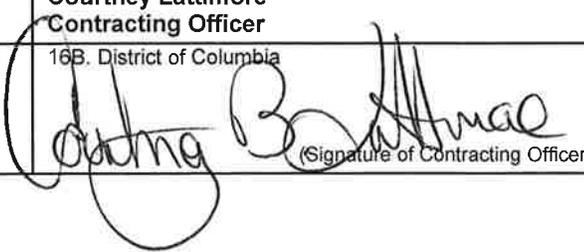


<b>AMENDMENT OF SOLICITATION / MODIFICATION OF CONTRACT</b>			1. Contract Number	Page of Pages 1   112 plus attachments
2. Amendment/Modification Number  <b>007</b>	3. Effective Date  See Box 16C	4. Requisition/Purchase Request No.	5. Solicitation Caption <b>Emergency Communication Systems for the Mall Tunnel</b>	
6. Issued by: District Department of Transportation Office of Contracting and Procurement 55 M Street, SE, 7 <sup>th</sup> Floor Washington, DC 20003		Code	7. Administered by (If other than line 6)	
8. Name and Address of Contractor (No. street, city, county, state and zip code)  <b>ALL PROSPECTIVE VENDORS</b>		X	9A. Amendment of Solicitation No. <b>DCKA-2014-B-0075</b>	
Code			9B. Dated (See Item 11)	
Facility			10A. Modification of Contractor/Order No.	
			10B. Dated (See Item 13)	
11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS				
<input type="checkbox"/> The above numbered solicitation is amended as set forth in item 14. The hour and date specified for receipt of Offers <input checked="" type="checkbox"/> is extended. <input type="checkbox"/> is not extended. Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing Items 8 and 15, and returning <u>1</u> copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) BY separate letter or fax which includes a reference to the solicitation and amendment number. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such may be made by letter or fax, provided each letter or telegram makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.				
12. Accounting and Appropriation Data (If Required):				
13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTORS/ORDERS, IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14				
A. This change order is issued pursuant to (Specify Authority): The changes set forth in Item 14 are made in the contract/order no. in item 10A.				
B. The above numbered contract/order is modified to reflect the administrative changes (such as changes in paying office, appropriation data etc.) set forth in item 14, pursuant to the authority of 27 DCMR, Chapter 36, Section 3601.2.				
C. This supplemental agreement is entered into pursuant to authority of:				
D. Other (Specify type of modification and authority)				
E. IMPORTANT: Contractor <input type="checkbox"/> is not <input checked="" type="checkbox"/> is required to sign this document and return <u>1</u> copies to the issuing office.				
14. Description of Amendment/Modification (Organized by UCF Section headings, including solicitation/contract subject matter where feasible.)  Solicitation <b>DCKA-2014-B-0075</b> is hereby amended as follows:  A. Updated Special Provisions, amended 10/27/2014, please note, all appendices with the exception of the Wage Determination remain the same. B. Responses to Requests for Information C. Bid Opening Date has been extended to Wednesday, November 12, 2014. The time and location remains unchanged. D. Incorporate General Wage Decision Number: DC140001, Mod. 17, dated 10/03/2014.				
15A. Name and Title of Signer (Type or print)		16A. Name of Contracting Officer <b>Courtney Lattimore Contracting Officer</b>		
15B. Name of Contractor  (Signature)	15C. Date Signed	16B. District of Columbia   (Signature of Contracting Officer)	16C. Date Signed  10/27/14	

GOVERNMENT OF THE DISTRICT OF COLUMBIA

# DEPARTMENT OF TRANSPORTATION

INFRASTRUCTURE PROJECT MANAGEMENT

ADMINISTRATION



## SPECIFICATIONS

INVITATION NO.: DCKA-2014-B-0075

**CAPTION: EMERGENCY COMMUNICATION SYSTEMS FOR THE MALL TUNNEL**

**FAP No.: STP-8888(466)**

Bids Will Be Publicly Opened By The Office of Contracting and Procurement, 55 M Street SE,  
Washington DC 20003

AMENDMENT NO. 007, DATED 10/27/2014

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AND

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The “STANDARD SPECIFICATIONS FOR HIGHWAYS AND STRUCTURES, 2013” and the “Standard Contract Provisions for Use with Specifications for District of Columbia Government Construction Projects” 1973 and amendments thereto are incorporated herein by reference and are made a part of the requirements of this Contract.

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As Amended, 10/27/2014

## **1. SCOPE**

Work under this contract consists of constructing emergency communication systems in the Mall Tunnel. The work includes but is not limited to the following items:

- a. Installation of AM-FM Channelized Rebroadcast System.
- b. Installation of Emergency Public Address System throughout the Tunnel area.
- c. Installation of Tunnel Radio System compliant with DCFD, MPD, and DDOT radio bands.
- d. Installation of VMS signs and Emergency Pedestrian Egress Routes.
- e. Installation of CCTV cameras.
- f. Installation of Dynamic Message Signs at the Tunnel portals.
- g. Providing a construction schedule for the project and making adjustments to keep the schedule updated.
- h. Implementation and monitoring of vehicular traffic and its maintenance for the construction period.
- i. Mobilization and demobilization, provision and maintenance of work and storage areas, Engineer's Field Facilities and performance of Employee Training.

All above items shall be furnished and installed by the Contractor. Work also includes all other incidentals items required as shown in the contract plans and/or as specified in the Standard Specifications and Special Provisions.

The Contractor is also required to produce all shop/working drawings, material certifications, laboratory test reports, and other required submittals for review by the Chief Engineer in accordance with 105 of the Standard Specifications.

For the duration of the contract, the Contractor shall be fully responsible for protection against damage of all the utility structures within the contract limits and adjacent thereto. The utilities include but are not limited to, public and/or private electricity and communications lines. No separate measurement of payment will be made. Cost of this protective work shall be reflected and distributed among the contract pay items.

## **2. QUALIFICATIONS OF BIDDERS**

**Reserved**

## **3. PRE-BID CONFERENCE**

Prospective bidders are invited to attend a meeting to discuss the proposed work under this contract. The meeting will be held in DDOT's offices at 55 M Street, SE, Washington, D.C. The contractors will be notified about the date and time for the Pre-Bid Conference at a later date.

Representatives of the Department will be available to answer questions relative to the work. Bidders who expect to attend should inform the Department before the meeting date. Any pertinent data or change resulting from the conference will be included in any Addendum issued to all prospective bidders after the conference; however, the importance of attending the meeting is stressed. Any questions or conflicts identified before bid should be brought out during this meeting.

#### **4. CONTRACTOR IDENTIFICATION**

This Special Provision supplements 102.01 Article 1 of the Standard Specifications.

All Contractors doing business with the District of Columbia Government shall have a Federal Identification Number.

#### **5. CONTRACT TYPE**

In accordance with Title 27 DCMR, Chapter 24, the contract type shall be a fixed price contract.

#### **6. CONTRACT ADMINISTRATION DATA**

##### **A. CONTRACTING OFFICER.**

Contracts may be entered into and signed on behalf of the District Government only by contracting officers. The contracting officer is the only District official authorized to contractually bind the District. The Contracting Officer is Courtney B. Lattimore, Department of Transportation, Office of Contracting and Procurement, 55 M Street SE, 7<sup>th</sup> Floor, Washington DC 20003. Telephone (202) 671-2288.

##### **B. AUTHORIZED CHANGES BY THE CONTRACTING OFFICER (ACCO).**

1. The Contracting Officer is the only person authorized to approve changes in any of the requirements of this Contract.
2. The Contractor shall not comply with any order, directive or request that changes or modifies the requirements of this contract, unless issued in writing and signed by the Contracting Officer.
3. In the event the Contractor effects any changes at the discretion of any person other than the Contracting Officer, the changes will be considered to have been made without authority and no adjustment will be made in the contract price to cover any cost increase incurred as a result thereof.

##### **C. CONTRACTING OFFICER'S TECHNICAL REPRESENTATIVE (COTR).**

The term COTR is the Program Manager; the name, address and telephone number is:

Name: Mr. Ali Shakeri  
Title: Program Manager  
Agency: District Department of Transportation  
Address: 55 M Street, SE, 4<sup>th</sup> Floor  
Washington, D. C. 20003  
Telephone: (202) 671-4612

The COTR will have the responsibility of ensuring that the work conforms to the requirements of this contract and such other responsibilities and authorities as may be specified in the contract. The COTR will act as the contracting officer's representative for technical matters, providing technical direction and discussion, as necessary with respect to the specifications or statement of work, and monitoring the progress and quality of the Contractor's performance. Other responsibilities include the following:

1. Keeping the COTR fully informed of any technical or contractual difficulties encountered during the performance period and advising the ACCO of any potential problem areas under the contract;
2. Coordinating site entry for Contractor personnel, if applicable;
3. Reviewing and approving invoices for fixed-price deliverables to ensure receipt of goods and services. This includes the timely processing of invoices and vouchers in accordance with the District's Payment provisions; and
4. Maintaining a file that includes all contract correspondence, modifications, records of inspections (site, data, and equipment) and invoices/vouchers.

It is understood and agreed, in particular, that the COTR is not a contracting officer and does not have the authority to:

1. Award, agree to, or sign any contract, delivery order or task order. Only the ACCO shall make contractual agreements, commitments, or modifications;
2. Grant deviations from or waive any of the terms and conditions of the contract;
3. Direct the accomplishment of effort, which is beyond the scope of the statement of work in the Contract;
4. Increase the dollar limits of the contract or authorize work beyond the dollar limit of the contract; or authorize the expenditure of funds by the Contractor;
5. Change the period of performance; and
6. Authorize the furnishing of District property, except as specified under the contract.

When in the opinion of the Contractor, the COTR requests effort outside the existing scope of the contract, the Contractor shall promptly notify the contracting officer in writing. The Contractor under such direction shall take no action until the contracting officer has issued a modification to the contract or until the issue has been otherwise resolved.

## **D. ORDERING AND PAYMENT.**

The Contractor shall not accept orders for items under this contract unless a purchase order has been issued. The participating agency shall be the District Department of Transportation.

Invoices shall be submitted in duplicate to the D.C. Department of Transportation, Office of the Chief Engineer, 55M Street SE, 4<sup>th</sup> Floor, Washington DC 20003, Telephone (202) 671-2800.

Each invoice must provide the following minimum information:

1. Contractor's name, address, invoice number and date
2. Contract line number (CLIN) being billed for payment and total amount due
3. Purchase order and contract number
4. Addressee's name and address
5. Period of service;
6. Description of services and deliverables provided
7. Name, title, signature and phone number of preparer, and
8. Name of the contracting officer's technical representative.

Payment may be delayed for improperly prepared invoices.

## **7. PRE-AWARD APPROVAL**

Pursuant to Title XXII of the "Fiscal Year 2003 Budget Support Amendment Act of 2002", D.C. Law 14-307, effective June 5, 2003, the Mayor must submit to the Council for approval any contract action over one million dollars.

## **8. SPECIFICATIONS AND DRAWINGS**

**The District of Columbia Department Transportation Standard Specifications (2013) and amendments thereto are incorporated by reference into this contract. In case of discrepancy:**

1. The Contracting Officer shall be promptly notified, in writing, of any error, discrepancy or omission, apparent or otherwise.
2. Applicable Federal and D.C. Code requirements have priority over: The Contract Form, General Provisions, Labor Provisions, Change Orders, Addenda, Contract Drawings, Special Provisions and Specifications.
3. The Contract Form, General Provisions and Labor Provisions have priority over: Change Orders, Addenda, Contract Drawings, Special Provisions and Specifications.
4. Change Orders have priority over: Addenda, Contract Drawings and Specifications.
5. Addenda have priority over: Contract Drawings, Special Provisions and Specifications. A later dated Addendum has priority over earlier dated Addenda.

6. Special Provisions have priority over: Contract Drawings and other Specifications.
7. Shown and indicated dimensions have priority over scaled dimensions.
8. Original scale drawings and details have priority over other different scale drawings and details.
9. Large scale drawings and details have priority over small scale drawings and details.

Any adjustment by the Contractor without a prior determination by the Contracting Officer shall be at his/her own risk and expense. The Contracting Officer will furnish from time-to-time, such detail drawings and other information as he may consider necessary, unless otherwise provided.

## **9. AWARD OF CONTRACT**

The Department of Transportation intends to award this contract within ninety (90) calendar days.

## **10. UTILITY STATUS**

This Special Provision supplements 103.01 Article 17E of the Standard Specifications.

DDOT maintains coordination with the public/private utility companies during the preliminary engineering and construction phases of the project. The Contractor shall continue with this coordination with the public/private utility companies before the start of construction and during all construction phases of the project.

It is understood and agreed that the Contractor has considered in his bid all of the permanent and temporary utility appurtenances in their present or relocated positions. The District will not allow any additional compensation for reasonable delays, inconveniences, or damage sustained by the Contractor due to any interference from the said utility appurtenances or the operation of moving them.

The Contractor shall be responsible for notifying all affected utility companies before performing any work on their utilities, and shall cooperate with them in achieving the desired result. Refer to 107.16 of the Standard Specifications for the list of Utility contacts. The Contractor shall cooperate with the owners of any underground or overhead utility lines in their removal and rearrangement operations. This is in order that the operations may progress in a reasonable manner, that duplication or rearrangement work may be reduced to a minimum, and that services rendered by those parties will not be interrupted.

If utility services are interrupted because of accidental breakage or because of being exposed or unsupported, the Contractor shall promptly notify the proper authority and shall cooperate with the authority in the restoring service. No work shall be undertaken around fire hydrants until the local fire authority has approved provisions for continued service.

## **11. COORDINATION WITH OTHERS**

This Special Provision supplements 103.01, Article 18 of the Standard Specifications.

The Contractor is alerted to the fact that other contracts have been or may be let for work near the project area. These contracts may be associated with this project, or they could be different in scope.

The Contractor shall coordinate his work and cooperate fully with all others in order to eliminate or curtail delays and interference of any kind. Particular attention shall be paid to the proper maintenance of highway traffic through the tunnel. The Contractor shall perform his lane closings and reopening so as not to cause interference with others, or conflict with traffic maintenance by others.

DDOT reserves the right to resolve any conflicts between adjoining Contractors to provide convenience and safety for the traveling public. If the conflict resolution results in delay to the Contractor, only extra non-compensable time will be added to the contract.

## **12. MAINTENANCE OF HIGHWAY TRAFFIC**

This Special Provision supplements 104.02 of the Standard Specifications.

### **A. TRAFFIC FLOW RESTRICTIONS.**

Within the Mall Tunnel and the approaching ramps the full roadway width shall be opened to traffic between the hours of 4:00AM and 8:00PM. The Contractor may perform the work on the project during these restricted hours provided that the full roadway width remains opened to traffic.

The Contractor will be permitted to temporarily close one (1) outside lane of traffic (either left or right lane) and the adjacent shoulder within each tube of the Mall Tunnel between the hours of 8:00PM and 4:00AM, keeping a minimum of two (2) adjacent lanes open in each direction at all times. Two lanes in each direction must be maintained at all times. Refer to 105.11 of the Standard Specifications for Night Work requirements.

The Contractor shall follow the lanes closures within the Construction Staging Drawings of the Contract Documents. The entire lane closure must be in place in accordance with MUTCD standards before any work can begin. The Contractor can close off the shoulders for work with the Chief Engineer's approval provided that shoulder closures meet MUTCD requirements.

The Contractor is not allowed to park vehicles or store equipment along any shoulders or travel lanes, while NOT working.

The Contractor shall contact the COTR, in order to coordinate with the Infrastructure Project Management Administration, Asset Management Division for use of the tunnels variable message boards and overhead lane control signals.

The Contract Drawings contain a suggested Maintenance of Traffic Plans for implementation during construction of the project. The Contractor may use the Maintenance of Traffic Plans in the contract drawings as the Traffic Control Plan (TCP) or submit a Contractor-designed TCP to the Chief Engineer for review and approval. A Contractor-supplied TCP shall comply with 104.02(B) of the Standard Specifications.

The Contractor shall, at all times, maintain an existing vertical clearance within the Mall Tunnel for the duration of construction. No new equipment installed by the Contractor as part of this project shall impede the existing clearance.

### **B. PEDESTRIAN TRAFFIC REQUIREMENTS.**

The Contractor shall at all times maintain and keep accessible an emergency egress for pedestrians within the tunnel for the duration of the project.

**C. MEASUREMENT AND PAYMENT.**

No direct measurement or payment will be made for the work required by this Special Provision. Payment for work under this Special Provision will be incidental to MAINTENANCE OF HIGHWAY TRAFFIC, Item 612002. Refer to Contract for Measurement and Payment for other maintenance of traffic items, such as:

- TEMPORARY CONSTRUCTION SUPPORTS – Item 612010
- CONSTRUCTION WARNING AND DETOUR SIGNS – Item 612014
- REFLECTORIZED TRAFFIC CONES – Item 612016
- FLASHING AMBER WARNING LIGHTS, TYPE B – Item 612018
- TRAFFIC DRUMS – Item 612034
- TRUCK MOUNTED ATTENUATOR – Item 612092
- PORTABLE CHANGEABLE MESSAGE SIGNS – Item 612100
- SEQUENTIAL ARROW BOARD - Item 612022
- TYPE III PVC BARRICADE – Item 612028

**13. CONTRACTOR'S SUBMITTALS**

This Special Provision supplements 105.02 (B)(2) of the Standard Specifications. All shop and working drawings, materials certifications, test reports and other required submittals shall be transmitted to the following DC-DDOT office:

**Mr. Abdullahi Mohamed**  
**Infrastructure Project Management Administration**  
**District Department of Transportation**  
**55 M Street, SE, 4<sup>th</sup> Floor**  
**Washington, DC 20003**

**14. INSURANCE**

This Special Provision supplements 107.13 of the Standard Specifications.

All policies and certificates shall be sent to the Contracting Officer, DDOT, 2000 14th Street, NW, Washington, DC 20009.

The District of Columbia shall be named as an additional insured on all such policies. All such policies shall specify that the insured shall have no right of subrogation against the District for payments of any premiums or deductibles hereunder and such insurance policies shall be assumed by, be for the account of, and be at the sole risk of the insurer.

Each insurance policy shall contain a binding endorsement stating that: The insurer hereby warrants and agrees that it shall not cancel or alter the insurance coverage afforded by this policy, except after thirty (30) days written notice has been received by the Contracting Officer, from the insurer."

**A. GENERAL REQUIREMENTS.**

The Contractor shall procure and maintain, during the entire period of performance under this contract, the types of insurance specified below. The Contractor shall submit a Certificate of Insurance giving

evidence of the required coverage either before or after contract award but before work commences. All insurance shall be written with financially responsible companies authorized to do business in the District of Columbia or in the jurisdiction where the work is to be performed; have either an A.M. Best Company rating of AVID or higher, a Standard & Poor's rating of AA or higher, or a Moody's rating of Aa2 or higher. The Contractor shall require all subcontractors to carry the insurance required herein, or the Contractor may, at its option, provide the coverage for any or all subcontractors, and if so, the evidence of insurance submitted shall so stipulate. All policies (excluding Workers' Compensation and Professional Liability, if applicable) shall name the District as an additional insured with respect to work or services performed under the Contract. All policies shall provide that the insurance coverage provided hereunder will be primary and noncontributory with any other applicable insurance. All policies shall contain a waiver of subrogation in favor of the District of Columbia. In no event shall work be performed until the required Certificates of Insurance signed by an authorized representative of the insurer(s) has been furnished. All policies shall provide that the Contracting Officer shall be given thirty (30) days prior written notice via certified mail in the event coverage is substantially changed, canceled or not renewed.

1. Certificate of Insurance Requirement. The policy description on the Certificate of Insurance form shall include the District as an additional insured and a waiver of subrogation in favor of the District.
2. Commercial General Liability Insurance. The Contractor shall provide evidence satisfactory to the Contracting Officer with respect to the operations performed that it carries \$ 2,000,000.00 per occurrence limits; \$ 4,000,000.00 per aggregate limits; and includes coverage for products and completed operations and personal and advertising injury. The policy coverage shall be primary and non-contributory, shall contain the CGL 2503 per project endorsement, and shall include the District of Columbia as an additional insured.

Commercial General Liability Insurance If the Contractor is providing insurance for a subcontractor, the Contractor shall provide evidence satisfactory to the Contracting Officer with respect to the operations performed that it carries \$ 2,000,000.00 per occurrence limits; \$ 4,000,000.00 per aggregate limits; and includes coverage for products and completed operations and personal and advertising injury. The policy coverage shall be primary and non-contributory, shall contain the CGL 2503 per project endorsement, and shall include the District of Columbia as an additional insured.

3. Automobile Liability Insurance. The Contractor shall provide automobile liability insurance to cover all owned, hired or non-owned motor vehicles used in conjunction with the performance of the contract. The policy shall cover the operations performed under the contract with a \$ 2,000,000.00 per occurrence combined single limit for bodily injury and property damage. The policy coverage shall be primary and non-contributory and shall include the District of Columbia as an additional insured.
4. Workers' Compensation Insurance. The Contractor shall provide Workers' Compensation insurance in accordance with the statutory mandates of the District of Columbia or the jurisdiction in which the contract is performed.
5. Employer's Liability Insurance. The Contractor shall provide employer's liability insurance as follows: \$ 1,000,000.00 per accident for injury; \$ 1,000,000.00 per employee for disease; and \$ 1,000,000.00 for policy disease limit.

6. Umbrella or Excess Liability Insurance. The Contractor shall provide umbrella or excess liability insurance as follows: \$ 5,000,000.00 per occurrence, with the District added as an additional insured.
7. Professional Liability Insurance (Architect & Engineers). The Contractor (including but not limited to architects, attorneys, engineers, environmental consultants, and healthcare professionals) shall provide Professional Liability Insurance (Errors and Omissions) to cover liability resulting from any error or omission caused by the performance of professional services under this Contract.  
  
The policy shall provide limits of \$ 1,000,000.00 per occurrence for each wrongful act and \$ 3,000,000.00 per aggregate for each wrongful act.  
The Contractor shall maintain this insurance for five (5) years following the District's final acceptance of the work. The policy shall cover the Contractor and its subcontractors of every tier, and shall identify the District as the Project Owner on the policy.
8. Pollution Liability Insurance. The Contractor shall provide a policy to cover costs associated with pollution incidents including, but not limited to, mold, asbestos or lead removal. The policy shall provide a minimum of \$2,000,000.00 in coverage per occurrence.
9. Crime Insurance. The Contractor shall provide a policy to cover costs associated with the criminal activities of its employees including, but not limited to, robbery, burglary, larceny, forgery, or embezzlement. The policy shall provide a limit of \$ 0.00 per occurrence for each wrongful act and \$ 0.00 per aggregate for each wrongful act.

**B. DURATION.**

Except as proved in I.5.A.6, the Contractor shall carry all insurance until all contract work is accepted by the District. Each insurance policy shall contain a binding endorsement that: The insurer agrees that the Contracting Officer shall be given thirty (30) days prior written notice via certified mail in the event coverage is substantially changed, canceled or not renewed.

**C. CONTRACTOR'S PROPERTY.**

Contractors and subcontractor are solely responsible for any loss or damage to their personal property, including owned and leased equipment, whether such equipment is located at a project site or "in transit". This includes Contractor tools and equipment, scaffolding and temporary structures, and rented machinery, storage sheds or trailers placed on the project site.

**D. MEASURE OF PAYMENT.**

The District shall not make any separate measure or payment for the cost of insurance and bonds. The Contractor shall include all of the costs of insurance and bonds in the contract price.

**15. PROJECT SECURITY**

This Special Provision supplements 107.15 of the Standard Specifications.

The Contractor shall be responsible for adequate protection of the project site during the performance of this Contract. The Contractor shall be responsible, on a 24-hour basis, for necessary protection to prevent

unauthorized access to any DDOT owned facilities and/or areas to prevent vandalism or injuries. No direct measure or payment will be made. Cost of Project Security shall be incidental to Engineer's Field Facilities, Pay Item 624002.

## **16. PRE-CONSTRUCTION SCHEDULING CONFERENCE**

The Engineer will schedule and conduct a Pre-Construction Scheduling Conference with the Contractor's Project Manager and Construction Scheduler within fifteen (15) working days after the Bidder has received the Contract for execution.

At this meeting, the requirements of 108.03 of the Standard Specifications regarding scheduling will be reviewed with the Contractor. At the Pre-Construction Scheduling Conference, Contractor shall furnish a Preliminary Baseline Schedule as discussed in section C, and be prepared to discuss both its proposed methodologies for fulfilling the scheduling requirements and its sequence of operations.

At the Pre-Construction Scheduling Conference, the Contractor shall be prepared to discuss the requirements for all off-site material testing and submittals applicable to the Contract, discuss their respective preparation, and review durations.

## **17. WEEKLY PROGRESS MEETINGS**

Engineer and the Contractor shall hold weekly progress meetings to discuss, among other things, (i) the near-term schedule activities; (ii) the current status of as-Built documentation, RFI's, Contractor Daily Reports, Quality Control, submittals, correspondence, and Contract Change Orders; and (iii) Jobsite safety, cleanup, traffic control, and coordination issues. Furthermore, the meeting shall address any long-term schedule issues discussion of any relevant technical issues. Contractor shall develop a look-ahead schedule identifying the previous week; current week and a 2-week look ahead. Contractor's look-ahead schedules shall provide sufficient detail to address all activities to be performed and to identify issues requiring Owner action or input. Twenty-four hours prior to the weekly progress meetings, the Contractor shall furnish the look-ahead schedule in hard copy and electronic format to the Engineer for review.

No later than 2 days prior to the Weekly Progress Meeting, Contractor shall furnish a list of critical items relating to the look-ahead schedule. During the meeting the parties will jointly determine whether additional items need to be listed, the priority of items, the parties responsible for resolving the critical item and the scheduled resolution date. The updated list will be distributed with the weekly meeting minutes. Nothing herein shall be construed to excuse Contractor's obligation to timely provide either a Notice of Delay or a Notice of Potential Claim.

## **18. CONSTRUCTION COMPLETION TIME**

This Special Provision supplements 108.08 of the Standard Specifications.

The Contractor shall start work on the date specified in a written Notice to Proceed issued by the Contracting Officer and complete the work as followed:

For the Mall Tunnel Work as specified in Section 1- Scope the Contractor shall have ONE HUNDRED AND EIGHTY (180) consecutive calendar days after specified starting date to complete all Work. The Contractor is expected to order equipment with excessively long lead times as early as possible, as not to affect the overall

schedule. Additionally, the Contractor is expected to perform work on different items of scope concurrently.

## **19. REPLACE/REPAIR DAMAGED CEILING PANELS**

### **A. DESCRIPTION.**

This item covers removal of ceiling panels damaged during construction, fabrication and installation of replacement panel support members where required, fabrication and installation of tunnel ceiling panels, and repairing surface coating on scratched panels as required and directed by the Engineer.

### **B. MATERIALS.**

The new ceiling panels shall match the existing panels in size, material, finish, color, support type and installation methods.

### **C. CONSTRUCTION REQUIREMENTS.**

Prior to beginning the construction activity within the tunnel, the Contractor shall perform a survey of the tunnel ceiling panels and inventory the panels damaged before any work has begun in the tunnel. The list of damaged panels shall be presented to the Engineer. Any panels found to be damaged during construction due to the Contractor's activities shall be repaired/replaced at the Contractor's expense to the Engineer's satisfaction.

## **20. DDOT TITLE VI ASSURANCE**

During the performance of this Contract, the Contractor, for itself, its assignees and successors in interest (hereinafter referred to as the "contractor") agrees as follows:

### **A. COMPLIANCE WITH REGULATIONS.**

The contractor shall comply with the Regulations relative to Non-Discrimination in Federally Assisted Programs of the Department of Transportation, Title 49, Code of Federal Regulations, Part 21, (hereinafter referred to as the "Regulations"), as they may be amended from time to time, which are incorporated by reference and made a part of this Contract.

### **B. NON-DISCRIMINATION.**

The Contractor, with regard to the work performed by it during the contract, shall not discriminate on the grounds of race, color, gender or national origin in the selection and retention of Subcontractors, including procurements of materials and leases of equipment. A Contractor shall not participate either directly or indirectly in the discrimination prohibited by Section 21.5 of the Regulations, including employment practices when the contract covers a program set forth in Appendix B of the Regulations.

### **C. SOLICITATIONS FOR SUBCONTRACTORS, INCLUDING PROCUREMENTS OF MATERIALS AND EQUIPMENT.**

In all solicitations either by competitive bidding or negotiation made by the Contractor for work to be performed under a Subcontract, including procurements of materials or leases of equipment, each potential Subcontractor or Supplier shall be notified by the Contractor of the Contractor's obligations

under this contract and the Regulations relative to nondiscrimination on the grounds of race, color, gender, or national origin.

**D. INFORMATION AND REPORTS.**

The Contractor shall provide all information and reports required by the Regulations or directives issued pursuant thereto, and shall permit access to its books, records, accounts and other sources of information, and its facilities as may be determined by DDOT or the Federal Highway Administration (FHWA), to be pertinent to ascertain compliance with such Regulations, orders and instructions. Where any information required of a Contractor is in the exclusive possession of another who fails or refuses to furnish this information, the Contractor shall so certify to DDOT, or the Federal Highway Administration, as appropriate, and shall set forth what efforts it has made to obtain the information.

**E. SANCTIONS FOR NON-COMPLIANCE.**

In the event of the Contractor's non-compliance with non-discrimination provisions of this Contract, DDOT shall impose such contract sanctions as it or the Federal Highway Administration may determine to be appropriate, including, but not limited to:

1. Withholding of payments to the contractor under the contract until the Contractor complies, and/or
2. Cancellation, termination, or suspension of the contract, in whole or in part.

**F. INCORPORATION OF PROVISIONS.**

The Contractor shall include the provisions of paragraphs (A) through (F) of this Assurance in every Subcontract, including procurements of materials and leases of equipment, unless exempt by the Regulations, or directives issued pursuant thereto.

The Contractor shall take such action with respect to any subcontract or procurement as DDOT or FHWA may direct as a means of enforcing such provisions including sanctions for non-compliance provided, however, that in the event a Contractor becomes involved in, or is threatened with, litigation with a Subcontractor or Supplier as a result of this direction, the Contractor may request DDOT to enter into such litigation to protect the interests of DDOT, and in addition, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

**21. SUBCONTRACTING**

This Special Provision supplements 108.01 of the Standard Specifications.

