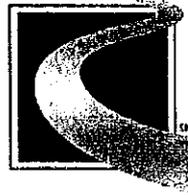


**MARYLAND TRANSPORTATION AUTHORITY**  
*Baltimore, Maryland*

*Invitation for Bids*



Maryland  
Transportation  
Authority

Contract No. HT-2258-000-002

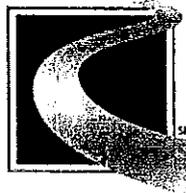
**Replace Existing BHT Overheight Detection System**

Baltimore City

**May 2010**

**MARYLAND TRANSPORTATION AUTHORITY**  
**Baltimore, Maryland**

***Invitation for Bids***



Maryland  
Transportation  
Authority

Contract No. HT-2258-000-002

**Replace Existing BHT Overheight Detection System**

Baltimore City

**May 2010**

**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 **10:00 am** on **June 10, 2010**, in the Francis Scott Key Bridge Administration Building conference room at 303 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 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.
- 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**

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](http://www.eMarylandMarketplace.com)



**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) and Trailer Truck Mounted Attenuators (TTMAs).
- (b) Temporary Barrier.
  - (1) Concrete Barrier.
  - (2) Traffic Barrier W Beam and Water Filled Barrier.
  - (3) Steel/Aluminum 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 (TMAs); Trailer Truck Mounted Attenuators (TTMAs) (b) Temporary Barriers (1) Concrete Barrier (2) Traffic Barrier W Beam and Water Filled Barrier (3) Steel/Aluminum 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.



## 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.



### **Security Guidelines and Procedures Applicable to Contractors Working on Non-Security Sensitive Contracts**

The following guidelines and procedures shall be enforced for Contractors. Contractors shall include vendors, prime contractors, subcontractors, consultants, or service personnel.

1. All Contractor personnel shall exercise due diligence in carrying out the Authority required security policies, laws, and regulations, as described below, while conducting work for the Authority.
2. The Contractor shall coordinate on-site visitations with the Office of Engineering - Construction. Situations that require Contractor employees to make "on site" visits will need to be planned in advance and coordinated with the Authority in order to have supervision provided. The Contractor shall coordinate with the Authority in advance of his/her visit. For roadway access, the Contractor shall follow the MOT requirements.
3. In the event of a security incident or suspected security incident, Contractor employees shall notify the Contractor's Project Manager immediately. The Contractor's Project Manager will in turn notify the nearest police detachment for investigation. The Contractor shall cooperate fully in all security incident investigations.
4. Any individual who is an employee or agent of the Contractor or any subcontractor shall display his or her company badge at all times while on the Authority's premises. Such employees or agents shall provide additional photo identification upon request of the Authority's employees. If the employee has an Authority ID, displaying a company badge is not necessary.
5. All Contractor's vehicles must display a valid Authority permit (hanging on the rearview mirror) while parked on the Authority's premises. The hanging tags are issued through the Division of Engineering - Construction.
6. The Contractor's personnel - who, in the performance of their duties, must have access to the site and security systems - shall obtain a valid Authority temporary/contractual ID badge. The Contractor shall apply for a badge and is required to present two forms of identification, one with the individual's photograph.
7. ID badges must be displayed at all times on outer garment above the waist while at Authority facilities.
8. Any Contractor employee, who is assigned to work on an Authority Contract and will be in and out of the facilities on a daily basis, must participate in an Authority-sponsored security orientation and training session. This training is sponsored by the Authority Security Office.
9. The Authority requires each person entering the premises with tools, equipment, etc., to have a written inventory of such tools and equipment being brought onto the site and to provide that inventory to the Authority when requested.



10. The Contractor is hereby warned that all persons not properly identified by an Authority issued ID badge or without a Company badge may be challenged, and if positive identification cannot be made, the appropriate corrective action shall be taken.
11. At the completion of the contract or when work at a given facility is complete, or in the event any employees are terminated, the Contractor must return all ID badges to the Authority within one business day.
12. The Contractor shall comply with and adhere to the "State Information Technology Security Policy and Standards." These policies may be revised from time to time. The Contractor shall comply with the most recent version. Current and revised versions of the security policy are available on-line at the following web location:  
  
<http://doit.maryland.gov/support/Pages/SecurityPolicies.aspx>
13. All personnel working on this contract are required to attend a 1-hour MdTA Security Awareness training session.
14. The Contractor shall not connect unauthorized equipment (including but not limited to laptops, desktops, storage devices, such as thumb drives, or other peripherals) or other personal equipment to any Authority LAN/WAN without prior written approval by the Authority. The Authority will provide equipment as necessary for support that requires connection to the Authority LAN/WAN, or give prior written approval as necessary for connection. All approvals shall be in writing from a Director or Assistant Director from the Division of Information Technology. Unauthorized equipment shall be any equipment that is not indented to be part of a final delivery to the MDTA as part of the contract deliverable items.



**TABLE OF CONTENTS**

	<u>Page No.</u>
Invitation for Bids .....	1
<b>Contract Provisions</b>	
Notice to Bidders - Check List Prior to Submitting Bids .....	3
Notice to Bidders/Offerors about eMaryland Marketplace .....	4
National Cooperative Highway Research Program .....	5-6
High Visibility Safety Apparel Policy .....	7-8
Security Guidelines and Procedures .....	9-10
Table of Contents .....	11-12
<b>Special Provisions</b> .....	<b>13-17</b>
Revisions to General Provisions .....	18-25
Revisions to Terms and Conditions – Control of Work .....	26-30
Revisions to Terms and Conditions – Legal Relations .....	30-33
Revisions to Terms and Conditions – Payment .....	34-37
Revisions to Technical Requirements:	
103 – Engineer’s Office .....	38-40
104 - Maintenance of Traffic (General) .....	41-50
108 – Mobilization .....	51
110 - Activities Chart Project Schedule .....	52
308 – Erosion and Sediment Control .....	53
800 – Traffic – BHT OHDS .....	54-130
805 – Electrical Conduit and Fittings .....	131-132
807 – Electrical Service Equipment .....	133-134
809 – Trenching and Backfill .....	135-136
810 – Electrical Cable, Wire and Connectors .....	137-139
811 – Hand Holes; Manholes, Hand boxes, Pull boxes and Splice Boxes .....	140-141
820 – Electrical Work and Testing .....	142-149
831 – Miss Utility .....	150
863 – Warranties .....	151-152
890 – Spare Parts .....	153-154
899 – Miscellaneous Construction and/or Repairs .....	155
921 – Materials - Miscellaneous .....	156
950 – Traffic Materials .....	157



Wage Rates .....	158
Contractor Affirmative Action Program .....	159-175
Affirmative Action Requirements Utilization of Minority Business Enterprises for Straight State Contracts.....	176-181
Bid/Proposal Form .....	182
Schedule of Prices .....	183-188
Contract Time and Bonding.....	189
Buy American Steel Act .....	190-192
Bid/Proposal Affidavit.....	193-203
Escrow Account For Retained Funds .....	204
Proposal Guaranty.....	205
Bid Guarantee .....	206-207
Bid Bond .....	208-210
Appendix A – Diagrams of Existing System.....	211-220



**SP 1-1 PROJECT DESCRIPTION**

**CONTRACT NO.:** HT-2258-000-002

**TITLE:** Replace Existing BHT Overheight Detection System

**FACILITY:** Baltimore Harbor Tunnel

**LOCATION:** Baltimore City

**ADVERTISED:** **May 25, 2010**

**PRE-BID MEETING:** **10:00 AM on Thursday June 10, 2010** in the Conference Room at the Maryland Transportation Authority, 303 Authority Drive, FSK Administration Building, Baltimore, MD 21222

**SITE VISIT:** **10:00 AM on Friday, June 11, 2010** in the parking lot of the FMT East Vent Building, 2310 South Clinton Street, Baltimore, MD 21224

**ALL QUESTIONS DUE:** On or before **June 30, 2010** at 4:00 p.m.

**PROJECT CONTACT:** Project Manager: Mr. Robert Jordan, P.E. at 410-537-7851.  
Contract Administration: Ms. Maggie Johnson at 410-537-7807.

**BIDS DUE:** **12:00 Noon on July 13, 2010** in the Bid Box on the 1st floor of the Maryland Transportation Authority, Engineering Building, 300 Authority Drive, Baltimore, MD 21222

**CLASSIFICATION:** Class B (\$100,001 to \$500,000)

**CONTRACT TIME:** 180 calendar days

**LIQUIDATED DAMAGES:** **\$800.00 per Calendar Day**

**MINIMUM MBE GOALS:** N/A

**BID DOCUMENTS:** \$60.00 - Bid documents can be purchased between 7:30am and 3:30pm, Mondays, Wednesdays, Thursdays and Fridays and between 10:00am and 4:00pm on Tuesdays at the Ticket Office located at the Francis Scott Key Bridge, Maryland Transportation Authority, Administration Building, 303 Authority Drive, Baltimore, MD 21222.



The Maryland Transportation Authority (Authority) is issuing this Invitation for Bid (IFB) to procure a Contractor to furnish, install, integrate, test, commission, and warrant an Overheight Detection System (OHDS) for 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. In addition, all terms and conditions of the Standard Specifications for Construction and Materials dated July 2008, revisions thereof, or additions there to, shall apply to this IFB unless specified herein.

#### **SP 1-3 SITE VISITS**

Parties interested in visiting the site should contact Mr. Dave Dikes, MdTA's ITS Manager at (410) 537-1096.

#### **SP 1-4 PROMPT PAYMENT TO SUBCONTRACTORS**

The prime Contractor is responsible for making timely payments to all Subcontractors and Suppliers as required in the 1988 edition of the State Finance and Procurement Article of the Annotated Code of Maryland, Section 17-106.

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

Each month, the 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 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 Director of Construction of the dispute. The Director 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 Contractor withholds payment from a Subcontractor, the 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 Director of Construction if this payment is not made. Upon receipt of notification, the Director 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 (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 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 pursuing a claim with the surety under the Prime Contractor's payment bond at any time.

#### **SP 1-5 WORK HOURS**

Reference Section 104 – Maintenance of Traffic for the hours that maybe worked at MdTA's facilities.

#### **SP 1-6 INSURANCE**

Refer to Section TC-5 of the Standard Specifications and the revisions herewith.

#### **SP 1-7 FOR INFORMATIONAL PURPOSES ONLY. MINORITY BUSINESS ENTERPRISE REGULATIONS GOVERNING CONSTRUCTION CONTRACTS IN EXCESS OF \$50,000 EFFECTIVE JULY 1, 2001**

No MBE goal has been assigned to this project. MBE firms will be directly solicited.

#### **SP 1-8 PROGRESS SCHEDULE REQUIREMENTS**

Refer to Section 110 of the Standard Specifications and the revisions herewith.



### **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 web site at e-mail address: [www.dat.state.md.us](http://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 the 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 remove 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 Project 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 on the transportation facility projects of the Authority, Contractor's personnel shall have an ID decal displayed on their hardhat. These decals will be provided by the Authority. All Contractor's 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. Request for hardhat and rearview mirror decals shall be made to the Construction Division before the beginning of construction and should include the number required of each type.

All costs associated with ID's 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 Research, 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 2**

**BIDDING REQUIREMENTS AND CONDITIONS**

**GP-2.04 SITE INVESTIGATION**

Revise the paragraph to read as follows:

The Contractor acknowledges that he has investigated and satisfied himself 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 and 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 he has satisfied himself as to the character, quality and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory INFORMATION IN POSSESSION OF THE AUTHORITY, as well as from information presented by any drawings and specifications made a part of this contract. Any failure by the Contractor to acquaint himself with the available information shall not relieve him from responsibility for estimating properly the difficulty or cost of successfully performing the work. The MdTA assumes no responsibility for any conclusions or interpretations made by the Contractor on the basis of the information made available by the MdTA.

**GP-2.06 PREPARATION OF THE BID**

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

The Contractor may elect to submit his bid on forms he has generated in the development of his 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, of 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
- (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 points 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 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 D. McGill, CPPB  
Chief Procurement Officer  
Maryland Transportation Authority  
Office of Procurement & Statutory Program Compliance  
300 Authority Drive, 1<sup>st</sup> Floor  
Baltimore, MD 21222-2200

**Acceptance of Terms and Conditions, and Amendments to General Provisions and Conditions**

By submitting an offer in response to this IFB, an Offeror, if selected for award, shall be deemed to have agreed to and accepted all of the terms, conditions and requirements set forth in the following: this IFB; Part I (General Provisions) and Part II (Terms and Conditions); Section 103 (Engineer's Office), Section 104 (Maintenance of Traffic), Section 108 (Mobilization), Section 110 (Activities Chart Project Schedule), Section 308 (Erosion and Sediment Control) and other Sections referenced in the Maryland Department of Transportation, State Highway Administration Standard Specifications of Construction and Materials, dated July 2008. Contracts are also subject to all other requirements of Maryland Law, including the State Finance and Procurement Article, Annotated Code of Maryland, and the Code of Maryland Regulations, (COMAR) Title 21, State Procurement Regulations. The particular attention of all Offerors is directed to Title 17, Subtitle 2, State Finance and Procurement Article, dealing with Prevailing Wage Rates on Public Works Contracts of \$500,000 or more.



**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 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.



Maryland  
Transportation  
Authority

**CONTRACT PROVISIONS**  
CONTRACT NO. HT-2258-000-002  
Replace Existing BHT Overheight Detection System  
Page 23 of 220  
May 2010  
**Page 6 of 8**

**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 comply with the provisions of GP 5.11 above, will result in the procurement officer immediately providing written notice to the Contractor to comply with the required maintenance provisions. In the event that the Contractor fails to COMPLETE CORRECTIONS 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 COMPLY WITH GP 5.11 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.



Maryland  
Transportation  
Authority

**CONTRACT PROVISIONS**  
CONTRACT NO. HT-2258-000-002  
Replace Existing BHT Overheight Detection System  
Page 24 of 220  
May 2010  
**Page 7 of 8**

**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.



Maryland  
Transportation  
Authority

**CONTRACT PROVISIONS**  
CONTRACT NO. HT-2258-000-002  
Replace Existing BHT Overheight Detection System  
Page 25 of 220  
May 2010  
**Page 8 of 8**

**GENERAL PROVISIONS**  
**GP SECTION 9**

**PAYMENT**

**GP 9.05 LATE PAYMENTS**

**ADD the following:**

- 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% per annum beginning on the 31<sup>st</sup> 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 specifications 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 submittals involving structural work must be submitted and stamped by a registered Structural Engineer with Professional Engineer certifications valid in Maryland. 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 or Special Provisions 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 approved 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 approved 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 approved 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 approved 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 Authority. 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, or Special Provisions 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 Authority, 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 the Authority 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 Authority upon notice to proceed of the project and shall include [bjordan@mdta.state.md.us](mailto:bjordan@mdta.state.md.us). Where electronic submittals are larger than what the Authority's email can support (currently about 4MB), the submission may be made using one or more of the following alternatives:

1. Post the submittals on a Contractor-supported FTP server, or a service-provider server that may be accessed by the Authority, as long as an email notice with downloading instructions (including user ID and password if applicable) is made with the 'cover' sheet.
2. Copied onto a CD, DVD, or other supported data media and submitted to the Authority via standard mail. At least 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: Robert Jordan

**ADD:**

(c) Electronic Submittal Format. All electronic submittals shall be in a format readable by the Authority. The submittals shall be in Adobe portable document format (PDF) compatible with version 6.0 of Adobe Acrobat (not any later version).

Each submittal shall be a single file and for a single component or a group of components described in the associated bid line item. The Contractor may divide a bid item into multiple submittals for convenience if the situation warrants. 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 a re-submittal 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 the reviewers' stamps may be placed (electronically) without covering the data in the page.

The electronic file must not be secured. The reviewers of the electronic submittals will place electronic stamps and may include comments in the electronic submittals provided by the Contractor. Any security or incompatibility 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 MA 510-000-006, the first five characters of the file name must be MA510.
2. The sixth character must be a dash.
3. The seventh through ninth characters shall be the text "SUB," which is short for "Submittal" and 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. MA510-SUB-001-Conduit.pdf
  - ii. MA510-SUB-001R2-Conduit.pdf
  - iii. MA510-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 Authority 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 Authority 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 3 copies of all media.

**TC-4.02 FAILURE TO ADEQUATELY MAINTAIN PROJECT**

**ADD:** To the existing paragraph.

Additionally, an appropriate deduction will be made from the Contractor's net 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 prorata share of the price bid for Maintenance of Traffic bid items 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 up 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 payment 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 price bid for Maintenance of Traffic bid items or **\$500.00** 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.**

**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 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 \$1,000,000 per occurrence/\$2,000,000 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 30 days notice of cancellation or non-renewal to:

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

The Contractor shall satisfy the following:

1. The Contractor shall not commence work under this contract until he has obtained all of the minimum amounts of insurance required by these Special Provisions and the insurance has been approved by the Project Engineer. The Contractor shall furnish to the Maryland Transportation Authority ("Authority") duly executed certification of all required insurance on forms satisfactory to the Authority (e.g., ACCORD FORM). The certificates of insurance shall state that it is in force and cannot be cancelled, released 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 Authority has accepted the Contract 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 \$100,000. 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) 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 (\$500,000) 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) 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 from default/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 and Bid Item 1003), or if the Contract does not include such an item, the insurance costs are to be included in pay items for the Proposal.



TERMS AND CONDITIONS  
TC SECTION 7

PAYMENT

See Section TC 7 of the SHA's *Standard Specifications (Part II Terms and Conditions)* in conjunction with the changes shown in this Section.

Revise as follows:

Revise the definition of Administration to read as follows:

Administration - The word "Administration" shall mean the Maryland Transportation Authority (MdTA).

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, false work, 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 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), which are designed and fabricated exclusively for use on a specific project.

- (e) Materials 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 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 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) whichever 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% 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.



**CATEGORY 100**  
**SECTION 103 — Engineer's Office**

See Section 103 of the SHA's *Standard Specifications for Construction and Materials (Part III Technical Requirements)* in conjunction with the changes shown in this Section.

**103.01 DESCRIPTION.**

**ADD:** The office must be centrally located, near the project site.

**103.03 CONSTRUCTION.**

**103.03.05 Requirements for all Offices.**

144 **ADD:** the following after (v).

(w) One paper shredder capable of shredding at least 10 sheets (20 lb bond) at a time. Throat width of at least 12 in. Speed of at least 20 feet per minute. Auto reverse or auto stop for paper jams. Power of at least 115 v.

146 **DELETE:** 103.03.09 Recyclable Materials (Paper, Bottles, Cans, Etc.) in its entirety.

**INSERT:** The following.

**103.03.09 Recycling.** Recycling of recyclable paper (bond, newsprint, cardboard, mixed paper, packaging material and packaging), bottles (glass and plastic), and aluminum cans will be required at the Engineer's Office and the Contractor's facilities for the project.

Furnish approved containers, and remove the material from the site on an approved schedule or as directed. All material shall be taken to an authorized recycling facility. Maintain a log for the duration of the project documenting the type of materials recycled. The log shall include the types of material, date, time, location of facility, and signature line. Furnish a copy of the log at the completion of the project and upon request.

The Contractor shall be considered the owner of any profit and be responsible for all incurred costs.

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

**INSERT:** The following.

**103.03.06 Microcomputer System for all Offices, including Type 'C' and 'D' Offices.**

(a) Desktop Unit.

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



- (2) Minimum microprocessor speed of 2.8 GHz.
- (3) Minimum hard drive storage of 100 GB (gigabyte).
- (4) Minimum of 2.0 GB RAM (Random Access Memory).
- (5) Enhanced 101 keyboard with wrist rest.
- (6) Super Video Graphics Accelerator (SVGA).
- (7) Modem 56K BPS, ITU V.92 compliant, with separate independent telephone line and phone number to dedicated phone jack.
- (8) Mouse with mouse pad.
- (9) One CD-ROM drive.

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

**(c) Video Monitor.** LCD monitor conforming to Energy Star requirements with a minimum screen size of 17-inch.

**(d) Printer.** HP (Hewlett-Packard) Compatible Laser Jet Printer with minimum resolution of 1200 DPI (dots per inch) and a minimum of 8 MB of RAM. Office jets and Bubble jets will not be accepted. Printer shall have a minimum print speed of 10 PMM (pages per minute) with flat scanner.

**(e) Software.**

- (1) Microsoft® Office 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 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.

**(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 Authority. The remaining microcomputer system shall remain the property of the Contractor.

**103.04 MEASUREMENT AND PAYMENT**

**ADD:**

Refer to Bid Item 1004.



**CATEGORY 100**  
**SP 104 – MAINTENANCE OF TRAFFIC**

**104.01 TRAFFIC CONTROL PLAN (TCP)**

**104.01.01 DESCRIPTION**

149 **DELETE:** The entire sentence “Refer to contract Documents for Work Restrictions” in the 4th paragraph

**INSERT:** The following.

This project is to procure a Contractor to furnish, install, integrate, test, commission, and warrant an Overheight Detection System (OHDS) for the Baltimore Harbor Tunnel (BHT). All work related to the BHT OHDS shall be conducted in such a way as to minimize impacts to the free flow of traffic and other higher priority construction work (e.g., decking repair, signal repair). The schedules below provide guidance as to when such work will be permitted, but any number of events may cause additional limits. The Contractor will have no claims for delays gaining access to install or maintain any equipment and must request permits and obtain approval for access wherever lane or shoulder closures are required.

**AGENCY CONTACTS**  
 (Pre-Construction/Existing Contract Coordination)

CONTACT	TITLE	PHONE NUMBER
Dave Roehmer	Fort McHenry and Baltimore Harbor Tunnels (FMT/BHT) Administrator, MdTA	410-537-1310
Jeff Robson	BHT Electrical Supervisor, MdTA	410-537-1274
Roxane Y. Mukai	Traffic Manager, MdTA	410-537-7848
Robert Jordan	Design Engineer, MdTA	410-537-7851
William Mentzer	Construction, MdTA	410-538-5730
David Dikes	ITS Manager, MdTA	410-537-1096

**INSERT:** The following:

**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 14 calendar days or 10 working days notification. The Engineer shall then notify the affected facilities, the Engineering Division’s Traffic Section and other appropriate offices.



No lane or shoulder 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. The Contractor shall cooperate with, and coordinate work activities with Contractors in adjoining or overlapping work areas.

The Contractor is responsible for obtaining lane/shoulder closure or other Permits from all affected agencies that require permits for work on their right of way, including those listed in this Special Provision. The Contractor shall make contact with the representative from the affected agency, through the Project Engineer and provide a copy of all coordination correspondence to the Authority. Sufficient time shall be allowed for review and approval of the permit application.

No equipment, material or debris shall be stored or permitted to stand in open areas closer than 30 (thirty) feet from where traffic is being maintained unless protected by traffic barriers. The Contractor's employees shall not park their vehicles within the right-of-way of the through highway, unless written permission for an exception is given by the Engineer.

#### **ALLOWABLE LANE CLOSURE SCHEDULES**

The allowable closure schedules below depict the times that will typically be approved for access. However, many events and special circumstances may render specific dates and times inaccessible, including, but not limited to, other Contractors working in the area, special events known to significantly increase traffic volumes, expectation of inclement weather, or work by the Authority in the area. The Contractor shall coordinate the scheduling of work with the Authority and other Contractors working on the facility to ensure that there are no conflicts that result in severe traffic backups or safety risks for motorists or workers.

Additionally, although not typical, it is possible that in special circumstances access may be granted outside of the scheduled times listed below at the sole discretion of the Authority. Flexibility of the Contractor with respect to access dates and times is required and highly desired. The Contractor must be able to adjust his schedule based on the availability of roadway.

**HIGHWAYS:** The following schedule applies to highways and roadways in this project (i.e., I-895). Applicable highways also include the *approaches* to the BHT. No installations will be permitted the day preceding, the day of, or the day following State Holidays.



**Table A – Work Hour Restrictions**

TIME OF DAY	DAYS OF THE WEEK	ALLOWED CLOSURES	MOT PROVIDED BY
9:30 AM – 2:30 PM	Monday-Thursday	Southbound, 1 Lane	Contractor
9:30 AM – 1:00 PM	Friday	Southbound, 1 Lane	Contractor
9:00 AM – 1:00 PM	Monday-Thursday	Northbound, 1 Lane	Contractor
9:30 AM – 12:00 N	Friday	Northbound, 1 Lane	Contractor

Contractor’s request for changes to the allowed hours of closure must be submitted to the Engineer. Requested changes cannot be approved without the approval of the BHT Facility Administrator and the Authority’s Traffic Manager.

**Work Restrictions – all locations**

The Traffic Control Plan (TCP) for work consists of a staged Maintenance of Traffic (MOT) Plan which will be employed to perform all work in the contract. 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 be in writing and shall require written approval from the Engineer at least seventy-two (72) hours prior to implementing the change. The Contractor shall submit a copy of the original work restrictions with the written request.

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, or periods of time for which a permit has not been issued. All existing lanes of traffic along the subject roadway must be completely open during these hours.

No lane or shoulder closures are permitted on the Holidays listed below. No lane or shoulder closures are permitted on the work day preceding and work day following the Holidays with checked boxes indicated below:

- New Year's Day (January 1)
- Martin Luther King's Birthday (third Monday in January)
- President’s Day (third Monday in February)
- Good Friday
- Easter Weekend
- Memorial Day (last Monday in May)
- Independence Day (July 4)



- Labor Day (first Monday in September)
- Columbus Day (second Monday in October)
- Veteran's Day (November 11 – checked box only applies if Holiday falls on a Friday or Monday)
- Thanksgiving Break (fourth Thursday in November and the Wednesday before)
- Christmas Day (December 25)

If a holiday falls on a Thursday, Friday, or Monday, no closures will be permitted during that weekend. If a holiday happens to fall between May 1 and September 30, no closures will be permitted during the week of the holiday without the expressed approval of the Facility Administrator.

No lane or shoulder closure will be permitted without the written approval of the Facility Administrator that is being impacted by the work and an approved lane/shoulder closure permit from the Traffic Manager.

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 30 minutes.

The MdTA reserves the right to cancel any scheduled closure for any reason. Typically, cancellations will be made for inclement weather and unusual traffic conditions or the expectation of inclement weather and unusual traffic conditions. For the purposes of maintaining a schedule and for the purposes of delay claims, the following applies:

- A workday shall be any day that the Contractor should be permitted to work as stated above.
- A cancellation (cancelled workday) is any event where the MdTA cancels or refuses to permit work on a workday that the Contractor has requested access to work. This shall include, but not be limited to cancellations due to weather; traffic; visibility; other contractor's working in the area; or other cause. (Listed holiday restrictions and restrictions in Table A – Work Hour Restrictions above shall not be included as cancellations).
- The Contractor shall assume that 40% of the workdays (rounded up to the nearest full workday) at the BHT are unavailable due to MdTA cancellations.
- No delay claims shall be permitted as long as the overall number of cancelled work days over the life of the project is 40% or fewer of the total workdays available.



Maintenance, repair and installation work shall generally be the lower priority whenever another Contractor is working, or other work, is requested at a site and the Contractor MUST coordinate frequently and be prepared for cancellations. Cancellations by the Authority up to two (2) hours prior to scheduled work shall not result in claims or adjustments. Cancellations within two (2) hours of the scheduled work will allow claims for actual costs incurred for equipment rental or mobilization that may be deemed reasonable by the Authority.

The Contractor should make every attempt to work during approved times or times the Authority makes available, including changing the order in which work progresses. The Contractor should take full advantage of working time when it is available by using multiple crews or working on different facilities and multiple facilities simultaneously in order to complete work within the contract time.

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

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 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 Traffic Control Plan (TCP) including procedures to be implemented for lane/shoulder closures.

All lane or shoulder 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 or shoulder 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 the 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.

<b>ELAPSED TIME (MINUTES)</b>	<b>DEDUCTION</b>
1 – 5	\$ 75.00
Over 5	\$ 75.00 per minute (in addition to the original 5 minutes)

**Use of Typical.** The TCP shall consist of plan sheets and the following Maryland Standard Traffic Control Typical, which will be employed as required to perform all construction and installation.

*Note:* Use 65 mph anticipated operating speed for channelization taper design on I-895. For distance between advance work zone signs use Urban (high speed) Road Type.

<b>TCP TYPICAL</b>	<b>MD STANDARD NO.</b>
Right Lane Closure/Expressway-Freeway	104.05-07
Left Lane Closure/Expressway-Freeway	104.05-08
Shoulder Work/Expressway-Freeway	104.05-01
Partial Ramp Closure/Expressway	104.05-18

**104.01.02 MATERIALS.** No Changes.

**104.01.03 CONSTRUCTION.** No Changes.

**104.01.04 MEASUREMENT AND PAYMENT.**

150 **DELETE:** 104.01.04 MEASUREMENT AND PAYMENT in its entirety.

**INSERT:** The following:



Maintenance of Traffic will not be measured but will be paid for at the Contract price per each type of closure provided (1-shoulder or 1-lane).

The payment will be full compensation for all labor (including Traffic Manager), material and equipment including truck mounted attenuator, cones, barriers, arrow panels and other items for which a bid item has not been established but which are required by the approved maintenance of traffic plan, 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. Refer to Bid Items 1001 – 1002.

**104.02 MAINTENANCE OF TRAFFIC (MOT)**

No changes.

**104.03 TEMPORARY RAISED PAVEMENT MARKERS (RPM)**

No changes.

**104.04 TEMPORARY CONCRETE TRAFFIC BARRIER (TCB) FOR MAINTENANCE OF TRAFFIC.**

**104.04.03 CONSTRUCTION.**

**104.04.04 MEASUREMENT AND PAYMENT. No Changes.**

No changes.

**104.05 TRAFFIC BARRIER W BEAM (TBWB) FOR MAINTENANCE OF TRAFFIC**

No changes.

**104.06 TUBULAR MARKERS**

No changes.

**104.07 ARROW PANEL (AP)**

No changes.

**104.08 TEMPORARY TRAFFIC SIGNS (TTS)**

No changes.



**104.09 TEMPORARY TRAFFIC BARRIER END TREATMENTS**

No changes.

**104.10 TEMPORARY CRASH CUSHION SAND FILLED PLASTIC BARRELS (SFPB)**

No changes.

**104.11 TEMPORARY PAVEMENT MARKINGS**

No changes.

**104.12 DRUMS FOR MAINTENANCE OF TRAFFIC**

**DELETE:** Section 104.12.04 MEASUREMENT AND PAYMENT in its entirety.

**INSERT:** The following.

**104.12.04 MEASUREMENT AND PAYMENT.** Drums for Maintenance of Traffic will be included in the price for lane and shoulder closures bid items. The payment will include reflectorization, setting, resetting, removing, sandbags, maintenance, cleaning of drums to like new condition, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

**104.13 BARRICADES FOR MAINTENANCE OF TRAFFIC**

No changes.

**104.14 CONES FOR MAINTENANCE OF TRAFFIC**

**104.14.02 MATERIALS.**

171 **DELETE:** First paragraph on this page "Cones shall be...an upright position".

