exceed a width of 36".. The dimensions of LCS and housing shall be 39" x 27".

- **Type 4** - Within the face, the signal shall contain one Light Emitting Diode ("LED") display of a red "X" symbol. The display shall create the appropriate symbol by a single stroked row of clustered LED pixels. The character size shall be nominal 24" x 24". The dimensions of LCS and housing shall be 48 " wide by 32" high.
- **Type 5** - Within the face, the signal shall contain three Light Emitting Diode ("LED") displays. Each display shall be designated to display a red "X" symbol, a yellow "X" symbol or a green "arrow" symbol. Each display shall create the appropriate symbol by a single stroked row of clustered LED pixels. The character size shall be nominal 24". It shall be permissible for the yellow "X" character to be located to the left of the overlapping green arrow / red "X"; however the LED face shall not exceed a width of 42". The dimensions of LCS and housing shall be 48 " wide by 32" high.

For each type of LCS, the symbols shall be clearly visible in normal daylight and nighttime conditions, i.e., at full intensity; the LCS shall be clearly visible and legible for ¼ mile distance anywhere within a 15-degree cone centered about the optical axis under normal atmospheric conditions and under any lighting conditions.

The LCS shall be capable of operating over an ambient temperature range of –35°F to +165°F and from 5 percent to 95 percent relative humidity, non-condensing.

The signal enclosure shall not contain the 120-volt power supplies for each indication; instead these power supplies shall be installed in the field cabinet and field wiring. Each LCS head shall be independently controlled to indicate the status of each lane. Each LCS enclosure shall contain screw down terminal blocks to allow for the easy replacement of signal faces in the field. A method to indicate loss of a character ("X" or "arrow") shall also be provided that will be external to the signal enclosure. LCS units install outside of the tunnel bores shall use surge suppression on the AC mains as described below. The surge suppression shall be utilized in the field cabinet which provides the AC to the LCS enclosure and within the LCS enclosure that is mounted on the structural supports above the roadway.

SP 2–3.2 LANE CONTROL SIGNALS INSTALLATION

The existing LCS shall be removed by the Contractor and replaced by the new LED LCS on the existing support structures (overhead structure, mast arm, structure wall). Type 1 and Type 2 LED LCS shall be installed on the existing mounting brackets, as shown on the

Plans. Contractor shall inspect existing mountings for any damage or deterioration prior to removing existing LCS. Contractor shall notify Authority in writing of deficiencies and proposed repairs and costs. Contractor shall not initiate repairs without written authorization from the Authority.

The Contractor shall design and implement an alternative mounting arrangement for Type 4 and Type 5 LED LCS. Details of the existing mountings are provided in the plans for the Contractor's information. As indicated in the details, the mountings must allow for both horizontal and vertical adjustment. Shop drawings detailing the alternative mounting arrangement shall be submitted by the Contractor to the Authority for approval prior to removal of the existing LCS. Alternative mounting hardware design must be in accordance with the SHA Standard Specifications. Costs associated with the design and fabrication of new mounting, removal of existing mounting, installation of new mounting and all incidentals shall be incidental to the LCS Type 4 and Type 5 Supply and Installation pay item.

The existing LCS shall either be transported by the Contractor to a storage site or disposed of, as directed by the Authority.

The existing LCS shall remain functional until the replacement LCS is installed. The replacement LCS shall be operational by the end of the work shift.

SP 2–3.3 LED PIXEL REQUIREMENTS

Each pixel shall meet the following physical and performance characteristics:

1) A pixel shall consist of 7 LEDs maximum soldered into a printed circuit board, a brass housing and a polycarbonate lens and shall be watertight to NEMA 4X and IP 66 requirements.
2) The pixel shall have a minimum diameter of 1 inch and a maximum diameter of 1.25 inches.
3) Each pixel shall be rated for 100,000 hours continuous operation with no more than 50 percent lumen depreciation
4) The LEDs shall be TS-AlInGap or InGan type.

    a. Each RED LED pixel shall provide a minimum of 1200 mcd (millicandelas) on the optical axis and have a dominant light wavelength between 620 and 635 nanometers at 10.5 ma.
    b. Each YELLOW LED pixel shall provide a minimum of 1200 mcd on the optical axis and have a dominant light wavelength between 585 and 595 nanometers at 10.5 ma.

c. Each GREEN LED pixel shall provide a minimum of 1800 mcd on the optical axis and have a dominant light wavelength between 525 and 565 nanometers at 7 ma.

5) Internal circuitry for each pixel shall have an operating voltage of 120VAC.
6) The pixel housing for the printed circuit board shall be made from brass and shall have a nickel plated finish.
7) A flat, impact resistant polycarbonate lens shall be required to cover the LED cluster. The lens shall meet UL94VO ratings.
8) The lens and housing shall be sealed to create a watertight enclosure per NEMA 4X and IP66 standards.
9) Electrical connection to the indicator shall be through 6-32 screws in the rear of product.
10) The light output from the pixel shall meet ITE requirements for chromaticity (i.e. the color of the light emitted by the module, specified as x-y chromaticity coordinates on the chromaticity diagram according to the 1931 Commission Internationale d'Eclairage ("CIE") standard observer and coordinate system).
11) The pixels shall consume 1.5 watts typical at 125 VAC at 25 centigrade. Operating current shall be as described in 4 (a/b/c) above..
12) The LEDs used in the LCS shall be dimmable for improved nighttime visibility.
13) The condition of all illuminated LEDs shall be verified. A signal or contact closure shall be provided to the controller when the failure of 20 percent of the pixels of any color is reached. If any LED color fails to illuminate, a critical fault signal or contact closure shall be provided for immediate notification to the controller.
14) No LED shall be illuminated at any intensity unless commanded ON by the controller. If any solid-state relays are utilized for the LEDs, when in the OFF state, no leakage current shall be allowed to the LEDs.

As an alternative to number 2 above, double-strike characters may be provided. This will require a minimum pixel diameter of 0.75".

SP 2–3.4 LANE CONTROL SIGNAL ENCLOSURE

Each Lane Control Signal enclosure shall meet the following physical characteristics:

1) The enclosure shall be fabricated from 0.125" aluminum, 5052-H32 series.
2) The enclosure shall have all corners and seams welded to provide a weatherproof seal around the entire case.
3) The signal face shall be aluminum, 5052-H32 series. The signal face shall be attached to the enclosure with stainless steel hinges. A stainless steel latch shall secure the signal face to the enclosure. The signal face shall be removable and

replaceable in the field to allow for easy replacement without removing the entire enclosure. The signal face shall have a quick disconnect plug for easy door removal.

4) The signal face visor shall be aluminum, 5032-H32 series, welded securely to the signal enclosure. The visor shall not impede the removal of the signal face.
5) A waterproof seal shall be created between the signal face and signal housing by use of a 3/16" x 1" neoprene gasket.
6) The enclosure shall include a terminal block for termination of the 120 volt supply for the red "X" symbol, the 120 volt supply for the yellow "X" symbol, the 120 volt supply for the "arrow" symbol, and the 120 volt supply for the NEUTRAL. Each termination point will be labeled to correspond to the appropriate function.
7) The bottom of the housing shall contain four holes to allow proper drainage, each of which shall be fitted with a dense screen to filter against insects or foreign matter entering the signal housing. The enclosure, signal face visor and signal face shall be acid etched, primed with zinc chromate primer and painted white, with the exception of the signal face and the inside of the signal face visor which shall be painted flat black, with two coats of exterior enamel.

SP 2 – 3.5 Lane Control Signal Electrical

1) All conductor wire runs shall be continuous with no splices.

2) All wiring harnesses shall be encased in a continuous sheath. The use of cable ties to arrange wiring harnesses is not acceptable. The use of adhesive backed wire holders is also not acceptable.

3) All cabinet back and panel harness wiring shall be soldered at its destination point as specified.

4) Cabinet internal mounting panels shall have a grounding conductor to the cabinets main ground bar/lug.

5) All conductors shall be labeled. Labels shall be either attached to each end of the conductor and indicate the destination of the other end of the conductor, or shall be a continuous, permanent identification of the conductor's function and located every six inches along the conductor.

6) All conductors used in the controller cabinet wiring shall conform to the following color code requirements.

   a. AC Neutral conductors shall be identified by a continuous white color.

b. AC Ground conductors shall be identified by a continuous green color.

c. AC Positive conductors shall be identified by a continuous black or red color depending on phase.

d. All other conductors shall be identified by any color not previously specified as defined in NFPA 70 National Electrical Code.

e. All conductors for 120 volts, 60 hertz, AC branch circuits shall use a minimum 12 AWG conductor, type THHN/THWN, 600V insulation. AC branch circuits for 120VAC, 20 ampere service, which are longer than 75 feet shall use a minimum 10 AWG conductor, type THHN/THWN insulation. Conductor sizes are based on copper and any other material used for the conductor shall be pre-approved for use by the Authority Project Engineer.

f. All wire insulation class not already specified shall be THHW minimum.

7) All bolts used for electrical connections shall be fabricated from stainless steel.

8) All hardware used for electrical connections and terminal facilities shall be fabricated using cadmium-plated brass.

9) Terminal blocks shall be screw-down compression type, DIN rail mount type acceptable.

10) All fuse holders shall be of the encased type.

11) All LCS units mounted outside of the tunnel shall have surge suppression installed as follows:

The surge suppression shall be connected in series upstream of the device to be protected so that the maximum operating current flows through a base element. However the surge suppression unit supplied, shall have the ability to be connected in parallel to the power source using the base elements without a decoupling inductor for operating currents that to the device to be protected which may require current greater than 20 A. The base element shall be labeled on the input and output side with individual strip labels.

Varistors in the protective circuit can be overloaded by surge voltage loads which are too high or too frequent. The result is too high a leakage current in the components and as a consequence, a rise in temperature. To compensate for this, the varistors shall be monitored

by a thermal disconnect device which disconnects the protection path from the power source before the path overheats. Disconnection shall be indicated by a red control lamp. In addition, it shall be possible to communicate this signal via the remote indicator contacts.

The following specification shall apply to the surge suppressors used for the LCS:

IEC category/VDE requirement class:	III / D / T3
Nominal voltage U_N: [V AC]	120VAC
Arrester rated voltage U_C: [V AC]	150 / 200
Nominal current I_N: [A]	26
Operating current I_C at U_C (L-N): [mA]	[1.1
Discharge current to PE at U_N: [µA]	2,5
Nominal discharge surge current I_n (8/20) µs: [kA]	10
Max. discharge surge current I_{max} (8/20) µs: [kA]	[0.62 / [0.85
Protection level: [kV]	[25 / [100
Response time t_a : [ns]	25
Max. required back-up fuse: [A gL/C]	- 40 bis + 85
Temperature range: [°C]	IP 20
Protection type in acc. with IEC 60 529/ EN 60 529:	PA
Insulation housing:	V0
Inflammability class in acc. with UL 94:	8 mm
Stripping length:	M3/0.8 Nm
Thread / Torque:	0,2-4 / 0,2-2,5 / 24-
Connection data: [mm^2] solid / stranded / AWG	IEC 61643-1, prEN 61643-1,
Test standards:	E DIN VDE 0675-6/A1, E DIN VDE 0675-6/A2, UL 1449

The surge suppression device shall be the Phoenix Contact Mains-PlugTab PT 2-PE/S series base element and plug for 120VAC or equal.

SP 2–3.6 CONDUIT

The Contractor shall replace old conduit with new conduit from the field equipment cabinet to the lane control signal. New electrical or fiber optic wire or cable shall be installed in new conduit or raceway by the Contractor.

When new wire conductors or cables are installed in conduit, for lengths of more than 20 feet, cable lubricant shall be used when pulling the wire/cable through the conduit. Once

removed to loosen conduit, existing conduit fittings shall not be re-used. Conduit, either existing or new, shall have pull ropes installed. Conduit grounding collars of conduits that enter the base of a ground-mounted traffic cabinet should also be connected into the earth grounding system.

All conduit for the LCS used outside of the tunnel bores shall be a minimum of 1 inch Galvanized rigid steel (GRS) conduit.

All conduit, conduit fittings and mounting hardware shall be in conformance with Maryland SHA Standard Specifications for Construction and Materials, July 2008, Section 805 and Section 921.7 "Electrical Conduit and Fittings."

SP 2 – 3.7 Pull Boxes and Junction Boxes

Furnish junction boxes made by an approved cast iron manufacturer and having a hot dipped zinc coating. The covers shall be heavy duty, with a hot dip zinc coating, and equipped with watertight neoprene gasket and recessed, hex head, stainless steel cover bolts. Junction boxes shall be UL listed for application.