The Subcontractor approval request form included in the Appendices should be used to request approval of subcontractors on this project. The form should be completed for each subcontractor requested for approval and submitted to:

**Attention: Office of Chief Engineer**

**District Department of Transportation  
55 M Street SE, 4<sup>th</sup> Floor  
Washington, D.C. 20003**

Copies of this form are available on request.

Copies of subcontracts shall be made available for review at any time to representatives of the Department of Transportation and the Federal Highway Administration.

## **22. TUNNEL RADIO SYSTEMS**

### **22.01 GENERAL**

The Work under this Section includes:

1. AM and FM radio rebroadcast with voice override system.
2. Multi-agency two-way radio rebroadcast system.
3. Air-interface antennas.
4. In-tunnel distributed antenna system (DAS), including coaxial cables, connectors, AM radiator wire and components, and mounting accessories.
5. Operator Control-room radio consoles.

#### **22.01.01 SUMMARY**

All of the designated enclosed tunnel overage areas, ramps and emergency egress passageways, shall employ an in-tunnel Two-way Radio Rebroadcast system to enable Public Safety first responders, highway police, DDOT and maintenance personnel with bi-directional communications to/from the above ground agencies' network in multiple frequency bands (700 MHz and 800 MHz) for all the designated agencies' FCC-licensed channels. Facilities to enable Tunnel operators with communications capabilities with emergency responders on site and at the tunnel equipment building shall be provided at the Tunnel Control Room.

Additionally, a commercial AM/FM Radio Rebroadcast System with Emergency Voice Override (Break-in) capability shall allow the Tunnel Control Room to broadcast in-tunnel emergency messages to the commuters over the in-car commercial radio receiver for traffic advisories and alerts in case of emergency. An In-tunnel Broadcast Monitoring System (IBMS) shall be installed in order to allow the tunnel operator personnel at the Tunnel Control Room to listen and verify the content and quality of the actual AM/FM rebroadcast transmission within the enclosed tunnel roadways.

The radio systems to be installed shall employ the latest digital signal processing (DSP) and field reconfigurable semiconductor technology to be a future-proof system, compatible with current and new RF digital modulation schemes, reduced risks of technology obsolescence, based on the principles of software defined radio features and functions.

The Contractor shall be responsible for the supply, installation, testing, commissioning, training and documentation of the Tunnel Radio Communications System.

**Single-Source Responsibility:** The Contractor shall select a Radio Specialist Equipment supplier who shall implement the proposed design, perform site surveys, supply radio and related equipment and specialty materials, integrate the system components purchased with those that are furnished, supervise installation,

demonstrate its operation with shop and field acceptance test, commission, document as-built and train the DDOT personnel on the radio systems as detailed in this specification.

All provided equipment shall be designed and built for the purpose for which it will be used in radio rebroadcast applications.

The Radio Specialist Equipment supplier shall perform an initial site survey and provide a verification of the minimum system signal strength requirements.

The Radio Specialist Equipment supplier shall provide Operations & Maintenance (O&M) manuals, guarantees, warranties, test specifications, test reports and test certificates for all equipment including a recommended list of tools and spares holding.

### **22.01.02 SCOPE**

The Contractor shall install and commission a multi-agency Public Safety two-way radio signal booster system covering 700 MHz and 800 MHz, and an AM/FM radio rebroadcast signal repeater system with emergency override capability. This system must provide radio coverage within the limits of the project.

The radio systems shall include air-interface antennas and their mounting masts; radiating (leaky) coaxial-cable, in-tunnel AM loop-radiator wires; feeder coaxial cable (transmission line), copper multi-conductor cables; multi-channel AM/FM digital rebroadcast head-end equipment; multi-channel 700 MHz and 800 MHz bi-directional RF signal boosters; RF couplers, RF multi-coupling, RF splitter/combiners, RF filters and termination equipment; audio and networking equipment; discrete in-tunnel monitoring pick-up antennas and equipment; electronic equipment cabinets or enclosures; grounding and lightning surge protection devices; panel boards and power lines; support hardware (conduits, cable trays, cable supports, junction boxes, etc).

The donor antennas shall be installed at the Tunnel Equipment Building roof-top to provide an air-interface path for multi-agency two-way radio signals and AM/FM commercial radio reception for re-transmission into the tunnel distributed antenna system.

The two-way radio equipment, AM/FM Rebroadcast/Override Head End Equipment and AM/FM In-tunnel broadcast monitoring (IBMS) equipment shall be installed at the Tunnel Radio Room. Discrete In-tunnel monitor (pick-up) AM/FM antennas shall be installed for the IBMS operation.

The proposed locations are recommended for the setup and installation of equipment and facilities. The Contractor shall verify the suitability, in terms of installation, operations and maintenance, of the locations for its equipment and facilities and recommend, if necessary, other locations to the Project Engineer's Representative for approval to meet the requirements in this Specification.

#### **22.01.03 AM/FM RADIO REBROADCAST WITH VOICE OVERRIDE SYSTEM**

The air-interface multi-channel AM/FM Radio Rebroadcast with voice override system aims at advising vehicular travelers within the tunnel complex of emergency conditions within the Tunnel, ramps and approach roads, and providing instruction for proper actions to be taken. Under normal circumstances, the travelers in the tunnel will receive the FM or AM radio through the car radio. Wherever the situation requires special coordination, the system will allow AM and FM radio signals to be overridden within the tunnel for the purpose of dissemination of emergency information.

The air-interface multi-channel AM/FM Radio Rebroadcast with override system is comprised of AM and FM receive antennas, AM and FM digital Receive channelizers (multi-channel on frequency repeaters) with built-in override generators, AM and FM Multi-carrier Power Amplifiers, Digital Recorder and Rebroadcast Controller, and AM/FM console computers.

- a. The tunnel AM radio rebroadcast shall cover the frequency range from 0.53 to 1.7 MHz.

A radio station is considered to be “local” if its off-air reception on top of the Tunnel Equipment Building has signal strength within 40 dB below the average of the stronger stations, or greater than 10 mV/m. The AM radio rebroadcast system shall have provisions to rebroadcast up to 20 channels. The AM radio rebroadcast system shall conform to the requirements of CFR Title 47 Part 15, Subpart C, Sections 15.211 and 14.221.

- b. The tunnel FM radio rebroadcast shall cover the frequency range from 87.5 to 108 MHz.

An FM radio station is considered to be “local” if its off-air reception on top of the Tunnel Equipment Building has signal strength within 40 dB below the average of the stronger stations, or it is greater than 700 mV/m. The FM radio rebroadcast system shall have provisions to rebroadcast up to 32 channels.

The FM radio rebroadcast system shall conform to the requirements of CFR Title 47 Part 15, Subpart C, Sections 15.211 and 15.239.

The AM/FM system shall provide 95% probability of AM/FM radio rebroadcast in 95% of the tunnel area.

The AM/FM system shall provide coverage of the entire tunnel traffic sections, without radiating outside the enclosed areas above the FCC limits. Therefore, the following minimum field strength requirements apply starting from the insets defined below and into the enclosed areas.

Table 2 AM/FM Bands

	AM band	FM band
Terminating distance from the portals and openings	20 ft	200 ft
Minimum field strength, 95% percentile of the readings over 100ft longitudinal grid sections	-100 dBm	-90 dBm
Measuring test-probe standard	1 meter whip antenna installed on the roof of a car, connected via 50-ohm coaxial cable directly (without coupling or Impedance matching) to the 50-Ohm RF power meter input (narrowband detector)	98 MHz ¼ wavelength whip antenna installed on the roof of a car, connected via 50-ohm coaxial cable directly (without coupling or impedance matching) to the 50-ohm RF power meter input (narrowband detector)

The system shall be capable of overriding the stations with separate independent content per tunnel or keeping the normal off/air rebroadcast in one direction while the opposite direction tunnel bore is being overridden. In addition, the system shall be capable of overriding the stations in their normal broadcast language, by having at least two programmable override language groups per tunnel bores.

22.01.04 DIGITAL RECORDER AND REBROADCAST CONTROLLER

The Digital Recorder and Rebroadcast Controller shall be fully integrated with the AM & FM Radio Rebroadcast channelizers. The Radio Override subsystem shall be zoned, which means that it has an

independent audio source for each tunnel traffic-flow direction and language group. All AM & FM stations within the same tunnel or traffic flow direction will be overridden with the same advisory message; however it shall be capable of different for each tunnel bore. Pre-recorded messages shall be bore-specific since confusion could result if the wording of the announcement may be misunderstood by others for whom the broadcast was not intended. The tunnel operator shall be able to assign playback zones for each new message to be entered into the message registry or database. The Radio Override sub-system shall not allow messages for zones which they are not intended to be broadcast

The AM/FM Digital Recorder and Rebroadcast Controller shall be provided with graphical user interfaces (GUI) thru remote client AM/FM radio console computers at the Tunnel Control Room. The functionality provided to the users will include, but not necessarily be limited to the following:

1. Create messages with real voice recordings, use text to speech software.

One demo (basic synthesis quality) voice shall be included for the project. The system shall allow addition of professional synthesized voices licenses at future stages.

2. Provide capability for users to manage existing and future AM/FM Rebroadcast systems.
3. Create AM/FM Rebroadcast messages and message lists.
4. Defining and managing a AM/FM Rebroadcast message schedule.
5. Defining and managing a AM/FM Rebroadcast Message Library.

The user will have the option of creating new messages either by using a voice recorder GUI or by using a text-to-voice GUI.

The AM/FM Rebroadcast subsystem will maintain a library of messages for use in all AM/FM Rebroadcast zones. The user will be able to create message lists for each AM/FM Rebroadcast system from the messages in the AM/FM Rebroadcast Message Library.

AM/FM Rebroadcast systems will be managed from the Tunnel Control Room using an AM/FM radio console computer. The user will be able to log on to the application and make the changes to the AM/FM Rebroadcast systems from any authorized networked workstations with the AM/FM software installed. The application will allow the user to select from a pre-defined message broadcast list, or to create a new broadcast message. All messages can be stored for future use as well. Additionally, the application will track information about this message (who entered it, when it was entered, and who approved it). The messages will be set to run indefinitely or automatically turned off at a certain time.

The AM/FM Rebroadcast GUIs will be responsible for providing command and control capability and displaying the current status of AM/FM Rebroadcast equipment and will be fully integrated into the Graphical User Interface (GUI). The GUIs will allow users to modify all subsystem parameters and make the changes effective without requiring a software restart and allowing normal functions to continue. If a user changes any field device parameter, the GUI will make the user confirm the change before being accepted.

The AM/FM Rebroadcast GUIs will ensure that only users who have proper authorization will be permitted to update the subsystems configuration that include, but are not necessarily limited to the following:

- Add/Modify/Delete messages
- Add/Modify/Delete message lists
- Add/Modify/Delete the AM/FM Rebroadcast subsystem software schedule

- Add/Modify/Delete AM/FM Rebroadcast messages in the AM/FM Rebroadcast Message Library
- Change equipment configuration parameters.

The AM/FM Graphical User Interface will allow a user to add/modify/delete messages to/from the AM/FM Rebroadcast Message Library. When updating the broadcast for an AM/FM Rebroadcast, the messages can be either routine or emergency and the AM/FM Rebroadcast subsystem software will allow the user to create both types of messages to be stored in the AM/FM Rebroadcast Message Library.

The AM/FM Rebroadcast subsystem will provide the user with the capability to schedule certain AM/FM Rebroadcast commands to be executed at a predetermined date/time in the future (such as changing a message within the transmitter, turning off the broadcast) based on the existing command permissions the user has. The schedule entries can be added, modified, or deleted by any user based on the user's permissions. When a user makes any change to the schedule, the action will be recorded as a message with the log, recording the user information and the scheduled command. Similarly, when the AM/FM Rebroadcast subsystem software executes an AM/FM Rebroadcast scheduled command, the action and results of the action will be recorded in the log. Any failure or error condition resulting from a scheduled action will result in an alarm being sent to the log.

Before any scheduled entry has been sent, a user with appropriate permissions will be able to suspend the scheduled command. The command will stay in the list of scheduled entries, but if suspended, will not execute.

The AM/FM Rebroadcast subsystem will maintain a central library of transmitter messages stored in such a way that software does not limit the number of messages created nor limit the length of a message entry. Each message entry will be identified by a unique title that can only exist once in the library. If a user chooses a title that already exists, the user will be given the option to create a new entry or overwrite the existing entry. Each message entry will include, at a minimum, but not necessarily be limited to the following information: the message, date and time of creation based on the operating system clock, message description, whether the message is routine or emergency. The user will be able to select the criteria in a logical fashion (using AND/OR operators) in order to create a smaller subset of messages to choose.

All messages will be stored in a pre-defined voice file format such as a wav file. When creating a message, the user will have the option of creating a message using a voice recorder or manually typing in the message text and then converting the text to the voice file format. If the user chooses to create a message using a voice recorder, a GUI will be displayed that includes a record button, a stop button, and a play button that will allow the user to record and listen to the message. If the user chooses to create a message by typing in the message text, the text will be converted to the voice file format. In order to save the message to the library, the user will be required to listen to a playback of the message to verify the message content.

The Contractor shall request the DDOT Engineer to develop the scripts for a set of initial messages to be included into the message library during the implementation phase for ensuring the initial message library contains a minimum set as approved by the Engineer.

The AM/FM Rebroadcast subsystem will provide the following logging functionality:

As the AM/FM Rebroadcast subsystem software functions, it will record alarms (errors within the subsystem) and messages (commands, requests, changes from users and other subsystems, unauthorized attempts by users, and any other items as defined by the Engineer.

Any user command will register a message in the log, including, but not necessarily limited to, changing the AM/FM Rebroadcast broadcast, changing any configuration within the equipment, within the internal AM/FM Rebroadcast subsystem database, adding, modifying or deleting any message within the AM/FM Rebroadcast Message Library, adding, modifying or deleting any portion of the schedule.

The AM/FM Rebroadcast subsystem will generate alarms to indicate a lack of signal reception within the tunnel.

The AM/FM Rebroadcast subsystem software will provide the user with the ability to display the following summary and detailed reports to the screen, a file, or to a printer, as specified by the user.

- Equipment Configuration – This report will list the current values of all changeable parameters (such as ID, location, description, and type) stored in the device, clearly labeled as approved by the engineer.
- Current Status – This report will list, at a minimum, equipment ID number, location, equipment type and operational status (such as normal or failed).
- Message Library – This report will list the title and description of each message in the message library. Also lists the transmitters for which the message is applicable and whether the message is routine or emergency. The user will be able to specify that only messages whose names fit a certain pattern are included in this report.
- Schedule – This report will list all information in the AM/FM Rebroadcast subsystem's schedule, clearly labeled. The user will be able to specify that only events between certain times, or pertaining to certain equipment, or pertaining to a certain type of event, or combination of the foregoing be included in this report. Schedule entries will be listed chronologically.
- Recorder/Player memory – This report will list, at a minimum, the transmitter ID and location, the name, description, and all schedule information stored in the recorder/player. All information will be clearly labeled as approved by the designated Project Resident Engineer. The user will be able to specify that this report only cover a particular transmitter or all transmitters. If the AM/FM Rebroadcast subsystem is unable to upload the data from a particular transmitter, it will use the corresponding data from its database, but will indicate in this report that the data is from the database and may not be current.

22.01.05 TUNNEL FM/AM RE-BROADCAST MONITORING SYSTEM

The system shall be also enabled with an AM & FM In tunnel broadcast monitoring system (IBMS) to enable personnel at the Tunnel Control Room to monitor and listen to the actual AM/FM radio rebroadcast signals inside the tunnel.

The AM & FM system shall also be provided with in-tunnel pick-up antennas and broadcast receivers to allow the Operations Control Center to remotely monitor the actual radio signals being broadcast.

The IBMS shall be enabled with at least a dual AM/FM broadcast radio receiver/tuner to allow operator personnel using the primary receiver for monitor and listening to the in-tunnel rebroadcast transmissions on any user-selected station on either AM or FM bands. A demodulated audio output shall be provided to feed the monitoring amplified speakers available on the Digital Recorder and Rebroadcast Controller. IBMS software shall be fully integrated with the other AM/FM Graphical User Interface.

AM/FM broadcast radio receiver/tuner shall have a network data port to allow automated access & control from the Digital Recorder and Rebroadcast Controller and/or distant client AM/FM workstations at the Tunnel Control Room.

In tunnel pick-up discrete antennas shall be provided and installed (by others) on key locations to assess proper monitoring. Antennas shall be suitable for wall/ceiling mounting installation. One antenna could be installed per tunnel zone.

By means of the software Graphical User Interface, either on the Digital Recorder and Rebroadcast Controller Server or a distant client workstations at the operations control center, the operator shall be able to perform the following minimum operations:

6. Zone tube selection
7. AM/FM band selection
8. Station selection
9. Pre-set scan
10. Memory pre-set
11. Audio Mute

**22.01.06 TWO-WAY RADIO REBROADCAST SYSTEM**

The purpose of the two way radio rebroadcast system is to provide radio coverage, within the limits of the project, to the benefit of Public Safety First Responders and operating DDOT personnel.

This system is a repeater system and shall be designed to repeat the radio signals, uplink and downlink from and to the Aboveground DC First Responder System.

There will be discussions among the Contractor, DDOT and OUC.

The Office of Unified Communications is responsible for the Aboveground DC First Responder Radio System. Information about the Aboveground DC First Responder Radio System:

Ten site simulcast Phase 2, 700MHz Motorola system

The radio system gives excellent coverage throughout the entire DC area including in-building coverage with buildings having multiple basement levels.

More information is available at the OUC

The DC contact for detailed information about the Aboveground DC First Responder System is:

Office of Unified Communications

Mr. Teddy Kavaleri

202-715-7557

[Teddy.Kavaleri@dc.gov]

The Contractor is required to coordinate regularly with Mr., Kavaleri or his designee, at his convenience, for any information necessary concerning this Contract. Each meeting shall be documented by the Contractor and a copy sent to the DDOT Project Manager and Mr. Kavaleri.

The Contractor shall arrange necessary coordination meetings with the Office of Unified Communications through:

Mr. Abdullahi Mohamed  
Infrastructure Project Management Administration  
District Department of Transportation  
55 M Street, SE, 4<sup>th</sup> Floor  
Washington, DC 20003

A Radio Equipment Room is available for installation of the equipment required for the TWO-WAY RADIO REBROADCAST SYSTEM (see drawings for location).

The Contractor is required to procure and install in the Radio Room a power distribution system to be fed from Panel PPN (reference on sheet 48 of 69 for more Details) to provide feed for the communication and radio equipment systems. The power distribution system shall consist of the following:

30KVA Drytype Transformer

- 480 Delta Primary, 208Y/120 Secondary
- Primary Feeder to be (3) #6 and (1) # 10 in ¾" EMT conduit
- Secondary Feeder to be (4) #3 and (1) # 6 in ¾" EMT conduit

Panelboard

- Nema 1 Enclosure
- 208Y/120 VAC 100Amp Rated 30 –POLE
- Panel shall be label Panel "NES-A2"

The Contractor shall install the required power cabling for the following tunnel remote cabinets from Panel NES-A2:RC-1, RC-2, RC-3, RC-4, RC-5, RC-6, RC-7, RC-8, RC-10 and North Bound PTZ camera.

The remaining tunnel remote cabinets shall be fed from Panel C-5 in the CO Analyzer Room: RC-9, RC-11, RC-12, RC-13, RC-14, RC-15, RC-16 and South Bound PTZ camera.

Signal booster amplifiers with software-defined narrowband filters shall receive, amplify and transmit radio signals in their frequency range. The system shall provide a way in and out to/from the above-ground radio network communications of the designated agencies on selected channels on all specified for tunnel roadways. The digital channelized bi-directional amplifier shall be provided with integral programmable narrowband filters to meet the class a signal booster definition as per FCC 90.7 to operate as on-frequency repeaters.

ID	Rx (MHz)	Tx (MHz)
1	799.90625	769.90625
2	799.96875	769.96875
3	800.40625	770.40625
4	800.46875	770.46875
5	800.71875	770.71875
6	800.96875	770.96875
7	803.34375	773.34375
8	804.03125	774.03125
9	804.28125	774.28125
10	804.34375	774.34375
11	809.8625	854.8625
12	810.2125	855.2125
13	810.2375	855.2375
14	810.4625	855.4625
15	811.1875	856.1875
16	811.5875	856.5875

17	811.9875	856.9875
18	812.1875	857.1875
19	812.5875	857.5875
20	812.9875	857.9875
21	813.5875	858.5875
22	813.9875	858.9875
23	814.0375	859.0375
24	814.0875	859.0875
25	814.9875	859.9875
26	815.9875	860.9875
27	806.0125	851.0125
28	807.5125	852.5125
29	808.0125	853.0125

The 700MHz and 800 MHz multi-channel bi-directional signal booster must perform channelization which includes the following operations on a per-channel basis: narrowband filtering, center frequency selection, received signal strength detection, automatic gain control with output level equalization and on-frequency (on-channel) retransmission.

The air-interface bi-directional Two-way Radio Rebroadcast System shall be configured to meet the following system signal strength criteria and shall provide 95 percent probability of 2-way radio communication in 95 percent of the tunnel area.

Measured downlink signal strength in the project limits shall be -90 dBm minimum, measured off a 1/4 wave whip antenna tuned to the center of the frequency band under test. The 95% percentile of the readings shall be above this threshold measured in 100 FT grids.

For Uplink, the tunnel antenna system must deliver a minimum signal level of -100 dBm measured at the Uplink signal booster system service-side antenna input terminal. The test signal source shall be transmitting +25 dBm Effective Radiated Power at 2 meters above the roadway surface. The 95% percentile of the readings shall be above this threshold.

**22.01.07 RF MULTI-COUPLING DEVICES**

Passive RF filtering, combiners/couplers, splitters, isolators, shall be included in the design to combine multiple radio frequency sub-bands for all requested radio services.

**22.01.08 TUNNEL DISTRIBUTED ANTENNA SYSTEM**

The tunnel antenna system shall consist of radiating (leaky) coaxial cables for FM and 700 MHz, and 800 MHz signals. The proposed design shall consider the operational frequency plan for all radio agencies to assess the overall design, determine if separate downlink and uplink cables are needed to provide proper coverage while maintaining adequate levels of isolation between frequency sub-bands.

The Contractor shall review the feasibility of a single radiating cable shared between downlink (Tx) and uplink (Rx) channels. .

The proposed radiating (leaky) cable shall be of nominal outer-conductor diameter of 1-5/8” or bigger. The Contractor shall provide a RF link calculation analysis to demonstrate the minimum requirements.

The AM tunnel radiator shall consist of loops of #8 AWG copper electrical building wire, as depicted in the contract drawings. Each AM radiator-loop has a radiator wire suspended off the ceiling and counterpoise

wire installed in an embedded non-metallic conduit on the side barrier as shown on the drawings. One per every two lanes on the ceiling with the radiator wire installed a top the traffic lane divider as shown on drawings

The AM band is rebroadcast by creating an electric or voltage field between two wire conductors and not by conventional RF propagation methods used at higher frequencies. The AM loop tunnel radiators shall employ transformer coupling devices (balun, balance-to-unbalance transformer) to interface with coaxial feeders and provide proper impedance matching to the AM transmitters/amplifiers.

### **22.01.09 ENVIROMENTAL CONDITIONS**

Outdoor equipment shall be rated for continuous operation under the following service conditions:

- A. Temperature: -10°C to +50°C
- B. Relative Humidity: 5 to 100 percent
- C. Weather: Protect connections and equipment to prevent entry of moisture due to rain or fog

Indoor equipment shall be rated for continuous operation under the following service conditions in environment-controlled communications rooms:

- A. Temperature: 0°C to 40°C
- B. Relative Humidity: 0 to 95 percent

### **22.01.10 SUBMITTALS**

The Contractor shall submit shop drawing, consisting of equipment list and drawings in conformance with the general provisions in 105.02 of the Standard Specifications. The Contractor shall submit complete shop drawings for all proposed products to the Engineer for approval a minimum of 15 work days before ordering or fabrication of equipment.

Manufacturer's technical data for each component in the system, including data on features, ratings, and performance shall be submitted for approval.

Shop drawings for equipment, including plans, elevations, sections, details, and attachments to other work, and plan views of equipment locations and routing of raceway connections, shall be submitted for approval.

Shop wiring diagrams of power and signal wiring, differentiating between manufacturer-installed and field-installed wiring, shall be submitted for approval.

Coordination plans for of radio equipment, including leaky coaxial cable antenna hangers and method of attaching hangers to the building structure, and location of items requiring installation coordination, including lighting, access panels, and other architectural features, shall be submitted for approval.

Signal strength calculations shall be submitted for the path out of the tunnel and the path into the tunnel to verify system performance. Calculations shall be prepared using the signal strength from the nearest base station for Public Safety Agencies, measured near by the off-air antennas site.

The Contractor shall provide the Engineer a Certificate of Compliance from the manufacturer for each product shipment in conformance with the provisions of 105.03 of the Standard Specifications.

### **22.01.11 RADIO SYSTEM INSTALLATION**

The radio rebroadcast systems installation shall consist of:

1. A RF Field Strength survey for AM and FM commercial radio stations outside the Tunnel Equipment Building.
2. A RF Field Strength Survey for Public Safety Radio “donor” signals.
3. Initial Site Survey to assess pre-installation requirements and site constraints, conduit paths and interfaces.
4. Installation of AM and FM roof-top receive antennas with coax cables connecting between the roof top antennas and the radio equipment room
5. Installation of two-way radio roof-top transmit/receive antennas with coax cables connecting between the roof top antennas and the Radio Equipment Room
6. Installation layout of conduits and feeder cables (transmission line) for roof-top air-interface antennas down to the Radio Equipment Room. Provide isolated/dedicated grounding and surge protection of coaxial feeder cables.
7. Installation of the AM and FM radio equipment cabinets at the radio equipment room Radio Equipment Room.
8. Installation of the two-way radio equipment cabinets at the Radio Equipment Room.
9. Installation of tunnel distributed antenna system (DAS), including radiating (leaky) coax cable for Southbound and Northbound tunnels in traffic areas, cross-passages and emergency egress passageways for coverage of two-way radio signals.
10. Installation of in-tunnel AM loop-radiator wires, coupling devices in traffic areas for Southbound and Northbound tunnels
11. Installation layout of conduits and feeder cables (transmission line) from the radio cabinets down to the Southbound and Northbound Tunnels Distributed antenna system.
12. Installation layout of conduits and multi-conductor copper cables between radio cabinets in separate buildings between head-end and slave remote sites.
13. Installation of remote control AM/FM console (PC workstation) at the Radio Equipment Room.
14. Installation of IBMS in-tunnel pick-up antennas.
15. Installation of two-way radio transceivers and an operator’s console.
16. Installation layout of conduits and power cables from the radio cabinets to the designated power panel and grounding panel.
17. Installation layout of conduits and multi-conductor cables from the radio cabinets to the designated SCADA PLC/RTU cabinet.
18. Installation layout of conduits and networking cables from the radio cabinets to the designated Network backbone switch cabinet.
19. Test and verification of AM and FM radio rebroadcast systems to be fully functional.
20. Test and verification of Two-way radio rebroadcast systems to be fully functional.

## 22.01.12 SYSTEM BREAKDOWN

The system breakdown shall include the following items in addition to those listed in the Standard Specifications:

1. Radio Field strength surveys nearby the Tunnel Equipment Building (head-end location), and initial pre-installation design surveys.
2. Furnish and install radiating (leaky) coax cables and AM loop-radiator cables/wires and coupling devices for Southbound and Northbound Tunnels.
3. Furnish and install layout of conduits and cables for Southbound and Northbound Tunnels.
4. Furnish and install air-interface antennas, layout of conduits and cables for AM/FM and two-way radio sub-systems
5. Furnish and Install all required AM/FM and Two-way radio equipment and accessories, at the corresponding locations.
6. Furnish and install layout of conduits and multi-conductor copper cables between head-end at Tunnel Equipment Building and remote slave radio cabinets in tunnel sub-station electrical rooms.
7. Furnish and install panel boards, plus associated layout of conduits and cables towards radio cabinets
8. Furnish and install layout of conduits and cables from Networking cabinet (project backbone switch) towards radio cabinets
9. Test and verification of AM and FM rebroadcast systems and the two-way radio broadcast systems.

## 22.02 PRODUCTS

### 22.02.01 RF COAXIAL (FEEDER) CABLE (TRANSMISSION LINE)

#### 0.195" Jacket-O.D. BRAIDED COAXIAL CABLE

- Inner Conductor : Solid bare copper
- Outer conductor: Tinned Copper braid over aluminum foil tape (double Shielded)
- Jacket Outer diameter: 0.195 inch
- Typical Insertion Loss (dB/100ft):

50 MHz	150 MHz	450 MHz	900 MHz
2.5	4.4	7.8	11.1

- Dielectric: Foam (PE)
- Low-Smoke, halogen-free fire retardant jacket (PE)
  - UL/NEC CMR, CSA FT4, or better
- Single-turn bend radius: 0.5 inch

- Multiple-turn bend radius: 2 inch
- Bending moment: 0.2 ft-lb
- Tensile strength: 40 lb
- UV resistant

**0.400" Jacket-O.D. BRAIDED COAXIAL CABLE**

- Inner Conductor : Solid bare copper clad aluminum
- Outer conductor: Tinned Copper braid over aluminum foil tape (double Shielded)
- Jacket Outer diameter: 0.405 inch
- Typical Insertion Loss (dB/100ft):

50 MHz	150 MHz	450 MHz	900 MHz
0.9	1.5	2.7	3.9

- Dielectric: Foam (PE)
- Low-Smoke, halogen-free fire retardant jacket (PE)
  - UL/NEC CMR, CSA FT4, or better
- Single-turn bend radius: 1 inch
- Multiple-turn bend radius: 4 inch
- Bending moment: 0.5 ft-lb
- Tensile strength: 160 lb
- UV resistant

**0.600" Jacket-O.D. BRAIDED COAXIAL CABLE**

- Inner Conductor : Solid bare copper clad aluminum
- Outer conductor: Tinned Copper braid over aluminum foil tape (double Shielded)
- Jacket Outer diameter: 0.590 inch
- Typical Insertion Loss (dB/100ft):

50 MHz	150 MHz	450 MHz	900 MHz
0.5	1.0	1.7	2.5

- Dielectric: Foam (PE)
- Low-Smoke, halogen-free fire retardant PE jacket

- UL/NEC CMR, CSA FT4, or better
- Single-turn bend radius: 1.5 inch
- Multiple-turn bend radius: 6 inch
- Bending moment: 2.75 ft-lb
- Tensile strength: 350 lb
- UV resistant

**7/8” COAXIAL CABLE (SOLID TRANSMISSION LINE)**

- Inner Conductor : Solid Copper Tube
- Outer conductor: Solid (Copper or Aluminum) tube
- Jacket Outer diameter: 1.142 inch
- Typical Insertion Loss (dB/100ft):

50 MHz	100 MHz	150 MHz	450 MHz	894 MHz
0.23	0.33	0.40	0.73	1.08

- Dielectric: Air
- Low-Smoke, halogen-free fire retardant PE jacket
  - IEC332-1, or better
- Single-turn bend radius: 5 inch
- Multiple-turn bend radius: 10 inch
- Bending moment: 26 ft-lb
- Tensile strength: 734 lb
- UV resistant

**CABLE TESTING** - The ACC shall be tested after installation. The cable found to have faults shall be replaced by the Contractor.