**INSERT:** The following.

All cones shall meet Md MUTCD and be new or like new condition. All cones shall be orange in color. Cones shall be at least 28 in. high, 10 in. diameter at the inside of the base, and reflectorized with two white retroreflective stripes. The top stripe shall be 6 in. wide and located 3 to 4 inches from the top of the cone. The second stripe shall be 4 in. wide and located 2 inches below the top band.



**Tall-Weighted Cones.** When specified, tall-weighted cones shall be at least 42 in. high and 7 in. diameter at the inside of the base. Tall-weighted cones shall be manufactured of low density polyethylene (LDPE) and have four high performance wide angle white and orange retroreflective stripes. The stripes shall be horizontal, circumferential and 6 in. wide. Alternate stripe colors with the top stripe being orange. Any nonretroreflective spaces between the orange and white stripes shall not exceed 1/2 in.

**104.14.03 CONSTRUCTION.**

**ADD:** The following after the first paragraph "The Contractor's name...away from traffic".

Equip all cones with approved weights or anchor collars, (15 lb maximum) as needed to maintain an upright position. Anchor collars shall fit to the base of the cone. For tall-weighted cones use anchor collars weighing 10 to 30 lb.

**104.15 FLAGGER**

No changes.

**104.16 MODIFICATION OF EXISTING SIGNS**

No changes.

**104.17 TEMPORARY MOVABLE TYPE CONCRETE TRAFFIC BARRIER (MCTB)**

No changes.

**104.18 TRAFFIC MANAGER (TM)**

No changes.

**104.19 PORTABLE VARIABLE MESSAGE SIGNS (PVMS)**

No changes.

**104.20 TEMPORARY ORANGE CONSTRUCTION FENCE**

No changes.

**104.23 PROTECTION VEHICLE (PV).**

**DELETE:** Section 104.23.04 MEASUREMENT AND PAYMENT in its entirety.



**INSERT:** The following.

**104.23.04 MEASUREMENT AND PAYMENT.** Protection Vehicles will be included in the price for lane and shoulder closures bid items. The payment will be full compensation for the complete PV, including the TMA and arrow panel, licensed work vehicle operator, connecting and disconnecting the attenuator to/from the work vehicle, transporting and relocating the PV, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.



**CATEGORY 100**  
**SECTION 108 — Mobilization**

See Section 108 of the SHA's *Standard Specifications for Construction and Materials* in conjunction with the changes shown in this Section

Revise as follows:

Revise the definition of Administration to read as follows:

Administration - The word "Administration" shall mean the Maryland Transportation Authority (MdTA).

**ADD:**

**108.04 MEASUREMENT AND PAYMENT**

**ADD:**

Refer to Bid Item 1003.



## SECTION 110 — ACTIVITIES CHART PROJECT SCHEDULE

### 110.01 DESCRIPTION

#### **ADD:**

Activities Chart Project Schedules shall be shall be submitted to the Engineer two (2) weeks prior to starting work and shall be updated to reflect progress and resubmitted to the Engineer once per month.

### 110.04 MEASUREMENT AND PAYMENT

**DELETE:** 110.04 Measurement and Payment in its entirety.

**INSERT:** The following.

Activities chart project schedules will not be measured but the cost to develop, prepare, write, record, meetings, revise, distribute, update and all incidentals necessary to complete the work will be included in the other pay items specified in the Contract Documents.



**CATEGORY 300**  
**SECTION 308 — EROSION AND SEDIMENT CONTROL**

See Section 308 of the SHA's *Standard Specifications for Construction and Materials (Part III Technical Requirements)* in conjunction with the changes shown in this Section.

Revise as follows:

Revise the definition of Administration to read as follows:

Administration - The word "Administration" shall mean the Maryland Transportation Authority (MdTA).

**308.04 MEASUREMENT AND PAYMENT**

**DELETE:** 308.04 Measurement and Payment in its entirety.

**INSERT:** The following.

Erosion and sediment control will not be measured, but the cost to perform the necessary work and furnish the required materials will be considered incidental to the work and will be included in the other pay items specified in the Contract Documents. Refer to Bid Items 8015, 8016, 8017, 8018, 8021, 8022, 8023, 8024, 8025, 8026, and 8027.



**CATEGORY 800  
TRAFFIC**

**800.01 DESCRIPTION**

The Maryland Transportation Authority (Authority) is issuing this Invitation for Bid (IFB) to procure a licensed and experienced Contractor to furnish, install, integrate, test, commission, and warrant an Overheight Detection System (OHDS) for the Baltimore Harbor Tunnel (BHT).

This project includes work at the following locations:

BALTIMORE HARBOR TUNNEL (B.H.T.)  
Administration Building, 1200 Frankfurst Avenue, Brooklyn, MD 21226

The facility contact for coordination is Mr. Jeff Robson. His telephone number is 410-537-1274

**800.01.01 SCOPE**

The scope of this project is to remove and replace the BHT OHDS at Post #3 and Post #4. This effort entails the following tasks:

1. Remove and replace Programmable Logic Controllers (PLCs);
2. Remove and replace through beam photoelectric sensors;
3. Remove and replace buzzer alarms;
4. Remove and replace sensor status indicator lights inside the Post #3 and Post #4 buildings;
5. Remove and replace sensor status indicator beacons outside the Post #3 and Post #4 buildings;
6. Remove and dispose of existing power and communication wiring from the existing PLC to each existing sensor, and from the PLC to the existing buzzers and indicator lights/beacons;
7. Furnish and install new power and communication wiring from the new PLC location to each new sensor, and from the new PLC location to the existing buzzers and indicator lights/beacons;
8. Reuse existing conduits where possible;
9. Trench, furnish and install new conduits where required;
10. At the Contractor's option, utilize existing network connections and fibers, where dark fibers exist;
11. Furnish, install, configure, and test the system to conform to the concept of operations;
12. Furnish, install and test two (2) new CCTV cameras, two (2) new Refers, and two (2) new 19" LCD monitors to capture and display snapshot images of over-height trucks at the instant the beam is broken at designated sensor locations;
13. Furnish and install web-based graphics and event logging capability on existing workstations in Post #3 and Post #4;
14. Reuse existing sensor poles, structures, electronic fiber optic message signs, and canopy signals.
15. Furnish and install power supplies, UPSs, and racks where required.



Note: It is important for the Contractor to understand that the existing system must remain operational, to the extent possible, as the new system is installed. Under no circumstances shall the entire existing OHDS be taken offline for any period greater than 24 hours.

**800.01.02 POST #3 CONCEPT OF OPERATION**

The Contractor shall deploy the system to satisfy the following concept of operation. *Note: blue italicized text is used to indicate changes from the current configuration.* Please also note that as of February 2009, the Post #3 building was replaced with a new building. The illustrations of the building in the photos below are of the older building. The new building is of comparable size.

It is also important to note that an effort has been made to standardize the operation between Post #3 and Post #4 where possible. In many cases the quantity of status lights/beacons, the meaning of each on/off state, and their locations described below do not always match the photos. The photos are intended for reference only. The specification governs the required functionality.

The system consists of five (5) electronic sensors that cross the northbound (NB) traffic lanes only, three (3) electronic fiber optic message signs at Lanes 1-3 of the Toll Plaza, three (3) buzzers at Lanes 1-3 of the Toll Plaza, three (3) beacons at Lanes 1-3 of the Toll Plaza, one (1) PLC, one (1) building buzzer, one (1) camera, one (1) DVR, three (3) canopy lights, a set of eight (8) status-indicator lights inside the Post #3 Building, and two (2) sets of five (5) status-indicator beacons outside the Post #3 Building. *The new system shall be expandable (i.e., input and output expansion modules on the PLC) to accommodate future sensors in Lanes 4-7.*

Table 1 below provides a summary of the equipment composing the Post #3 OHDS.

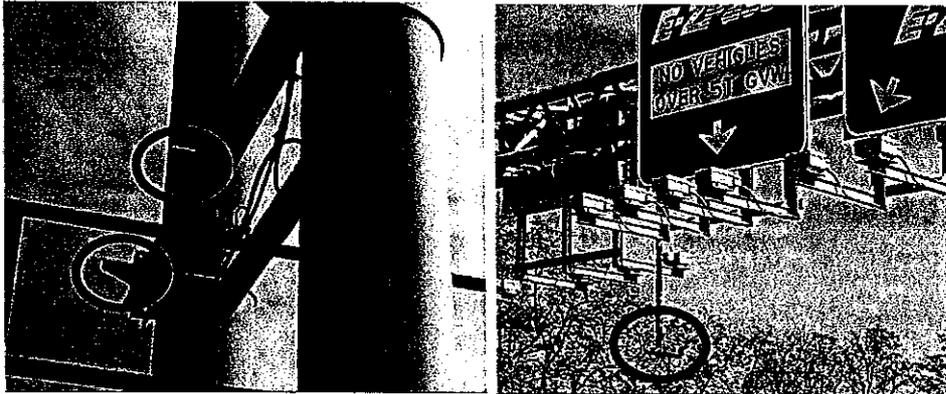
**Table 1: Post #3 OHDS Equipment**

Item #	Description	Quantity
1.	Photoelectric Sensor Pairs	5
2.	Programmable Logic Controllers (PLCs)	1
3.	Interior Status Indicator Lights with Panel at Post #3 (5 sensors and 3 signs, <i>and test input button</i> )	9
4.	Electronic Fiber Optic Message Signs at Toll Booth Lanes 1-3	3
5.	Buzzers at Toll Booth Lanes 1-3	3
6.	Exterior Status Indicator Beacons at Toll Booth Lanes 1-3	3
7.	Canopy Light on Reverse Side of Toll Plaza Rooftop over Toll Lane	3
8.	Outside Buzzer at Post #3 Building	1
9.	Exterior Status Indicator Beacons with Fixture at Post #3 Building	2 Sets of 5
10.	New Camera and DVR	1

I. NORMAL OPERATION

The normal mode of operation is as follows:

- A. Operations are normal when all sensors are active and functioning. There are two (2) sensor pairs (transmitter/receiver) after the K-Truss Bridge, referred to as Primary A and Primary B. They are approximately 4' apart and shoot across the NB I-895 lanes. There are three (3) secondary sensors, referred to as lane sensors for Lane 1, Lane 2, and Lane 3 of the Toll Plaza. These are located at the beginning of the concrete island that separates the lanes in front of the toll booth (also known as the "dead man" area). The lane sensors shoot only across one lane. Note that Lanes 4-7 have no sensors, as trucks are required to pass through Lanes 1-3 only. The Primary and Secondary sensors are shown in Figure 1.



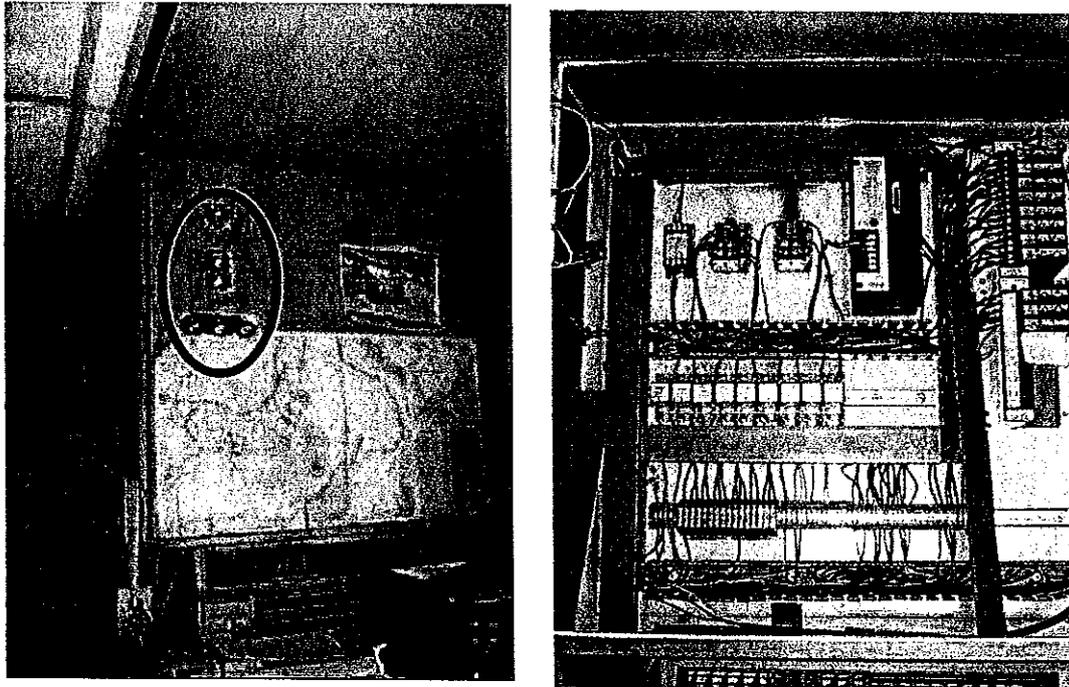
Primary A and Primary B



Secondary in Lanes 1 through 3

**Figure 1: Primary and Secondary Over-Height Vehicle Sensors**

- B. Operations are normal when all *eight (8)* of the sensor status **indicator lights inside** of Post #3 *are off* (refer to Figure 2), indicating that the 5 sensors are functioning and aligned, *and the 3 DMS signs have no messages.*



**Figure 2: Post #3 PLC Panel Sensor Interior Status Indicator Beacons (left) and View Inside of Existing Panel (right)**

- C. Operations are normal when two (2) sets of five (5) sensor status indicator **beacons outside** of Post #3 *are off* (refer to Figure 2), indicating that the 5 sensors are functioning and aligned. Note: it is not necessary to have DMS status lights on the outside of the Post #3 Building.
- D. If any of the sensors comes out of alignment or becomes dirty, or its reflector is blocked, the sensor status indicator light of that sensor inside the Post #3 Building will flash slowly (approximately once per second) and will remain flashing until the problem is corrected. Similarly, the sensor status indicator beacons outside the Post #3 Building, which corresponds to that sensor, will flash slowly (approximately once per second) and will remain flashing until the problem is corrected. Under this condition, the receiving sensor transmits an alarm condition back to the PLC which triggers the system to light/flash the appropriate lights and beacons to cue the operator of this condition, all other sensors remain functional and will operate normally.
- E. If the panel light is flashing, the detector should be cleaned according to the manufacturer's recommendations.

## II. ALARM MODE

The system enters alarm mode any time a beam (i.e., Primary A or Primary B) is broken that is not due to misalignment, a dirty lens, or a blocked reflector. An overheight vehicle traveling NB and approaching the tunnel will break the beams starting at the Primary A location, then the Primary B location, and then one of Lanes 1-3. Note that trucks are not permitted to use toll Lanes 4-7 at the BHT Toll Plaza.

The alarm mode is defined as follows:

- A. If the Primary A sensor detects a beam break (i.e., overheight condition) or the Primary B sensor detects a beam break, the following occurs:
  1. The buzzer outside the Post #3 Building will come on for 15 seconds (refer to Figure 3). This time shall be configurable. At MdTA's option, the Contractor shall program a different ring pattern (or pulsing) for buzzer alarms, allowing the Police to differentiate the audible from a Primary A/B sensor break versus a Lane 1-3 sensor break.

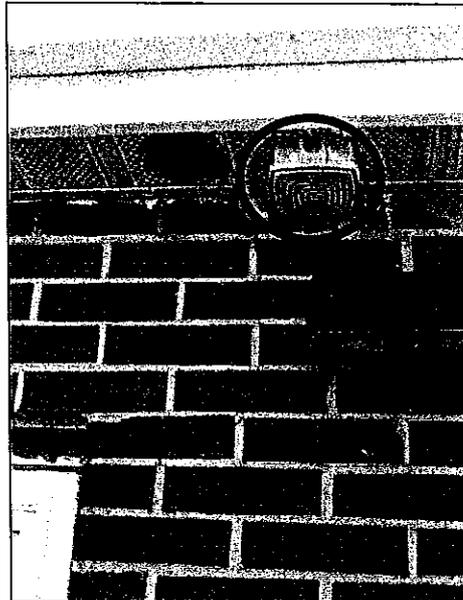


Figure 3: Post #3 Buzzer

2. The sensor status indicator light **inside the building** (refer to the earlier Figure 2), corresponding to the sensor with the broken beam, will be steadily lit for 15 seconds to indicate the sensor (Primary A or Primary B, or both) that had the broken beam. This time shall be configurable.

3. The sensor status indicator beacons **outside the building**, corresponding to the sensor with the broken beam, will be steadily lit for 15 seconds to indicate the sensor (Primary A or Primary B, or both) that had the broken beam. This time shall be configurable.
  4. Note that the system can enter the alarm mode if either Primary A or B is functioning. In other words, the sensors are independent and the system will alarm if one of the two sensor beams is broken.
- B. In addition to the above, when any lane sensor (for Lanes 1-3) beam is broken the following occurs:
1. The buzzer outside the Post #3 building will come on for 15 seconds (refer to Figure 3). This time shall be configurable.
  2. The sensor status indicator light **inside the building** (refer to Figure 2), corresponding to the sensor with the broken beam, will be steadily lit for 15 seconds to indicate the sensor that had the broken beam (Lane 1, 2, or 3, or any combination thereof). This time shall be configurable.
  3. The sensor status indicator beacons **outside the building**, corresponding to the sensor with the broken beam, will be steadily lit for 15 seconds to indicate the sensor that had the broken beam (Lane 1, 2, or 3, or any combination thereof). This time shall be configurable.
  4. The dynamic message sign, beacon, and buzzer at that toll lane will come on for the same 15-second time period. The Canopy Traffic Light on the Post #3 side of the Toll Plaza will flash over the activated lane. Note that the Canopy Traffic Light is located on the reverse side of the toll plaza rooftop (over the toll booth lane) and is visible by the Police from Post #3. The Police officer is alerted by the buzzer and can look at the toll booth to observe the vehicle as it comes out the toll area and prior to its entry into the tunnel (refer to Figure 4). This capability is useful when the Police Officer is outside the Post #3 Building, and the lights outside the building can't be seen, but the buzzer can be heard and the Canopy lights at roof level on the plaza can be seen.



**Figure 4: Lane Sign, Buzzer, Beacon (left); the 3 Signs of Lanes 1-3 (center); Canopy Signal on Post #3 Side (right)**

- C. In an alarm condition, the receiving sensor transmits a PNP alarm condition back to the PLC which triggers the system to light/flash the appropriate lights and beacons, illuminate the signs, sound the buzzers and flash the canopy signal to cue both the Police Officer and the Truck Driver.
- D. *In addition to the above, the system will take a snap shot video clip (with 2 seconds of pre-event, 5 seconds of event, and 2 seconds of post-event video) when an overheight truck breaks the beam at either the Primary A or Primary B location. A new, fixed color camera will be installed by the Contractor atop the Toll Plaza, on the E-ZPass sign's structure (refer to Figure 5) and have a zoomed in (auto-home) view up to the Primary A and Primary B sensor location. The view will be zoomed in enough to clearly show all vehicles in the NB direction immediately (within 0.5 seconds) after the beam is broken. A snapshot of the video will be transmitted and made available for immediate display on the monitor at Post #3. All camera video will also be stored on the DVR for a minimum of 30 days.*

### III. TEST MODE

*The test mode is defined as follows:*

*When the Officer presses a Test button located inside the Post #3 Building, the system shall enter the Alarm mode (refer to Alarm Mode above). In this mode, the system simulates a beam break at all sensors simultaneously and allows the system's buzzers, DMSs, and sensor status indicator lights and beacons to be tested. The system functions exactly as it would if a true beam break were to occur. Note: the Contractor should understand that the system must function as long as at least one (1) sensor pair is functional.*



Figure 5: Location of Future Camera (on the E-ZPass Sign Structure)

### 800.01.03 POST #4 CONCEPT OF OPERATION

The Contractor shall deploy the system to satisfy the following concept of operation. *Note that blue italicized text is used to indicate changes from the current configuration.* Also note that as of February 2009, the Post #4 Building was replaced with a new building. The illustrations of the building in the photos below are of the older building. The new building is of comparable size.

It is also important to note that an effort has been made to standardize the operation between Post #3 and Post #4 where possible. In many cases the quantity of status lights/beacons, the meaning of each on/off state, and their locations described below do not always match the photos. The photos are intended for reference only. The specification governs the required functionality.

The system consists of five (5) electronic sensors that cross all SB and NB traffic lanes, two (2) electronic fiber optic message signs, one (1) PLC, one (1) building buzzer, one (1) camera, one (1) DVR, a set of two (2) exterior status indicator beacons at the Sensor #4 pole, a set of seven (7) status indicator lights inside the Post #4 building and two (2) sets of five (5) status indicator beacons outside the Post #4 building. *The new system shall be expandable (i.e., input and output expansion modules on the PLC) to accommodate future sensors in toll Lanes 4-7.*

Table 2 below provides a summary of the equipment composing the Post #4 OHDS.



**Table 2: Post #4 OHDS Equipment**

Item #	Description	Quantity
1.	Photoelectric Sensor Pairs	5
2.	Programmable Logic Controllers (PLCs)	1
3.	Interior Status Indicator Lights with Fixture at Post #4 (2 signs, 5 sensors, and test input button)	8
4.	Electronic Fiber Optic Message Signs on Freeway	2
5.	Outside Buzzer at Post #4 Building	1
6.	Exterior Status Indicator Beacons with Fixture at Post #4 Building	2 Sets of 5
7.	New Camera and DVR	1
8.	Exterior Status Indicator Beacons at Sensor #4 Pole	2

**I. NORMAL OPERATION**

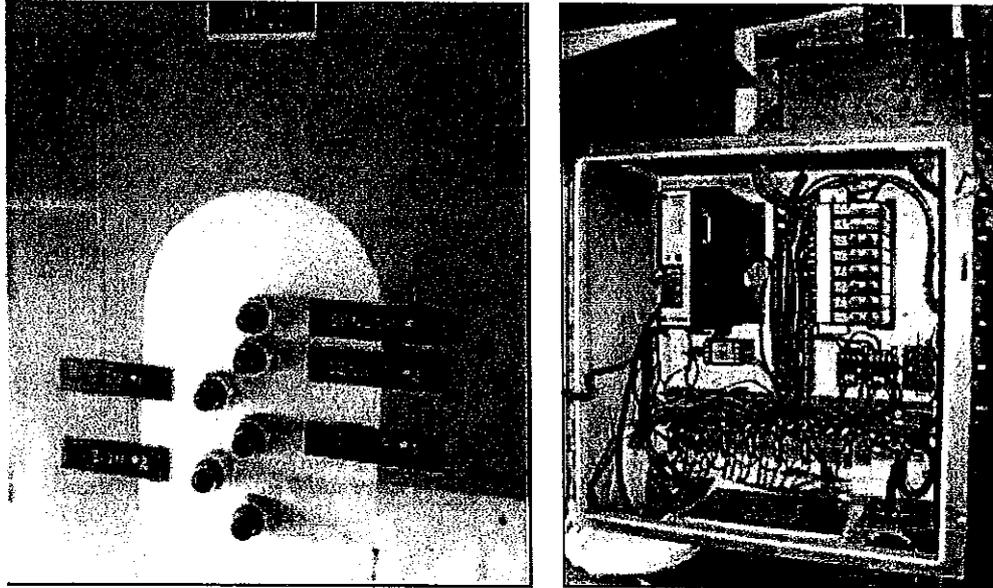
The normal mode is defined as follows:

A. Operations are normal when all sensors are active and functioning. All five (5) sensor pairs (transmitter/receiver) are prior to Post #4. Similar to Post #3, the Post #4 sensors are split into two (2) categories, primary and secondary as follows:

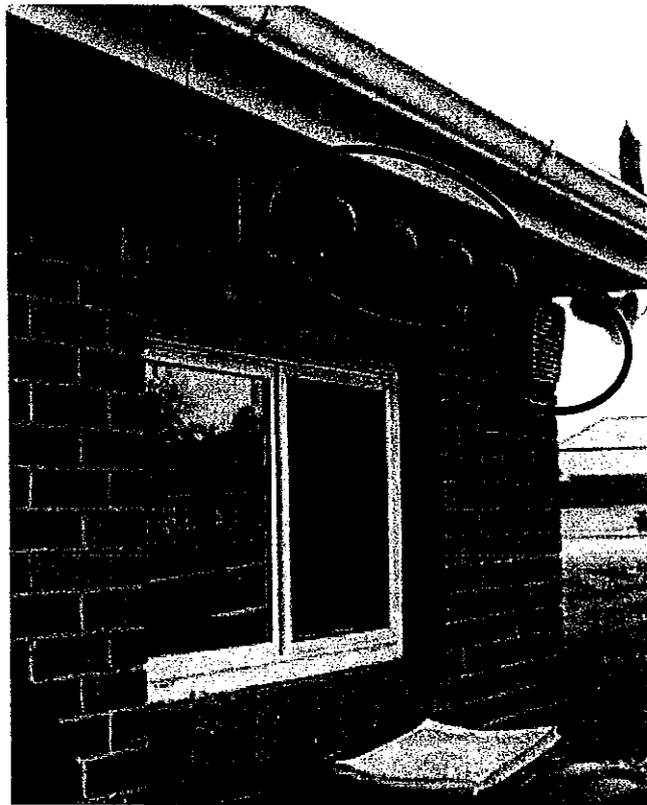
1. There are two (2) primary sensor pairs (transmitter/receiver) at Sensor #1, referred to as Primary Sensor #1A and Primary Sensor #1B. The #1A/B sensors are located just after Gantry G-14 when traveling Southbound. They are approximately 4' apart and shoot across the SB and NB I-895 lanes.
2. There are three (3) additional secondary sensor pairs spaced approximately 0.10 miles (or 500') apart. These secondary sensors are referred to as Sensors #2, #3 and #4, and shoot across the SB and NB I-895 lanes.

The NB lanes are included only because there is no median to mount the transmitting side of the sensor pair. No overheight trucks should be coming out of the tunnel and going Northbound (they would have been detected prior to going into the tunnel on the Post #3 side). Detections in the NB direction may occur, but are not relevant.

B. Operations are normal when all *seven (7)* of the sensor status indicator **lights inside** of Post #4 are off (refer to Figures 6 and 7), indicating that the 5 sensors are functioning and aligned, and the 2 DMS signs have no messages. Note: it is not necessary to have DMS status lights on the outside of the Post #3 Building.



**Figure 6: Post #4 PLC Panel Sensor Status Indicator Lights (left) and  
Inside of Panel (right)**  
(Note: Sensor #1A/B and #4 not shown accurately)



**Figure 7: Post #4 Exterior Sensor Status Indicator Beacons and Buzzer**

- C. Operations are normal when the two (2) sets of five (5) sensor status indicator **beacons outside** of Post #4 are off (refer to Figures 6 and 7), indicating that the 5 sensors are functioning and aligned.
- D. If any of the sensors comes out of alignment or becomes dirty, or its reflector is blocked, the sensor status indicator light of that sensor inside the Post #4 Building will flash slowly (approximately once per second) and will remain flashing until the problem is corrected. Similarly, the sensor status indicator beacons outside the Post #4 Building, which corresponds to that sensor, will flash slowly (approximately once per second) and will remain flashing until the problem is corrected. Under this condition, the receiving sensor transmits an alarm condition back to the PLC which triggers the system to light/flash the appropriate lights and beacons to cue the operator of this condition, all other sensors remain functional and will operate normally.
- E. If the panel light is flashing, the detector should be cleaned according to the manufacturer's recommendations.

## II. ALARM MODE

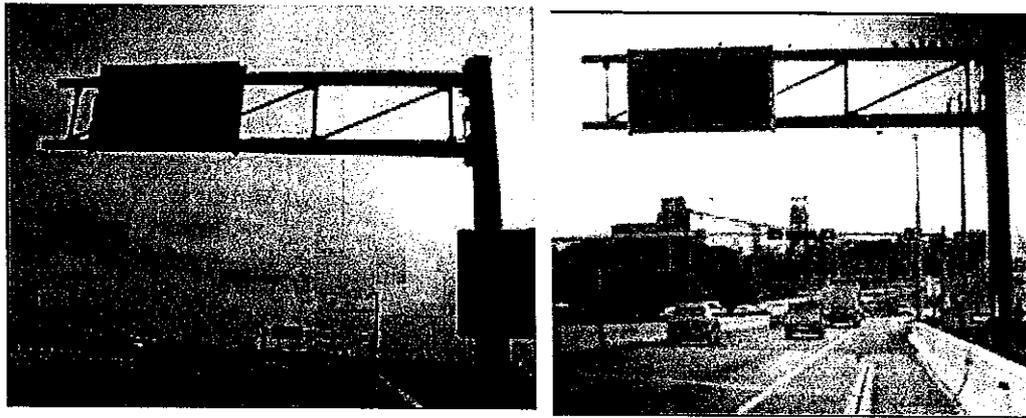
The system enters alarm mode any time a beam is broken that is not due to misalignment, a dirty lens, or a blocked reflector. An overheight vehicle traveling SB and approaching the tunnel will break the beams starting with Sensor #1A/B then #2 through #4.

Following is the sequence of operation any time sensors #1A/B through #4 detect a beam break (i.e., overheight condition):

- A. The buzzer outside the Post #4 Building will come on for 15 seconds (refer to Figure 7). This time shall be configurable. At MdTA's option, the Contractor shall program a different ring pattern (or pulsing) for buzzer alarms, allowing the Police to differentiate the audible from a Sensor #1A/B sensor break versus a sensor #2-#4 break.
- B. The sensor status indicator light **inside the building** (refer to Figure 6), corresponding to the sensor with the broken beam, will be steadily lit for 15 seconds to indicate the sensor (Sensor #1 through #4) that had the broken beam. This time shall be configurable.
- C. The sensor status indicator beacons **outside the building** (refer to Figure 7), corresponding to the sensor with the broken beam, will be steadily lit for 15 seconds to indicate the sensor (Sensor #1 through #4) that had the broken beam. This time shall be configurable.

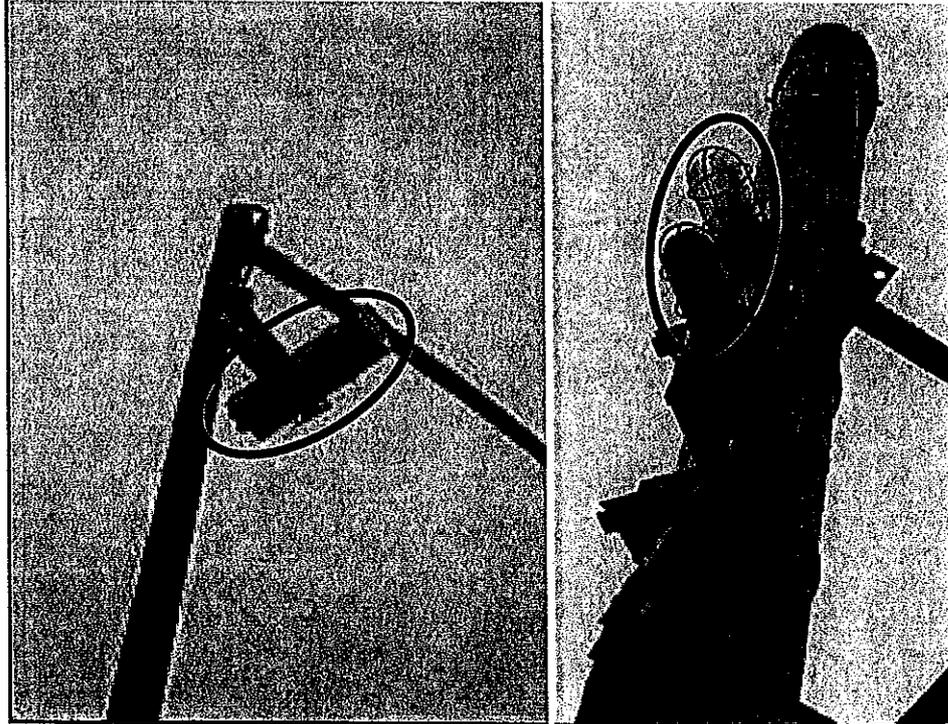
Note that the system can enter the alarm mode if any sensor is functioning. In other words, the sensors are independent and the system will alarm if one of the four sensor beams is broken.