Furnish grounding lugs, mechanical connectors that are UL listed and approved for copper wire. Use stainless steel for both inside and outside mechanical connections to the junction box. Provide engineer-approved protection that totally and permanently seals connections with neoprene gasketing, using silicone or rubberized caulking compound if necessary.

Coordinate with the engineer factory knockouts for conduit entrance to the pull box. Knockouts shall not negate boxes UL listing.

Minimum 14 gauge thickness shall be provided for all boxes. All edges and corners shall be rounded and without burrs.

Minimum NEMA rating of 3X shall be provided for all boxes.

SP 2–3.8 MEASUREMENT AND PAYMENT

Removal of Lane Control Signals (3 message) will be measured per each. Work will include removal of controllers, all incidentals and delivery to site or disposal as determined by the Authority.

Removal of Electronic Speed Limit Signs (any type) will be measured per each. Work will include removal of controllers, all incidentals and delivery to site or disposal as determined by the Authority.

Purchase and Installation of Lane Control Signal Type 1 or Type 2 (3 message) will be measured per each. Work will include all labor, materials, including all incidental connections and testing in order to assure operation, as approved by the Authority, and development of shop drawings as required.

The payment shall be full compensation for all materials, labor, equipment and all other incidentals necessary to complete this work.

Purchase and Installation of Lane Control Signal Type 4 or Type 5 (3 message) will be measured per each. Work will include all labor; materials; removal of existing mountings; design, fabrication and installation of new mountings; including all incidental connections and testing in order to assure operation, as approved by the Authority, and development of shop drawings as required. The payment shall be full compensation for all materials, labor, equipment and all other incidentals necessary to complete this work.

Installation of new conduit will be measured per linear foot. Work will include removal of the existing conduit and installation of new conduit as indicated on the plan sheets. Payment includes labor for removal and installation and material. See Section *SP 2-5 Field Equipment Cabinets* for line item.

Payment for installation and purchase of pull boxes and junction boxes required for this contract will be considered incidental to the LCS purchase costs.

The Authority will make payment for the following items only upon completion of the installation and commissioning of the LCS and acceptance by the Authority.

Item 8003	Removal of Existing LCS (3 Message)	Each
Item 8004	Remove Existing Electronic Speed Limit Signs	Each
Item 8005	Supply and Installation of New Type 1 LCS (18" Characters)	Each
Item 8006	Supply and Installation of New Type 2 LCS (18" Characters) (3 message)	Each
Item 8007	Supply and Installation of New Type 4 LCS (24" Characters)	Each
Item 8008	Supply and Installation of New Type 5 LCS (24" Characters) (3 message)	Each

SPECIAL PROVISIONS

SP 2–4 LED SIGNALS FOR LANE CONTROL

This work shall consist of removing and disposal of existing Signals for Lane Control ("SLC") and the furnishing and installing self-contained 8-inch LED signal head modules for lane control (SLC). The modules shall employ a lens assembly that presents an appearance that is similar to those found on standard incandescent signals.

All SLC equipment components, modular assemblies, and other materials located in the SLC housing shall be removable, transportable, and capable of being installed by a single technician. All components furnished under this functional specification shall be current production equipment and of recent manufacture. To ensure overall system compatibility, all SLC shall be from the same manufacturer.

LED traffic signals shall be installed in accordance with the most recent guidelines in effect at the time of installation. These guidelines can be obtained from State Highway Administration's Office of Traffic & Safety.

Manufacturers of Red and Green 8-inch LED traffic signal modules are required to file a statement with the Maryland Energy Administration, certifying that each signal to be sold or offered for sale in Maryland is in compliance with the State's energy efficiency standard. Information on this requirement can be found at the Maryland Energy Administration's website.

SP 2–4.1 GENERAL REQUIREMENTS

The SLC signal housing shall be standard housings in accordance with Section 814 Signal Heads and Section 950.15 Traffic Signal Heads of SHA's Standard Specifications for Construction and Materials (Latest Edition) with LED lenses. Two types of SLC shall be specified as follows:

- **Type A** – One Section 8-inch signal head with a red indication.
- **Type B** – Three Section 8-inch signal head with red, yellow/amber, green indications.

SP 2–4.2 MATERIALS

LED signal heads, and all component parts shall meet the latest edition of the National Electrical Manufacturers Association ("NEMA"). In addition, LED signals shall meet the requirements set forth in the most recent, formally-adopted version of the specification titled "Vehicle Traffic

SPECIAL PROVISIONS

Control Signal Heads - Part 2: Light Emitting Diode ("LED") Vehicle Traffic Signal Modules," published by the Institute for Transportation Engineers ("ITE").

- All signals shall be certified by the manufacturer to meet or exceed all requirements of that specification over their entire 5-year warranty period.
- The advertising date of this Contract shall be used to determine the date of the applicable standards.
- Serial numbers and model numbers, if available, shall be permanently identified on all removable components and hardware. The serial number and model number shall be etched, stamped, molded, or attached using metallic self-adhesive labels. The use of adhesive backed paper labels is not acceptable.

SP 2–4.3 CONSTRUCTION

LED modules shall fit in standard, incandescent vehicle traffic signal housings without modifications or the need for special tools, and shall be complete with a one-piece, integral lens assembly that is tinted for the appropriate color.

SP 2–4.3.1 Design

LED traffic signal modules shall have:

(a) A printed circuit board inclusive of all of the LEDs and required circuit components.

(b) Minimum 39- inch wire leads, minimum # 20 AWG, 600 volt, 105 C, with strain relief and spade terminals. Screw-type terminals shall not be allowed.

(c) A rigid housing for protection in shipping, handling and installation:

(d) A one piece neoprene gasket shall be used to seal out water and contaminants.

SP 2–4.3.2 Assembly Techniques

(a) The LEDs within the modules shall be mounted and soldered to a printed circuit board.

(b) LED signal modules shall be watertight when properly installed in traffic signal housings.

(c) LED signal modules shall utilize the same mounting hardware used to secure a standard incandescent lens and gasket assembly, and shall only require a screwdriver or basic installation tools to complete the mounting.

(d) LED signal module assemblies shall weigh less than 5 pounds.

(e) LED signal modules may not protrude into the signal visor area more than two and three-quarters of an inch in depth.

(f) LED signal modules shall be marked 'TOP' or have an up arrow to designate the proper orientation of the signal module in the traffic signal housing.

(g) LED signal module housings shall utilize an integral metal layer in their design and construction.

(h) LED signal modules shall utilize the latest technology in thermal management.

SP 2–4.3.3 Lenses

Lenses for ball type modules shall be made of ultraviolet stabilized polycarbonate, and incorporate facets that serve to enhance the optical efficiency of the LED traffic signal module. Individual *lens-lets* or external lens facets shall not be permitted.

(a) The ball type signals shall incorporate a diffuser-type lens system that serves to collimate the light emitted by the LEDs. The lens and diffuser system shall focus the collimated light, to meet ITE intensity and distribution standards.

(b) LED signals shall almost perfectly approximate the appearance of an incandescent traffic signal to the motorist.

1. The face of the ball LED lamps shall appear to the motorist as uniform in illumination, and have a wide viewing angle that makes it suitable for installation on wide boulevards.

2. The external lens surface for all vehicle signals shall be smooth, with no raised features, so as to minimize the collection of dirt, diesel smoke, and other particulate contaminates, and to facilitate periodic cleaning.

3. The lens shall be keyed to the housing of the LED signal module to ensure

the proper orientation and to avoid possible rotation during any handling.

4. External lenses shall be hard-coated to prevent an accumulation of dust and dirt.

5. For LED turn arrow signals, the LED arrow lens may be a replaceable part without the need to replace the complete LED arrow.

SP 2–4.3.4 Optical

The light intensity, chromaticity, and distribution from eight and twelve-inch Red and Green, and eight-inch Yellow LED traffic signal modules shall meet all photometric values stated in the most recent, formally-adopted version of the specification titled "Vehicle Traffic Control Signal heads – Part 2: Light Emitting Diode (LED) Vehicle Traffic Signal Modules," published by the Institute for Transportation Engineers ("ITE"). Twelve-inch Yellow LED traffic signal modules shall meet the chromaticity requirements of the most recently-adopted ITE specification, with a minimum intensity of 1,500 candelas.

(a) Red and Green LED signals shall be certified by the manufacturer to meet or exceed all requirements of that specification over their entire 5-year warranty period.

(b) The light output from twelve-inch Yellow/Amber LED signals shall be the peak instantaneous intensity, measured at instant-on and at the highest intensity point.

SP 2–4.3.5 Design

(a) The LEDs shall be connected in series-parallel strings.

1. No more than 1 percent of the total luminosity of the entire signal module may be lost in the event of a single string failure.

2. The failure of a single LED shall cause loss of light from only that LED.

3. No loss of light output from the complete module assembly shall occur as a result of a single LED failure.

(b) The control circuitry shall prevent the current flow through the LEDs in the off state to avoid any false indication as may be perceived by the human eye, during daylight and evening hours.

1. The LED traffic signal module shall be operationally compatible with NEMA TS - 1 and NEMA TS - 2 conflict monitoring parameters.

2. The intensity of the LED signal module shall not vary by more than 10% over the allowable voltage range as specified in the electrical section below.

SP 2–4.3.6 Electrical

(a) The Power factor shall be 0.90 or greater, at nominal rated voltage, at 25° C, after 60 minutes of operation.

(b) Total harmonic distortion ("THD") shall be less than 20 percent at rated voltage, at 25° C.

(c) All LED traffic signal modules shall be in compliance with FCC noise regulations and must meet the FCC Title 47, SubPart B Section 15 regulation.

(d) The LED junction technology used in all signal modules shall not exhibit degradation of more than 30 percent of the modules' initial light intensity following accelerated life testing (operating at 85 degrees C and 85 percent humidity, for 1000 hours). Under no circumstances shall AlGaAs technology be acceptable.

(e) The LED signal modules shall be connected directly to line voltage, 120 Volts AC nominal, and shall be able to operate over the voltage range of 80 VAC to 135 VAC.

(f) Red and Green LED traffic signal modules shall consume no more than a nominal 15 watts for either the 8" or 12" signal. Yellow signal modules shall consume no more than 24 watts.

(g) Transient voltage suppression rated at 1500 watts for 1 millisecond and fusing with a maximum rating of 2 amps shall be provided to minimize the effect and repair cost of an extreme over voltage situation or other failure mode.

(h) Low Voltage Turn OFF: There shall be no visible illumination from the LED signal module when the applied voltage is less than 50 VAC.

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(i) Turn-ON and Turn-OFF Time: A module shall reach 90 percent of full illumination (turn-ON) within 75 msec of the application of the nominal operating voltage. The signal shall cease emitting visible illumination (turn-OFF) within 75 msec of the removal of the nominal operating voltage.

SP 2–4.3.7 Compatibility Testing

The LED module manufacturer shall certify that their modules meet the Load Switch and Signal Conflict Monitor Compatibility testing requirements found in the most recent, formally-adopted version of the specification titled "Vehicle Traffic Control Signal heads - Part 2: Light Emitting Diode (LED) Vehicle Traffic Signal Modules," published by the Institute for Transportation Engineers ("ITE").

SP 2–4.3.8 Warranty

Manufacturers shall provide a written warranty with the following minimum provisions:

(a) Modules shall be replaced, repaired or purchase value refunded if the module fails to function as intended due to workmanship or material defects within the first 60 months from the date of delivery.

(b) Modules which exhibit luminous intensities less than the minimum specified values within the first 60 months of the date of delivery shall be replaced, repaired or purchase value refunded.

SP 2–4.3.9 Miscellaneous

(a) The manufacturer's part number, date code, and electrical characteristics of the LED signal module shall be visible on the rear of the assembly.

(b) The LED traffic signal manufacturer shall be ISO 9000 series certified

SP 2–4.4 MEASUREMENT AND PAYMENT

Removal of existing Signals for Lane Control One or Three Section Heads will be measured per each section. Work will include removal and disposal of signal heads and cleaning/repair of existing mountings to accept the new signal heads.

SPECIAL PROVISIONS

Installation of Self-contained LED signal heads One Section or Three Sections will be measured and paid for at the Contract unit price each. The payment will be full compensation for the LED traffic signal sections, hardware, assembly, and for all material, labor, equipment, tools, and incidentals necessary to complete the work. Contractor shall inspect existing mounting and provide the Authority with a written plan of any required repairs or modifications necessary to accept the new signals. Contractor must receive written approval of proposed actions relating to the mountings prior to fabrication of new mountings or modifications to existing mountings. All costs associated with the signal mountings will be incidental to the pay item for the 8-inch one or three section signal heads.