For the purpose of these special provisions, a fault in a length of cable is defined as any of the following:

1. A return loss measurement indicating that there is a short, cut or open in the cable.
2. A visual inspection which reveals exposure or damage to the cable shielding.

**22.02.02 RADIATING (LEAKY) COAXIAL CABLE**

**1 5/8” RADIATING COAXIAL CABLE (LEAKY)**

- Inner Conductor : Solid Copper Tube

- Outer conductor: Slotted Solid (Copper or Aluminum) tube
- Jacket Outer diameter: 2.047 inch
- Typical Insertion Loss (dB/100ft):

150 MHz	450 MHz	900 MHz
0.40	1.78	1.22

- Dielectric: Air
- Low-Smoke, halogen-free fire retardant jacket
  - IEC332-1 Vertical Single Cable Test, or better
- Single-turn bend radius: 8 inch
- Multiple-turn bend radius: 20 inch
- Bending moment: 60 ft-lb
- Tensile strength: 1500 lb
- UV resistant

The radiating (leaky) coaxial cables shall start at least 150 feet inside the tubes to prevent leaking-out above FCC allowance, unless otherwise determined by the Resident Project Engineer after preliminary post-installation tests.

They can be installed in the exhaust or fresh air ducts, or in the traffic area out-of-reach of the tunnel washing machines. The system shall be designed, furnished and installed to meet the field strength requirements.

**Clicks (self-locking hanger) and Stand-offs Mounting hardware**

- One-piece plastic clicks (hanger/clamps)
- Plastic stand-offs
- Material quality Polymer-blend
- Flammability HB according to UL 94
- Fire class B2 according to DIN 4102
- Halogen free as per IEC 754-2
- UV-stabilized
- Corrosion-resistant
- Stainless steel mounting hardware
- The cable hangers shall be installed and spaced per the cable manufacturer’s instructions and recommendations

**22.02.03 OUTSIDE PUBLIC SAFETY ANTENNAS**

**OUTSIDE ANTENNAS GROUNDING SYSTEM**– The outside antennas shall be grounded as per manufacturer’s recommendations. If there is no existing building adequate electrical ground connection point nearby where the antennas are located, the Contractor shall provide approved means to reach the electrical ground point. The proposed antenna grounding method shall be submitted for the Engineer’s revision and approval.

**LIGHTNING SURGE ARRESTOR** – The outside antennas coaxial feeders shall be terminated in lightning surge arrestors prior to entering the radio equipment cabinets. The arrestors shall be installed and connected to the electrical ground following the manufacturers recommendations or as directed by the Engineer.

**ANTENNA MOUNTING STRUCTURES** – The Contractor shall furnish and install the required antennas’ mounting structures (poles or brackets), as required to optimize the signals reception, subject to the Engineer’s approval.

**ANTENNA** - The Contractor shall demonstrate the antennas are tuned and performing as specified by the manufacturer after installation in the presence of the Engineer. The Contractor shall provide all required test equipment for antenna tuning.

**22.02.04 MULTI-CHANNEL 700/800 MHz BAND DIGITAL BI-DIRECTIONAL AMPLIFIER (NARROWBAND SIGNAL BOOSTER)**

Signal booster amplifiers with software-defined narrowband filters shall receive, amplify and transmit radio signals in their frequency range. The system shall provide a way in & out to/from the above-ground radio network communications of the designated agencies on selected channels, on all specified tunnels roadways.

The 800 MHz multi-channel bi-directional signal booster must perform narrowband amplification & processing which includes the following operations on a per-channel basis: narrowband filtering, center frequency selection, received signal strength detection, automatic gain control with output level equalization and on-frequency (on-channel) re-transmission (repeater function)

The 800 MHz channelized bi-directional amplifier (BDA) shall meet the following requirements:

- Downlink Frequency Range: 769-773 MHz
- Uplink Frequency Range: 799-803 MHz
- Number of Narrowband Channels: full-duplex, 10 channels in 700 MHz band and 20 channels in 800 MHz band.
- On Frequency repeater design with digital filtering technology
- Employ Digital Signal Processing, field reconfigurable.
- Channel frequency shall be programmable by user.
- Filter mask and group-delay: firmware programmable, field reconfigurable
- Channel Spacing: 12.5 or 25 kHz.
- Downlink Multi-carrier Power Amplifier: 20W minimum with output isolator
- Uplink Multi-carrier Power Amplifier: 20W minimum with output isolator
- By-Channel Small Signal Gain: 120 dB max
- Narrowband Automatic Gain Control: 45 dB minimum per channel

- Broadband Gain Control Range: 25 dB minimum programmable in 1 dB digital steps.
- Input Automatic Limit Control: 25 dB minimum, broadband, non-spurious
- Minimum sensitivity for 20 dB audio SINAD: -105 dBm, per channel.
- RSSI Threshold, the channel opens (transmits) only if the receive signal is above the user preset threshold
- Duty Cycle: 100% Continuous
- Donor (base-side) cavity filter duplexer
- Service (mobile-side) filtering
- Input and Output Impedance: 50 ohms
- RF Connectors: N-Type Female
- Non-intrusive RF test (maintenance) ports
- Built-in RF power monitors with forward and reverse power sensors
- Local LCD display and keypad shall allow stand-alone for basic operation setup and maintenance.
- Discrete Alarm Interfaces: Voltage-free Dry Contact Local Alarm
- Data Ports: Ethernet 10/100 RJ-45
- RS-232 (factory debug)
- Management software support: web server and SNMP v2.
- Power Supply: 120 V AC / 60 Hz
- Enclosure: rack mounted

**22.02.05 800 MHz BAND-SELECTIVE BI-DIRECTIONAL SIGNALS AMPLIFIER (BDA), RF SIGNAL-BOOSTERS**

The bi-directional amplifiers shall receive, amplify and transmit radio signals in their frequency range.

- Bi-directional amplifiers shall meet the following requirements:
- Downlink Frequency Range: 851-861 MHz and 769-773 MHz
- Uplink Frequency Range: 806-816 MHz and 799-803 MHz
- Downlink Power Amplifier: 20W minimum
- Uplink Power Amplifier: 0.5W minimum
- Gain: Maximum 50 dB. Gain shall be programmable, 25 dB minimum attenuation range (30 dB typ.) in 1 dB digital steps
- Automatic Gain Control: 25 dB minimum (30 dB typ.) in 1 dB digital steps
- Input Automatic Limit control (broadband RF limiter), : 25 dB minimum (30 dB typ.) in 1 dB digital steps

- Noise Figure: 8 dB maximum
- Duty Cycle: Continuous
- Input and Output Impedance: 50 ohms
- Built-in RF power monitors with forward and reverse power sensors
- Local LCD display and keypad shall allow stand-alone for basic operation setup and maintenance.
- Discrete Alarm Interfaces: Voltage-free Dry Contact Local Alarm
- Data Ports: Ethernet 10/100 (RJ-45 )
- RS-232 (factory debug)
- Power Supply: 120 V AC 60 Hz
- Mechanical: rack-mount or wall-mount

**22.02.06 OUTSIDE AM/ FM RECEIVE ANTENNAS**

**OUTSIDE ANTENNAS GROUNDING SYSTEM**– The outside antennas shall be grounded as per manufacturer’s recommendations. If there is no existing building adequate electrical ground connection point nearby where the antennas are located, the Contractor shall provide approved means to reach the electrical ground point. The proposed antenna grounding method shall be submitted for the Engineer’s revision and approval.

**LIGHTNING SURGE ARRESTOR** – The outside antennas coaxial feeders shall be terminated in lightning surge arrestors prior to entering the radio equipment cabinets. The arrestors shall be installed and connected to the electrical ground following the manufacturers recommendations or as directed by the Engineer.

**ANTENNA MOUNTING STRUCTURES** – The Contractor shall furnish and install the required antennas’ mounting structures (poles or brackets), as required to optimize the signals reception, subject to the Engineer’s approval.

**ANTENNA** - The Contractor shall demonstrate the antennas are tuned and performing as specified by the manufacturer after installation in the presence of the Engineer. The Contractor shall provide all required test equipment for antenna tuning.

**22.02.07 MULTI-CHANNEL AM/FM RADIO REBROADCAST WITH VOICE OVERRIDE SYSTEM**

The air-interface multi-channel AM/FM Radio Rebroadcast with Override System aims at advising vehicular travelers within the Tunnel complex of emergency conditions within the Tunnel and approach roads and providing instructions for proper actions to be taken. Under normal circumstances, the travelers in the tunnel will receive the FM or AM radio through the car radio. Wherever the situation requires special coordination, the system will allow AM and FM radio signals to be overridden within the Tunnel for the purpose of dissemination of emergency information.

The system shall be capable of overriding the stations with separate independent content per tunnel or traffic direction, or keeping the normal off-air rebroadcast in one direction while the other is being overridden. In addition, the system shall be capable of overriding the stations in their normal broadcast language, by having up to two override language groups per traffic direction (i.e. English, Spanish, or other)

The air-interface multi-channel AM/FM Radio Rebroadcast with Override System is comprised of an AM/FM digital channelizer with override generators (audio modulators), and a Digital Recorder and Rebroadcast Controller Server.

The air-interface multi-channel AM/FM Radio Rebroadcast digital channelizers shall meet the following requirements:

- Antenna inputs: independent AM & FM
- Separate AM and FM channelizers
- Frequency Response: AM 0.53 – 1.7 MHz, FM 87.5 – 108 MHz
- Number of Channels: 16 AM, 32 FM
- On Frequency repeater design with digital filtering
- Employ Digital Signal Processing and field reconfigurable technology
- In order to avoid signal degradation, and reduce out of phase interference with the above ground signal near the tunnel portals it shall not employ demodulator / modulator devices to perform the repeater function.
- Be of industrial/professional grade quality, designed and built for the intended purpose for which they are to be employed
- AM Channel Spacing: 20 kHz in 10 kHz steps
- FM Channel Spacing: 400 kHz in 100 kHz steps
- Automatic Gain Control: 40 dB min. per channel
- Per channel Gain: 80 dB minimum
- Broadband Gain Control Range 25 dB minimum programmable in 1 dB digital steps.
- Input Automatic Limit Control: 25 dB minimum, broadband, in 1 dB digital steps
- RSSI Threshold, the channel opens (transmits) only if the receive signal is above the user preset threshold
- Override Generator: digital-based AM and FM modulators
- Override Audio inputs: balanced analog, + 4dBu drive level
- Number of override (tunnel) zone outputs: 2
- Duty Cycle: Continuous
- Input and Output Impedance: 50 ohms
- RF Connectors: N-Type Female
- Built-in Non-intrusive RF test (maintenance) ports
- Built-in RF power monitors
- Local LCD display and keypad
- Discrete Alarm Interfaces: Voltage-free Dry Contact Local Alarm

- Data Ports: Ethernet 10/100 and RS-232
- Management support: web server and SNMP
- Power Supply: 120 V AC, 60 Hz

**22.02.08 AM/FM MULTI-CARRIER POWER AMPLIFIERS**

The AM/FM multi-carrier power amplifiers shall boost commercial broadcast station signal transmitted from AM/FM Rebroadcast and Override Head-End Equipment. The AM and FM amplifiers are independent of each other. AM/FM power amplifiers shall meet the following requirements:

- Frequency Response: AM 0.53 – 1.7 MHz, FM 87.5 – 108 MHz
- Power Output: 20W minimum
- Gain: 50 dB minimum
- Gain Control Range: 10 dB minimum
- Noise Figure: 10 dB maximum
- Duty Cycle: 100% Continuous
- Input and Output Impedance: 50 ohms
- RF Connectors: N-Type Female
- Non-intrusive RF test (maintenance) ports
- Built-in RF power monitors with forward and reverse power sensors
- Local LCD display and keypad
- Discrete Alarm Interfaces: Voltage-free Dry Contact Local Alarm
- Data Ports: Ethernet 10/100 and RS-232
- Management support: web server and SNMPv2
- Power Supply: 120 V AC
- Enclosure: rack-mount

**22.02.09 AM/FM DIGITAL RECORDER AND REBROADCAST CONTROLLER**

The Digital Recorder and Rebroadcast Controller shall be fully integrated with the AM/FM Radio Rebroadcast channelizer(s). The Radio Override sub-system shall be zoned which means that it has an independent audio source for each tunnel traffic-flow direction and language group. All AM&FM stations within the same tunnel or traffic flow direction will be overridden with the same advisory message, however it could be different for each tunnel bore, or one bore could be kept re-broadcasting the normal off-air station content while for the other bore all stations are being overridden with a voice break-in. In addition, the system shall be capable of overriding the stations in their normal broadcast language, by having up to four override language groups per traffic direction (for example: English, Spanish, Chinese, Japanese).

Pre-recorded messages shall be bore-specific since confusion could result if the wording of the announcement may be misheard or misunderstood by others whom the broadcast was not intended. The tunnel operator shall be able to assign playback zones for each new message to be entered into the message

registry or database. The Radio Override sub-system shall not allow messages to play for zones for which they are not intended to be broadcast.

The Digital Recorder and Rebroadcast Controller shall meet the following minimum requirements:

1. PC computer hardware
2. Multi-channel audio playback and voice recording system
3. Independent override zone audio outputs
4. Recording/microphone input
5. Simultaneous multi-zone override capability, with the same or different pre-recorded message
6. Real-time microphone feed-thru (Mic-live) override on any single zone, or combination of multiple zones
7. Pre-recorded or microphone feed-thru (Mic-live) override on any combination of ones
8. Multi-zone override command capability
9. Single or loop playback capability
10. Override Scheduler with date/time calendar
11. Audio Monitor output and local monitoring speakers
12. Management functions: login users with privileges; message database, settings, etc
13. Audio outputs: balanced, + 4dBu drive level
14. Full local control with a local Graphical User Interface (GUI). Remote control from optional client GUI workstations/consoles over the TCP/IP network. Standard input/output devices (LCD display, keyboard, pointing device). Data Ports: (1) Ethernet 10/100, USB ports 4 or more.
15. Integrated IBMS control software
16. Remote Management support: web server and SNMP
17. Discrete Digital I/O ports 16 relay contact outputs and 16 optic-isolated inputs
18. Duty Cycle: Continuous
19. Power Supply: 120 Vac, 60 Hz
20. Enclosure: rack-mount

#### **22.02.10 AM/FM IN-TUNNEL BROADCAST MONITORING SYSTEM (IBMS)**

The AM & FM In-tunnel broadcast monitoring system (IBMS) shall also be provided with in-tunnel pick-up antennas and automated broadcast receivers to allow the Tunnel Control Room to remotely monitor (listen to) the actual radio signals being broadcast in the tunnels.

An AM/FM broadcast radio receiver/tuner with external PC control shall be installed in the equipment room to monitor the in-tunnel rebroadcast transmissions. A demodulated base-band audio output shall be provided to feed the monitoring amplified speakers available on the Digital Recorder and Rebroadcast Controller and AM/FM console at the Tunnel Control Room. IBMS software shall be fully integrated with the other AM/FM rebroadcast controller functions.

The IBMS shall have at least a dual AM/FM tuner/receiver set. The main (or primary) receiver is under user control for continuous listening of the broadcast signal via Graphical-User-Interface (GUI) commands in the Rebroadcast Controller and/or the AM/FM console at the Tunnel Control Room.

The AM/FM broadcast radio receiver/tuner shall have a networked Ethernet data port to allow automated access & control from the Override Controller and/or distant client workstations (AM/FM consoles) at the Tunnel Control Room.

A multi-port RF switch shall be provided in order to feed the AM/FM broadcast radio receiver/tuner. Switch path selection and monitoring shall be controlled by the Digital Recorder and Rebroadcast Override Controller.

In-tunnel pick-up discrete antennas shall be provided and installed on key locations to assess proper monitoring in the traffic area. Antennas shall be rated for exposed outdoor environment.

By means of the software Graphical User Interface (GUI), either on the Digital Recorder and Rebroadcast Controller or distant client workstations at the Operations Control Center, the operator shall perform the following minimum operations:

- Radio Input Selection:
  - Tunnel Zone (tube) selection, Southbound or Northbound (from external in-tunnel pick-up antennas)
  - AM /FM head end channelizer sample inputs, per zone
- AM / FM band selection
- Station selection
- Pre-set scan
- Memory pre-set
- Audio Mute
- The IBMS shall provide numeric quality indicators of Received Signal Strength Indicator (RSSI, in dBm) and Signal-to-noise ratio (SNR, in dB)

#### General IBMS specifications

- Two tunnel monitoring inputs (AM & FM)
- Dual Monitoring inputs for AM/FM channelizer output sample ports
- Rebroadcast head-end inputs per tunnel zone
- Frequency Response: AM 0.53 – 1.7 MHz, FM 87.5 – 108 MHz
- User-controlled AM/FM main tuner
- Silent AM/FM secondary tuner for automated signal monitoring, with autonomous scan monitoring of radio signals presence and quality.
- Duty Cycle: 100% Continuous
- RF Input Impedance: 50 ohms

- RF Connectors: Type-N Female
- Data Ports: Ethernet 10/100 (RJ-45)
- Alarm output: Visual LED indicator, and Relay-contact output (voltage free)
- Zone Selector Status: Visual LED indicator, and Relay-contact output (voltage free) per tunnel zone
- Power: 120Vac, 60 Hz
- Enclosure: rack-mount

#### **22.02.11 RADIO SYSTEMS ENCLOSURES**

The radio system enclosures shall be installed at the location shown on the plans.

##### **INDOOR RF EQUIPMENT ENCLOSURES**

The RF equipment enclosures shall have NEMA Type-12 (equivalent or better) rating with their own NEMA Type-12 (equivalent or better) compliant cooling system, either heat-exchanger or air-conditioner, suitable for stand-alone floor-standing.

The radio equipment enclosures shall have brackets for mounting internal EIA 19” rack frame assembly, equipped with front and rear access doors. Doors shall have handles with provisions for padlocking.

##### **OUTDOOR RF EQUIPMENT ENCLOSURES**

Outdoor enclosures shall have NEMA-4X (equivalent or better) rating. Exposed forced ventilation devices, if any, shall be also rated as NEMA-4X. Enclosures can be designed for floor-standing or wall-mounting, depending on the room location and constraints. Such us requirement shall be determined during the design phase and/or the initial pre-installation survey.

#### **22.03 TESTING**

- A. The Contractor shall prepare test procedures and submit them to DDOT for approval.
- B. The Contractor shall perform all testing and corrective measures to fix any problems identified during installation and testing as required to ensure fully operational Tunnel Radio Systems.
- D. Test procedures shall be submitted to the DDOT for review and approval as specified.
- E. All radio systems shall be tested for proper functioning.
- F. 30-Day Field Operational Test
  - The 30-Day Field Operational Test shall be conducted on the integrated system of which the Radio Systems, described here-in, are a part.
  - All equipment shall be subject to the same 30-day field operation test requirements. Upon completion and acceptance, DDOT will provide final approval.
  - The Contractor shall submit for each site, facility, and subsystem, well documented, witnessed, test reports for each and every test outlined in the test plan for each subsystem.
- G. The test report shall include:
  1. A summary listing the overall results of the testing.
  2. A list of failures or problems identified during testing, with a plan of action for the resolution of each.

3. A detailed account of testing, keyed to the test procedures followed for the testing, indicating pass or failure in each case.
  4. Additional remarks as warranted.
- H. Acknowledgement by the DDOT: DDOT will provide a written acknowledgement of the receipt and acceptance of each submitted test report within ten (10) days of submittal.
- I. The Contractor shall supply a certified Commissioning Authority (CxA). The CxA has overall responsibility for planning and coordinating the testing and commissioning process. The CxA shall certify all test results, reports and documentation.

#### **22.04 MEASUREMENT AND PAYMENT**

This work will not be measured for payment, but will be paid at a Lump Sum bid price for each item below:

1. DCFD, MPD, DDOT First Responder Radio Systems – Item 614991 includes:
  - Channelized BDA’s for off the air pickup
  - Antennas
  - Radiating Cable
  - Brackets and miscellaneous hardware
  - Dispatcher console unit in the Control Room
  - BDA’s.
2. ROAD TUNNEL FM/AM RE-BROADCAST SYSTEM – Item 614991 includes:
  - AM/FM Channelizers
  - AM antenna in the tunnel
  - Server AM/FM override (voice break-in) controller
  - Brackets and miscellaneous hardware
  - AM BDA’s
  - Control equipment in the Control Room
  - SCADA LAN server.
  - 30KVA Transformer
  - 208Y/120VAC, 100AMP Rated, 30 –Pole, NEMA 1 Enclosure
  - (1) 50 amp Lockable circuit breaker
  - (2) 30 amp circuit breaker
  - (6) 15 amp circuit breaker

Each item under these Specifications shall include:

- A. Labor costs including furnishing and installing all equipment, production of working and as-built drawings, testing and commissioning and associated management and support activities.
- B. Materials costs including specified equipment, hardware and firmware, licenses, tools, appurtenances, and all other Products specified.
- C. All Labor and Material required for a full functioning system related to this particular section and related specifications not specifically identified in the Bid Items will be considered incidental and included in the Lump Sum bid price.

# **23. TUNNEL EMERGENCY PUBLIC ADDRESS (PA) SYSTEM**

## **23.01 GENERAL:**

- A. This Section includes Specifications for furnishing, installation and testing of the Emergency Public Address (PA) equipment and associated components.
- B. The work shall consist of, but not be limited to, the furnishing of all labor, materials, tools, and equipment specified for the satisfactory installation and completion of all work in conformance with these Contract Documents and the final design approved by the DDOT.
- C. This section includes the requirements for the Mall Tunnel hardware components of the PA system.
- D. Each Speaker shall be connected to the communications power cabinet. Related work specified elsewhere:
  - 1. SECTION 017823 - OPERATION AND MAINTENANCE DATA
  - 2. SECTION 078413 - PENETRATION FIRESTOPPING
  - 3. SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
  - 4. SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES
  - 5. SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
  - 6. SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
  - 7. SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
  - 8. SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING
  - 9. SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS
  - 10. SECTION 262726 - WIRING DEVICES
  - 11. SECTION 262813 – FUSES

### **23.01.01 QUALITY ASSURANCE:**

- A. All work specified under this section shall be performed per the requirements in this section, applicable sections elsewhere, applicable codes and standards, and industries best practices to ensure a good quality workmanship.
- B. Installation of new equipment shall be done as required herein, following the manufacturer's instructions and recommendations, industry's best practices, applicable codes and standards, and as specified elsewhere in the contract documents to ensure good quality product
- C. All components and materials shall be UL listed.

### **23.01.02 SUBMITTALS:**

Submit the following in accordance with 105.02 of the Standard Specifications and with the additional requirements as specified for each:

- A. Submit in accordance with General Provisions for Construction.
- B. Shop Drawings: Indicate electrical characteristics and connection requirements. Indicate layout of equipment mounted in racks and cabinets, component interconnecting wiring, and wiring diagrams of network equipment.
- C. Product Data: Submit catalog data showing electrical characteristics and connection requirements for each component.
- D. Test Reports: Submit a test plan and acceptance test checklist for DDOT approval.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- F. Manufacturer's Field Reports: Indicate activities on site, adverse findings, and recommendations.
- G. Project Record Documents: Record actual locations of workstations, servers, UPS, network switches and cabling connections.
- H. Operation and Maintenance Manuals: Submit instructions for adjusting, operating, troubleshooting, administrating and extending system, and repair procedures and spare parts documentation.
- J. As-built drawings: The drawings shall depict the installation conditions of the equipment to be provided. These shall clearly show all the equipment, facilities, conduits, hand boxes, junction boxes, Egress Signs, and any information that could be useful for troubleshooting the system. DDOT will review the drawings for approval.
- K. Mockup of the PA system will be installed for final DDOT approval of the product and its installation quality.
- L. An overview document, describing all supervisory monitoring and control software on a subsystem basis, including a brief description of the hardware interfaces. This document shall functionally describe all software with simplified block/flow diagrams. Include the relationship among programs, the database, and the hardware. Provide this document prior to issuance of any individual software documents.
- M. Field Installation Acceptance Test (FIAT) Reports: The Contractor shall submit for the mall tunnel, well documented, witnessed, test reports for each and every test outlined in the test plan for each subsystem.
- N. Bill of Materials (BOM): This document shall be produced to show all material and system sub-components. The Bill of Material shall contain a detailed breakdown for each system showing all parts contained therein, manufacturer, model, and part number of each item where necessary. Bill of Material shall also show all spare parts, manuals, software packages, warranty registration cards supplied. Clearly indicate where each spare part is to be used.
- O. Proof of compliance with NEC requirement to be listed and approved.

### **23.01.03 ENVIRONMENTAL REQUIREMENTS**

- A. All PA equipment and mounting hardware shall not fail under high winds. The PA speaker and ambient noise sensor installations shall meet the latest American Association of State Highway and Transportation Officials (AASHTO) "Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals" for wind loads.

- B. All hardware to be located in public access areas shall be vandal resistant. Station components shall be installed at a height such that the distance between the station platform and the ground, whichever is closer, to the bottom of the device is 10 feet.
- C. All equipment shall withstand vibration generated by trucks, buses and passenger car traffic.
- D. All equipment shall withstand specified environmental conditions without reduction of service life.
- E. Outdoor equipment shall be rated for continuous operation under the following service conditions:
  - 1. Temperature: -20°C to +50°C
  - 2. Relative Humidity: 5 to 100 percent
  - 3. Weather: Protect connections and equipment to prevent entry of moisture due to rain or fog.
- F. Indoor equipment shall be rated for continuous operation under the following service conditions in environment-controlled communications rooms:
  - 1. Temperature: 0°C to 40°C
  - 2. Relative Humidity: 0 to 95 percent

**23.01.04 PA AUDIO PERFORMANCE:**

- A. The computer generated voice shall be provided in male and female tones and shall be approved by the DDOT personnel and able to communicate with the approved Head-End Software vendor or ATMS system.
- B. It shall be possible, for authorized personnel, to adjust volume of PA at the amplifier.
- C. The Contractor shall not exceed the sound pressure levels (dB) as dictated by all applicable State, County and City laws and ordinances which regulate noise.
- D. The Contractor shall install the speakers at a height that all messages broadcasted by the PA system shall be intelligible in all public areas where coverage is required.
- E. The system shall be completely free from feedback at all operational audio volume levels.
- F. The Contractor shall perform an acoustical analysis before procuring and installing the PA system and shall submit all findings and final reports to DDOT for approval before proceeding with the project.

**23.01.05 PRODUCT, DELIVERY, STORAGE, AND HANDLING:**

- A. Each unit shall be individually packaged and labeled for shipment and protected against damage and loss during shipping, handling, and storage.

- B. Store equipment in a secure and dry storage facility.

**23.01.06 MAINTENANCE SERVICE:**

- A. The Contractor shall service and maintain the PA system during construction and for a period of one year after Final Acceptance of the complete Emergency Communication Systems.

**23.02 PRODUCTS**

**23.02.01 GENERAL**

Materials furnished shall be standard products of manufacturer regularly engaged in the production of materials specified. The unit shall be a highly vandal-resistant communication module.

**23.02.02 PA SYSTEM EQUIPMENT:**

- A. Manufacturers: Talk-A-Phone's PA Speaker/System or approved equal:
  - 1. PA model type: WEBS-PA-2A Outdoor Area WEBS Paging Unit
    - a. Minimal Dimensions: (W X D X H): 11.24" L x 8.75" W x 19.72" H
    - b. Weight: 24LBS.
    - c. Construction: 16GA (.0625 in.) brushed stainless steel
    - d. Audio Broadcast: Two 40 watt speaker, 118 dBA @ 1 meter
    - e. Power: Maximum total 32 watts, 120/240 VAC required)
    - f. Network: 10/100 BaseT Ethernet, RJ45 connectors, Cat 5e or better
    - g. Programming: Non-volatile Flash Memory programming and configuration through WebGUI
    - h. Configuration: Static IP address provisioning and DHCP client. Should be monitored via 3rd party VMS or ATMS system
    - i. The unit shall have a NEMA 4X (IP66 compliant) construction with liquid tight cord grips.

**23.02.03 PA SYSTEM EQUIPMENT COMMUNICATIONS:**

- 1 Communication device shall accept standard copper wire.
- 2 Adheres to communication protocols TCP/IP
- 3 Communication device shall have a 10/100 BaseT Auto-Negotiating Ethernet LAN interface
- 4 Paging unit will be managed through a web browser and will be flash upgradeable

- 5 Unit shall be compatible with a 2.4GHz Radio Frequency Interface, model VOIP-RF, to create a radio frequency emergency paging system.
- 6 Unit shall be compatible with a 900MHz Radio Frequency Interface, model VOIP-RF-900, to create a radio frequency emergency paging system.

**23.02.04 PA SYSTEM EQUIPMENT ELECTRICAL:**

- A. Manufacturers: Talk-A-Phone's PA Speaker/System or approved equal
1. All wiring and electrical fixtures comply with the standards of the National Electrical Code, UL and C.S.A.
  2. Liquid Tight flexible conduit coating shall consist of thermal plastic or thermoset product and meet NFPA 502 standard.

**23.02.05 PA SYSTEM EQUIPMENT SOFTWARE:**

- A. Manufacturers: Talk-A-Phone's PA Speaker/System or approved equal
1. The selected PA system software shall work with the (ATMS) provided under this contract.
  2. The approved equipment shall work with the (ATMS) provided under this contract.