- D. **If the beam break is at Sensor #1A or #1B**, the PLC will turn on the existing electronic fiber optic message Sign #1 for 15 seconds, informing the truck that it is overheight. The DMS status indicator light for Sign #1, inside the Post #4 Building, will also be lit. A standard, pre-programmed overheight msg will be displayed. This time shall be configurable.
- E. **If the beam break is at Sensor #2**, the PLC will turn on the existing electronic fiber optic message Sign #1 (refer to Figure 8) again for 15 seconds. This time shall be configurable. The main purpose of this sensor is that in back-up traffic conditions, Sign #1 will be turned on again for 15 seconds as the truck gets close to the sign. The DMS status indicator light for Sign #1, inside the Post #4 Building, will also be lit. A standard, pre-programmed overheight msg will be displayed.



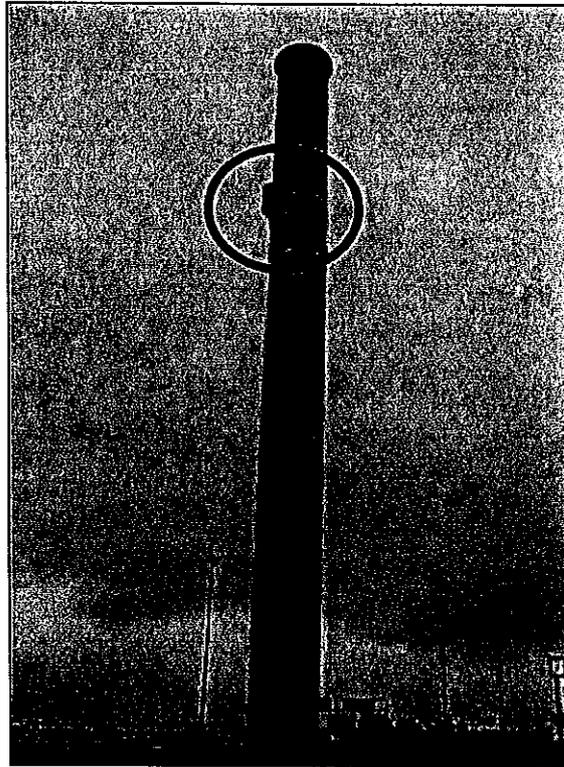
**Figure 8: Sign #1 (left) and Sign #2 (right)**

- F. **If the beam break is at Sensor #3**, the PLC will turn on existing electronic fiber optic message Sign #2 (refer to Figure 8) for 15 seconds, informing the overheight trucks to pull into the truck check area. This time shall be configurable. The DMS status indicator light for Sign #2, inside the Post #4 Building, will also be lit. A standard, pre-programmed overheight msg will be displayed.
- G. **When a beam break occurs at any sensor (#1A/#1B, #2, #3, or #4)**, the PLC will turn on the two (2) beacons mounted on the side of the Sensor #4 pole (located in sight of Post #4, about 500 ft away) for 15 seconds to indicate an overheight vehicle is approaching. This time shall be configurable.
- H. There is also a camera (refer to Figure 9) mounted on a light pole just outside of the Post #4 Building. The video is viewable in the Post #4 Building. Note that this camera is to remain as-is and is considered outside the scope of this contract.



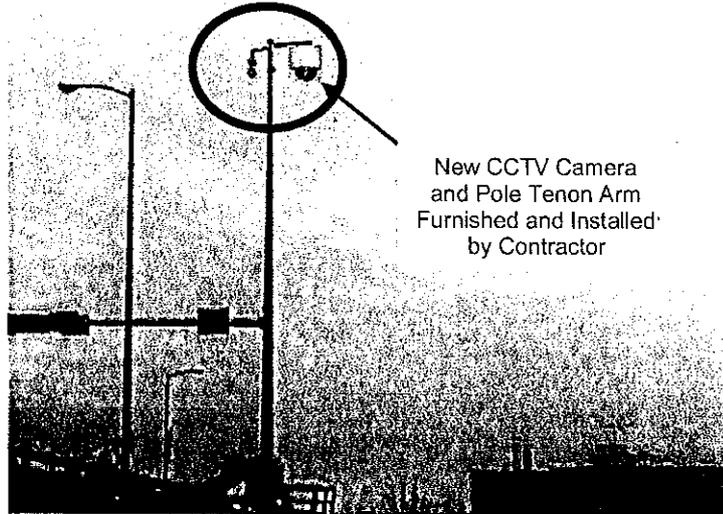
**Figure 9: Post #4 Camera (left) on Nearby Light Pole and Sensor #4 Receiver and Pole Indicator Lights (right)**

- I. In an alarm condition, the receiving sensor (refer to Figure 10) transmits a PNP alarm condition back to the PLC which triggers the system to light/flash the appropriate lights and beacons, illuminate the signs, and sound the buzzer to cue both the Police Officer and the Truck Driver.



**Figure 10: Illustration of Typical Post #4 Sensor (Typical of Sensors 1-4)**

- J. *In addition to the above, the system will take a snap shot video clip (with 2 seconds of pre-event, 5 seconds of event, and 2 seconds of post-event video) when an overheight truck breaks the beam at either the Sensor #1A or #1B location. A new, fixed color camera will be installed by the Contractor on the existing C-036 camera (refer to Figure 11) and have a zoomed in (auto-home) view up to the Sensor #1A/#1B location. The view will be zoomed in enough to clearly show all vehicles in the SB direction immediately (within 0.5 seconds) after the beam is broken. A snapshot of the video will be transmitted and made available for immediate display on the monitor at Post #4. All camera video will also be stored on the DVR for a minimum of 30 days.*



**Figure 11: Existing C-036 Camera with New Camera**

*IV. TEST MODE*

*The test mode is defined as follows:*

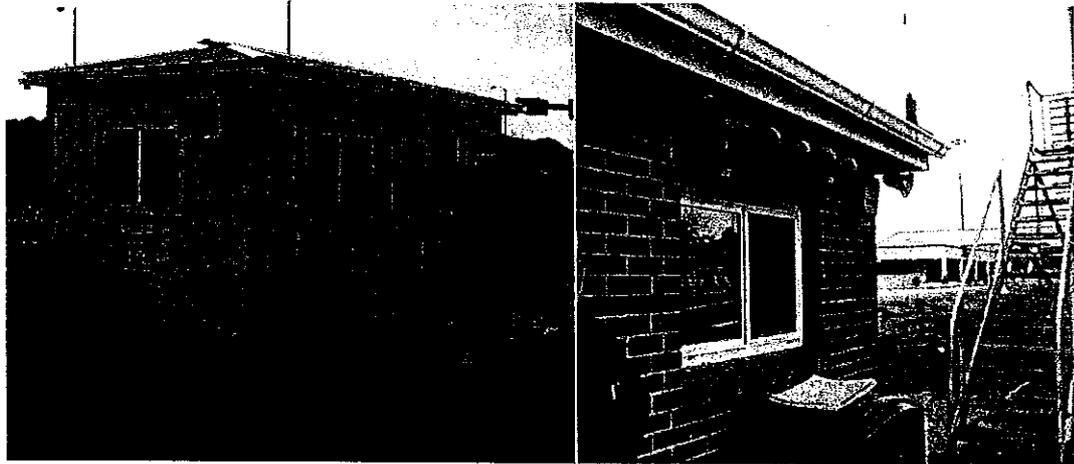
*When the Officer presses a Test button located inside the Post #4 building, the system shall enter the Alarm mode (refer to Alarm Mode above). In this mode, the system simulates a beam break at all sensors simultaneously and allows the system's buzzers, DMS, and sensor status indicator lights and beacons to be tested. The system functions exactly as it would if a true beam break were to occur. Note: the Contractor should understand that the system must function as long as at least one (1) sensor pair is functional.*

Table 3 lists the relevant devices near Post #4 sorted by milepost.

**Table 3: Post #4 OHDS Devices and Other Nearby Devices**

Road	Milepost	Device
I-895 Southbound	11.1	Gantry G-14
	10.9	OHDS Sensor #1A/#1B
		Gantry G-13
	10.8	OHDS Sensor #2
		OHDS DMS #1
	10.7	OHDS Sensor #3
		Gantry G-12
	10.6	OHDS DMS #2
OHDS Sensor #4		
		Gantry G-11

As described above the Post #3 and Post #4 Buildings were recently replaced. Figure 12 below provides an illustration of the old building and the new building. The Contractor shall install the new buzzers and sensor lights on a new free standing fixture mounted outside each building (not attached to the building).



**Figure 12: Illustration of New Post #3/#4 Building (Left) and  
Prior Post #3/#4 Building (Right)**

#### **800.02 MATERIALS**

All materials shall be new and approved by the Engineer. All equipment shall be the latest revision or product version under production by the equipment supplier. Obsolete, no-longer-supported, or no-longer-produced equipment will not be acceptable.

The Contractor is to furnish, install, integrate, test, commission, and warrant the following equipment types specified in this section.

1. Through Beam Photoelectric Sensor;
2. Power Supply for Photoelectric Sensor;
3. Programmable Logic Controller;
4. Rack Mounted Uninterruptible Power Supply (UPS);
5. Wall Mounted Rack;
6. Exterior Status Indicator Beacon Strips;
7. Exterior Status Indicator Beacons;
8. Interior Status Indicator Lights and Panel;
9. Exterior Buzzer;
10. DVR;
11. 19" LCD Monitor;
12. Cameras.



**800.02.01 Through Beam Photoelectric Sensor**

**Description.** The Contractor shall furnish, install, integrate, test, commission and warrant through beam photoelectric sensors. Through Beam Photoelectric Sensors shall meet the requirements described in Table 4. Unless stated otherwise, the requirements apply to both the transmitting and the receiving unit.

**Table 4: Through Beam Photoelectric Requirements**

REQ'T NUMBER	FEATURE	SPECIFICATION
1.	Quantity	The Contractor shall furnish, install, integrate, test, commission, and warrant the following quantity of OHDS sensor pairs (transmitters/receivers): <ul style="list-style-type: none"> <li>• At Post #3, five (5) send/receive pairs are required.</li> <li>• At Post #4, five (5) send/receive pairs are required.</li> </ul>
2.	Range	The sender unit shall have a transmit range of 300 feet or greater.
3.	Housing	The housing shall be constructed of a rugged die cast metal.
4.	Heater	The unit shall have an integrated heater.
5.	Sensitivity Adjustment	The receiving unit shall have a sensitivity adjustment using a potentiometer.
6.	Time Adjustment	The receiving unit shall have a time adjustment using a potentiometer.
7.	Time Delay Switch	The receiving unit shall have a time delay selector switch, allowing (a) no delay; (b) ON-delay when the object enters the detection zone; and (c) OFF-delay when the object leaves the detection zone. The delay shall be adjustable from 0.015 seconds to 0.3 seconds and 0.5 seconds to 12 seconds.
8.	Optics	The unit shall have optical sight using photoelectric LED infrared light technology for ease of alignment.
9.	LED Indicator	The receiving unit shall have an LED signal strength indicator.
10.	Status Indicator	The sending unit shall have a status indicator when powered up.
11.	View Finder Lens	The unit shall have a view finder lens.
12.	Eyepiece Alignment	The unit shall come with an eyepiece for alignment.
13.	Terminal Connections	The unit shall have a terminal chamber for electrical and signal connections. The terminal strips shall be able to accommodate a #12 to #28 AWG wire.
14.	Test Input	The sending unit shall have a test input that allows the transmitter's beam to drop out briefly simulating a beam break. The test input shall be PNP to 0 V.
15.	Alarm Output	The receiving unit shall have a digital alarm output if the unit becomes misaligned. If the unit receives insufficient light, the alarm output shall be triggered. The maximum alarm output shall be 100 mA, open collector.
16.	Beam Break Output	The receiving unit shall have a digital PNP beam break output, used when the beam is broken by an overheight truck. The unit shall provide PNP, Q and $\bar{Q}$ outputs.



REQ'T NUMBER	FEATURE	SPECIFICATION
17.	Mounting Brackets	<p>The unit shall come with all required mounting brackets to mount to MdTA's existing sensor poles. All mounting locations and mounting types must be approved by MdTA. Contractor is responsible for furnishing and installing all required mounting brackets/kits, as required.</p> <p>Each of sensors shall be provided with means for rigidly attaching the unit to a vertical pole without requiring any machining operation. The attachment means shall not stress or deform the unit and shall prevent the movement of the unit in any direction by the force developed by wind. The mounting means shall allow adjustment of the vertical position on the pole. The mounting means for the transmitter unit and the receiver unit shall have the capability of adjusting the angular orientation of the optical axis in both the horizontal and vertical plane over an angular range of plus or minus five degrees from horizontal. The transmitter and receiver unit shall be mounted to detect the presence of vehicles that exceed the specified vertical height.</p>

REQ'T NUMBER	FEATURE	SPECIFICATION
18.	Response Time	<p>The response time of the receiving unit shall be &lt;math&gt;&lt;500\mu s&lt;/math&gt;. The unit shall be able to detect a beam break from a 3"-diameter smoke stack pipe on a tractor trailer moving at 75 MPH.</p> <p><b>Note to Contractor:</b> The definition of response time is "the time delay between a beam breaking and the output-point changing state". To be more accurate, most manufacturers define it as: "delay between the time the switch point threshold is reached and the output changing state". This threshold is affected by the size of the object, spacing between sender and receiver, location of the object between the sender and receiver and the sensitivity adjustment of the receiver. The beam width comes into play also and depends on the distance between the sender and the receiver. The closer the units are together, generally, the better they work, with a faster response time. The minimum target size is also dependent on the sensitivity adjustment. If the gain is set so the operating reserve is low, the minimum object size is smaller. There is a trade-off because the lower the gain, the more often the lens will have to be cleaned to prevent false trips. The sensitivity adjustment sets the threshold of light the unit needs to receive to trigger an alarm. When the sensitivity adjustment is high, a lower percentage of light is needed to trigger an output.</p> <p>The response time is a key criterion in the BHT OHDS. For reference, the following are useful rules-of-thumb:</p> <ol style="list-style-type: none"> <li>1. A 1" beam would stay broken for approximately 2.6 milliseconds with a 3" pipe moving through at 65 MPH.</li> <li>2. A 1" beam would stay broken for approximately 1.7 milliseconds with a 2" pipe moving through at 65 MPH.</li> <li>3. A 1" beam would stay broken for approximately 2.2 milliseconds with a 3" pipe moving through at 75 MPH.</li> <li>4. A 1" beam would stay broken for approximately 1.5 milliseconds with a 2" pipe moving through at 75 MPH.</li> </ol> <p>For reference <math>500 \mu s</math> (microseconds) = 0.5 milliseconds. Thus, theoretically the 500 microsecond requirement would allow any of the above four cases to be detected.</p>
19.	Weather Hood	The sending and receiving units shall come with a weather hood to keep weather elements from coming in contact with the lens.
20.	Circuit Protection	The receiver's output shall be protected against short circuits. The receiver units shall provide interference pulse suppression. The sender and receiver shall be reverse-polarity protected.
21.	Outdoor Rating	The unit shall have an IP67 rating and NEMA 6 rating.
22.	Operating Temperature Range	The unit shall be rated for outdoor use with minimum operating range of -13°F to +131°F.
23.	Power Input	The unit shall accept a 10 – 60 VDC power input for the supply voltage ( $V_s$ ).
24.	Current Consumption	The unit (with heater) shall have a current consumption of 250 mA or less.
25.	Output Current	The unit shall have an Output Current $I_{max}$ of 200 mA.

REQ'T NUMBER	FEATURE	SPECIFICATION
26.	Average Service Life	The unit shall have an average service life of 100,000 hours or more.
27.	Sensor Vendor Qualifications	The sensor manufacturer shall have demonstrated experience in having a minimum of three (3) outdoor OHDS assemblies, installed with three (3) different customers, which have been operational for at least six (6) months.
28.	Product Model 	The product shall be a SICK WS/WE 45-P960 or approved equal. The dust shield shall be SICK part number 2011431 or approved equal. The mount bracket shall be SICK part number 2011480 or approved equal.
29.	Manufacturer Warranty	The sensor units must have a one-year minimum warranty. Technical support must be made available Monday-Friday during normal business hours on a toll-free number. Technical support shall be included in the Warranty and be available for the entire duration of the Warranty at no additional cost.
30.	Contractor Warranty	The Contractor shall supply a one-year warranty commencing after the Acceptance period is successfully completed.

**Measurement and Payment.** This item shall be paid on the basis of each item completed, installed, and tested by the Contractor, and accepted by the MdTA. The installation shall occur at the designated MdTA locations. The payment under these items will include all materials and labor as may be necessary to furnish and install, setup, configure, test, warrant, and perform any other work needed to make the installation operational and acceptable.

Refer to Bid Items 8001, 8002, 8004, and 8005.

**800.02.02 Power Supply for Photoelectric Sensors**

**Description.** The Contractor shall furnish, install, integrate, test, commission and warrant a sufficient number of 24 VDC rack mount power-supply units to provide power to the send/receive sensor pairs. Power-supply units shall meet the requirements described in Table 5.

**Table 5: Rack Mount Power Supply Requirements for Photoelectric Sensors**

REQ'T NUMBER	FEATURE	SPECIFICATION
1.	Quantity	<p>The Contractor shall furnish, install, integrate, test, commission, and warrant the following quantity of power-supply units to provide power to the send/receive sensor pairs:</p> <ul style="list-style-type: none"> <li>• At Post #3, a minimum of two (2) power-supply units are required.</li> <li>• At Post #4, a minimum of (2) power-supply units are required.</li> </ul>
2.	Product Model 	<p>The power supply shall be a 24 VDC redundant power supply system compatible with the OHDS sensor. The model shall be Optimal Power OPR300-24R or approved equal. A minimum of two (2) redundant power-supply units shall be provided at each PLC location to serve the photoelectric sensors. It is the Contractor's responsibility to select components that meet this specification and the manufacturer's specification for each device that this power supply will service.</p> <p>In lieu of the above, the Contractor may utilize other options, provided each option has redundancy, including the following:</p> <ol style="list-style-type: none"> <li>1. The Contractor may use the redundant power supply of the PLC, sized accordingly. Refer to Table 6 for more information.</li> <li>2. The Contractor may use SICK product number PS50W-24V-ENC (7029741), one per sensor, and devise their own power supply redundancy scheme that meets with MdTA approval.</li> </ol>
3.	Rack Mountable	Each power-supply unit shall be rack mountable. The Contractor shall procure any required rack mount brackets.
4.	Redundancy	The power-supply system shall have redundancy to prevent a single point of failure.
5.	Output Voltage	The output voltage shall be 24VDC.
6.	Power Input	The power input shall be a standard 120 VAC input.
7.	Power Output	Each unit shall provide a minimum 300 W power output. Each output shall be separately fused. Fuse ratings shall be obtained by the Contractor per manufacturer recommendations for each component. The output ripple shall be 200 mV or less. The output current shall be 12A maximum.
8.	Operating Temperature Range	The unit shall be rated for indoor use with minimum operating range of 32 °F to +131 °F.
9.	Manufacturer Warranty	The power supply system shall have at least one-year warranty.
10.	Contractor Warranty	The Contractor shall provide a one-year warranty commencing after the Acceptance period is successfully completed.

**Measurement and Payment.** The payment for the power supplies shall be included in that of the through beam photoelectric sensors bid items. Refer to Bid Items 8001, 8002, 8004, and 8005.



**800.02.03 Programmable Logic Controller**

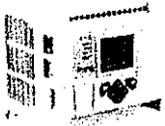
**Description.** The Contractor shall furnish, install, integrate, test, commission and warrant Programmable Logic Controllers (PLC) to meet the requirements described in Table 6.

**Table 6: PLC Requirements**

REQ'T NUMBER	FEATURE	SPECIFICATION
1.	Quantity	The Contractor shall furnish, configure, program, install, integrate, test, commission, and warrant the following quantity of PLCs: <ul style="list-style-type: none"> <li>• One (1) rack mounted PLC at Post #3.</li> <li>• One (1) rack mounted PLC at Post #4.</li> </ul>
2.	Dimensions	Each PLC shall be 3.5" D x 4.3" W x 3.4" H or smaller
3.	Mounting Location	The exact location of PLCs shall be coordinated with the MdTA. The Post #4 PLC will be located in the South side of the FMT Mechanical Building. The Post #3 PLC will be located in the Toll Tunnel of the BHT Administration Building. All mounting locations and mounting types must be approved by MdTA. All PLCs must be rack mounted in a wall cabinet.
4.	Ethernet	The PLC shall have a built-in 10/100 Mbps Ethernet/IP port for peer-to-peer messaging. The Contractor shall run the necessary CAT5E connections to MdTA's existing Cisco Layer 3 Multi-Layer Switch (MLS) switch in each building's Computer Room or to the closest network jack.
5.	BOOTP	The PLC shall support the BOOTP protocol. The Contractor shall provide one (1) serial cable for each PLC to assign an IP address and configure the unit. The cables shall be delivered at the completion of the project.
6.	DHCP	The unit shall support static IP addresses as well as DHCP addresses.
7.	Serial Ports	The PLC shall have a minimum of one RS-232/RS-485 combo ports.

REQ'T NUMBER	FEATURE	SPECIFICATION
8.	Inputs/Outputs	<p>The PLC shall have a minimum of sixteen (16) digital inputs, two (2) analog inputs and twenty-two (22) dry contact relay outputs. Refer to Table 7 and Table 8 below for the number of inputs and outputs required at each site.</p> <p>Additional Requirements and Notes:</p> <ol style="list-style-type: none"> <li>3. The default configuration of the PLC is ten (10) digital inputs, two (2) analog inputs and six (6) isolated dry contact relay outputs. The Contractor shall supply the necessary quantity of input/output cards to meet the sixteen (16) input and twenty-two (22) output requirement.</li> <li>4. The PLC shall be expandable up to a minimum of thirty (30) digital inputs and thirty (30) dry contact relay outputs.</li> <li>5. Each input shall be 24 VDC sinking or sourcing.</li> <li>6. The inputs shall accept an ON logic state with a 10-to-30 VDC input. The input shall accept an OFF logic state with a 0-to-5 VDC input.</li> <li>7. The Contractor shall be aware that "fast" 24 VDC inputs have a lower tolerance for the On-State and these inputs shall be avoided as they may generate false alarms or cause missed alarms. The Contractor shall supply enough input expansion cards such that the 16-digital-input requirement is satisfied, where each input is not a "fast" input.</li> <li>8. The ON state means that the input must be between 10-30 VDC for the input to go high (turn on logically in the processor). Once the input goes high the input must drop below 5 VDC for the input to go off again (turn off logically in the processor). Once the input is in the OFF state, the input would need to go above 10 VDC again for the input to go high again. It is important that the Contractor deploys a system such that the voltage does not go above the maximum input rating which would result in damage to the PLC.</li> <li>9. Each dry contact relay output configured for operations must be isolated and not share terminals with other outputs.</li> <li>10. Each output shall be able to use 24 VDC or 120 VAC to drive the outputs, as required.</li> </ol>
9.	Web Browser	The PLC shall allow the user to configure the unit through Internet Explorer.
10.	Scaleability	The PLCs shall be expandable (i.e., input and output expansion modules/cards) to accommodate a minimum of an additional 10 inputs and 10 outputs. The Contractor shall ensure there is empty I/O rack space to accommodate this future growth.
11.	Relays	The Contractor shall supply the correct quantity and type of relays to drive all outputs (e.g., the signs require a double-pole 480 V single phase AC relay with 480 V rated contacts; other devices require standard 120 VAC, 12 VDC, or 24 VDC power relays).
12.	Digital Trim Potentiometers	The unit shall have digital trim potentiometers that allow quick and easy adjustments of timers, counters, and set points.
13.	Downloadable Configuration	The PLC shall allow a data file to be downloaded into the controller to restore a configuration, without overwriting protected data.

REQ'T NUMBER	FEATURE	SPECIFICATION
14.	Software	Each PLC shall come with all manufacturer-provided software allowing the PLC to be programmed, controlled, monitored, and troubleshot. The software shall support Microsoft Windows 2003, XP, Vista and Windows 7. The Contractor shall be required to configure the software and perform any customizations (e.g., custom software), as required, to provide a fully functional OHDS meeting the requirements and Concept of Operations in these specifications.
15.	Memory	The PLC shall provide 128 KB for data logging and 64 KB for configuration data.
16.	LCD Screen	The PLC shall have a built-in LCD screen to display controller status, I/O status, display simple operator messages, and display information for modifying the configuration.
17.	High Speed Counters	The PLC shall have one (1) 40 KHz embedded high-speed counter.
18.	Power Input	The power input shall be a standard 120 VAC input.
19.	Power Supply	The Contractor shall supply at 24 VDC power supply for each PLC to power the PLC and five (5) sensors at each site (refer to Table 5 for other options to power the sensors). The power supply shall be redundant and have 50% spare capacity.
20.	Surge Protection	Because of the potentially high current surges that occur when switching inductive load devices, the use of some type of surge suppression to protect and extend the operating life of the controllers output contacts is required. Switching inductive loads without surge suppression can <i>significantly</i> reduce the life expectancy of relay contacts. By adding a suppression device directly across the coil of an inductive device, you prolong the life of the output or relay contacts. This also reduces the effects of voltage transients and electrical noise from radiating into adjacent systems. The Contractor is required to locate the suppression device as close as possible to the load device. The Contractor should also adhere to the PLC manufacturer's recommendations for type and location of surge suppression.
21.	Receptacles	The Contractor shall furnish and install two (2) 20 amp, 1 phase circuits at each PLC location (i.e., Post #4 FMT Mechanical Building and Post #3 BHT Administration Building). The receptacles shall be within 3' of the PLC location. The cable route shall be a home run to the nearest power distribution panel. All power cable shall be run in 3/4" EMT. This work shall be considered incidental to the PLC bid item.
22.	Battery Backup	Each PLC shall come equipped with a battery backup to maintain memory (RAM) configuration during power failures.
23.	Data Backup	The contractor shall provide a copy of all configuration and programming files (data backup) for the PLC's on a CD ROM, USB Stick, or other approved media. The Data Backup shall include all files necessary to load a new-factory fresh PLC with the code necessary to operate within the system. The Contractor shall demonstrate the backup and restore process during the testing and training periods. The Contractor shall provide a detailed and step-by-step procedure to describe this process.
24.	Operating Temperature Range	The unit shall be rated for indoor use with minimum operating range of -4 °F to +140 °F.

REQ'T NUMBER	FEATURE	SPECIFICATION
25.	Rack Mountable	Each PLC shall be rack mountable. The Contractor shall procure any required rack mount brackets, or DIN rail end anchors as required.
26.	Product Models 	<p>The following are the relevant product numbers that should be furnished and installed by the Contractor:</p> <ul style="list-style-type: none"> <li>• Each PLC shall be a Rockwell/Allen-Bradley Micrologix 1100/1763 model number 1763-L16BWA (Small Logic Controller) or approved equal.</li> <li>• The PLC input expansion cards shall be Allen-Bradley part number 1762-IQ16 or approved equal. Each input card shall be able to handle 16-discrete digital 24 VDC inputs.</li> <li>• The PLC output expansion cards shall be Allen-Bradley part number 1762-OW16 or approved equal. Each relay output card shall be able to handle 16 24 VDC dry contact relay outputs.</li> <li>• The power supply shall be Allen-Bradley part number 1606-XLSDNET8 with the required number of redundancy modules, part number 1606-XLPRED.</li> <li>• The sign relay shall be a 480 V AC power relay (Cutler Hammer Motor Style) for Overhead Sign Control at Post #4. The Contractor shall size and supply all required 480 VAC, 120 VAC, and 24 VDC relays.</li> <li>• The PLC software shall be Allen-Bradley RSLogix 500 Professional Edition software with documentation part number 9324-RL0700NXENE or approved equal. The Contractor shall be required to turn over 1 valid/licensed copy of this software for MdTA use at the completion of the project. This software includes the Allen-Bradley RSLogix Emulate 500 software, which is capable of emulating an 1100 PLC.</li> <li>• The PLC Programming cable shall be Allen-Bradley part number 1761-CBL-PM02 or approved equal. The Contractor shall be required to turn over the cable for MdTA use at the completion of the project.</li> <li>• Use DIN rail end anchors (Allen-Bradley part number 1492-EA35 or 1492-EAH35 or approved equal).</li> </ul> <p>Contractor responsible for validating all part numbers and design prior procuring materials.</p>
27.	Manufacturer Warranty	The PLCs must have a two-year minimum warranty.
28.	Contractor Warranty	The Contractor shall provide a one-year warranty commencing after the Acceptance period is successfully completed.