The Authority will make payment for the following items only upon completion of the installation and commissioning of the SLC and acceptance by the Authority.

Item 8009	Removal of Exiting SLC (Each Section)	Each
Item 8010	Supply and Installation of New One Section SLC (8" Lens)	Each
Item 8011	Supply and Installation of New Three Section SLC (8" Lens)	Each

SPECIAL PROVISIONS

SP 2–5 FIELD EQUIPMENT CABINETS

SP 2–5.1 DESCRIPTION

This work shall consist of furnishing and installing pole-mounted or wall-mounted field equipment cabinets at locations shown on the plans. This work shall include all materials, labor, necessary hardware and electrical connections. The Contractor will be required to coordinate and schedule with the Authority delivery of the equipment to the site.

All components furnished under this functional specification shall be current production equipment and of recent manufacture. To ensure overall system compatibility, all field equipment cabinets shall be from the same manufacturer.

SP 2–5.2 MATERIALS

Electrical/electronic equipment, cabinets, and all component parts shall meet the requirements as specified in Section 820.02 and the standards as set forth in these special provisions.

1) Anchor bolts/Bolts/Nuts/Washers
2) Cabinets and doors
3) Mounting hardware
4) Conduit and weatherproof wire trough
5) Power service conditioning and distribution equipment
6) Electrical wires, harnesses and connectors
7) Ground rods or grounding system as defined below.
8) Environmental control equipment

SP 2–5.3 CONSTRUCTION

SP 2–5.3.1 Electronic Equipment

Any additional electronic equipment (controllers, multiplexers, etc.) to be installed in the field cabinets shall be as specified.

SP 2–5.3.2 Cabinets: General

1) Serial numbers and model numbers, if available, shall be permanently engraved on all removable components and hardware.

2) The serial number and model number shall be etched, stamped, or molded.

    a. The use of adhesive backed labels is not acceptable.

b. Mainframe serial numbers and model numbers shall be readable without disassembly or removal of any part of the cabinet or components located within the cabinet and located on the front face of the mainframe unit.

3) All cabinets shall meet or exceed the requirements of a NEMA 3R rating and shall be UL listed.

4) All cabinets and doors shall be fabricated from 5052-H32 sheet aluminum alloy with a minimum one eighth of an inch (1/8 in.) thickness.

5) All mounting hardware and cabinet bracing shall also be made from aluminum.

6) All external welds shall be made using the Tungsten Inert Gas ("TIG") welding method.

7) Detailed cabinet drawings and material catalog cuts shall be submitted to the Authority for review and approval prior to ordering cabinets. Drawings shall include, at a minimum, dimensions, equipment placement layout, and cabinet wiring schematics.

8) Cabinets shall be equipped with a snow shield covering vents and other openings to prevent penetration of snow and ice. The shield shall not impact the environmental functions of the cabinet.

SP 2–5.3.3 Cabinets: Electrical

1) All conductor wire runs shall be continuous with no splices.

2) All wiring harnesses shall be encased in a continuous sheath. The use of cable ties to arrange wiring harnesses is not acceptable. The use of adhesive backed wire holders is also not acceptable.

3) All cabinet back and panel harness wiring shall be soldered at its destination point as specified.

4) Cabinet internal mounting panels shall have a grounding conductor to the cabinet's main ground bar/lug. The cabinet shall be furnished with ground bars, capable of accepting 4 to 14 gauge stranded wire, to provide a minimum of eighteen positions for chassis ground.

a) An earth ground wire shall be connected from either from the earth ground buss on the inside of the panel board (load center) inside the traffic cabinet or the ground lug on the inside of the cabinet, to an earth ground rod or rods at the base of the sign. The earth ground rod or rods should be located as close to the base of the traffic cabinet as possible, and must be within at least ten feet of the base of the cabinet.

The wire used should be at least 8 AWG. The quantity and size of the ground rod(s) shall be as specified in the National Electrical Code. Wires shall terminate at the ground rod(s) using brass or copper connectors.

b) Conduit grounding collars of conduits that enter the base of a ground-mounted traffic cabinet shall also be connected into the earth grounding system.

c) A ground resistance of 10 Ohms or less must be achieved. This shall be verified/tested immediately upon completion of installation of the cabinet or the grounding system in order to prevent rework during final testing.

5) All conductors shall be labeled. Labels shall be either attached to each end of the conductor and indicate the destination of the other end of the conductor, or shall be a continuous, permanent identification of the conductor's function and located every six inches along the conductor.

6) All conductors used in the controller cabinet wiring shall conform to the following color code requirements.

   a. AC Neutral conductors shall be identified by a continuous white color.

   b. AC Ground conductors shall be identified by a continuous green color.

   c. AC Positive conductors shall be identified by a continuous black or red color depending on phase.

   d. All other conductors shall be identified by any color not previously specified.

7) All bolts used for electrical connections shall be fabricated from stainless steel.

8) All hardware used for electrical connections and terminal facilities shall be fabricated using cadmium-plated brass.

9) Terminal blocks shall be screw-down compression type, DIN rail mount type acceptable.

10) All fuse holders shall be of the encased type.

11) All switches shall be encased, environmentally sealed, and rated for one hundred and twenty-five percent of capacity. Switches and thermostats shall break the "hot" side of the line

12) All welds shall be neatly formed and free of cracks, blow holes and other irregularities.

13) All inside and outside edges of the cabinet shall be free of burrs.

14) All access door openings shall have a double flange on all four sides.

15) All field cabinets (ground-mount or pole-mount) shall be properly earth grounded properly as described below.

16) All AC wiring that exits the cabinet shall utilize wire insulation THHW at a minimum.

SP 2 – 5.3.4 Pull Boxes and Junction Boxes

This section shall exclude work on structures OH-27 and OH-49.

1) Furnish junction boxes made by an approved cast iron manufacturer and having a hot dipped zinc coating. The covers shall be heavy duty, with a hot dip zinc coating, and equipped with watertight neoprene gasket and recessed, hex head, stainless steel cover bolts. Junction boxes shall be UL listed for application.

2) Furnish grounding lugs, mechanical connectors that are UL listed and approved for copper wire. Use stainless steel for both inside and outside mechanical connections to the junction box. Provide engineer-approved protection that totally and permanently seals connections with neoprene gasketing, using silicone or rubberized caulking compound if necessary.

3) Coordinate with the engineer factory knockouts for conduit entrance to the pull box. Knockouts shall not negate boxes UL listing.

4) Minimum 14 gauge thickness shall be provided for all boxes. All edges and corners shall be rounded and without burrs.

5) Minimum NEMA rating of 3X shall be provided for all boxes.

SP 2–5.4 Cabinets:

I. Mechanical

1) **Size**

All Type A cabinets shall be pole-mounted or wall-mounted NEMA TS-2, size 6. The size 6 cabinets shall be a minimum of fifty-five inches in height by thirty-eight inches in width by twenty-six inches in depth (55 in. H x 38 in. W x 26 in. D). The top of the cabinet shall have a depth of twenty-eight inches to provide the necessary ventilation opening.

2) **Equipment Racks**

The Contractor shall furnish and install a removable E.I.A. 19-rack-mount assembly in all NEMA size 6 cabinets furnished and installed under this contract. The rack(s) shall be

installed on the left side of the cabinet, facing the door. All power distribution equipment shall be mounted on the right inside wall, opposite the rack assembly. The Contractor shall provide all hardware associated with the mounting of equipment in the rack assembly.

a. Features:

i. Forty-two (42) inches vertical space (24 rack spaces);
ii. All welded 16 gauge carbon steel tubing construction;
iii. Four point leveling;
iv. Modular construction; and
v. ASA 61 Gray color.

b. Accessories:

i. One (1) Patch Panel Frame 48" High (Color Gray);
ii. Two (2) 48-inch, 14-gauge, zinc-plated carbon steel mounting rails; and
iii. Three (3) sliding, ventilated shelves: gray color.

3) **Fan-Forced Ventilation**

A thermostatically controlled cooling fan shall be provided for all cabinets.

a. The fan and thermostat shall be mounted at the top of the cabinet.

b. The fan and thermostat shall be rated for one hundred and twenty-five percent of capacity.

c. The thermostat shall be manually adjustable, within a ten degree range, from seventy degrees Fahrenheit to one hundred and sixty degrees Fahrenheit.

d. The fan bearing mechanism shall be of ball bearing design.

e. The fan shall have a minimum rated capacity of one hundred cubic feet per minute (100 CFM) air flow.

f. The fan shall have a minimum rated design life of one hundred thousand hours (100,000 hrs).

4) **Natural Ventilation**

The cabinets shall be designed for continuous operation over an outside temperature range of -13 degrees F to +113 degrees F (-25° C to +45° C) without requiring fans, in the event

the cabinet cooling system fails.

a. All cabinets shall be provided with louvered vents in the front door with a removable air filter. Louvers shall satisfy the NEMA Rod Entry Test for a 3R rated ventilated enclosure.

b. Three extra filters shall be supplied for each cabinet installed.

c. The filter shall cover the vents and be held firmly in place with top and bottom brackets and a spring loaded upper clamp.

d. Exhaust air shall be vented out of the cabinet between the top of cabinet and the main access door.

e. The exhaust area shall be screened with a material having a maximum hole diameter of one eighth of an inch (1/8").

5) **Water Runoff**

All cabinets shall have a sloped top surface to prevent the accumulation of water on the cabinet.

6) **Finish**

All outside surfaces of the cabinets shall have a smooth, uniform, natural aluminum finish.

7) **Access Door**

All cabinets shall have a single access door located on the front of the cabinet.

a. The door opening shall be a minimum of eighty percent of the front surface area of the cabinet.

b. All doors shall be provided with a gasket conforming to the physical properties listing in UL508 Table 21.1 and be such that the gasket forms a weather tight seal between the door and the cabinet.

c. All doors shall be hinged on the right side as viewed facing the cabinet.

d. Hinges shall be of a single, continuous design utilizing a fixed hinge pin.

e. All hinging shall be bolted to the cabinet and door utilizing ¼-20 stainless steel

carriage bolts and nylon lock nuts.

f. All hinge pins shall be capped at the top and bottom by weld to render the pin tamper proof.

g. All cabinets shall have hinges fabricated from 0.093 in. stainless steel using a 0.250 in. diameter stainless steel hinge pin and shall provide a three inch open width.

h. All cabinets shall include a door restraint to restrict the door to a maximum one hundred and thirty-five degrees (135°) of swing.

i. The restraint mechanism shall provide latching positions at ninety degrees and at one hundred and thirty-five degrees.

j. All cabinets shall be equipped with a lock compatible with the State's existing cabinet locks, (dead bolt type) and key hole cover and be keyed for a number 1 key. The Offeror shall provide the State with a minimum of one key each per cabinet.

II. Electrical

1) Interior Lighting

a. A 1100 lumens light output rated Compact Fluorescent ("CFL") bulb with 0 degrees Fahrenheit start mounted to the inside a non-corrosive metal cage, top front portion of the cabinet. A door-activated switch shall be installed to turn the cabinet light on when the front door is opened. The door switch shall be on a separate circuit by itself and used only to turn on the cabinet light.

2) Internal Heating

a. The cabinet shall be equipped with a 250 watt resistance type heater. The heating element shall be controlled by a thermostat, the set point of which shall be manually adjustable.

3) Electrical Power

a. The control cabinet shall be equipped with a metal-encased, split-phase load center, equipped with main breakers rated at 60 amperes for all cabinets.

4) **Main Breakers.** The main breakers shall be double-pole type, so that an overload on either phase will disconnect the entire cabinet from the line.

5) **Branch Circuit Breakers.** All branch circuit breakers shall be molded case single or

double-pole, 120/240 volts AC, 10,000-ampere interruption capacity, supplied in a Q.O.U. mounting system. Circuit breakers shall be provided in all panel spaces as follows:

a. 15 or 20-ampere single pole circuit breakers shall be provided for each side of the load center.

b. If panelboard breaker space allows, cabinets shall one double-pole 40-amper breaker and four 15-ampere single-pole circuit breakers (two per phase).

6) **GFI.** One convenience Ground Fault Interrupter dual electrical outlet shall be provided on the cabinet power panel. This outlet shall be wired to remain energized at all times.