**23.02.06 PA SYSTEM EQUIPMENT SERVER:**

- A. Manufacturers: Talk-A-Phone's PA Speaker/System or approved equal
1. All wiring and electrical fixtures comply with the standards of the National Electrical Code, UL and C.S.A.
  2. The approved equipment will work with an existing or furnished advanced traffic management system (ATMS)

**23.02.07 SPARES**

- A. The Contractor at the conclusion of the project shall submit to DDOT recommended spare parts list for review.

**23.03 EXECUTION**

**23.03.01 SURVEYS**

- A. The Contractor shall perform surveys at the mall Tunnel where work shall be performed to confirm:
1. Location of speakers and computer equipment.
  2. Adequate speaker coverage.
  3. Existence of conduits or facilities that may be used for this project.
- B. The Contractor shall use information gathered during the site surveys to generate final working As-Built drawings for the mall tunnel project.

### **23.03.02      INSTALLATION:**

- A. The number and placement shall be such that a uniform and intelligible audio coverage is provided in the areas where coverage is required. The Contractor shall refer to drawing (E301-E309) for recommended placement of the PA system and devices and must receive approval of final placement by DDOT.
- B. The Contractor shall adhere to the installation instructions provided by the manufacturers of the equipment.
- C. The contractor shall route all power and communications to the Tunnel Remote Cabinet as shown on the plans.(Sheet-45)
- D. The Contractor shall install the required power cabling, connectors and plugs to provide 120-Vac, 60-Hz to the various PA system as shown on the plans.
- E. All external mounting hardware shall be made of a DDOT approved corrosion resistant material.
- F. Speakers shall utilize the manufactures recommended mounting bracket, which will allow tilting of the speaker for a maximum sound distribution pattern.
- G. The Contractor shall evaluate and implement lightning protection methods for all components in accordance to the guidance of standard IEC 62305: Protection Against Lightning.
- H. All electrical installations shall meet the specification requirements, NFPA 70 and NFPA 502: National Electrical Code (NEC), and all applicable city, county and/or State regulations.
- I. The Contractor shall restore the tunnels building aesthetics to their original condition after completion of emergency communications system project.
- J. All communications and required power equipment shall be installed in the new remote tunnel communication cabinet in a manner that ensures proper airflow and heat dissipation while maximizing the use of space in the cabinet.
- K. The Contractor shall install all conduits and fittings. The Contractor shall install the required connectors, and inter-rack wiring between the various equipment and make all necessary connections and cross-connections required for a complete installation.

### **23.03.03      TESTING**

- A. The Contractor shall prepare test procedures and submit them to the DDOT for approval.
- B. The Contractor shall perform all testing and corrective measures to fix any problems identified during installation and testing as required to ensure a fully operational and intelligible PA system.
- C. Test procedures shall be submitted to the Engineer for review and approval as specified.
- D. All audio sources shall be tested for proper functioning.
- E. Testing of the electrical integrity (impedance matching, loading, etc.) of the PA system for every audio circuit shall be required.
- F. SPL and sound level measurements shall be performed using a calibrated (certified) meter.
- G. Ambient noise measurements shall be performed using a sound level meter. Ambient noise readings shall be taken at each station in the areas that require coverage for a full 24-hour period. Lowest and highest ambient noise time intervals shall be identified and submitted to DDOT for

acceptance.

H. Sound measurements shall be made:

- a. In the mall tunnel area one measurement for every 150 square feet. The measurement shall be made in the geometric center of the 150 square ft. area.
  - i. No two measuring points shall be less than 12 feet apart unless there is an obstacle, a platform edge or an incomplete area (less than 150 square feet).
  - ii. For incomplete areas (less than 150 square feet), a measurement shall be made in the geometrical center of such area.
  - iii. If more than 1 row of measurement points is needed at any location, the rows shall be distributed such that a staggered grid pattern is formed.
  - iv. The grid pattern shall be as symmetrical as possible to the centerline of the locale.
- b. At worst case locations as identified by the Contractor on the survey reports.
- c. At up to 10 randomly selected points per station chosen by the DDOT personnel at a height of 4 feet from the floor.

I. Individual loudspeaker SPL readings shall be made along the axis of the loudspeaker.

J. Intelligibility testing shall be done according to IEC 60849 Sound Systems for Emergency Purposes, IEC 60268- Part 16 Objective Rating of Speech Intelligibility by Speech Transmission Index, and industry best practices. The tests shall demonstrate that the PA system is intelligible in all areas where coverage is required during both the busiest time of the day and off-peak hours.

K. 30-Day Field Operational Test

- The 30-Day Field Operational Test shall be conducted on the integrated system of which the Tunnel Emergency PA systems, described here-in, is a part.
- All equipment shall be subject to the same 30-day field operation test requirements. Upon completion and acceptance, DDOT will provide final approval.
- The Contractor shall submit for each site, facility, and subsystem, well documented, witnessed, test reports for each and every test outlined in the test plan for each subsystem.

L. The test report shall include:

1. A summary listing the overall results of the testing.
2. A list of failures or problems identified during testing, with a plan of action for the resolution of each.
3. A detailed account of testing, keyed to the test procedures followed for the testing, indicating pass or failure in each case.
4. Additional remarks as warranted.

M. Acknowledgement by the DDOT: DDOT will provide a written acknowledgement of the receipt and acceptance of each submitted test report within ten (10) days of submittal.

- N. The Contractor shall supply a certified Commissioning Authority (CxA). The CxA has overall responsibility for planning and coordinating the testing and commissioning process. The CxA shall certify all test results, reports and documentation.

#### **23.03.04 PA SYSTEM EQUIPMENT:**

- A. Installation shall be performed per the approved drawings and all applicable standards and codes.
- B. The Contractor shall adhere to the installation instructions provided by the manufacturers of the equipment. Deviations to the manufacturer's installation instructions shall be justified by the Contractor and shall be pre-approved prior to design approval.

#### **23.03.05 GROUNDING:**

- A. Per Section 260526 - Grounding and Bonding for Electrical System and Contract drawings.

### **23.04 MEASUREMENT AND PAYMENT**

This work will not be measured for payment, but will be paid at a Lump Sum bid price for: TUNNEL EMERGENCY PUBLIC ADDRESS SYSTEM – Item 614991, which includes:

- PA speakers
- PA software
- Software licenses
- Fiber cable (6 strand)
- Media converter
- EMT Conduit
- Communication Cable
- Power Cable

This Lump Sum item shall include:

- A. Labor costs including fabrication, installation, configuration, integration, testing, commissioning, software programming, and associated management and support activities.
- B. Materials costs including specified equipment, hardware, firmware, software, software licenses, tools, appurtenances, software integration with the ATMS system and all other Products specified.
- C. All Labor and Material required for a full functioning system related to this particular section and related specifications not specifically identified in the Bid Items will be considered incidental and included in the Lump Sum bid price.

### **24. PEDESTRIAN EGRESS SIGN CONTROL SYSTEM**

#### **24.01 GENERAL**

##### **24.01.01 DESCRIPTION:**

- A. This section provides specifications for design, furnishing, installing and testing a new PEDESTRIAN EGRESS CONTROL System.

- B. The design shall include a workstation to permit an operator to control the pedestrian egress system during an emergency situation and other emergencies that require vehicle pedestrian egress out of the Mall Tunnel. The Pedestrian Egress system will be controlled from the Tunnel Control Room via the recommended Head-End software as described in Section 26 of this document.
- C. Each pedestrian egress system will consist of a 36" x 24" Running Man sign with "Chevron" arrows from each side of the running man box pointing in direction of the nearest exit. Please refer to drawings (E301-E308) for consistency.
- D. The pedestrian egress system will be a combination of self-illumination and a low power system that will operate by the condition in the Mall Tunnel and areas.
- E. For the powered pedestrian egress system it shall be on a battery backup power.
- F. The Contractor shall be responsible for any work not specifically mentioned in this specification, but which is necessary, either directly or indirectly, for the proper functioning of a complete new Pedestrian Egress system.

**24.01.02 RELATED SECTIONS:**

- 1. SECTION 017823 - OPERATION AND MAINTENANCE DATA
- 2. SECTION 078413 - PENETRATION FIRESTOPPING
- 3. SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
- 4. SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES
- 5. SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- 6. SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
- 7. SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
- 8. SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING
- 9. SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS
- 10. SECTION 262726 - WIRING DEVICES
- 11. SECTION 262813 - FUSES

**24.01.03 QUALITY ASSURANCE:**

- A. All work specified under this section shall be performed per the requirements in this section, applicable sections elsewhere, applicable codes and standards, and industries best practices to ensure a good quality workmanship.

- B. Installation of new equipment shall be done as required herein, following the manufacturer's instructions and recommendations, industry's best practices, applicable codes and standards, and as specified elsewhere in the contract documents to ensure good quality product.

#### **24.01.04 SUBMITTALS**

Submit the following in accordance with 105.02 of the Standard Specifications and with the additional requirements as specified for each:

- A. Submit in accordance with General Provisions for Construction.
- B. Shop Drawings: Indicate electrical characteristics and connection requirements. Indicate layout of equipment mounted in racks and cabinets, component interconnecting wiring, and wiring diagrams of network equipment.
- C. Product Data: Submit catalog data showing electrical characteristics and connection requirements for each component.
- D. Test Reports: Submit a test plan and acceptance test checklist for DDOT approval.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- F. Manufacturer's Field Reports: Indicate activities on site, adverse findings, and recommendations.
- G. Project Record Documents: Record actual locations of workstations, servers, UPS, network switches and cabling connections.
- H. Operation and Maintenance Manuals: Submit instructions for adjusting, operating, troubleshooting, administrating and extending system, and repair procedures and spare parts documentation.
- J. As-built drawings: The drawings shall depict the installation conditions of the equipment to be provided. These shall clearly show all the equipment, facilities, conduits, hand boxes, junction boxes, Egress Signs, and any information that could be useful for troubleshooting the system. DDOT will review the drawings for approval.
- K. Mockup of the pedestrian egress system will be installed for final DDOT approval of the product and its installation quality.
- L. An overview document, describing all supervisory monitoring and control software on a subsystem basis, including a brief description of the hardware interfaces. This document shall functionally describe all software with simplified block/flow diagrams. Include the relationship among programs, the database, and the hardware. Provide this document prior to issuance of any individual software documents.
- M. Field Installation Acceptance Test (FIAT) Reports: The Contractor shall submit for the mall tunnel, well documented, witnessed, test reports for each and every test outlined in the test plan for each subsystem.
- N. Bill of Materials (BOM): This document shall be produced to show all material and system sub-components. The Bill of Material shall contain a detailed breakdown for each system showing all parts contained therein, manufacturer, model, and part number of each item where necessary. Bill of Material shall also show all spare parts, manuals, software packages, warranty registration cards supplied. Clearly indicate where each spare part is to be used.
- O. Proof of compliance with NEC requirement to be listed and approved.

#### **24.01.05 ENVIRONMENTAL REQUIREMENTS**

- A. All hardware to be located in public access areas shall be vandal resistant. Station components shall be installed at a height such that the distance between the Tunnel roadway to the bottom of the device is less than 10 feet.
- B. All equipment shall withstand vibration generated by trucks, buses and cars.
- C. All equipment shall withstand specified environmental conditions without reduction of service life.
- D. All equipment shall meet NFPA 502 requirements
- E. WEED/RoHS Compliant
  - 1. 2002/96/EC WEED Directive
  - 2. 2002/95/EC RoHS
- F. EMC Emissions Compliant
  - 1. EN55015 (CISPR15) Radiated and Conducted Emission
  - 2. IEC/EN 51000-2-3 CLASS C
- G. FR Flame Resistance Compliant
  - 1. EN60695-2-11:2001 in accordance with Paragraph 2. Article EC5 UTE C 12.201
  - 2. Honeywell Barrier Film tested to UL746C and CSA 0.6
  - 3. UL 94VTM-0 Flame resistance
- H. IP68 Rating for Exterior Use
  - 1. EN60529 + A1: 2004
  - 2. EN60598 + A1: 2003
- I. Underwriters Laboratories Approval Testing
  - 1. File number E319670
- J. Outdoor equipment shall be rated for continuous operation under the following service conditions:
  - 1. Temperature: -40°C to +65°C
  - 2. Relative Humidity: 5 to 100 percent
  - 3. Weather: Protect connections and equipment to prevent entry of moisture due to rain or fog
- K. Indoor equipment shall be rated for continuous operation under the following service conditions in environment-controlled communications rooms:
  - 1. Temperature: 0°C to 40°C
  - 2. Relative Humidity: 0 to 95 percent

#### **24.01.06 PRODUCT, DELIVERY, STORAGE, AND HANDLING:**

- A. Each unit shall be individually packaged and labeled for shipment and protected against damage and loss during shipping, handling, and storage.
- B. Store equipment in a secure and dry storage facility.

**24.01.07 MAINTENANCE SERVICE:**

- A. The Contractor shall service and maintain the Pedestrian Egress system during construction and a period of one year after Final Acceptance of the complete Emergency Communication System.

**24.02 PRODUCTS**

**24.02.01 GENERAL**

Materials furnished shall be standard products of manufacturer regularly engaged in the production of materials specified. The unit shall be a highly vandal-resistant system module.

**24.02.02 PEDESTRIAN EGRESS CONTROL SYSTEM EQUIPMENT**

- A. Manufacturers: Electro-LuminX® Lighting Corporation Running Man Power Sign with Micro-Prismatic film or approved equal.
- B. Pedestrian Egress System model type: Electro-LuminX® Lighting Corporation Running Man Power Sign with Micro-Prismatic film.
  - 1. Minimum Dimensions: (W X H): 36”x 24”
  - 2. The system will weigh less than 1 pound per square foot
  - 3. Construction: 2” Light-tape with Pol Carbonate profile with directional chevron arrow
  - 4. Power: 120/240 VAC - connected power to the remote control cabinet as specified on drawings. Each Running man sign will connect to the SMART ballast located in the remote cabinet
  - 5. Mounting: (OPTION-A) Mounts to a wall in any direction using supplied mounting grommets and brackets.
  - 6. (OPTON-B) Industrial strength adhesive.

**24.02.03 PEDESTRIAN EGRESS SYSTEM EQUIPMENT ELECTRICAL:**

- A. The Egress system shall use a combination of reflective devices (self-illumination) and a 120/240VAC power source for emergency illumination with a battery backup supply.
- B. A programmable logic controller module (PLC) will interface with the egress system to allow software communication to the Tunnel Control center.
- C. All wiring and electrical fixtures comply with the standards of the National Electrical Code, UL and C.S.A. and meet requirements of the following :

NFPA-502 Sections:

- 7.14.1.1 for Emergency egress.
- 7.14.1.2 for Exist Identification
- 7.14.2 Tenable Environment

- 7.14.6 Emergency Exits
- 7.14.7 Cross-Pass ways in any Direction

**24.02.04 SPARES:**

- A. The Contractor at the conclusion of the project shall submit to DDOT a recommended spare parts list for review.

**24.03 EXECUTION**

**24.03.01 SURVEYS**

- A. The Contractor shall perform surveys at the mall Tunnel where work shall be performed to confirm:
1. Location of pedestrian (Running Man) sign and reflective material and installation equipment.
  2. Adequate pedestrian egress coverage.
  3. Existence of conduits or facilities that may be used for this project.
- B. The Contractor shall use information gathered during the site surveys to generate final working drawing for the mall tunnel project.

**24.03.02 WIRING AND CONDUIT:**

- A. The Contractor shall install all conduits and fittings. The Contractor shall install the required connectors, and low voltage wiring between the various egress ballasts and NEMA enclosures and make all necessary connections and cross-connections required for a complete installation.
- B. All Pedestrian Egress conduits shall be a minimum of 1-in. The Contractor is encouraged to utilize existing empty conduits if the conduits meets the minimum standards set for the in this specification.
- C. All wiring for the Pedestrian Egress equipment shall be new and it shall be labeled according to Section 271500.
- D. All conduits shall be provided with a pull string to facilitate their use on future installations. These strings shall be additional to the cables run in the conduits.

**24.03.03 INSTALLATION:**

- A. The number and placement shall be such that the egress system provides adequate coverage that will allow the progression of pedestrian traffic exit the Mall Tunnel during an emergency situation. The preliminary number of egress display signs specified on the drawings must be confirmed during final design as performed by the Contractor.
- B. The Contractor shall adhere to the installation instructions provided by the manufacturers of the equipment.
- C. The Contractor shall install the required power cabling, connectors and plugs to provide 120/240VAC circuit to each designated PLC module and to the Egress ballast system, which will

be installed inside the remote cabinet.

- D. All external mounting hardware shall be made of approved corrosion resistant material.
- E. Run all conduits in a raceway above the drop ceiling of the tunnel. All conduits will terminate as per the approved drawing details.
- F. Install a single 200-300VAC circuit in the egress conduit which will terminate in a remote cabinet as designated on drawings.
- G. Install the Smart Driver™ DC ballasts inside the remote cabinet
- H. There are two means of installations that are options to the contractor.  
 OPTION-A- Mounting Brackets as indicated on drawings  
 OPTION-B- Double-sided Adhesive tape-3M™ VHB™ Acrylic Foam Tapes  
 Pedestrian Egress system shall be mounted in a way not to impede the flow of vehicular traffic in the tunnel and sidewalk area.
- I. The Contractor shall evaluate and implement lightning protection methods for all components in accordance with the guidance of standard IEC 62305: Protection Against Lightning.
- J. All electrical installations shall meet the specification requirements, NFPA 70: National Electrical Code (NEC), NFPA 502, and all applicable DDOT regulations.
- K. The Contractor shall restore the tunnels building aesthetics to their original condition after completion of emergency communications system project.
- L. All communications and required power equipment shall be installed in the new remote tunnel communication cabinet in a manner that ensures proper airflow and heat dissipation while maximizing the use of space in the cabinet.
- M. All PED signs will display actual (Feet in distance) to nearest exit. The table below details each distance.

PED Number#	Distance to Nearest Exit	PED Number#	Distance to Nearest Exit	PED Number#	Distance to Nearest Exit	PED Number#	Distance to Nearest Exit
PED-5N	250'	PED-18N	1350'	PED-9S	800'	PED-23S	850'
PED-6N	250'	PED-19	1650'	PED-8S	800'	PED-22S	850'
PED-7N	500'	PED-20	1650'	PED-11S	1050'	PED-25S	650'
PED-8N	500'	PED-21N	1400'	PED-10S	1050'	PED-24S	650'
PED-9N	800'	PED-22N	1400'	PED-13S	1150'	PED-27S	400'
PED-10N	800'	PED-23N	1100'	PED-12S	1150'	PED-26S	400'
PED-11N	1020'	PED-24N	1100'	PED-1S	300'	PED-29S	200'
PED-12N	1050'	PED-25N	950'	PED-2S	600'	PED-28S	150'
PED-1N	300'	PED-26N	950'	PED-3S	850'		
PED-2N	250'	PED-27N	700'	PED-15S	1400'		
PED-3N	350'	PED-28N	700'	PED-14S	1400'		
PED-4N	550'	PED-29N	500'	PED-17S	1650'		
PED-14N	1200'	<u>PED-30N</u>	<u>500'</u>	PED-16S	1650'		

PED-13N	800'	PED-5S	250'	PED-19S	1400'		
PED-15N	1050'	PED-4S	250'	PED-18S	1400'		
PED-16N	1050'	PED-7S	500'	PED-21S	1150'		
PED-17N	1350'	PED-6S	500'	PED-20S	1150'		

**24.03.04 TESTING:**

- A. The Contractor shall prepare test procedures and submit them to DDOT for approval.
- B. The Contractor shall perform all testing and corrective measures to fix any problems identified during installation and testing as required to ensure a fully operational Pedestrian Egress System
- C. The Contractor shall perform all testing and corrective measures to fix any problems identified during installation and testing as required to ensure a fully operational and Pedestrian Egress System.
- D. Test procedures shall be submitted to the DDOT for review and approval as specified.
- E. All egress signage shall be tested for proper functioning.
- F. Testing of the reflective material will be performed on all egress clusters, with final approval from the Engineer.
- G. Electrical integrity of the Pedestrian Egress system for every circuit shall be required.
- H. 30-Day Field Operational Test
  - The 30-Day Field Operational Test shall be conducted on the integrated system of which the Pedestrian Egress Sign System, described here-in, is a part.
  - All equipment shall be subject to the same 30-day field operation test requirements. Upon completion and acceptance, DDOT will provide final approval.
  - The Contractor shall submit for each site, facility, and subsystem, well documented, witnessed, test reports for each and every test outlined in the test plan for each subsystem.
- I. The test report shall include:
  1. A summary listing the overall results of the testing.
  2. A list of failures or problems identified during testing, with a plan of action for the resolution of each.
  3. A detailed account of testing, keyed to the test procedures followed for the testing, indicating pass or failure in each case.
  4. Additional remarks as warranted.
- J. Acknowledgement by the DDOT: DDOT will provide a written acknowledgement of the receipt and acceptance of each submitted test report within ten (10) days of submittal.
- K. The Contractor shall supply a certified Commissioning Authority (CxA). The CxA has overall responsibility for planning and coordinating the testing and commissioning process. The CxA shall certify all test results, reports and documentation.

### **24.03.05 PEDESTRIAN EGRESS SYSTEM EQUIPMENT**

- A. Installation shall be performed per the approved drawings and all applicable standards and codes.
- B. The Contractor shall adhere to the installation instructions provided by the manufacturers of the equipment. Deviations to the manufacturer's installation instructions shall be justified by the Contractor and shall be pre-approved prior to design approval.

### **24.03.06 GROUNDING:**

- A. Grounding and Bonding for Safety and Security per Contract drawings.

## **24.04 MEASUREMENT AND PAYMENT**

This item will not be measured for payment and will be paid in a lump sum bid price, which price shall include:

PEDESTRIAN EGRESS SIGN CONTROL SYSTEM – Item 614991 including:

- Exterior, Media White, 28 Piece(s), 24 in. x 36 in., LIT AREA, Add 0.25 in. To Each Side for Finished Area, Power Short Side.
- Custom Light Tape Panel Preparation for measuring and attaching 2 in. tab.
- Exterior Light Tape Connection, potted with waterproof epoxy for IP68 seal.
- Connector for 0.50 in. Light Tape & Wider Includes Caps with 6 ft. Lead DIRECTIONAL ARROW SYSTEM.
- Exterior, Extreme Green, 56 Piece(s), 2 in., 100 ft. each piece, Factory Seal.
- Exterior Light Tape Connection, potted with waterproof epoxy for IP68 Seal.
- Connector for 0.50 in. Light Tape & Wider Includes Caps with 6 ft. Lead.
- Custom Light Tape Connection Covering Connector / Extrusion.
- (3) Shrink Sleeve for 2.0 in. for Connector / Extrusion.
- Snap-N-Light for Light Tape installation inside mounting channel.
- Mount-Clip 200.
- 2.0 in. mounting clips to secure 2 in. channel to structure.
- Application of double sided adhesive to rear of Light Tape to facilitate installation.
- Double Sided Adhesive Tape - Ideal for Shock, Vibration and Noise Absorption. 1.0 in. X 36 Yds POWER SYSTEM
- Power Supply, 120/240 Volt AC, Illuminates 4700 8000 square inches.
- NEMA Single Door Medium Wall Mount 20x16x6in
- UPS Backup Battery with Invertor.
- Communication cable – CAT 6 sign to fiber drop.
- Power cable – 12 awg. 120 vac. 3 conductor cable.
- 1" EMT conduit.

The price for this Lump Sum item shall include:

- A. Labor costs include fabrication, installation, configuration, integration, testing, commissioning, and other necessary support activities.
- B. Materials costs include specified equipment, hardware, firmware, software, software licenses, tools, appurtenances, and all other Products specified herein.
- C. All Labor and Material required for a full functioning system related to this particular section

and related specifications not specifically identified in the Bid Items will be considered incidental and included.

## **25. DYNAMIC MESSAGE SIGNS**

### **25.01 GENERAL**

Dynamic Message Sign (DMS) equipment to be furnished at each field site shall include, but not be limited to LED DMS, sign controller, and other systems such as DMS Controller Cabinet and Communications Equipment specified elsewhere in these Special Provisions. The DMS message display, including character and interline spacing, shall be in conformance with the Manual on Uniform Traffic Control Devices (MUTCD) 2009. To ensure overall system compatibility, all DMS signs shall be from the same manufacturer.

A. DMS to be supplied under this contract shall be the following:

1. Product Description: The DMS shall be LED Full-Matrix DMS (18 x 125 pixels, 46 mm pitch), Outdoor, 30-degree viewing angle, capable of displaying up to two lines, with 15 12-inch characters per line, cantilever or pedestal mounted, and front access for installation on city streets. Nominal dimensions for cabinet shall be 6ft H x 18ft W x 2ft D and 2,000 lbs.

B. Operation Specifications:

1. Character Height: 12"
2. Maximum Lines/Characters: 2/21
3. Pixel Pitch: 1.75" inch (46mm).
4. Cabinet Enclosure: NEMA 3R
5. Face Panel: Aluminum mask over polycarbonate face panel
6. Input Power: 120 Vac.
7. Viewing Distance: 600' using 12" characters
8. Maximum Power Consumption: 486 W.
9. Ambient Operating Temperature: -30 to 165 degrees F.
10. Display Software: Third party integrators.
11. Communications: RS232, RS422, and Ethernet
12. Viewing angle: 30 degrees horizontal x 30 degrees vertical

C. Definition:

Full-Matrix is defined as a type of DMS without fixed lines, columns or characters and the entire display area contains equally spaced pixels. The DMS and controller shall have the ability to display characters using proportional spacing on the full-matrix configuration. Any graphic, symbol, character or font can be placed in any location within the display area of the DMS without regard to lines or columns.

D. Test Certificate:

The DMS manufacturer shall submit a test certificate from an independent laboratory to certify compliance with the cone-of-vision requirement. The cone of vision shall be measured at the front of the sign in its final position with any component that could impede or otherwise affect the light output (such as the front face, mask, and polycarbonate) in place. An LED component manufacturer certificate shall not satisfy this requirement, since the test shall consider the mounting of display boards within the sign and the front face.

E. DMS Manufacturer Pre-qualification:

The DMS manufacturer shall have been in the successful business of the DMS design and manufacture of multi-unit, multi-line State or Interstate Highway overhead, permanently-mounted DMS systems; installation and maintenance of State or Interstate Highway, permanently-mounted, overhead DMS electronics and control systems for highway use at least 10 years prior to the advertisement date. The DMS manufacturer shall provide documentation and references of manufacturing history.

The DMS manufacturer shall have supplied and/or installed DMS systems similar to that required by the Project Specifications on a project of similar size and scope in the past three (3) years. Untried or prototype units shall not be considered for acceptance. The DMS manufacturer shall submit three (3) references for work similar in size and scope to the work specified in the Scope of Work that it has completed successfully in the past three (3) years, including a walk-in housing highway LED full-matrix NTCIP-compliant DMS system, supplied by this manufacturer under the current corporate name, which otherwise meets this specification, and that has been operational for a period of no less than one year. At least one of these references shall be from a U.S. State Department of Transportation.

The DMS manufacturer shall design, manufacture, and test its LED module boards and controller. These may not be sub-contracted or 3<sup>rd</sup>-party products. The manufacturer shall have its own lab environment on the North American continent for continual sample testing of production line products, including temperature, humidity, corrosion, and accelerated life testing programs.

The DMS manufacturer shall have a USA-based sales and distribution point of operation. This operation shall have been present for at least 5 years and the manufacturer shall keep such operation present for the life of the contract. At no time shall shipments to or from the manufacturer be subject to customs processing, delays, or other international shipping issues. Any parts or pieces that are fabricated from outside the country shall be stocked in ample supply at the USA-based operation such that no delays in the shipment or delivery of such parts are experienced by the customer.

The DMS manufacturer shall have USA-based technical staff with minimum 5 year experience available to assist with the project for duration of the contract.

The DMS manufacturer shall be ISO 9001 or equivalent, formally-documented Quality System certified.

F. Terminology:

Due to the varying definitions used in Dynamic Message Sign technology, this section defines specific terms as they apply to this specification.

Sign: The sign housing and its contents.

Sign Controller: Located in a cabinet (as detailed in this specification), the sign controller manages all aspects of the sign operation including: specifying the message to be displayed, diagnostics, and remote communications. Messages can be selected either remotely from the central controller, locally from a laptop computer or from the front panel of the sign controller.

Central Controller: The Microsoft Windows Server computer system and related software, which operates the system from a remote control site.

Workstation: The Microsoft Windows workstation computer and related software that operates as a remote client over a computer network to the central controller. A workstation operator can access the central controller and gain access to the functions of the central by using the appropriate access codes.

LED (Light Emitting Diode): The DMS display lighting technology.

Pixel: Any of the small discrete elements that, when arranged in a pixel matrix, create a character. A pixel contains a cluster of LEDs.

Pitch: Distance measured from center to center of adjacent pixels within a matrix. This distance is measured both horizontally and vertically.

Poll: The central controller and laptop computer are said to “poll” a sign when they request the sign’s status information. The term is derived from the periodic status polling, which a central controller can perform, but is loosely used to refer to any status request.

Message: Text; the information displayed on the sign.

Display: The message seen by the motorist. A display may include more than one page of text (an alternating display). Any character or set of characters of a display may be flashed (a flashing display).

Neutral State: Sign is blank, or displaying a predefined message that is displayed regularly.

- G. The Contractor shall register with the manufacturer(s) all equipment in the name of the Department. Photocopies of the registration forms shall be forwarded to the Chief Engineer.
- H. The Contractor shall store and handle all materials and equipment in a clean, dry location; free from construction dust, precipitation and excess moisture, so as not to degrade quality, serviceability or appearance.
- I. The Contractor shall contact the DMS manufacturer for information on proper storing and installation of the DMS equipment.

## **25.02 MATERIALS**

### **25.02.01 GENERAL**

All materials furnished, assembled, fabricated or installed under this item shall be new and of the latest design and recent manufacture, corrosion resistant, and in strict accordance with this specification. No

used or refurbished hardware is permitted. Furthermore, firmware and software shall be tested and in working order. Neither prototype firmware, nor prototype software is permitted. Failure to meet all details and functionality detailed in this specification shall be grounds for rejection of the equipment.

All parts shall be of high-quality workmanship, and no part or attachment shall be substituted or applied contrary to the manufacturer's recommendations and standard practices.

All external screws, nuts, and locking washers shall be stainless steel. Self-tapping screws shall not be used on the exterior of the sign. All nuts shall be nyloc nuts or similar. All parts shall be made of corrosion-resistant materials, such as plastic, stainless steel, aluminum or brass. All materials used in construction shall be resistant to fungal growth and moisture deterioration. All dissimilar metals shall be separated by an inert dielectric material.