**Table 7: PLC Input/Output Requirements for Post #3**

Post #3 / BHT Administration Building Toll Tunnel					
PLC Inputs			PLC Outputs		
PLC Inputs	No. of Inputs	Type of Input	PLC Outputs	No. of Outputs	Type of Outputs
PNP Output from OHDS Sensors	5	Digital (PNP) –	Eight (8) Interior LED Status Indicator Lights (status of 3 signs	8	Digital-24VDC



<b>Post #3 / BHT Administration Building Toll Tunnel</b>					
<b>PLC Inputs</b>			<b>PLC Outputs</b>		
(Primary A/B, #1-#3)		24 VDC	and 5 OHDS sensors)		
Alarm Output from OHDS Sensors (Primary A/B, #1-#3)	5	Digital - 24 VDC	Two (2) sets of 5 Exterior LED Status Indicator Beacons (status of 5 OHDS sensors) <u>Note:</u> Wired in parallel to the 5 interior status lights.	0	Digital-24VDC
Test Button	1	Digital-24VDC	Three (3) Fiber Optic DMS Signs at Lanes 1-3. <u>Note:</u> Sign control is via an AC relay controlled by the PLC. The signs are single message blank-out-signs. The Post #4 signs are powered using a 480 V power supply stepped down to 120V at the sign.	3	Digital- to control 480V Analog Relay
			Exterior Post #3 Buzzer	1	Digital - 24VDC
			Buzzers at Lanes 1-3 <u>Note:</u> Wired in parallel to signs in Lanes 1-3	0	Digital - 24VDC
			Flashers at Lanes 1-3 <u>Note:</u> Wired in parallel to signs in Lanes 1-3	0	Digital - 24VDC
			DVR	1	Digital - 24VDC
			Test Input to Drop Senders for OHDS Sensors Primary A/B, #1-#3. <u>Note:</u> Contractor shall connect each of the field wires back to a terminal block where they'll be joined with the single wire connecting to the PLC	1	Digital - 24VDC
			Canopy Lights on Reverse (downstream) Side of Toll Booth	3	Digital - to control 120V Analog Relay
Spare Inputs	5	Digital-24 VDC	Spare Outputs	5	Digital - to control 120V Analog Relay
<b>Total</b>	<b>16</b>			<b>22</b>	



**Table 8: PLC Input/Output Requirements for Post #4**

Post #4 / FMT Mechanical Building					
PLC Inputs			PLC Outputs		
PLC Inputs	Quantity of Inputs	Type of Input	PLC Outputs	Quantity of Outputs	Type of Input
PNP Output from OHDS Sensors (#1A/#1B, #2-#4)	5	Digital (PNP) - 24VDC	Seven (7) Interior Status Indicator Lights (status of 2 signs and 5 OHDS sensors)	7	Digital-24VDC
Alarm Output from OHDS Sensors (#1A/#1B, #2-#4)	5	Digital - 24VDC	Two (2) sets of 5 Exterior Indicator Beacons (status of 5 OHDS sensors) <u>Note:</u> Wired in parallel to the 5 interior status lights.	0	Digital-24VDC
Test Button	1	Digital-24VDC	Two (2) Fiber Optic DMS Signs near OHDS Sensor #2 and #3. <u>Note:</u> Sign control is via an AC relay controlled by the PLC. The signs are single message blank-out-signs. The Post #4 signs are powered using a 480V supply stepped down to 120V at the sign.	2	Digital- to control 480V Analog Relay
-	-	-	Exterior Post #4 Buzzer	1	Digital-24VDC
-	-	-	DVR	1	Digital-24VDC
-	-	-	Test Input to Drop Senders for OHDS Sensors Primary A/B, #1-#3. <u>Note:</u> Contractor shall connect each of the field wires back to a terminal block where they'll be joined with the single wire connecting to the PLC	1	Digital-24VDC
-	-	-	Exterior Flashers at OHDS Sensor #4 Pole. <u>Note:</u> Contractor shall program the PLC to have these flashers lit any time there is a beam break at sensors #1A/#B, #2, #3, or #4.	1	Digital-24VDC
Spare Inputs	5	Digital-24VDC	Spare Outputs	9	Digital- to control 120V Analog Relay
<b>Total</b>	<b>16</b>			<b>22</b>	



**Measurement and Payment.** This item will not be measured separately, but instead will be paid separately as a lump sum for the items referenced by this bid item and as described herein. The installation shall occur at the designated MdTA locations. The lump sum for this item shall include all materials, labor, and equipment as may be necessary to furnish and install, setup, configure, test, warrant, and perform any other work needed to make the installation operational and acceptable. Any requirements of the specifications or special provisions not specifically detailed or mentioned in a pay item shall be considered incidental to the pay items.

Refer to Bid Items 8006 and 8007.

**800.02.04 Rack Mounted UPS**

**Description.** The Contractor shall furnish, install, integrate, test, commission, and warrant rack mounted Uninterruptible Power Supply units (UPSs) to provide power to the PLC and photoelectric sensors. UPSs shall meet the requirements described in Table 9. The Contractor shall, furnish, install, and configure the UPS according to MdTA’s directions. All settings for configuration, network, and alarm shall be approved by MdTA. The contractor shall plug in the UPS to the new Contractor-installed power outlet located near the cabinet location (Refer to the item titled “Receptacles” in Table 6).

**Table 9: Rack Mounted UPS Requirements**

REQ'T NUMBER	FEATURE	SPECIFICATION
1.	Quantity	The Contractor shall furnish, install, integrate, test, commission, and warrant the following quantity of UPSs to provide power to the PLCs and photoelectric sensors: <ul style="list-style-type: none"> <li>• At Post #3, a minimum of one (1) UPS is required.</li> <li>• At Post #4, a minimum of one (1) UPS is required.</li> </ul>
2.	Rack Mountable	Each UPS shall be rack-mounted and need no more than 2 rack-unit spaces (2U maximum). The Contractor shall procure any required rack mount brackets.
3.	Power Input	The power input shall be a standard 120 VAC input.
4.	Operating Temperature Range	The unit shall be rated for indoor use with minimum operating range of 32 °F to +104 °F.
5.	Capacity	The UPS capacity shall be 1980 Watts/2200 VA minimum. The Contractor shall ensure the UPS is sized to handle the inrush amperage ratings and continuous amperage ratings of the PLCs and photo electric sensors (e.g., the Micrologix 1100 PLC is 25A inrush for 8 ms and 2.1A continuous).
6.	Backup Time	Each UPS shall be rated for 15 minutes (minimum) of backup time at 990 Watts.
7.	Batteries	The UPS batteries shall be user-replaceable without the need to power down equipment (i.e., hot swappable).

REQ'T NUMBER	FEATURE	SPECIFICATION
8.	SNMP	<p>The UPS shall be managed via a built-in interface. The management interface shall provide SNMP, TELNET, and http (web) management via a 10 Base-T RJ45 Ethernet port or a 10/100 Base-T RJ45 Ethernet port. The management interface shall provide remote shutdown and restart of the UPS and attached electrical devices via http (web) interface, email alert for power outages, SNMP monitoring, and scheduling of UPS self tests.</p> <p>The Contractor shall run the necessary CAT5E connections to MdTA's existing Cisco Layer 3 Multi-Layer Switch (MLS) switch in each building or to the closest network jack.</p>
9.	Indicators	Each UPS shall have overload, site-wiring fault, and replace battery indicators.
10.	Power Output	Each output shall be 120 VAC, 60 Hz, sine wave.
11.	Alarm	The UPS shall be able to generate an alarm (e.g., e-mail alert) when the unit is running on battery backup.
12.	Input Receptacles	Each UPS shall have a minimum of six (6) NEMA 5-15R and two (2) NEMA 5-20R receptacles for connecting devices.
13.	Surge Protection	Each UPS shall have integral surge protection and noise filtering. Surge protection shall be rated at 480 joules or more. Surge and filtering shall be UL1449 compliant.
14.	Control Panel	Each UPS shall have an integral control panel with LED bar-graph status display for load and battery, and an indicator LED for overload and on-battery.
15.	Product Model	Each UPS shall be a APC® Smart-UPS 2200 VA RM 2U model number SUA2200RM2U with network management (with environmental monitoring) smart-slot card AP9619, or approved equal.
16.	Manufacturer Warranty	The UPSs must have a two-year minimum warranty.
17.	Contractor Warranty	The Contractor shall provide a one-year warranty commencing after the Acceptance period is successfully completed.

**Measurement and Payment.** The payment for the UPS shall be included in that of the PLC bid items. Refer to Bid Items 8006 and 8007.

**800.02.05 Wall Mounted Rack**

**Description.** The Contractor shall furnish, install, integrate, test, commission and warrant wall mounted racks to house the PLC and power supplies for the photoelectric sensors. The racks shall meet the requirements described in Table 10.

**Table 10: Wall Mounted Rack Requirements**

REQ'T NUMBER	FEATURE	SPECIFICATION
1.	Quantity	The Contractor shall furnish, install, integrate, test, commission, and warrant the following quantity of wall mounted racks to house the PLCs and photoelectric sensor power supplies: <ul style="list-style-type: none"> <li>• At Post #3, a minimum of one (1) wall mounted rack is required.</li> <li>• At Post #4, a minimum of one (1) wall mounted rack is required.</li> </ul>
2.	Standards	All equipment racks shall meet and be installed in accordance with ANSI/EIA RS-310 and EIA-310-D, where applicable.
3.	Enclosure	All equipment racks shall be fully enclosed. Wall units shall have front door. Side panels shall conceal and protect interior electronics. With doors closed, it shall not be physically possible to directly access the equipment inside.
4.	Locks	Front and back doors shall have locks. The Contractor shall provide two (2) sets of keys for each rack.
5.	Construction	All doors and side panels shall be constructed of 14-gauge structural steel or better.
6.	Rails	All equipment racks shall have vertical 10/32 mounting rails with nominal 19-inch standard opening suitable for use with standard rack-mounted equipment. Rails shall be made of 14-gauge structural steel, and shall meet applicable EIA standards. Equipment Racks shall be listed with UL1863-Standard for Communication Circuit Assembly.
7.	Fans	All equipment racks shall be equipped with a fan assembly consisting of three (3) fans at the top of the rack. The fan shall run continuously. The fan shall be a ball bearing, low noise (less than 40 dB) type with minimum capacity of 225 CFM. The fan shall blow exhaust air through the top of the enclosure. Additional fan trays shall be supplied, as required. The cost of these fan trays shall be considered incidental to the cost of the rack. The Contractor shall size the fans based on the equipment selected, the electrical draw, and BTUs generated.
8.	Edges	The equipment racks shall be free of sharp edges, burrs, or other defects that may cut wires and cables or create a safety hazard.
9.	Louvers	All equipment racks shall have air intake louvers, or other acceptable air intake, through the front and back doors.
10.	Color	All equipment racks shall have a finished appearance. Unpainted metal surfaces are not acceptable. All racks shall be <u>black</u> in color.
11.	Cable Managers	All equipment racks shall be equipped with two (2) 72" vertical-cable managers for routing and tying off cables (e.g., video coax, CAT 5 Ethernet, serial, etc.). The cable managers shall be BlackBox RM037 (or equivalent). The cabinet shall have built in rubber grommet protection.
12.	Outlet Strip	Each rack shall come equipped with a built in 6-outlet power strip.
13.	Knockouts	The cabinet shall have a minimum of three (3) knockouts at the top and bottom.
14.	Filler Panels	All racked equipment shall have a minimum of one RU separation between all units. Black filler panels, or equivalent, shall be used, as required, to cover all gaps and to provide a finished professional end product.

REQ'T NUMBER	FEATURE	SPECIFICATION
15.	Dimensions	Each wall-mounted rack shall be sized (outside dimensions) 22" wide (19" rack space opening) x 36" high x 20" deep (20" usable space). Each rack shall have 19U rack spaces.
16.	Rack Elevation	The Contractor shall provide a rack elevation drawing (showing the details of the equipment to be installed in rack) for MdTA's review and approval prior to cabling, racking, and stacking equipment. It is the Contractor's responsibility to ensure that all procured rack-mounted (i.e., PLC, power supplies, DVR, UPS) equipment will fit properly in the racks.
17.	Location	The exact location of equipment racks shall be coordinated with the MdTA. The Post #4 rack will be located in the South side of the FMT Mechanical Building. The Post #3 rack will be located in the Toll Tunnel of the BHT Administration Building. All mounting locations and mounting types must be approved by MdTA. The Contractor shall be responsible for securely mounting the rack to a wall.
18.	Fasteners	Upon completion, all installed equipment shall be securely fastened into the equipment rack. Loose equipment, wires, or other appurtenances shall not be accepted.
19.	Door Closure	Equipment rack doors shall close tightly and securely. Equipment installed in such a way so as to prevent the doors from closing completely, opening completely, or otherwise interfering with the operation of the doors shall be unacceptable.
20.	Clearance	Wall mounted equipment racks shall have 36" of clear space in front of each unit.
21.	Product Model 	Each wall mount equipment rack shall be BlackBox RM412A (Elite Series Wall-Mount Cabinets) or approved equal.  Rack filler panels shall be BlackBox RM318 (1 RU), RM217 (2 RU), RM219 (3 RU), RM319 (4 RU), RM222 (5 RU) or RM223 (6 RU), and shall be black in color.
22.	Manufacturer Warranty	The racks must have a one-year minimum warranty.
23.	Contractor Warranty	The Contractor shall provide a one-year warranty commencing after the Acceptance period is successfully completed.

**Measurement and Payment.** The payment for the rack shall be included in that of the PLC bid items. Refer to Bid Items 8006 and 8007.

**800.02.06 Exterior LED Status Indicator Beacon Strips**

**Description.** The Contractor shall furnish, install, integrate, test, commission, and warrant exterior LED status indicator beacon strips as described below. The beacon strips shall meet the requirements described in Table 11.

**Table 11: LED Exterior Status Indicator Beacon Strip Requirements**

REQ'T NUMBER	FEATURE	SPECIFICATION
1.	Quantity	<p>The Contractor shall furnish, install, integrate, test, commission, and warrant the following quantity of building-mounted exterior LED status indicator beacon strips:</p> <ul style="list-style-type: none"> <li>At Post #3, two (2) exterior mounted set of five (5) exterior LED status indicator beacon strips.</li> <li>At Post #4, two (2) exterior mounted set of five (5) exterior LED status indicator beacon strips.</li> </ul>
2.	Features	<p>All LED beacon strips shall meet the following:</p> <ol style="list-style-type: none"> <li>LED beacon strips shall provide a steady-on mode.</li> <li>LED beacon strips shall be PLC compatible and shall be able to be turned on steady or flashed from the PLC.</li> <li>Each strip shall be a compact warning-style light that provides 14 pulse patterns including steady-on.</li> <li>The LED beacon strips shall be encapsulated with no glass or filaments and be rated for 100,000 hours of operation.</li> <li>All beacon strips shall be heavy duty and designed for professional use.</li> <li>The LED technology shall be based on super bright LED technology such that it is easily visible in all weather conditions (sunshine, rain, fog, etc.) and times of day (day/night).</li> <li>The LEDs shall be bright enough to be seen at distances up to 100' in darkness, in bright sunshine and in adverse weather conditions.</li> </ol>
3.	Power Input	<p>The power input shall be 12 VDC with nominal current of 1.5 amp average (3.8 amp max) consumption. The Contractor shall furnish and install all necessary power supplies and relays, as required, to provide control via the PLC. The Contractor shall route and conceal power supply cables in the building, as required.</p>
4.	Enclosure	<p>The LED strip modules shall be rated for outdoor use.</p>
5.	Colors	<p>LED strip modules shall be available in different colors. The final colors shall be submitted and approved by MdTA prior to ordering.</p> <ul style="list-style-type: none"> <li>Lights shall be available in red, amber, blue or white LEDs.</li> <li>The Contractor shall provide each set of 5 in the following colors: 2 red, one amber, one blue, one white.</li> </ul> <p>The final colors shall be submitted and approved by MdTA prior to ordering.</p>
6.	LED Life	<p>Each LED shall be rated for a minimum of 100,000 hours of use.</p>
7.	Epilepsy Frequency	<p>The LED beacon strips shall not use any frequencies in the range known to trigger epileptic seizures.</p>
8.	Dimensions	<p>Each LED beacon strip shall be approximately 1.4" W x 11.5" L.</p>



REQ'T NUMBER	FEATURE	SPECIFICATION
9.	Mounting Type	Each LED strip shall be surface mountable. The Contractor shall supply all conduit and brackets as required. The Contractor shall route all wire to the interior status lights (to be wired in parallel with interior LED lights, and/or the PLC), as required. The Contractor shall make all building penetrations as necessary for cable runs. The Contractor shall seal up any openings to make a water tight seal at all attached locations. All building penetrations shall be sealed to prevent moisture, and rodents from entering. All penetrations shall be concealed from the outside. All work shall be neat and professional. Any holes or cracks caused by the installer shall be patched with suitable materials and painted to match existing.
10.	Mounting Location	The units shall be mounted at approximately 6.5' high horizontally along the front building wall and side building wall. The exact location of LED beacons shall be coordinated with the MdTA. The lights will be mounted to two (2) exterior sides of the Post #3 and Post #4 buildings. One location must be viewable when the Police Officer is outside the building standing near the measuring chains. The other location must be viewable by the Officer when the truck is in the pull-off area. All mounting locations and mounting types must be approved by MdTA.
11.	Product Model 	Each LED indicator beacon strip shall be Whelen Strip-Lite Series warning LEDs, model PS*00F*R (where = color code) or approved equal.  Note: The Contractor shall provide all mounting brackets, adapters and mounting boxes, as required. At the Contractor's request, with MdTA approval, or at MdTA's request, the site conditions may warrant additional brackets (e.g., part PSBKT451 [45-degree mounting bracket] or PSBKT1 [mounting guard]). If required, this shall result in no additional cost to the Authority.
12.	Manufacturer Warranty	The LED strips must have a one-year minimum warranty.
13.	Contractor Warranty	The Contractor shall supply a one-year warranty commencing after the Acceptance period is successfully completed.

**Measurement and Payment.** This item will not be measured separately, but instead will be paid separately as a lump sum for the items referenced by this bid item and as described herein. The installation shall occur at the designated MdTA locations. The lump sum for this item shall include all materials, labor, and equipment as may be necessary to furnish and install, setup, configure, test, warrant, and perform any other work needed to make the installation operational and acceptable. Any requirements of the specifications or special provisions not specifically detailed or mentioned in a pay item shall be considered incidental to the pay items.

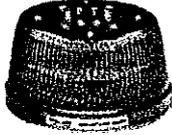
Refer to Bid Items 8010 and 8011.

**800.02.07 Exterior Status Indicator Beacons**

**Description.** The Contractor shall furnish, install, integrate, test, commission and warrant single exterior status indicator beacons as described below. The beacons shall meet the requirements described in Table 12.

**Table 12: LED Exterior Status Indicator Beacon Requirements**

REQ'T NUMBER	FEATURE	SPECIFICATION
1.	Quantity	The Contractor shall furnish, install, integrate, test, commission, and warrant the following quantity of surface-mounted LED status indicator beacons: <ul style="list-style-type: none"> <li>• At Post #4, two (2) exterior mounted LED beacons mounted to the top of the Sensor #4 Pole.</li> <li>• At Post #3, three (3) exterior mounted beacons, one (1) mounted to the top of each overheight sign in Toll Lanes 1-3.</li> </ul>
2.	Standards	All beacons shall be Class 1, SAE Certified
3.	Features	All LED beacons shall meet the following: <ol style="list-style-type: none"> <li>a. All beacons shall be heavy duty, rugged, and designed for use in industrial applications.</li> <li>b. The LED technology shall be based on super bright LED technology such that it is easily visible in all weather conditions (sunshine, rain, fog, etc.) and times of day (day/night).</li> <li>c. The LEDs shall be bright enough to be seen at distances up to 100' in darkness, in bright sunshine and in adverse weather conditions.</li> <li>d. The LED shall provide a 360° degree view.</li> <li>e. The beacon shall provide a built-in flasher with a selectable flash pattern for high or low intensity.</li> <li>f. The beacon shall have a minimum of 28 built-in flash patterns and 4 simulated rotating patterns.</li> <li>g. The units shall have a heavy-duty powder coated die-cast base.</li> <li>h. LED beacons shall be PLC compatible and shall be able to be turned on from the PLC.</li> </ol>
4.	Power Input	The power input shall be 12 VDC with nominal current of 1.5 amp average consumption. The Contractor shall furnish and install all necessary power supplies, relays, and fuses, as required, to provide control via the PLC. The Contractor shall provide the necessary safeguards to ensure the input tolerance is not over-driven. The Contractor shall provide the properly sized power supply to accommodate the voltage drop for long runs using #16 AWG with a 12VDC input. The Contractor shall route and conceal power supply cables in the pole and sign structures, as required. Note: existing sign structures have 120V boards inside.
5.	Enclosure	The modules shall be outdoor rated for outdoor use and weather proof.

REQ'T NUMBER	FEATURE	SPECIFICATION
6.	Colors	LED beacons shall be available in amber, blue or red colors. Each unit shall be <u>blue</u> in color. The final colors shall be submitted and approved by MdTA prior to ordering.
7.	LED Life	Each LED shall be rated for a minimum of 100,000 hours of use.
8.	Epilepsy Frequency	The LED beacon shall not use any frequencies in the range known to trigger epileptic seizures.
9.	Dimensions	Each LED beacon shall be approximately 7.25" W x 4" H.
10.	Mounting Type	<p>The unit shall be available in two (2) mounting configurations:</p> <ol style="list-style-type: none"> <li>1. 1" NPT conduit attachment.</li> <li>2. Panel/Surface mount.</li> </ol> <p>The Contractor shall select the most stable type of mount, based on field conditions. The Contractor shall provide all conduit, mounting brackets, NPT pipe adapters and mounting boxes, as required. The Contractor shall route all signal and power wire to the PLC, as required.</p>
11.	Mounting Location	<p>The exact location of LED beacons shall be coordinated with the MdTA. Two (2) of the beacons shall be mounted atop the Sensor #4 Pole and shall be clearly viewable from Post #4. Three (3) of the beacons shall be mounted to the top of each overheight sign in Toll Lanes 1-3.</p> <p>The Contractor shall seal up any openings (e.g., to poles, sign structures, buildings, etc.) to make a water tight seal at all attached locations. Any holes or cracks caused by the installer shall be patched with suitable materials and painted to match existing. Resulting damage due to water leaks from an improper installation shall be the responsibility of the Contractor to repair.</p>
12.	Product Model 	<p>Each LED indicator beacon shall be a Whelen Super-LED L360 Series Beacon unit, model number L31H*F (where * = color available in amber, red, blue) or approved equal.</p> <p>The Contractor is to select the most stable mounting after site inspection. All mounting locations and mounting types must be approved by MdTA. Contractor to furnish and install all required mounting parts/kits. The Contractor shall supply the L360PMKT or approved equal, 1" NPT pipe mount kits as required.</p>
13.	Manufacturer Warranty	The beacons must have a one-year minimum warranty.
14.	Contractor Warranty	The Contractor shall provide a one-year warranty commencing after the Acceptance period is successfully completed.



**Measurement and Payment.** This item will not be measured separately, but instead will be paid separately as a lump sum for the items referenced by this bid item and as described herein. The installation shall occur at the designated MdTA locations. The lump sum for this item shall include all materials, labor, and equipment as may be necessary to furnish and install, setup, configure, test, warrant, and perform any other work needed to make the installation operational and acceptable. Any requirements of the specifications or special provisions not specifically detailed or mentioned in a pay item shall be considered incidental to the pay items.

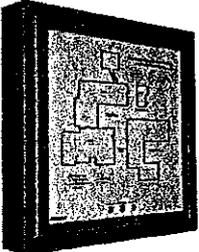
Refer to Bid Items 8003, 8010 and 8011.

**800.02.08 Interior LED Status Indicator Light Panel**

**Description.** The Contractor shall furnish, install, integrate, test, commission, and warrant interior LED status indicator light panels as described below. The indicator light panels shall meet the requirements described in Table 13.

**Table 13: Interior LED Status Indicator Light Panel Requirements**

REQ'T NUMBER	FEATURE	SPECIFICATION
1.	Quantity	The Contractor shall furnish, install, integrate, test, commission, and warrant the following quantity of interior LED status indicator light panels: <ul style="list-style-type: none"> <li>• The Contractor shall supply one (1) interior LED status indicator light panel at Post #3.</li> <li>• The Contractor shall supply one (1) interior LED status indicator light panel at Post #4.</li> </ul>
2.	Standards	All panels shall utilize UL-listed components.

REQ'T NUMBER	FEATURE	SPECIFICATION
3.	Custom Panel Specification  	<p>Panels shall be used to graphically display all alarms to the Officers in the Post Buildings. Panels shall be custom fabricated to meet the following requirements.</p> <ol style="list-style-type: none"> <li>a. The panel shall be manufactured to approximately 2'W x 2'L x 3"D.</li> <li>b. The panel shall be constructed of aluminum.</li> <li>c. The panel shall be professionally painted black in color.</li> <li>d. The panel shall have a graphical overlay depicting the sensor and sign layout for each Post. MdTA will provide the conceptual graphic to the Contractor (refer to Figure 15 and 17 for a sample of the envisioned type of graphic). The final graphic to be developed by the Contractor and submitted for approval to MdTA.</li> <li>e. The panel shall be engraved and or professionally painted to show the sensor numbers and sign numbers.</li> <li>f. The panel shall have a heavy duty test push button to test that the sensors are aligned and functional. Note: when the Officer presses the test button located inside the Post Building, the system shall enter the alarm mode. In this mode, the system simulates a beam break at all sensors simultaneously and allows the system's buzzers and sensor status indicator lights and beacons to be tested. The system functions exactly as it would if a true beam break were to occur.</li> <li>g. The panel shall use an LED light to display the status of each sensor. Each light shall be independent from one other. The light shall be in the off state when the sensor is in the normal mode, in the slow blinking state when sensors are misaligned, and the steady-on (or steady-on strobe) state when there is a beam break.</li> <li>h. The panel shall use an LED light to display the status of each sign at each Post. The light shall be off when no message is being displayed. The light shall be on when the overheight message is displayed on a beam break.</li> <li>i. At Post #3, one (1) test button, and eight (8) LEDs for the five (5) sensors and three (3) signs shall be provided on the graphical panel.</li> <li>j. At Post #4, one (1) test button, and seven (7) LEDs for the five (5) sensors and two (2) signs shall be provided on the graphical panel.</li> </ol> <p>The Contractor shall supply a shop drawing to MdTA for approval prior to fabrication.</p>
4.	Power Input	<p>The power input shall be 12 VDC or 24 VDC with maximum current of 1 amp. The Contractor shall furnish and install all necessary power supplies and relays, as required, to provide control via the PLC. The Contractor shall route and conceal power supply cables in the building, as required.</p>
5.	Colors	<p>Each LED shall be RED in color.</p>
6.	LED Life	<p>Each LED shall be rated for a minimum of 100,000 hours of use.</p>



REQ'T NUMBER	FEATURE	SPECIFICATION
7.	Mounting Type	Each panel shall be mounted to an interior wall inside the Post building and anchored to the studs. The Contractor shall supply all conduit and brackets as required. The Contractor shall route all wire as required to the PLC. The Contractor shall make all building penetrations as necessary. All building penetrations shall be sealed to prevent moisture, and rodents from entering. All penetrations shall be concealed from the outside. All work shall be neat and professional. Any holes or cracks caused by the installer shall be patched with suitable materials and painted to match existing. Resulting damage due to water leaks from an improper installation shall be the responsibility of the Contractor to repair.
8.	Mounting Location	The exact location of panels shall be coordinated with the MdTA. The Officer should be able to easily see the panel from his behind the desk position. All mounting locations and mounting types must be approved by MdTA.
9.	Product Model	Each panel shall be a Graphics National Active Graphic Annunciator, or approved equal.
10.	Manufacturer Warranty	The panel and LEDs must have a one-year minimum warranty.
11.	Contractor Warranty	The Contractor shall supply a one-year warranty commencing after the Acceptance period is successfully completed.

**Measurement and Payment.** This item will not be measured separately, but instead will be paid separately as a lump sum for the items referenced by this bid item and as described herein. The installation shall occur at the designated MdTA locations. The lump sum for this item shall include all materials, labor, and equipment as may be necessary to furnish and install, setup, configure, test, warrant, and perform any other work needed to make the installation operational and acceptable. Any requirements of the specifications or special provisions not specifically detailed or mentioned in a pay item shall be considered incidental to the pay items.

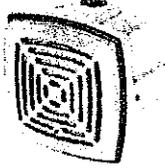
Refer to Bid Items 8010 and 8011.

**800.02.09 Exterior Buzzer**

**Description.** The Contractor shall furnish, install, integrate, test, commission, and warrant exterior buzzers (horns) as described below. The exterior buzzers shall meet the requirements described in Table 14.

**Table 14: Exterior Buzzer Requirements**

REQ'T NUMBER	FEATURE	SPECIFICATION
1.	Quantity	The Contractor shall furnish, install, integrate, test, commission, and warrant the following quantity of exterior buzzers: <ul style="list-style-type: none"> <li>• The Contractor shall supply one (1) exterior buzzer at Post #3.</li> <li>• The Contractor shall supply three (3) exterior buzzers at Toll Lanes 1 – 3 at Post #3.</li> <li>• The Contractor shall supply one (1) exterior buzzer at Post #4.</li> </ul>
2.	Standards	All buzzers shall utilize UL-listed components.
3.	Features	All buzzers shall meet the following: <ol style="list-style-type: none"> <li>a. All buzzers shall be heavy duty designed for use in industrial applications where corrosion resistance is required.</li> <li>b. All buzzers shall be PLC compatible and shall be able to be turned on from the PLC.</li> <li>c. All buzzers shall have a convenient plug-in assembly.</li> <li>d. All buzzers shall be grille type and have a corrosion resistant finish.</li> <li>e. All buzzers shall be low-current, high decibel, vibrating buzzers and have a volume adjustment from 78 dB to 101 dB using a hex set screw on the face of the panel.</li> <li>f. All buzzers shall have a maximum output of 101dB when measured at 10 feet from the buzzer.</li> <li>g. All buzzers shall be DC and shall have a 200 hour rating.</li> </ol>
4.	Power Input	The power input shall be 24 VDC with nominal current of 0.16A maximum. The Contractor shall furnish and install all necessary power supplies and relays, as required, to provide control via the PLC. The Contractor shall route and conceal power supply cables in the sign structure and/or building, as required. Note: existing sign structures have 120V boards inside.
5.	Enclosure	The buzzer shall be NEMA 4X rated for outdoor use (protection against corrosion) and weather proof. There shall be a ¾" hole at the top for a NPT conduit attachment. The unit shall have knockouts on the bottom and rear of the enclosure. The enclosure shall come with the plastic projector accessory to project the audible warning.
6.	Finish	The buzzer shall be a die-cast weatherproof box with a durable, corrosion resistant, electrostatic heat flowed powder epoxy gray finish.
7.	Dimensions	Each buzzer shall be approximately 4.875" W x 4.875" L x 3.3"D.

REQ'T NUMBER	FEATURE	SPECIFICATION
8.	Mounting Type	<p>The unit shall be available in two (2) mounting configurations:</p> <ol style="list-style-type: none"> <li>1. 3/4" (19 mm) double-threaded NPT conduit attachment.</li> <li>2. Panel attachment.</li> </ol> <p>The Contractor shall select the most stable type of mount, based on field conditions. The Contractor shall supply all conduit and brackets as required. The Contractor shall route all wire to the PLC or signs, as required. The Contractor shall seal up any openings (e.g., to poles, sign structures, etc.) to make a water tight seal at all attached locations. All work shall be neat and professional. Any holes or cracks caused by the installer shall be patched with suitable materials and painted to match existing. Resulting damage due to water leaks from an improper installation shall be the responsibility of the Contractor to repair.</p>
9.	Mounting Location	<p>The exact location of the buzzers shall be coordinated with the MdTA. The buzzers at Toll Lanes 1-3 at Post #3 shall be installed on the same side as the passing vehicle, so as to be heard on the driver's side of the vehicle. Note: the existing buzzers are located on the opposite side of the sign (away from the vehicle). The buzzers at these locations shall be removed by the Contractor and the opening to the cabinet capped and sealed off.</p>
10.	Product Model 	<p>Each buzzer shall be an Edwards 877 series unit, model number 877-G1, or approved equal. The plastic projector accessory shall be model number 872-PO or approved equal.</p> <p>The Contractor is to select the most stable mounting after site inspection. All mounting locations and mounting types must be approved by MdTA. Contractor to furnish and install all required mounting parts/kits.</p>
11.	Manufacturer Warranty	<p>The buzzer must have a one-year minimum warranty.</p>
12.	Contractor Warranty	<p>The Contractor shall provide a one-year warranty commencing after the Acceptance period is successfully completed.</p>

**Measurement and Payment.** This item will not be measured separately, but instead will be paid separately as a lump sum for the items referenced by this bid item and as described herein. The installation shall occur at the designated MdTA locations. The lump sum for this item shall include all materials, labor, and equipment as may be necessary to furnish and install, setup, configure, test, warrant, and perform any other work needed to make the installation operational and acceptable. Any requirements of the specifications or special provisions not specifically detailed or mentioned in a pay item shall be considered incidental to the pay items.