7) **Grounding.** The cabinet shall be furnished with ground bars, capable of accepting 4 to 14 gauge stranded wire, to provide the following:

a. Two AC to Neutral - Minimum of thirty-six positions.

b. Chassis ground - Minimum of eighteen positions.

8) **Wiring Harnesses and Terminals.** All wiring harnesses shall be of sufficient length to allow for the placement of the electronic equipment as specified on the Plans.

a. The cabinet shall be wired to permit the utilization of all of the specified functions and capabilities of all electronic equipment contained therein.

b. All back panel or rack wiring is to be complete such that no additional hardware or wiring shall be necessary to utilize all functions of the electronic equipment.

c. All terminal facilities shall be readily accessible for field connection without requiring the removal of any of the equipment installed inside the cabinet.

d. All wires not utilized shall be terminated and labeled as a terminal strip. The practice of tying back of unused wires is unacceptable.

9) **Certification**

The following must accompany all electrical and mechanical components supplied:

a. Instruction manuals.

b. Maintenance manuals.

c. Descriptive parts list with industry standard part numbers where applicable.

d. Three (3) complete sets of wiring and schematic diagrams. Schematics shall include a list of tests points with the following information provided for each point:

i. Nominal operating voltage.
ii. Wave form and all pertinent information regarding the wave form at each test point.
iii. Integrated circuit schematics.
iv. Connection and I/O diagrams.

SP 2–5.5 FIELD EQUIPMENT CABINET INSTALLATION

The existing cabinets shall be removed by the Contractor and replaced by the new Type A cabinets which shall be installed at the locations as shown on the Plans and as directed by the Authority. Control equipment in the existing cabinet shall be transferred in installed in the new cabinet. Field equipment cabinets shall be mounted in one of two ways: wall-mounted or pole-mounted. If the existing mounting arrangements are not suitable for mounting the new field equipment cabinet, the Contractor shall design and implement an alternative mounting arrangement. Shop drawings detailing the alternative mounting arrangement shall be submitted by the Contractor to the Authority for approval prior to the installation of the field equipment cabinet. The existing cabinets shall be transported by the Contractor to a storage site, as directed by the Authority.

1) Conduit

a. The Contractor shall replace old conduit with new conduit from the field equipment cabinet to the dynamic message sign and lane control signal. All outside or exposed conduit shall be Galvanized rigid steel (GRS) conduit, and shall be no smaller than 3/4 inch on the project. All conduit for LCS, SLC, and DMS which are to be mounted on structures shall be a minimum of 1 inch.

b. New electrical or fiber optic wire or cable shall be installed in new conduit or raceway by the Contractor.

c. All conduit wire/cable pulls shall have a pull rope installed beside installed conductors.

d. Once removed to loosen conduit, existing conduit fittings shall not be re-used.

e. All conduit, conduit fittings and mounting hardware shall be in conformance

with Maryland SHA Standard Specifications for Construction and Materials, July 2008, Section 805 and Section 921.7 "Electrical Conduit and Fittings."

2) Wire and Cable

a. New DMS/TIF cabinet: new power wiring from panelboard circuit breaker shall be 12 AWG.

b. Pulling lubricants shall be used during the pull to reduce friction. The Contractor shall use approved pulling compound or lubricant compatible with the cable, as approved by the Manufacturer. The pulling lubricant shall be non-petroleum based and of the highest quality. The lubricant shall be used in ample quantity to reduce friction and applied in such a manner that the cable is lubricated throughout the entire length being pulled through the conduit. Residue shall be cleaned from conductors, boxes and equipment after the pull is made.

c. Tag conductors with new sleeve tag using the sign number as the conductor lable identification. Affix wire tag at panelboard and sign ends for each conductor.

3) Area Cabinets

a. Existing field equipment cabinet enclosures targeted for removal shall have their associated hardware removed and discarded by the Contractor. Refer to Demolition Plans for specific enclosure locations.

b. Proposed field equipment cabinet enclosure shall be refurbished or installed new. Refer to Replacement Plans for specific enclosure locations.

SP 2–5.6 MEASUREMENT AND PAYMENT

Removal of Control Cabinets (all types) will be measured per each. Work will include removal of all incidentals, cleaning of the site, and delivery to site as determined by the Authority.

Furnishing and installing Field Equipment Cabinets will be measured and paid for at the Contract unit price. Work will include all labor, materials, including all lenses, housing, door, gasket, visor, reflector, wiring, transfer of control equipment from existing cabinet and lamp socket complete and operational and incidental connections and testing in order to assure operation, as approved by the Authority, and development of shop drawings as required.

Installation of new conduit will be measured per linear foot. Work will include removal of the existing conduit and installation of new conduit as indicated on the plan sheets. Payment includes labor for removal and installation and material.

Payment shall be full compensation for all materials, labor, equipment and all other incidentals including removable racks, electronic equipment, including all incidentals necessary to complete the work necessary to complete this work. The Authority will make payment for the following items only upon completion of the installation and commissioning of the Field Equipment Cabinets acceptance by the Authority

Item 8012	Supply and Installation of New Type A Cabinets	Each
Item 8013	Furnish and Install new GRS conduit	Linear Foot

SP 2-6 REFURBISH EXISTING FIELD EQUIPMENT CABINET

SP 2-6.1 DESCRIPTION

This work shall consist of removing cabinets from existing sign structures at locations shown on the plans, installing the cabinets on proposed sign structures at locations shown on the plans and refurbishing the cabinets to "like-new" condition. This work shall include all materials, labor and necessary hardware to complete the relocation, reinstallation and refurbishing.

All components furnished under this functional specification shall be current production equipment and of recent manufacture.

SP 2-6.2 FIELD EQUIPMENT CABINET REFURBISHING

Relocated existing cabinets shall be refurbished to "like-new" condition per specifications provided. Contractor shall replace, at a minimum, heaters, fans, light bulbs and air filters. All replaced equipment shall meet specifications noted below. Cabinets shall be vacuumed and wiped out to provide a clean appearance.

1) Fan-Forced Ventilation

Contractor shall remove existing and replace all existing thermostatically controlled cooling fan.

a. The fan and thermostat shall be mounted at the top of the cabinet.

b. The fan and thermostat shall be rated for one hundred and twenty-five percent of capacity.

c. The thermostat shall be manually adjustable, within a ten degree range, from seventy degrees Fahrenheit to one hundred and sixty degrees Fahrenheit.

d. The fan bearing mechanism shall be of ball bearing design.

e. The fan shall have a minimum rated capacity of one hundred cubic feet per minute (100 CFM) air flow.

f. The fan shall have a minimum rated design life of one hundred thousand hours (100,000 hrs).

2) Natural Ventilation

a. Contractor shall replace all removable air filters on all cabinets.

b. Three extra filters shall be supplied for each cabinet relocated.

c. The filter shall cover the vents and be held firmly in place with top and bottom brackets and a spring loaded upper clamp.

3) Interior Lighting

A 1100 lumens light output rated Compact Fluorescent (CFL) bulb with 0 degrees Fahrenheit start mounted to the inside a non-corrosive metal cage, top front portion of the cabinet.

4) Internal Heating

Contractor shall replace all existing 250 watt resistance type heaters.

5) Transformer

Contractor shall replace 7.5 KVA transformer and support hardware, as required by MdTA.

6) General Maintenance

Contractor shall provide electrical equipment maintenance and insulation resistance testing of interior and exterior power wiring.

SP 2-6.3 MEASUREMENT AND PAYMENT

Relocating and Refurbishing Field Equipment Cabinets will be measured and paid for at the contract unit price per each. Work will include all labor and materials and operational and incidental connections and testing in order to assure operation, as approved by the Authority.

Payment shall be full compensation for all materials, labor, equipment and all other incidentals including removable racks, electronic equipment, including all incidentals necessary to complete the work. The Authority will make payment for the following items only upon completion of the relocation and refurbishing of the Field Equipment Cabinets acceptance by the Authority.

Item 8014	Refurbish Existing Field Equipment Cabinet	Each

SPECIAL PROVISIONS

SP 2–7 COLORED TRAFFIC DOT PUCK REPLACEMENT

SP 2–7.1 DESCRIPTION

Contractor shall be responsible for replacing the bulbs and removable housings in each overhead Colored Traffic Dot Puck within the tunnel limits.

SP 2–7.2 INSTALLATION

Work efforts will include removal of the existing bulb and removable housing, cleaning the permanent housing and furnishing and installing new luminaries and housings. The Contractor is responsible for determining the number and configuration of pucks to be replaced. A sample detail of the existing housing is provided in the plan sheets for the Contractors general information. As noted on the details, all dimensions, design and layout provided are approximate. Contractor must contact Mr. Jeff Robson of the Authority at 410-537-1274 to view an existing housing. All parts removed and not reused become the property of the Contractor. Contractor is responsible for determining the number and color of Colored Traffic Dot Puck.

SP 2–7.3 MATERIALS

The Contractor shall be responsible for submitting catalogue cut sheets and a sample replacement Colored Traffic Dot Puck to the Authority for approval prior to fabrication. The information must document the materials and properties used for the LED light housing and means of attachment.

SP 2–7.4 MEASUREMENT AND PAYMENT

The replacement of Colored Traffic Dot Puck will be measured and paid for a the unit price bid per each which price and payment will be full compensation for the removal of the existing fixtures, clearing of the permanent mounting, installation of new lighting pucks (any configuration) and all labor, tools and incidentals necessary to complete the work.

The Authority will make payment for the following item only upon completion of the installation and commissioning of the Colored Traffic Dots (Pucks) and acceptance by the Authority.

Item 8015	Supply and Installation of Colored Traffic Dot (Puck)	Each

SP 2–8 TESTING

The Contractor shall configure and test the overall system for functionality and shall provide a complete, in place and operational system, as described in the Plans and these specifications.

The Contractor shall obtain the services of the manufacturer for technical installation assistance, field testing, system startup and commissioning, as required.

The Contractor shall perform the following tests:

- Communication Protocol and Firmware Tests;
- Lane Control Signal Tests to include LCS, SLC and Pucks;
- Field Cabinet Tests;
- Integration Tests; and
- Reliability Test.

With the exception of the Communications Protocol and Firmware Tests, all tests shall be performed on 100 percent of installed equipment.

SP 2–8.1 ORGANIZATION OF TESTS

SP 2–8.1.1 Test Procedures

Prior to each phase of testing the Contractor shall submit detailed test procedures to the Authority for approval. These procedures shall provide a step-by-step test script that will demonstrate that all the site components are installed and operate correctly. Specification sections and manufacturers specific features shall be referenced by the test script. The test script will be optimized to accomplish the maximum level of testing with the fewest steps (tasks). The script will contain step numbers, space for a date, time, pass/fail designation, and comment along with the task. The test procedures shall be submitted to the Authority for review and approval at least four (4) weeks prior the start of the first tests for each phase.

SP 2–8.1.2 Test Schedule

The Contractor shall prepare a schedule for conducting tests. The Contractor shall give a minimum of two (2) weeks advance notice to the Authority before conducting tests. The notice shall clearly identify the type of test and exact location of the equipment to be tested.

SP 2–8.1.3 Witnessing of Tests

Tests conducted by the Contractor shall be witnessed by the Authority or a representative of the Authority.

SP 2–8.1.4 Test Reports

Following completion of each test, the Contractor shall provide a written report detailing all test results and a proposed course of action for resolving any anomalies.

In the event of a requirement deficiency requiring repair or replacement of a component, the Authority will require a full test to be repeated.

The Contractor shall not commence Integration and Reliability Tests without satisfactorily passing the previous phase of tests and without written approval to commence testing from the Authority.

SP 2–8.2 COMMUNICATIONS PROTOCOL AND FIRMWARE TESTS

Prior to installation of any equipment on-site the Contractor shall demonstrate to the satisfaction of the Authority that the proposed Lane Control Signals can be successfully controlled and monitored via the proposed Lane Controller using the existing central system workstation and communications protocol. These tests may require the temporary connection of one of more lane controllers and lane control signals to the central system for testing purposes, while the lane controllers and signals are physically located in the Authority Operations Center. The Contractor's Test Procedures shall clearly define the proposed equipment configuration necessary to conduct this Test.

SP 2–8.3 LANE CONTROL SIGNAL TESTS

Lane Control Signal tests shall thoroughly test all required functionality of the individual Lane Control Signs, Signals for Lane Control and Colored Traffic Dots ("Pucks") in their installed locations at the Baltimore Harbor Tunnel ("BHT"). These tests shall be conducted, to the extent possible, independently of the associated Lane Controller. The Contractor shall provide and operate any special test equipment required to conduct these tests.