#### **25.02.02 PHYSICAL CHARACTERISTICS**

- A. The latest available techniques shall be utilized in equipment design and construction of the LED DMS with a minimum number of different parts, subassemblies, circuits, cards and modules to maximize standardization and commonalty.
- B. The equipment shall be designed for ease of maintenance with all component parts readily accessible for inspection and maintenance. Test points for checking essential voltages shall be provided.
- C. All DMS equipment components, modular assemblies, and other materials located in the DMS housing shall be removable, transportable, and capable of being installed by a single technician.
- D. Solid-state display elements and modules shall be provided. Mechanical or electromechanical elements or shutters shall not be used.
- E. The DMS, including the sign housing and all modules and assemblies, shall be designed and manufactured by company certified by ISO 9001 or equivalent formal Quality Systems, and shall comply with the provisions of NEMA Standard TS 4-2005, latest revision.
- F. The LED DMS shall be designed for a minimum life of 10 years.
- G. The signs shall be designed and constructed to present a clean and neat appearance. Poor workmanship will be cause for rejection of the sign.
- H. If cable attachments are used in the sign housing, the cables shall be securely clamped in a manner as approved by DDOT. No adhesive attachments shall be allowed.
- I. The complete sign housing of the LED DMS shall be designed and manufactured in-house by the LED DMS Sign Manufacturer.
- J. The presence of power transients or electromagnetic fields, including those created by any components of the system, shall have no deleterious effect on the performance of the system. The system shall not conduct or radiate signals which will adversely affect other electrical or electronic equipment including, but not limited to, other control systems, data processing equipment, audio, radio, and industrial equipment.

#### **25.02.03 ELECTRICAL COMPONENTS**

- A. All electronic equipment shall be of solid-state design and modular construction. Individual electronic modules shall provide easy service access and shall be field replaceable. The design shall be such as to prevent incorrect assembly or installation of connectors, fasteners, etc., where possible malfunction or personnel hazards might occur. Each item of equipment shall be designed

to protect personnel from exposure to high voltage during equipment operation, adjustments, and maintenance.

- B. All electronic components, except printed circuit boards, shall be commercially available, easily accessible, replaceable and individually removable using conventional electronics repair methods. All electronic assemblies shall meet or exceed IPC 610A workmanship standards.
- C. The sign and its sign controller shall be capable of operating with 240/120 VAC, 40 amp per leg, 60 hertz, single-phase power.
- D. The system shall be protected by transient voltage suppression devices, including MOVs, RIS and spark gap arrestor. Resettable surge protection shall be provided. Tripping of the surge protection shall prevent power from reaching any components of the sign until the surge protection has been reset. Tripping of the surge protection shall cause the sign controller to call the TMC and report the error condition.
- E. Each DMS provided shall consist of internal wirings, terminal strips for interconnecting wire, duplex outlets for maintenance equipment, photosensors, and heating strips.

#### **25.02.04 SIGN HOUSING**

- A. The equipment within the sign housing shall be protected from moisture, dust, dirt and corrosion.
- B. The sign housing shall be constructed of .125" (3 mm) high-quality aluminum alloy 5052-H32 or 3003-H14 (AIMg3) and capable of withstanding a wind loading of 120 mph at a minimum, without permanent deformation or other damages. At a minimum, the DMS housing, structural frame, face covering, and mounting members shall be capable of withstanding the environmental loadings specified in AASHTO's Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 5<sup>th</sup> Edition.
- C. Framing structural members shall be constructed from aluminum alloy 6061-T6 or 6063-T5.
- D. All welding shall be by an inert gas process in accordance with the American Welding Society (AWS) Standards, ANSI/AWS D1.2-97. The LED DMS manufacturer's welders and welding procedures shall be certified by an ANSI/AWS Certified Welding Inspector to the 1997 ANSI/AWS D1.2-97 Structural Welding Code for Aluminum. Proof of certification of all the LED DMS manufacturer's welders and applicable welding procedures shall be supplied with the submittals. The name, phone number and address of the ANSI/AWS Certified Welding Inspector that certified the LED DMS manufacturer's welders and procedures shall also be provided with the submittals.
- E. The number of seams shall be minimized and all exterior seams and joints shall be sealed to form a rain-tight enclosure.
- F. The skin material shall be stitch-welded to the internal structural members to form a unitized structure.
- G. The performance of the LED DMS, including the visibility and legibility of the display, shall not be impaired due to continuous vibration caused by wind, traffic or other factors.
- H. The housing shall be designed to accommodate mounting on the rear vertical plane only.
- I. The sign housing shall be designed so that the angular alignment is adjustable in the vertical direction from zero (0) degrees to ten degrees down in one-degree increments to optimize the viewing angle.
- J. The serial number and model number shall be etched, stamped, or molded on the housing.

- K. The sign housing shall be designed to protect all inside equipment from dust, water, and any other environmental exposure.
- L. A minimum of 3 photocells shall be installed on each sign. These devices shall permit automatic light intensity measurement of light conditions at each sign location. These photocells shall be of sufficient quantity and mounted in a manner to fully measure ambient light conditions to set the sign brightness levels.
- M. Mounting devices shall be provided for the photoelectric cells, allowing full adjustment of the cell orientation.
- N. Photocells shall be mounted so that they may be serviced from inside the sign enclosure or from the front face and/or catwalk.
- O. Automatic adjustment of the LED brightness shall occur in small enough increments so that the brightness of the sign changes smoothly, with no perceivable brightness change between adjacent levels. Provision shall be made to prevent perceivable brightening of the sign due to stray headlights shining upon the photo sensors at night.

#### **25.02.05 HOUSING FACE**

- A. The housing face shall be of three-piece construction, consisting of internal structural members, external face panels and lens panel assemblies.
- B. The interior structural members shall be fabricated from 6061-T6 or 6063-T6 aluminum alloy extrusions and shall:
  - 1. Accommodate both display module mounting and air distribution.
  - 2. Retain the display modules in a manner to facilitate easy and rapid removal of each display module without disturbing adjacent display modules.
- C. There shall be no exposed fasteners or welds on the housing face.
- D. The external face panels shall be designed to minimize heat conduction between the exterior surfaces and the interior components.
- E. The external face panels shall be made of UV stabilized high-impact resistant polycarbonate material with a UV silk-screened mask that provides a high level of contrast and readability. The Panel shall absorb greater than 80% of UVA and UVB.
- F. The border and therefore, the external fascia perimeter panels shall be a minimum of 12 inches wide.
- G. The external face panels shall be thermally isolated from the rest of the sign housing.
- H. The housing face shall be finished with a matte black, licensed factory-applied KYNAR 500 Resin, fluopolymer based coating system. Certification shall be provided from the licensed factory KYNAR 500 coater for all aluminum face materials. All other exterior and interior surfaces shall be a natural aluminum mill finish. Surfaces shall not be painted.
- I. The Lens Panel Assembly shall consist of a KYNAR 500 coated aluminum mask over a clear glazing and shall be modular in design, interchangeable with no misalignment with the LED pixels and sealed with a closed-cell resilient gasket.
- J. The lens panel shall be heated to prevent fogging and condensation.

- K. No manufacturer and/or vendor logos shall be allowed on the housing face. Logos, preapproved by the Chief Engineer, may be allowed on the sides and/or rear of the sign housing.

#### **25.02.06 SIGN DISPLAY**

- A. The signs shall be capable of displaying ASCII characters 32 through 126 (including all upper and lower case letters and digits from 0 to 9), up to 32 user-defined graphic characters, and all standard Manual on Uniform Traffic Control Devices (MUTCD) traffic symbols or icons at any size and location on the display.
- B. The signs shall be capable of supporting customized fonts using variable-width or proportional spacing, modifying the ASCII space character to achieve 3 pixels width, modifying the inter-character spacing to achieve 2 pixels between characters and the interline spacing to achieve 3 pixels between lines within the fonts.
- C. The sign shall be capable of displaying alphanumeric text only, graphics only, or a combination of both.
- D. The sign shall be capable of displaying from one to six messages in sequence.
- E. The LED DMS shall enable the display of text, consisting of a string of alphanumeric and other characters and programmed and customized graphics. Each character shall be formed by a matrix of luminous pixels. The matrix of a standard character shall consist of 35 pixels over 5 columns and 7 rows.
- F. The rectangular display modules shall have an identical horizontal and vertical pitch between pixels.
- G. The separation between the last column and row of one module and the first column and row of the next shall be equal to the horizontal distance between the columns and rows of a single display module.
- H. The characters shall be legible under all light and normally-encountered weather conditions up to the rated distance within a 30-degree cone of vision centered on the optical axis of the pixel. It shall be bright enough to have a good target value, but not to the point where the pixels bloom, especially in low ambient light level conditions. Its 50% intensity points shall define the cone perimeter.
- I. The brightness and color of each pixel shall be uniform over the entire face of the sign within the 30-degree cone of vision up to the rated distance in all lighting conditions. Non-uniformity of brightness or color over the face of the sign under these conditions shall be cause for rejection of the sign.
- J. Each display shall have the necessary light output intensity to meet or exceed the legibility requirements. Each pixel shall have an initial luminous intensity of 35 candelas or greater on the optical axis when the sign is operating in the overbright mode. Light output shall be measured at a distance of 100 ft. from a test character in a fully instrumented optical testing chamber.
- K. The DMS shall be capable of changing from one message to another without visual disturbance or high-speed scrolling of messages.
- L. DMS messages shall be legible within a distance range of 200 ft. to 700 ft. from the DMS display face under the following conditions:
  - 1. When the DMS is displaying alphanumeric text that is 12-inches high.
  - 2. 24 hours per day and in most normally encountered weather conditions.

3. During dawn and dusk hours when sunlight is shining directly on the display face or when the sun is directly behind (silhouetting) the DMS.
  4. When viewed by motorists that have 20/20 corrected vision.
  5. When the motorist eye level is 3 to 12 feet above the roadway surface.
- M. Replacement of a complete display module shall be possible without the use of any tools.
- N. The DMS shall have a power distribution system connecting each display module to all power supplies and minimizing the voltage drop over the face of the sign. The voltage measured at the display modules shall not vary more than 50 millivolts over all the display modules in the sign with 17 pixels on at 100% intensity in each and every display module.
- O. The time required to clear any display and post any new display shall not exceed 500 milliseconds.

#### **25.02.07 LED AND PIXEL CHARACTERISTICS**

- A. The LEDs will be AlInGaP technology. The diodes will have a 30-degree viewing angle, amber color of dominant wavelength between 585 and 595 nm, with all LED pixels in a sign having the same dominant wavelength.
- B. All pixels in all signs in this project, including the spare parts, will have equal color and on-axis intensity.
- C. The LEDs shall be mounted directly to a printed circuit board and be easily replaceable and individually removable using conventional electronics repair methods.
- D. The sign display using LED shall consist of a continuous full-matrix format consisting of smaller matrices of pixels. Each pixel shall consist of a high-intensity LED cluster. The LED lamps shall run at a minimum voltage to provide extended life. Each pixel shall be either square in shape with a minimum of two-inch (2") sides or round in shape with a minimum two-inch (2") diameter.
- E. LED boards and daughter boards that are fully interchangeable and do not require any address switches or adjustment when interchanged or placed in service shall be provided.
- F. All LEDs shall be mounted so that their mechanical axes are normal  $\pm 1.00$  degree to the face of the sign to ensure brightness uniformity over the face of the sign.
- G. The LEDs shall be protected from the outside environmental conditions, including moisture, snow, ice, wind, dust, dirt and UV rays.
- H. Pixel brightness shall be controlled by pulse-width modulation of the DC current. Brightness shall be manually settable from the front panel of the sign controller and remotely from the central controller in 1% increments. Brightness control shall be able to be returned to automatic from the sign controller front panel and the central computer.
- I. Dimming circuitry that does not reduce the LED rated life shall be used.
- J. The operational status of the LEDs in each pixel string shall be tested and then transmitted to the central controller or laptop computer.
- K. The state of the LEDs (full on, half on or off) in each pixel of the sign shall be read by the sign controller to allow the central controller or laptop computer to show the actual message, including static, flashing and alternating messages, that is visibly displayed on the sign in a WYSIWYG format, including any half-out, full-out, half stuck-on or fully stuck-on pixels. This

pixel status reading will take place while a message is displayed on the sign without disturbing the message in any way. Any flashing, flickering, blinking, dimming, or other disturbance of the message during this pixel status reading will be cause for rejection of the sign. A list of defective pixels, listing pixel status, line number, module number, column number and row number shall be provided for each defective pixel.

- L. All printed circuit boards, except the LED circuit board, shall be conformal coated. The LED board shall be conformal coated except at the pixels.
- M. All printed circuit boards shall be provided with a solder mask and a component identifier silk screen.
- N. The voltage to the LED modules and associated electronics shall not exceed 25 VDC. The power supplies shall be paralleled in a diode OR configuration such that if one supply completely fails, the sign will still be supplied with enough power to run 50% of all pixels at 100% duty cycle. Functioning supplies shall current share to within 10%. The combined effect of line (95 to 135 VAC) and load (10% to 100%) on the power supplies shall not exceed 1.0%. The efficiency of the power supplies shall be 80% or greater at 120 VAC 50% to 100% of maximum load. Power supplies having a power factor of 0.95 or greater at 120 VAC from 50% to 100% of maximum load shall be provided.
- O. The LED shall be rated for 100,000 hours continuous operation, at 30 mA drive current, with less than 30% lumen depreciation.

#### **25.02.08 ENVIRONMENTAL**

- A. The sign shall operate without malfunction and without any decrease in performance over an ambient temperature range of -30° F to +140° F and with a relative humidity of up to 95% non-condensing.
- B. The DMS sign controller shall automatically shut down the LED modules to prevent damaging the LEDs if the measured internal cabinet air temperature exceeds a 140° F threshold temperature.

#### **25.02.09 DMS SIGN CONTROLLER**

- A. The controller shall meet NTCIP requirements and shall be provided with resident software stored in non-volatile memory. The sign controller shall be programmed to receive sign control commands from the central controller or laptop computer, transmit responses as requested to the central controller or laptop computer via the communication system, monitor sign and message status and control sign operation and message displays.
- B. The controller shall be a software-driven microprocessor-type DMS controller with printed circuit boards and front panel indicators.
- C. The controller shall continuously monitor the display of the sign independent of any external commands, and cause the signs to display all the appropriate characters
- D. The controller shall incorporate an audible tone that sounds about every 15 minutes when messages are displayed to alert the operators that a message or messages is/are running during an incident clearing activity, a stationary or roving work crew, etc. The sound will alert the operators to check on the message status so that they may update the message or blank out as needed.

- E. The controller shall accumulate data about the sign status (to be transmitted upon request), and receive commands from the central computer, maintenance laptop computer, and a local panel.
- F. The controller shall have the ability to control the brightness level, using the photosensor controls in the DMS cabinet. The controller shall have the ability to achieve an “overbrightness” mode operation in fog or intense sunlight.
- G. The operator shall be able to select independent display times for alternating, flashing messages and blank-out time between messages in one-tenth (0.1) second increments. Upon terminating the display time for a message, the controller shall either blank the sign or place the sign in a neutral condition.
- H. A fail-safe mechanism shall be provided to automatically blank the sign upon encountering an error, or improper information display in the case of malfunction, or communication and/or power failure.
- I. The controller shall have power-up and auto-restart capabilities with automatic sign blanking when recovering from a power off condition. A watchdog circuit shall be utilized to provide automatic reset to the controller. The central controller shall be capable of remotely commanding a sign controller reset.
- J. The controller shall be 19-inch rack mounted in the DMS Controller Cabinet.
- K. The controller will communicate with the display modules via fiber-optic cable.
- L. The controller shall include a local/remote control switch and LED indicator, allowing a local operator to override central operations and take over local control of the sign. A timeout feature will force the controller to revert to central operations after a configurable timeout or inactivity period.
- M. A controller shall be provided that is able to read the internal temperature sensors, external ambient temperature sensor and the humidistat. The controller shall use these readings in an algorithm that turns on the heat at the appropriate times to reduce both frost on the face of the sign and condensation on the display modules and other display system circuitry.
- N. A temperature reading greater than a user selectable critical temperature shall cause the sign to go to blank and the sign controller shall report this error message to the central computer.
- O. The controller shall continuously measure all LED module power supply voltages. The controller will provide these voltage readings to the central controller or laptop computer when the central controller or laptop computer polls the sign controller.
- P. The controller shall be easily replaceable/interchangeable in case of any failures.
- Q. The controller shall provide a library with a minimum of 50 permanent messages, consisting of 30 or fewer characters per line, stored in PROM. The controller shall also be able to accept a downloaded library from the central or laptop computer containing at least 25 changeable messages stored in non-volatile RAM. These messages may be displayed on the sign from the keypad on the front panel of the controller. The RAM shall be backed up by a long life battery allowing power outages of a minimum of 12 months without loss of data.
- R. The controller shall also be capable of displaying messages on the sign that are downloaded from the central controller or laptop computer, but are not located in the library stored in non-volatile memory of the sign controller.

- S. The full matrix display shall also be capable of displaying other sized characters and other number of lines depending on the height of the character utilized. The interline spacing shall be variable.
- T. The DMS controllers shall be housed in the existing enclosure.
- U. Central Communications
  - 1. Exchanges between the DMS sign controller and central controller shall be made only upon the central controller request inviting the DMS sign controller to send (select) or receive (poll) data. The three modes of operation shall be:
    - a. Central Mode: The central controller controls and monitors the sign.
    - b. Local Mode: The sign controller LCD panel and keypad are used for direct sign operations and diagnostics.
    - c. Remote Mode: A local laptop computer is used to control and monitor the sign.
  - 2. The communications between the sign controller and the central controller or laptop computer shall comply with the NEMA National Transportation Communication for ITS Protocol (NTCIP) as detailed in this specification. Unless otherwise stated, the software shall comply with the versions of the relevant NTCIP standards that are current at the date of this document.
- V. Communications Interfaces:
  - 1. The controller will include separate RS-232/422/485 serial interface and an RJ45 Ethernet 10/100 Base T interface for communication with the central controller.
  - 2. The controller will include a separate RS-232 serial interface for communication with the laptop computer. A minimum 6-foot long serial cable will be supplied to connect the laptop computer to the sign controller.
  - 3. The controller will contain 8 digital inputs, 4 analog inputs, and 4 digital outputs to support external alarm and contact closure monitoring.

#### **25.02.10 DMS CONTROLLER WIRING**

- A. The communication and control cables between DMS controller and sign housing shall be fiber optic. The cables shall terminate in a fiber patch panel at both ends. Fiber patch cords, meeting the same specifications of the fiber cable and 3 ft. length, shall be used to connect local equipment to the patch panel.
- B. The fiber optic cable shall meet the following requirements:
  - 1. A 6-fiber optic 62.5/125 cable shall meet the specifications of Corning OM1 fiber type multimode, or equal, at a minimum. The duplex fiber optic cable shall have a nominal fiber OD of 2 x 4 mm and shall be orange in color. The fiber optic cable shall have a maximum attenuation of 3.75dB/km @ 850 nm and 1.5 dB/km @ 1300 nm. The fiber optic cable shall have a minimum gigabit Ethernet capability of 220 meters @ 850 nm and 550 meters @ 1300 nm. The fiber shall have a maximum tensile load capability of 48 lb-ft short term and 15 lb-ft long term with a minimum installed bend radius of 2.5 cm (1 inch). Maximum insertion loss shall be less than 0.4 dB with a maximum back reflection of less than -25 dB.

2. The fiber optic cable shall be terminated with “ST” connectors on all ends within the fiber patch panel. The “ST” connectors shall be Corning Glass Insert Connectors (GIC) Anaerobic (95-101-52 SP multimode 62.5/125 um) or equal.

### **25.02.11 DMS SIGN CONTROLLER SOFTWARE**

Sign Controller software and firmware shall be NTCIP 1203 v.2 compliant and support the following minimum functions:

- A. Report errors and failures, including, but not limited to:
  1. Power recovery
  2. Power Failure
  3. Pixel string failure
  4. Fan failure
  5. Over user selectable critical temperature
  6. Power supply failure
- B. Message and status monitoring – The sign controller will respond to the central controller whenever it receives a request for status. The return message will be capable of providing the following information:
  1. Actual message that is visibly displayed on the sign on an individual pixel basis
  2. Current sign illumination level
  3. Local Control Panel switch position (central or local)
  4. Error and failure reports
  5. Temperature readings
  6. Power supply voltage levels
  7. Origin of display message transmission (laptop or central)
  8. Heater status
  9. Uninterruptible power supply status
- C. Severe error condition response:
  1. In multi-drop mode, the sign controller will report severe error conditions to the central controller during the next polling. In network communication mode (UDP/IP), the sign controller will automatically send the diagnostic information to the Traffic Management Center (TMC) to notify the technicians of any reported errors.
  2. The severe error conditions are:
    - a. AC power failure
    - b. AC power recovery
    - c. Surge protection has tripped
    - d. Temperature reading over a user selectable critical temperature
    - e. The sign housing and controller cabinet door is open

- D. Display Control:
  1. Displays static, flashing, and alternating messages
  2. Supports amber monochrome alphanumeric characters and graphics messages
  3. Has the ability to control any size character, line, or full matrix DMS
  4. Scheduling is based on to-the-minute time-of-day, day-of-week, holiday or special days, one-time or recurring scenarios
  5. Photo sensor override and manual brightness control
- E. DMS Messaging:
  1. Includes message-creating editing tool with preview
  2. Manages DMS font database
  3. Has the ability to create, save, and adjust message duration and priority settings
  4. Configures flash rates, scrolling and other message attributes
  5. Can create and save banned words list (white and black lists)
  6. Spell checks messages before display and can edit one line (or word) of text without having to retype the entire message
  7. Supports multi-phase (3-phase minimum) messages
  8. Supports beacon activation by message
  9. Has the ability to create and save default messages for each DMS
- F. Utilities and Diagnostics:
  1. Has the ability to view status, errors, and any error codes of all DMS subsystems in real time and historical date/time stamped logs.
  2. Has the ability to locate pixel failures and verify the error
  3. Has a built-in pre-programmed common pixel test patterns and diagnostics
  4. Has the ability to monitor the DMS environmental conditions based on DMS sensors
  5. Has the ability to accept remote firmware upgrades
- G. Security:
  1. Has the ability to restrict each user's functional areas (read/write restrictions) with user accounts containing unique user names and passwords.

### **25.03 CONSTRUCTION AND INSTALLATION**

Installation of the DMS cabinet and all utility and DMS sign connections shall be in accordance with the approved final design plans and all applicable DDOT standards.

- A. Conduit
  1. The Contractor shall install new conduit from the DMS Controller Cabinet to the Dynamic Message Sign (DMS) and from the DMS Controller Cabinet to the utility service pedestal and meter.

2. Liquid Tight flexible conduit coating shall consist of thermal plastic or thermoset product and meet NFPA 502 standard.
3. New electrical and fiber optic wire or cable shall be installed in existing conduit or raceway as shown on the plans. Electrical cable and communications cable shall be installed in separate conduit or raceway.
4. All conduit wire/cable pulls shall have a pull rope installed beside installed conductors.
5. Construction and materials – refer to DDOT Standard Specification Sections 614.12 – 614.14.

**B. Wire & Cable –**

1. DMS Controller Cabinet to Service Pedestal: The Contractor shall install the power cables from the service pedestal to the cabinet in existing conduit. Power and communications cables shall be routed in separate conduits where conduits are required as shown on the plans.
2. DMS Controller Cabinet to Sign: The Contractor shall install cables from the DMS to the Controller Cabinet through existing conduits as indicated on the plans.
3. The Contractor shall install waterproof connectors where the cables enter into the cabinet. All cables shall be clearly marked or tagged. A minimum of 3 ft. of cable shall be left coiled in the cabinet.
4. Panelboard (Breaker Box) enclosure:
  - a. Tag conductors with new sleeve tag using the sign number as the conductor label identification. Affix wire tag at panelboard and sign ends for each conductor.
  - b. Refer to the Plans as a basis for specific sign / circuit assignment (wire tag) labels.
  - c. New sign power wiring from panelboard circuit breaker shall be 10AWG.
5. Wire insulation class shall be THHW minimum.

**C. Electrical Power**

1. The Contractor shall connect installed equipment to the Power Distribution Panel within the cabinet as indicated in the approved design plans. Prime operating power to each site shall be supplied from nominal 240/120 VAC power.
2. All conductors entering and leaving the cabinet shall be protected by surge protectors and lightning arrestors to protect against damage resulting from voltage surges.

**D. Mounting**

1. DMS signs will be mounted on the face of the Mall Tunnel portals.
2. The Contractor shall perform field investigation of the portal structures to ensure the signs can be securely installed.
3. The Contractor shall develop mounting details including brackets, anchorage, and methods of installation and submit them to the Engineer for review and approval along with calculations demonstrating the adequacy of attachments.

**25.03.01 RELATED SECTIONS:**

1. SECTION 017823 - OPERATION AND MAINTENANCE DATA

2. SECTION 078413 - PENETRATION FIRESTOPPING
3. SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
4. SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES
5. SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
6. SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
7. SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
8. SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING
9. SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS
10. SECTION 262726 - WIRING DEVICES
11. SECTION 262813 – FUSES

### **25.03.02 REFERENCES**

- A. Institute of Electrical and Electronics Engineers:
  1. ANSI/IEEE C2 – National Electrical Safety Code.
  2. ANSI/IEEE C62.41 – Guide for Surge Voltages in Low-Voltage AC Power Circuits.
  3. ANSI/IEEE C62.45 – Guide on Surge Testing for Equipment Connected to Low- Voltage AC Power Circuits.
- B. International Electrical Testing Association:
  1. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems. C. Telecommunications Industry Association/Electronic Industries Alliance.
  2. ANSI/EIA 310-D – Cabinets, Racks, Panels, and Associated Equipment.
- C. National Fire Protection Association:
  1. NFPA-70 – National Electrical Code.
  2. NFPA-502 - Standard for road Tunnels, Bridges, and Other Limited Access Highways.

### **25.03.03 TESTING**

#### **A. System Integration Test**

The system integration test shall demonstrate that all equipment is fully integrated and operational. This test shall verify that all equipment installed at each location is installed properly and that all functions are in conformance with the Contract Documents.

B. 30-Day Field Operational Test

- The 30-Day Field Operational Test shall be conducted on the integrated system of which the Pedestrian Egress Sign System, described here-in, is a part.
- All equipment shall be subject to the same 30-day field operation test requirements. Upon completion and acceptance, DDOT will provide final approval.
- The Contractor shall submit for each site, facility, and subsystem, well documented, witnessed, test reports for each and every test outlined in the test plan for each subsystem.

C. Test Documentation

The Contractor shall submit to DDOT for approval appropriate documentation related to each phase of testing. No testing shall commence without appropriate documentation approval. Test procedures and test data forms shall be submitted. The Contractor shall submit Test Reports for all testing levels. The Test Reports shall verify that the approved test procedures were conducted. All Test Reports shall be presented and organized in logical groups of equipment and shall be signed by the Contractor.

- D. The Contractor shall supply a certified Commissioning Authority (CxA). The CxA has overall responsibility for planning and coordinating the testing and commissioning process. The CxA shall certify all test results, reports and documentation.

**25.03.04 DOCUMENTATION**

The following shall accompany all electrical and mechanical components supplied:

A. Operator Manuals

Operator Manuals shall be provided for all equipment and components supplied as part of the cabinet. The manuals shall be comprehensive, easy to use and understand, and completely descriptive of the product.

B. Maintenance Procedures Manuals

1. A service manual containing detailed preventive and corrective maintenance procedures shall be provided for each different type or model of equipment. The manual shall cover as a minimum the proper method of adjusting and otherwise maintaining each item, a concise statement of the necessary operating functions in proper sequence, and a detailed description of the component function in relation to the various operation steps.
2. Systematic field and bench trouble shooting procedures shall be included, as shall normative waveforms and test voltages as applicable.
3. A detailed parts list shall be included. For each part, its circuit or pictorial identifications shall be shown, as shall all necessary rating information and a manufacturer and associated model or part number. The list shall also include cross-references to parts numbers of other manufacturers who make the same replacement part.

C. As-Built Drawings

1. A complete set of as-built shop drawings including equipment layout, assembly drawings, electrical schematic, wiring diagram and a logic diagram shall be provided for each cabinet. All connections, conduits, wiring, function and I/O

information shall be detailed. A stage-by-stage explanation of the circuit theory shall be provided with the circuit wiring diagrams. All drawings shall be identified by cabinet location.

2. Schematics shall include a list of tests points detailing the nominal operating voltage, wave form and all pertinent information regarding the wave form at each test point.
3. The as-built drawings shall provide a complete record of the final installation by location. The Contractor shall incorporate all design modifications, change orders and field installation changes.

D. Media

1. The Contractor shall provide one (1) complete set of all Manuals, Drawings and other documentation in bounded paper format to be stored in the equipment cabinet documentation holder.
2. Three (3) additional complete sets of all documentation, bound, loose-leaf copies of a booklet, 8-1/2 inches x 11 inches in size, and One (1) reproducible electronic copy in .pdf format shall be delivered to the District Engineer prior to DMS System Integration Testing.

**25.03.05 NTCIP COMPLIANCE**

- A. The sign controller and central computer software shall comply with the National Transportation Communications for ITS Protocol (NTCIP) Standards when installed. The Contractor shall be responsible for furnishing DMS equipment that is compliant with NTCIP standards as defined below. The Department reserves the right to define conformance groups to be supported. The Contractor shall provide a detailed description of how the system shall conform to the following minimum NTCIP requirements at the time of bid.

B. NTCIP References

The DMS shall comply with all applicable NTCIP standards that are current at the date of this document, including all Recommended or Approved Amendments. Under this contract, the Contractor shall ensure that each NTCIP component covered by these technical specifications implements the most recent version of the standard at the development stage of "Recommended" or higher, including any and all Approved or Recommended Amendments to these standards. It is the responsibility of the Contractor to monitor NTCIP activities to discover any recent additional documents. The following is a list of these Standards:

1. NTCIP 1101:1996 (V01.12) Simple Transportation Management Framework, December, 2001 with Amendment 1 v08
2. NTCIP 2104:2003 (V01.11) Ethernet Sub network Profile, September, 2005
3. NTCIP 2202:2001 (V01.05) Internet (TCP/IP and UDP/IP) Transport Profile, December, 2001
4. NTCIP 2301:2001 (V01.08) Simple Transportation Management Framework Application Profile
5. NTCIP1203 (V2.35a): Object Definitions for Dynamic Message Signs (DMS) Information Profile, March 2007

6. NTCIP 1201:2005 (V02.32) Global Object (GO) Definitions - Version 02, Information Profile October 2005

C. NTCIP Framework

The software shall comply with NTCIP 1101 (NEMA TS 3.2, Amendment #1) the Simple Transportation Management Framework, and shall meet the requirements for Conformance Level 1 as clarified by Amendment #1.