Refer to Bid Items 8003, 8010 and 8011.

**800.02.10 DVR**

**Description.** The Contractor shall furnish, install, integrate, test, commission, and warrant Digital Video Recorders (DVRs) as described below. The DVRs shall meet the requirements described in Table 15.

**Table 15: DVR Requirements**

REQ'T NUMBER	FEATURE	SPECIFICATION
1.	Quantity	The Contractor shall furnish, install, integrate, test, commission, and warrant the following quantity of DVRs: <ul style="list-style-type: none"> <li>• The Contractor shall supply one (1) DVR at Post #3.</li> <li>• The Contractor shall supply one (1) DVR at Post #4.</li> </ul>
2.	Standards	All DVRs shall utilize UL-listed components.
3.	Features	<p>All DVRs shall meet the following:</p> <ol style="list-style-type: none"> <li>a. Shall be a 4 NTSC input device minimum;</li> <li>b. Shall provide MPEG-4, MJPEG video compression;</li> <li>c. Shall provide broadcast quality recording;</li> <li>d. Shall provide recording of H.264 streams from IP video;</li> <li>e. Shall provide dynamic settings based on status, including alarm, event or schedule.</li> <li>f. Shall provide per camera configurations for resolution, quality, and recording rate.</li> <li>g. Shall provide client software (included with DVR and an unlimited number of copies) to allow the DVR video to be viewed remotely using DVR client software from a Windows XP, Vista, and Windows 7 PC.</li> <li>h. Shall provide quick export of video to DVD using the easy evidence blue button.</li> <li>i. Shall provide easy playback of exported video without additional media play.</li> <li>j. Shall provide the simultaneous display of live video and replay of alarm event;</li> <li>k. Shall provide digital zoom and on-screen pan/tilt/zoom controls for each connected camera. Contractor shall run the required cabling from the DVR to the PLC, and from the PLC to the camera. Contractor to ensure all PTZ functions operate. The Contractor shall provide the mechanism to disable PTZ functions for normal operators. The PTZ function shall be reserved for setup purposes by the System Administrator (or Electronics Technician) only. This feature is not for use by the Police as the camera is indented to capture the overheight vehicle.</li> <li>l. Shall be able to record at 30 FPS at full DI resolution.</li> <li>m. Shall provide the ability to perform email notifications of alarms, events, and system messages.</li> <li>n. Older video shall automatically be purged when the disk becomes full.</li> <li>o. Shall provide the ability to search the storage archive by date, time, and location.</li> <li>p. Shall utilize Intel Core 2 Duo 2.4 GHZ or later processor.</li> <li>q. Shall have a minimum of 512 MB RAM.</li> <li>r. Shall provide audible alarms as .wav files on alarm inputs.</li> </ol>

REQ'T NUMBER	FEATURE	SPECIFICATION
4.	Power Input	The power input shall be 110VAC with power consumption of 300W. The Contractor shall furnish and install all necessary power supplies and relays, as required, to provide control via the PLC. The Contractor shall route and conceal power supply cables in the building, as required.
5.	Storage	Each DVR shall come equipped with 1 TB of storage.
6.	Network Interface	Each DVR shall have one (1) 10/100/1000Base-T network interface.
7.	Input/Outputs	Each DVR shall provide the following: <ol style="list-style-type: none"> <li>a. One (1) Form C relay output.</li> <li>b. Fifteen (15) dry contact alarm inputs.</li> <li>c. One (1) RS-422/RS-485 terminal block serial connection. Refer to Item 3 above regarding camera PTZ functions.</li> <li>d. Six (6) high speed USB ports.</li> <li>e. One (1) Digital Video Interface (DVI) port.</li> <li>f. Two (2) 6-pin mini-DIN for PS/2 mouse and keyboard connection.</li> <li>g. Four (4) BNC style video inputs with looping outputs.</li> <li>h. Terminal blocks for input triggers, audio inputs, RS-422/RS-485 and output relays.</li> </ol>
8.	Operating Temperature Range	The unit shall be rated for indoor use with minimum operating range of +50°F to +95°F. The operating humidity shall be rated for 20% to 80% non-condensing.
9.	Enclosure	The enclosure shall be a desktop type enclosure.
10.	Dimensions	Each DVR shall be approximately 15" D x 13" W x 5.5"H.
11.	Mounting Type	The DVR shall be installed on the Officer's desk at each Post.
12.	Mounting Location	The exact location of the DVR shall be coordinated with the MdTA.

REQ'T NUMBER	FEATURE	SPECIFICATION
13.	Configuration	<p>The DVR shall have the capability to be configured to satisfy the concept of operations for this project with regard to video capture. The Contractor shall configure the unit as follows:</p> <ul style="list-style-type: none"> <li>a. Decode H.264 video from each camera.</li> <li>b. Record all video 24x7, 5 FPS at full D1 resolution for a minimum of 30 days.</li> <li>c. On a beam break at Sensor #1A/B (Post #4) or Sensor #A/B (Post #3), the PLC will sense the PNP alarm from the overheight sensor and trigger an output off the PLC that will become a dry contact input alarm on the DVR.</li> <li>d. When the DVR senses the alarm input it will immediately start recording to capture a video clip of the truck that caused the overheight condition. The system will be configured to record 2 seconds of pre-event video, 1 second of event video that shows the vehicle breaking the beam, and 2 seconds of post-event video. Each video clip will be 5 seconds in total. The settings for pre-event and post-event record times shall be configurable.</li> <li>e. The DVR will sound an audible alarm and will automatically pop-up a window with the recorded incident playing for the operator. No intervention shall be required by the operator to see the recorded clip.</li> <li>f. The DVR will show the recorded video clip in one window, while continuing to show live video from the camera in a side-by-side window configuration.</li> <li>g. The acceptable delay from the time the input is received by the DVR to the point at which the alarm is sounded and the clip is playing shall be 4 seconds or less (2 seconds of post-event recording is accounted for in the 4 second delay).</li> <li>h. The DVR shall log all alarm inputs with the date/time and alarm input name.</li> </ul> <p>The Contractor shall perform all wiring/conduit runs and configure the DVR to enable the capability described above. The Contractor shall configure the system such that video clip shows the beam break roughly in the middle of the video clip (i.e., about 2.5 seconds into the 5 second clip). The Contractor shall make all adjustments necessary to compensate for latency of communication signals and video signals. The use of time delay relays/switches and other circuit devices maybe required. These shall be considered incidental to the contract.</p>
14.	Product Model 	<p>Each DVR shall be Integral Digital Sentry DS RealVue Desktop Enterprise-Class DVMS, model number DSD041000 (4-channel, 120 IPS, 1000GB), or approved equal.</p> <p>The DVR shall come equipped with 4 IP camera licenses to be able to decode the H.264 video.</p>
15.	Manufacturer Warranty	The DVR must have a three-year minimum warranty.
16.	Contractor Warranty	The Contractor shall provide a one-year warranty commencing after the Acceptance period is successfully completed.



**Measurement and Payment.** This item will not be measured separately, but instead will be paid separately as a lump sum for the items referenced by this bid item and as described herein. The installation shall occur at the designated MdTA locations. The lump sum for this item shall include all materials, labor, and equipment as may be necessary to furnish and install, setup, configure, test, warrant, and perform any other work needed to make the installation operational and acceptable. Any requirements of the specifications or special provisions not specifically detailed or mentioned in a pay item shall be considered incidental to the pay items.

Refer to Bid Items 8010 and 8011.

**800.02.11 19" LCD Monitor**

**Description.** The Contractor shall furnish, install, integrate, test, commission, and warrant 19" LCD monitors as described below. The monitors shall meet the requirements described in Table 16.

**Table 16: 19" LCD Monitor Requirements**

REQ'T NUMBER	FEATURE	SPECIFICATION
1.	Quantity	The Contractor shall furnish, install, integrate, test, commission, and warrant the following quantity of 19" LCD monitors: <ul style="list-style-type: none"> <li>• The Contractor shall supply one (1) monitor at Post #3.</li> <li>• The Contractor shall supply one (1) monitor at Post #4.</li> </ul>
2.	Standards	All monitors shall utilize UL-listed components.
3.	Features	All monitors shall meet the following: <ol style="list-style-type: none"> <li>a. Shall be a flat panel design.</li> <li>b. Shall provide a vertical desktop stand.</li> <li>c. Shall provide a 3-D digital comb filter with deinterlacing for the display of high quality video.</li> <li>d. Shall provide a contrast ration of 500:1.</li> <li>e. Shall provide a maximum brightness of 450 cd/m<sup>2</sup>.</li> <li>f. Shall provide a maximum response time of 8 ms.</li> <li>g. Shall provide a panel lamp life of 40,000 hours.</li> <li>h. Shall provide a 150° horizontal and 130° vertical viewing angle.</li> <li>i. Shall provide a 10° to 45° tilt adjustment.</li> <li>j. Shall provide support for display 16.7 million colors.</li> <li>k. Shall provide integrated front speakers.</li> <li>l. Shall provide an LED for power on, standby, and sleep.</li> <li>m. Shall provide an on-screen indicator for no video signal.</li> <li>n. Shall be compatible with the DVR and be able to display all 4-channels of video from the DVR at the same time.</li> </ol>
4.	Power Input	The power input shall be 110VAC with power consumption of 60W. The Contractor shall furnish and install all necessary power supplies, as required.



REQ'T NUMBER	FEATURE	SPECIFICATION
5.	Input/Outputs	Each monitor shall provide the following: a. Shall provide two looping composite inputs and one s-video input. b. Shall provide a VGA resolution up to 1280x1024. c. Shall provide a DVI input. d. Shall provide picture-in-picture capability. e. Shall provide a USB port.
6.	Operating Temperature Range	The unit shall be rated for indoor use with minimum operating range of +32°F to +104°F. The operating humidity shall be rated for 20% to 85% non-condensing.
7.	Dimensions	Each monitor shall be approximately 3.3" D x 16.6" W x 14.7"H.
8.	Mounting Type	The monitor shall be installed on the Officer's Desk at each Post.
9.	Mounting Location	The exact location of the monitor shall be coordinated with the MdTA.
10.	Product Model 	Each monitor shall be Pelco PMCL419, or approved equal.
11.	Manufacturer Warranty	The monitor must have a one-year minimum warranty.
12.	Contractor Warranty	The Contractor shall provide a one-year warranty commencing after the Acceptance period is successfully completed.

**Measurement and Payment.** This item will not be measured separately, but instead will be paid separately as a lump sum for the items referenced by this bid item and as described herein. The installation shall occur at the designated MdTA locations. The lump sum for this item shall include all materials, labor, and equipment as may be necessary to furnish and install, setup, configure, test, warrant, and perform any other work needed to make the installation operational and acceptable. Any requirements of the specifications or special provisions not specifically detailed or mentioned in a pay item shall be considered incidental to the pay items.

Refer to Bid Items 8010 and 8011.

**800.02.12 CCTV Camera**

**Description.** The Contractor shall furnish, install, integrate, test, commission, and warrant outdoor rated PTZ dome cameras and related equipment as described below. The cameras shall meet the requirements described in Table 17.

**Table 17: Camera and Related Equipment Requirements**

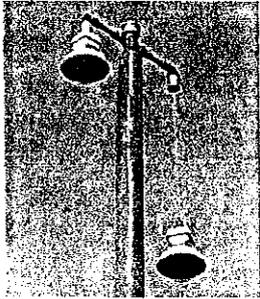
REQ'T NUMBER	FEATURE	SPECIFICATION
1.	Quantity	The Contractor shall furnish, install, integrate, test, commission, and warrant the following quantity of outdoor rated PTZ dome cameras: <ul style="list-style-type: none"> <li>• The Contractor shall supply one (1) camera atop the Post #3 Toll Plaza to view the Primary A/B sensor locations.</li> <li>• The Contractor shall supply one (1) camera atop the existing camera C-036 pole at the Post #4 location to view the Sensor #1A/B locations.</li> </ul>
2.	Standards	All camera equipment shall utilize UL-listed components.

REQ'T NUMBER	FEATURE	SPECIFICATION
3.	Camera Features	<p>All outdoor rated PTZ dome cameras shall meet the following:</p> <ul style="list-style-type: none"> <li>a. the camera/dome shall be a color/black&amp;white (day/night) camera;</li> <li>b. the camera/dome shall have 35X optical zoom;</li> <li>c. the camera/dome shall have 360 degree continuous pan;</li> <li>d. the camera/dome shall have tilt +2° to -92°;</li> <li>e. the camera/dome shall have pan speed .1° to 80°/second;</li> <li>f. the camera/dome shall have tilt speed .1° to 40°/second;</li> <li>g. the camera/dome shall support up to 256 presets;</li> <li>h. the dome shall have a smoked color lower dome sealed lens/bubble;</li> <li>i. the camera/dome shall support up to 7 alarm inputs;</li> <li>j. the camera/dome shall be a autofocus;</li> <li>k. the camera/dome shall be high resolution day/night camera with 540 TVL;</li> <li>l. the camera/dome shall provide a Wide Dynamic Range (WDR) capability;</li> <li>m. the camera/dome shall provide Electronic Image Stabilization;</li> <li>n. the camera/dome shall provide a 20 user-definable character title overlay;</li> <li>o. the camera/dome shall provide an on-screen compass and tilt display;</li> <li>p. the camera/dome shall provide password protection;</li> <li>q. the camera/dome shall provide built-in surge and lightning protection;</li> <li>r. the camera/dome shall provide an integrated passive unshielded Twisted Pair (UTP) Circuit;</li> <li>s. the camera/dome shall meet NEMA4X and IP66 requirements;</li> <li>t. each new camera/dome shall be connected with the DVR in the Post building;</li> <li>u. the Contractor shall be required to test new cameras for PTZ (pan/tilt/zoom) control;</li> <li>v. the Contractor shall run the required cabling from the DVR to the PLC, and from the PLC to the camera. Contractor to ensure all PTZ functions operate.</li> <li>w. the Contractor shall install all necessary outdoor rated RG6 coax cable, and the appropriate RS-422 communication and power cables, as well as any necessary video or control signal splitters to enable the transport of high quality video to, and PTZ controls from, the Post building; This shall be considered incidental to the contract.</li> <li>x. the Contractor shall supply all required power supplies for the camera/dome assembly and provide connections, as required;</li> </ul>
4.	Power Input	<p>The power input shall be 24 VDC with current consumption of 3 amps (with heater). The Contractor shall supply all necessary power supplies.</p>

REQ'T NUMBER	FEATURE	SPECIFICATION
5.	Operating Temperature Range	The camera/dome assembly shall be rated for outdoor use with minimum operating range of -40°F to +122°F and 15% to 90% relative humidity, non-condensing;
6.	Post #3 Mounting Location	The Contractor shall install the Post #3 camera/dome atop the Post #3 Toll Plaza on the E-ZPass sign's structure (refer to Figure 5).
7.	Post #4 Mounting Location	The Contractor shall install the Post #4 camera/dome atop existing C-036 camera (refer to Figure 11)
8.	Mounting Type	The Post #3 and Post #4 camera/dome shall be a pendant mount option (with all required accessories provided by the Contractor, e.g., arm, mounting plate, brackets, etc.). The Contractor shall provide a shop drawing for approval prior to procuring equipment and prior to installation.
9.	Default View (AutoHome) / Presets	<p>The Contractor shall configure the presets as requested by MdTA and configure the auto-home position to provide a view of the front of the truck at a zoom-level that makes it easy to see the type of truck at the point of beam breakage. At the Post #4 location, the camera shall be zoomed into the Sensor #1A/B location. At the Post #3 location, the camera shall be zoomed into the Primary A/B location. The Contractor shall ensure the camera has the proper lens and zoom capability to provide the views as specified herein.</p> <p>The final autohome and preset locations shall be approved by MdTA.</p>
10.	Local Control Panel	<p>The Contractor shall furnish and install a 2<sup>nd</sup> 19" wide Local Control Panel for the OHDS camera, with a DB-9 connection for local PTZ control via a laptop (used by a technician), a VDA with an isolated BNC video connection to display the video on a laptop or a portable monitor. The panel shall also have a connection for a multi-pin video connector that carries the video, control signals, and power from the camera.</p> <p>The Contractor will install all necessary cables to enable a fully functional CCTV system, including all serial and NTSC cables between the camera, local control panel, and the encoder. The installation shall allow the OHDS camera, when commanded through the DVR, to receive the PTZ commands and trigger movement of the camera.</p> <p>The installation should preserve control of the ITS camera which is accomplished today using the State's CHART software.</p> <p>The Contractor shall be responsible for ensuring both CCTV cameras site are fully operational, that all video is jitter-free at the AOC, and that PTZ commands properly and reliably traverse the network.</p>
11.	H.264 Encoder	The Contractor shall provide one environmentally hardened H.264 encoder for each camera. At the Post #4 camera, the H.264 encoder shall be installed in the existing C-036 cabinet. At the Post #3 camera, the H.264 encoder shall be installed in the PLC cabinet. The Contractor shall be responsible for configuring the encoder and providing the CAT5E cable that connects to an MdTA provided Ethernet switch in the cabinet.



REQ'T NUMBER	FEATURE	SPECIFICATION
12.	Post #3 Cabling	<p>At Post #3, the Contractor shall route the power and communication (video/PTZ) cables from the camera atop the Toll Plaza EZ-Pass sign along the roof (all exterior cables shall be in 3" RGS"), down and into the pedestrian tunnel where the PLC is located. The cables may follow the existing Tri-Message wiring/conduit run. At this location, the Contractor shall install the camera power supply, and encode the video. The RS-422 camera control cable is required to be routed by the Contractor to the DVR in the Post #3 building. Or alternatively, the DVR manufacturer may provide the capability to control the camera via IP to the encoder. In either case it is the Contractor's responsibility to provide a fully functional camera control system.</p> <p>Note: The Contractor provides the network connection at Post #3 PLC location.</p>
13.	Post #4 Cabling	<p>At Post #4, the Contractor shall route the power and communication (video/PTZ) cables from the camera atop the existing C-036 pole, along the inside of tenon arm, down the inside of the pole and into the existing C-036 cabinet. At this location, the Contractor shall install the camera power supply, and encode the video. The RS-422 camera control cable is required to be routed by the Contractor to the DVR in the Post #4 building. Or alternatively, the DVR manufacturer may provide the capability to control the camera via IP to the encoder. In either case it is the Contractor's responsibility to provide a fully functional camera control system.</p> <p>Note: MdTA will provide the network connection at this site.</p>

REQ'T NUMBER	FEATURE	SPECIFICATION
14.	Post #4 Lowering System	<p>At the Post #4 C-036 location, the Contractor shall provide a 2<sup>nd</sup> tenon arm to mount the new camera, a 2nd camera lowering system to raise/lower the new camera, and a 2<sup>nd</sup> eyebolt with a locknut and ¼" bolt drilled into the pole to tether the aerial support cable from the new lowering system. The Contractor shall replace or reuse existing top rotating tenon as required. All equipment shall be compatible with the Camera Lower Systems CDP-16HD series product. The Contractor is required to reinstall/reroute cables for the existing C-036 cameras as required. The Contractor shall ensure that the C-036 camera maintains its present view range with no obstructions. The Contractor shall also ensure the new camera has a clear unobstructed view of the Sensor 1A/B location. The Contractor shall ensure the cables are installed in such a fashion as to preclude tangling. Refer to Table 18 for additional requirements with regard to the camera lowering system.</p>  <p>The two lowering systems shall be clearly labeled in the pole base.</p>
15.	Product Model	The camera/dome shall be a Spectra IV SE Series Dome (or approved equal). The model number shall be Pelco SD435-PGE1 (or equal) for the Pendant Mount. The Contractor shall provide all required arms, brackets, 1.5" NPT pipes, mounting plates to create a stable, vibration free mount.
16.	Manufacturer Warranty	The camera must have a two-year minimum warranty.
17.	Contractor Warranty	The Contractor shall provide a one-year warranty commencing after the Acceptance period is successfully completed.

**Table 18: Camera Lowering System Requirements**

REQ'T NUMBER	FEATURE	SPECIFICATION
1.	Quantity	The Contractor shall furnish, install, integrate, test, commission, and warrant one (1) camera lowering system.
2.	Pole Height	The C-036 pole height is 50'.
3.	Location	The Contractor shall ensure that both cameras when lowered are able to be safely lowered without the potential for banging on fencing, cabinet, transformers, or other structures.

REQ'T NUMBER	FEATURE	SPECIFICATION
4.	Support Cable	The support cable shall be a stainless steel aircraft cable with a minimum 1/8" diameter.
5.	Cable Strength	The cable strength shall have a 1500-lb minimum safe working load capacity.
6.	Access Opening	The Contractor shall utilize the existing pole access holes for raising/lowering the cameras. The Contractor shall install a 2 <sup>nd</sup> eyebolt with a locknut and 3/4" bolt drilled into the pole to tether the aerial support cable from the new lowering system. The Contractor shall touch up with an approved galvanized paint all disturbed areas.
7.	Winch – Manual/Power	The lowering system shall be equipped with a manual winch and a power winch (e.g., a special electric drill capable of lowering/raising the camera/dome assembly). The lowering system winch support ring clamp, to be mounted on the outer surface of the pole, shall be adequately sized to fit the different diameter poles. Field bending of the winch's support ring clamp to fit the pole surface shall not be allowed. The Contractor shall provide a total of one (1) manual winch to the MdTA at the completion of the project.
8.	Winch – Clutch	The winch device shall have a clutch that prevents over-torque at 300 lbs.
9.	Self-Aligning Top Contact Unit	The lowering system shall have a self-aligning top contact unit such that the system, when raised, will automatically align the connectors on the dome to the receptacles on the mounting bracket at the top of the lowering system.
10.	Contact Type	For support cable systems, the Contractor shall determine the number of pins, contact type, connector type, and conductivity requirements that will support all functionalities and features of the <b>new OHDS camera and the existing camera</b> . The connector shall be self-aligning, self-adjusting, and environmentally sealed to prevent condensation on the pins when in the locked position. It is the Contractor's responsibility to furnish and install a system that provides raising and lowering of each camera independently, and provides high quality video for each camera.
11.	Power Input	The power input to the lowering system shall be at most 10 amps.
12.	Extension Cable	The camera lowering system shall provide an extension cable that allows a technician to test the camera/dome assembly (e.g., view video and PTZ camera) when the dome is in the lowered position. If the Contractor selects a lowering system with a composite cable, this capability is inherent. If the Contractor selects a lowering system with only a support cable, the dome/lowering system must come equipped with a composite connector and extension cable for video, control, and power directly to the dome. The extension cable shall have a minimum length of 15'. The Contractor shall provide a total of two (2) extension cables.



REQ'T NUMBER	FEATURE	SPECIFICATION
13.	Product Module	The lowering system shall be the Camera Lower Systems CDP-16HD series product or an approved equal product. Each camera lowering system shall include but not be limited to the following: <ul style="list-style-type: none"> <li>• Mounting hardware for camera/dome assembly;</li> <li>• Cables, wires, cable tracks and connectors;</li> <li>• Pole/Camera tenon arm for adjusting the horizontal angle of the arm that supports the camera/dome assembly and facilitates various horizontal-mounting angles as required. The tenon arm shall be able to rotate a full 360°, with a maximum of 45° increments. The tenon arm must also provide adjustments to plumb the arm, both side-to-side and from top-to-bottom.</li> </ul>
14.	Manufacturer Warranty	The camera lowering system assembly (including winch and other materials) must provide a 2-year minimum warranty.
15.	Contractor Warranty	The Contractor shall supply a one-year warranty commencing after Acceptance is successfully completed.

**Measurement and Payment.** This item will not be measured separately, but instead will be paid separately as a lump sum for the items referenced by this bid item and as described herein. The installation shall occur at the designated MDTA locations. The lump sum for this item shall include all materials, labor, and equipment as may be necessary to furnish and install, setup, configure, test, warrant, and perform any other work needed to make the installation operational and acceptable. Any requirements of the specifications or special provisions not specifically detailed or mentioned in a pay item shall be considered incidental to the pay items.

Refer to Bid Items 8008 and 8009.

**800.02.13 Wiring**

**Description.** The Contractor shall furnish and install #16 AWG shielded wire and #8 AWG wire, as required. The wiring shall meet the requirements described in Table 19. The Contractor may propose variations (e.g., shielded composite cable of various counts) of the required cabling as long as all functional and performance requirements are satisfied. The general design principal is the Contractor shall use a separate cable for each location (e.g., sensor location, Post Building, etc.). If multiple devices are at a location, the main cable shall be brought to a termination point, and then jumper cables run from there.

**Table 19: Wiring Requirements**

REQ'T NUMBER	FEATURE	SPECIFICATION
1.	Wiring	<p>The Contractor shall furnish and install the following wiring:</p> <ul style="list-style-type: none"> <li>• #16 AWG shielded wiring run to sensors, buzzers, and beacons/lights. All wire shall be twisted pairs, with PVC/nylon insulation, individually shielded, with an overall Beldfoil shield with a PVC jacket. The Contractor shall use Belden Part No. 1055A (2-pair #16 AWG shielded for OHDS transmitters, buzzers, beacons/lights) and Belden Part No. 1039A (4-pair #16 AWG shielded for receivers), as required, or approved equals. May also use Belden 1040A (6 pair), 1041A (8 pair), 1042A (12 pair), 1043A (16 pair), 1044A (20 pair), 1045A (24 pair), or 1046A (36 pair), as required. Wire must be rated for 600V.</li> <li>• 2 conductor #8 AWG outdoor stranded wiring run to overheight detection message signs. Wire must be rated for 600V.</li> <li>• RG6 video coax cable to cameras and DVRs, as required.</li> <li>• All underground cable shall be installed in Schedule 80 4" PVC. Indoor cable shall be installed in ¾" EMT. Bridge attached cable to be installed in 3" RGS. Use existing conduit where possible. Liquid sealtite shall be used where required and kept to 6' runs or less. Liquid sealtite shall be considered incidental to the contract.</li> <li>• Power and signal cabling shall be provided (splice free) between each set of OH transmitter(s) and OH receiver(s) units and the PLC, and any conduits, pull boxes, junction box adjacent to the device unit and its mounting pole and foundation.</li> <li>• Note: where existing empty conduit is to be utilized, conduit shall be cleaned prior to use. Where existing pull strings are used, pull strings are to be replaced for future use.</li> </ul>
2.	Transient Suppressors	<p>The Contractor shall furnish and install transient surge suppressors to provide common and differential mode protection against lightning strikes, current surges, and voltage spikes. The Contractor shall provide the necessary number of transient surge suppressors to accommodate all PLC-to-field wiring. The surge suppressors shall be DIN-rail mountable and operator -40° to +185°F. The Contractor shall use Axiomatic model # TSP-WG6-24V-1A-0y or an approved equal.</p>

**Measurement and Payment.** This item shall be paid on the basis of each item completed, installed, and tested by the Contractor, and accepted by the MdTA. The installation shall occur at the designated MdTA locations. The payment under these items will include all materials (including wiring, galvanized clamps, galvanized brackets, galvanized bolts, galvanized screws, galvanized nuts, short liquid sealtite runs, etc.) and labor as may be necessary to furnish and install, setup, configure, test, warrant, and perform any other work needed to make the installation operational and acceptable.

Refer to Bid Items 8015, 8016, 8017, 8018, 8021, 8022, 8023, 8024, 8025, 8026, and 8027.