Prior to installation the Contractor shall perform internal tests of all Lane Control Signals to confirm proper operation following transportation to the Site.

SP 2–8.4 FIELD CABINET TESTS

Field Cabinet Tests shall thoroughly test all required functionality. These tests shall also verify the correct installation and operation of all features of the field cabinet, including cabinet lighting, ventilation/cooling systems, heating systems and emergency power disconnect functions.

The Contractor shall prepare a detailed checklist of items required for full and proper installation of the field cabinet. This checklist shall be submitted to the Authority two weeks in advance of the Field Cabinet Tests. The checklist shall be reviewed and verified on-site with the Contractor as part of the Field Cabinet Tests.

Field Cabinet testing shall be included in the respective pay items described in Section SP 2-4.

SP 2–8.5 INTEGRATION TESTS

Following completion of all Lane Control Signal Tests and Field Cabinet Tests, an Integration Test shall be conducted. The purpose of this test is to verify that the Traffic Control System operates as a complete, integrated system in accordance with the requirements of the Plans and these specifications.

These tests shall be conducted primarily from the Authority Operations Center, with the system being observed by the CCTV system and by observers in the field. In addition to the Lane Control Signals, these tests shall also verify the control of all other equipment connected to the Traffic Control System.

These tests shall also be designed and conducted to confirm that the work of the Contractor in upgrading the Traffic Control System, as specified, has not damaged or made non-operational any other part of the electrical or electronic infrastructure at the BHT. The Contractor shall have personnel available to support this test when conducted by others.

SP 2–8.6 RELIABILITY TEST

Following satisfactory completion of the Integration Tests, the Traffic Control System shall undergo a 90-day Reliability Test. During this Test the Traffic Control System shall operate normally, 24-hours per day, seven days per week. Authority and Police personnel shall operate the system during this period.

SP 2-8.6.1 Requirements for Successful Completion

During the Reliability Test all equipment (hardware and firmware) furnished and installed by the Contractor shall operate with the specified level of functionality and reliability and shall

operate to the satisfaction of the Authority without unresolved, intermittent or sporadic failures.

Successful completion of the Reliability Test will occur at the end of ninety (90) continuous days of operation without system failure attributable to software or hardware furnished under this project or ninety (90) days from successful completion of the Integration Tests, whichever is later. That is, should the system operate successfully for sixty (60) days and then fail, it would then have to operate successfully for ninety (90) consecutive days to complete a successful Reliability Test -- sixty (60) days beyond the original ninety (90) day period.

SP 2-8.6.2 System Failures

System failure is defined as a condition under which the system is unable to function as a whole or in significant part to assist the traveling public as designed. While a single component failure may not constitute a system failure, chronic failure of that component or component type or subsystem will be sufficient to be considered a system failure. The Authority will determine if failures experienced in the Reliability Test constitute a system failure. General communication failure due to hardware or software furnished under this project or failure of ten (10) percent or more of the system is considered a system failure in any case. Communication failure due to a minor component may not be a system failure. Faults affecting all of an area or type of component are considered to be system failures. Specifically exempted are failures caused by acts of God or external forces beyond the control of the Contractor.

The Authority will advise the Contractor in writing when it considers that a system failure has occurred or chronic failure exists.

SP 2-8.6.3 Repairs During The Reliability Test

The Contractor's warranty for the hardware and software supplied under this project shall provide that in the event of a malfunction during the Reliability Test, the defective component, card, module, subassembly or auxiliary device shall be replaced with a working component at no cost to the Authority.

Any component of the system which, in the opinion of the Authority fails three or more times prior to the expiration of the Reliability Test, shall be judged as unsuitable and with the Authority approval, shall be replaced by the Contractor at its expense with a new component of the same type. The unsuitable component shall be permanently removed from the system.

All diagnosis and repair during the Reliability Test shall be performed by a qualified, authorized representative of the manufacturer of the respective equipment. The Contractor shall furnish a letter to the Authority signed by the equipment manufacturer designating the authorized representatives of the equipment manufacturer whom will be used by the Contractor to perform warranty and maintenance work.

Any repair, routine maintenance or other work conducted by the Contractor during the Reliability Test shall be documented and reported in writing to the Authority.

SP 2–8.7 WATERPROOFING TESTS

The lane control signal unit shall meet standard (NEMA 4X) waterproofing requirements. The Contractor shall submit test procedures for authority's approval. At minimum 5 percent of total number of units shall be tested and approved by the Authority before beginning the installation phase.

SP 2–8.8 TRAFFIC OPERATIONS DURING TESTING

All installation and testing activities shall be designed to have the least impact on traffic operations in the BHT and shall be conducted in close coordination with Authority Operations Center personnel. All installation and testing activities shall be performed by the Contractor in accordance with Maintenance of Traffic requirements, as specified by the Authority and as noted in the Plans.

The Contractor shall include the impact of traffic operations in the test procedures specified in Section SP 2-9.1 of these Specifications, including the schedule, sequence and duration for which normal lane control signal displays will be disrupted at each display location.

SP 2–8.9 MEASUREMENT AND PAYMENT

Measurement for System Integration and Reliability Testing will be based on successful completion of these activities as described in Sections SP 2-9.2 through 9.6 above. All other testing shall be measured and paid as stipulated in Sections SP 2-9.2 through 6.4 above.

Payment will be made for System Integration Testing and Reliability Testing based on lump sum amounts upon successful completion of the tests and related repairs required to fulfill the operational requirements of these Specifications. System Integration Test payment shall not be less than ten percent (10%) of the total Contract amount minus the cost of Reliability Testing. The Reliability Testing payment shall not be less than fifteen percent (15%) of the total Contract amount minus the cost of System Integration Testing.

Item 1010	System Integration Testing	Lump Sum
Item 1011	Reliability Testing	Lump Sum

SP 2–9 MAINTENANCE, SPARE PARTS AND WARRANTIES

SP 2–9.1 MAINTENANCE

The Contractor shall be responsible for maintenance of all equipment installed under this project with the exception of the dynamic message signs ("DMS") until satisfactory completion of the Reliability Test and acceptance of the Traffic Control System by the Authority.

SP 2-9.1.1 General Requirements

Maintenance shall include all preventive and corrective maintenance required to maintain the BHT Lane Control System in a fully operational state, with minimum down time for system components and minimum disruption to the traveling public. Authority personnel may accompany the Contractor's Maintenance staff during maintenance activities to continue their training on the installed equipment.

All maintenance activities shall be conducted in close coordination with Authority Operations Center ("AOC") personnel. Following written acceptance of the BHT Lane Control System by the Authority, responsibility for maintenance of equipment installed under this project with the exception of the DMS shall be transferred to the Authority.

SP 2–9.1.2 Tools and Special Test Equipment

The Contractor shall furnish two (2) each of any special tools and test equipment, which are designed to perform diagnostic tests or to meet specific tests, operation and maintenance requirements after the equipment is placed into service. The special tools and test equipment shall be handed over to the Authority upon successful completion of the Reliability Test.

The Contractor shall provide an operation and maintenance manual with each item that includes:

- Functional description of the operation; and
- Detail procedures for its use.

The Contractor shall submit a list of the tools and test equipment provided, which shall contain complete ordering and procurement information and prices. The list shall include the following information for each item listed:

- Manufacturer;

- Manufacturer's part number;
- Manufacturer's reference number (i.e. number used to identify a time of production or number used either by itself or in conjunction with other reference numbers to identify an item of supply);
- Name of tool or test equipment;
- Description (include gender if applicable, and indicate if the item is a standard off the shelf part, or if certain characteristics of an item make it unique because of tolerance, fit, test or other requirements that affect its identification);
- Unit of measure (e.g. each, pair);
- Current price; and
- Quantity.

The Contractor shall provide the Special Tools and Test Equipment List to the Authority prior to commencement of the Reliability Test.

SP 2–9.2 SPARE PARTS

The Contractor shall provide to the Authority the number of new replacement parts (System Spares) for the components of the BHT Lane Control System installed under this project, which would allow the Authority to maintain and repair all components critical to the operation of the System for a period of four (4) years from the end of the Reliability Test.

All System Spares, including those to be used by the Contractor during the Reliability Test, shall be delivered to the Authority for storage upon completion of the Integration Tests.

SP 2–9.2.1 Spare Parts List

The Contractor shall submit a spare parts list, which shall include the following information for each item listed:

- Manufacturer;
- Manufacturer's part number;
- Manufacturer's reference number (i.e. number used to identify an item of production or number used either by itself or in conjunction with other reference numbers to identify an item of supply);
- Name;
- Description (include gender if applicable and indicate if the item is a standard off the shelf part, or if certain characteristics of an item make it unique because of tolerance, fit, test, or other requirements that affect its identifications);
- Unit of measure (e.g. each, pair);
- Current price; and

- Quantity.

The list shall contain a column indicating parts delivery time in excess of sixty (60) days.

The Contractor shall provide the Spare Parts List to the Authority prior to commencement of the Reliability Test.

SP 2–9.3 WARRANTIES

SP 2–9.3.1 Contractor's Warranty

The Contractor shall warrant:

- That all services performed hereunder shall conform to the requirements of this contract and shall be performed by qualified personnel in accordance with the highest professional standards;
- That all items furnished hereunder shall conform to the requirements of the Contract Documents and shall be free from defects in design materials and workmanship; and
- That it has ownership and/or marketing rights for all items provided pursuant to the Contract Documents.

There shall be no maintenance charges for the period up to successful completion of the Reliability Test. The Contractor agrees that it will, at its own expense, provide all labor and parts required to remove, repair or replace, and reinstall any such defective workmanship and/or materials, which become or are found to be defective during the period up to successful completion of the Reliability Test.

Upon successful completion of the Reliability Test as defined herein, the Authority will issue a final acceptance of the system.

SP 2–9.3.2 Manufacturer's Warranties

The Contractor shall transfer and assign to the Authority all of its rights under any and all warranties, guaranties, and any similar provisions from the manufacturers or vendors of equipment supplied under this project, or any component or part thereof, and shall take all steps necessary to ensure that said manufacturer or vendor recognizes the Authority as a beneficiary of any such warranty, guarantee, etc.

Warranties are required for system components where documented in these Special Provisions and the Contractor shall provide documentation to the Authority to that effect for each of the items warranted.

SP 2–9.4 MEASUREMENT AND PAYMENT

Measurement for Spare Parts shall be based on Lump Sum.

Payment will be made for Spare Parts upon successful completion of the Reliability Testing.

Item 8016	Spare Parts	Lump Sum

CATEGORY 100

PRELIMINARY

SP 2-10 SECTION - 104 MAINTENANCE OF TRAFFIC

104.01 TRAFFIC CONTROL PLAN ("TCP").

104.01.01 DESCRIPTION.

149 **DELETE:** The fourth paragraph sentence "Refer to contract Documents for Work Restrictions." in its entirety.

INSERT: The following.

Project Description.

This project Baltimore Harbor Tunnel Lane Control Signal and Dynamic Message Sign System Upgrade will require coordination with the Maryland Transportation Authority ("Authority"). The Authority will be responsible for providing traffic control for bore closures only. The Contractor will be responsible for providing traffic control for all single lane and shoulder closures. The Contractor will be responsible for supplying and maintaining Protection Vehicle(s) and for providing a Certified Traffic Manager.

It is necessary to plan and coordinate the Construction and Maintenance of Traffic (MOT) sequencing schedule of this project with that of previously advertised projects.

AGENCY CONTACTS
Pre-Construction / Existing Contract Coordination:

CONTACT	TITLE	PHONE NUMBER
Dave Roehmer	Administrator, MdTA	(410) 537-1310
Michael Darago	Maintenance Supervisor, MdTA	(410) 537-1269
William Mentzer	ITS Construction Manager	(410)-538-5730
Jeff Robson	Utility Coordinator, MdTA	(410) 537-1274
Roxane Y. Mukai	Traffic Manager, MdTA	(410) 537-7848
David Dabkowski	Design Engineer, MdTA	(410) 537-7852
Carrie DeBoy	IT Operations, MdTA	(410) 537-1352

Work Restrictions. On Monday of each week, the Contractor shall provide the Engineer with a complete list of anticipated lane and shoulder closures for the following two weeks, allowing the Authority a minimum of fourteen (14) calendar days or ten (10) working days notification. The Engineer shall then notify the affected facilities, the Engineering Division's Traffic Section and other appropriate offices. No lane closures shall be made without prior written approval of the Engineer in the form of an Authority lane/shoulder closure permit. The Authority is not responsible for lost workdays resulting from the Contractor failing to submit schedules or providing notification of maintenance of traffic requirements in a timely manner. Other contractors may be actively working in or around the vicinity of this project, (i.e., FT 706-000-002 closures will have to be in opposite directions of travel). The Contractor shall cooperate with and coordinate work activities with contractors in adjoining or overlapping work areas.