D. NTCIP Communications, Subnet Level –

1. Each NTCIP Component that communicates remotely shall conform to all mandatory NTCIP 2104 (Ethernet) subnet profile requirements. Each NTCIP component shall support the receipt of application data packets at any time.
2. NTCIP Components may support additional Subnet Profiles at the vendor's option. At any one time, only one Subnet Profile shall be active on a given serial port of the NTCIP Component. If the NTCIP Component has a serial port that supports multiple Subnet Profiles, the NTCIP Component shall be configurable to allow the field technician to activate the desired Subnet Profile and shall provide a visual indication of the currently selected Subnet Profile.

E. Transport Level

Each NTCIP Component shall comply with NTCIP 2202 (TCP/IP and UDP/IP). Each NTCIP component shall support the receipts of datagrams conforming to the DMS configured TCP/IP and UDP/IP Transport profiles. NTCIP Components may support additional Transport Profiles at the manufacturer's option. Each NTCIP Component shall support the receipt of datagrams conforming to any of the identified Transport Profiles at any time.

- F. Application Level – Each DMS controller shall comply with NTCIP 2301, (NEMA TS 3.AP-STMF), as a Managed Agent and shall meet the requirements for Conformance Level 1. SNMP shall be required and STMP shall not be required. An NTCIP Component may support additional Application Profiles at the manufacturer's option. Responses shall use the sample Application Profile used by the request. Each NTCIP Component shall support the receipt of Application data packets at any time allowed by the subject standards.

## 25.04 MEASUREMENT AND PAYMENT

This item of Work will not be measured for payment, but shall be paid for on a Lump Sum basis. The price shall include:

DYNAMIC MESSAGE SIGNS – Item 614991 including:

- Variable Message Sign I Line 32 characters, tri-color display in NEPA 4X enclosure with mount.
- Media converter Fiber –Ethernet.
- Communication cable – CAT 6 sign to fiber drop.
- Power cable – 12 awg. 120 vac. 3 conductor cable.
- 6-strand outdoor-rated MM fiber cable.
- 1” EMT conduit.
- DMS control software for sign message management.

- DMS control unit work station for sign management.

This price shall be full compensation for:

- Labor costs including fabrication, installation, configuration, integration, testing, commissioning, and other necessary support activities.
- Materials costs including specified equipment, hardware, firmware, software, software licenses, tools, appurtenances, and all other Products specified herein.
- All Labor and Material required for a full functioning system related to this particular section and related specifications not specifically identified in the Bid Items will be considered incidental and included.
- The cost of developing attachment details including mounting details and calculations for the portal mounting.

## **26 ADVANCED TRAFFIC MANAGEMENT SYSTEM (ATMS) CCTV / PUBLIC ADDRESS AND DMS/LED/EGRESS SIGNS - CONTROL DETAILS**

### **26.01 GENERAL**

#### **26.01.01 DESCRIPTION:**

- This section provides specifications for design, furnishing, installing and testing of a new Head-End Control System for the CCTV ,PA, DMS/LED Sign and Pedestrian Egress System using an Advanced Traffic Management System (ATMS).
- The design shall include a workstation, associated software and other computer and network peripherals to allow an operator to use text to speech technology for the PA and DMS Systems and at the same time control direction of the egress system during emergencies and non-emergency situations. The system shall also allow for control and monitoring of the CCTV System installed under this Contract.
- Server and workstation shall be housed in the Department of Labor Building- Washington D.C. – Tunnel Control Room as shown on the contract drawings.
- Servers and workstation clocks will be synchronized via a network connection to a Network Time Protocol (NTP) server provided by others.
- The ATMS server shall house a database for archival of CCTV /PA/LED /DMS Sign/Egress system data and associated software applications. The database, used to archive PA and sign messages, schedules, statistics, etc., shall be by the Scheduler software, GUI functionality.
- The Contractor shall be responsible for any work not specifically mentioned in this specification, but which is necessary, either directly or indirectly, for the proper functioning of a complete, new ATMS for control and monitoring of the CCTV /PA speakers /DMS Sign/Egress systems and is part of the scope of work, at no additional cost to the Administration.
- The Contractor shall maintain in escrow all proprietary source code for all software and the compilers, linkers, etc. used to develop it. The source code held in escrow shall be the latest version installed and tested. The Contractor shall provide sufficient documentation of the source code to allow DDOT to maintain it, troubleshoot it and adjust parameters.

#### **26.01.02 OBJECTIVE:**

The following is a list of general objectives of the ATMS to be designed, procured, installed and tested

by the Contractor:

- A. Control of CCTV / DMS /LED Signage, PA speakers, Egress system and future ITS devices from a single platform.
- B. View the status of CCTV / DMS /LED Signage, PA speakers, Egress system and future ITS devices on a single GIS-based mapC. Ability to add devices by properly trained DDOT staff without input from the vendor.
- D. Provide for automated travel times to be displayed on DMS /LED Signage.
- E. Provide text to speech technology with pre-scanned messaging and allow “Live” messaging to be displayed on the DMS /LED Signage, and all audio through the PA speaker system.
- F. Control, receive, and distribute video images from CCTV cameras installed under this Contract.
- G. Allow for automated and planned messages (Text to Speech) to be displayed on DMS /LED Signage, PA System in response to anticipated events. System shall include ability to use prerecorded messages and LIVE messaging.
- H. Provide browser-accessible data to authorized personnel over the DDOT Fiber network. Interface to DDOT network will be by others. Such data will include DMS /LED Signage, PA speakers, Egress system and CCTV system. Browser access shall be for status and view-only capability.

**26.01.03 RELATED SECTIONS:**

- 1. SECTION 017823 - OPERATION AND MAINTENANCE DATA
- 2. SECTION 078413 - PENETRATION FIRESTOPPING
- 3. SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
- 4. SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES
- 5. SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- 6. SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
- 7. SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
- 8. SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING
- 9. SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS
- 10. SECTION 262726 - WIRING DEVICES
- 11. SECTION 262813 – FUSES

**26.01.04 QUALITY ASSURANCE:**

- A. All work specified under this section shall be performed per the requirements in this section, applicable sections elsewhere, applicable codes and standards, and industries best practices to ensure a good quality workmanship.
- B. Installation of new equipment shall be done as required herein, following the manufacturer’s instructions and recommendations, industry’s best practices, applicable codes and standards, and as specified elsewhere in the contract documents to ensure good quality product.

**26.01.05 SUBMITTALS:**

Submit the following in accordance with Section 105.02 of the Standard Specifications, and with the additional requirements as specified for each:

- A. Submit in accordance with General Provisions for Construction and integration.
- B. Shop Drawings: Indicate electrical characteristics and connection requirements. Indicate layout of equipment mounted in racks and cabinets, component interconnecting wiring, and wiring diagrams of network equipment.
- C. Product Data: Submit catalog data showing electrical characteristics and connection requirements for each component.
- D. Test Reports: Indicate procedures and results for specified field testing and inspection.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Manufacturer's Field Reports: Indicate activities on site, adverse findings, and recommendations.
- G. Project Record Documents: Record actual locations of workstations, servers, UPS, network switches and cabling connections.
- H. Operation and Maintenance Manuals: Submit instructions for adjusting, operating, troubleshooting, administrating and extending system, and repair procedures and spare parts documentation.
- I. As-built drawings: The drawings shall depict the installation conditions of the equipment to be provided. These shall clearly show all the equipment, facilities, conduits, hand boxes, junction boxes, DMS/LED signs, Egress Signs, poles, wires, cables, speakers, rack, other rack equipment, computer equipment, computer switches and any information that could be useful for troubleshooting the system. DDOT will review the drawings for approval.
- J. CCTV / PA and DMS/LED /Egress Signs System Software Design Specification (SDS): An overview document, describing all supervisory monitoring and control software on a subsystem basis, including a brief description of the hardware interfaces. This document shall functionally describe all software with simplified block/flow diagrams. Include the relationship among programs, the database, and the hardware. Provide this document prior to issuance of any individual software documents.
- K. CCTV / PA and DMS/LED/ Egress Signs Control System Display Overview: The Contractor shall submit a document and prototype console displays and Overview display for the ATMS Control System GUI. The overview shall include the displays and a document containing the displays and display design guidelines related to use of Icons for each possible state, colors, labels display attributes, menus bars, pop ups and prompt and messages.
- L. Field Installation Acceptance Test (FIAT) Reports: The Contractor shall submit for each site, facility, and subsystem, well documented, witnessed, test reports for each and every test outlined in the test plan for each subsystem.

**26.01.06 PRODUCT, DELIVERY, STORAGE, AND HANDLING:**

- A. Each unit shall be individually packaged and labeled for shipment and protected against damage and loss during shipping, handling, and storage.

- B. Store equipment in a secure and dry storage facility.

## **26.02 PRODUCTS**

The requirements specified below are minimum requirements. The contractor shall submit in their proposal all latest Hardware and Software technology related to this specification to ensure that the product proposed for installation can function successfully.

### **26.02.01 GENERAL**

All Hardware and Software materials furnished shall be standard products of manufacturer regularly engaged in the production of materials specified.

### **26.02.02 ATMS CONTROL SYSTEM EQUIPMENT:**

- A. Advanced Traffic Management System (ATMS) software aiming to integrate and facilitate the management of the emergency communications systems for the DDOT Mall Tunnel project.

#### **26.02.02.1 ATMS FEATURES**

- a.. Dynamic Message Sign System Control and Monitoring
- b. PA System Control and Monitoring
- c. CCTV System Control and Monitoring
- d. Pedestrian Egress System Control and Monitoring

### **26.02.03 ATMS CONTROL SYSTEM SOFTWARE :**

- 1. Real-time monitoring and control.
- 2. GIS Map and schematic based GUI.
- 3. Integrated Incident Response Management with on-line decision support.
- 4. Seamless digital and analog video management.
- 5. WYSIWYG Electronic Sign control.
- 6. Historical data recording system.
- 7. Traffic and Equipment Maintenance Reports.
- 8. Alarm paging.

#### **26.02.03.1 CCTV SUB-SYSTEM**

The CCTV control software and user interface shall be fully integrated into the ATMS software. All CCTV functions shall be accessible from the ATMS workstation using the standard keyboard and mouse. The ATMS software shall support the following CCTV interfaces and functions:

- A. Digital video streaming, switching and stream management.
- B. Software decoding of digital video streams on client workstations.
- C. Pan/tilt/zoom (PTZ) controller for the installed PTZ cameras. This shall also include other features such as iris control, wipers, color balance, etc. if supported by the hardware.
- D. Contention management between users for camera control.
- E. Video "Tour" or sequence construction.
- F. Camera "Pre-set" definition on a per-camera basis.
- G. Drag and drop camera to display device switching.
- H. End-user graphical map modifications.
- I. Online addition of cameras and camera icons to graphical map displays.

- J. Online camera addition or camera configuration changes.
- K. User and Workstation level permissions for camera control, switching and viewing.

#### **26.02.03.1.1.1 CCTV-Digital Video streaming and Display**

- A. The streams shall be capable of being either multicast or uni-cast on the network and shall support the streaming of digital video using MJPEG, MPEG-2 or MPEG-4 encoding.
- B. The workstation client applications shall support the display of software decoded video in video player windows.
- C. The display shall be configurable by the operator to support a single player, two players side by side, four players in a two-by-two arrangement or nine players in a three-by-three arrangement.
- D. Individual video player windows shall be initiated by clicking on a camera icon on a graphical map display.
- E. The players shall be capable of full-screen display.
- F. Each video player shall be capable of displaying live video or recorded video archives.
- G. There shall be no per-seat licensing cost associated with viewing clients nor shall there be any limit to the number of client workstations that can access the server.

#### **26.02.03.1.2 CCTV-Camera Control**

- A. The operator shall be able to select any camera FIXED or PTZ control from a list of cameras or by selecting a camera on a graphical display.
- B. The camera shall be controlled using the mouse on a set of controls such as a Simulated joystick, sliders or other convenient user interface object.
- C. The response time of the control action as observed on a monitor shall be within 500 milliseconds for any camera in the system.
- D. For digitally encoded camera streams, the operator shall be able to control the movements of a PTZ camera by either using a software joystick or by clicking in the video display window itself.
- E. Any device that is defined shall have the option of assigning an associated video camera and preset.
- F. When the device is selected on a graphic display an option shall be provided to call up the associated camera view on a monitor or on the workstation.

#### **26.02.03.1.3 CCTV-Recording**

- A. The ATMS system shall record each camera stream for a configurable amount of time in a continuous recording "loop".
- B. The recording of all video shall be maintained on the ATMS server for a minimum of 30 days.
- C. All event logs shall be maintained on the ATMS server for a period of 7 days.
- D. When the operator stops the recording, he or she shall be able to save the clip as a video archive.

#### **26.02.03.1.4 CCTV Permissions**

- A. The ATMS system shall be capable of establishing permissions for camera control, video display, video switching, preset and tour construction, setting of limits, camera locking, blocking broadcast and recording and playback of digital video on a user and workstation basis.

- B. The ATMS system shall support workstation specific monitor and display wall configurations so that only those workstations located in control rooms with these types of output devices can route video to them.

### **26.02.03.2 DYNAMIC MESSAGE SIGN (DMS) SUB- SYSTEM**

The ATMS Software Sign Manager shall provide an integrated interface for the monitoring and control of all types of signs including:

- VMS – variable message signs with a local sign library
  - DMS – dynamic message signs.
  - Other types of signs providing information to the public
- A. The ATMS software shall be able to interface with message signs from multiple manufacturers.
- B. The ATMS interface software shall be provided for the NTCIP VMS protocol and any proprietary protocols required to control signs provided and installed under this contract.
- C. The ATMS Software Sign Manager shall provide a graphical user interface (GUI) that displays a list of all signs in the system along with the current displayed message.
- D. The operator shall be able to select a sign for display and control actions either from this list or from a symbol on a graphical display.
- E. The user interface shall support a full graphical WYSIWYG (what you see is what you get) display of each sign including size, fonts, color, graphics, and phasing/blinking
- F. The ATMS software shall support a master library of predefined messages a subset of which can be loaded into the sign controller (if supported).
- G. The software shall support the entry of freeform messages if the operator has been provided with this specific privilege.
- H. The software shall support multiple character fonts, multi-line phased messages with variable frame rates, blinking of individual characters and control of associated beacons.
- I. The software shall support the grouping of signs such that a single command from an incident plan can send the same message to multiple signs and all signs can revert to their previous message when the incident is cleared.
- J. All VMS messages shall be checked against a custom dictionary before entry into the library or directly transmitted to the sign.
- K. The system administrator shall be alerted to any words that are not in the dictionary and have the ability to add the word to the dictionary.
- L. The VMS user interface shall provide a character set editing function to allow the creation or editing of character fonts

### **26.02.03.3 PUBLIC ADDRESS (PA) SUB-SYSTEM**

- A. The ATMS software shall provide a fully integrated interface for Public Address Subsystem Management.
- B. The System shall enable a User to create (microphone recording and file import), replace, update and deleted pre-record files to be played across the PA subsystem.
- C. The System shall enable a User to play back, stop (on completion of message) and immediate stop playing live-to-air messages sent across the PA subsystem.

- D. The System shall enable a User to configure the PA zones across the Tunnel where the PA message is to be played.
- E. The ATMS shall generate an alarm indicating PA Subsystem faults.
- F. The ATMS shall log operator requests and commands including pre-recorded messages, live-to-air messages and stop broadcast commands.

**26.02.03.4 PEDESTRIAN EGRESS SUB-SYSTEM**

- A. The ATMS software shall provide a fully integrated interface for the Pedestrian Egress Subsystem Management.
- B. The ATMS software shall support an interface with industry standard programmable logic controllers and/or remote terminal unit devices that are part of the Contractor-provided Egress System.
- C. The software shall support the collection of analog and discrete data and the output of control actions to these devices.
- D. The data received from PLC and RTU devices shall be processed, alarm checked and placed into the real-time Device ATMS database.
- E. The PLC will be installed in each installed Mall remote cabinet and connected to the egress ballast of each pair of Egress signs and communicated back to the ATMS database for all communications control.
- F. The ATMS database will control the pedestrian egress signs to flash, turn off and on, and isolate groups of egress signs at any given time.
- G. The ATMS database will control the pedestrian egress chevron arrows to flash, turn off and on, and isolate groups of egress signs at any given time .

**26.02.04 ATMS CONTROL SYSTEM ARCHITECTURE:**

- 1. True client-server software using a Windows based or other approved system that is standards based open architecture and COTS (Computer off the shelf) compliant.
- 2. ITS Architecture and NTCIP compliant.
- 3. ATMS architecture uses proven three tier architecture (Client, Business, and Enterprise Information System) for dependency and functional isolation.
- 4. ATMS client applications run on any enabled computer. No special workstation software or hardware is required.
- 5. Compatible with standard RDBMS products such as PostgreSQL, Oracle, Sybase and MS SQL Server.

**26.02.05 ATMS SYSTEM EQUIPMENT- HARDWARE:**

- A. **SERVER:** Manufacturers: Dell or approved equal.
  - 1. A server shall be supplied that meets the requirements of the Contractor’s ATMS software solution. At a minimum, it shall meet the following:
    - a. Intel SR52612UR 2U 12x SATA RAID Hot Swap with SAS Expander
    - b. Intel Xeon Quad-core + DDR3 DIMM

- c. SAS/SATA RAID +SATA Hard Drive
- d. RAID Configuration & Video File Capacity

**B. WORKSTATION:**

- 1. Manufacturers: Dell or approved equal. A workstation shall be supplied that meets the requirements of the Contractor's ATMS software solution.

**C. MONITORS:**

Manufacturers: Dell or approved equal. Two (2) monitors shall be provided for monitoring and control of the ATMS. Minimum requirements for the monitor are as follows:

- a. Viewable area - 22" wide
- b. Native resolution of 1680 x 1050
- c. Approximate 16 - 9 perspective
- d. Pixel Pitch - 0.282 mm
- e. Brightness (Typical) - 280 cd/m<sup>2</sup>
- f. Response Time (Typical) - 5ms (GTG)
- g. Detachable base

**26.02.06 STANDARDS AND REPORTS:**

- A. National ITS Architecture that have been approved and published for use in ATMS.
- B. Ethernet and TCP/IP networking standards.
- C. ODBC and SQL database standards. Generic support for any relational database.
- D. HTML, DHTML, HTML5 Javascript, JSP, etc. standards for web based application servers and documentation.
- E. Modbus protocol for data acquisition devices using both serial and TCP/IP communications.
- F. Lightweight Directory Access Protocol (LDAP) and integration with Microsoft Active Directory.
- G. Simple Network Management Protocol (SNMP) – the system shall support basic polling of all network devices for status information.
- H. All reports shall be created as pdf format files.
- I. Database and configuration files shall be in a standard XML format.

**26.03 EXECUTION**

**26.03.01 SURVEYS**

- A. The Contractor shall perform hardware and software assessments with the client, identify needs and existing infrastructure. General assessment development should at least include the following:
  - 1. Location of all new ATMS equipment.
  - 2. Identify main control room and server and workstation placements.
- B. The Contractor shall use information gathered during the site surveys to generate final working plans for the mall tunnel project.

**26.03.02 INSTALLATION:**

- A. Provide a seamless integration between all subsystems and programs.
- B. Utilize a fully integrated graphical user interface that provides the operator with real time information and control through the use of maps and schematic displays containing dynamic objects.

- C. Provide multi-user and multi-workstation capability without operator restrictions other than password and access rights.
- D. Install (1) workstation with (2) desktop monitors in the new Mall Tunnel Control Room area. A definite placement location will be provided by DDOT personnel.
- E. Provide access to real time and historical data through on-line applications as well as logging, report generation and charting.
- F. Provide real-time monitoring and logging of equipment status and state.
- G. Control and monitor dynamic message signs using free-format, local library and master (server) library messages.
- H. Support continuous operation with availability of at least 99.9%.

**26.03.04 TESTING:**

- A. The Contractor shall perform all testing and corrective measures to fix any problems identified during installation and testing as required to ensure a fully operational ATMS solution.
- B. Test procedures shall be submitted to DDOT for review and approval as specified.
- C. The operator shall be able to start any application on the workstation within five (5) seconds of logging in.
- D. Acknowledge entered commands within one second of command entry.
- E. Update the appropriate transaction data in the database within two seconds of the command entry.
- F. All graphic displays shall be updated once per second without redrawing the entire screen. All displays shall allow smooth scrolling, panning and zooming (mays may be zoomed to fixed zoom levels) functions with barely perceptible redrawing of the image on the screen.
- G. All alarm conditions shall be displayed to the operator within two (2) seconds after they are received at the server or are generated by the server.
- H. Prepare and display report information to the requestor within 60 seconds of request.
- I. 30-Day Field Operational Test
  - The 30-Day Field Operational Test shall be conducted on the integrated system of which the ATMS, described here-in, is a part.
  - All equipment shall be subject to the same 30-day field operation test requirements. Upon completion and acceptance, DDOT will provide final approval.
  - The Contractor shall submit for each site, facility, and subsystem, well documented, witnessed, test reports for each and every test outlined in the test plan for each subsystem.
- J. The test report shall include:
  1. A summary listing the overall results of the testing.
  2. A list of failures or problems identified during testing, with a plan of action for the resolution of each.
  3. A detailed account of testing, keyed to the test procedures followed for the testing, indicating pass or failure in each case.
  4. Additional remarks as warranted.
- K. Acknowledgement by the DDOT: DDOT will provide a written acknowledgement of the receipt and acceptance of each submitted test report within ten (10) days of submittal.

- L. The Contractor shall supply a certified Commissioning Authority (CxA). The CxA has overall responsibility for planning and coordinating the testing and commissioning process. The CxA shall certify all test results, reports and documentation.

**26.03.04 ATMS SYSTEM SOFTWARE :**

- A. The ATMS software shall use a client-server architecture based on J2EE or other similar technologies to support a three-tier system of database server, application server and client.
- B. Clients shall use a web browser to access the system and download applications from the server that will offload processing to the client.
- C. All graphics intensive processing shall be performed on the client workstation with no limit to the number of workstations that may be connected to the server.
- D. The software shall be written in C++, Java or other standard object-orientated programming language that is fully supported by the operating system used for the servers and workstations.
- E. The software shall be scalable and have no artificial (license-based) limits on the addition of additional devices, workstations, graphics, reports, etc.
- F. All system functions shall be available to a DDOT operator on any workstation with functionality limited only by the password protected access level and workstation configuration. Any additional functions (e.g., AVL, HAR, etc.) shall be integrated into the software and available on all workstations.
- G. Workstations shall not require the installation of any proprietary ATMS software to support the functions described in this specification.
- H. There shall be no per-seat licensing cost associated with viewing clients nor shall there be any limit to the number of client workstations that can access the server.

**26.03.05 GROUNDING:**

- A. Per Section 260526 - Grounding and Bonding for Electrical System and Contract drawings.

**26.04 MEASUREMENT AND PAYMENT**

This item will not be measured for payment and will be paid in a lump sum bid price, which price shall include:

ADVANCED TRAFFIC MANAGEMENT SYSTEM – Item 614991 including:

- Development of ATMS software.
- ATMS hardware – server.
- Software licenses.
- Network router – communication port
- ATMS workstation, operator monitors and CPU.
- Network cabling – interconnecting cables, Ethernet, fiber.
- Maintenance and on-call support including software upgrades during the warranty period.

The Lump Sum item shall include:

- A. Labor costs including fabrication, installation, configuration, integration, testing, commissioning, software programming, and associated management and support activities.
- B. Materials costs including specified equipment, hardware, firmware, software, software licenses, tools, appurtenances, and all other Products specified herein.

- C. All Labor and Material required for a full functioning system related to this particular section and related specifications not specifically identified in the Bid Items will be considered incidental and included in the lump sum bid price.

## **27 CLOSED CIRCUIT TELEVISION (CCTV) – EQUIPMENT SPECIFICATIONS**

### **27.01 GENERAL**

#### **27.01.01 DESCRIPTION:**

- A. The Contractor shall provide the labor, tools, equipment, and materials necessary to install a CCTV System with all necessary enclosures and appurtenances in accordance with the plans and as specified herein.
- B. Work in this Section includes, but is not limited to:
  - 1. Video cameras.
  - 2. Lenses (fixed and telephoto)
  - 3. Camera housings
  - 4. Digital video recorders
  - 5. Video monitors
  - 6. Video switcher/control system
  - 7. Receiver/drivers
  - 8. Mounting hardware
  - 9. Equipment cabinets and enclosures.
  - 10. Surge protection devices.
  - 11. Digital video management system
- C. All CCTV servers and recorders will terminate in the designated equipment rack located in Department of Labor- Washington D.C. – New Tunnel Control Room area.
- D. Servers and workstation clocks will be synchronized via a network connection to a Network Time Protocol (NTP).
- E. The CCTV Hardware and Software system shall integrate with the proposed ATMS as outlined in the previous section.
- F. The CCTV Hardware and Software system will have the capabilities of storing and archiving all CCTV video with the capabilities of retrieving all alarm events as deemed necessary by DDOT personnel.
- G. The Contractor shall be responsible for any work not specifically mentioned in this specification, but which is necessary, either directly or indirectly, for the proper functioning of a complete, new CCTV system and is part of the scope of work, at no additional cost to the

Administration.

**27.01.02 OBJECTIVE:**

The following is a list of general objectives of a CCTV system:

- A. A robust system that will assist with emergency operations and record any and all events.
- B. This system must be capable of 24/7 operations with the ability to monitor, record and archive all video streams in compliance with requirements of NFPA 502 (2014 Edition), Section 7.4.
- C. Industrial CCTV surveillance system shall be capable of monitoring vehicles and unauthorized persons.
- D. Megapixel cameras shall be suitable in areas where fine details are required for future enhancements to the DDOT -CCTV system.
- E. The Network Video Recorder (NVR) shall be the central server for all the cameras. It shall provide for recording, storage, retrieval, and facilitates viewing of all video feeds.
- F. The cameras shall be directly wired to the NVR through Ethernet/Fiber cables.
- G. The NVR shall control, receive, and distribute video images from CCTV cameras installed inside the both the Northbound and Southbound Mall Tunnels.
- H. The NVR shall contain the management software and the Hard Disk space for management and viewing of the video footage from all cameras.
- I. This is our advanced state of the art surveillance system solution that supports IP technology.
- J. All cameras shall be IP based.
- K. The IP cameras shall be connected to a multiport switch on the LAN. Power over Ethernet (PoE) support reduces cable connections for wired cameras as the same Ethernet cable provides power to the cameras where applicable.
- L. The NVR shall interface to the network through an Ethernet port.
- M. Configuration of the NVR shall be done through the LAN via a static IP address on normal browser.
- N. Monitoring shall be done on any DDOT approved computer with the appropriate JAVA applet on the DDOT WAN /LAN network.
- O. The NVR shall provide all the indexing storage, retrieval, playback of video footage while the monitors allow configuration and viewing.

**27.01.03 RELATED SECTIONS:**

- 1. SECTION 017823 - OPERATION AND MAINTENANCE DATA
- 2. SECTION 078413 - PENETRATION FIRESTOPPING
- 3. SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
- 4. SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES
- 5. SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- 6. SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL

SYSTEMS

- 7. SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
- 8. SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING
- 9. SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS
- 10. SECTION 262726 - WIRING DEVICES
- 11. SECTION 262813 – FUSES

**27.01.04 QUALITY ASSURANCE:**

- A. All work specified under this section shall be performed per the requirements in this section, applicable sections elsewhere, applicable codes and standards, and industries best practices to ensure a good quality workmanship.
- B. Installation of new equipment shall be done as required herein, following the manufacturer's instructions and recommendations, industry's best practices, applicable codes and standards, and as specified elsewhere in the contract documents to ensure good quality product.
- C. Codes and Standards: Perform all work associated with the CCTV System in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.
  - 1. National Electrical Code (NEC).
  - 2. Underwriters' Laboratories, Inc. (UL) Compliance: Provide CCTV system components which are UL-listed and UL-labeled.
  - 3. National Electrical Manufacturers Association (NEMA) Compliance: Comply with NEMA Standards for enclosures.

**27.01.05 SUBMITTALS:**

Submit the following in accordance with Section 105.02 of the Standard Specifications, and with the additional requirements as specified for each:

- A. Shop Drawings: Indicate electrical characteristics and connection requirements. Indicate layout of equipment mounted in racks and cabinets, component interconnecting wiring, and wiring diagrams of network equipment.
- B. Product Data: Submit catalog data showing electrical characteristics and connection requirements for each component.
- C. Test Reports: Indicate procedures and results for specified field testing and inspection.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Field Reports: Indicate activities on site, adverse findings, and recommendations.
- F. Project Record Documents: Record actual locations of workstations, servers, UPS, network switches and cabling connections.

- G. Operation and Maintenance Manuals: Submit instructions for adjusting, operating, troubleshooting, administrating and extending system, and repair procedures and spare parts documentation.
- H. As-built drawings: The drawings shall depict the installation conditions of the equipment to be provided. These shall clearly show all the equipment, facilities, conduits, hand boxes, junction boxes, mounting brackets and other rack equipment, computer equipment, computer switches and any information that could be useful for troubleshooting the system. DDOT will review the drawings for approval.
- I. CCTV System Software Design Specification (SDS):  
An overview document, describing all supervisory monitoring and control software on a subsystem basis, including a brief description of the hardware interfaces. This document shall functionally describe all software with simplified block/flow diagrams. Include the relationship among programs, the database, and the hardware. Provide this document prior to issuance of any individual software documents.
- J. CCTV Control System Display Overview:  
The Contractor shall submit a document and prototype console displays and Overview display for the ATMS Control System GUI. The overview shall include the displays and a document containing the displays and display design guidelines related to use of Icons for each possible state, colors, labels, display attributes, menus bars, pop ups and prompt and messages.
- K. Maintenance data for CCTV systems shall be included in the Operation and Maintenance Manual. Include data for each type of product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations that carry stock of repair parts for the system to be furnished.