## **800.03 CONSTRUCTION**

### **800.03.01 GENERAL**

The Contractor shall be responsible for the following:

- I. The Contractor shall complete the replacement of the existing system within 6 calendar months. This schedule shall be firm and includes a sufficient number of days to accommodate lane closures, adverse weather, etc.
- II. The Contractor installer must strictly adhere to manufacturer's installation, configuration, and calibration instructions for all equipment.
- III. All existing OHDS hardware and parts that are replaced under this contract, including wiring, shall be carefully removed. All parts of the existing system, except wiring, shall be delivered to Mr. David Dikes, ITS Supervisor (ph: 410-537-1096), and stored at the Fort McHenry Tunnel East Ventilation Building. A transmittal letter, signed by the Contractor and the Authority, for all delivered existing equipment shall be provided to Mr. Dikes. At Mr. Dikes' option, he may request the Contractor dispose of portions of, or all of, said equipment.
- IV. The Contractor shall provide catalog cuts of the proposed system to the Authority for approval prior to installation. If the Authority is not familiar with the proposed products, the Authority may require, at no additional charge, that the Contractor set up a demonstration consisting of one unit to verify product quality.
- V. The Contractor shall provide all installation services necessary to complete the installation in a neat and workmanlike manner. Existing conduit may be utilized, where available and allowed by code. The Contractor shall provide all final connections and terminations.
- VI. The Contractor shall perform "Lab Testing" as specified herein.
- VII. The Contractor shall configure the system as specified in these contractual documents and as directed by the Authority.
- VIII. The Contractor shall coordinate all OHDS replacement work with the Project Engineer, and the Facility Administrator at each facility.
- IX. It is the Contractor's responsibility to provide Maintenance of Traffic for lane/shoulder closures. The Contractor is required to provide a schedule to the Authority, 14 days in advance, that clearly indicates when OHDS will be installed. The Contractor is also expected to work within the Authority's lane closure constraints defined by the Facility Administrator at each location. Refer to Section 104 for additional information.
- X. The Contractor shall perform the following:

1. Remove and replace Programmable Logic Controllers (PLCs) as follows:
  - a. Remove existing Programmable Logic Controllers (PLCs) and all input/output cards at Post #3;
  - b. Remove existing Programmable Logic Controllers (PLCs) and all input/output cards at Post #4;
  - c. Furnish and install new PLC at Post #3 in the Toll Tunnel which connects to the BHT Administration Building;
  - d. Furnish and install new PLC at Post #4 in the FMT Mechanical Building.
2. Remove and replace through beam photoelectric sensors as follows:
  - a. At the Post #4 location, remove existing through beam photoelectric sensors (both sender and receiver) at the Sensor #1 through Sensor #4 locations;
  - b. At the Post #3 location, remove existing through beam photoelectric sensors (both sender and receiver) at the Primary A and B sensor locations, and the locations at lanes 1-3 of the Toll Plaza;
  - c. At the Post #4 location, furnish and install new through beam photoelectric sensors (both sender and receiver) at the Sensor #1 A/B through Sensor #4 locations;
  - d. At the Post #3 location, furnish and install new through beam photoelectric sensors (both sender and receiver) at the existing Primary A and B sensor locations, and the locations at lanes 1-3 of the Toll Plaza.
3. Remove and replace buzzer alarms as follows:
  - a. At the Post #4 location, replace the buzzer mounted to the outside of the building;
  - b. At the Post #3 location, replace the buzzer mounted to the outside of the building;
  - c. At the Post #3 location, replace the buzzer mounted to the Overheight sign in lanes 1-3.
  - d. Patch any holes with like material, as required.
4. Remove and replace sensor status indicator **lights inside** the Post #3 and Post #4 buildings as follows:
  - a. At the Post #4 location, remove all sensor status indicator lights inside the building;
  - b. At the Post #3 location, remove all sensor status indicator lights inside the building;
  - c. At the Post #4 location, furnish and install all new sensor status indicator light and panel inside the building;
  - d. At the Post #3 location, furnish and install all new sensor status indicator lights and panel inside the building.
5. Remove and replace sensor status indicator **beacons outside** the Post #3 and Post #4 buildings as follows:
  - a. At the Post #4 location, remove all sensor status indicator beacons outside the building;
  - b. At the Post #3 location, remove all sensor status indicator beacons outside the building;
  - c. At the Post #3 location, remove all sensor status indicator beacons at lanes 1-3;
  - d. At the Post #4 location, furnish and install all new sensor status indicator beacons outside the building;
  - e. At the Post #3 location, furnish and install all new sensor status indicator beacons outside the building;

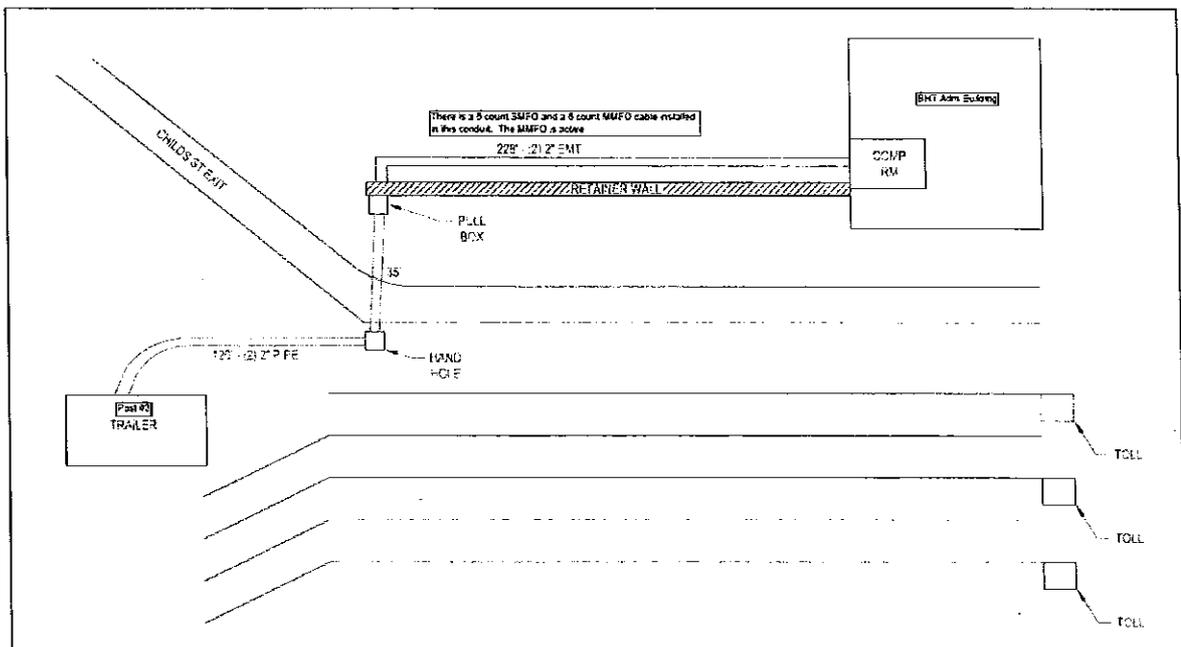
- f. At the Post #3 location, furnish and install all new sensor status indicator beacons at lanes 1-3.
6. Remove and dispose of existing power and communication wiring from the existing PLC to each existing sensor (use as pull string as required), and from the PLC to the existing buzzers, and indicator lights/beacons as follows:
  - a. At the Post #4 location, remove existing wiring between the PLC, located at Post #4, and the Sensor #1 through Sensor #4 locations;
  - b. At the Post #4 location, remove existing wiring between the PLC, located at Post #4, and the buzzers and indicator lights also located at Post #4;
  - c. At the Post #3 location, remove existing wiring between the PLC, located at Post #3, and the Primary A and B sensor locations, and the locations at lanes 1-3 of the Toll Plaza;
  - d. At the Post #3 location, remove existing wiring between the PLC, located at Post #3, and the buzzers and indicator lights also located at Post #3; Preserve the wiring to each Canopy Light on Reverse Side of Toll Plaza Rooftop over Toll Lanes 1-3.

The Contractor shall be careful to preserve all other power and communication cable that may be in existing conduits and used for other purposes (e.g., lighting, traffic control, etc.). Any damage to these existing cables shall be the responsibility of the Contractor to repair.

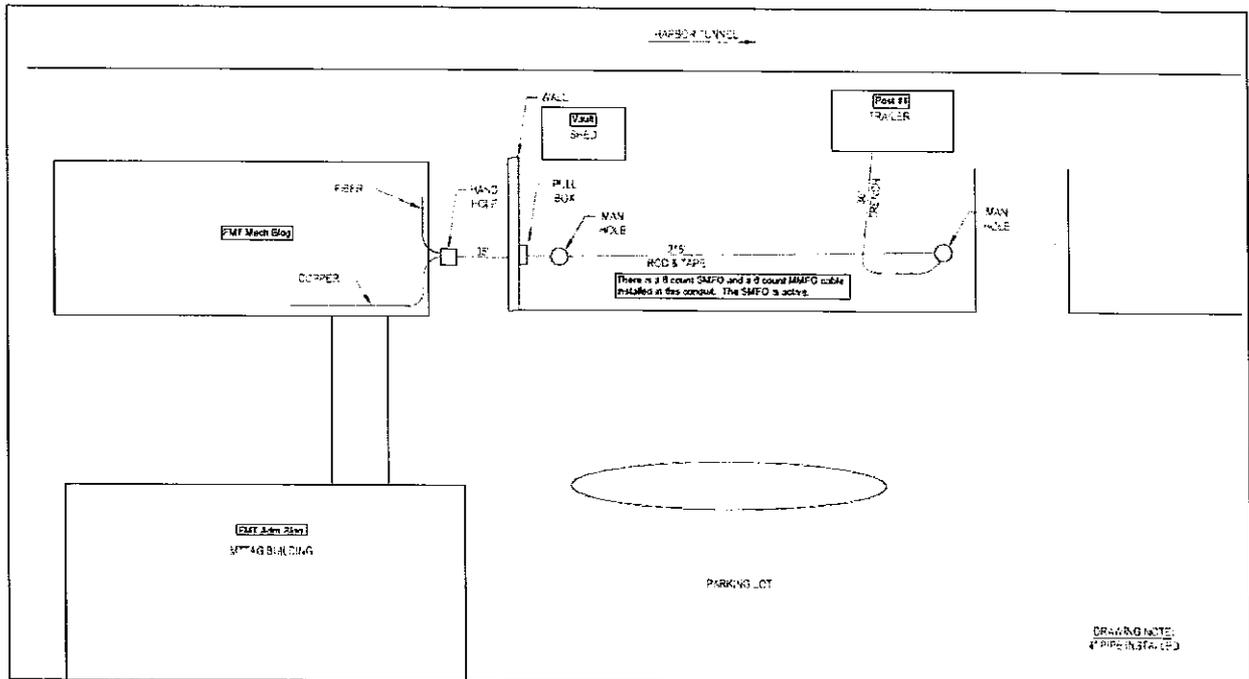
7. Replace all existing power and communication wiring from the new PLC location to each new sensor and from the new PLC location to the existing buzzers and indicator lights/beacons as follows:
  - a. At the Post #4 location, furnish and install new wiring between the PLC, located in the FMT Mechanical Building, and the Sensor #1A/B through Sensor #4 locations;
  - b. At the Post #4 location, furnish and install new wiring between the PLC, located in the FMT Mechanical Building and the buzzers and indicator lights/panel located in Post #4;
  - c. At the Post #3 location, furnish and install new wiring between the PLC, located in the BHT Administration Building, and the Primary A and B sensor locations, and the locations at lanes 1-3 of the Toll Plaza;
  - d. At the Post #3 location, furnish and install new wiring between the PLC, located in the BHT Administration Building and the buzzers and indicator lights/panel located in Post #3. From the Pedestrian tunnel, cable can be run in the cable trays, then through ceiling on the Second Floor, through the computer room, and through the smoking room. cables can be run outside along the side of the Second Floor rooftop, along the side of the building, and along the wall to the corner of the off ramp in existing conduit.
8. Reuse existing conduits where possible as follows:
  - a. The Contractor shall use the recently installed empty 2" conduit between the Post #3 Building and the BHT Administration (refer to Figure 13 below);
  - b. The Contractor shall use the existing conduit between the BHT Administration Building to approximately the mid-way point to the Primary A and B sensor locations;



- c. The Contractor shall use the existing conduit, where available, between the new PLC location in the Toll Tunnel up to lanes 1-3 above.
- d. The Contractor shall replace all junction boxes/pull boxes installed at each sensor location at Post #3 and Post #4 and where required along each wiring run. This shall be considered incidental to the contract. Junction boxes shall be NEMA 4X rated (stainless steel) sized 12" X 12" X 6".
- e. The Contractor shall use the recently installed 4" conduit between the Post #4 Building and the FMT Mechanical Building (refer to Figure 14 below);
- f. The Contractor shall use existing conduit between the PLC located in the FMT Mechanical Building and the vault just outside the FMT Mechanical Building;
- g. The Contractor shall use existing conduit between the vault outside the FMT Mechanical Building and the manhole at Sensor #1;
- h. The Contractor shall use the existing conduit between the manhole at Sensor #1 and the hand hole at the South side of the Canton Viaduct abutment;
- i. The Contractor shall use existing conduit run which is bridge attached transitioning to conduit inside the jersey wall from the South side of the Canton Viaduct abutment to the Sensor #1 through Sensor #4 locations. Note: The conduit from Sensor #4 to Sensor #1 is run mostly in the jersey wall conduit, though it weaves in and out of the jersey wall at lighting locations when near sensor locations. There is a relay/junction box within 30' of each sensor location (on the receiver or Southbound side of I-895). The conduit comes out of the jersey wall at the nearby lighting locations; it is then attached to the bridge to enter the junction box and go up the sensor pole to the sensor location. The Contractor should also note that the conduit runs under the Canton viaduct and provides power to the transmitters on the NB side of the road. The conduit on the NB side of the road weaves in and out of the jersey wall similar to the conduit on the SB side of the road.



**Figure 13: Post #3 Existing Conduit Runs**  
(All Shown Hand Holes, Pull Boxes, and Conduit are Existing)



**Figure 14: Post #4 Existing Conduit Runs**  
(All Shown Hand Holes, Pull Boxes, and Conduit are Existing)

9. Trench, furnish and install new conduits where required, as follows:
  - a. The Contractor shall trench, furnish and install new 4" Schedule 80 PVC conduit between the Primary A and B sensor locations and the midway point to the BHT Administration Building (refer to Figures 15 and 16) at Post #3; Starting at the Primary A/B sensor location, trench (or bore) down the embankment and along the New BHT Maint building to the first manhole. Note that MdTA will need to have this area marked by Miss Utility. From the first manhole there is an existing empty conduit that runs between the New BHT Maintenance Building and the BHT Admin Building. Use the existing spare PVC duct. The cable enters the building in existing 3" PVC;
  - b. The Contractor shall furnish and install new 3/4" EMT conduit in the Toll Plaza and in the BHT Administration Building where existing conduit or cable trays are not available; Cables can then be run into the BHT Admin building to the new PLC location in the Pedestrian tunnel;
  - c. The Contractor shall trench and install new 4" Schedule 80 PVC conduit from the FMT Mechanical Building to the vault just outside the FMT Mechanical Building, as required (existing conduit is expected to be reused); Refer to Figures 17 and 18.
  - d. Where the underground/guardrail conduit/wire meets the existing jersey wall conduit/wire, the Contractor shall install a new NEMA 4X stainless steel junction box (this shall be considered incidental to the contract);

- e. The Contractor shall install 3" RGS where required at Post #4.
  - f. Inside buildings the Contractor shall install ¾" EMT where required.
10. At the Contractor's option utilize existing network connections and fiber where dark fibers exist, as follows:
- a. Utilize existing SMFO/MMFO cable between Post #3 and the BHT Administration Building;
  - b. Utilize existing SMFO/MMFO cable between Post #4 and the FMT Mechanical Building.
11. Furnish, install, configure, and test the system to mimic existing system, except where noted otherwise, and to be consist with the concept of operations and theory of operations.
12. Furnish, install and test two (2) new CCTV cameras, two (2) new DVRs, two (2) H.264 encoders, and two (2) new 19" LCD monitors to capture and display snapshot images of over overheight trucks at the instant the beam is broken at designated sensor locations;
- a. Location 1 is on the Post #3 side on top of the Toll Plaza roof EZ-Pass sign. Power and communication cabling to be run into the BHT Administration Building. Note: network gear to be provided by MdTA.
  - b. Location 2 is on the existing Post #4 side on top of the existing C-036 CCTV pole. Contractor to install a new top rotating tenon arm, and Camera lowering system. Note: network gear to be provided by MdTA.
- The Contractor shall cable the monitors to connect to the PC to allow video from the DVR to be viewed.
13. Furnish and install power supplies, UPSs, and racks where required.
14. The Contractor shall reuse existing sensor poles, structures, electronic fiber optic message signs, and canopy signals, as required.
15. The Contractor shall ensure all new sensors are mounted at heights 13' 7". The Contractor shall confirm this in the presence of MdTA. The overheight setting shall be 13' 7" above the highest point in the roadway cross section. The overheight detectors' beams shall be set as nearly parallel to the roadway cross section as possible. The mounted height shall be adjustable to ± 6 inches in the vertical plane after being set.
16. The Contractor shall furnish and install all wiring and conduit as required to provide a fully operational OHDS. Refer to Figures 15 through 18 and Tables 20 through 23.
17. All installation work shall be neat and professional.
18. The Contractor shall following the sequence of work below:
- a. Post #4 replacement prior to Post #3.
  - b. Replace once sensor at a time, while keeping existing system operational.
  - c. Install new buzzers and lights.
  - d. When all sensors are replaced decommission old PLC, lights, and buzzers.

Note: It is important for the Contractor to understand that the existing system must remain operational, to the extent possible, as the new system is installed. Under no circumstances shall the entire existing OHDS be taken offline for any period greater than 24 hours.

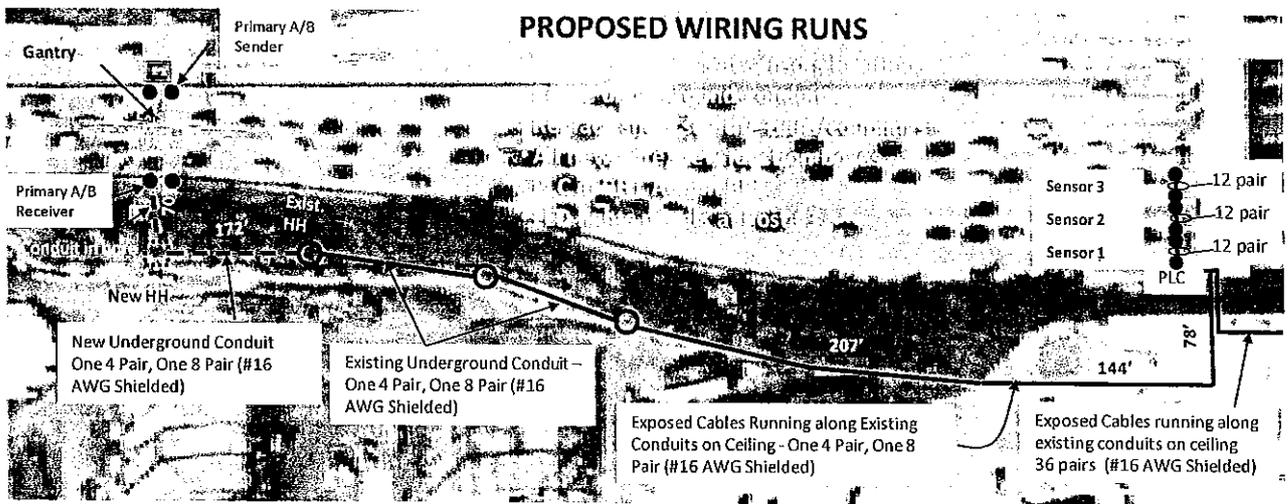


Figure 15: Post #3 Conduit Runs (1 of 2)

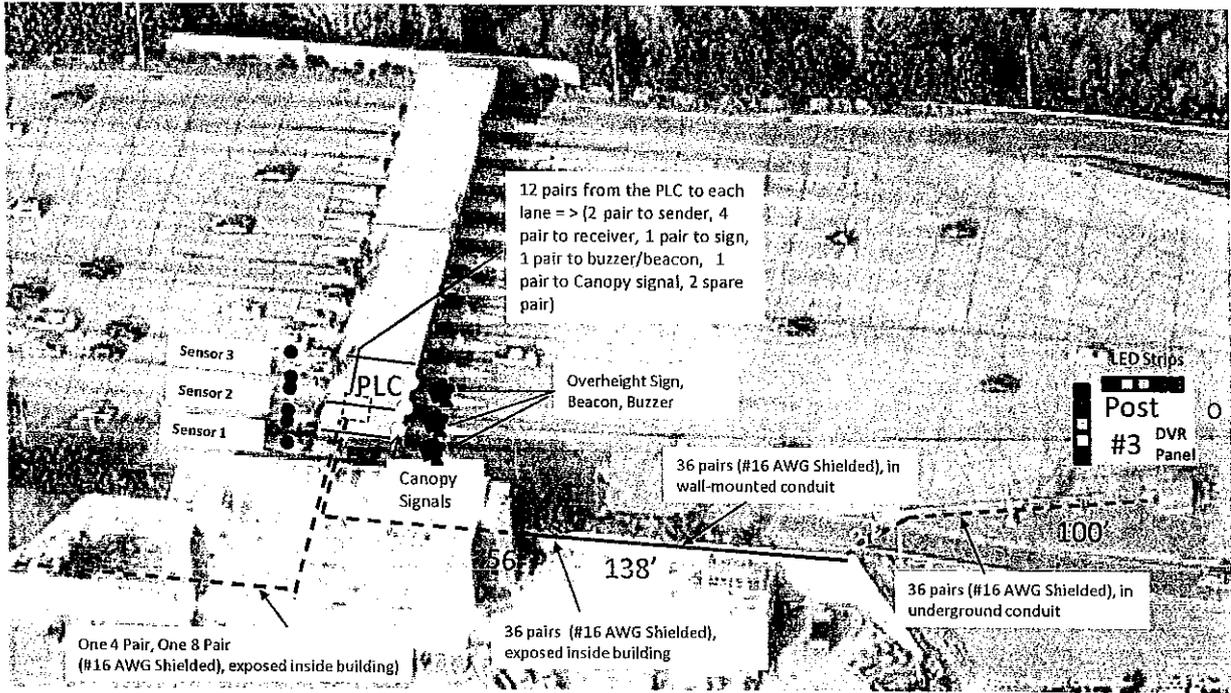
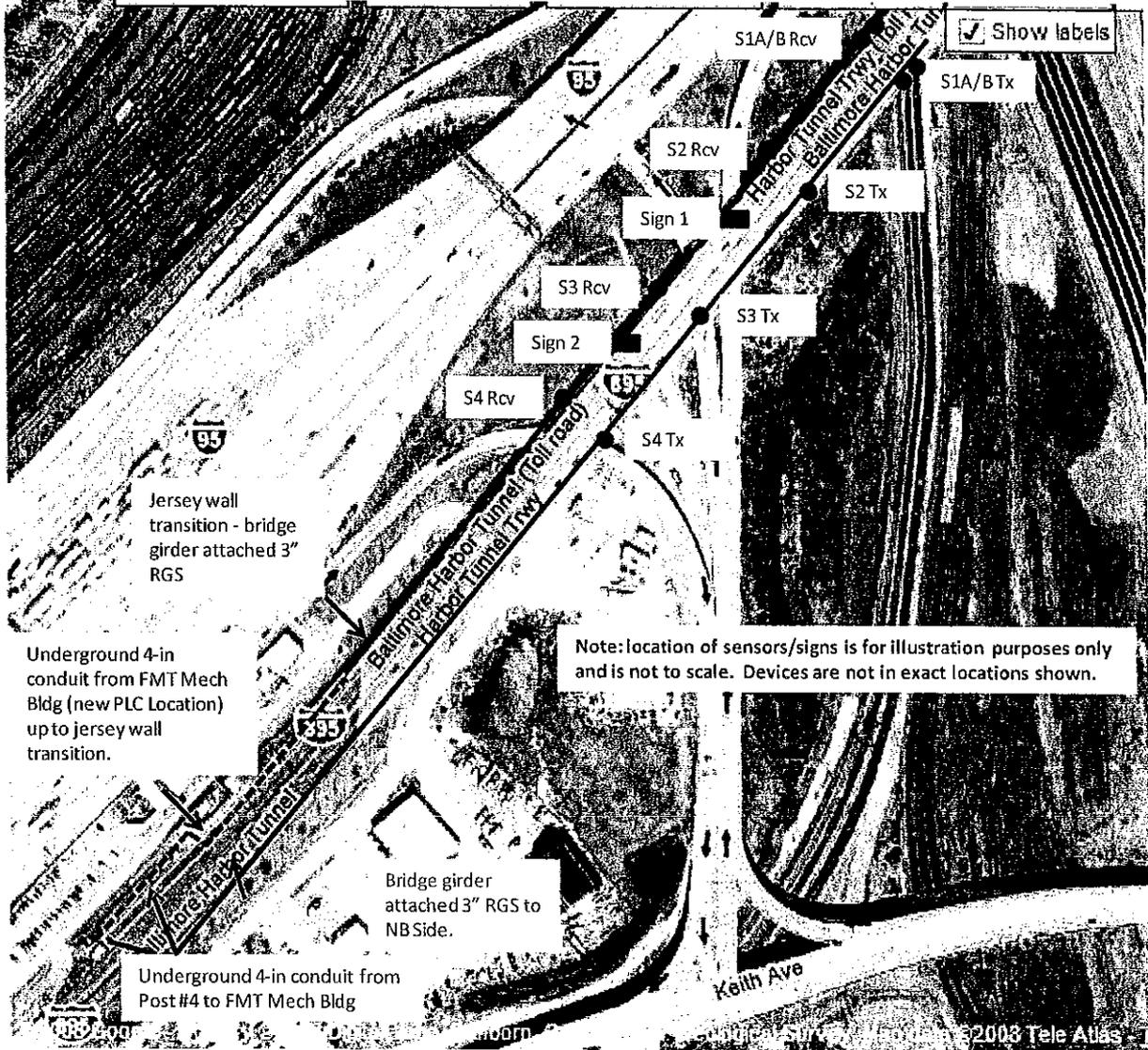
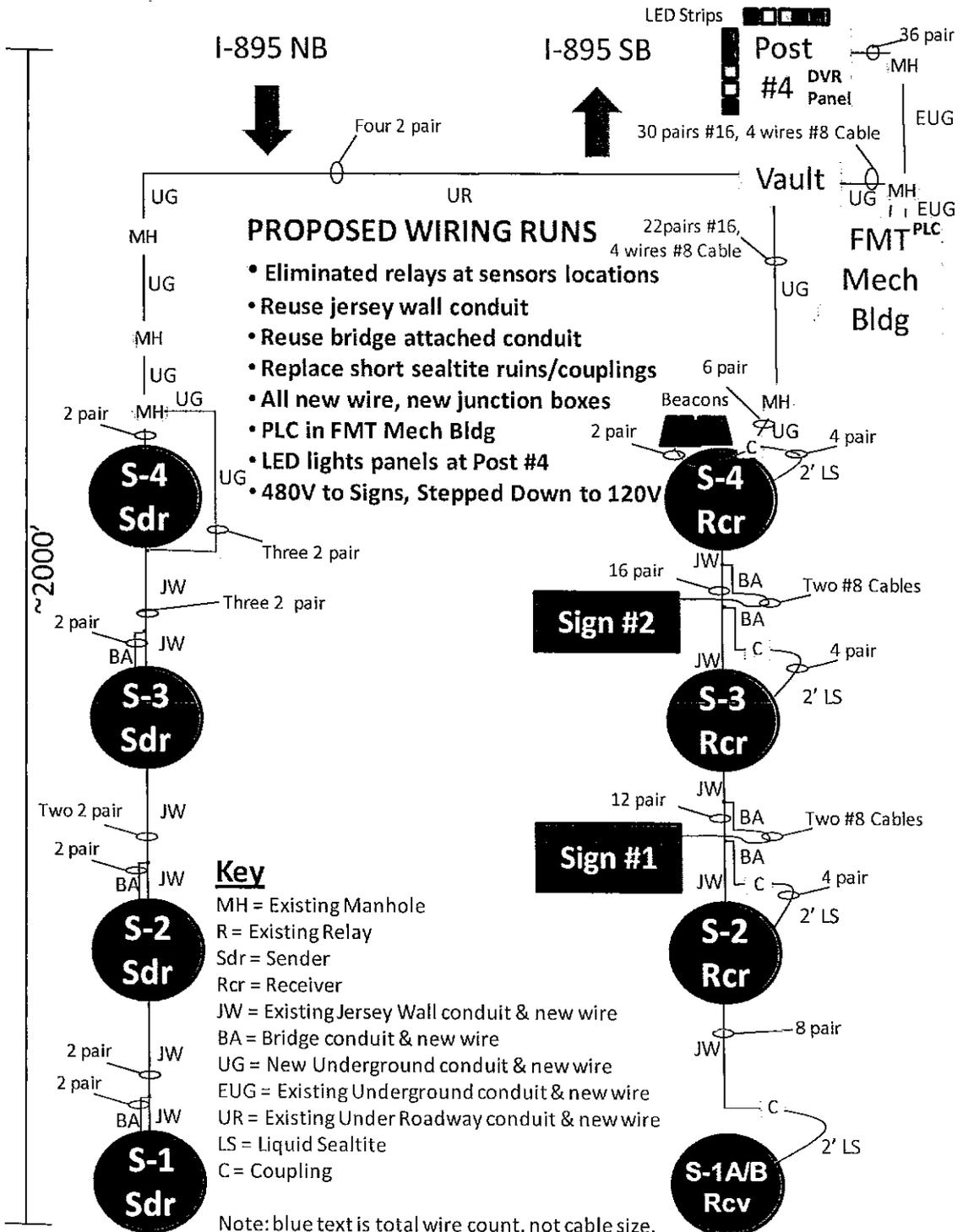


Figure 16: Post #3 Conduit Runs (2 of 2)



**Figure 17: Post #4 Conduit Runs (1 of 2)**

**Baltimore Harbor Tunnel**



**Figure 18: Post #4 Conduit Runs (2 of 2)**



**Table 20: Post #3 Wiring Summary**

Item #	Description	# Pairs Needed	# Pairs Spec'd	LF Wire	Use Any Existing Wire	Use Any Existing Conduit	LF Under-Ground 4" Conduit	LF Bridge Attached 3" RGS	LF Jersey Wall Ex. Conduit	LF Guard-Rail Attached 3" RGS	LF 3/4" EMT Inside Bldg			
1	Toll Plaza Pedestrian Tunnel PLC to Primary A & B Transmitters (2-positive, 2-neutral, 2-test input)	4	4	1100										
2	Toll Plaza Pedestrian Tunnel PLC to Primary A & B Receivers (2 pnp, 2 alarm)	8	8	1100		850	250							
3	Toll Plaza Lane 1 to Pedestrian Tunnel PLC for Sign, Beacon/Buzzer, Canopy Light, Transmitter & Receiver	9	12	120							25			
4	Toll Plaza Lanes 2 to Pedestrian Tunnel PLC for Sign, Beacon/Buzzer, Canopy Light, Transmitter & Receiver	9	12	140							25			
5	Toll Plaza Lanes 3 to Pedestrian Tunnel PLC for Sign, Beacon/Buzzer, Canopy Light, Transmitter & Receiver	9	12	160							25			
6	Future Toll Plaza Lanes 4-7 to Pedestrian Tunnel PLC for Sign, Flasher, Buzzer, Canopy Light, Transmitter & Receiver	32	*								0			
7	Future Post #3 to Lanes 4-7 Transmitters (4-test inputs)	4	*								0			
8	Toll Plaza Pedestrian Tunnel PLC to Post #3 Hut for Status Lights (8 [5 sensors, 3 signs]), Buzzer (1), Building LEDs (5), DVR (2) = TOTAL => 11-positive, 11-neutral) Note: 5 Building LEDs feed from Status Lights.	11	36	400		400					25			
9	Distance from Toll Plaza Roof Top Camera (1) to Post #3 Hut (1 coax)	1	1	200		50				50	25			
<b>TOTALS</b>							3220	0	1300	250	0	0	50	125

**Table 21: Post #4 Wiring Summary**

Item #	Description	# Pairs Needed	# Pairs Spec'd	LF Wire	Use Any Existing Wire	Use Any Existing Conduit	LF Under-Ground 4" Conduit	LF Bridge Attached 3" RGS	LF Jersey Wall Ex. Conduit	LF Guard-Rail Attached 3" RGS	LF 3/4" EMT Inside Bldg			
1	FMT Mechanical Building PLC to Post #4 Hut for Status Lights (7 [5 sensors, 2 signs]), Buzzer (1), Building LEDs (5), DVR (2) = TOTAL => (9-positive, 9-neutral) Note: 5 Building LEDs feed from Status Lights.	10	36	250							25			
2	FMT Mech Bldg to Camera at Sensor #2 Pole (1 coax)	1	1	50							25			
3	FMT Mech Bldg to Sensor #1A/B Receiver (alarm/pnp/positive/neutral)	8	8	1750		1500		25						
4	FMT Mech Bldg to Sensor #2 Receiver (alarm/pnp/positive/neutral)	4	4	1250		1000		25						
5	FMT Mech Bldg to Sensor #3 Receiver (alarm/pnp/positive/neutral)	4	4	750		500		25						
6	FMT Mech Bldg to Sensor #4 Receiver (alarm/pnp/positive/neutral + 2 for beacons)	6	6	250				25						
7	Mech Bldg Vault to Sensor #1 Transmitter (test input, positive/neutral)	2	2	1850		1600		25						
8	Mech Bldg Vault to Sensor #2 Transmitter (test input, positive/neutral)	2	2	1350		1100		25						
9	Mech Bldg Vault to Sensor #3 Transmitter (test input, positive/neutral)	2	2	850		600		25						
10	Mech Bldg Vault to Sensor #4 Transmitter (test input, positive/neutral)	2	2	350		100	250	25		100	25			
11	FMT Mech Bldg to Sign #1 Power (after Sensor #2)	1	1	1000		750		25						
12	FMT Mech Bldg to Sign #2 Power (after Sensor #3)	1	1	500		250		25						
13	FMT Mech Bldg to Sensor #1 Future Upstream Sensors	5	*											
<b>TOTALS</b>							10200	0	7400	250	250	0	100	75



**Table 22: Post #3 OHDS Equipment**

Item #	Description	Existing Quantity	Replaced Quantity
1.	Photoelectric Sensor Pairs	5	5
2.	Programmable Logic Controllers (PLCs)	1	1
3.	Interior Status Indicator Lights with Panel at Post #3 (5 sensors, 3 signs, and test input button)	5	9
4.	Electronic Fiber Optic Message Signs at Toll Booth Lanes 1-3	3	0
5.	Buzzers at Toll Booth Lanes 1-3	3	3
6.	Exterior Status Indicator Beacons at Toll Booth Lanes 1-3	3	3
7.	Canopy Light on Reverse Side of Toll Plaza Rooftop over Toll Lane	3	0
8.	Outside Buzzer at Post #3 Building	1	1
9.	Exterior Sensor Status Indicator Beacons with Fixture at Post #3 Building	5	2 Sets of 5
10.	New Camera and DVR	1	1

**Table 23: Post #4 OHDS Equipment**

Item #	Description	Existing Quantity	Replaced Quantity
1.	Photoelectric Sensor Pairs	4	5
2.	Programmable Logic Controllers (PLCs)	1	1
3.	Interior Status Indicator Lights with Panel at Post #4 (2 signs, 5 sensors, and test input button)	6	8
4.	Electronic Fiber Optic Message Signs on Freeway	2	0
5.	Outside Buzzer at Post #4 Building	1	1
6.	Exterior Sensor Status Indicator Beacons with Fixture at Post #4 Building	4	2 Sets of 5
7.	New Camera and DVR	0	1
8.	Exterior Status Indicator Beacons at Sensor #4 Pole	2	2

**800.03.02 THEORY OF OPERATION**

Design Goals

The proposed design attempts to address the complexity of the existing implementation and improve safety from a maintenance perspective. Specifically, the MdTA has expressed dissatisfaction with the existing implementation which uses 120 VAC relays for the signalling from the detectors to the Post buildings (refer to Appendix A for diagrams of the existing system). These relays require a separate cabinet co-located with the detectors. The MdTA would like to be able to eliminate the relay cabinet at the detector sites and simplify the installation. A separate concern is that the 120 VAC signalling also presents an electrical shock hazard to maintenance personnel.