Fort McHenry and Baltimore Harbor Tunnels combined (6 bores/tubes); only one bore/tube in each direction may be closed at any given time.

ALLOWABLE LANE CLOSURE SCHEDULES
BALTIMORE HARBOR TUNNEL – (Roadway)

TIME OF DAY	*DAYS OF THE WEEK*	*ALLOWED CLOSURES*
9:30 A.M. – 3:00 P.M.	Monday – Thursday	Southbound Single Lane Closure
9:00 A.M. – 2:30 P.M.	Monday – Thursday	Northbound Single Lane Closure
8:00 P.M. – 5:00 A.M.	Monday – Thursday	Single Lane Closure
9:30 A.M. – 12:00 Noon	Friday	Southbound Single Lane Closure
9:00 A.M. – 12:00 Noon	Friday	Northbound Single Lane Closure
10:00 P.M. – 10:00 A.M.	Continuous: Friday (10 P.M.) to Sunday (10 A.M.)*	North or Southbound Single Lane Closure
10:00 P.M. – 5:00 A.M.	Sunday	Southbound Single Lane Closure

*These closures are subject to the facility Administrator's approval, the Contractor should anticipate being limited to no more than 4, continuous Friday to Sunday closures, over the life of the contract.

No lane or shoulder closures are permitted 2 hours before, during or 2 hours after major traffic generating events in downtown Baltimore or during stadium events.

TOLL LANE CLOSURE SCHEDULE
BALTIMORE HARBOR TUNNEL
(Two – Way Operation while Tunnel Bore is Closed)

TIME OF DAY	DAYS OF THE WEEK	TOLL LANES CLOSED
8:00 P.M. – 10:00 P.M.	Monday – Thursday	Northbound Toll Lanes 3, 4 and 5. Toll Lane 1 may also be closed.
8:00 P.M. – 10:00 P.M.	Monday – Thursday	Southbound Toll Lane 11 may be closed.
10:00 P.M. – 5:00 A.M.	Monday – Thursday	Northbound Toll Lanes 3, 4, 5 and 7.
10:00 P.M. – 5:00 A.M.	Monday – Thursday	Southbound Toll Lanes 10 and 11.

Toll lane closures are activated by the Baltimore Harbor Tunnel Toll Supervisor. Modification of toll lane closures must be coordinated with the Baltimore Harbor Tunnel Toll Supervisor at least ten (10) days in advance of scheduled closures.

ALLOWABLE LANE CLOSURE SCHEDULE
BALTIMORE HARBOR TUNNEL
(Two-Way Operation while Tunnel Bore is Closed)

TIME OF DAY	*DAYS OF THE WEEK*	*ALLOWED CLOSURES*
8:00 P.M. – 5:00 A.M.	Monday – Thursday	North or Southbound

Maintenance of Traffic for Harbor Tunnel Bore Closures are furnished and installed by Baltimore Harbor Tunnel Maintenance staff.

Work is not permitted on the holidays, or work day preceding and following holidays indicated below with an "X":

- ☒ New Year's Day, January 1
- ☒ Martin Luther King's Birthday, the third Monday in January
- ☒ President's Day, the third Monday in February
- ☒ Good Friday
- ☒ Easter Weekend
- ☒ Memorial Day, the last Monday in May
- ☒ Independence Day, July 4
- ☒ Labor Day, the first Monday in September
- ☒ Columbus Day, the second Monday in October
- ☒ Veteran's Day, November 11
- ☒ Thanksgiving Day, the fourth Thursday in November
- ☒ Christmas Day, December 25

If a holiday happens to fall on a Thursday, Friday or Monday, no closures will be permitted during that weekend. No lane closures are permitted two days prior to and following the Thanksgiving and Christmas Day holidays.

The Contractor will not be permitted to use any portions of the existing roadway or interfere with or impede the free flow of traffic in any manner during prohibited hours.

The Engineer reserves the right to modify or expand the methods of traffic control or working hours as specified in the Contract Documents. Any request from the Contractor to modify the work restrictions shall require written approval from the Engineer at least 72 hours prior to implementing the change. The Contractor shall submit a copy of the original work restrictions with the written request.

As directed by the Engineer, temporary lane and shoulder closures will not be permitted during periods of falling precipitation, in heavy fog or otherwise poor visibility, or in the event of emergencies such as serious traffic accidents or unusually severe traffic congestion. In the event that a temporary lane or shoulder must be reopened as directed by the Engineer or authorized Authority staff, the Contractor shall evacuate all equipment, materials and personnel from the lane within thirty (30) minutes.

149 **ADD:** The following after the last paragraph, "Any monetary savings...and the Administration."

When a temporary lane or shoulder closure is in effect, work shall begin within one (1) hour after the lane or shoulder is closed. Any delay longer than one hour with no work in progress shall require the Contractor to remove the lane or shoulder closure at no

additional cost to the Authority. The Contractor's Traffic Manager shall attend pre-construction meetings and shall discuss traffic control and the TCP including procedures to be implemented for lane/shoulder closures.

When closing or opening a lane on freeways, expressways, and roadways with posted speed $\geq$ 45 mph, a work vehicle shall be closely followed by a protection vehicle (PV) during installation and removal of temporary traffic control devices. The PV shall consist of a work vehicle with approved flashing lights, a truck-mounted attenuator (TMA) with support structure designed for attaching the system to the work vehicle, and arrow panel (arrow mode for multilane roadways and caution mode on two-lane, two-way roadways) The work vehicle size and method of attachment shall be as specified in the TMA manufacture's specification as tested under NCHRP Test Level 3.

When a temporary lane or shoulder closure is in effect, work shall begin within one hour after the lane is closed. Any delay greater than one hour with no work in progress shall require the Contractor to remove the lane closure at no additional cost to the Administration. The Contractor's Traffic Manager shall attend Pre-Construction and Pre-Paving Meetings and shall discuss traffic control and the Traffic Control Plan including procedures to be implemented for lane closures.

All closures shall be in conformance with the approved TCP and under the direction of the Contractor's Certified Traffic Manager and the Engineer.

Workers and equipment, including temporary traffic control devices needed for setting up a lane closure or restriction, are prohibited in the lane or shoulder to be closed or restricted before the time permitted in the Contract work restrictions unless otherwise noted below or as approved by the Engineer.

Temporary traffic control devices to be used for lane/shoulder closure may be placed on the shoulder of the roadway by workers no earlier than 15 minutes prior to actual time lane/shoulder closure or restriction is permitted. Temporary traffic signs may be displayed to traffic at this time.

Workers shall not enter a lane open to traffic. Workers may be present on shoulders to prepare for lane closure setup no earlier than 15 minutes prior to actual time lane/ shoulder closure or restriction is permitted.

All temporary lane or shoulder closures shall be restored at the end of the closure period and no travel lane shall be reduced to less than 11 ft. Prior to opening the closed lane or shoulder, the Contractor shall clear the lane or shoulder of all material, equipment, and debris.

Failure to restore full traffic capacity within the time specified will result in a deduction being assessed on the next progress estimate in conformance with the following. This is in addition to the requirements specified in TC-4.02.

ELAPSED TIME, MINUTES	DEDUCTION
1 - 5	$ 75.00
Over 5	$ 75.00 per Minute (In addition to the Original 5 minutes)

104.02.04 MEASUREMENT AND PAYMENT

104.02.04.02 When specified in the Contract Documents, Maintenance of Traffic will be measured and paid for at lump sum.

Item 1004	MAINTENANCE OF TRAFFIC	LUMP SUM

INSERT: The following:

Maintenance of Traffic will not be measured but will be paid for at the Contract lump sum price. The payment will be full compensation for all labor (including Traffic Manager), material and equipment (for which a bid item has not been established), and any incidentals necessary to complete the work.

The cost shall include all required equipment and set ups shown on the maintenance of traffic standards, as well as removal of all traffic control set-ups.

SP 2-11

MISCELLANEOUS REPAIRS AND/OR CONSTRUCTION

899.01 DESCRIPTION

A contingent allowance of Forty Five Thousand Dollars ($45,000.00) has been included in the Proposal Form for miscellaneous repairs and/or construction that may be deemed necessary by the Engineer during the construction period.

This work shall be performed only upon written direction of the Engineer. Upon the direction from the Engineer, the Contractor shall submit a written time and material cost for this task, for the Engineer's review prior to commencing any work. The Contractor shall allow two (2) weeks for the review and notice of approval or rejection of the proposal. If the proposal is rejected, the Contractor shall have no claim for time, materials, or other costs associated with the preparation of the proposal. If the proposal is approved, the costs, if any, associated with preparation of the proposal shall be incidental to the proposal.

In lieu of a proposal, the Engineer may direct the Contractor to perform the work in accordance with the requirements of "Force Account Work" Section GP9.02 of the Specifications.

899.02 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

All work performed under this item will be paid for on the basis of approved price proposals and/or force account records submitted in accordance with section GP9.02 of the Specifications and with the authorization of the Engineer.

The Approved amounts shall be full compensation for all labor, equipment, materials, and incidentals complete and in place as directed by the Engineer. The agreed upon or documented costs, only, shall be paid from a lump sum amount as specified in the schedule of prices as follows:

Item 8017	MISCELLANEOUS REPAIRS AND/OR CONSTRUCTION	Lump Sum

SP 2-12 PRELIMINARY

SHA SECTION 109 — CRITICAL PATH METHOD PROJECT SCHEDULE TYPE A

109.01 DESCRIPTION. This work shall consist of the Contractor planning, scheduling, and constructing the project by using a Critical Path Method Project Schedule ("CPM"). The CPM shall be used for coordinating and monitoring all the work specified in the Contract Documents including all activities of subcontractors, vendors, suppliers, utilities, railroads, the Administration, and all other parties associated with the construction of the Contract. All work including, but not limited to submittals, major procurement, delivery, and construction activities shall be included. All activities, including bid items, quantified in the Contract Documents shall be included in the CPM. The CPM shall be based upon the entirety of the Contract Documents. The software utilized for the CPM shall generate files that are compatible with Primavera Project Planner.

Float. The CPM utilizes float. Float is defined as the amount of time between when an activity "can start or finish" and when an activity "must start or finish." Float is a shared commodity for the use of the Administration and the Contractor and is not for the exclusive use or benefit of either party. The parties have the full use of the float until it is depleted.

Scheduling Representative. The Contractor shall designate a scheduling representative, prior to submission of the Initial Critical Path Method Project Schedule ("ICPM"). The scheduling representative is the person primarily responsible for development and maintenance of the Contractor's CPM schedule. The scheduling representative shall represent the Contractor in all matters regarding the schedule and shall attend all schedule related meetings. Replacement of the scheduling representative by the Contractor will require written approval from the Administration.

The Contractor shall submit the qualifications of the designated scheduling representative to the Administration for approval. This approval is required before the ICPM will be accepted. The designated scheduling representative shall have at least three years of verifiable experience for preparing and maintaining CPM project schedules on Contracts of the same or similar size and complexity.

Initial Critical Path Method Project Schedule ("ICPM"). The ICPM shall consist of:

(a) A time scaled diagram. The ICPM time scaled diagram shall have a scale and format that is acceptable to the Engineer. The activities shall be labeled with the activity identification clearly shown for each activity. All relationships between activities shall be shown.

(b) Tabular reports with activities sorted as follows:

(1) Activity ID. This report shall include predecessors and successors for each activity with leads and lags shown.

(2) Activity ID. This report shall include resources. This report shall clearly define the resources assigned to each activity.

(3) Early Start, Total Float.

(4) Total Float, Early Start.

(5) Project Area (if applicable).

(6) Project Phase (if applicable).

(7) Responsibility, e.g., Contractor, specific subcontractor, specific supplier, the Administration, etc.

The header of each tabular report shall include the project name, Contract number, data date, run date and number, and report type.

The body of each report shall include the activity identification, activity description, original and remaining duration, early/late start and finish dates, percent complete, actual start/finish dates, total float, and calendar designation for every activity.

(c) Written Narrative ("WN"). The WN shall comply with the requirements described hereinafter.