**27.01.06 PRODUCT, DELIVERY, STORAGE, AND HANDLING:**

- A. Deliver CCTV System components properly packaged in factory-fabricated-type containers.
- B. Handle CCTV System components carefully to avoid breakages, impacts, denting, and scoring finished. Do not install damaged equipment; replace and return damaged units to equipment manufacturer.
- B. Store CCTV System components in original packaging and in a clean, dry space; protect from weather and construction traffic.

**27.01.07 SEQUENCING AND SCHEDULING :**

- A. Coordinate installation of CCTV System components and enclosures with installation of wires/cables and other electrical work.
- B. Coordinate installation of CCTV System components and enclosures with installation of other emergency control sub-systems as detailed in this specification.

**27.02 PRODUCTS**

**27.02.01 GENERAL**

All Hardware and Software materials furnished shall be standard products of manufacturer regularly engaged in the production of materials specified.

### **27.02.02CCTV EQUIPMENT ( FIXED CAMERA DESCRIPTION):**

Fixed and Thermal cameras shall be provided to meet the video coverage. At a minimum the cameras provided shall meet the following requirements:

- A. The camera shall capture video using a 1 / 2.7” SD progressive scan CMOS, 1 Megapixel sensor that supports Wide Dynamic Range (WDR), with a SNR of better than 39dB and an effective TVL of 690 (horizontal).
- B. The camera shall capture video at up to 720p resolution (1280 x 720).
- C. In day mode, the camera shall operate down to 0.7 Lux (color).
- D. In night mode, the camera shall operate down to 0.035 Lux (mono).
- E. The cameras shall be a true day/night cameras with mechanical IR cut filter.
- F. The camera shall support an option for Back Light Compensation (BLC).
- G. The camera shall support auto or fixed white balance.
- H. The video compression shall be carried via dedicated hardware compression; software compression via DSP is not acceptable.
- I. The camera shall support H.264 (ISO 14496-10) compression algorithm and should guarantee the compression at 25/30 frames per second.
- J. The camera shall have a RJ-45 connector and comply with IEEE802.3 and ETF standards: 10/100 Base-T Ethernet5.2.
- K. The camera shall support the following network protocols: TCP, UDP, IGMP, SNMP, HTTP, CMP, IGMP, SNMP, HTTP, NTP, Telnet, FTP.
- L. The camera shall support Power over Ethernet (802.3af Class 0); 24V AC/DC @ 0.45A.
- M. Meets NEMA Type 4X and IP66 Standards.

### **27.02.03CCTV EQUIPMENT (PAN ,TILT, ZOOM CAMERA DESCRIPTION):**

- 1. The PTZ camera shall support 360° continuous movement at a speed of 200° per second
- 2. The PTZ camera shall support up to 200 presets at an accuracy of 0.05°.
- 3. The PTZ camera shall support up to 24 independently configurable privacy zones.
- 4. The PTZ camera shall respond to commands with a latency no greater than 150ms
- 5. The camera shall contain an embedded real-time clock as well as acting as an NTP client.
- 6. The camera shall have 2 opto-isolated inputs and 1 solid state opto-isolated relay output for the transmission and receiving of binary outputs/inputs.
- 7. The camera shall support the following network protocols: TCP, UDP, IGMP, SNMP, HTTP, GlobalCMP, IGMP, SNMP, HTTP, NTP, Telnet, FTP.

8. The camera shall have a RJ-45 connector and comply with IEEE 802.3 and IETF standards: 10/100 Base-T Ethernet5.2.
9. The camera shall support H.264 (ISO 14496-10) compression algorithm and should guarantee the compression at 25/30 frames per second.
10. The camera shall support ACF (Activity Controlled Frame rate) so that the frame rate can be reduced when there is little or no motion in the scene.
11. The camera shall capture video using a 1/3" HD progressive scan CMOS, 2 Megapixel sensor that supports Dynamic Range > 50dB.
12. The camera shall capture video at up to 720p resolution (1280 x 720p).
13. In day mode, the camera shall operate down to 1.0 Lux (color), F1.8.
14. In night mode, the camera shall operate down to 0.1 Lux (mono), F1.8.
15. The camera shall be a true day/night.
16. The camera shall support an option for Back Light Compensation (BLC).
17. The camera shall support auto or fixed white balance.
18. The camera shall support native image stabilization to reduce shake during zoom.
19. Meets NEMA Type 4X and IP66 Standards.

**27.02.04CCTV EQUIPMENT ( THERMAL CAMERA DESCRIPTION):**

1. Advanced thermal imaging system designed for video security applications.
2. At a minimum the camera shall meet the following:
  - A. Uncooled, Sun-Safe, Amorphous Silicon Microbolometer
  - B. Long Wave Infrared (LWIR)
  - C. IP and Analog Capability
  - D. 640 x 480, 384 x 288, or 240 x 184 Resolution Options
  - E. 17 µm Pixel Size (640 x 480 model)
  - F. 25 µm Pixel Size (384 x 288 and 240 x 184 models)
  - G. Sensitivity Below NETD <50 mK at f/1.0
  - H. 24 VAC/24 VDC
  - I. H.264 and MJPEG Compression
  - J. Up to 2 Simultaneous Video Streams
  - K. Multiple Lens Options
  - L. Designed for Maximum Environmental Protection
  - M. Compact, Lightweight Aluminum Construction
  - N. Meets NEMA Type 4X and IP66 Standards
  - O. Complete with Sun Shroud and Heater/Defroster
  - P. Adaptive Motion Detection

Q. ONVIF v1.02 Conformant

**27.02.05CCTV- CAMERA HOUSING:**

1. Housings shall be steel or 6061 T6 aluminum enclosures with internal camera mounting and connecting provisions that are matched to camera/lens combination and mounting and installing arrangement of camera to be housed.
2. At a minimum the camera housings provided shall meet the following:
  - A. Meets NEMA Type 4X and IP66 standards
  - B. Adjustable light shield (“Y” models)
  - C. Hinged wall mount allows for easy installation
  - D. Standard wall / pole mount
  - E. PoE or 12/24v input model

**27.02.06CCTV- NETWORK VIDEO RECORDER(NVR):**

1. All equipment and materials used shall be standard components that are regularly manufactured and used in the manufacturer’s system.
2. All systems and components shall have been tested and proven in real installations.
3. All components shall be provided with a two-year warranty. Additional warranty can be obtained by purchasing a specific warranty package via an approved system integrator.
4. Each distributor/integrator/installer and end users shall have access to technical assistance as well as the ability to download software updates, datasheets, manuals and FAQs.
5. At a minimum the NVR shall meet the following:
  - A. The NVR shall provide the function of recording video and audio streams directly from IP cameras and/or encoders.
  - B. The NVR shall be codec agnostic and support a number of standard codecs.
  - C. The NVR shall provide the function of reviewing video and audio streams on-demand Control Center workstations.
  - D. The NVR shall provide the function of storing alarms generated by any supported device on the system.
  - E. The NVR shall provide the function of notifying workstations on the system of any alarms.
  - F. The NVR shall support the function of indexing recordings for rapid display of time, alarm or motion based thumbnails.
  - G. The NVR shall provide the function of notifying Recording and logging of bookmarks in association with recordings.
  - H. The NVR shall support recording and playback of motion analysis data from supported cameras.

- I. The NVR shall have a policy-based management option to control space and/or time-based reaping of old recordings as well as having the ability to ignore the reaping of protected recordings.
- J. The NVR shall have the option to digitally sign recordings at the moment of recording and automatically verify this signature on export.
- K. The NVR shall have a Linux operating system.
- L. All configuration of the NVR-AS shall be done via HTML interface via web browser.
- M. The NVR shall provide self-diagnostics including: Disk status, CPU usage, motherboard temperature, network status, fan status.
- N. The NVR shall have two RJ-45 connectors and comply with IEEE 802.3 and IETF standards: 10/1000 Base-T Ethernet5.2.
- O. The NVR shall support a maximum video throughput of 64Mb/s.
- P. The NVR shall support the following network protocols: TCP, UDP, IGMP, SNMP, HTTP, IGMP, SNMP, HTTP, NTP, Telnet, FTP.
- Q. The NVR shall contain an embedded Linux firewall, salted passwords and MD5 encryption.
- R. The NVR shall contain an embedded real-time clock as well as an NTP client.
- S. The operating voltage: shall be 100-240V, ~ 47-63Hz, with a maximum current of 1A.
- T. The NVR shall have an additional connector for redundant external power supply.
- U. The operating temperature shall be 0°C (32°F) to 45°C (113°F).
- V. The storage temperature shall be -20°C (-4°F) to +70°C (158°F).
- W. The NVR shall utilize SATA Seagate SV35 Series drives.
- X. The NVR shall support 4 drives.
- Y. The drives shall have a 3-year warranty independent of the NVR.
- Z. The NVR shall support 1, 2 and 3TB drives.
- AA. The NVR shall have options for RAID 6.
- BB. The NVR shall support a maximum of 64 recorded streams and 20 playback streams with a maximum playback bitrate of 40Mb/s.
- CC. DDOT requires at a minimum of 30days of video storage for all cameras defined in this specification. DDOT is requiring that all new cameras will record in the 8-15 frames per second (fps) mode.

**27.02.07 STANDARDS AND REPORTS:**

- 1. EN 55022 ITE emission standard – Class A
- 2. EN61000-3-2 Mains Harmonics – Class A

3. EN61000-3-3 Voltage Fluctuation
4. EN55024 ITE immunity standard
5. UL 60950-1, Information Technology Equipment
6. Safety Part 1: General Requirements
7. CFR47: 2002 Part 15 Sub Part B (US federal code of regulations)
8. ITE - Safety - Part 1 General Requirements CSA C22.2 No. 60950 - 1 - 07
9. EN 60068-2-30 Humidity up to 95% Non-condensing
10. EN 60068-2-1 & 2 (1993) Low & High temp
11. EN 60068-2-6 & 64 (2008) Sinusoid & Random vibration
12. EN 60068-2-29 (1993) Bump
13. EN 60068-2-30 Humidity up to 95% Non Condensing

## **27.03 EXECUTION**

### **27.03.01 SURVEYS**

- A. The Contractor shall perform hardware and software assessments with DDOT, identify needs and existing infrastructure. General assessment development should at least include the following:
  1. Location of all new and existing CCTV equipment.
  2. Identify main control room and server placements.
  3. The Contractor shall use information gathered during the site surveys to generate As-Built drawings.

### **27.03.02 INSTALLATION:**

- A. Review all plans and specifications to ensure proper installation techniques per the DDOT provisions.
- B. Conduct site surveys and field studies and provide coordination schedule with other contractors that are involved in this project.
- C. Develop a plan for deinstallation of existing CCTV system and submit the plan to the DDOT Project Manager for review and authorization.
- D. All deinstalled equipment shall be packaged and labeled accordingly and submitted to the DDOT Project Manager for acceptance and acknowledgement.
- E. A deinstalled equipment schedule shall be submitted to the DDOT Project Manager for review and acknowledgement.
- F. Install all new CCTV equipment as per manufacturer's instructions.

- G. Install all new CCTV equipment in locations as indicated in the plans and specifications.
- H. CCTV cameras will be hard –wired for both power and communications to dedicated RC cabinet boxes that are located in designated areas of both the North- and South-Bound tubes of the Mall Tunnel per the plans herein.
- I. All conduit runs, raceways, junction boxes, and associated hardware fittings will be included with this item of work.
- J. All wiring to each camera junction box will be included with this item of work.
- K. All final testing and acceptance testing will be included with this item of work.
- L. Liquid Tight flexible conduit coating shall consist of thermal plastic or thermoset product and meet NFPA 502 standard.
- M. The contractor shall abide by all government, state and local jurisdictional codes and regulations during construction, testing and final acceptance of the CCTV system.
- N. The Contractor shall comply with DDOT’s requests to suspend all work in the Mall Tunnel due to some unforeseen circumstances with no added cost to the project.
- P. Install all new CCTV equipment only using qualified and trained personnel.
- Q. Install electrical devices in accordance with local electrical codes.
- R. Ensure area is clear of any adverse electromagnetic interference.
- S. Protect all devices from damage during construction.
- T. Test correct torque of all screws in accordance with manufacturer’s specifications.
- U. Ensure video quality at both live monitoring stations and video recording.
- V. Ensure that all NVR’s are working within manufacturer’s specified tolerances.
- W. Report all problems to appropriate manufacturer via an approved support system.

**27.03.03 TESTING:**

- A. Make proper adjustments of the system according to manufacturer’s recommended settings.
- B. Ensure that all recorded video is retained for the appropriate period.
- C. Ensure that the full function of the system has been demonstrated to confirm that the entire system is working correctly.
- D. Perform 30-Day Field Operational Test.
  - The 30-Day Field Operational Test shall be conducted on the integrated system of which the ATMS, described here-in, is a part.
  - All equipment shall be subject to the same 30-day field operation test requirements. Upon completion and acceptance, DDOT will provide final approval.
  - The Contractor shall submit for each site, facility, and subsystem, well documented, witnessed, test reports for each and every test outlined in the test plan for each subsystem.
- E. The Contractor shall submit for each site, facility, and subsystem, well documented, witnessed, test reports for each and every test outlined in the test plan for each subsystem.

- G. Test procedures shall be submitted to DDOT for review and approval as specified.
- H. The test report shall include:
1. A summary listing the overall results of the testing.
  2. A list of failures or problems identified during testing, with a plan of action for the resolution of each.
  3. A detailed account of testing, keyed to the test procedures followed for the testing, indicating pass or failure in each case.
  4. Additional remarks as warranted.
- I. The Contractor shall perform all testing and corrective measures to fix any problems identified during installation and testing as required to ensure a fully operational CCTV solution.
- J. Acknowledgement by the DDOT: DDOT will provide a written acknowledgement of the receipt and acceptance of each submitted test report within ten (10) days of submittal.
- K. The Contractor shall supply a certified Commissioning Authority (CxA). The CxA has overall responsibility for planning and coordinating the testing and commissioning process. The CxA shall certify all test results, reports and documentation.

**27.03.04 GROUNDING:**

Per Section 260526 - Grounding and Bonding for Electrical System and Contract drawings.

**27.04 MEASUREMENT AND PAYMENT**

This item will not be measured for payment and will be paid in a lump sum bid price, which price shall include:

CCTV SYSTEM – Item 614991 including:

- HD Fixed CCTV Cameras - environmental vandal-resistant Fixed Dome cameras.
- ONVIF software license per device.
- HD PTZ CCTV Cameras – environmental pendant PTZ, 30X lens.
- HD CCTV Network Video Recorder, NVR-40TB windows, 12 disk RAID 6, 2U rack mount, plus hardware and support.
- PTZ dome pole mount adaptor.
- CCTV software.
- Thermal camera.
- Camera wall-mount hardware, enclosure.
- Enhanced management software license per device.
- NEMA single door wall-mount housing.
- Communication cable – camera to fiber drop.
- Power cable – 12 awg. 120 vac. 3 conductor cable.

- 1” EMT conduit.
- De-installation of existing CCTV equipment.

These Lump Sum items shall include:

- A. Labor costs including fabrication, installation, configuration, integration, testing, commissioning, software programming, and associated management and support activities.
- B. Materials costs including specified equipment, hardware, firmware, software, software licenses, tools, appurtenances, and all other Products specified herein.

All Labor and Material required for a full functioning system related to this particular section and related specifications not specifically identified in the Bid Items will be considered incidental and included in the lump sum bid price.

## **28 DOCUMENTATION AND TRAINING**

### **28.01. MANUALS.**

Manuals shall be provided in accordance with the following:

1. Manufacturer's standard manuals will be acceptable, subject to the approval of DDOT personnel. Each manual must contain specific identification of products by model and part and number supplied under this contract. A detailed list of manuals to be provided is listed in the Table-1(see below).
2. Documentation shall be provided for all system software, utilities, compilers, assemblers, linkers, editors, maintenance software, and other packages used to develop, debug and load software, with the exception of COTS products.
3. Revisions to any manual shall be reflected in a revision index that is part of each handbook or manual and is revised according to a revision control method approved by DDOT. Revisions shall be made for all design changes, retrofits, and errors.
4. Maintenance and Repair Manuals: These manuals shall provide sufficient information, including schematics, layout drawings, test and alignment procedures, inter-cabling diagrams, and parts lists, to permit quick and efficient maintenance and repair of the equipment by a qualified technician.
4. Manual Types and Quantity: The Contractor shall supply complete documentation of the entire system provided. The following Table No. 1 indicates the level and quantities required, the Contractor shall amend this table to meet the actual equipment and components provided. In addition to hard copy versions of the manuals, provide five (5) CD-R copies in Microsoft Word 2010 format of every manual supplied.

<b>Table 1</b>		
<b>Maintenance and Repair Manuals</b>		
Item.	Document Title or Description	Quantity Required
1	Operator Manual (quick guide)	50
2	System Administrator Guide	10
3	Data Administrator Guide	10
4	Data Communications Guide	10
5	Component or sub-system Manuals	10 (each component)
6	Operations and Maintenance Manual	20
7	Other Manuals (as appropriate)	10

## **28.02. TRAINING.**

Provide a program to train DDOT personnel in all aspects of the operation and maintenance (O & M) of the systems and equipment provided, as follows:

1. Design the program such that the DDOT may assume control and accomplishment of the training.
2. Submit five (5) complete sets of printed training program materials on two CDs and five complete hard copies. In addition, provide copies required for implementation of the training program. For example, if there are eight (8) in the class, then supply thirteen (13) hard copies and two (2) CD-Rs in Microsoft Word 2010 format.
3. All training course program materials, including training manuals and audio/video tapes or disks, shall become the property of the MTA and for use by the MTA for internal training purposes.

### **28.02.01 TRAINING PROGRAM.**

Develop a detailed training program plan to be submitted to DDOT for approval as follows:

1. Provide an overview description of instructor and student materials, and schedules necessary to provide system operations and maintenance courses for operations personnel and maintenance technicians. The schedule is contained in the plan and shall address the availability of operations and maintenance manuals and shall show all training program milestones for the development of training materials and manuals for the schedule of classes.
2. Instructor Material: Develop course outlines, lesson plans, classroom notes, video recordings, films, slides, printed materials, and mock-ups or models. Course outlines for each class shall be submitted sixty (60) days prior to the beginning of training classes and lesson plans shall be submitted no later than thirty (30) days prior to the beginning of training classes. Final course material shall be delivered to DDOT no later than ten (10) days prior to the commencement of the training.

3. Student Materials: The primary source of instructional material shall be applicable operations and maintenance manuals. In addition, the Contractor shall develop notebooks, drawings, and procedures to supplement these manuals to ensure that all learning objectives are met in an orderly and timely manner.
4. Facilities: Space for classroom lectures and practical training on equipment will be furnished at the DDOT(Mall Tunnel) facilities. The Contractor will provide projectors, screens, easels, testing equipment and other training aids as needed.
5. Installed equipment, such as operator positions, may be used to demonstrate the practical function and operation of the system.

## 28.02.02 TRAINING COURSES

The following table lists the required training courses.

<b>Table 2 Training Courses</b>			
#	Course Title	Description	Recipients, size/sessions/hours class
1	Management	High level system overview	DDOT senior personnel
2	Operator	Operations (train the trainer)	Operators, DDOT training staff.
3	System Administrator	Host administration, Statistics and data capabilities	System Administrator
4	Maintenance	Technician training	Technicians
5	Data Administration	Reporting capabilities	Department Managers, Planners
6	Report Generation	Management Report generation	Planning staff

(Note 1): The operator training should be based on a course assuming that the operators know nothing about the operation of the emergency communication systems in the Mall Tunnel.

## 28.03 MEASUREMENT AND PAYMENT

The items described in this Section will not be measured and paid for separately, but the cost for providing required Manuals and Training shall be included in the Lump Sum bid price for the pertinent items.

## 29 DISPUTES

- A. All disputes arising under or relating to this contract shall be resolved as provided herein.
- B. Claims by a Contractor against the District.

Claim, as used in Section B of this clause, means a written assertion by the Contractor seeking, as a matter of right, the payment of money in a sum certain, the adjustment or interpretation of contract terms, or other relief arising under or relating to this contract. A claim arising under a contract, unlike a claim relating to that contract, is a claim that can be resolved under a contract clause that provides for the relief sought by the claimant.

- (a) All claims by a Contractor against the District arising under or relating to a contract shall be in writing and shall be submitted to the Contracting Officer for a decision. The contractor's claim shall contain at least the following:
  - (1) A description of the claim and the amount in dispute;
  - (2) Any data or other information in support of the claim;
  - (3) A brief description of the Contractor's efforts to resolve the dispute prior to filing the claim; and
  - (4) The Contractor's request for relief or other action by the contracting officer.
- (b) The Contracting Officer may meet with the contractor in a further attempt to resolve the claim by agreement.
- (c) For any claim of \$50,000 or less, the Contracting Officer shall issue a decision within sixty (60) calendar days from receipt of a written request from a Contractor that a decision be rendered within that period.
- (d) For any claim over \$50,000, the Contracting Officer shall issue a decision within ninety (90) calendar days of receipt of the claim. Whenever possible, the Contracting Officer shall take into account factors such as the size and complexity of the claim and the adequacy of the information in support of the claim provided by the Contractor.
- (e) The Contracting Officer's written decision shall do the following:
  - (1) Provide a description of the claim or dispute;
  - (2) Refer to the pertinent contract terms;
  - (3) State the factual areas of agreement and disagreement;
  - (4) State the reasons for the decision, including any specific findings of fact, although specific findings of fact are not required and, if made, shall not be binding in any subsequent proceeding;
  - (5) If all or any part of the claim is determined to be valid, determine the amount of monetary settlement, the contract adjustment to be made, or other relief to be granted;
  - (6) Indicate that the written document is the contracting officer's final decision; and
  - (7) Inform the Contractor of the right to seek further redress by appealing the decision to the Contract Appeals Board.
- (f) Any failure by the Contracting Officer to issue a decision on a contract claim within the required time period will be deemed to be a denial of the claim, and will authorize the

commencement of an appeal to the Contract Appeals Board as authorized by D.C. Official Code § 2-309.04.

- (g) (1) If a Contractor is unable to support any part of his or her claim and it is determined that the inability is attributable to a material misrepresentation of fact or fraud on the part of the Contractor, the Contractor shall be liable to the District for an amount equal to the unsupported part of the claim in addition to all costs to the District attributable to the cost of reviewing that part of the Contractor's claim.
- (2) Liability under this paragraph (f) shall be determined within six (6) years of the commission of the misrepresentation of fact or fraud.
- (h) The decision of the Contracting Officer shall be final and not subject to review unless an administrative appeal or action for judicial review is timely commenced by the Contractor as authorized by D. C. Official Code § 2-309.04.
- (i) Pending final decision of an appeal, action, or final settlement, a Contractor shall proceed diligently with performance of the contract in accordance with the decision of the Contracting Officer.

#### C. Claims by the District against a Contractor

- (a) Claim as used in Section C of this clause, means a written demand or written assertion by the District seeking, as a matter of right, the payment of money in a sum certain, the adjustment of contract terms, or other relief arising under or relating to this contract. A claim arising under a contract, unlike a claim relating to that contract, is a claim that can be resolved under a contract clause that provides for the relief sought by the claimant.
- (b) (1) All claims by the District against a Contractor arising under or relating to a contract shall be decided by the Contracting Officer.
- (2) The Contracting Officer shall send written notice of the claim to the Contractor. The Contracting Officer's written decision shall do the following:
  - (a) Provide a description of the claim or dispute;
  - (b) Refer to the pertinent contract terms;
  - (c) State the factual areas of agreement and disagreement;
  - (d) State the reasons for the decision, including any specific findings of fact, although specific findings of fact are not required and, if made, shall not be binding in any subsequent proceeding;
  - (e) If all or any part of the claim is determined to be valid, determine the amount of monetary settlement, the contract adjustment to be made, or other relief to be granted;
  - (f) Indicate that the written document is the Contracting Officer's final decision; and
  - (g) Inform the Contractor of the right to seek further redress by appealing the decision to the Contract Appeals Board.
- (3) The decision shall be supported by reasons and shall inform the Contractor of his or her rights as provided herein.

(4) The authority contained in this clause shall not apply to a claim or dispute for penalties or forfeitures prescribed by statute or regulation which another District agency is specifically authorized to administer, settle, or determine.

(5) This clause shall not authorize the Contracting Officer to settle, compromise, pay, or otherwise adjust any claim involving fraud.

(c) The decision of the Contracting Officer shall be final and not subject to review unless an administrative appeal or action for judicial review is timely commenced by the District as authorized by D.C. Official Code §2-309.04.

(d) Pending final decision of an appeal, action, or final settlement, the Contractor shall proceed diligently with performance of the contract in accordance with the decision of the Contracting Officer.

### **30 WEEKEND WORK**

This Special Provision supplements 105.10:

Most scheduled work will be initiated and completed between the hours of 7:30 a.m. and 4:00 p.m., Monday through Friday. However weekend work may be required as determined by the Engineer in congested areas where serious traffic difficulties would result if the repairs were performed during the normal work week.

It is estimated that the amount of weekend work will not exceed fifteen percent (15%) of total work to be performed under the contract.

### **31 APPLICABLE WAGE DECISION/WAGE RATES**

In accordance with the applicable provisions of 29 CFR Part 1, which require that the correct wage determination and the appropriate wage rates therein be incorporated into this contract, General Wage Decision No. DC140001, dated 10/03/2014 is bound herein and contains the specific applicable wage rates, which are:

#### **HIGHWAY CONSTRUCTION RATES**

In accordance with 29 CFR, Part 1, Section 1.6(c)(3)(IV), if the intent to award letter is not issued within ninety (90) days of bid opening, the executed contract will include all intervening modifications. The Contractor will be reimbursed this added labor cost.

### **32 FAILURE TO COMPLETE ON TIME**

Replace 108.07 with the following:

For each calendar day that contract work remains incomplete after expiration of the specified construction completion time, or main part thereof, the sum of \$ 2000.00 has been set by the Contracting Officer as liquidated damages from any money due the Contractor. The Contractor's operation after expiration of construction completion time as extended will in no way waive the District's rights under the contract. A memorandum justifying these amounts will be placed in the Contract file.

### **33 BID GUARANTY**

This Special Provision supplements Article 12.A., of the **INSTRUCTIONS TO BIDDERS, STANDARD CONTRACT PROVISIONS, 2005, Revised 2007**

The bid guaranty period shall be **ninety (90) calendar days** after bid opening.

An Irrevocable Letter of Credit or United states government securities that are assigned to the District which pledge the full faith and credit of the United States are acceptable.