### Approach

The proposed approach uses DC signalling over shielded twisted pair cabling between programmable logic controllers (PLC's) located in each of 2 Post buildings (Post #3 and Post #4), and overheight (OH) sensors at various locations in the roadway, at distances of up to 2600 feet from the PLC's. The OH sensor output is essentially the collector of a PNP transistors with a "pull-down" resistor connected to the ground (refer to Figure 19 below). The output has two states, either a "high voltage" state when the transistor is on, or a "low voltage" state when the transistor is off<sup>1</sup>. When the OH detector receiver is tripped (i.e., when an overheight vehicle breaks the beam from the sender unit), the transistor is driven from one state to the other.

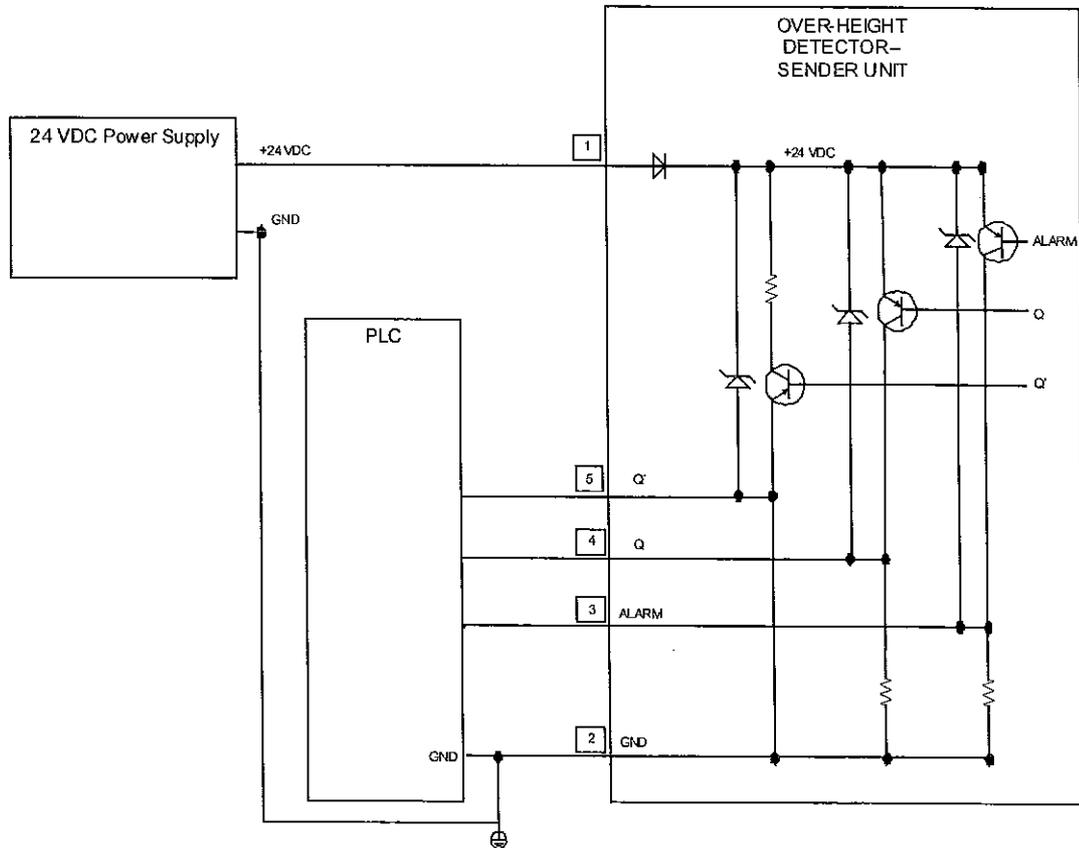
The proposed PLC digital input modules sense the two voltage states of the OH detector and activate outputs (not shown in Figure 19) according to the PLC programming (or "recipe"). The PLC input modules are rated for 0 to +24 VDC. If the voltage present at the input to the PLC is between +10 and +24 VDC, the PLC considers this the "high voltage" state, and between 0 and +5 VDC as the "low voltage" state. These "capture ranges" for the two logical states provide significant margin for voltage fluctuations on the inputs caused either by electrical noise or voltage drop.

To provide a more specific description of the "low state" margin, since the low-state input range is 0 to +5 VDC, and the OH sensor will drive the input to < 0.5 VDC, the PLC input low-voltage "capture range" provides 4.5 volts of operating margin. Since the electrical shielding should minimize induced voltages, and the twisted pairs should keep any induced voltage as a common-mode potential (which can be rejected by the PLC input), any remaining electrical-noise-induced voltage that would raise the potential at the PLC input will be minimal.

The "high state" PLC input margin depends more on the voltage drop since the operating current through the circuit with the OH sensor transistor in its "on" state is higher. In this case, the current through the circuit can be reasonably approximated as the OH sensor operating voltage divided by the sum of the wire resistance and the PLC input resistance.

---

<sup>1</sup> This describes the "Q" output. The complement to Q, Q', is also provided as an OH detector (receiver unit) output, and presents a "high voltage" state when the transistor is off, and a "low voltage" state when the transistor is on.



**Figure 19: Proposed OHDS Circuit Model**

Circuit Models and Expected Operating Margins

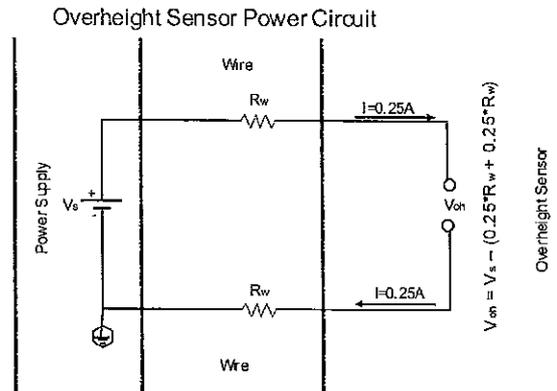
It is important to note the design of the interface between the detectors and the PLC with regard to voltage drop is minimal. The issue that drives the design is actually electrical noise. While the estimated maximum voltage drop as a percentage of the operating voltage may be considered to be relatively high, the operation of the signalling circuit is not affected by it, since the effective voltage delivered to the input of the PLC is well within the operating range, and provides more than sufficient operating margin.

To demonstrate this assertion, simple models were developed for the power circuit for the OH detectors, and signalling circuit for the interface between the OH detectors and PLC, and sets of calculations prepared considering operating voltages of +24 VDC and +28 VDC, a range of cabling distances, and the known value of the PLC input impedance.

OH Detector Power Circuit

The results of the calculations show that for the “worst-case” condition, defined as +24 VDC supply voltage, 2600 cable feet between detector and PLC, the OH detector operating with its heater on

(maximum current draw of 250 mA), the voltage delivered to the OH detector drops to just over +19 VDC. Refer to Figure 20 below.



**Power Circuit Calculations**

Wire Resistance (16 AWG STP): 3.67 ohms/kft  
 OHD Max Current Draw (with heater): 0.25 A  
 Supply voltage (DC volts): 28 VDC

Supply voltage (DC volts): 24 VDC

Sensor Power Circuit with Heater:  $V_{oh} = V_s - 0.5 * R_w$   
 Voltage at Sensor

Sensor Power Circuit with Heater:  $V_{oh} = V_s - 0.5 * R_w$   
 Voltage at Sensor

Site	Distance (ft)	Wire DC Resistance (ohms)	Voh (VDC)
Sensor Pair 1	2600	9.542	23.229
Sensor Pair 2	2000	7.34	24.33
Sensor Pair 3	1500	5.505	25.2475
Sensor Pair 4	1000	3.67	26.165
Sensor Pair 5	500	1.835	27.0825

Site	Distance (ft)	Wire DC Resistance (ohms)	Voh (VDC)
Sensor Pair 1	2600	9.542	19.229
Sensor Pair 2	2000	7.34	20.33
Sensor Pair 3	1500	5.505	21.2475
Sensor Pair 4	1000	3.67	22.165
Sensor Pair 5	500	1.835	23.0825

Sensor Power Circuit without Heater:  $V_{oh} = V_s - 0.1 * R_w$   
 Voltage at Sensor

Sensor Power Circuit without Heater:  $V_{oh} = V_s - 0.1 * R_w$   
 Voltage at Sensor

Site	Distance (ft)	Wire DC Resistance (ohms)	Voh (VDC)
Sensor Pair 1	2600	9.542	27.0458
Sensor Pair 2	2000	7.34	27.266
Sensor Pair 3	1500	5.505	27.4495
Sensor Pair 4	1000	3.67	27.633
Sensor Pair 5	500	1.835	27.8165

Site	Distance (ft)	Wire DC Resistance (ohms)	Voh (VDC)
Sensor Pair 1	2600	9.542	23.0458
Sensor Pair 2	2000	7.34	23.266
Sensor Pair 3	1500	5.505	23.4495
Sensor Pair 4	1000	3.67	23.633
Sensor Pair 5	500	1.835	23.8165

**Figure 20: Voltage Loss Calculations on Power Circuit**

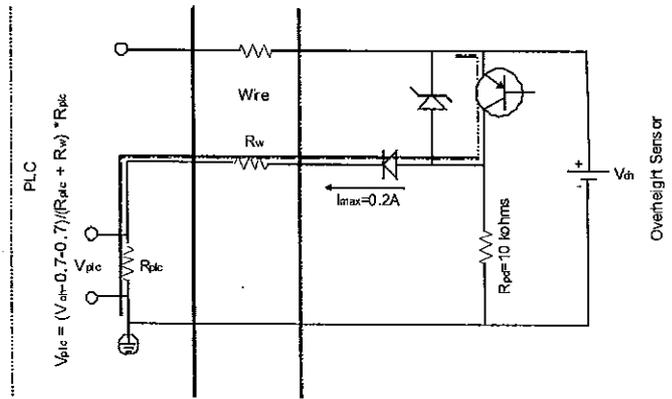
OH Detector – PLC Signaling Circuit, High Voltage State

As modeled, the estimate of the voltage delivered to the input of the PLC depends on the operating voltage of the OH detector, the wire resistance (dependent on the cabling distance), and the input impedance of the PLC.

Given that that the value of the PLC input impedance is 3100 ohms, the voltage delivered to the input of the PLC is calculated as the operating voltage of the OH detector, reduced by the voltage drop through

the input diode and transistor (assumed to be operating in its saturation region) plus the voltage drop through the wire. The “worst-case” high-state voltage at the input of the PLC is estimated as approximately 17.7 volts. This is well within the PLC “high voltage” input range of +10 to +24 VDC, providing a margin of over 7 volts. Refer to Figure 21 below.

Overheight Sensor Signalling Circuit



**Signalling Circuit Calculations - Logic State "1" - "High"**

PLC Logic State "1" - "high" input  
 Sensor Signaling Circuit - OHD Transistor On  
 Output Current =  $(V_{oh} - 0.7 - 0.7) / (R_w + R_{plc})$   
 $V_{plc} = I_{oc} * R_{plc}$   
 Maximum PLC Input Voltage = 24 VDC

Sensor Supply Voltage = 24 VDC  
 Sensor with Heater On

**Voltage at PLC**

Site	Distance (ft)	Wire DC Resistance (ohms)	Vplc (VDC)	Ioc (mA)
Sensor Pair 1	2600	9.542	21.76202	22.78054
Sensor Pair 2	2000	7.34	22.87584	23.8817
Sensor Pair 3	1500	5.505	23.80523	24.79933
Sensor Pair 4	1000	3.67	25.71696	26.6346
Sensor Pair 5	500	1.835	26.6346	26.6346

Sensor Supply Voltage = 24 VDC  
 Sensor with Heater On

**Voltage at PLC**

Site	Distance (ft)	Wire DC Resistance (ohms)	Vplc (VDC)	Ioc (mA)
Sensor Pair 1	2600	9.542	21.76202	22.78054
Sensor Pair 2	2000	7.34	22.87584	23.8817
Sensor Pair 3	1500	5.505	23.80523	24.79933
Sensor Pair 4	1000	3.67	25.71696	26.6346
Sensor Pair 5	500	1.835	26.6346	26.6346

PLC Input Impedance

3100 ohm

PLC Logic State "1" - "high" input  
 Sensor Signaling Circuit - OHD Transistor On  
 Output Current =  $(V_{oh} - 0.7 - 0.7) / (R_w + R_{plc})$   
 $V_{plc} = I_{oc} * R_{plc}$   
 Maximum PLC Input Voltage = 24 VDC  
 Sensor Supply Voltage = 24 VDC  
 Sensor with Heater On

**Voltage at PLC**

Site	Distance (ft)	Wire DC Resistance (ohms)	Vplc (VDC)	Ioc (mA)
Sensor Pair 1	2600	9.542	17.77429	5.718502
Sensor Pair 2	2000	7.34	18.88528	6.069476
Sensor Pair 3	1500	5.505	19.81232	6.361761
Sensor Pair 4	1000	3.67	20.74045	6.65387
Sensor Pair 5	500	1.835	21.66967	6.945602

Sensor Supply Voltage = 24 VDC  
 Sensor with Heater Off

**Voltage at PLC**

Site	Distance (ft)	Wire DC Resistance (ohms)	Vplc (VDC)	Ioc (mA)
Sensor Pair 1	2600	9.542	21.57938	6.934246
Sensor Pair 2	2000	7.34	21.81435	7.00426
Sensor Pair 3	1500	5.505	22.01041	7.062597
Sensor Pair 4	1000	3.67	22.20671	7.120925
Sensor Pair 5	500	1.835	22.40324	7.179246

**Figure 21: Voltage Loss Calculations on Signaling Circuit**

OH Detector – PLC Signaling Circuit, Low Voltage State

The low voltage condition is relatively straight-forward, since the OH detector transistor is operating in its “cut-off” region, and the output is effectively at ground.



### Operating Voltages with +28 VDC Supply and PLC Input Clamping

The operating voltages were also calculated with a 28 VDC supply voltage. Under the same “worst case” conditions described earlier, the OH detector power circuit calculations show the operating voltage as just over +21 VDC. However, for the OH detector pairs that are located within 1000 feet of the police facility, the voltage at the input to the PLC’s will exceed the rated maximum. In addition, at all of the OH sensor locations, the voltage presented to the PLC inputs will exceed the rated limit for the input if the heater is off.

To prevent damage to the PLC inputs, zener diodes would be required to “clamp” the voltage at the input such that the 24 VDC maximum input voltage would not be exceeded. The zener diodes add complexity to the installation, without improving system performance.

### Induced Electrical Noise and Wiring Configuration

Since the wiring distances are fairly long and in an electrically noisy environment, induced voltages on the signalling circuits were considered an important design issue. To mitigate the effects of electrical noise, the design approach proposes the use of shielded, twisted-pair (STP) cabling between the detectors and the PLC.

The proposed cable configuration uses AWG No. 16 individually shielded pairs with an outer shield. The 16-gauge cable is proposed since it is more readily available in a multi-pair configuration, will be easier to work with, smaller in diameter, and voltage drop is well within the operating limits. The shields are to be grounded at the PLC locations and left open (insulated) at the sensor end, to avoid setting up ground loops. Between the PLC and the overheight “sender” unit, a 2-pair cable will be used. The first pair will supply +24 VDC and electrical ground from the power supply in the police facility, and the second pair will be used for connecting the TEST input on the detector. Since the TEST input requires a single conductor, the second conductor in the pair will also be grounded.

Between the PLC and the overheight “receiver” unit, a 4-pair cable will be used. The first pair will supply +24 VDC and ground from the power supply in the Police facility. The other three pairs connect from the PLC to the detector Q, Q’ and alarm outputs. The Q’ output connection is not required for this installation, but one benefit of connecting both Q and Q’ is that if the PLC configuration is “backwards”, the problem can be simply corrected by switching from one input to the other. As with the TEST connection on the sender unit, the second conductor on each pair should be grounded. Refer to Figure 22 below.



**Signalling Circuit Calculations - Logic State "1" - "High"**

PLC Logic State "1" - "high" input  
 Sensor Signalling Circuit - OHD Transistor On  
 Output Current =  $(V_{oh}-0.7-0.7)/(R_w+R_{plc})$   
 $V_{plc} = I_{oc} \cdot R_{plc}$   
 Maximum PLC Input Voltage = 24 VDC

Sensor Supply Voltage = 24 VDC  
 Sensor Input Resistance = 240 Ohms

**Voltage at PLC**

Site	Distance (ft)	Wire DC Resistance (ohms)	V <sub>plc</sub> (VDC)	I <sub>oc</sub> (mA)
Sensor Pair 1	2600	9.542	21.76202	22.78054
Sensor Pair 2	2000	7.34	22.87584	23.8817
Sensor Pair 3	1500	5.505	23.80523	24.79933
Sensor Pair 4	1000	3.67	24.73872	25.71696
Sensor Pair 5	500	1.835	25.66761	26.6346

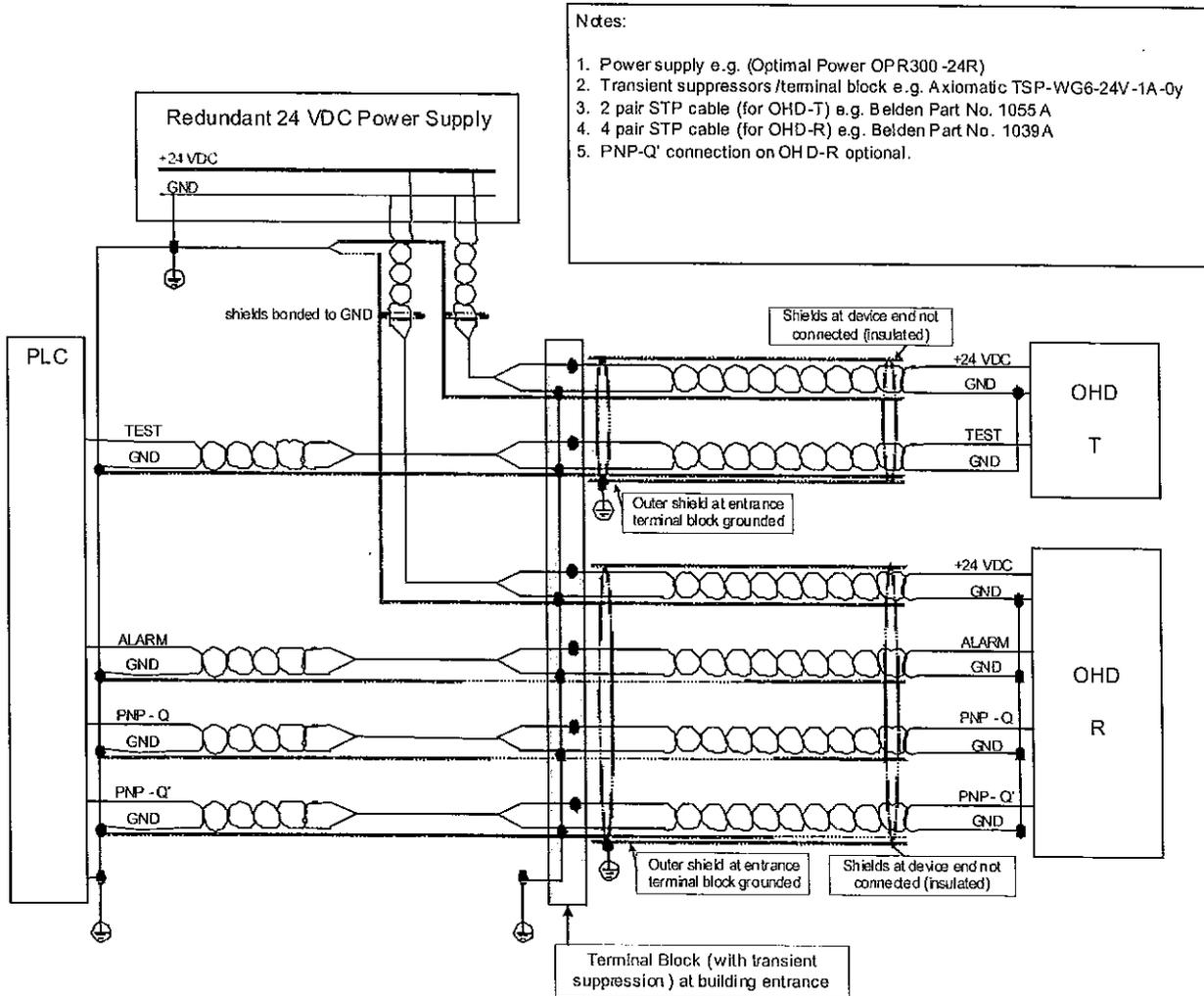
Sensor Supply Voltage = 24 VDC  
 Sensor Input Resistance = 240 Ohms

**Voltage at PLC**

Site	Distance (ft)	Wire DC Resistance (ohms)	V <sub>plc</sub> (VDC)	I <sub>oc</sub> (mA)
Sensor Pair 1	2600	9.542	25.66771	26.59788
Sensor Pair 2	2000	7.34	26.66733	26.81812
Sensor Pair 3	1500	5.505	27.66722	27.00164
Sensor Pair 4	1000	3.67	28.66733	27.18517
Sensor Pair 5	500	1.835	29.66767	27.3687

**Figure 22: Signaling Circuit Calculations – Logic State “1”**

Figure 23 below depicts the proposed cabling configuration. This figure identifies several “example” items in the notes, including Belden part numbers for the wiring, a redundant 24 VDC power supply, and transient voltage surge suppressors to be installed at the cabling entrance of the PLC location. The Contractor may propose other cabling, power supply, terminal block and transient suppression, as long as the design intent and functional and performance requirements are met.



**Figure 23: OHDS Cabling Configuration**

**800.03.03 LAB TESTING**

The Contractor shall perform integration and lab testing prior to deploying the system. These activities shall validate the following:

- I. The theory of operation, wire sizes, length of runs, wire counts, and voltage drop calculations are as anticipated, confirming the system will function in a reliable and accurate manner.
- II. That the buzzers are of sufficient loudness to be heard when near traffic.
- III. That the LEDs are bright enough to be seen at distances up to 100' in darkness, in bright sunshine and in adverse weather conditions.



IV. That the DVR functions according to the concept of operations.

V. That the overall OHDS can be successfully deployed with relatively little technical risk and fully satisfy the concept of operations and theory of operations.

The Contractor shall host two (2) meetings to demonstrate the working system to MdTA at their development lab.

**Measurement and Payment.** Lab Testing will not be measured separately, but instead Lab Testing will be paid separately as a lump sum for the entire OHDS system as described herein. The lump sum for Lab Testing shall include all materials, labor, and equipment necessary to Lab Test the system as specified herein. Any requirements of the specifications or special provisions not specifically detailed or mentioned in a pay item shall be considered incidental to the pay items.

Refer to Bid Item 8013.

#### **800.03.04 CALIBRATION OF SENSORS**

The Contractor is required to configure/calibrate the sensors in accordance with the manufacturer's installation instructions.

After that is complete, the Contractor shall use this procedure for calibrating the sensors. The procedure to check height is to use a pole that is 13'-6" long.

1. Attach a 2'x2'x 1/2" thick board, with a 13'6" radius cut on the upper edge. The board is attached with U bolts so it is adjustable. The U bolts are installed in the lower 1' of the board giving ~12" of adjustment (13'6" to 14'6").
2. A line is determined by two points. It is understood that one cannot get perfect alignment across more than one lane. However, two points are required for some degree of accuracy.
  - a) If it's one lane – use each wheel rut in the lane.
  - b) If it's two or more lanes – assume the road crowns (as is the case most of the time). Use the far left lane left wheel rut and the far right lane right wheel rut as the two points. This sets the heights to fail-safe (i.e., the higher middle lanes will cause detection at lower heights). Note: in order to catch the uneven loads, e.g., flatbed with a construction boom truck that has a high boom, the Contractor shall use the outside (fail-safe) measurement.
3. A pole level is needed. This has a level in the X and Y plane and attached to the pole via a magnet, rubber band or approved equal.



- <A> = max height at which no detection is desired. Usually 13'-7" (13'6" is the legal limit. But the Contractor should allow a little room for bouncing).
  - <B> = height at which detection is desired. Say 13'8". Need to confirm with operations.
4. The board is set at <A>.
  5. Using survey gear or a laser level align the units between sender and receiver.
  6. The pole is set on the laser line in the leftmost tire rut and leveled. No detection should occur.
  7. The pole is set on the laser line in the rightmost tire rut and leveled. No detection should occur.
  8. The pole is adjusted to <B>
  9. The pole is set on the laser line in the leftmost tire rut and leveled. Detection should occur.
  10. The pole is set on the laser line in the rightmost tire rut and leveled. Detection should occur.

The Contractor is responsible for all settings between the sender and receiver. Generally, using a laser level line and two 13'6" poles can be done to measure the 13'6" mark on the supports. This enables setting the transmitter and receiver based on the marked support poles. It is important to note that the sender and receiver are not "level" because in general the roads are not level.

**Measurement and Payment.** The payment for calibration activities shall be included in that of the through beam photoelectric sensors bid items. Refer to Bid Items 8001, 8002, 8004, and 8005.

#### **800.03.05 ACCEPTANCE TESTING**

The Contractor shall perform the necessary steps to successfully accomplish acceptance testing as described below.

- I. The Contractor shall supply a test procedure submittal to the Engineer for approval. There shall be one test procedure for each aspect of the system (OH sensors, PLC, lights/beacons/buzzers, DVR, cameras, test button, etc.), each with multiple tests. The test procedure must be detailed, step-by-step, and provide testing of all functional requirements. A testing traceability matrix shall be required that maps each test procedure to the requirements in this specification. A written test procedure must be provided to the MdTA Engineer for approval prior to execution, and after execution signed by the tester and the MdTA witness at each facility.



- II. The Contractor shall perform the required tests from each Post and document the results in the test report. The Authority requires the completion of acceptance testing, and a signed test report, prior to final payment.
- III. In addition to the functional requirements, there shall be a 30-day observation period test to ensure the following:
- i. There are no more than 10% false alarms (i.e., out of 100 detections, no more than 10 shall be false alarms). This will be measured using actually data collected over the 30-day period.
  - ii. There are no more than 10% missed detections. This will be measured using a test vehicle with a 3" pipe extended to 14' 8". This test will be executed a minimum of ten (10) times.
  - iii. All video signals are 30 FPS, clear, jitter-free, and of broadcast quality. Video signals will be tested in all weather conditions and at various times of day.
  - iv. That the DVR is capturing the video clips accurately according to the specification, and that video is being archived to satisfy the retainage requirements.

It should be understood that the Acceptance Testing period will not conclude successfully until Items I, II, or III above are fully satisfied. It should also be understood that if items i, ii, iii, or iv (under Item III) are not satisfied at the end of the 30-day observation period the 30-day observation period test must be repeated.

**Measurement and Payment.** Acceptance Testing will not be measured separately, but instead Acceptance Testing will be paid separately as a lump sum for the entire OHDS system as described herein. The lump sum for Acceptance Testing shall include all materials, labor, and equipment necessary to Acceptance Test the system as specified herein. Any requirements of the specifications or special provisions not specifically detailed or mentioned in a pay item shall be considered incidental to the pay items.

Refer to Bid Item 8013.

#### **800.03.06 SOFTWARE**

The Contractor shall provide one licensed copy of the PLC programming software, any required firmware, and 2 copies of all operating manuals for each Post. The software shall be compatible with a MS-Windows based operating system and shall be supplied with necessary cables for laptop computer connection to the PLC.

The Contractor shall provide a copy of the DVR client software and 2 copies of all operating manuals for each Post. The software shall be compatible with a MS-Windows based operating system.



The Contractor shall provide a copy of the camera client software and 2 copies of all operating manuals for each Post. The software shall be compatible with a MS-Windows based operating system.

**Measurement and Payment.** The payment for the software shall be included in that of the PLC, DVR, and Camera bid items. Refer to Bid Items 8006 through 8011.

### **800.03.07 DOCUMENTATION**

The Contractor shall provide the following documentation:

- a. submittals of catalog cut sheets for MdTA approval prior to procuring all equipment;
- b. submittals of all manufacturer documentation (user/operator manual, maintenance manual, specifications) as part of the training submittal. Deliver two (2) hard copies and 2 electronic copies on CD-ROMs;
- c. submittals of all MOT plans, certifications, and materials used (e.g., arrow boards, TMAs, etc.);
- d. user manuals for each piece of hardware and software provided in the system;
- e. user manual for the OHDS tailored for MdTA's configuration;
- f. system administration manuals;
- g. maintenance manuals for each piece of hardware and software provided in the system;
- h. maintenance manual for the OHDS tailored for MdTA's configuration;
- i. submittals of all test procedures;
- j. submittals of all training materials;
- k. submittals of all shop drawings for camera mounts, sensor mounts, mounting plates, as required.
- l. as-built design information showing all hardware and software components;
- m. as-built plans showing the exact location (accurate to within 5') and sizes of all trenches, cables, conduits, OHDS devices, handboxes, junction boxes, control and distribution cabinets, and identification of all circuits leaving the cabinets and routing to sensors; The Contractor shall note the exact location 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 the as-built drawings;
- n. GPS coordinates and digital photographs (minimum 5 megapixel resolution) for all field devices, cabinets, and junction boxes/manholes;
- o. submittals of all as-built wiring diagrams and schematics for all components of the OHDS, and CCTV system, including an overall one-line block diagram and rack elevation drawings;
- p. the Contractor shall ensure all cables (coax, CAT5E, serial, signal, power) are professionally labeled on each end.
- q. submittals to show the exact location and sizes of all cables, conduits, transmitter/receiver detectors, signs, handboxes, junction boxes, control and distribution cabinets, and identification of all circuits leaving the PLC and distribution cabinets and routing to sensors.