(d) Printed Calendars. The printed calendars shall include a listing, description, and calendar form tabulation of all calendars used in the ICPM. The calendars shall contain the total number of anticipated work days required to complete all the work required in the Contract. The calendars shall delineate the holidays and anticipated nonwork days or periods. An explanation of the Contractor's basis for determining each nonwork day or period shall be included in the WN.

(e) Data disc containing all of the information contained in the CPM. The format shall be compatible with Primavera Project Planner software.

All construction activities shall have durations not exceeding ten (10) working days, unless otherwise approved by the Engineer. Activities required for review and approval of the working drawings and materials by the Administration shall be given a duration of not less than thirty (30) calendar days. The Contractor may submit a short list of highly critical approval activities to the Engineer. The Engineer will make every effort to expedite the approval of these submittals; however, this will not alter the requirements to include thirty (30) calendar days for all approvals in the ICPM. Activities for curing, pre-load, etc. shall be

scheduled in calendar days. Durations for procurement activities will be evaluated on a case by case basis.

The latest calculated early finish date in the ICPM shall equal the Contract calendar date for completion specified in the Contract Documents. If the Contractor submits an earlier completion date than specified in the Contract Documents, the Administration, upon approval of the ICPM, will issue a change order to adjust the Contract time to the completion date shown on the ICPM.

The Contractor shall resource load all construction activities in its schedule with the material, equipment, and manpower planned to be utilized by the Contractor and its subcontractor in accomplishing each activity. Resource loading of the CPM shall be fully explained in the WN.

The Engineer reserves the right to specify the number of activities and to require at any time additional breakdown of the activities.

The Contractor shall utilize activity codes to categorize activities by at least the following: project area, project phase, and responsibility, e.g. Contractor or specific subcontractors.

The Contractor shall provide a WN as part of the ICPM. This WN shall explain the sequence of work, the critical path, interim completion dates, project phasing, nonwork days or periods, maintenance of traffic, and labor and equipment resources. In addition, the Contractor shall explain how it has provided for permit requirements, environmental requirements, coordination with other public Contractors, milestone dates (for the Contract or other related contracts), coordination with other entities, coordination with all utility companies, special nonwork days or periods, and weather in its ICPM. The WN shall be used to explain the specific scope of each activity and the basis used to determine the original duration of each activity, i.e., production rates and anticipated quantities. All activities quantified in the Contract Documents shall be addressed in the WN. The Contractor shall utilize the WN to explain the following:

(a) Relationships between activities not obviously identified;

(b) Equipment usage and limitations;

(c) Manpower usage and limitations;

(d) Use of additional shifts and overtime;

(e) Activity codes, abbreviations, and activity identification system;

(f) All calendars utilized in the CPM;

(g) Date or time constraints;

(h) All abbreviations in the ICPM;

(i) Use of calendars; and

(j) Scheduling of weather and temperature sensitive activities.

The Contractor shall complete and submit the proposed ICPM within thirty (30) calendar days after receiving the Notice of Award and submit five (5) sets of all information required to the Engineer for review and acceptance. No work shall begin until the Engineer has accepted the ICPM. Upon issuance of the Notice to Proceed, the start date utilized in the ICPM shall be adjusted to comply with the Notice to Proceed.

The Engineer will complete the review of the Contractor's ICPM within thirty (30) calendar days after the submittal. If required, the Engineer will convene a Joint Review Conference at which time the Engineer and Contractor may make corrections and adjustments to the proposed ICPM. If a revision is necessary due to the Engineer's review or the Joint Review Conference, the proposed revision shall be submitted by the Contractor within seven (7) calendar days after the Contractor receives the Engineer's review comments or within seven (7) calendar days after the date of the Joint Review Conference whichever is the latest. Revisions shall conform to the requirements for the ICPM. The Engineer will respond to the revised ICPM within seven (7) calendar days after the revised ICPM is received.

Any delay in starting work caused by the acceptance of the ICPM by the Engineer will not be considered as a basis for any adjustment in the Contract amount or time.

When the Engineer notifies the Contractor that the ICPM has been accepted, that document will become the CPM of record. The Contractor shall be responsible for implementing and executing the work specified in the Contract in strict conformance with the CPM of record. The CPM of record shall be the Contractor's work plan for completing the entire Contract as specified in the Contract Documents.

Failure of the Contractor to adhere to the CPM of record will be cause for the Administration to deny any and all requests for additional compensation or extensions of the Contract duration and may result in the Engineer withholding pay estimates.

CPM Updates. Monthly updates of the CPM of record are required. CPM update submissions shall contain the activity data as specified in (a) through (e) of the ICPM. The update shall be used to describe the progress of the project to date. The WN shall include a description of the work performed during the update periods, current critical path, the amount of float on the critical path, any delays or disruptions experienced by the Contractor during the period of the update, any change in manpower or equipment, and any potential delays or disruptions.

The Contractor's scheduling representative and the Engineer shall meet to review, mutually agree to, and sign-off on the information required to update (actual start and finish dates, remaining durations and percentages complete) the schedule. The Contractor shall use an update form acceptable to the Engineer. The data date for each update shall be seven (7) days

prior to the cut-off date of the pay estimate for that month. The update shall be submitted by the Contractor within seven (7) calendar days from the data date. Failure to timely submit the update, may result in the Engineer withholding pay estimates. Upon acceptance by the Engineer, the update shall become the CPM of record for the period between its data date and the data date of the next approved update or revision.

Updates shall not include any revision to the CPM, unless prior approval by the Engineer is received for the insertion of minor revisions.

Revisions to the Schedule of Record. Revisions are defined as one or more of the following:

(a) A change in the original duration of an activity.

(b) A change in the logic of the schedule.

(c) A change in the calendars or to the calendar to which an activity is assigned.

(d) A change to resources.

(e) A change to any actual date, previously established.

(f) The deletion or addition of an activity.

(g) A change to, addition of, or deletion of a date or time constraint.

(h) A change to, addition of, or deletion of an activity code.

(i) A change to an activity description.

(j) Any change other than updating an activity.

When the Contractor proposes to make a revision to the CPM, the Contractor shall verbally discuss the proposed revision with the Engineer. If the revision is minor in nature, the Engineer may allow the Contractor to include the revision on the next Update of the CPM. If the Engineer determines that the revision is not minor in nature, the Contractor shall submit the proposed revision to the Engineer for review and approval prior to deviating from the approved CPM.

When the Contractor is required to make a revision to the CPM due to changes in the Contract initiated by the Engineer, the Contractor shall immediately contact the Engineer to discuss the changes. If the revision is minor in nature, the Engineer may allow the Contractor to include the revision on the next Update of the CPM. If the Engineer determines that the revision is not minor in nature, the Contractor shall submit the proposed revision to the Engineer for review and approval prior to deviating from the approved CPM.

The Engineer may allow the Contractor to deviate from the approved CPM for specific mitigating activities.

The proposed revision shall be submitted to the Engineer in the same format and with the same requirements used for the ICPM. The proposed revision shall be made to the CPM of record at the time the revision is made, i.e. the revision shall include all update information and revisions previously approved and the additional progress to the date of the revision. The WN accompanying the proposed revision shall describe the reason for the revision, the resulting critical path, and all particulars of the revision. These shall include, but not be limited to, changes in the method or manner of the work, changes in specifications, changes in resources, addition or deletion of work, increased or decreased quantities, defective work, and acceleration of the work.

The Engineer will review and respond to the Contractor's proposed revision within fourteen (14) calendar days after its receipt. Resubmittal by the Contractor, if required, shall be made within seven (7) calendar days after receipt of the Engineer's review comments. The Administration reserves the right to reject any proposed revision which adversely impacts the Administration, utilities, or other concerned parties.

Extensions of Contract Time or Incentive/Disincentive Date. All requests for an extension of Contract time shall be made in writing and are subject to the notice and timeliness of submission provisions as provided for elsewhere in the Contract. Any written request for an extension of Contract time or change in an incentive/disincentive date will be evaluated by the Engineer's analysis of the CPM of record and a proposed revision submitted by the Contractor. The request shall include a WN of the events which would require an extension of the Contract time or incentive/disincentive date.

Only delays to activities which affect the Contract completion date or incentive/disincentive date will be considered for an extension of Contract time. The extension of the specified Contract completion date or incentive/disincentive date will be based upon the number of calendar days the Contract completion date or incentive/disincentive date is impacted as determined by the Engineer's analysis.

When the Contractor fails to submit an acceptable Update or Revision within the time limits prescribed above, the Engineer may withhold pay estimates for all work until an acceptable Update or Revision is submitted.

109.02 MATERIALS. Not Applicable.

109.03 CONSTRUCTION. Not Applicable.

109.04 MEASUREMENT AND PAYMENT. The accepted Initial Critical Path Method Project Schedule, Critical Path Method Project Schedule Revisions, and all accepted Critical Path Method Project Schedule Updates will be paid for at the Contract lump sum price for the Type A CPM Project Schedule item. Fifty percent of the lump sum price will be paid upon

acceptance of the Initial Critical Path Method Project Schedule (except when the price bid exceeds half of one percent of the total Contract price bid). The balance will be paid as a monthly prorated sum based upon the specified Contract duration. This monthly payment will be made on the next progress payment following the Administration's acceptance of the required monthly Critical Path Method Project Schedule updates.

When the price bid for the Type A CPM Project Schedule exceeds half of one percent of the total Contract price, the total progress payments for the Critical Path Method Project Schedule will be limited to half of one percent of the total Contract price. Any remaining balance (over half of one percent of the total Contract price bid) will be paid upon final Contract payment.

Item 1002 Type A CPM — Lump Sum

820 GENERAL ELECTRICAL WORK AND TESTING

See Section 820 of the SHA's *Standard Specifications for Construction and Materials* in conjunction with the changes shown in this Section.

820.01 DESCRIPTION

ADD: The following.

(a) This work includes contacting, coordinating and cooperating with BG&E (or other local utility company) for the changes and additions to the electrical service.

(b) The Plans show only diagrammatic locations of cables, conduits, and other underground utilities. They are approximate and do not show every detail. The Contractor shall provide working drawings, shop drawings, and catalog cuts, etc., which show final details of the installation.

820.01.01 Codes, Standards, Inspection, and Documentation

(a) All work shall be performed in accordance with the codes and standards listed below. In addition, materials and construction methods shall meet the minimum requirements and recommendations of the listed codes, standards, and organizations. Unless otherwise stated, the latest edition, revision, or supplement, as of the date of advertisement, of the specified codes shall be used.

- ANSI - American National Standards Institute
- ASTM - American Society for Testing and Materials
- IEEE - Institute of Electrical and Electronic Engineers
- NEC - National Electrical Code (NFPA70)
- NECA - National Electrical Contractors Association (NECA 1-2006)
- NEMA - National Electrical Manufacturers Association
- NESC - National Electrical Safety Code
- NFPA - National Fire Protection Association
- UL - Underwriters' Laboratories
- TIA - Telecommunications Industry Association

(b) All materials supplied by the contractor shall be new and UL listed, where such listing is possible. Submit catalog cuts for all materials in accordance with Shop Plans & Working Drawings in SPECIAL PROVISIONS (TC4.01).

(c) The MDTA Chief Electrical Inspector or his appointed representative will inspect the entire installation. The Contractor shall contact the Electrical Inspector at least 48 hours before needed inspections. All trenches shall be inspected before backfilling. All equipment, conduits, etc. shall be inspected at rough in and prior to concealment. All work shall be inspected prior to power-up. Contact the Chief Electrical Inspector, Douglas Evans, at 410-977-2687 or devans3@mdta.state.md.us to arrange necessary inspections.

(d) All rough-in work shall be documented via a digital camera prior to concealment. Camera shall be color, minimum of 5 mega pixels, and images shall be clear and readable to the naked eye. All color photos shall be time stamped with the date of the picture. Filename or other label shall identify project number and general location of the picture. All pictures shall be submitted on a CD or DVD at the conclusion of the project, however, electronic copies shall be made available at any time by request to the project engineer, inspector, and/or electrical inspector.

(e) Special attention is directed to the fact that the Standard Specifications For Construction and Materials dated July 2008 and published by the Maryland Department of Transportation, State Highway Administration, also governs this work, and is referenced frequently herein as the "Specifications."

(f) All work shall be performed in accordance with NECA 1-2006 (Standard for Good Workmanship in Electrical Construction) or latest revision.

(g) Unless clearly specified otherwise, all voltages indicated are AC (alternating current), shall be at 60 Hz, and stated as RMS values.