**APPENDIX A:      STANDARD SPECIFICATIONS**

**EMERGENCY COMMUNICATION SYSTEMS FOR THE MALL TUNNEL**  
**DDOT INVITATION NO. DCKA-2014-B-0075**  
**PRE-BID QUESTIONS AND RESPONSES**

*Question #1: What is the purpose of Critical Infrastructure Protection Design and Integration drawings provided in Amendment #2?*

**Response: # 1: This set is added to the contract documents for reference purposes only. Please see a framed note on Sheet 2.**

*Question #2: The legend for sheets 22 to 29 include a PTZ camera, however no PTZ camera is shown on the plans. Please confirm there are no PTZ cameras.*

**Response: #2: PTZ cameras are required at the North and South Portal entrances. The locations of the cameras are shown on Sheet 43.**

*Question #3: Amendment 2 has drawings that have not been placed on the dashboard. Can you please upload them so that we can print them full scale? I have attached Amendment 2 so that you can view the drawings that need to be placed on the dashboard.*

**Response: #3: Amendment 2 legible drawings have been posted on the DDOT Portal. The link is as follows:**

**[http://app.ocp.dc.gov/RUI/information/scf/solicitation\\_detail.asp?solicitation=DCKA-2014-B-0075](http://app.ocp.dc.gov/RUI/information/scf/solicitation_detail.asp?solicitation=DCKA-2014-B-0075)**

*Question #4: We have gathered the Mall spec on Friday afternoon; have noticed the radiating leaky coax was downsized to 7/8", instead of 1-5/8" as originally planned. The RF Link Budget does not work with 7/8", ends short on coverage margin, unless I am missing a point, do you know why?*

**Response: #4: The leaky coax cable is properly labeled on the plans as 1-5/8". The specification has been revised to match the plans and the modified pages are included in Amendment 006.**

*Question #5: In section 26.02.02, Transdyne Corp: ATMS is specified or "approved equal". Are you looking for potential vendors to specifically supply the Transdyne system? How are potential bidders going to be made aware of other approved ATMS providers?*

**Response #5: Section 26 has been updated to reflect system requirements without reference to a specific manufacturer. Any manufacturer will be acceptable as long as the specified requirements are met.**

*Question #6: In section 26.02.02.A.1.g, Bridge and Tunnel Facilities Management feature is listed, what features is DDOT looking for the ATMS provider? Are you looking for SCADA feature to monitor typical tunnel devices such as ventilation units, fire alarms, PLC?*

**Response #6: Section 26 has been updated to address this question. Please see the revised Section 26.**

*Question #7: Section 26.02.02 ATMS CONTROL SYSTEM EQUIPMENT, Transdyn Corporation's Advanced Traffic Management System (ATMS) is specifically called out by make and model. While an "or approved equal" clause is present, the detailed functional criteria for meeting this approval is not specifically described. In our opinion, this effectively creates a "sole source" specification with no stated justification. Does DDOT intend to sole source the ATMS system to Transdyn? If so, on what grounds is the sole source warranted?*

**Response #7: Section 26 has been updated to address this question. Please see the revised Section 26.**

*Question #8: Section 26.02.02, item A.1 lists the features of the DYNAC ES ATMS software. Are these listed features intended to be requirements of the ATMS system? If so, please describe, in detail, the full set of functional and operational requirements for each of the bullet items listed in this section. Also, if these listed features are intended as requirements, please describe how each relates to the operational requirements of the DDOT Tunnels.*

**Response #8: Section 26 has been updated to address this question. Please see the revised Section 26. The ATMS must interactively control and monitor the PA, DMS, Egress Sign and CCTV Systems. Ability to control others in the future is desirable.**

*Question #9: The differences between sections 26.02.02 and 26.02.03 are not well defined. Section 26.02.02 is entitled ATMS CONTROL SYSTEM EQUIPMENT and section 26.02.03 is entitled ATMS CONTROL SYSTEM SOFTWARE. Please explain the intent of each of these sections. They both seem to be describing ATMS software requirements, the only difference been that 26.02.02 is focused on features of the Dynac software. Please clarify the intent of each of these sections.*

**Response #9: Section 26 has been updated to address this question. Please see the revised Section 26. The ATMS must interactively control and monitor the PA, DMS, Egress Sign and CCTV Systems.**

*Question #10: Section 26.02.02 and 26.02.03. Please explicitly list all the equipment types that the ATMS System/software is required to interface with or provide monitoring and control functionality. Please indicate the monitoring and control functions that are required for each type of equipment. If this is existing equipment, please list make and model if possible.*

**Response #10: Section 26 has been updated to address this question. Please see the revised Section 26. The ATMS must interactively control and monitor the PA, DMS, Egress Sign and CCTV Systems.**

*Question #11: The specification is unclear on how the ATMS system/software fits in or interfaces with the existing tunnel monitoring/control and fire/life safety systems. Is this a replacement for existing system(s) or a completely new system? How will the ATMS system interface with any existing systems?*

**Response #11: Section 26 has been updated to address this question. Please see the revised Section 26. The ATMS must interactively control and monitor the PA, DMS, Egress Sign and CCTV Systems. The ATMS will not interface with existing tunnel monitoring/control or fire/life safety systems.**

*Question #12: Please provide a list of alarms, indications and controls required for the ATMS system/software*

**Response #12: Section 26 has been updated to address this question. Please see the revised Section 26. The ATMS must interactively control and monitor the PA, DMS, Egress Sign and CCTV Systems.**

*Question #13: 26.03.02 INSTALLATION. Item I states "Provide real-time monitoring and logging of equipment status and state." Please provide more detail. What types of equipment?*

**Response #13: Section 26 has been updated to address this question. Please see the revised Section 26. The ATMS must interactively control and monitor the PA, DMS, Egress Sign and CCTV Systems.**

*Question #14: 26.03.02 INSTALLATION. Item K states "Provide table driven and dynamically created response plans that can incorporate any type of field device, operator input, and response." Please provide more detail? What types of field devices, operator inputs and response plans are required? How many response plans are required? Please provide a list of response plans if possible.*

**Response #14: Section 26 has been updated to address this question. Please see the revised Section 26. The ATMS must interactively control and monitor the PA, DMS, Egress Sign and CCTV Systems.**

*Question #15: 26.03.02 INSTALLATION. Item M states "Provide an interface both electrical and software to the Pedestrian Egress System." Please clarify what is as to meant by this "electrical connection and how."*

**Response #15: The ATMS software shall support and interface with industry standard programmable logic controllers and/or remote terminal unit devices used to control the Egress Signs provided and installed by the Contractor under this Contract. Under this Contract, the ATMS must interactively control and monitor the PA, DMS, Egress Sign and CCTV Systems. The software shall support the collection of analog and discrete data and the output of control actions to these devices. The data received from PLC and RTU devices shall be processed, alarm checked and placed into the real-time Device database.**

*Question #16: Section 26.03.01 SURVEYS, item A.3 states "Meet with Client to develop an implementation plan and Concept of Operations (CONOPS) methodology." However, section 26.02.02 already identifies Transdyn's DYNAC ATMS software as the preferred software package. Since this is a Federal Aid Project, how does this conform to the FHWA Rule 940 ITS Architecture requirements? How can an ATMS software product already meet the requirements for a project that has yet to develop a even a preliminary Concept of Operations, which is the first step in the Systems Engineering Process required by Rule 940?*

**Response #16: Section 26 has been updated to address this question. Please see the revised Section 26. The ATMS must interactively control and monitor the PA, DMS, Egress Sign and CCTV Systems. The DDOT Mall Tunnel Emergency communications project is based on the ITS network architecture mandate. All DDOT Mall Tunnel sub systems and their components shall meet the minimum qualification set forth by the ITS network standards body.**

*Question #17: The 180 day contract time limit will be unattainable given the vague technical requirements for the ATMS system being specified. Would DDOT extend the contract time limit.*

**Response #17: 180 days of contract duration shall be adequate for this project.**

*Question #18: Section 2, page 3 of the Specifications requires bidders to provide a "certified statement of their organization." Please confirm that a just a list of similar projects performed by the bidder, including owner contacts for each project, will be sufficient documentation for the submittal.*

**Response #18: The list of similar projects performed by the contractor with reference contacts for each project is sufficient.**

*Question #19: Please provide a list of any DDOT projects that will be taking place in the vicinity of the Mall Tunnel or its approaches during the term of this contract that may affect tunnel infrastructure or equipment including maintenance of traffic and/or access to the tunnel. Please include any known projects by the Architect of the Capitol, US Marshal Service or the US Park Service that may affect the tunnel project during the term of this contract.*

**Response #19:**

**1. Tunnel Maintenance by DDOT contractor: Transfield**

**Contact: Jeff Dove at (443) 623-2317**

**Simon Rennie of DDOT at 202 438-8607**

*Question #20: Are minutes from the Pre-Bid Meeting available?*

**Response #20: Since this was informal meeting, Minutes of the meeting were not prepared. However the list of the attendees was provided via amendment.**

*Question #21: Is the 30-day Field Operational Test included in the 180 day contract duration?*

**Response #21: Yes.**

*Question #22: Spec section 12 indicates that full tunnel closures will not be allowed. Please confirm the contractor will be able to test subsystems including RRB, PA, and DMS under live traffic conditions.*

**Response #22: The contractor will be allowed to test subsystems under live traffic condition. This work shall be performed between 8:00PM and 4:00AM when the traffic is the lightest.**

*Question #23: RRB. Does the Department require integration between the Radio Rebroadcast system and ATMS? If so, please provide functional requirements.*

**Response #23: No integration is required. Each system will have separate controls.**

*Question #24: Public Address. "23.01.04 PA AUDIO PERFORMANCE: A - The computer generated voice shall be provided in male and female tones and shall be approved by the DDOT personnel and able to communicate with the approved Head-End Software vendor or ATMS system." Please clarify this requirement with respect to the generated voice communicating with the Head-End Software.*

**Response #24: The ATMS software shall be interfaced to the PA Systems such that computer generated voice can be used to make announcements over the selected PA System. Section 26 has been updated to address this question. Please see the revised Section 26.**

*Question #25: Public Address. "23.02.05 PA SYSTEM EQUIPMENT SOFTWARE: 1. The selected PA system software shall work with the (ATMS) provided under this contract." Please clarify the integration required.*

**Response #25: The ATMS software shall be interfaced to the PA System such that the ATMS controls and monitors the PA System. All voice announcements, pre-recorded, ad hoc or otherwise, shall come from the ATMS. The ATMS shall interface to the PA System to allow monitoring of the system in terms of failed devices or failed communications. Section 26 has been updated to address this question. Please see the revised Section 26. The ATMS must interactively control and monitor the PA, DMS, Egress Sign and CCTV Systems.**

*Question #26: Pedestrian Egress. "24.04 MEASUREMENT AND PAYMENT, PEDESTRIAN EGRESS SIGN CONTROL SYSTEM – Item 614992 Including: UPS Backup Battery with Inverter." What are the performance requirements for the UPS Backup Battery?*

**Response #26: The UPS Backup Battery shall be designed to provide the backup power required to operate the system for at least 1 hour (refer to NFPA 502, Annex B.4).**

*Question No. 27: DMS. "25.02.09 DMS SIGN CONTROLLER: D The controller shall incorporate an audible tone that sounds about every 15 minutes when messages are displayed to alert the operators that a message or messages is/are running during an incident clearing activity, a stationary or roving work crew, etc. The sound will alert the operators to check on the message status so that they may update the message or blank out as needed." Please clarify how the sign controller alerts operators in the control room.*

**Response #27: The ATMS systems shall be interfaced to and be used to control and monitor the DMS. The ATMS will provide the controller alerts in the control room. Section 26 has been updated to address this question. Please see the revised Section 26. The ATMS must interactively control and monitor the PA, DMS, Egress Sign and CCTV Systems.**

*Question #28: DMS. In section 25.01 Dynamic Message Sign General Section A; it is states that the 18x125 matrix shall display 2 lines of 15 characters. Is this the intent for character requirements? A standard 7x5 font with 2 inter pixels is only 105 pixels in width. Additionally the max width is 18'. (125 pixels x 1.75 pixel pitch is over 18' with no contrast borders.) Please clarify your intent, 18' or 125 pixels.*

**Response #28: The 18 x 125 matrix shall display 2 lines of (21) 12" characters.**

*Question #29: DMS. In section B, Item 2, it is states that the DMS shall display 2 lines of (21) 12" characters. Is it the Departments intent to use a condensed font to achieve this? A 7x4 font with 1 inter character space will need 110 pixels. Please clarify your intent, what is the character capacity and font intended?*

**Response #29: With response to Question #28, a 7x5 font with 1 character spacing shall meet the requirements for the 2 lines of (21) 12" characters.**

*Question #30: DMS. Section 25.1 DMS Specifications notes a 2 line DMS with either a 15 or 21 character display capacity, whereas Section 25.04 Measurements and Payments refer to a 1 line 32 character display; please clarify the number of lines, characters per line and required font.*

**Response #30: The DMS shall display 2 lines of (21) 12" characters per line utilizing 7x5 fonts, Amber color in NEMA 3R enclosure. Communication cable from controller to sign shall be fiber optic.**

*Question #31: DMS. Section 25.02.07 DMS specification refers to Amber color, whereas Section 25.04 Measure and Payments refer to tri-color; please clarify what color of LED is intended?*

**Response #31: The display color shall be Amber.**

*Question #32: DMS. (1) Section 25.03.04 subsection F states the DMS controllers shall be NTCIP 2301 compliant—Is this just for the SNMP transport layer only for network diagnostics (ping)?*

**Response #32: DMS Controller shall meet the most recent released versions of NTCIP. Please see table below.**

<b>Document Number and Version</b>	<b>Document Title</b>	<b>Document Status</b>
NTCIP 1101:1996 and Amendment 1	Simple Transportation Management Framework (STMF)	Approved Standard with Amendment
NTCIP 1102:2004 v01.15	Octet Encoding Rules (OER) Base Protocol	Approved Standard
NTCIP 1103: 2010 v02.17	Transportation Management Protocols	Recommended Standard
NTCIP 1201:2010 v03.13	Global Object (GO) Definitions	Approved Standard with Amendment
NTCIP 1203:2010 v02.39b	Object Definitions for Dynamic Message Signs	Approved Standard with Amendment
NTCIP 2101:2001 v01.17	Point to Multi Point Protocol (PMPP) Using RS-232 Subnetwork Profile	Approved Standard
NTCIP 2102:2003 v01.09	Point to Multi Point Protocol (PMPP) Using FSK Subnetwork Profile	Approved Standard
NTCIP 2103:2008 v02.07	Point-to-Point Protocol Over RS-232 Subnetwork Profile	Approved Standard
NTCIP 2104:2003 v01.11	Ethernet Subnetwork Profile	Approved Standard
NTCIP 2201:2003 v01.15	Transportation Transport Profile	Approved Standard
NTCIP 2202:2001 v01.05	Internet (TCP/IP and UDP/IP) Transport Profile	Approved Standard
NTCIP 2301:2010 v02.19	Simple Transportation Management Framework (STMF) Application Profile	Approved Standard

*Question #33: DMS. (2) Also states "responses shall use the sample Application Profile used by the request" Is there a Network agent used in this facility that may only talk certain application diagnostics?*

**Response #33: No, there is no Network agent used in this facility. Section 26 has been updated to address this question. Please see the revised Section 26. The ATMS must interactively control and monitor the PA, DMS, Egress Sign and CCTV Systems.**

*Question #34: DMS. (NTCIP 2301 Application layer definition is: **Application Layer**: That portion of the OSI Reference Model (Layer 7) that provides access to the communications services.)*

**Response #34: DMS Controller must meet the most recent released versions of NTCIP.**

*Question #35: ATMS. "26.01.01 DESCRIPTION: D - Servers and workstation clocks will be synchronized via a network connection to a Network Time Protocol (NTP) server." Does an NTP server exist on the DDOT network for time synchronization? Will it be accessible from the Tunnel Communication Cabinet?*

**Response #35: The NTP shall be provided on the network by DDOT.**

*Question #36: ATMS. 1. "26.01.02.E - Provide text to speech technology with pre-scanned messaging and allow "Live" messaging to be displayed on the DMS /LED Signage, and all audio through the PA speaker system." 2. "26.01.02.G - Allow for automated and planned messages (Text to Speech) to be displayed on DMS /LED Signage, PA System in response to anticipated events. Responses will include predetermined messages and appropriate group notifications." Please clarify the text to speech requirement with respect to the DMS messages.*

**Response #36: The ATMS Sign Manager shall provide an integrated interface for the monitoring and control of all types of signs including:**

- VMS – variable message signs with a local sign library

**The ATMS software shall be able to interface with message signs from multiple manufacturers. At a minimum, interface software shall be provided for the NTCIP VMS protocol and any proprietary protocols required controlling existing signs.**

**The user interface shall support a full graphical WYSIWYG (what you see is what you get) display of each sign including size, fonts, color, graphics, and phasing/blinking. The ATMS software shall support a master library of predefined messages a subset of which can be loaded into the sign controller. The software shall support the entry of freeform messages if the operator has been provided with this specific privilege. The software shall allow the embedding of dynamic data within the sign message to support travel times.**

*Question #37: ATMS. "26.01.02.I - Provide for a "lite" Web-based version for use by DDOT staff when out of the facility as well as for use by approved external agencies." What functions are required in the "lite" ATMS version?*

**Response #37: Section 26 has been updated to address this question. Please see the revised Section 26. The ATMS must interactively control and monitor the PA, DMS, Egress Sign and CCTV Systems.**

*Question #38: ATMS. "26.02.06 STANDARDS AND REPORTS: Section F - Lightweight Directory Access Protocol (LDAP) and integration with Microsoft Active Directory." Is ATMS integration with an existing Active Directory server in the scope of this tender? If so, please provide functional requirements.*

**Response #38: Integration with existing Active Directory server is not part of this RFP.**

*Question #39: ATMS. "26.03.02 INSTALLATION: L - Provide an interface to manage audio devices such as PA, emergency telephones and PBX systems." Is integration with emergency telephones and PBX within the scope of this tender? If so, please provide functional requirements.*

**Response #39: Interface with PBX and emergency telephones is not required with this procurement.**

**Section 26 has been updated to address this question. Please see the revised Section 26. The ATMS must interactively control and monitor the PA, DMS, Egress Sign and CCTV Systems.**

*Question #40: ATMS. "26.04 MEASUREMENT AND PAYMENT: Maintenance and on-call support including software upgrades." What is the required duration of on-call support and ATMS upgrades?*

**Response #40: Section 26 has been updated to address this question. Please see the revised Section 26. The ATMS must interactively control and monitor the PA, DMS, Egress Sign and CCTV Systems.**

*Question #41: ATMS. "26.04 MEASUREMENT AND PAYMENT: Interoperability connection to provide integration support for outside agencies." Please elaborate on the functions required interoperability connection?*

**Section 26 has been updated to address this question. Please see the revised Section 26. The ATMS must interactively control and monitor the PA, DMS, Egress Sign and CCTV Systems.**

*Question #42: ATMS. Drawing 30 shows a rack mounted ATMS server. Section 26.02.05 specifies a Dell T5600 Tower-type server. Please clarify the hardware required.*

**Response #42: A rack-mounted server as shown in the drawings shall be provided. The server shall be designed to meet the requirements of the vendor's proposed ATMS solution. Section 26 has been updated to address this question. Please see the revised Section 26. The ATMS must interactively control and monitor the PA, DMS, Egress Sign and CCTV Systems.**

*Question #43: ATMS. Will an Exchange Email Server be available for use by the ATMS?*

**Response #43: Yes**

*Question #44: ATMS. Will internet access be required from the ATMS Workstation?*

**Response #44: Internet access will not be required at the ATMS workstations unless specifically required by the vendor's proposed ATMS solution.**

*Question #45: CCTV. "27.01.02 OBJECTIVE: A - A robust system that is **able to detect unlawful vehicle access, assist with emergency operations and record any and all events.**" Please define an unlawful vehicle and elaborate on the required detection method? Is Automatic Video Incident Detection required?*

**Response #45: Section 27 has been updated to address this question. Please see the revised Section 27.**

*Question #46: CCTV. "27.01.02 OBJECTIVE: N - Monitoring shall be done on any computer in the LAN provided with a secure access, or shall be done remotely over the Internet." Is it the Departments intention to allow video from cameras in the tunnel to be displayed on the Internet?*

**Response #46: CCTV images shall be available only on the DDOT LAN/WAN. With appropriate logon credentials, DDOT personnel shall be able to access CCTV via a standard web browser. No CCTV shall be displayed on the Internet.**

*Question #47: CCTV. "27.02.04 CCTV EQUIPMENT (THERMAL CAMERA DESCRIPTION): 2. At a minimum the camera shall meet the following: K. Built-in Analytics" What analytics are required in the camera?*

**Response #47: Section 27 has been updated to address this question. Please see the revised Section 27.**

*Question #48: CCTV. Drawing 30 shows Northbound Remote Cabinets connecting to cabinet NES-A1 for power. Drawing 44 shows NES-A2 powering Northbound Remote Cabinets. Which is correct?*

**Response #48: Per Amendment 003, all Northbound Remote Cabinets shall be fed from Panel NES-A2 in the radio room.**

*Question #49: CCTV. DWG 45 shows PoE to cameras and an Altronix Power Supply for the cameras. Are all cameras expected to be Power over Ethernet? What is the function of the Power Supply for the cameras?*

**Response #49: All cameras will require power from the Altronix power supply. The Garrettcom switch is for communication purpose only, not PoE.**

*Question #50: Network. Does DDOT require a firewall for the Tunnel Communications Cabinet?*

**Response #50: DDOT network is protected by DCGOV managed by OCTO, no separate firewall is required.**

*Question #51: Network. Is there preference of manufacturer for the network equipment in the Tunnel Communication Cabinet?*

**Response #51: There is no preference of the manufacturer. The Contractor shall meet all contract requirements stipulated in the specifications and on the plans.**

*Question #52: Network. Please provide drawings showing existing network architecture.*

**Response #52: Network architecture is not required for bidding this project. The requested information will be provided by DDOT at a later date.**

*Question #53: Redundancy. "26.03.02 INSTALLATION: A - Utilize a fault tolerant architecture which minimizes the impact of a single point of failure and provides for central system expansion and upgrades." Does this requirement extend to the network architecture? If so, please provide drawings showing the required redundant architecture.*

**Response #53: This requirement does not extend to network architecture. Section 26 has been updated to address this question. Please see the revised Section 26. The ATMS must interactively control and monitor the PA, DMS, Egress Sign and CCTV Systems.**

*Question #54: Redundancy. Drawing 30 shows a single ATMS server in the Communication Cabinet. Are redundant ATMS servers required?*

**Response #54: No.**

*Question #55: We respectfully request an extension to the bid date by one week to October 29<sup>th</sup>*

**Response #55: The bid date has been extended.**

*Question #56: The "Radio System One-Line Diagram", sheet 21 of 69, and the Special Provisions Narrative, calls for providing radio coverage in the on&off ramps. However, the "Radio System Plans" are not depicting the radiating cable runs in the ramps. Please clarify if the ramps shall have radio coverage as specified and provide amended plan layout dwgs showing the radiating cable location in the ramps.*

**Response #56: Table 2 (page 18) in the Specification Section 22.01.03 specifies radio coverage. The AM Band shall terminate at 20 feet inside of the off-ramp portals. The FM Band shall terminate at 200 feet inside of the ramp portals.**

*Question #57: The "AM Radiators Layout" drawing, sheet 33 of 69, and the Special Provisions Narrative, calls for providing AM radio coverage in the on&off ramps. However, the "AM-FM Rebroadcast System Plans" are not depicting the AM #8 ceiling wires nor the FRE conduit runs for the roadbed level counterpoise wire runs in the ramps. Please clarify if the ramps shall have AM radio coverage as specified and provide amended plan layout dwgs showing the AM wires and FRE conduits location in the ramps.*

**Response #57: Table 2 (page 18) in the Specification Section 22.01.03 specifies radio coverage. The AM Band shall terminate at 20 feet inside of the off-ramp portals. The FM Band shall terminate at 200 feet inside of the ramp portals.**

*Question #58: The "Radio System One-Line Diagram", sheet 21 of 69, among others, specify the radiating cable shall be 1-5/8" nominal OD size. However, the Special Provisions section 22.02.02 (add#3 page 32), specify it as 7/8" OD with typical performance parameters for that cable size. Please clarify if the radiating coaxial cable shall be 1-5/8" OD and provide specification requirements for it.*

**Response #58: Refer to Response #4. The leaky coax cable is properly labeled on the plans as 1-5/8". The specification has been revised to match the plans and the modified pages are included in Amendment 006.**

*Question #59: The Special Provisions narrative, sections 22.01 and 22.04, call for a First Responders Radio System "Dispatcher console unit in the Control Room". Please clarify what are the specifications and functionality requirement for this dispatch console and if the First Responders Agencies have authorized the Tunnel Operators to listen and communicate with them using the public safety channels.*

**Response #59: Section 22.01.06 (page 23) specifies coordination requirements between the contractor, DDOT and Office of Unified Communications. The contractor shall meet these requirements to determine procedures for First Responders in this critical area.**

*Question #60: Please provide specifications for the Fiberglass Reinforced conduit specified for the bottom roadbed level AM #8 wire and clarify if it could be 3/4" or 1" OD optional to the contractor.*

**Response #60: The Fiberglas Reinforced conduit is specified in DDOT Standard Specifications for Highways and Structures as: “Fiberglass Reinforced Epoxy Conduit. FRE conduit shall be heavy wall type and conform to NEMA TC-14 and bear the UL label.” The ¾” or 1” OD conduit is not optional to the contractor.**

*Question #61: As an alternate for polycarbonate front screen, will lensing technology be allowed?*

**Response #61: No, The Lens Panel Assembly shall consist of a KYNAR 500 coated aluminum mask.**

*Question #62: Would rear access be acceptable?*

**Response #62: DMS signs shall be mounted on the face of the Mall Tunnel portals and will require front access. Rear access is not allowed.**

*Question #63: Are redundant power supplies required?*

**Response #63: Yes**

*Question #64: Is it acceptable to bid even though our LED pixel panels are manufactured by a third party in Europe, but tested in house?*

**Response #64: Refer to the Standard Contract Provisions, Article 24 “Buy American”, DDOT Standard Specifications for Highways and Structures, 2013.**

*Question #65: Will a full Lab at one of our manufacturing facilities in Austria, where our signs are designed, but not manufactured (our signs are manufactured in the US) be acceptable?*

**Response #65: Refer to the Standard Contract Provisions, Article 24 “Buy American”, DDOT Standard Specifications for Highways and Structures, 2013.**

*Question #66: As a manufacture of vms for over 15 years we have over 50,000 VMS signs throughout the world, will references outside the US be acceptable 7. Will Sign Housing manufactured by a third party US manufacturer be acceptable?*

**Response #66: Refer to the Standard Contract Provisions, Article 24 “Buy American”, DDOT Standard Specifications for Highways and Structures, 2013.**

*Question #67: Is KYNAR 500 on the front face required? Our front face material is part of our lensing system and provides greater contrast ratios than KYNAR 500.*

**Response #67: Yes, the Lens Panel Assembly shall consist of a KYNAR 500 coated aluminum mask.**

*Question #68: Would a pixel pitch smaller than 46 mm be acceptable?*

**Response #68: A pixel pitch smaller than 46mm is acceptable only if the 12” character is maintained.**



General Decision Number: DC140001 10/03/2014 DC1

Superseded General Decision Number: DC20130001

State: District of Columbia

Construction Types: Heavy (Heavy and Sewer and Water Line)  
and Highway

County: District of Columbia Statewide.

HEAVY CONSTRUCTION PROJECTS (Including Sewer and Water Lines);  
HIGHWAY CONSTRUCTION PROJECTS

Modification Number	Publication Date
0	01/03/2014
1	01/24/2014
2	01/31/2014
3	04/11/2014
4	04/25/2014
5	05/09/2014
6	05/16/2014
7	05/23/2014
8	05/30/2014
9	06/27/2014
10	07/04/2014
11	07/18/2014
12	07/25/2014
13	08/01/2014
14	08/15/2014
15	08/29/2014
16	09/05/2014
17	10/03/2014

ASBE0024-001 10/01/2013

	Rates	Fringes
Asbestos Worker/Heat and Frost Insulator Includes the application of all insulating materials, protective coverings, coatings and finishes to all types of mechanical systems.....	\$ 33.13	13.76

ASBE0024-002 10/09/2013

	Rates	Fringes
HAZARDOUS MATERIAL HANDLER Includes preparation, wetting, stripping, removal, scrapping, vacuuming, bagging and disposing of all insulation materials,		

whether they contain  
 asbestos or not, from  
 mechanical systems.....\$ 20.86 5.46

ASBE0024-005 10/01/2013

	Rates	Fringes
Fire Stop Technician.....	\$ 26.06	5.90

Includes the application of materials or devices within or around penetrations and openings in all rated wall or floor assemblies, in order to prevent the passage of fire, smoke of other gases. The application includes all components involved in creating the rated barrier at perimeter slab edges and exterior cavities, the head of gypsum board or concrete walls, joints between rated wall or floor components, sealing of penetrating items and blank openings.

BOIL0193-001 01/01/2014

	Rates	Fringes
Boilermakers:.....	\$ 38.07	22.58

BRDC0001-001 05/04/2014

	Rates	Fringes
Bricklayer.....	\$ 29.17	8.61

BRMD0001-004 05/04/2014

	Rates	Fringes
BRICKLAYER Refractory (Firebrick).....	\$ 36.08	8.78

CARP0132-001 05/01/2013

	Rates	Fringes
Carpenter/Lather.....	\$ 26.81	8.13
Piledriver.....	\$ 26.62	8.15

CARP1831-001 04/01/2013

	Rates	Fringes
MILLWRIGHT.....	\$ 31.59	8.58

CARP2311-002 05/01/2013

	Rates	Fringes
DIVER TENDER.....	\$ 29.00	8.15
DIVER.....	\$ 37.74	8.15

ELEC0026-001 06/02/2014

	Rates	Fringes
Electricians.....	\$ 41.60	14.75

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 ELEC0070-001 05/05/2014

	Rates	Fringes
Line Construction:		
Cable Splicers.....	\$ 34.16	19%+5.00
Equipment Operators.....	\$ 34.16	19%+5.00
Groundman.....	\$ 15.89	19%+5.00
Linemen.....	\$ 34.16	19%+5.00
Truck Driver.....	\$ 18.06	19%+5.00

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 \* ENGI0077-001 05/01/2014

	Rates	Fringes
Power equipment operators: (HEAVY AND HIGHWAY CONSTRUCTION)		
GROUP 1.....	\$ 34.92	8.55+a
GROUP 2.....	\$ 33.62	8.55+a
GROUP 3.....	\$ 32.40	8.55+a
GROUP 4.....	\$ 29.00	8.55+a
GROUP 5.....	\$ 25.00	8.55+a
GROUP 6.....	\$ 23.00	8.55+a
GROUP 7.....	\$ 35.52	8.55+a

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Tower Cranes and Cranes 100 ton and over.

GROUP 2: 35 ton cranes & above, derricks, concrete boom pump, drill rigs (+50,000 lbs torque), mole.

GROUP 3: Cranes, hoists, drill rigs (under 50,000 lbs torque), tie back machines, paving mixers, tunnel shovels, batch plants, shields, tunnel mining machines, draglines, mucking machines, graders in tunnels, pile driving engines, welder, horizontal directional drill operator, Tug boats.

GROUP 4: Front end loaders, boom trucks, backhoes, excavators, gradalls, power driven wheel scoops & scrapers, blade graders, motor graders, bulldozers, trenching machines, ballast regulator, hoe ram, locomotive (standard, narrow gauge, tuggers).

GROUP 5: Boilers (skelton), asphalt spreaders, bullfloat finishing machines, concrete finishing machines, concrete spreaders, concrete mixer, concrete pump, well points, hydraulic pumps, elevators, freeze uniits, tunnel motorman or dinky operator, conveyors, grout pump, fireman, ultra high pressure water jet cutting tool system operator/mechanic, horizontal directional drill locator, skid steers (fine grading), High lifts (lull type lifts).

GROUP 6: Fork lifts, ditch witch, bobcat, skid steer, space

heaters, sweepers, assistant engineers, oilers, service unit equipment, roller.

GROUP 7: Master mechanic.

a. PAID HOLIDAYS: New Years Day, Inaugural Day, Decoration Day, Independence Day, Labor Day, Martin Luther King's Birthday, Veterans' Day, Thanksgiving Day, Friday after Thanksgiving and Christmas Day.

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ENGI0077-002 06/01/2014

Rates Fringes

Power equipment operators:  
(PAVING AND INCIDENTAL GRADING)

GROUP 1.....	\$ 28.24	7.15
GROUP 2.....	\$ 25.20	7.15
GROUP 3.....	\$ 21.64	7.15
GROUP 4.....	\$ 19.50	7.15
GROUP 5.....	\$ 28.95	6.95

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

- GROUP 1: Gradall operator, Crane.
- GROUP 2: Boom Truck, Milling Machine, Excavator, Rubber Tire Backhoe, Asphalt Paver, Asphalt Plant Engineer, Motor Grader, Track Loader, Rubber Tire Loader, Track Dozer, Concrete Paver.
- GROUP 3: Broom Truck, Asphalt Roller.
- GROUP 4: Air Compressor, Grade Rollers.
- GROUP 5: Mechanic.

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ENGI0077-003 07/01/2014

Rates Fringes

Power equipment operators:  
(SEWER, GAS AND WATER LINE CONSTRUCTION)

GROUP 1.....	\$ 24.95	7.25+a
GROUP 2.....	\$ 24.55	7.25+a
GROUP 3.....	\$ 24.04	7.25+a
GROUP 4.....	\$ 23.72	7.25+a
GROUP 5.....	\$ 22.90	7.25+a

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

- GROUP 1: Excavators, Cranes, Gradalls.
- GROUP 2: Backhoes, Front-end Loaders, Fork alift/Lull, Bulldozers, Motor Graders. Qualified Mechanics, Hydraulic Tamper and Hoe Pack, Paving Mixers, Pile Driving Engines, Batch Plant, Concrete Pumps, Low-Boy Driver, Lube Truck.
- GROUP 3: Trenching Machine, Well Drilling Machines, Concrete Mixers, Motor Graders, Truck Driver.