- r. a submittal of the Configuration Manual. The Contractor shall assemble a manual detailing the as-built configuration of the devices, including jumper settings and software configuration. Where settings may vary site by site, the manual shall clearly indicate the settings, or changes in settings, from site to site. The manual shall include, but not be limited to, the following devices: DVR, PLCs, Sensors, Buzzers, Beacons, LED lights, and Cameras.

At the conclusion of the project the Contractor is to deliver two (2) hard copies and 2 electronic copies on CD-ROMs of all documentation.

**Measurement and Payment.** The payment for the documentation shall be included in that of the training bid item. Refer to Bid Item 8012.

#### **800.03.08 TRAINING**

The Contractor shall provide training courses to the Authority for the OHDS. The training shall include how to operate, maintain, and trouble shoot the system. A training submittal shall be submitted for approval 30 days prior to performing any training. The Authority must approve the training material in advance of the training. Copies of all approved training materials must be provided by the Contractor to all trainees. The Contractor shall provide an operator training class and a separate class for maintenance training. All training materials shall provide detailed step-by-step instructions for trainees. Standard off-the-shelf reference manuals may be used, but tailored step-by-step procedures and exercises must be provided during training to place emphasis on those features that will be utilized by MdTA. Under no circumstances shall generic training be required. The training must be specific to the Authority's configuration.

The Contractor shall perform the following training tasks:

- I. The Contractor shall conduct two (2), 1-day maintenance and troubleshooting training classes for up to 6 electronics technicians at the BHT Administration Building. The 1<sup>st</sup> training class will be conducted within 1 week of successful acceptance testing of the system. The last training class will be conducted as a make-up or refresher class on an as-needed basis;

The training shall cover module replacement, programming, configuration, troubleshooting, testing, and other items as necessary to maintain the OHDS in operational condition. Training must be provided to the Authority to allow Authority personnel to program/enable any programmable capability provided by the system. The Contractor shall supply copies of a maintenance manual complete with catalog cuts of all parts and components utilized within the system, including user manuals, and installation and configuration guides. Detailed procedures providing step-by-step instructions for configuring and maintaining the system shall be provided along with the training materials. Exercises shall be provided for all operations and maintenance functions. The Contractor shall include this information in the training package for each trainee. All information shall be bound in a 3 ring binder with an outside label on the binder cover and spine. In addition to each trainee receiving a copy of this binder, one full copy of the binder



shall be left in each Post Building. This manual is for use by on-call Electronics Technicians and must contain all information necessary to repair/reinstall/reprogram any aspect of the system.

- II. In addition to the above, the Contractor shall provide a 1-page laminated instruction set for users of the OHDS. The Contractor shall provide 5 copies of the laminated material. The manual should provide all instructions and codes for the configured functions (e.g., alarm monitoring, video playback, test button feature). The Contractor shall provide at least two (2), 30-minute training sessions with the Duty Officer, Telecommunication Officer and his/her designees. The 1<sup>st</sup> training class will be conducted within 2 days of successful acceptance testing of the system. The last training class will be conducted as a make-up or refresher class when needed;

**Measurement and Payment.** Training will not be measured separately, but instead training will be paid separately as a lump sum for the entire OHDS system as described herein. The lump sum for training shall include all materials, labor, and equipment necessary to warrant the system as specified herein. Any requirements of the specifications or special provisions not specifically detailed or mentioned in a pay item shall be considered incidental to the pay items.

Refer to Bid Item 8012.



**CATEGORY 800**  
**SECTION 805 ELECTRICAL CONDUIT AND FITTINGS**

See Section 805 of the SHA's Standard Specifications for Construction and Materials in conjunction with the changes shown in this Section.

**805.02 MATERIALS**

**DELETE:** Concrete.

**805.03 CONSTRUCTION**

**ADD:** The following after paragraph 805.03.10:

**805.03.11 Guardrail.** Where guardrail is to be placed, reset, removed, or otherwise worked in any manner that tends to disturb the earth, place conduits and wiring only after such work is complete so as to avoid damage to the electrical work.

**805.03.12 Buried Conduit.** Fiber optic conduits shall have a Minimum cover of 24" and a maximum cover of 48 inches in all trenches. Fiber optic conduits shall be placed so that a distance of two (2) inches or more exists between the outside of the conduit and virgin undisturbed earth.

**805.03.13 Pull Cord.** Pull cord shall be placed in all conduit runs for future use.

**805.03.14 Cable Tray.** A conduit run in between a cable tray shall end between 3 and 6 inches from the cable tray. Ends of conduit shall have compression fittings and grommets.

**805.03.15 Conduit Type.** All outdoor conduits underground, except as stated elsewhere in the contract, shall be PVC schedule 80. All outdoor conduits above ground, within concrete or exposed conduits shall be galvanized steel. All indoor conduits shall be EMT with compression connectors and couplers. At the transition between below ground and above ground conduit runs, the elbow and all conduit within 24" below grade to grade level shall be galvanized rigid steel.

**805.03.16 Bend Radius.** All conduits shall have a bend radius greater than the manufacturers recommended minimum bend radius of the cables inside the conduit.

**805.03.17 Conduit Ends.** The Contractor shall seal all conduit ends with an approved compression fitting. Where conduit openings penetrate a cabinet, the conduit shall be sealed around the cables entering the opening using a mixed combination of copper mesh (approved for rodent exclusions and rodent-proofing) and duct seal putty.



**805.03.18 Conduit Support.** Conduits shall be supported within 2 feet of the beginning, and on each side, of a 90 degree bend or offset. Each support shall be applied to the straight section of conduit and shall be firm fixed support.

**805.03.19 Conduit Color.** Conduit used indoors (EMT) shall be color coded where exposed. When the following systems are contained in the conduit, the color specified shall be used. The conduit color shall be continuous for the entire length (except fitting and hangers which may be colored to match or remain standard silver color) of conduit and may be factory applied or applied via spray paint in the field. If field applied, overspray onto other non-conduit surfaces shall not be permitted.

- (a) Dedicated Security System conduit shall be Blue.
- (b) Dedicated Fire Alarm System conduit shall be Red.
- (c) Dedicated telephone/Data System, including fiber optic cables conduit shall be Yellow.
- (d) Dedicated low voltage signaling, SCADA, and related PLC I/O, shall be orange.
- (e) Dedicated radio system (police two way radio or other radio system) shall be green.
- (f) All other conduits shall be standard silver.

#### **805.04 MEASUREMENT AND PAYMENT**

**ADD:** The following after paragraph 805.04.04:

**805.04.05** Electrical conduits and fittings installed will be measured and paid for as part of the each or lump sum bid items that requires them.



**CATEGORY 800**  
**SECTION 807—ELECTRICAL SERVICE EQUIPMENT**

See Section 807 of the SHA's Standard Specifications for Construction and Materials in conjunction with the changes shown in this Section.

**807.01 DESCRIPTION**

**CHANGE:** The first sentence from "...for the utility company to connect the electrical power supply." to "...for the utility company, or the Contractor at existing State-owned service points, to connect the electrical power supply.

**807.02 MATERIALS**

No changes.

**807.03 CONSTRUCTION**

**ADD:** The following:

**Construction Stake Out 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 at no additional cost to the Authority.
- (b) The Contractor shall keep an up-to-date set of as-built, red-lined drawings on the job site. Submit the 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 the as-built drawings.

**Meters**

Meters shall be installed at all locations where local utility company electrical service is provided. Meter installation and materials MUST be in accordance with the local utility company's standards and requirements. Use Metered Service Pedestal as indicated where shown on the plans. Use standard utility-company-provided meter and mount as shown on the plans in all other locations.

- (a) At no time shall conduits enter the top of a meter assembly.
- (b) Use only pre-cut conduit knockouts for connections to meter assemblies.
- (c) The meter assembly must be protected from the environment before installation of the metering device by the utility company.



**Sections 807.03.01 to 807.03.07:** No changes.

**ADD:** The following:

**807.03.08 Transformers:** At all locations shown in the drawings, the Contractor shall install power transformers as specified in Section 950.13 in accordance with the drawings, the manufacturer's requirements, and all applicable codes.

**807.03.09 Enclosures:** At all locations shown in the drawings, the Contractor shall install enclosures as specified in Section 950.13 for electrical distribution equipment. The Contractor shall install the enclosures in accordance with the drawings and the manufacturer's requirements.

**807.04 MEASUREMENT AND PAYMENT**

**DELETE:** Sections 807.04.01 to 807.04.10 in their entirety.

**ADD:** The following:

The cost of all electrical service equipment will be measured and paid for as part of the each or lump sum bid items that requires them.



**CATEGORY 800**  
**SECTION 809 TRENCHING AND BACKFILL**

Refer to Section 809 of the Specifications with the following changes:

**809.03 CONSTRUCTION**

**CHANGE:** Text which reads: '...reads "CAUTION: SHA ELECTRICAL LINE BURIED BELOW," repeated every 36 in.'

**TO:** '...reads "BURIED ELECTRICAL LINE," or other approved message, repeated every 36 inches and buried to a depth of at least 6" and not more than 12" below finished grade. The tape shall be terminated above grade and shall be secured to the same conduit or cable it is identifying. Securing shall be by sunlight resistant cable tie or other approved means. If terminating at a handhole or manhole the detector tape shall be brought 6" above grade along side the handhole or manhole.'

**ADD:** the following paragraphs before the "Cable Treatment" paragraph:

**"Miss Utility"**. Where trenching and backfilling for the placement of conduits, splice boxes, handholes and handboxes is required, the Contractor must contact "Miss Utility". "Miss Utility" shall be notified 48 hours in advance of any work under the contract and test pit all marked locations for exact position of cables, conduits, and other underground utilities.

**Depth.** Unless otherwise specified on the contract drawings, trenches shall be excavated to a depth such that all conduits, wires, and duct cable in trench is at a finished elevation at least 24" below the final grade. Where trenches are placed on slopes, cover shall be measured from the outside jacket of the duct cable or conduit to the nearest top of grade. This measurement will generally be perpendicular to the slope of the grade.

Where proper trench depth cannot be obtained, and improper depth presents a hazard to the cables, or conduit, the Engineer may direct that lengths of 4" galvanized rigid steel conduit be installed as a sleeve. The sleeve length shall be in intervals of 10'. The Contractor must bend conduit to conform to the line and grade of the trench. Additionally, the Engineer may require concrete cover in shallow trench, on slopes, or where other conditions indicate the need.

**Width.** Unless otherwise specified on the contract drawings, trenches shall be excavated to a width such that all conduits, wires, and duct cables in the trench are placed with at least 3" of backfilled material between the outside edge of the conduits, wires, and duct cables and undisturbed earth.

**Stake Out.** Stake out trenches prior to trenching and review the exact placement with the Engineer. Generally, keep trenches at least 3' behind guardrail and curb, and out of drainage ditches, gutters, culverts etc.. Run trenches in as straight a line as possible and parallel to the nearest roadway.



**Guardrail.** Where guardrail is to be placed, reset, removed, or otherwise worked in any manner, that tends to disturb the earth, place conduits and wiring only after such work is complete so as to avoid damage to the electrical work by the guardrail work.

**Curb and Gutter.** Where curb or gutter work is to be done in close proximity to electrical work, perform the work in the order and fashion necessary to minimize the risk of damaging either of the two types of works.

**Unsuitable Materials in Trench.** Remove any objects or projections into a trench, which may damage the wire or cable duct. These may include rocks, debris, glass, old cables, concrete, etc.. Alternatively, provide a galvanized rigid steel sleeve with grommets where projections into the trench cannot be removed.

#### **809.04 MEASUREMENT AND PAYMENT**

**DELETE:** Text in its entirety.

**INSERT:** The following.

The Contractor's quality assurance and quality control responsibilities shall be incidental to the pay items below. Construction stake out and coordination shall be incidental to the items listed below. Testing as specified in the Special Provisions and Specifications shall be incidental to the pay items listed below.

Trench shall be paid for per linear foot for any width or depth required to meet the Specifications, Special Provisions, and details in the plans. Payment for each linear foot of trench shall include all excavation, backfill, trench marking tape, tamping, seeding, mulching, etc. as required. The cost per linear foot includes supplying "sand" for the lower 1 foot of trench in accordance with section 950.05 of the Specifications, and removal of any excess material. Trench and backfill shall be paid per linear foot as "LINEAR FEET OF TRENCH AND BACKFILL".

Refer to Bid Items 8015, 8016, 8017, 8018, 8021, 8022, 8023, 8024, 8025, 8026, and 8027.



**CATEGORY 800**  
**SECTION 810—ELECTRICAL CABLE, WIRE AND CONNECTORS**

See Section 810 of the SHA's *Standard Specifications for Construction and Materials* in conjunction with the changes shown in this Section.

**810.01 DESCRIPTION**

**DELETE:** The following text from the paragraph: "loop detector wires and leads" and "micro-loop probe sets."

**810.02 MATERIALS**

**DELETE:** "Micro-Loop Probe" and "Sealer for Loop Detector."

**ADD:** the following

810.02.1 SPLICE KITS FOR REPAIR OF UNDERGROUND DIRECT BURIED CABLES:

Splice kits shall consist of a mechanical single conductor connector with four lugs (two for each end of cable), arranged in-line. The kit shall also consist of two heat shrink sleeves. The first sleeve shall be slightly smaller than the outer sleeve. An adhesive shall be applied to the inner portion of the heat shrink sleeves. Kits and components shall be UL listed for direct burial.

810.02.2 SPLICE KITS FOR AERIAL CABLE

Aerial cable splicing shall be performed using copper H or T compression taps. The taps shall be made of high-conductivity extruded copper, manufactured according to ASTM designations, and shall be tinned. Contractor shall install flame retardant, snap on type insulation covers on the splices. The insulation covers shall be made of flame retardant, high impact polypropylene with a voltage rating of 600 V and temperature rating of 90 °C. The taps and insulation covers shall be UL listed for this application. Contractor shall refer to contract documents for cable sizes and shall select the appropriate taps and insulation covers for the splices based on the cable sizes. Contractor shall obtain Engineer's approval on the selected taps and insulation covers prior to installation.

**810.03 CONSTRUCTION**

**DELETE:** The second sentence, "When specified, lighting cable...and hand holes."

**DELETE:** The last two sentences, "Provide 8 in. drip loops...terminal blocks."

**INSERT:** The following before Paragraph 810.03.01



All wires intended for systems of 60 VAC to 600 VAC shall be color-coded and #12 AWG minimum. Wire size #10 AWG and smaller shall have permanently colored insulation. Wire size #8 AWG and larger may have permanently colored insulation or have colored tape applied in all hand-boxes, pull boxes, junction boxes, light standards, and signs. The colored tape shall measure at least 6 inches along the length of the wire and shall wrap completely around the wire. The colored tape shall be applied to clean dry wires. Wire colors shall be as indicated in the following table:

Voltage	Phase A	Phase B	Phase C	Neutral	Ground
60 V to 240 V	Black	Red	Blue	White	Green
277 V to 600 V	Yellow	Brown	Orange	Gray	Green

Aerial cable shall be installed at locations as shown in the drawings and in accordance with the design details, manufacturer’s recommendations and applicable codes (including NEC and NESC). Contractor shall properly ground the messenger cable of the aerial cable according to code and manufacturer’s recommendations.

Contractor shall abide by the installation practices provided by the manufacturer while installing the cable. Contractor shall refer to the sag calculation charts and tables to calculate the nominal values of sag and tension on the cable prior to installation. Contractor shall ensure that the allowable sag and tension limits for the cable are not exceeded. In accordance with the manufacturer’s recommendations, maximum sag on the cable shall be no more than 1% of the total length of the cable. Contractor shall use appropriate devices to ensure the tensioning requirements are met while tensioning the cable.

**DELETE:** Paragraphs 810.03.04, 810.03.06 and 810.03.09 in their entirety.

**INSERT:** The following.

**810.03.10 Splice Kits For Repair Of Underground Direct Buried Cables**

These kits shall be used where underground duct cable, or direct buried cable is damaged. Ends of each cable shall be inserted under two of the lugs and fastened into place. Two heat shrink sleeves shall be applied over the mechanical connector. The first sleeve shall be slightly smaller than the outer sleeve, but shall completely cover the mechanical connector and overlap the still-insulated portion of the attached cables by at least ½ inch. An adhesive shall be applied to the inner portion of the heat shrink sleeves. Each sleeve shall be centered over the mechanical connector and heat-shrunk into place. Follow manufacturer instructions for underground splice kits.



### **810.03.11 Splice kits for aerial cable**

These kits shall be used to splice aerial cable or where aerial cable is damaged. Contractor shall strip the cables to be spliced, with the strip length not exceeding the manufacturer's recommendations and follow the manufacturer's instructions in splicing the cables. Contractor shall install insulation covers on the splices according to the manufacturer's recommendations. Splices for multiple phases shall be offset (longitudinally) to prevent shorting between phases. At locations requiring tapping into individual phases of a multi-conductor cable, the Contractor shall provide proper insulation between the individual splices in accordance with the manufacturer's recommendations for the aerial cable and splice kits.

### **810.04 MEASUREMENTS AND PAYMENT**

**DELETE:** Paragraph 810.04.01

**INSERT:** Paragraph 810.04.01 to read.

**810.04.01** Electrical cable, conduit, cable duct, and grounding wire will be measured and paid for as part of the each or lump sum bid items. Wires and cables inside ground control panels, between ground mounted control panels and other assemblies shall be incidental to the related items of work. Wires and cables included inside equipment, or contained completely inside a manufactured device shall be incidental to the device or equipment. Any wire or cable from termination to termination shall be incidental to related equipment.

**ADD:** the following

**810.04.04** Underground splice kits for the repair of underground direct buried cables will be measured and paid for as part of the each or lump sum bid items that requires them.

**810.04.06** Cost of furnishing and installing associated electrical cable and appurtenances will be measured and paid for as part of the each or lump sum bid items.



**CATEGORY 800**  
**SECTION 811—HAND HOLES, MANHOLES, HANDBOXES, PULLBOXES,  
AND SPLICE BOXES**

See Section 811 of the SHA's *Standard Specifications for Construction and Materials* in conjunction with the changes shown in this Section.

**811.01 DESCRIPTION**

**DELETE:** The entire text of Paragraph 811.01.

**INSERT:** The following.

This work shall consist of furnishing and installing electrical and communication hand-holes, man-holes, hand boxes, pull boxes, and fiber optic splice boxes as specified in the Contract Documents or as directed by the Engineer.

**811.02 MATERIALS**

**DELETE:** Paragraph 811.02.03 in its entirety

**ADD:** The following.

**811.02.03 Pull boxes.** Pull Boxes shall be of the size and rating shown on the plans. Pull boxes shall be supplied with factory-applied gray enamel finish, except boxes rated NEMA 4X, which shall have a natural aluminum or stainless steel finish.

**CONSTRUCTION**

**DELETE:** Paragraph 811.03.02 in its entirety

**INSERT:** The following.

**811.03.03 Hand Boxes**

- (a) Prior to placing hand boxes, the Contractor shall place 12 inches of AASHTO NO. 57 Aggregate to act as a drain. The bottom of the box shall be left open. The aggregate shall extend up the outside of the box, no closer than 12 inches to the surface.
- (b) A standard manhole cover shall be applied to the top and sealed with grout. Hand-boxes shall not be placed in ditches.
- (c) Hand-boxes for fiber optic cables shall be spaced at a maximum of 1000 feet apart. Where conduit bends will increase pulling tension, additional hand boxes shall be installed to allow an intermediate pull-point. Hand-boxes serving as fiber optic splice boxes shall be installed at all



splice locations. A minimum of 50 feet of fiber optic cable shall be coiled in each hand-box. A minimum of 50 feet of each cable entering a splice box shall be coiled in hand-boxes at splice locations.

- (d) For fiber optic cable installation, a splice box shall be placed at the end of each cable reel (approximately every 6000 feet).

#### **811.03.04 Fiber Optic Splice Boxes**

- (a) Prior to placing splice boxes, the Contractor shall place 12 inches of AASHTO NO. 57 Aggregate to act as a drain. The bottom of the box shall be left open. The aggregate shall extend up the outside of the box, no closer than 12 inches to the surface.
- (b) Splice boxes shall be shaped at the bottom to help maintain cable minimum bend radii. A standard manhole cover shall be applied to the top and sealed with grout.
- (c) All splices to fiber optic cables shall be made inside waterproof splice enclosures inside Splice Boxes

#### **811.04 MEASUREMENT AND PAYMENT**

**ADD:** The following.

811.04.01 Splice boxes will be measured and paid for as part of the each or lump sum bid items that requires them. The cost of splice kits, connections, and testing of spliced fibers inside splice boxes shall be incidental to the cost of other bid items that requires them.

811.04.02 Pull boxes will be measured and paid for as part of the each or lump sum bid items that requires them. The cost of miscellaneous and incidental hardware shall be incidental to the cost of other bid items that requires them.

**CATEGORY 800**  
**SECTION 820 GENERAL ELECTRICAL WORK AND TESTING**

Refer to 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](mailto: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, refer to 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, i.e., 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.

**820.03.22 Conduit Fill.** All conduit, new or existing, shall not exceed conduit fill requirements as specified in ANSI/NECA/BICSI-568-2006. Discrepancies shall be brought to the attention of the engineer prior to incorporation into the work.

**820.03.23 Existing Conduits.** Where existing empty conduits are used, the conduit shall be cleaned by pulling a mandrel of at least 80% conduit fill and a swab through the empty conduit. Any existing pull strings used (empty or partially used conduits) shall be replaced by pulling a new pull string with the new electrical or communications cables.

**820.03.24 Conduit/Cabinet Penetrations.** Where conduit openings penetrate a cabinet, the conduit shall be sealed around the cables entering the opening using a mixed combination of copper mesh (approved for rodent exclusions and rodent-proofing) and duct seal putty.



**ATTACHMENT 820-A**  
**SAMPLE FIBER OPTIC CABLE TEST REPORT**

(To be filled out after installation is complete)

<b>Job Name:</b> <b>Job ID:</b>	<b>Fiber Cable:</b>
<b>Location (A):</b>	<b>Location (B):</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 800**  
**SECTION 831 MISS UTILITY**

**831.01 DESCRIPTION**

This work shall consist of contacting Miss Utility as required by Law and providing evidence of Miss Utility Marking of the construction area.

**831.02 CONSTRUCTION**

The Contractor shall contact Miss Utility and assure that all construction areas are marked where excavation will take place. The Contractor shall maintain the markings. The Contractor shall pay any Miss Utility fees. The Contractor shall submit copies of Miss Utility tickets to the Engineer as evidence of this work. Notification to "Miss Utility" at 1.800.257.7777 shall be given 72 hours (three full working days) in advance of working in the area of the specific affected utility.

Forty-eight (48) hours prior to trenching or excavating, the Contractor is required to contact Mr. Jeff Robson, BHT Electrical Supervisor at 410-537-1274.

**831.03 MEASUREMENT AND PAYMENT**

This work will not be measured or paid separately, but shall be considered incidental to other work on the project.



**CATEGORY 800**  
**SECTION 863 — WARRANTIES**

**863.01 DESCRIPTION**

This work shall consist of providing equipment and system warranties as specified in the Contract Documents. The MdTA (or Authority) reserves the right to accept self-standing subsystems for maintenance in advance of a total system-wide acceptance.

**863.02 MATERIALS**

New or replacement materials required during the warranty period shall meet the original specifications for such equipment. The Engineer must approve any substitute equipment prior to use. All repairs must return equipment to "like new" condition.

**863.03 CONSTRUCTION**

**863.03.01 Contractor's Warranty.** The Contractor shall provide a system performance assurance warranty program for all equipment furnished for a period of one (1) year from the date of system acceptance. The Contractor shall provide a warranty of all parts for a minimum period of one year from completed installation and successful system acceptance. The warranty shall cover the cost of parts and labor at no additional expense to the Authority. If any component of the system fails during the warranty period, it must be replaced by the Contractor at his expense.

For failures that occur during the warranty period, a Contractor technician is expected to be on-site within 4 business hours from the time they are notified by the Authority. All after hour communications will be coordinated with the Duty Officer at the facility. The Contractor must provide a telephone number for the Technician on-call, and if that contact number changes the Duty Officer must be contacted with the new number.

During the warranty period the following shall apply.

A. This warranty shall apply to the entire system, and shall include the following:

- Two scheduled preventative maintenance checkups (at three months and at the end of the warranty period). Maintenance checkups shall be supervised and observed by MdTA personnel to supplement training and assure completion of the services.
- Emergency on-site maintenance or repair, completed within 24 hours of notification by Authority personnel. Some repairs and maintenance procedures will be observed by MdTA staff to supplement training and assure proper repair of equipment.



- B. In the event the defective equipment cannot be repaired within 24 hours, the Contractor shall install "loaner" equipment to restore system operation until repairs of the defective equipment are complete.
- C. The contractor will be permitted to utilize spare parts furnished under Specifications Section 890 to expedite 'back-in-service' repairs.
- D. Any spare parts used during the performance assurance warranty program shall be replaced or repaired to like-new condition at no cost to the Authority. The contractor will be required to demonstrate that replaced or repaired parts are like new.

**863.03.02** During the warranty period, the MdTA will provide any required maintenance of traffic. The Contractor may be required to work at night and/or during weekend hours where the MdTA determines that required traffic plans would severely impact traffic.

**863.03.03** All work performed during the warranty period shall remain consistent with the original Specifications and Requirements.

**863.03.04 Manufacturers' Warranties.** Manufacturers' standard warranties that extend beyond the Contractor's Warranty period shall automatically be transferred to the Authority. The Contractor shall inform the manufacturers of this requirement prior to purchase of the equipment, and provide a written agreement of compliance from the manufacturers to the Engineer.

**863.03.05 System Acceptance.** The system acceptance date shall be the date that all installation is complete, all systems are functioning, all systems have been tested and approved, the observation period has been successfully completed, all spare parts have been delivered, all training has been completed, and any and all "punch-list" items have been complete. The Contractor is required to request System Acceptance in writing and via certified mail delivery upon completion of all activities indicated above. System Acceptance shall be deemed to occur on the date of the request unless the request is rejected by the MdTA within 30 days.

#### **863.04 MEASUREMENT AND PAYMENT**

Individual warranties will not be measured separately, but instead the warranty on the entire system will be paid separately as a lump sum for the entire OHDS system as described herein. The lump sum for the warranty shall include all materials, labor, and equipment necessary to warrant the system as specified herein. Any requirements of the specifications or special provisions not specifically detailed or mentioned in a pay item shall be considered incidental to the pay items.

Refer to Bid Item 8014.



**CATEGORY 800**  
**SECTION 890 — SPARE PARTS AND MAINTENANCE ITEMS**

**890.01 DESCRIPTION**

This work shall consist of furnishing and delivering to the MdTA spare parts (“spares”) and maintenance items as described herein. All parts shall be delivered new and unused.

**890.02 MATERIALS**

The Contractor shall provide the spare equipment identified below. An employee of Authority will also designate where the spares shall be located. A transmittal letter, signed by the Contractor and the Authority, for all delivered spares shall be provided to ITS Supervisor, Mr. David Dikes (ph: 410-537-1096). The Contractor shall turn over spare parts to the Authority at the completion of acceptance testing. Note: Spare Parts have a separate bid item in the schedule of prices. There is no installation of the spares required. The Contractor furnishes the spares and provides them to the Authority.

The Contractor shall provide the following spare parts:

1. Two (2) Through Beam Photoelectric Sensor pairs;
2. One (1) Power Supply for each type of device (PLC, Photoelectric Sensor, Buzzer, Beacon, DVR, Camera, etc.);
3. One (1) Programmable Logic Controller;
4. Three (3) Exterior Status Indicator Beacon Strips;
5. Two (2) Exterior Status Indicator Beacons;
6. Two (2) complete sets of LED replacements for the Interior LED Status Indicator Light Panel;
7. Two (2) Exterior Buzzers;
8. One (1) H.264 Encoder.

The Contractor shall deliver the following maintenance items:

1. CD or USB Media with PLC backup and recovery files.
2. Maintenance and Troubleshooting Manual.
3. Schematic with wire-label identifications.

**890.04 MEASUREMENT AND PAYMENT**



Maryland  
Transportation  
Authority

**CONTRACT PROVISIONS**

CONTRACT NO. HT-2258-000-002

Replace Existing BHT Overheight Detection System

Page 154 of 220

May 2010

These components of the system will not be measured separately, but instead will be paid separately as a lump sum as described herein. The lump sum for designated spars shall include all materials, labor, and equipment necessary to furnish the spars as specified herein. The lump sum payment shall include any testing, if required to demonstrate working components, and warranty required by the specifications and special provisions. Any requirements of the specifications or special provisions not specifically detailed or mentioned in a pay item shall be considered incidental to the pay items. All materials required under this section shall be paid as a lump sum after delivery and successful testing.

Refer to Bid Item 8019.



**CATEGORY 800**  
**SECTION 899 — MISCELLANEOUS CONSTRUCTION AND/OR REPAIRS**

**899.01 DESCRIPTION**

A contingent allowance of \$45,000 has been included in the Bid/Proposal Form for miscellaneous construction and/or repairs 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 TC-7.03 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 TC-7.03 of the specifications and with the authorization of the Engineer. Approved amounts shall be a full compensation for all labor, equipment, materials, and incidental items complete and in place as directed by the Engineer. Only the agreed upon or documented costs shall be paid from a lump sum amount as specified in the schedule of prices.

Refer to Bid Item 8020.

**CATEGORY 900  
MATERIALS**

**SECTION 921 - MISCELLANEOUS**

**921.07 CONDUITS**

**ADD:**

This minimum size conduit for electrical raceway shall be  $\frac{3}{4}$ ". Larger sizes shall be used as indicated on the plans, within the special provisions or specifications, or as required by the NEC or other applicable code.

This minimum size conduit for communications raceway shall be 1". Larger sizes shall be used as indicated on the plans, within the special provisions or specifications, or as required by the NEC or other applicable code.

**921.07.01 METAL CONDUIT**

**ADD:**

- (h) All fittings (couplings, connectors, etc.) for metal conduit shall be steel, set screw or compression type. No malleable or aluminum fittings will be considered.
- (i) Fittings for all flexible metallic conduits shall be steel T&B Tite-Bite style or equivalent. No malleable or aluminum fittings will be considered.
- (j) All Conduit Outlet Bodies (LB's, T's, etc.) not subject to physical damage must be of Iron construction Crouse-Hinds Form 5, 7, 8, or equivalent shall be used. No Aluminum will be considered.
- (k) All Conduit Outlet Bodies (LB's, T's, etc.) installed where subject to physical damage must be of Malleable Iron construction Crouse-Hinds Form 5 or equivalent shall be used. No Aluminum will be considered.

**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 <sup>2</sup> ) 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.