820.01.02 Quality Assurance and Quality Control

The contractor shall inspect all materials furnished or installed under this contract and shall bring any damage, failure, or other problem to the attention of the project inspector prior to incorporation into the work. The contractor shall provide his own quality assurance and quality control for the work performed in the contract. The inspectors operating on behalf of the state are not a replacement for contractor's management and the contractor's own quality assurance and quality control.

Prior to final inspections/punch list development the contractor shall conduct his own inspections. The use of inspection checklists and quality control documents is required as evidence that inspections have been completed.

820.03 CONSTRUCTION

820.03.01 GENERAL

ADD: The following.

For the purpose of this specification, "direct supervision" shall mean that the qualified Master Electrician shall be at the job site at all times electrical work is performed. The Master Electrician shall be the single point of contact for inspection and quality control issues related to electrical work and shall be able to effectively manage the electrical work force.

The contractor must provide qualified labor to perform installation. Where licenses or certifications are available or required by local jurisdictions, state jurisdictions, or federal jurisdictions for certain skilled trades, such as electrical, mechanical, plumbing, welding, etc. The skilled trade workers shall have current versions of the appropriate license or certification prior to working the associated specialty and shall provide copies to the Project Engineer or Inspectors upon request.

Installation, splicing, terminating, and testing of fiber optic cable shall be performed by a trained and qualified fiber optic cable technician. Copies of certifications and experience shall be submitted to the Engineer prior to starting work.

ADD: The following just prior to paragraph 820.04.

820.03.04 Testing Fiber Optic Cables

Circuit tests shall be performed to verify that each fiber is connected to the proper circuit, and that it is continuous with no breaks, or damaged sections, in the fiber. All strands shall meet current EIA/TIA-568 specifications. Dark fibers and excessive attenuation due to breaks, bends, bad splices, defective connectors and bad installation practices shall not be accepted and shall be corrected. For fiber optic testing standards, see EIA-455-171 (FOTP-171), EIA 526-14.

(a) All cables shall have ST connectors installed prior to testing. All testing, for purposes of acceptance of the system, shall be conducted on fully installed and assembled fiber optic cables.

(b) Upon completion of testing, replace or repair any failed cable(s) with a new fiber or cable, and test the new cable to demonstrate acceptability.

(c) Insertion loss testing shall be performed.

(d) These tests shall be measured in dB.

(e) These tests shall use 850 nm and 1300 nm light sources for multimode fiber and 1300 and 1550 nm for single mode fiber.

(f) Test shall be documented for all wavelengths as noted above.

(g) Test results shall be documented on paper and stored on a computer diskette and shall be turned over to the electrical inspector after testing is complete. Attachment 820-A to this Section shows a sample fiber optic test report.

(h) An optical time domain reflectometer (OTDR) approved by the Engineer shall be used to conduct testing. The OTDR shall be calibrated to sheath (jacket) length, not optical length, by adjusting the unit's index of refraction. Properly trained technicians shall conduct tests.

(i) All OTDR traces shall maximize both the vertical and horizontal scales to the greatest extent possible and still fit the entire trace on the screen.

(j) A cable segment shall be deemed a failure if the total loss exceeds the calculated loss for that length of cable as indicated in Attachment 820-A. A cable segment shall fail if any individual splice loss is greater than 0.3dB, or if any mated connector pair loss is greater than 1.0dB, or if there is any point loss (over less than 1' of cable) of more than 1.0dB.

(k) After the circuit test, a functional test shall be performed. This test shall consist of allowing the system to operate as normal for 30 consecutive days. Any failures shall be repaired by the Contractor at his own expense, and the test restarted.

820.03.05 All switches and breakers shall be operational and the operation of the devices they control verified. That is, the Contractor shall test switches and breakers in the presence of the MDTA electrical inspector to prove and assure that the device (or devices) specified is (are) controlled and no other device (or devices) is (are) controlled. All panel schedules shall be accurate and reflect the final installation.

820.03.06 All GFI protected outlets shall be tested with a suitable tester in the presence of the MDTA electrical inspector. The tester shall be a device that plugs into the outlet and indicates proper wiring of the outlet. A switch on the tester shall be utilized to introduce a ground fault that must trip the GFI device.

820.03.07 All Uninterruptible Power Supplies shall be tested by removal of power sources. Verify proper transfer to battery and backup time consistent with the manufacturers load vs time data for the particular model of UPS. Restore normal power and verify that batteries are charged and normal operation commences.

820.03.08 All PVC conduit fittings, except threaded fittings, shall be schedule 80 and glued and water tight. All GRSC fittings shall be tight fit.

820.03.09 All photo electric controls shall be tested by applying a temporary shade to simulate photometric changes intended to activate the controls. Such testing shall be performed by the contractor in the presence of the MDTA electrical inspector.

820.03.10 All three phase panels, loads, motors, generators, UPS's, and ATS's shall be checked for proper phase rotation and consistent phase termination between termination points. Ie: Phase A is the same Phase at all Phase A termination points and the phase rotation is the same at all points. Such testing shall be performed by the contractor and witnessed by the electrical inspector.

820.03.11 Flexible metal conduit (Greenfield) and liquid tight flexible metal conduit (seal tight), and liquid tight flexible non-metallic conduit may be used as follows. Flexible fabric innerduct and innerduct used for low-voltage and fiber optic systems is not covered by this requirement.

(a) Lengths not exceeding 3' shall be used to connect transformers over 5KVA and motors.

(b) Lengths not exceeding 6' may be used for the final connection of light fixtures used in ceilings.

(c) Lengths not exceeding 6" may be used for the final connection devices that may be subject to minor vibration or minor movement perhaps from temperature expansion and contraction.

(d) Other lengths as clearly specified on the plans or as approved by the Engineer.

820.03.12 Conduit/Cable labeling. Interior cable and raceways shall be permanently labeled at a minimum of every 50 feet, **every 25 feet when view is obstructed, and within 5' of any wall or floor/ceiling penetration** at all junction boxes, terminations, **and within 12" of electrical panel.** Label color shall be Safety Orange with Black Letters and shall follow ANSI (ASME) A13.1 for location and size.

820.03.13 Unless specifically shown otherwise on the plans, wiring derived from different system voltages shall be installed in separate conduits. Wiring of different voltages derived from the same system (i.e. Control wiring) may be permitted to be installed in the same conduit or junction box provided that all requirements of the NEC are maintained.

820.03.14 No wiring other than the primary voltage indicated shall be installed in electrical panels and Safety/Disconnect Switches. Exception may be granted for wiring that terminates on a device within the panelboard or safety/disconnect switch that is integral to the operation of that device. Enclosures for switches or overcurrent devices shall not be used as junction boxes, auxiliary gutters, or raceways for conductors feeding through or tapping off to other switches or overcurrent devices.

820.03.15 Branch Circuits: Any circuits supplying more than 50% non-linear loads shall have a dedicated neutral conductor

820.03.16 Conduit or tubing 1" and larger shall be provided with a suitable insulating bushing.

820.03.17 Panel Board Labeling. All circuits installed or modified by the contractor in any way shall be properly labeled in the associated panel board panel schedule. This work shall include verifying that the existing load on the affected circuit(s) is also correctly identified. The label shall identify the type of load(s) served (e.g.: receptacles, lighting, appliances, motors, pumps, etc..) and the location (e.g.: room 103, sump pit#1, etc…). Where changes are minor (e.g. Two circuits or less being changed), the existing panel schedule may be modified as approved by the Electrical Inspector. Larger changes shall require a new panel schedule typed, neat in appearance. The new schedule may copy the identifying labels of the old schedule provided that the contractor has not made any changes to those circuits. To clarify, replacing a panel board, moving circuits within a panel board, or similar changes shall be considered modifying the circuit and shall require testing to verify the connections of all such circuits and coordinating the panel schedule with the existing conditions.

820.03.18 Fire Stopping. All penetrations into fire walls or core holes between floors and walls must be properly fire-stopped in accordance NEC requirements for fire stopping. Penetrations into the surface of any firewall or presumed firewall should be only slightly larger than the conduit, cable or cables that will need to pass through it. This will make fire stopping easier and allow the wall to maintain a better over all structural integrity.

820.03.19 Construction Stakeout and Coordination

(a) The Contractor shall coordinate this work with the work of other trades to avoid conflicts. Electrical cables and equipment damaged by the execution of work of other trades shall be completely removed and replaced with new.

(b) The Contractor shall keep an up-to-date set of as-built red lined drawings on the job site. Submit as-built drawings upon completion of the work. The Contractor shall note the exact location of trenches at 100-foot intervals on the as-built drawings by station, and offset from the roadway. The Contractor shall show only the work that is part of the final project on as-built drawings.

820.03.20 Boxes and Cabinets. Unless specified otherwise, junction boxes, pull boxes, disconnect switches, cabinets, and other boxes installed outdoors and above ground shall be NEMA4X rated; except cabinets and boxes requiring ventilation which shall be NEMA3X rated.

820.03.21 Rodent stopping. All conduits that connect to exterior mounted cabinets shall be stuffed with copper mesh at the cabinet end point to deter rodent egress through the conduit. The copper mesh shall be installed after all wires and cables have been installed. The mesh shall be removable and the mesh and installation and removal technique shall not damage wires or cables.

ATTACHMENT 820-A

SAMPLE FIBER OPTIC CABLE TEST REPORT

(To be filled out after installation is complete)

Job Name: **Job ID:**	**Fiber Cable:**
Location (A):	**Location (B):**

ANSI/EIA/TIA 568A: Cable Loss Factor (CLF); 1km=3280.83 feet

3.75 db/km **(0.00114 db/ft)** @ 850 nm for 62.5/125 μm MM

0.50 db/km **(0.00045 db/ft)** @ 1300 nm for 62.5/125 μm MM

0.50 db/km **(0.00015 db/ft)** @ 1310 nm and 1550 nm for OSP SM

1.0 db/km **(0.00030 db/ft)** @ 1310 nm and 1550 nm for ISP SM

0.5 Connector Loss (CL) = 0.75 db per pair of connectors

Splice Loss (SL) = 0.3 db each

To calculate ACCEPTABLE LOSS (db): Multiply cable length x (CLF) + (CL) + (SL) = DB margin:___

Cable Length	Strand No.	A to B	B to A	Fiber ID
Feet	1			Blue
850 NM MM	2			Orange
dB	3			Green
	4			Brown
	5			Slate
	6			White
	7			Red
	8			Black
	9			Yellow
	10			Violet
	11			Rose
	12			Aqua

Cable Length	Strand No.	A to B	B to A	Fiber ID
Feet	1			Blue
1300 NM MM	2			Orange
dB	3			Green
	4			Brown
	5			Slate
	6			White
	7			Red
	8			Black
	9			Yellow
	10			Violet
	11			Rose
	12			Aqua

Cable Length	Strand No.	A to B	B to A	Fiber ID
Feet	1			Blue
1550 NM MM	2			Orange
dB	3			Green
	4			Brown
	5			Slate
	6			White
	7			Red
	8			Black
	9			Yellow
	10			Violet
	11			Rose
	12			Aqua

Technician: _____ **Date:** _____

CATEGORY 900
MATERIALS

SECTION 950 - TRAFFIC MATERIALS

950.03 REFLECTORIZATION OF SIGNS AND CHANNELIZING DEVICES.

DELETE: 950.03.03 Type IX Retroreflective Sheeting in its entirety.

INSERT: The following.

950.03.03 Permanent Signs Retroreflective Sheeting. Retroreflective sheeting for permanent signs shall conform to ASTM D 4956-05, except as modified below:

MINIMUM REFLECTIVE INTENSITY VALUES FOR RETROREFLECTIVE SHEETING
Minimum Coefficient of Retroreflection·(R_A) cd/(lx · m^2)
Per ASTM E-810 (Average of 0 and 90 degree orientation)

Observation Angle°	Entrance Angle°	White	Yellow	Fluor. Yellow	Fluor. Yellow-Green	Red	Green	Blue	Fluor. Orange
0.2	-4	570	425	340	455	114	57	26	170
0.2	30	215	160	130	170	43	21	10	64
0.5	-4	400	300	240	320	80	40	18	120
0.5	30	150	112	90	120	30	15	6.8	45
1	-4	120	90	72	96	24	12	5.4	36
1	30	45	34	27	36	9	4.5	2	14

INSERT:

950.03.07 Permanent Traffic Signs (PTS) Unless otherwise specified in the Contract Documents, retroreflective sheeting for permanent signs shall conform to 950.03.03.